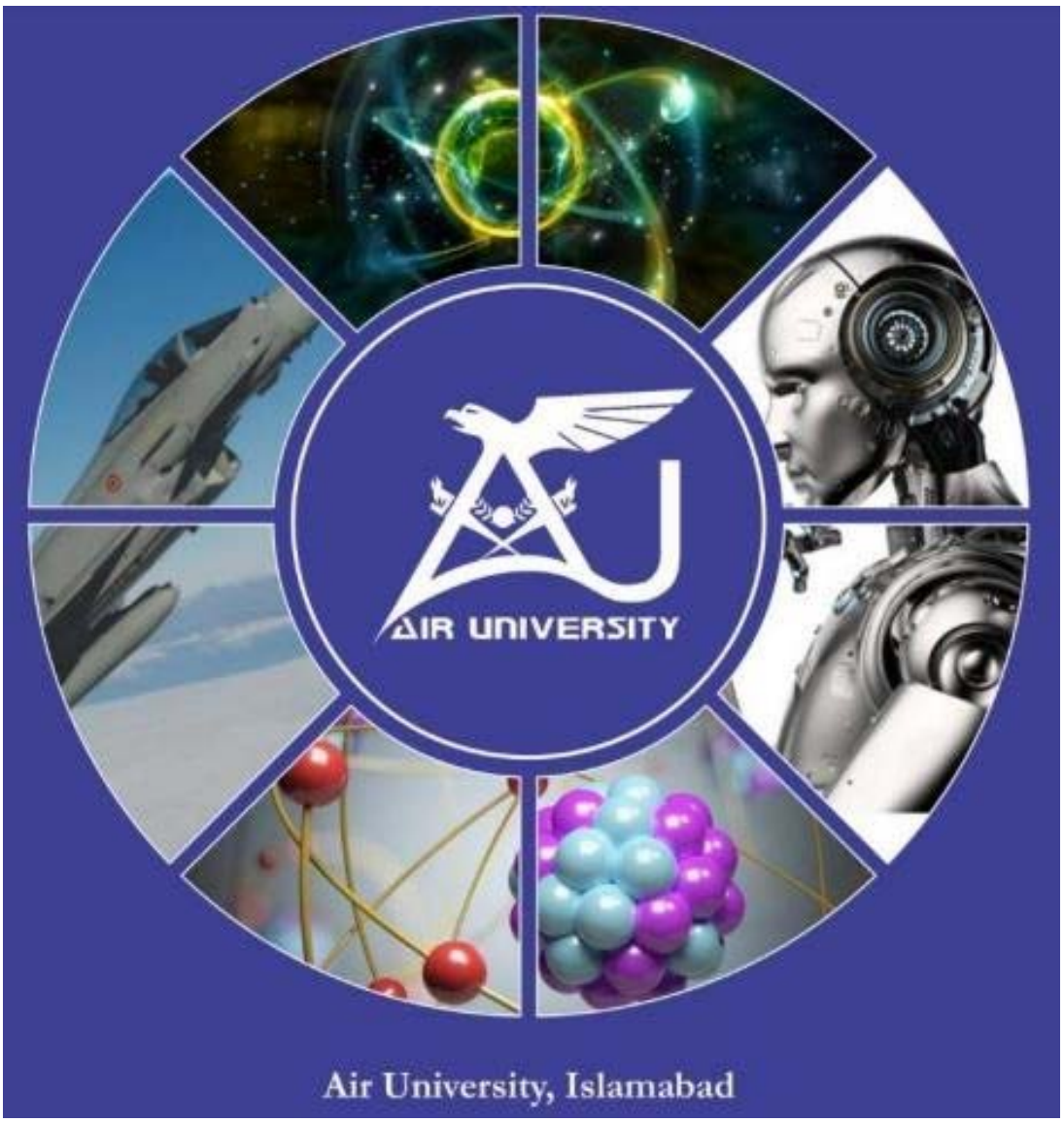
Air University Journal of Graduate Research (AUJOGR)

A Bi-Annual Reviewed Research Journal

Volume 3 **Issue 1** **2024**



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ABSTRACTS

AUJoGR-24401

Modelling and control of calcium levels from hormonal regulation in mammals for physiological Functions

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Abstract
Almost all cells employ calcium signals to transmit information and control a variety of metabolic activities. Without calcium ions, it would be unable to beat the heart, contract the skeletal muscles, activate the immune system to fight off invaders, or trigger the release of neurotransmitters to mediate cognitive functions. The cell nucleus can be reached by calcium signals, which can also function locally around the point of calcium entrance into the cytoplasm. The body attempts to maintain a constant level of calcium in the blood and tissues so that it can carry out essential everyday processes. The bones will release calcium into the circulation when blood calcium levels get dangerously low, according to parathyroid hormone. In order to enhance calcium absorption in the intestines, this hormone may also activate vitamin D. PTH instructs the kidneys to release less calcium into the urine at the same time. When the body has enough calcium, a separate hormone called calcitonin works to accomplish the opposite: it lowers the blood calcium levels by preventing the release of calcium from bones and telling the kidneys to excrete more calcium in urine. Our aim is to study the role of calcium in our body and how its homeostasis can affect organisms on both land and sea the work will enable mankind to understand organism better. Understand the diseases in organisms much better and to develop medicine for such diseases. This is only possible when mankind has sufficient knowledge. Our approach in this research paper will be to gain snippets of knowledge already gained by people all around the world.

Keywords: Calcium, Homeostasis, Mitochondria, medical system, Calcium Receptors.

1. INTRODUCTION

Calcium (Ca2+) is a vital element in biological systems, essential for numerous physiological processes such as muscle contraction, neurotransmission, and enzyme activity. The regulation of calcium levels within cells and tissues, known as calcium homeostasis, is crucial for maintaining cellular function and overall health. Disturbances in calcium homeostasis can lead to various disorders, including cardiovascular diseases, osteoporosis, and metabolic imbalances. Research in this field has highlighted the importance of proteins and receptors that regulate calcium levels, such as the calcium-sensing receptor (CaSR) and the mitochondrial calcium uniporter (MCU). Despite significant advances, the precise mechanisms by which these components contribute to calcium regulation and their dysfunction's implications remain inadequately understood. [1]

Calcium ions are involved in virtually all aspects of cellular physiology, acting as a key second messenger in signal transduction pathways. This universal messenger role of calcium is due to its unique properties, such as its ability to bind to proteins and influence their function, its versatility in various cellular compartments, and its rapid mobilization and sequestration by cellular organelles. Calcium's pivotal role in these processes underscores the importance of tightly regulating its concentration both inside and outside of cells. [2]

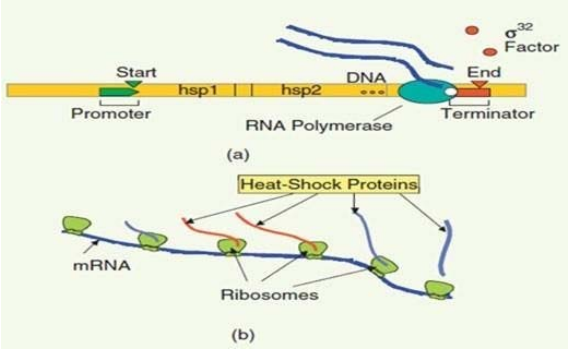


Figure 1: (a) Transcription of DNA gene sequence into messenger RNA (b) Translation process of mRNA into linear sequence of amino acids [13]

The importance of calcium in biological systems extends beyond human health. Calcium signaling is crucial in many different organisms, from simple unicellular organisms like yeast to complex multicellular organisms like plants and animals. For instance, in plants, calcium signaling is essential for responses to environmental stimuli, such as light, gravity, and pathogens. In animals, calcium signaling regulates processes as diverse as muscle contraction, hormone secretion, and neural activity. This widespread significance makes calcium homeostasis a fundamental topic of study across various fields of biology and medicine. [3]

Calcium homeostasis involves the intricate regulation of calcium levels in the body to ensure optimal cellular function. This process includes calcium absorption in the intestines, reabsorption in the kidneys, and storage in bones. Parathyroid hormone (PTH) and vitamin D are key hormones that regulate these processes, ensuring that calcium levels remain within a narrow physiological range. The balance of calcium is critical for various bodily functions, including muscle contraction, nerve transmission, blood clotting, and bone health. [4]

Calcium is absorbed from the diet through the small intestine. This process is regulated by vitamin D, which increases the expression of calcium-binding proteins in the intestinal cells, facilitating the transport of calcium from the gut into the bloodstream. There are two primary pathways for calcium absorption in the intestines: the transcellular pathway, which involves active transport through enterocytes, and the paracellular pathway, which involves passive diffusion between cells. The efficiency of calcium absorption can be influenced by several factors, including age, dietary components, and hormonal status. [5]

The kidneys filter calcium from the blood and reabsorb most of it back into the bloodstream, preventing excessive loss in the urine. This reabsorption process is regulated by PTH, which increases calcium reabsorption in the distal convoluted tubules of the kidneys. The renal handling of calcium is also influenced by other factors such as dietary calcium intake, acid-base balance, and the presence of certain hormones and medications. [6]

Bones serve as a major reservoir for calcium, storing approximately 99% of the body's total calcium. Bone remodeling is a dynamic process involving the coordinated actions of osteoclasts (cells that break down bone tissue) and osteoblasts (cells that form new bone tissue). PTH and vitamin D play crucial roles in regulating bone remodeling. PTH stimulates osteoclast activity, leading to bone resorption and the release of calcium into the bloodstream, while vitamin D enhances the absorption of calcium from the gut and its incorporation into the bone. [7]

Other factors, including mechanical stress, cytokines, and growth factors, also influence bone remodeling. Mechanical stress, such as weight-bearing exercise, promotes bone formation, while cytokines and growth factors can either stimulate or inhibit the activities of osteoclasts and osteoblasts depending on the physiological context. [8]

The mitochondrial calcium uniporter (MCU) is a significant channel that facilitates the uptake of calcium ions into the mitochondria. This process is vital for regulating mitochondrial function and energy production. Mitochondria, often referred to as the powerhouses of the cell, rely on calcium to generate ATP, the primary energy currency of the cell. Dysfunctions in the MCU can lead to altered cellular metabolism, contributing to various diseases, including neurodegenerative disorders and cardiac diseases. [9]

The MCU is part of a larger protein complex that spans the inner mitochondrial membrane. This complex includes regulatory proteins such as MICU1, MICU2, and EMRE, which modulate the activity of the MCU channel in response to changes in cytosolic calcium levels. The coordinated function of these proteins ensures that calcium uptake is tightly regulated and occurs only when necessary. Within the mitochondrial matrix, calcium ions activate several enzymes of the tricarboxylic acid (TCA) cycle, including pyruvate dehydrogenase, isocitrate dehydrogenase, and alpha-ketoglutarate

dehydrogenase. These enzymes increase the production of NADH and FADH2, which are essential for driving the electron transport chain and ATP synthesis. Therefore, MCU-mediated calcium uptake is crucial for maintaining cellular energy balance. [10]

While calcium is essential for mitochondrial function, excessive uptake can lead to mitochondrial dysfunction and cell death. High levels of mitochondrial calcium can trigger the opening of the mitochondrial permeability transition pore (mPTP), leading to loss of membrane potential, release of pro-apoptotic factors, and initiation of apoptosis. This dual role of mitochondrial calcium in supporting cell survival and promoting cell death underscores the importance of tightly regulating MCU activity. Dysfunctions in the MCU have been linked to various diseases, including neurodegenerative disorders such as Alzheimer's and Parkinson's diseases, as well as cardiac conditions like ischemia-reperfusion injury. Understanding the molecular mechanisms underlying MCU regulation and function can provide insights into potential therapeutic strategies for these conditions. [11]

G proteins and beta arrestin are responsible for the The calcium-sensing receptor (CaSR) is a G-protein-coupled receptor that plays a pivotal role in maintaining systemic calcium homeostasis. It is primarily expressed in the parathyroid glands and kidneys, where it detects changes in extracellular calcium levels and modulates PTH secretion accordingly. When extracellular calcium levels rise, CaSR activation leads to a decrease in PTH secretion, reducing calcium release from bones, reabsorption in the kidneys, and absorption in the intestines. The CaSR is a dimeric receptor with an extracellular domain that binds calcium ions, a seven-transmembrane domain typical of G-protein-coupled receptors, and an intracellular domain that interacts with G-proteins to initiate downstream signaling pathways. [12]

The receptor can bind not only calcium but also other divalent cations and polyamines, making it a versatile sensor of extracellular ionic changes. Upon binding calcium, the CaSR activates several signaling pathways, including the phospholipase C (PLC) pathway, which generates inositol trisphosphate (IP3) and diacylglycerol (DAG), leading to the release of intracellular calcium stores and activation of protein kinase C (PKC). These signaling events ultimately result in the regulation of PTH secretion and other cellular responses. [13]

Mutations in the CaSR gene can lead to disorders characterized by abnormal calcium levels. For instance, inactivating mutations in CaSR cause familial hypocalciuric hypercalcemia (FHH), a condition characterized by elevated blood calcium levels and reduced urinary calcium excretion. Conversely, activating mutations in CaSR lead to autosomal dominant hypocalcemia (ADH), characterized by low blood calcium levels and increased urinary calcium excretion. These conditions highlight the critical role of CaSR in maintaining calcium balance. Understanding the function and regulation of CaSR has therapeutic implications for various calcium-related disorders. For example, calcimimetics, which are CaSR agonists, are used to treat secondary hyperparathyroidism in patients with chronic kidney disease. Conversely, calcilytics, which are CaSR antagonists, have potential applications in treating conditions like osteoporosis by stimulating PTH secretion and increasing bone formation. [14]

Calcium ions serve as versatile signaling molecules in various cellular processes. The transient increase in intracellular calcium levels, known as calcium signaling, is a common response to external stimuli. This signaling mechanism is essential for processes such as muscle contraction, neurotransmitter release, cell proliferation, and apoptosis. [15]

In skeletal muscle cells, calcium signaling is crucial for contraction. The release of calcium from the sarcoplasmic reticulum into the cytoplasm triggers the interaction between actin and myosin, the proteins responsible for muscle contraction. This process is regulated by the troponin-tropomyosin complex, which undergoes a conformational change in response to calcium binding, allowing myosin to bind to actin and generate force. [16]

In cardiac muscle, calcium-induced calcium release (CICR) is a key mechanism. The entry of calcium through voltage-gated L-type calcium channels during the cardiac action potential triggers the release of additional calcium from the sarcoplasmic reticulum. This amplifies the calcium signal and ensures a robust contraction necessary for effective heart function. [17]

The calcium-sensing receptor (CaSR) mediates pluripotent effects by connecting to multiple heterotrimeric G-proteins and downstream signaling pathways in a ligand- and cell-type-specific manner. Calcium mobilization and activation of Gi/o through CaSR-induced Gq/11 activations, Calcium-dependent inhibition of adenylyl cyclase, or Calcium-dependent

activation of PDE-1 all reduce camp levels. CaSR-induced G12/13 activation regulates the activity of the small G-protein Rho-A and several other signalling checkpoints that contribute to gene expression regulation, cytoskeleton modulation, and shape change. Classical CaSR agonists such as calcium, magnesium, and potentially polyamine spermine are physiologically relevant CaSR activators. Endogenous positive allosteric modulators include L-amino acids and perhaps glutathione analogs. pH and ionic strength also influence CaSR, with protons and high ionic strength acting as negative modulators. For the treatment of hyperparathyroidism, synthetic positive modulators of CaSR function (calcimimetics) such as cinacalcet have entered clinical use. Synthetic negative modulators of CaSR function are still being researched. The CaSR is resistant to desensitization and elicits agonist-driven insertional signalling (ADIS) to maintain receptor density at the plasma membrane to sustain its systemic role in Ca2 o monitoring. Finally, CaSR agonists and positive modulators cause significant stimulus-biased signalling, which may be used to better understand a variety of ligand-dependent physiological processes such as L- amino acid-induced gut hormone release and Calcium o-induced modulation of calcium homeostasis. These discoveries may also pave the path for the creation of novel medications with tissue-specificity and therapeutic results. [18]

Calcium-Dependent Transcription Factors: Calcium signaling is involved in regulating gene expression by activating calcium-dependent transcription factors. For example, nuclear factor of activated T-cells (NFAT) and cyclic AMP response element-binding protein (CREB) are transcription factors that are activated by calcium-calmodulin-dependent kinase (CaMK) pathways. These factors regulate the expression of genes involved in cell proliferation, differentiation, and survival.[19]

Calcium signaling can also play a role in programmed cell death (apoptosis). Elevated intracellular calcium levels can activate apoptotic pathways by triggering the release of cytochrome c from mitochondria, leading to the activation of caspases, the enzymes responsible for executing apoptosis. Additionally, calcium can activate calcium-dependent proteases such as calpains, which contribute to the apoptotic process by cleaving cellular substrates. Dysregulation of calcium signaling can contribute to various diseases and pathological conditions. For example, abnormal calcium handling in cardiac cells can lead to arrhythmias and heart failure. In neurons, disrupted calcium homeostasis is implicated in neurodegenerative diseases such as Alzheimer's and Parkinson's disease. Understanding the mechanisms of calcium signaling and its dysregulation provides insights into potential therapeutic targets for these conditions. Research on calcium signaling has been greatly facilitated by advances in calcium imaging techniques. These techniques allow real-time visualization of calcium dynamics within cells and tissues. Fluorescent calcium indicators, such as Fura-2 and Fluo-4, are commonly used to monitor intracellular calcium levels. Genetically encoded calcium indicators (GECIs), such as GCaMP, have also been developed to enable cell-specific and subcellular resolution of calcium signals. These tools have provided valuable insights into the spatiotemporal dynamics of calcium signaling and its role in various physiological and pathological processes. [20]

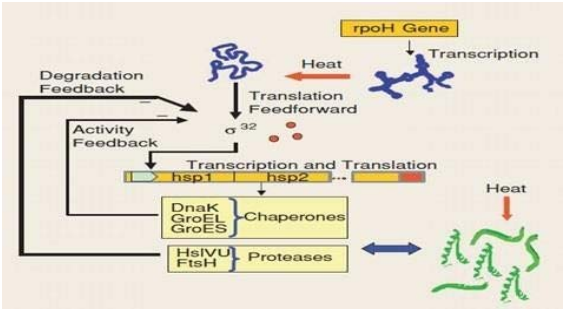


Figure 1: Block diagram of HS response [5]

Ref No	Paper Title	Approach	Outcomes
1	The physiological role of mitochondrial calcium revealed by mice lacking the mitochondrial calcium uniporter	Bioenergetic cell death have been postulated from mitochondrial calcium	The swelling of mitochondria was measured as a decrease in absorbance
2	Renal Control of Calcium, Phosphate, and Magnesium Homeostasis	Renal excretion is used to balance Gastrointestinal absorption	Renal Failure can be used to determine the importance of normal calcium
3	Role of Calcium Ions in the Regulation of Mammalian	Active system is possessed by mitochondria for specific transfer of calcium	Kinetics of mitochondria are damped down as matrix changes
4	Extracellular Ca2+ Sensing, Regulation of Parathyroid Cell Function, and Role of Ca2+ and	Calcium regulates muscle contraction hormonal	The sensitivity of calcium is important as it play important role in

	Other Ions as Extracellular (First) Messengers	secretion and cell metabolism	extracellular homeostasis
5	Regulation of sarcoplasmic reticulum Ca21 ATPase pump expression and its relevance to cardiac muscle physiology and pathology	The main role of the sarcoplasmic reticulum is to regulate cardiac function which has received great attention	For calcium removal and contraction SERCA2 is important because of its vital role
6	Extracellular Calcium Sensing and Extracellular Calcium Signaling	An actual molecular mechanism is provided by G protein for known effects of calcium on the cells and tissues	The sensors are versatile for calcium regulation and have great potential
7	Calcium Absorption Across Epithelia	Epithelia is important as calcium absorption take place there. The pathway into extracellular calcium is constituted by small intestine and kidney	Complex array is used for calcium transportation to regulate hormonal development and physiological functions
8	Calcium Dynamics: A Model System Approach	Calcium metabolism in growing chicks is simulated with the help of a computerized model and developing differential equations	The structural contribution of calcium to bone is emphasized by classical nutrition because of its importance in regulation purpose
9	Understanding calcium homeostasis in postnatal gonadotropin-releasing hormone neurons using cell-specific Pericam transgenics	Fertility in mammals is controlled using complex neuronal network which are the outputs of the gonadotropin hormone	Variable Pericam fluorescence hampered the simultaneous measurement of calcium In different neurons
10	Regulation of Calcium and Magnesium	Extrusion of calcium from the cell by ATP-dependent energy-driven calcium pumps is one of the mechanisms to	Calcium is the main regulator of PTH. The secretion of PTH is governed by a steep curve which is characterized
		prevent calcium-induced cell death	by the maximum rate
11	The calcium-sensing receptor in physiology and in calciotropic and noncalligraphic diseases	Parathyroid glands and kidneys are calciotropic tissues which is form in which calcium sensing receptor is expressed	CaSR influences many physiological processes as it is expressed in noncalcitropic tissues such as nutrient sensing and the secretion of insulin
12	Intracellular Calcium Dysregulation: Implications for Alzheimer's Disease	Mitochondria and endoplasmic reticulum are the subcellular components that are emerging in the pathogenesis and dysregulation of calcium	The proximal cause of cell dysfunction during AD is a mechanism of calcium imbalance mainly related to sub cellular organs
13	Ca2 homeostasis and endoplasmic reticulum (ER) stress: An integrated view of calcium signaling	Calcium sensors and buffers are used to maintain cellular calcium homeostasis through integrated and coordinated function	The in and out movement of calcium is maintained by the cell membrane containing many calcium transport and binding molecules
14	Nuclear calcium signaling in the regulation of brain function	Biochemical processes are initiated by synaptic activities leading to various outcomes like memory formation	Organism needs adaptation to cope with constantly changing environment
15	MICU1 regulation of mitochondrial Ca2 þ uptake dictates survival and tissue regeneration	Mitochondrial matrix receives signals from cytoplasmic for controlling ATP production but excessive can lead to death of cell.	The calcium transport measurement did not interfere with embryonic development and MICU1 deletion was validated
16	Calcium-sensing receptor (CaSR): Pharmacological properties and	the calcium-sensing receptor (CaSR) induces its	The calcium-sensing receptor (CaSR) mediates

	signaling pathways	cellular responses via the control of the signaling pathway	pluripotent effects by coupling in a ligand- and celltype-specific manner
17	Mitochondrial calcium and the regulation of metabolism in the heart	Mitochondria is important as it makes pathway for ATP production using calcium	Calcium is involved in regulating components involved in mitochondrial ATP production. In heart they are interconnected and are very abundant
18	Intracellular Calcium Homeostasis and Signaling	Calcium is released inside the cell with the interaction of first messenger as calcium is the second messenger with plasma membrane receptor. It can also deliver information without intermediation	Calcium is not only the signal that regulates cell life but also accesses the negative and death cells so that they could not cause damage to mammals
19	Calcium trafficking integrates endoplasmic reticulum function with mitochondrial bioenergetics	The divalent cation has an inherent ability to bind multiple target biological molecules reversibly for generating a versatile signaling system	There are numerous cell functions that extend beyond bioenergetics metabolism for which the communication between mitochondria and ER for coordination of cellular homeostasis is especially important
20	Calcium/calmodulin-mediated regulation of plant immunity	Diverse Calcium-binding proteins translate signatures to proper cell responses. Calmodulin protein is a primary calcium sensor that controls various functions by	CML are quite diverse in plants so defining the biological role will be difficult, However, the gene expression analysis and targeted isolations can to accessed to get more than enough
		simply targeting them	information about their behavior

2. METHODOLGY

A crucial physiological cation is calcium which plays a very important role in human functions. The integrity of the skeleton is maintained by calcium salts, and calcium ions in intracellular and extracellular fluids play a key role in the regulation of several metabolic processes. Extracellular calcium ions are required for many different processes, including hormone secretion, blood clotting, and neuro-muscular excitability, whereas intracellular calcium ions are important for the activity of many different enzymes and are also involved in transmitting information from the cell's surface to its interior. Extracellular and intracellular calcium concentrations must be kept within a certain range in order to carry out these crucial metabolic functions. In a publication, Ramberg et al (1984) attempted to describe the calcium homeostatic system in the dairy cow in terms of regulated, controlling, and disturbed signals. The plasma calcium concentration and bone calcium content are considered controlled signals, whereas intestinal calcium absorption, bone calcium resorption, and renal calcium reabsorption are considered controlling signals. The disturbing signals are those that cause loss of calcium from the blood plasma. Hurwitz et al. (1983) presented a model for the plasma calcium. The calcium plasma concentration is regulated sing a feedback control system to follow a setpoint, Calcium supply depends on the difference between the setpoint and the actual concentration. The proportional feedback model used by Ramberg et al. is based on the topic of overall calcium homeostasis mechanism. Proportional feedback cannot be used to achieve calcium homeostasis. Our approach is based on the dynamics formed from proportional feedback. In this case, proportionality constant is only the control block. It is very simple to design a minimal system. One approach uses the translational machinery for HS genes which are sensitive to temperature. Denatured proteins are refolded by chaperones produced during gene expression. This technique can be implemented using simple components used as open loop and do not require the complex HS system. Cells also have the ability to reduce the effect of undesirable noise. The model for basic calcium homeostasis is obtained

during lactation in dairy cows. This data is similar when obtained at the point of calving. Just before calving, the large increase in the lactational requirement for calcium is used as a step disturbance in Vcl ranging from 20 to 70 g/day. This is calculated as a proportionality constant between Vt and the tracking error e(t); that is given as,

$$V_T = K_p\, e(t) = 1770e(t) \ \frac{g}{day} \quad (1)$$

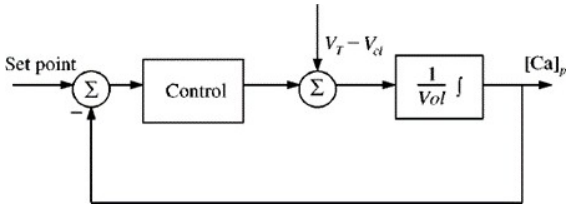


Figure 3: Block diagram for the controller system along with disturbances [16]

The characteristics of the feedback control system are characterized by the differential equation

$$\frac{d[Ca]_P}{dt} + \frac{K_P[Ca]_P}{vol} = -\frac{V_{cl}}{vol} + \frac{K_P(r)}{vol} \quad (2)$$

where r is calcium concentration setpoint.

A feedback model for Vt is proposed which has a proportional as well as an integral part. This is what is referred to as a PI controller. The expression for Vt at a given time instance is

$$V_T = K_P e + K_I \int e \quad (3)$$

where Kp and Ki are constants and e is the error in regulation which consists of a setpoint r and [Ca]p. the differential equation of the second order feedback system is given as,

$$\frac{d^2[Ca]_p}{dt^2} + \frac{K_P d[Ca]_p}{(vol)(dt)} + \frac{K_I[Ca]_P}{vol} \quad (4)$$

Step changes of any given magnitude results in zero steady-state error that too after a very short transient period. The transient response characteristics of the second order system are also desirable.

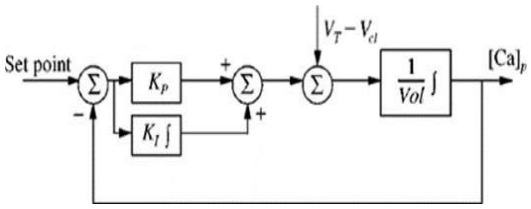


Figure 4: Block diagram of closed loop transfer function [16]

The Approach discussed is referred by Calcium Homeostasis and Parturient Hypocalcaemia by M. KHAMMASH

3. IMPLEMENTATION

For observing the system response and for improving it by the required characteristics we had options, we went for MATLAB as it is more compatible and user-friendly. MATLAB and Simulink used the main software for checking and implementing responses and results. MATLAB mostly was used for finding out transfer functions and for observing system transient characteristics whereas Simulink was used for plotting responses against various inputs and for making block diagrams of the system.

3.1 Time response of our system

Solving by partial fraction

$$s = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$s = \frac{-69 + \sqrt{69^2 - 4(1)(70.85)}}{2(1)}$$

$$s = \frac{-69 \pm 33.4574}{2}$$

$$s = -1.0426\,;\, -67.9574$$

$$\mathrm{T}(s) = \frac{1361}{(s+1.0426)(s+67.9574)}$$

$$\frac{1361}{(s+1.0426)(s+67.9574)} = \frac{A}{s+1.0426} + \frac{B}{s+67.9574}$$

A = 20.33; B = -20.33

So, our time response becomes

$$T(S) = \frac{1361}{(s+1.0426)(s+67.9574)} = \frac{A}{s+1.0426} + \frac{B}{s+67.9574}$$

$$\frac{1361}{(s+1.0426)(s+67.9574)} = \frac{20.33}{s+1.0426} - \frac{20.33}{s+67.9574}$$

And for time domain, we take inverse Laplace

$$f^{-1}\,T(s) = f^{-1}\left\{\frac{20.33}{s+1.0426} - \frac{20.33}{s+67.9574}\right\}$$

$T(t) = -20.33e^{-67.95t} + 20.33e^{-1.04t}$ (Natural Response)

3.2 System Characteristics

To find Natural Frequency ω_n and Damping Ratio ζ characteristics of a 2nd order system, we transform the transfer function into following form

$$G(s) = \frac{\omega^2 n}{s^2 + 2\,\zeta\omega n + \omega^2 n}$$

By comparing, we get

$$\omega^2 n = 70.85$$

which gives $\omega_n = 8.4172$

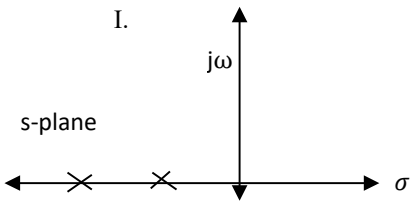
And from $2\,\zeta\omega n = 69$

We get $\zeta = 4.0988$ which is > 1

System is over damped because it has two real poles; and zeta is greater than 1

Hence Response is of form

$$c(t) = K_1 e^{-\sigma 1 t} + K_2 e^{-\sigma 2 t}$$



$$T_s = \frac{4}{\zeta\Omega N} = \frac{4}{(4.0988)(8.4172)} = 0.1159\ sec$$

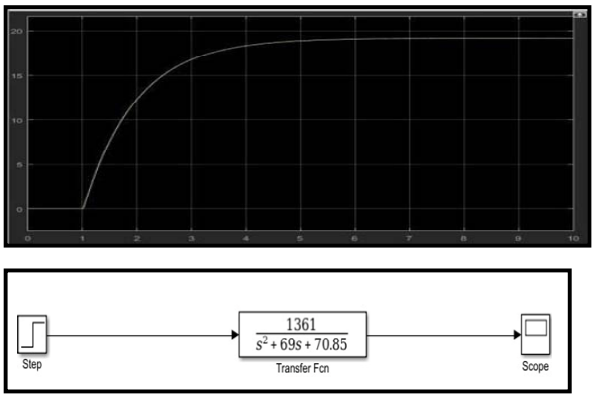


Figure 5: Step response of the system

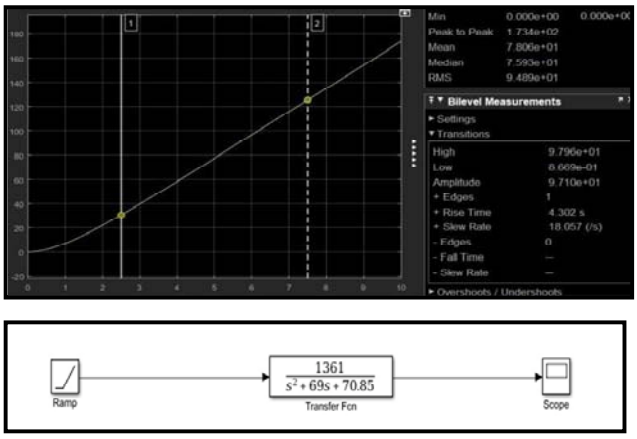


Figure 6: Ramp response of the system

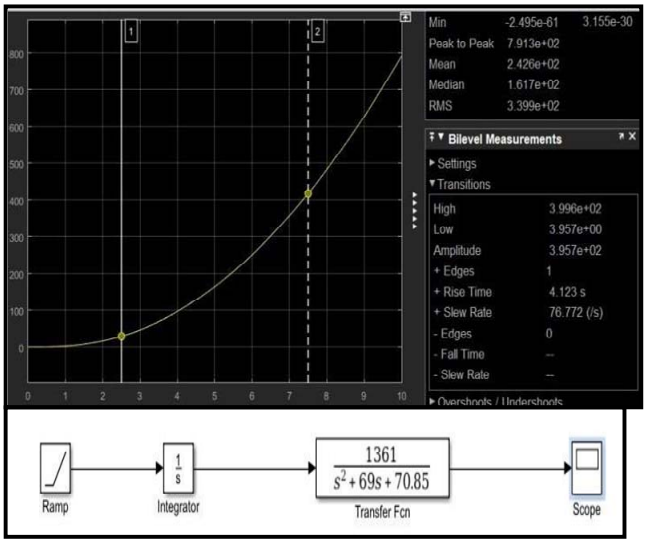


Figure 7: Parabolic response of the system

3.3 Stability of the system

Since both the closed loop poles lie in the left-half plane therefore, our system is stable.

3.4 Gain Limits of a P-Controller

Now for the gain limits of P-controller the transfer function of interest is as follows.

$$T(s) = \frac{1361k}{s^2 + 69s + (70.85 + 1361k)s^0}$$

Making Routh table with initial assumption that K>0.

s^0	1	70.85+1361k
s^1	69	0
s^0	$-\frac{\begin{vmatrix}1 & 70.85+1361k\\ 69 & 0\end{vmatrix}}{69} = 70.85 + 1361k$	0

For the system to be stable:

$$70.85 + 1361k > 0$$

$$k > -\frac{70.85}{1361}$$

$$k > -0.05$$

For the system to be marginally stable:

$$k = -0.05$$

For the system to be unstable:

Begin a sub-section on the same line but bold title.

$$k < -0.05$$

Since in the beginning we made assumption that K>0 therefore our P-controller gain K varies from 0 to $+\infty$ or $k > 0$.

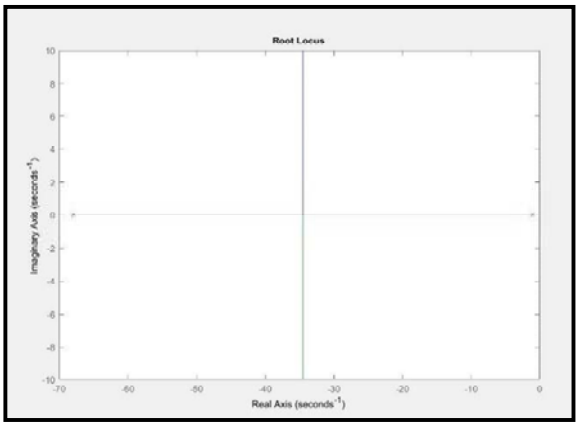


Figure 8: Root locus of the system

3.5 Steady State Error

The Open Loop Transfer Function is:

$$G(s) = \frac{1361}{s^2 + 69s + 70.85}$$

It is a type 0 system,

We compute steady-state error for step input

$$e_{step}(\infty) = \frac{1}{1 + K_p} = \frac{1}{1 + \lim_{s \to 0} G(s)}$$

$$= \frac{1}{1 + \frac{1361}{0 + 0 + 70.85}}$$

$$= \frac{1}{20.2095}$$

$$e_{step}(\infty) = 0.04948$$

$$e_{ramp}(\infty) = \frac{1}{K_v} = \frac{1}{\lim_{s \to 0} sG(s)}$$

$$= \frac{1}{0}$$

$$= \infty$$

$$e_{parabolic}(\infty) = \frac{1}{K_a} = \frac{1}{\lim_{s \to 0} s^2 G(s)}$$

$$= \frac{1}{0}$$

3.6 Root Locus

```
clc
clear all
num=[1361]
den=[1 69 70.85]
G=tf(num,den)
rlocus(G)
ylim([-10 10])
```

Figure 9: MATLAB coding for root locus

4 RESULTS

By plotting the response of the system against step input, it is observed that an error of 0.04948 is appearing and for ramp and parabolic inputs the errors appear to be infinity because the system is type 0 system and, in that case, $kkvv$ and $kkaa$ are 0 making the errors infinity. Moreover, a settling time of 0.1159 sec is observed, both these characteristics were not desirable under the situation and were meant to be improved. Less settling time and faster response along with least possible steady-state error was the requirement of the situation. Since the system response is ''Over-damped'' corresponding to ζ = 4.0988 (which is > 1). Because of it, peak time and percentage overshoot are not kept in regard. So, the only issue with the system appears to be steady state-error along with settling time. Both these characteristics were tried to be improved by usage of only P-controller but the results were not satisfying as steady-state error still sustained. The best approach to the solution was design of PI-controller to cater both settling time and steady-state error at the same time. The usage of PI-controller proved to be useful and gave the response that was required. Mat lab PID-Tuner was used to find the required values for gains of P and I controllers and then the values of $kkpp$ and kk were altered until the required response was achieved. The improved system response is as follows:

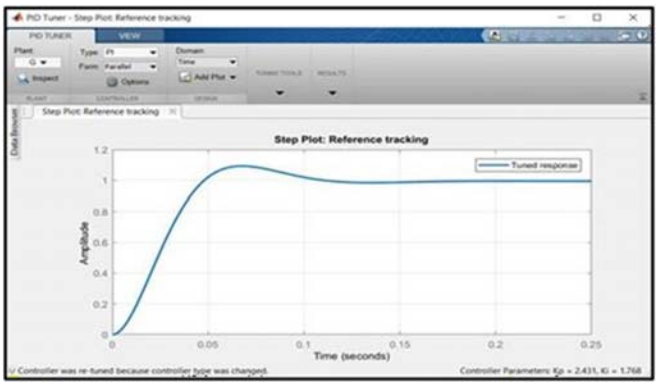


Figure 10: PID Tuner

4.1 MATLAB Code

```
clc
clear all
s=tf('s')
num=[201 252 50.4]
den=[1 10.93 109.26 193.4 126 25.2]
G=tf(num,den)
pidTuner(G,'p')
```

Figure 11: MATLAB Code for system parameters using PID Tuner

4.2 Improved Parameters

Controller Parameters

	Tuned
Kp	2.4314
Ki	1.7677
Kd	n/a
Tf	n/a

Performance and Robustness

	Tuned
Rise time	0.0321 seconds
Settling time	0.0999 seconds
Overshoot	9.29 %
Peak	1.09
Gain margin	Inf dB @ Inf rad/s
Phase margin	59 deg @ 41.5 rad/s
Closed-loop stability	Stable

Figure 12: Improved Parameters

4.3 Improved and unimproved system responses

	Un-improved	Improved
Steady-state error	0.04948	0
Settling time	0.1159 seconds	0.0999 seconds
Overshoot	0.0937 %	9.29 % (desired)
Rise time	0.0776 seconds	0.0321 seconds

4.4 Response

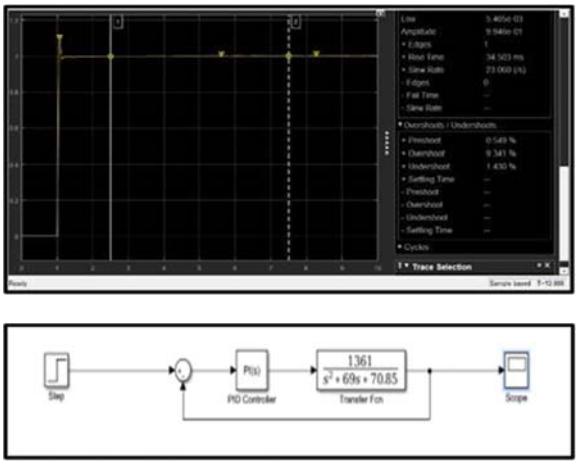


Figure 13: Final Response

5 CONCLUSION

We modelled a control system for hormonal regulation in mammals. We also analyzed responses that were generated from the transfer function Created Routh Table to check the stability and also calculated Steady State error and plotted Root Locus. We used PID controller to improve our system. The science of biology has undergone a revolution due to the discovery of DNA and its crucial involvement in cellular activity. Rapid advancements in biology have produced intriguing new findings that promise to reveal the fundamental principles of life. The importance of mathematics increases as biology gets more quantitative. Furthermore, an integrated systems approach is necessary due to the complexity of biological systems. Systems techniques have been heavily utilized in the technical sciences, notably engineering, to evaluate and create man-made systems. The idea of feedback serves as a major unifying principle. Very little work has been done to comprehend these complex mechanisms using concepts from control systems theory, despite the fact that feedback controllers are very common in biological systems and account for most of their complexity. For control scientists, studying and comprehending biological regulating processes offers a rare opportunity. One illustration may be taken from the significant discipline of endocrinology. Although several hormones have been shown to have a part in regulation, dynamical systems are rarely used as a setting for research on feedback mechanisms. statistical techniques involving the measurement of variables and their correlation with observed behavior. The vast disparities in these professions' methodologies, cultures, and instruments are one factor in the relative lack of engineering techniques in the biological sciences. However, the moment is right for a collaborative research project because of recent advances at the cellular level, new techniques for data collection, fast computers, and new theories for simulating and evaluating models. The important connection between what is understood at the system level and what is empirically seen may then be made as a result of this effort.

6 RECOMMENDATIONS

For the future generation, the changes of concentration of the intramitochondrial Ca2+ will prove to be a challenge, also in the respiratory chain components. When cytosolic concentrations rise, intramitochondrial Ca2+ plays a very important role. Cells of mammals when stimulated allow mitochondrial ATP production. The energy status is also maintained. It is to be noted that this will not always be the case. The effect of dehydrogenases activation may be less impactful in hearts perfused with medium contained glucose. When pyruvate is present, respiration is affected by an increased ADP concentration. Nevertheless, intramitochondrial Ca2+ acts as a catalyst for hormonal processes having an effect on the energy metabolism.

NOMENCLATURE

PTH: Parathyroid hormone

ATP: Adenosine triphosphate

MCU: Micturating Cystography

MICU: Medical Intensive Care Unit

Ca2+: Calcium Ion

SERCA: sarco/endoplasmic reticulum Ca^{2+}

V_t: Total calcium rate in plasma

V_{cl}: Total calcium clearance in plasma

vol: volume of plasma

CaSR: calcium-sensing receptor

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AUJoGR-24402

Control of Human Pupil Servo-mechanism with Retinal Light Flux Oscillations

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Abstract

In this research project, we aimed to develop an affordable control system to regulate the human eye's servomechanism response to light. Understanding the mechanisms of human body organs, especially the eye, can lead to better insights into their defects and potential treatments. The human eye's response to light, particularly how the pupil adjusts to different light intensities, was the focus of our study. We sought to construct a system capable of recording and analyzing the changes in pupil diameter when exposed to varying light intensities. The human eye's response to light operates as a servomechanism, where the pupil constricts under bright light and dilates under low-intensity light. By understanding these responses, we can develop treatments for vision defects. Our approach utilized a high-definition, affordable camera to capture changes in the pupil's diameter when subjected to light of different frequencies and intensities. We employed soft lights of varying colors to create a series of light frequencies that induced different responses in the eye. Our system's design was straightforward yet effective. It involved a camera for recording pupil diameter changes and light sources to simulate different lighting conditions. This setup allowed us to monitor and analyze the eye's responses in real time. We recorded the data and used it to understand the pupil's behavior under specific environmental conditions. The recorded data included the diameter of the pupil and the corresponding light intensity, which served as input and output parameters for our control system. We developed a control system that could predict the pupil's response based on the recorded data. The system used the difference between the input (desired light intensity) and the output (recorded pupil diameter) to actuate the control mechanism. This feedback loop allowed the system to adjust the light intensity to achieve the desired pupil diameter, effectively mimicking the natural servomechanism of the eye. Our results showed that the system could accurately predict and control the pupil's response to various light intensities. The system demonstrated stability and minimal overshoot, indicating that it could reliably manage the pupil's servomechanism. The ability to predict the eye's behavior under specific conditions makes this system a valuable tool for both medical research and practical applications in treating eye-related conditions. The significance of our research lies in its affordability and effectiveness. Traditional methods of studying the eye's response to light often involve complex and expensive equipment. Our system offers a cost-effective alternative without compromising accuracy or reliability. This accessibility can lead to broader applications in medical research and education, allowing more researchers to explore and understand the eye's mechanisms. In addition to its affordability, our system's design is user-friendly and easy to implement. It does not require extensive training or specialized knowledge to operate, making it accessible to a wider audience. This simplicity, combined with its effectiveness, enhances its potential for widespread use. The implications of our findings extend beyond the scope of this project. By providing a reliable and affordable means of studying the eye's servomechanism, our system can contribute to advancements in ophthalmology and related fields.

Keywords: Servomechanism, Pupillary light reflex, closed-loop feedback, Human pupil servo-mechanism.

1. INTRODUCTION

The pupillary light reflex is a fundamental physiological response where the human pupil adjusts its size in reaction to light exposure. This paper explores the medical aspects of this reflex and delves into the control mechanisms governing the eye's servomechanism. The reflex involves both pupils constricting when light falls on one eye, a phenomenon known as the consensual light reflex. This detailed examination sheds light on the functioning of the pupil as a servomechanism and the techniques employed to measure human responses to light. Understanding the pupillary light reflex is crucial for studying eye diseases and developing potential treatments. Our objective is to design a control system that manages the servo-mechanistic actions of the pupil by inducing retinal light flux oscillations. This system aims to predict and control changes in pupil size in response to varying light intensities.

The pupillary light reflex causes the pupil to constrict or dilate based on the intensity of the light source. Bright light triggers the sphincter muscles at the pupil's border to contract, reducing its size, whilelow-intensity light prompts the dilator muscles at the iris border to expand the pupil. When light is directed at one eye, such as the left, the pupil contracts in a direct light reflex. In a healthy pair of eyes, the right eye also contracts, demonstrating the consensual light reflex. This coordinated response results from the interconnected efferent and afferent pathways of both eyes. The efferent limb carries signals from the eye to the brain, and the afferent limb transmits signals from the brain back to the eye. For instance, when light is directed at the left eye, the efferent limb sends signals to the brain, which then sends signals through the afferent limbs to constrict both pupils. This interconnected pathway ensures a synchronized response to light exposure. Our proposed control system leverages this understanding to manage the eye's servomechanism effectively. By accurately predicting and controlling the pupil's response to light, the system aims to improve our understanding of the eye's mechanisms and contribute to the development of treatments for vision-related conditions. This research represents a significant step forward in ophthalmology, providing a foundation for more advanced studies and practical applications in vision science. [1]

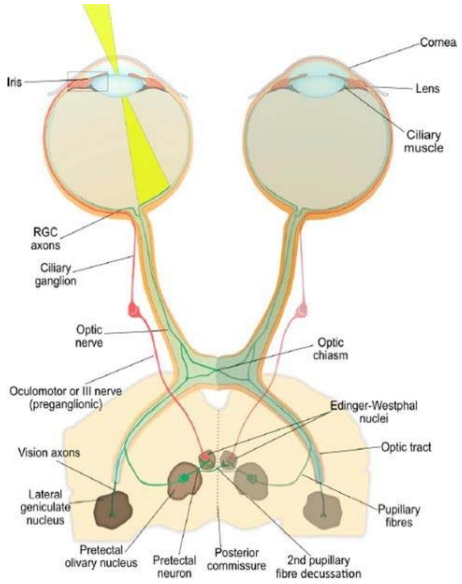

Figure 1: Parasympathetic pathway of human eye [1]

A lot of biological processes can be termed servo mechanisms. The human eye reflex to light can be studied as a servomechanism. Here, the human eye is considered as a control system and a reference light source is considered as input. The controlled light is used as a correcting factor for feedback. An infrared light source throws light at the eye, and the response of the eye is measured through another filter. The diagram illustrates the servo-loop for the human eye's response to light. The light falling on the retina of the eye is the reference light flux quantity which is compared with input light and their difference actuates the control system. The control system then varies the size of the pupil, which changes the controlled light. Thus, by controlling L_C we can change the actuating difference and control the error between the desired input and the present output. [2]

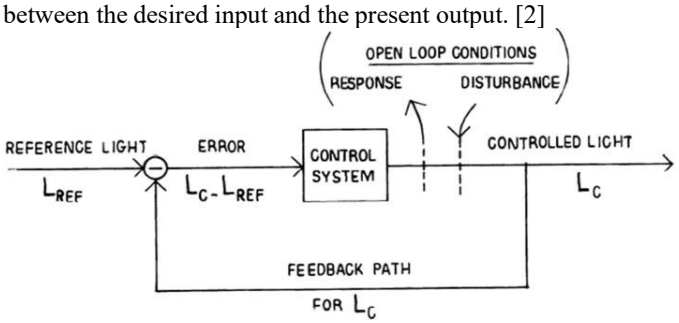

Figure 2: A schematic human eye as a servo-mechanism [2]

Stability, Oscillations, and Noise in the Human
The human pupil reflex to light has been thought to be a self-regulating servomechanism. A designed pupillometer was used for quantitative measurements in animals and human subjects with an intact central nervous system. The pupillometer generates light stimuli that are controlled electronically. For the determination of pupil response, sinusoidal light intensity changes were instilled in an open-loop manner. The pupil servo shows stability with an 18db attenuation slope. In another experiment, gain was artificially increased to instil unstable oscillations whose frequency could be anticipated from a low gain transfer function. Some experiments show noise in pupil response. This noise is not an error in the apparatus or the experimental arrangements of human subjects, but is administered in the loop by another part of the brain. [3] The calculations from this study give the transfer function for human pupil as follows;

$$G(s) = \frac{0.16e^{-0.18s}}{(1+0.1s)^3}$$

The following is the relationship between the closed loop transfer function and the open loop transfer function;

$$F(s) = \frac{G(s)}{1+G(s)}$$

Using neurophysiological and anatomical findings, a non-linear delay differential equation for the pupil light reflex with negative feedback is derived. As the reflex's gain or time delay increases, a supercritical Hopf bifurcation in the pupil area occurs, transitioning from a stable fixed point to a stable limit cycle oscillation. To determine the criteria for instability, as well as the period and amplitude of these oscillations, a Hopf bifurcation analysis is used. The numerical simulations of the model did not produce the more complicated waveforms associated with higher-order bifurcations. This model provides a general framework for studying the various dynamical behaviors induced by the pupil light reflex, such as edge-light pupil cycling. The pupillary constrictor muscle, which has a circular structure and is innervated by parasympathetic fibers, causes pupil constriction. The motor nucleus for this muscle is the Edinger-Westphal nucleus, which is located in the oculomotor complex of the midbrain. [4]. We investigate spontaneous oscillations in a second-order delayed-feedback shunting model of the pupil light reflex. In a straightforwardly manner, this model describes the nonlinear characteristics of the iris and retinal sections of the reflex circuit. In the case of smooth negative feedback, linear stability analysis is used to determine the optimal conditions for a Hopf bifurcation in the pupil region as a function of various neurophysiological system factors such as time delay and neural connection strength. In addition, we investigate oscillation initiation in the presence of piecewise negative feedback and present an analytical expression for oscillation time. Finally, complicated periodic behavior is shown to emerge in the presence of mixed input. The experimental technique known as clamping is an important way of inducing spontaneous oscillations in the eye.
In a second-order delayed-feedback shunting model of the pupil light reflex, we investigate spontaneous oscillations. This model simply describes the nonlinear characteristics of the iris and retinal parts of the reflex circuit. Linear stability analysis is used in the case of smooth negative feedback to determine the best conditions for a Hopf bifurcation in the pupil area as a function of various neurophysiological system parameters such as time delay and neural connection strength. In addition, we investigate oscillation initiation in the presence of piecewise negative feedback and present an analytical expression for oscillation time. Finally, sophisticated periodic behaviour is shown to occur in the presence of mixed input. The experimental technique known as clamping is an important way of inducing spontaneous oscillations in the eye. [5]. We present a unique mechatronic system for automated corneal cross-linking (CCL) treatment in keratoconus patients. Keratoconus is a dangerous disease that, if left untreated, can cause severe visual impairment. The CCL procedure, which is the most promising treatment for this condition, is currently done by hand. The designed automated system is the first of its kind to automate treatment with visual feedback, and it promises to increase treatment efficiency while removing potential side effects and hazards. To track the patient's eye, the system includes a camera, an image processing algorithm built on OpenCV sharp, a planar servomechanism system made up of several mechanical and electronic components, and a PIC microcontroller with digital PID controllers. Before being manufactured, the proposed system and algorithms are built and simulated in MATLAB, and numerous experiments with an eye pattern and animal eyes are carried out. The results are presented and discussed. [6]. Analogies between servo control analytic techniques and a physiologically appropriate nonlinear delay-differential equation (DDE) model for the pupil light reflex are demonstrated. This DDE is compatible with the measured open-loop transfer function, providing physiological insight into the gain

and characteristics of the reflex. According to a Hopf bifurcation analysis of the DDE, when the first mode of the characteristic equation becomes unstable, a limit cycle oscillation in pupil area occurs, with its period matching experimental measurements. More modes become unstable after the initial point of instability, corresponding to successive encircling of (-1, 0) on the Nyquist plot, which significantly influences the oscillation's shape. Bifurcation analysis can supplement servo control analytic methods for studying oscillations caused by nonlinear neural feedback processes. [7].

The Form of the Human Pupil: The purpose of this research was to define pupil morphology in healthy human participants. Pupil photographs were taken using a modified slit lamp under steady illumination and 10-20 seconds after darkness. After projection and scanning of transparencies, the pupil margin was represented as a circular Fourier series, and best-fit ellipses were identified. The position of the pupil relative to the limbus was also determined in several cases. The results from 23 participants showed an average pupil non-circularity of 0.0166 in both darkness and light (a value of 0.0200 is discernible with the unaided eye). The best-fitting ellipse accounted for over half of the non-circularity (59.6% in darkness and 47.7% in light). The first four or five harmonics contributed the most to the shape. Shapes were usually consistent throughout a session and could last for at least a year, though there was variation between subjects, especially in light conditions. [8]. Human perception significantly impacts medical image inspection, but little is known about whether professionals' cognitive processing differs or what visual strategies they use while viewing medical images. To address this, we conducted an eye-tracking experiment on three groups of volunteers with varying levels of medical knowledge, collecting data on eye movement and verbal descriptions. Each participant viewed and described 42 dermatological images. Within each expertise-specific category, we designed a hierarchical probabilistic framework to extract common and unique eye movement patterns from participants' fixation and saccadic eye movements. Expert annotations of thought units on recorded verbal descriptions were time-aligned with these eye movement patterns to identify semantic interpretations. This work reveals how participants adjusted their viewing strategies during inspection and extracts their perceptual knowledge for advanced medical image interpretation. [9]. A Neural-Network-Based Approximation

The foundation of a discrete-time nonlinear servomechanism feedback controller lies in solving a set of nonlinear functional equations known as discrete regulator equations. However, due to system nonlinearity, exact solutions to these equations are often unavailable. This research proposes using a feedforward neural network to approximate solutions to the discrete regulator equations, providing a realistic solution to the discrete nonlinear servomechanism problem. The effectiveness of this method was demonstrated using the well-known inverted pendulum on a cart arrangement. Simulation results show that the proposed control law outperforms the standard linear control law. The structure of this paper is as follows: Section II discusses the background of the nonlinear servomechanism problem and explains the concept of nonlinear servomechanism approximation solutions. Section III presents our key findings, while Section IV details a gradient-based strategy for calculating required weights and applies our method to the inverted pendulum on a cart system. Finally, Section V concludes with observations. [10]

A Nonlinear Universal Servomechanism:
A servomechanism problem of controlling a scalar output variable to track any reference signal from some prescribed function space while maintaining internal states bounded is addressed for a class of uncertain nonlinearly perturbed, single-input, single-output, minimum-phase, relative degree-one, linear systems with nonlinear actuator characteristics (encompassing, for example, hysteresis and dead-zone effects). Only the graph of a properly regular set-valued map can contain the actuator properties. For arbitrary prescribed $A > 0$, a (adaptive) feedback strategy that ensures the tracking error is asymptotic to the interval [-A, A] C R for every reference signal of class R and every system (unknown to the controller) of class S is sought. For feedback, only the reference signal and scalar output instantaneous values are available. The space (R) as the set R of admissible reference signals and rather mild assumptions on the nature of the system nonlinearities are used to create one such universal adaptive feedback solution to this servomechanism

problem. Feedback is continuous, and its evolution is not based on an internal model principle. [11]. Modern deterministic linear regulator and servomechanism theories either neglect system disturbances entirely or presume they can be represented as initial conditions on the plant state variable. When the system is subjected to persistently acting disturbances, controllers constructed using such theories may fail to achieve performance specifications. In this study, we illustrate how existing regulator and servomechanism theories can be modified to account for the presence of persistent fluctuating disturbances. This enables the development of a deterministic controller capable of maintaining set-point regulation or servo tracking in the face of a wide variety of genuine external disturbances. Furthermore, we show how to systematically capitalize on any beneficial effects that may exist in the action of external disruptions. Finally, one can argue that the influence of disturbances on plant response is not always wholly unwanted, and that part of the disturbances' action may be advantageous in achieving the primary control task. [12]. The compensator identification challenge for feedforward and robust control of a general servomechanism problem will be addressed in this study. To change the robust controller, some one-dimensional "on-line tuning" is required, which can be regarded of as a generalization of the conventional single input-single output example. The study's central premise is that the requirements for the existence of a servomechanism controller and the actual controller structure can be expressed in terms of the plant's steady-state gain parameters, which can be obtained easily experimentally. The following is how the paper is organized: Section 1 contains some preliminary results; Section 2 describes how the steady-state gain parameters in Experiments 1 and 2 are determined and deals with the feedforward controller case (Theorem 1); Section IV deals with the robust feedback controller case (Theorem 2) and describes how the controller is determined using a series of one-dimensional "on line tuning" experiments; and Section V contains some numerical examples. [13]

In two sessions with free scanning and memory instructions, the eye-movement patterns of nine artists were compared to those of nine artistically untrained participants viewing 16 pictures ranging from ordinary scenes to abstraction: 12 images were created to support an object-oriented viewing mode (selection of recognizable objects) and a pictorial viewing mode (selection of more structural features), and four were abstract. The artistically untrained participants preferred to investigate human characteristics and objects, whereas the artists concentrated on structural/abstract features. A group-by-session interaction revealed that the artists changed their seeing strategy in the memory task session, viewing more objects and human traits. A verbal recall memory test revealed no overall difference in the number of photographs remembered; however, the number of correctly remembered visual aspects was significantly higher for artists than for untrained observers, regardless of picture type. There were no differences in fixation frequencies/duration across sessions. Still, a significant task-dependent group-by-session interaction of fixation frequency/duration revealed that artistically untrained participants demonstrated repetition effects in fewer, longer fixations with repeated viewing, whereas artists demonstrated the opposite pattern. [14]

Pupil sensing in a human visual video or image is useful in a variety of applications, such as eye tracking, diabetic retinopathy screening, smart homes, iris recognition, and so on. Pupil detection is hampered by a variety of issues, including light reflections, cataract disease, pupil constriction/dilation moments, contact lenses, brows, eyelashes, hair strips, and closed eye. To address these issues, the research community has been working hard to develop robust pupil localization algorithms for image/video data obtained using near-infrared (NIR) or visible spectrum (VS) illumination. This paper provides a rigorous examination of several pupil detection algorithms derived from conventional sources. This paper covers pupil localization approaches based on machine learning, histogram/thresholding, the Integro-differential operator (IDO), the Hough transform, and other techniques. The potential benefits and drawbacks of each system are addressed. Finally, this research provides advice for developing a reliable pupil detection system. This review would be an excellent resource for the related research community because the scope of pupil detection is so broad. [15]

Our primary goal is to demonstrate how light controlling cycles of the eye can cause torment or distress from glaring or visual work conditions, and how photophobia impressions can be triggered by communicating at the trigeminal core with harmful contributions from the eye. It isn’t light fundamentally that is vitally causative specialist yet it is the visual light control framework working in combination with the trigeminal core that is the principal premise of aversion to light. This part broadens the properties of the model and sums up the forecasts that can be made both for photophobia and distress glare. It is proposed that cortical electrical activity is not the cause of photophobia, but rather the influence of this activity on central mechanisms as

defined in the gate control theory model. It is proposed that in this case of discomfort glare and visual task work, the retinal visual cortex system is constantly seeking to optimise visual image clarity. [16]

Complexity in the human pupillary light reflex:

We investigated the dynamical characteristics of the pupillary light reflex in order to contribute to their explanation using nonlinear dynamical systems. To introduce the terminology and relevant features of the pupillary light reflex and its associated delay, we will begin with a review of human eye anatomy and physiology, with a focus on the iris, pupil, and retina. In addition, we present the most highly regarded pupil dynamics models found in the current scientific literature. This model will be defined by a nonlinear differential equation with delay, and we will present our research on the qualitative and quantitative dynamic behaviour of that neurophysiological control system. It involves functions and their derivatives, all of which occur at the same time. It is a feature that fails to consider the non-instantaneous nature of many phenomena. [17]

The human pupillary reflex (PLR complex)'s bifurcations and oscillations are investigated. Autonomous pupil area oscillations are created by electronically substituting controllable nonlinear feedback for the reflex's normal negative feedback. A theoretical framework for studying pupillary oscillations that is physiologically grounded was developed. The delay differential equation (DDE) model fits quantitatively with the simplest periodic behaviors and qualitatively with the complex ones. Much of the data's aperiodicity can be attributed to noise and transitory phenomena rather than chaos. The critical behaviour of the PLR to one oscillation differs from smooth negative feedback. The relative fluctuations of period are larger than those of amplitude in the first case. This experimental result is explained using properties of temporal solutions and densities of a stochastic ODE. This system's bifurcation delayed response by a coloured noise that is both additive and multiplicative. A theoretical overview of the behavior of stationary densities of ODEs and the origin of the carry is provided, as well as the implications for the analysis of bifurcations in neural delayed feedback systems. [18].

The time course and degree of change in the understudy region of the pupil caused by light are assessed in all vertebrate and cephalopod classes. Although the speed and extent of these reactions vary, most species, except teleost fish, exhibit broad changes in the understudy region associated with light openness. The neuron muscular pathways hidden light-evoked understudy choking are depicted and viewed as moderately preserved, albeit the exact autonomic systems contrast fairly between species. In well evolved creatures, brightening of just a single eye is known to cause tightening in the unilluminated student. Such consensual reactions occur in a wide range of indifferent creatures, and their capability and connection to decussating of the visual pathway is considered. Natural photosensitivity of the iris muscles has long been known in amphibians, but it is truly limitless in other creatures. Changes in the understudied region balance the conflicting demands of high spatial keenness and expanded responsiveness in various light levels in most species. In the few teleosts where student development occurs, they do not serve a visual function but do play a role in concealing the eye of bottom dwelling species. [20]

This paper presents a proof of concept built around a servo-controlled pan/tilt platform controlled by pupil movement for the evaluation of pupil detection-based eye-tracking algorithms. A head-mounted infrared video camera captures an image of the eye, and after detecting the center position of the pupil, its coordinates are mapped to control the pan and tilt of a miniature platform controlled by a servo motor. The system enables efficient real-world evaluation of various eye-tracking algorithms, and depending on the type of accessory mounted on the platform, it can have a wide range of application scenarios. [21]

We investigate a non-straight, time-deferred model of Pupillary Light Reflex in this paper (PLR). We consider key exhibition metrics such as dependability, assembly, and heartiness. We focus on its solidity properties and proposition rules on boundary esteems that ensure neighbourhood dependability using time and recurrence space investigation. Soundness outlines are used to investigate compromises between framework boundaries. The advantages of boundaries for which oscillatory and non-oscillatory unions occur are investigated. We demonstrate that every boundary can prompt a deficiency of solidness by using nearby Hop bifurcation. Further, the soundness of as far as possible cycles is described scientifically utilizing typical structures furthermore, the middle complex hypothesis. Bifurcation graphs go with the insightful outcomes. We lay out that the cut off cycles created are generally unsound. It reveals that when the pupillary reflex model loses its nearby dependability, it becomes difficult to control. For uncertainties in boundary values, the model's heartiness is estimated. Our work provides plan cordial rules to ensure dependability and achieve the desired level of execution and heartiness. [22]

The capability of the iris and its reaction to light in man has been of extraordinary interest to the two physiologists and nervous system specialists who

needed to lay out the brain pathways engaged with the control of the student reaction, as well as to physicists also, natural designers who have frequently depicted the student light reflex (PLR) as a delightful illustration of a shut circle servomechanism. This system fundamentally could change retinal luminance with changes in encompassing light, albeit this has frequently been perceived as a valuable improvement. In expansion, numerous clinical, neuro-ophthalmological and pharmacological examinations have endeavored to lay out the convenience of the student in diagnosing sores of the visual pathways and the typical working of the retina. The frequently meandering contribution of countless brain connections in controlling the development of the iris makes the student a rich wellspring of data, in any case, it additionally guarantees that its mysteries are difficult to unwind. The presence of various uncorrelated signs in the student makes troublesome the extraction of other little signals that can reflect significant retinal and cortical handling of visual data. [23]

At the point when man attempts to discover something on a table in his grasp, he needs to measure mistake between the material and hand to play out his last reason. This implied that human manual control framework incorporates a criticism of visual framework, and is controlled by it. Obviously, albeit the manual control framework is convoluted and has various circles, servo analytic investigation of this framework has been done it might be said of robotics, As referenced over, the visual framework is one of input for human execution, while the visual framework comprises of the eyeball, eye muscles, visual cortex and association among fringe and focal device. Being constrained by this contraption, eye development should be possible easily to fulfil his will. To be specific, the visual framework, one criticism of the human manual control framework, has alleged different circle and data from the visual framework presumably proliferates to engine cortex and controls the human execution. To explain the manual control framework as far as servomechanisms, it could be viewed as that eye following control framework is a servomechanism and be sensible that the framework is considered and broke down by a technique for recurrence reaction. [24]. An original pupillary-based check framework is presented, alongside the early character confirmation results and investigation, in view of the spatio-worldly elements processed from the unconstrained pupillary motions. The creators show that this biometric quality has the capacity to give enough discriminative data to confirm the personality of a subject. Another approach to register the spatio-transient biometric format accounts of the student region changes, in a video-oculography succession under steady luminance level, is likewise presented in this paper. As indicated by the creators' information, there is no proof that different endeavours were made, addressing this system to recognize people in light of the spatio-fleeting portrayals, registered from the typical expansion withdrawal conduct of the student. In this work, aliveness will be distinguished by utilizing the data got from the unconstrained pupillary wavering instrument. [25]. The pupillary light reflex breaks down by delivering sores in afferent and efferent pathways in a progression of monkeys. One-sided enucleating and auto radiographic methods using axoplasmic stream were utilized to decide afferent pathways. Sores likewise were made in the pregeniculate core (PGN) and individual parts of the oculomotor instinctive cores. Degeneration was concentrated in Wiitanen and Nissl stained areas. Infrared pupillographic records were made during the medical procedure. Enucleation and autoradiographic studies revealed: (1) reciprocal retinal projections to the PON and PGN, and (2) predominantly lateral projections to parts of the optic plot and sub lentiform cores. [26]

The most important step in iris recognition systems is locating the iris, because all subsequent steps, such as iris normalization, feature extraction, and matching, rely on its accuracy. In an image of an eye, iris localization refers to the separation of the iris from other parts of the eye such as the pupil, sclera, eyelids, and eyelashes. This article introduces a novel method for pinpointing exact pupil location. The pupil is located by finding a point within the pupil, then the centre is obtained by using the centroid of the pupil region, and the radius for further processing is calculated from the region's binary image. The divide and conquer rule encode the student's non-circular limit. The student's circular boundary is divided into a defined number of points. These spikes are repositioned in relation to the maximum slope then together to get the exact pupil boundary. The intensity slope is used to determine the outer boundary of the iris and the eyelids. The experimental results demonstrate that the proposed iris localization method is quite effective. [27]

The iris is a profoundly precise biometric identifier. Anyway, boundless reception is ruined by the trouble of catching top notch iris pictures with insignificant client co-activity. This paper portrays an original model iris distinguishing proof framework intended for deadlock helpful access control. This framework recognizes people who stand before and face the framework after 3.2 seconds by and large. Subjects inside a catch zone are imaged with an adjusted sets of wide-field-of-view reconnaissance cameras. A subject is situated in three aspects utilizing face

identification and triangulation. A zoomed close to infrared iris camera on a container slant stage is then designated to the subject. The iris camera focal point has its central distance consequently changed in view of the subject distance. Coordinated with the iris camera on the dish slant stage is a close-infrared illuminator that is made out of a variety of coordinated LEDs. Video outlines from the iris camera are handled to distinguish and fragment the iris, create a format and afterward recognize the subject. [28]

The pupil is primarily regulated by the autonomic nervous system. Recently, rhythms related to autonomic changes in heart rate and blood pressure have been observed in unconstrained Pupil Diameter (PD) changes. However, the physiological mechanisms underlying these variations have not been extensively studied. This research aims to investigate the origin of pupil fluctuations in humans by gently stimulating carotid baroreceptors using Neck Suction (NS). ECG, respiratory movement, NS pressure, and PD fluctuations were recorded from 10 normal subjects. The equipment for PD measurement and NS stimulation was developed in our laboratory. The response of the pupil to NS was studied at stimulation frequencies of 0.10 and 0.20 Hz using parametric spectral and cross-spectral analysis. In all subjects, NS rhythms were evident in the heart rate variation series at both stimulation frequencies and in the PD spectra with significant peaks (>0.5). These findings suggest that blood pressure fluctuations transmit to the pupil through carotid baroreceptor afferent pathways, although a central contribution cannot be ruled out. [29]

Spatial considerations affect saccade planning and working memory. While saccade planning and working memory are linked to attention, the effects of saccade planning are less explored in relation to working memory. Recent studies show that spatial attention interacts with local luminance in the attended area, affecting pupil size. We used local luminance adjustment to investigate the effects of saccade planning and spatial working memory. Participants were tasked with making saccades toward visual or recalled target locations, with bright and dark stimuli presented during delays. Alignment of bright stimuli with target locations resulted in more pupil constriction, especially in tasks with no interval between stimulus and target presentation, particularly in memory-delay tasks.

Sr. no	**Paper Title / Author Names / Ref no.**	**Approach/ Techniques**	**Findings/ Comments**
1.	Eyeing up the Future of the Pupillary Light Reflex in Neuro-diagnostics Hall, C. A., & Chilcott, R. P. (2018)	The pupillary light reflex shows a response when light falls on it	For bright light eye pupil is contracted and for low light, it is expanded
2.	A SERVOANALYTIC STUDY OF CONSENSUAL PUPIL REFLEX TO LIGHT Stark, L., & Sherman, P. M. (n.d.)	The human eye is considered as a control system and a reference light source is considered as input	The difference between light falling on the retina and light flux actuates the control system
3.	Stability, Oscillations, and Noise in the Human Pupil Servomechanism Stark, L. (1959)	A designed pupillometer was used for quantitative measurements in animals and human subjects with an intact central nervous system	The pupil servo shows stability with an 18db attenuation slope
4.	MODELLING AUTONOMOUS OSCILLATIONS IN THE HUMAN PUPIL LIGHT REFLEX USING NON-LINEAR DELAY-DIFFERENTIAL EQUATIONS Spitschan M., Jain S., Brainard D. H., & Aguirre G. K. (2014)	A Hopf bifurcation analysis is used to identify the criteria for instability, as well as the period and amplitude of these oscillations	It provides a generic framework for investigating the various forms of dynamical behaviors induced by the pupil light reflex

5.	Spontaneous oscillations in a nonlinear delayed-feedback shunting model of the pupil light reflex Bressloff P. C., & Wood C. v. (1998)	We study oscillation beginning in the presence of piecewise negative feedback and provide an analytical expression for oscillation time	this model describes the nonlinear features of the iris and retinal parts of the reflex circuit
6.	Design and control of a visual servomechanism for automating corneal cross-linking treatment in keratoconus patients Şahin O., & Altuı E. (2015)	The system includes a camera, an image processing algorithm on OpenCV sharp, a planar servomechanism system to follow the patient's eye	for automated corneal cross-linking (CCL) treatment in keratoconus patients
7.	Insight into the Transfer Function, Gain, and Oscillation Onset for the Pupil Light Reflex Using Nonlinear Delay-Differential Equations Longtin A., & Milton J. G. (1989)	DDE is demonstrated to be compatible with the measured open loop transfer function	It can be used to supplement servo control analytic methods for studying oscillations
8.	The Form of the Human Pupil Wyatt H. J. (1995)	This study was to define the pupil morphology in normal human participants	The average pupil no circularity was 0.0166 in both darkness and light
9.	Learning Eye Movement Patterns for Characterization of Perceptual Expertise	we undertake an eye-tracking experiment and gather data on eye movement	We can reveal how these subjects changed their seeing tactics during the inspection
10.	A Neural-Network-Based Approximation Method for Discrete-Time Nonlinear Servomechanism Problem Wang, D., & Huang, J. (2001)	A discrete-time nonlinear servomechanism feedback controller is based on the solution of a set of nonlinear functional equations	It outperforms the standard linear control law
11.	A Nonlinear Universal Servomechanism Ryan, E. P. (1994)	A servomechanism problem of controlling a scalar output variable to track any reference signal from some prescribed function space	The feedback is continuous
12.	Accommodation of External Disturbances in Linear Regulator and Servomechanism Problems Johnson C. D. (1971)	To create a deterministic controller that maintains set-point regulation, or servo tracking	The disturbances' action may be advantageous in achieving the primary control task
13.	Multivariable Tuning Regulators: (The Feedforward and Robust Control of a General Servomechanism Problem) Davison E. J. (1976)	The compensator identification for feedforward and robust control of a general servomechanism	Helps in examining human eye behavior
14.	Expertise in pictorial perception: (eye-movement patterns and visual memory in artists and laymen)	Eye-movement patterns from nine artists were compared to those of nine artistically untrained	There were no differences in fixation frequencies

	Vogt S., & Magnussen S. (2007)	participants viewing 16 pictures ranging from ordinary scenes to abstraction	
15.	Pupil detection schemes in the human eye Min-Allah N., Jan F., & Alrashed S. (2021)	To develop robust pupil localization algorithms for image/video data obtained using near-infrared (NIR) or visible spectrum (VS) illumination	It is important in eye-tracking, diabetic retinopathy screening, smart homes, iris recognition
16.	A model for the explanation of discomfort and pain in the eye caused by light Stone, P. T. (2009)	To exhibit how light-controlling cycles of the eye could cause torment or distress from glaring or visual work conditions	The electrical activity of the cortex is not the cause of photophobia
17.	Complexity in the human pupillary light reflex] Laureano, R. D., Mendes, D., Grácio, C., & Laureano, F. (2020)	The dynamical characteristics of the pupillary light reflex	It doesn't consider the non-instantaneous nature of many phenomena
18.	Nonlinear Oscillations, Noise, and chaos in neural delayed feedback Longtin, A. (1989)	Autonomous pupil area oscillations were produced by electronically replacing controllable nonlinear feedback for the normal negative feedback of	The critical behavior of the PLR to one oscillation is different piecewise rather than smooth negative feedback
		this reflex	
20.	A review of their distribution, dynamics, mechanisms, and functions Douglas, R. H. (2018)	The neuron muscular pathways hidden by light-evoked understudy choking are depicted	Natural photosensitivity of the iris muscles is known in amphibian
21.	Servo Control Based on Pupil Detection Eye Tracking IEEE Electronics Packing Society., & Institute of Electrical and Electronics Engineers	It is developed for the evaluation of pupil detection-based eye-tracking algorithms, built around a servo-controlled pan	The system allows efficient real-world evaluation of different eye-tracking algorithms
22.	Stability and bifurcation analysis of a pupillary light reflex model Rajendran, J., Arutprakasam, S. S., & Warrier, A. M. (2015)	We researched a non-straight, time-deferred model of Pupillary Light Reflex	The pupillary reflex model becomes hard to control once it loses its nearby dependability
23.	Studies of basic mechanisms and clinical applications barbur, J., & Barbur, J. L. (2004)	Numerous clinical, neuro-ophthalmological, and pharmacological examinations shave endeavoured to lay out the convenience for students	Helps in cortical handling of visual data
24.	Servo analytical Study of eye tracking moment recorded by electro-oculography Iida, M. (n.d.)	The human manual control framework incorporates a criticism of the visual framework and is controlled	Proliferates to the engine cortex and controls the human execution

		by it	
25.	A new spontaneous pupillary oscillation-based verification system Villalobos-Castaldi, F. M., & Suaste-Gómez, E. (2013)	The creators show that this biometric quality can give enough discriminative data to confirm the personality of a subject	Aliveness will be distinguished by utilizing the data
26.	Anatomical analysis of pupillary reflex pathways Pierson, R. J. and M. B. Carpenter (1974)	The pupillary light reflex breaks down by delivering sores in afferent and efferent pathways in a progression of monkeys	Reciprocal retinal projections to the pretectal olivary cores (PON) and PGN
27.	Non-circular Pupil Localization in Iris Images Basit, A., Javed, M. Y., & Masood, S. (2008)	The pupil is located by finding a point in the pupil then the center is obtained using the centroid of the pupil region	The proposed method of iris localization is quite effective
28.	Stand-off iris recognition system Wheeler, F. W., et al. (2008)	Portrays an original model iris distinguishing proof framework intended for deadlock helpful access control	Recognizes people who stand before and face the framework after 3.2 seconds
29.	BARORECEPTOR-SENSITIVE FLUCTUATIONS OF HEART RATE ANDPUPIL DIAMETER	It is part realized that the student is under the control of the autonomic sensory	The reaction of the student to the NS was learned at excitement frequencies of 0.10 and 0.20 Hz
	Calcagnini G., Giovannelli P., Censi F., Bartolini P., & Barbaro V. (2001)	system	
30.	Comparing Pupil Light Response Modulation between Saccade Planning and Working Memory Wang C. A., Huang J., Yep, R., & Munoz D. P. (2018)	The mark of spatial consideration impacts has been shown through saccade arranging and working memory	The impacts were reduced when there was no possibility executed between the fix and target areas, especially in the memory-defer task

2. METHODOLGY

The purpose of this study is to design a basic control system for controlling the human pupil servo-actuator with the help of retinal light flux oscillations. Our strategy therefore is to investigate the PLR at various levels of the incident light and to deduce the changes in the size of the pupils.

Experimental Setup

- Light Source: An adjustable LED array to provide different light intensities.
- Camera System: High-speed cameras to capture real-time changes in pupil diameter.
- Data Acquisition System: Sensors and data loggers to record light intensity and pupil response.

Control System Design

The control system is designed based on the feedback mechanism of the PLR. The main components include:

- Sensors: Photodiodes to measure incident light intensity (L_REF).
- Actuators: Servomechanisms to simulate the constriction and dilation of the pupil.

- Controller: A PID controller implemented on a microcontroller (e.g., PIC) to adjust the pupil diameter based on the error signal.

Algorithm Development

We employ a digital PID control algorithm to manage the pupil's response. The algorithm's parameters are tuned to achieve optimal performance, ensuring quick and stable pupil adjustments. The control algorithm steps are:

1. Error Calculation: Determine the error as the difference between the desired light intensity (L_REF) and the actual pupil response (L_controlled).
2. PID Computation: Use the PID formula to compute the control signal.
3. Actuator Adjustment: Adjust the servomechanism based on the control signal to correct the pupil diameter.

Analytical Techniques

To analyze the system's performance, we employ several analytical techniques:

- Transfer Function Analysis: Derive the transfer function representing the delay in pupil response (transportation delay).
- Stability Analysis: Conduct linear stability analysis to determine system stability under different feedback conditions.
- Hopf Bifurcation Analysis: Examine the conditions for oscillations in pupil diameter using the Hopf bifurcation theory.

Comparison with Previous Models

Our approach builds on previous research:

- Longtin and Milton [31]: Modeled pupil dynamics under variable lighting, deriving parameters from experimental data.
- Sahin and Altug [32]: Developed a mechatronic system for automated corneal cross-linking, utilizing visual feedback for treatment efficiency.
- Stark and Sherman [33]: Conducted a servo-analysis of the light-induced pupil reflex, establishing a transfer function for the pupil. servo system.
- Bressloff and Wood [34]: Investigated spontaneous oscillations in a second-order delayed-feedback shunting model of the pupil light reflex.

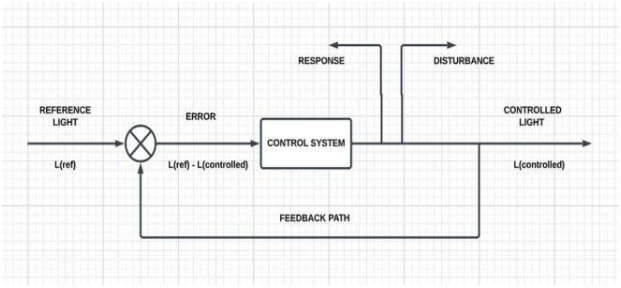

Figure 3: Block diagram for the working schematic of the proposed control system

Proposed System

In our proposed control system, the control mechanism takes into consideration the difference between the input (L_REF) and output (L_controlled) and yields a closed feedback control relationship of gain unity. This arrangement is well depicted on the system's block diagram shown earlier in figure 3.

This is expressed in our transfer function where the transportation delay also captures the response delay in terms of change in pupil diameter resulting from the presence /absence of light. While this system is capable of exerting some control over the pupil's servo functions, its usefulness is somewhat restricted when addressing the study of various eye diseases whereby in response to light, the brain is known to send out the wrong signal. Our system is designed and would be accurate for normal sighted specimens.

3. MODELLING

The transfer function governing equations are based on the Milton and Longtin model of the eye. Changes in pupil area, A, caused by imposed piecewise constant feedback can be described as follows;

$$\frac{dg}{da}\cdot\frac{da}{dt}+a\,g(A)=F(A_c) \quad (1)$$

where a is the pupillary movement rate constant, is the neural delay, and $F(A_c)$ is a continuous

piecewise function of A_c. The function $F(A_c)$ depending on whether the pupil area is greater than or less than a certain threshold. The notation A_c denotes the pupil area at one time τ in the past, i.e. $A_c = A(t-\tau)$. The feedback function, $g(A)$, changes in iris muscle activity, x, are related to changes in A, and the inverse relationship between x and A is considered.

The forcing term on the right side of (1) represents changes in retinal light flux, $\emptyset(\emptyset = IA,$ where I is the retinal illumination), due to changes in pupil area. For smooth negative feedback, (1) becomes;

$$\frac{dg}{dA}\cdot\frac{dA}{dt} + a\, g(A) = \gamma \ln \frac{\emptyset_x}{[\emptyset_t]} = \gamma[I_r A_r] \qquad (2)$$

where the logarithmic compression of light intensities at the retina was considered, γ is the neural firing frequency rate constant, and $\hat{I}\hat{A}$ are the values at the threshold.

By linearizing (2) we get;

$$a\, g(A^*) = \gamma \ln \left[\frac{I^*A^*}{\hat{I}\hat{A}}\right] \qquad (3)$$

Where A^* is the pupil area corresponding to I^*.

The linearization (2) about A^* leads to;

$$a^{-1}\frac{dA}{dt} + A = G.[A_c - A^*] + A^* \qquad (4)$$

Where;

$$G \equiv \frac{\gamma}{\alpha\beta A^*} \qquad (5)$$

And $\beta = \frac{dg}{dA}$ evaluated at A^*. When $\beta < 0$, As a result, G>0, corresponds to negative feedback.

The pupil light reflexes experimentally determined closed-loop transfer function;

$$H(s) = \frac{P(s)}{1+P(s)} \qquad (6)$$

where the open-loop transfer function is;

$$P(s) = \frac{G_0 \exp(-cs)}{(1+ks)^3} \qquad (7)$$

and where s denotes the Laplace variable and τ = 0.18 s. While the Bode amplitude plot's 18 db/octave roll-off suggested that the transfer function had three poles, they could not be determined individually and were all set equal to 10 s -I by selecting the time constant k=0.1 s. (derived from experimental work, Stark 1959).

The time domain form of the above transfer function is given by;

$$k^3\frac{d^3\emptyset}{dt^3} + 3k^2\frac{d^2\emptyset}{dt^2} + 3k\frac{d\emptyset}{dt} + \emptyset(t) = G_0.[F(t-r) - \emptyset(t-r)] \qquad (8)$$

3.1 State Space

The state space representation is achieved using MATLAB.

```
Tss =

  A =
         x1      x2
   x1  -11.11  -7.716
   x2       8       0

  B =
      u1
   x1  2
   x2  0

  C =
         x1     x2
   y1     0  3.858

  D =
      u1
   y1  0

Continuous-time state-space model.
```

3.2 Open loop transfer function

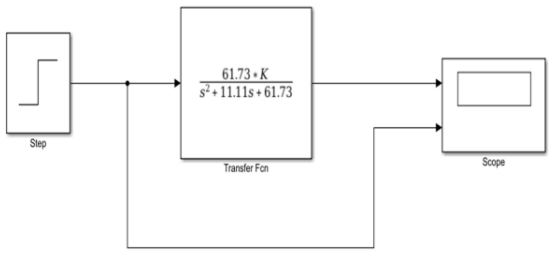

Figure 4: Open loop transfer function

3.3 Reduced transfer function

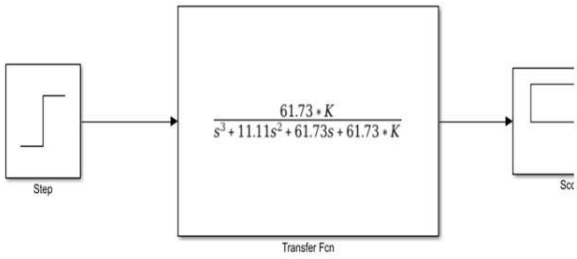

Figure 5: Reduced transfer function

4. IMPLEMENTATION AND RESULTS

The data for this project is imported from MATLAB and Simulink. Using Simulink is preferable as it has built-in commands for examining and designing control systems like step, impulse, and parabolic inputs. Other such parameters make it possible to implement our system design without designing any guide user interface. For the current scope of the project results obtained from both MATLAB and Simulink are synonymous. The graphs for responses are the same for both. In this section of the project, Simulink will be considered for tuning and designing the PID controller for this system. As our system is SISO (single input single output), we can also use MATLAB siso tool for designing stability margin and studying the effects of changing parameters on the stability of the system.

4.1 System Characteristics

The given lists all the system characteristics of our model:

Parameter	Values
Natural Frequency	7.8568
Damping Ratio	0.7070
Settling Time	0.7201
Peak Time	0.5654
%Overshoot	4.3245

For analysis purposes, the transfer function is approximated as second-order transfer with the error being less than 2%. The percentage error between our approximation and the actual transfer function is 0.5%.

4.2 Response Comparison

The tep response comparison is given in the following figure;

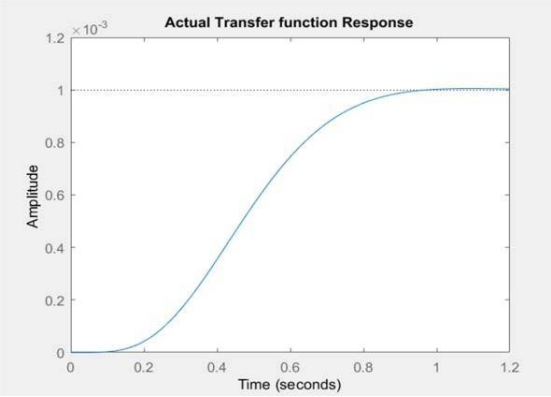

Figure 6: Actual step response

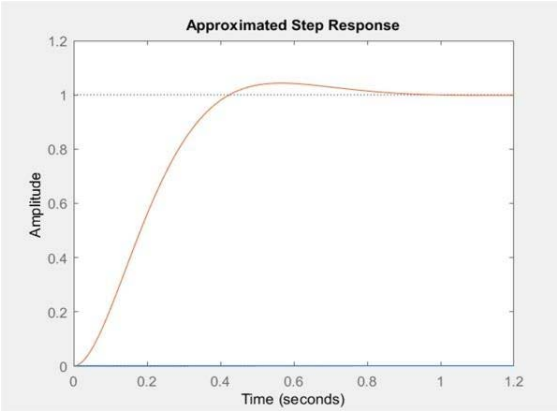

Figure 7: Approximated step response

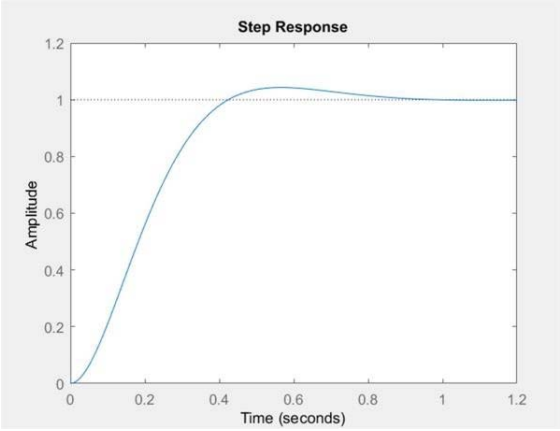

Figure 8: Step input resonance

Our system is quite stable as it has minimal overshoot and no oscillations. Considering the current response of our system, it shows near-ideal behavior for step responses. Our applications suggest inputs are in the form of single-step inputs and single outputs with certain transportation delays. Transportation delays are case-sensitive for individuals.

4.3 Ramp Input

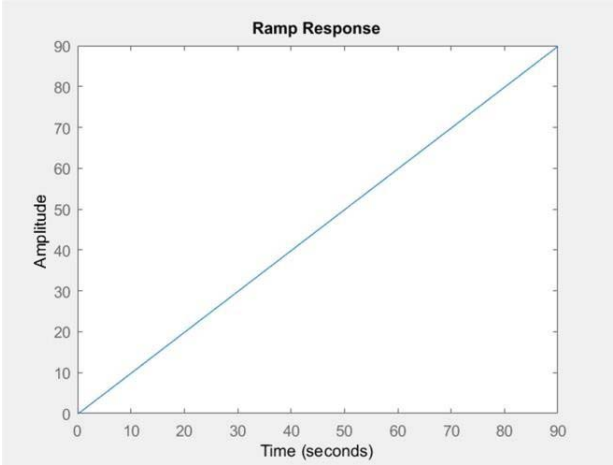

Figure 9: Ramp input response

For ramp input, our system shows instability. It is best suited to cater to step input operations.

4.4 Parabolic Input

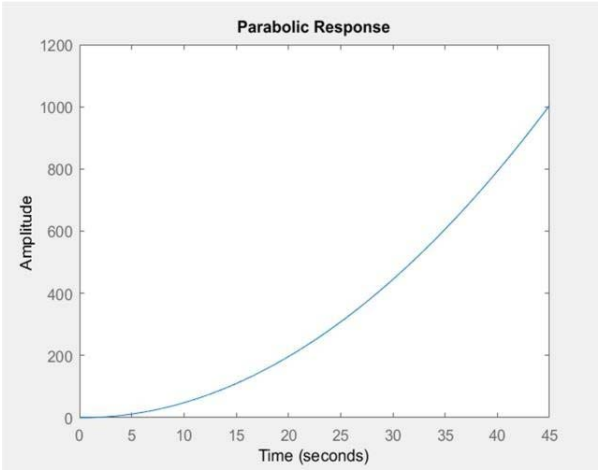

Figure 10: Parabolic input response

For parabolic input, we get an increasing slope towards infinity that shows that the system becomes unstable under parabolic inputs.

4.5 Stability and Gain Limits

The pole-zero plot from MATLAB shows two poles in the left half plane. So, our system is a table. At K=1 the poles stand between -5 and -6 points on the real axis so we can try to shift our plots toward the right to choose between sluggishness and controllability of the system.

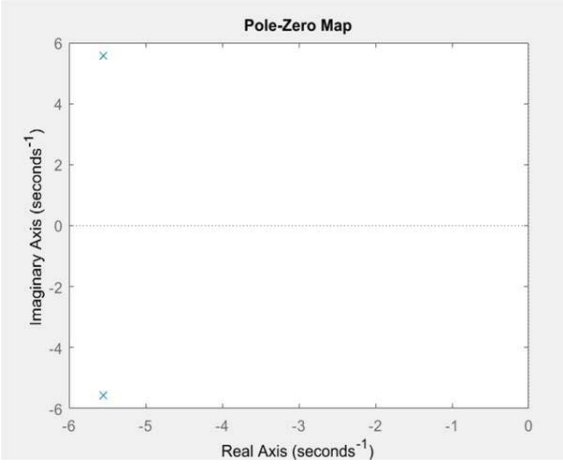

Figure 11: Pole-Zero Plot

Using MATLAB, we get the gain limits of the P controller as 0<K<12. So, the system is stable for values between 0 and 12 of the real axes.

The following code is used in MATLAB to find out the position constant, velocity constant, and acceleration constant with associated steady-state errors.

```
%main code
num = [61.73];
den = [1 11.11 61.73];
TF = tf(num,den);
step(TF)
stepresults = stepinfo(TF)
%STEP INPUT
kp = dcgain(TF)
essstep = 1/(1+kp)
%RAMP
numsg = conv([1 0],num);
%densg = [1 11.11 61.73];
densg = den;
sG = tf(numsg,densg);
sG = minreal(sG);
kv = dcgain(sG)
essramp = 1/kv
%PARABOLIC
nums2g = conv([1 0 0],num);
%dens2g = [1 11.11 61.73];
dens2g = den;
s2G = tf(nums2g,dens2g);
s2G = minreal(s2G);
ka = dcgain(s2G)
essparabolic = 1/ka
```

```
kp =

     1


essstep =

    0.5000

kv =

     0

essramp =

   Inf

ka =

     0

essparabolic =

   Inf
```

As the system under study is a 0-type system it has no poles on the origin so must show infinite steady-state error for ramp and parabolic inputs while having a constant steady-state error for step input.

4.6 Root Locus

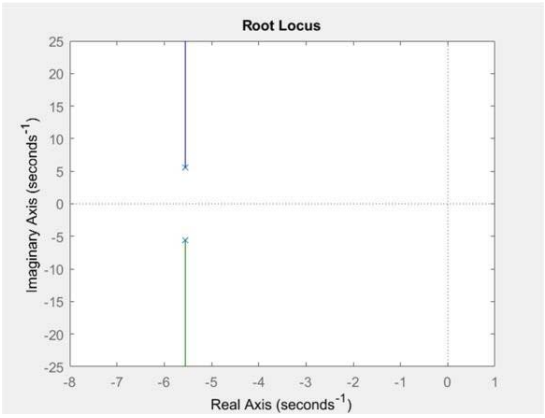

Figure 12: Root locus plot

Root locus shows locus starts from two points in the left half plane and ends at infinity as the system has no zeros.

4.7 PID controller:

The tuned PID response is shown which shows minimal overshoot and steady state error. So, the system is ideally tuned for step inputs. The current operational boundaries do not require the use of a ramp or parabolic input so, the system is sufficient enough in terms of stability and controllability for servo analytic control of the human eye pupil.

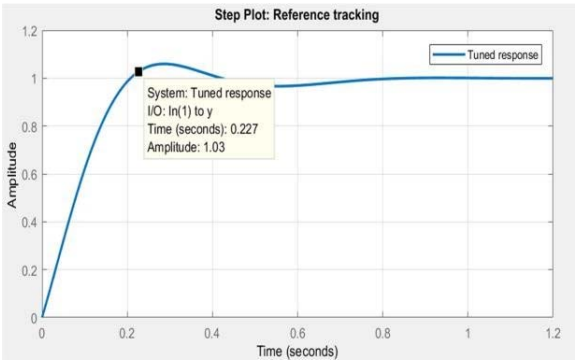

Figure 13: PID Response

The control parameters are represented in the table below:

Parameter	Gain values

Ki	2.1459
Kp	11.7334
Kd	0.098113

The tuned gains are minimal so in terms of cost the PID tuner is sufficient and desirable.

4.8 Discussion

In our project, we aimed to model and control the human pupil's response to light using a servomechanism approach. Our results are derived from simulations and analysis conducted using MATLAB and Simulink. The following outlines the key findings and their implications.

System Characteristics

The natural frequency of our system was found to be 7.8568, with a damping ratio of 0.7070. These values indicate a well-damped system, which is crucial for minimizing oscillations and ensuring stability. The settling time was calculated to be 0.7201 seconds, and the peak time was 0.5654 seconds. The percentage overshoot was relatively low at 4.3245%, indicating that the system is stable and does not exhibit excessive oscillatory behavior.

Step Response

The step response of the system was analyzed to determine its stability and performance. The actual step response showed minimal overshoot and no oscillations, demonstrating near-ideal behavior for step inputs. This stability is essential for accurately controlling the pupil's response to sudden changes in light intensity.

Ramp and Parabolic Inputs

For ramp inputs, the system exhibited instability, indicating that it is best suited for step input operations rather than gradual changes. Similarly, the response to parabolic inputs showed an increasing slope toward infinity, further confirming the system's instability under these conditions. These findings suggest that while the system performs well with sudden changes in light intensity, it may not handle gradual changes as effectively.

Root Locus and Pole-Zero Plot

The root locus plot revealed that the system's poles are located in the left half of the complex plane, confirming its stability. The pole-zero plot further supported this, showing that the poles are positioned between -5 and -6 on the real axis. This placement ensures that the system remains stable for a range of gain values.

PID Controller Tuning

To enhance the system's performance, a PID controller was implemented and tuned. The tuned gains were Ki = 2.1459, Kp = 11.7334, and Kd = 0.098113. The PID response showed minimal overshoot and steady-state error, indicating that the system is well-tuned for controlling the pupil's response to light. The tuned PID controller effectively balances stability and responsiveness, making it suitable for practical applications in controlling the eye's servomechanism.

5. CONCLUSIONS

Our objective was to design a control system for controlling the human eye pupil response. This could be achieved through a number of approaches, in our approach a light source is used to control the pupil size (its diameter) and a camera for capturing the change in its size. The data from the camera is used to account for transportation delay in eye response. The shift in pupil size is then utilized to generate a light function. The desired response of the pupil is then incorporated into a function of light. A data set obtained from experimentation will specify a light reading for a particular pupil diameter. In this way, input and output can be interpreted as a function of light. Alternatively, the incident light can also be interpreted as a function of the diameter change of the pupil (its size). A higher resolution camera will provide a more comprehensive data set of what type of light intensity produces what type of change in diameter. In the case of light as an input and output function, the feedback mechanism while accounting for transportation delay will vary light intensity to obtain a particular change in pupil size. The modeling results demonstrate that our control system can accurately predict and control the human pupil's response to light with high stability and minimal

overshoot. The system's performance is optimal for step inputs, showing instability under the ramp and parabolic inputs, indicating it handles sudden changes in light intensity better than gradual ones. The PID controller tuning with gains Ki = 2.1459, Kp = 11.7334, and Kd = 0.098113 ensures the system's stability and responsiveness. These results suggest that our control system is a reliable and practical tool for studying and managing the eye's servomechanism. This system has significant potential for applications in medical research and the treatment of vision-related conditions, providing a foundation for advancements in ophthalmology.

6. RECOMMENDATIONS

In the future instead of deriving a generic system for all sorts of specimens, a dynamic system should be devised that could incorporate different time delays and can obtain a data set for inputs and outputs specific to a person. The suggested system should work in phases; the first phase is for developing a data set for light-diameter relationship innate to a particular person under study, in the second phase the system should be checked. All these steps should be made possible to occur as fast as possible for a better practicality factor.

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AUJoGR-24403

Design and Modelling of An Active System for Control of Floor Vibrations

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Abstract

Typically, architectural elements, mass, and/or stiffness are considered potential solutions for floor vibration. Alternatives to these fixes include but are not limited to, adding frame members, erecting full-height partitions, and thickening the floor slab. These solutions are expensive to install in a new building, challenging to implement and uncomfortable for the residents of older structures. A solution like erecting full-height dividers also goes against the idea of open-plan offices that are common in tenant fit-outs. To address the treatment of vibrating floors, tuned mass dampers (TMDs) are frequently attached to the floor to provide reactive damping. TMDs are the most practical, affordable, and least disruptive floor vibration control option for both new and existing floor systems because of their little weight penalty, cheap cost, and ease of installation. It is important to include damping into a floor's design if you want it to be light, open, and free of vibrations while also adhering to the current serviceability standards. There are several kinds of floor vibrations that result in structural deterioration over time. Some are human induced, either through the usage of machines the improvement in structural design that allows for more slender build, or simply walking at differing resonating frequencies; others are natural, such as earthquakes or strong winds which create the need for active control of vibrations. This paper investigates the implementation of different vibrational control methods into the flooring or walls of the building in order to gain stability in times the building is under stress. TMDs are merged with control systems to form AVCs. Several different methods are discussed such as using the Hybrid tuned mass dampers, partial floor loads as multiple tuned mass dampers, VIVDs, PID controllers, lightweight floor systems, etc. Hybrid TMDs have modeling algorithms that are further studied. To achieve high optimization of any civil structure in order to have control over vibrations, the hybrid modelling technique uses both statistical analysis of energy (SEA) and finite element method (FEM) to foretell operation of the controller. There is a quick response to any predictions simulated, in structures that are targets of medium to high frequencies.

Most passive damping systems have drawbacks such as pre requirements of high mass of inertia and low efficiencies in transient waves, especially when there is a change in structure or mass. Active controlled tuned mass damper minimizes these drawbacks and increase efficiency of the damping system, even expanding to a larger range of frequencies located at the transient phase. Some major criteria for developing and designing AVCs that require careful consideration are the sturdiness and operational specifications, the minimum instability of closed loops, and the highest stroke and overloading of actuators.

Keywords: floor vibrations; control systems; vibration control; damping; TMDs

1. INTRODUCTION

Building floor vibrations brought on by human activity as well as natural factors, such as earthquakes and winds, pose serious problems for structural engineers working in the current era. By increasing the bulk and

rigidity of structural components through techniques like including frame members, building full-height walls, or increasing the thickness of the floor slabs has historically been the focus of strategies to lessen these vibrations. Even while these strategies work, they are frequently costly, challenging to execute, and disruptive, especially in open-plan office spaces that prioritize flexible layouts and preexisting structures.

One option that is becoming increasingly popular is Tuned Mass Dampers (TMDs). TMDs serve as a more affordable and useful method to absorb floor vibrations. Their working function includes a secondary load is attached directly to the building, adjusted to counteract vibrations produced at certain frequencies. In addition to lessening vibration amplitude, this technique preserves the architectural integrity of contemporary building designs. It maintains the architectural integrity of the building in addition to reducing the vibrational amplitude, further reiterating its benefits.

Although passive TMDs have many advantages, their effectiveness may be restricted by factors such as the large mass required to overcome inertial forces and its inefficiency in handling transient vibrations. This paper works to provide solutions for these drawbacks through the use of Active Vibration Control (AVC). In AVC systems, the use active control components, such actuators and sensors, in addition to the general working of TMDs, mitigate both periodic and non-periodic excitation. This hybrid technique improves the performance of TMDs through increased damping across a broader frequency range and an improvement in overall stability and comfort.

In order to precisely reduce floor vibrations using AVC, we look at the design and modeling of an active control system. The study focuses on modeling the control system using both frequency domain and temporal domain studies to minimize disturbances brought about by human presence. Many approaches are investigated, such as the use of PID controllers to provide accurate damping in real time, the addition of partial floor loads to increase the mass and therefore damping effect, and hybrid tuned mass dampers to highlight a multidisciplinary solution. The software which is used in the modelling includes MATLAB and SIMULINK. The simulations are beneficial in evaluating the system's stability as well as reactivity to various inputs, which provides insight into the proposed AVC system's capabilities.

2. LITERATURE REVIEW

Passive control techniques have been widely employed because of their simplicity and dependability, and active control is a logical progression from these techniques. Structural control may be divided into two categories: passive control, which does not require external energy, and active control, which employs active actuators and sensors

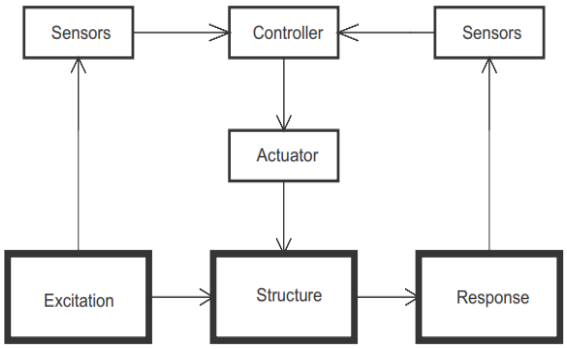


Fig. 1. Active Control. [1]

to regulate unwanted vibrations. There are several controls that are purpose-built for structural control applications. The most widely used mass-based drive—without a spring and a dash—may be the Active Mass Damper (AMD) [25]. First proposed in the 1950s, AVCs further development was hampered by an absence of the required equipment. In passive vibrational methods, PVCs, the vibrational sensitivity of each floor is enhanced by exerting a certain force as a reaction to any external movement. In AVCs the same phenomenon is achieved, except the reactionary force is produced with the aid of an outside source of energy. These AVCs are viewed as systems that provide force using real-time processing controllers and sensors placed at pre-set points inside the controlled structure. The sensors pick up on the movement and/or outside excitation of the building. As shown in Fig. 1 and Equation (1), the sensor's signals are placed into a specific algorithm in the controllers which analyse and produce a command in

the output which is used to move the device providing force.

$$M\ddot{x}(t) + C\dot{x}(t) + Kx(t) = F(t) + U(t) \quad (1)$$

where M = mass, F = force, C = damping coefficient, K = spring coefficient.

U(t) is the force provided and controlled by AVC where:

$$U(t) = f(x(t), \dot{x}(t), F(t)) \quad (2)$$

This control law includes a velocity feedback scheme, presented in the equation:

$$U(t) = f(\dot{x}(t)) = -K_G\dot{x}(t) \quad (3)$$

KG represents constant gain. An improvement occurs by the AVC's real-time response: an increase in the effectiveness of response in control and the adaptability to the numerous risks in vibration reduction systems. Yet, since more energy is being added to the fundamentally stable system, it is conceivable that the system might become unstable [1].

This paper also suggests a hybrid system that consists of separate slabs resting on a curved base. Gravity is used to hold the slab in place while the curvature stiffens the connection between the slab and the frame. The application of bumpers between the slab and the frame serves to prevent damage to either part during excitation. The suggested system is distinctive in that it uses TMDs in conjunction with the idea of base isolation to achieve the desired performance. This design demonstrates how vibrations in structures subject to seismic loading can be reduced by isolating the slab's mass and employing it as a translational tuned mass damper. In contrast to conventional composite slab constructions, it demonstrates the ability to reduce displacement and inter-story drift by up to 45%. Besides the lowest stories, the suggested methodology also improves the acceleration of the slabs. This improvement is the result of the mass's high proportion acting as a damper. The design can be improved and made more flexible thanks to the higher mass ratio. The strain on the structure's frame is still considerably less without major energy loss. To show how the mechanism would respond to a specific seismic excitation, the range of efficacy should be assessed against a variety of earthquake inputs while keeping design concerns in mind. The design of the system can be simply modified to take wind loading into consideration. Future research into the multi-hazard nature of this system has the potential to be beneficial [2].

Tuned mass dampers (TMDs) are regarded to be the most popular control method for reducing vibrations in tall structures. They have a broad range of practical uses in high-rise buildings all over the world because of their convenience and effectiveness. This particular thesis outlines the theoretical underpinnings of a novel concept that involves using Multiple Tuned Mass Dampers (MTMDs) to handle a portion of the load from various floors. If the weight of the floor slab, floor finishes, and architectural walls is isolated using bearing mechanisms akin to those used for base isolation, some of the weight of these components can be employed, particularly in the case of steel deck floors [3].

This review's objective is to discuss every structural control-related topic. In contrast to earlier reviews, this literature thoroughly describes the mathematical modelling of actuators and the structure-actuator coupled system utilizing both linear and nonlinear techniques. The strategies for optimal device placement, system identification, and state estimate are also discussed in this study. It is also thought about how time delays in active control systems affect system stability. The study outlines several control tactics, including modern intelligent control methods Like Fuzzy Logic, Neural Networks (NN), and Genetic Algorithms (GA). The performance of structural control systems applied to actual buildings has also been examined. [4]

Knowing the behavior and effects of excitations on buildings, such as powerful wind and seismic forces, is crucial for developing a dynamic model of a building's structure. Fig. 2 depicts the force that the earthquake and wind excitation had on the building. Seismic waves are produced when there is a rapid discharge of energy in the Earth's crust. Because of the ground motion brought on by these seismic waves, the building structure oscillates, causing the floor masses

to feel inertial force. The force is defined by the equation:

$$f = -m\ddot{x}_g \quad (4)$$

where m is the mass and ẍ is the earthquake-induced ground acceleration.

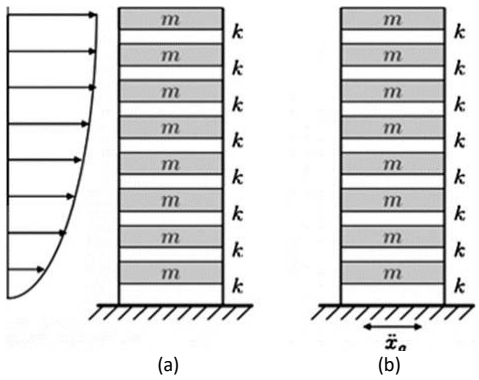


Fig. 2. a) wind excitation b) earthquake excitation [4]

The ground motion's amplitude and other characteristics, the structure's dynamic attributes, the materials the structure is made of, and its foundation are only a few of the variables that affect how the structure moves (soil–structure interaction).

Depending on the number of degrees of freedom (DOF) it has, a civil structure will have a number of natural frequencies. Resonance develops when the ground's vibration frequency is similar to the building's natural frequency. Due to resonance, the floors may thus move erratically in various directions, resulting in inter-story drift, or the relative translational displacement between two succeeding floors.

The building suffers serious damage if the drift value or deformation surpasses its critical threshold. High-frequency waves are more pronounced in small buildings, while low-frequency waves are more pronounced in massive structures or high-rise buildings. It's crucial to prevent the building from vibrating at its low order natural frequencies, where a large portion of the building's elastic energy is stored [4].

The use of an electric circuit to analyze a variable inertance and variable damping (VIVD) system as a vibration control investigates the single-degree of freedom (DOF) in accordance to the variable inerter theory. A VD device is placed in series with an inerter to create a VI device. This VI devise is used to change the corresponding inertance by regulating the damping characteristic in the VD device. The results are obtained by analyzing the frequency domain of a system with single degree of freedom that also has VI and VD abilities. The VIVD semi-active system is proven to have much better control over vibrations than the regular VD system. To overcome complications with respect to the mechanical networks, the mechanical energy is converted into electrical energy using a damper powered by electromagnetism using mechanical-electrical analogies. This permits the design of an electric circuit which replicates a VIVD device. Due to satisfactory findings from evaluations in frequency and time domains, the VIVD vibration control system would considerably develop the execution of a semi-active system [5].

When there are many potential places for actuators, the system used methods which were foundational in natural gradients. These methods can be very costly. The number of sites of test, sensors and actuators taken into consideration in this scenario is constrained by the calculation time required to get a local solution, which may be enormous and unaffordable. This study suggests an alternate strategy based on the Coral Reefs Optimization (CRO) algorithm, a newly developed meta-heuristic. In more context, the Coral Reefs Optimization with Substrate Layer is taken into consideration as an improved form of the CRO (CRO-SL). With the competitive revolutionary algorithm CRO-SL, various exploration techniques are collaboratively developed inside a single pool of possible solutions to the problem. In order to address challenging optimization issues, the suggested algorithm can encourage competition among various search techniques. With regard to structural design, this research represents a significant stride towards enhancing the operation of active vibration control systems to complicated, real structures - those that have several points of testing or/and variety of vibration modes - by solving designs which fit

optimization at the global level with acceptable time to compute them[6].

This study examines the integration of semi-active variable damping TMD (SAVDTMD) with piezoelectric friction dampers as an alternative to the techniques now in use to reduce floor vibrations, particularly vibrations brought on by walking. The utilization of an MDOF floor model during the investigation sheds some light on the impact of modes that the design of the controller did not specifically target. The analytical models included an ideal semi-active control law that was initially created for car suspension control. Two floor system examples that are typical of those with a floor vibration issue are assessed, and it is demonstrated that the SAVDTMD can successfully regulate both the targeted and untargeted modes. Problems with the control force spilling over to unintended modes were investigated and found to be stable. [7]

Long-span, light-weight floors are typically susceptible to structural vibrations due to their low resonance frequency and natural damping. Since they can be quickly triggered by persons walking or jogging, they present a serviceability problem for those who live or work in these buildings. Tuned mass dampers can be used to improve the dynamic behavior of such structures. These passive damping systems' poor transient damping performance and high inertial damper mass requirements are a drawback.

The damping efficiency dramatically decreases, particularly for systems with resonance frequencies that change over time (as a result of an increase in mass, a modification to the structure, or temperature-dependent events).

For a wide range of frequencies in transient phase, an active controlled tuned mass damper can be employed to decrease inertial mass and increase damping efficiency. When building a controller for an active vibration control device, a number of limitations, such as the stability in closed loop, robustness and performance standards, as well as the maximum stroke and saturation of the actuator, must be taken into account. This study examines various control strategies, simulating them with a second and fourth order system to weigh their benefits and cons [8].

This study also demonstrates how to employ an observer-based pole-placement controller and a proportional-integral (PI) controller to lower vibration in a walkway bridge structure with a single actuator and sensor pair. Results of the experimental modal analysis are used to find reduced-order models of the walkway. They are used in both the construction of a PI controller and the state estimation methods needed to build reduced-order observer controllers. The variety of ordering of the latter depends on the number of plant modes selected for their designs. To obtain gains in plant and observer feedback, they are made by articulating desired floor closed-loop eigenvalues and observer eigenvalues.

In contrast to the PI controller, which automatically chooses one solution, observer-based controller design processes allow for a wide range of possibilities. As shown in the analytical and practical investigations given, (Fig. 3) the flexibility of observer-based controllers for greater controller orders above a purely single-input single-output controller system also allows for the separation and control of target vibration modes. Additionally, the observer-based controller design method in this work has only used one plant mode. The optimal solution is then determined using a multi-objective evolutionary algorithm optimization strategy while abiding by a predetermined set of constraint restrictions. The best vibration mitigation performance among the available solutions in this situation is the ideal option [9].

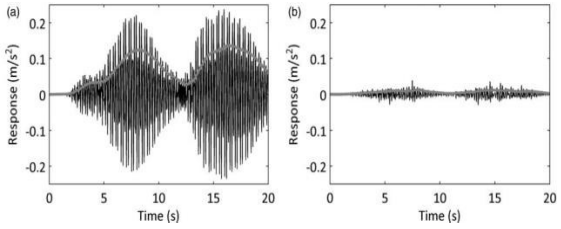
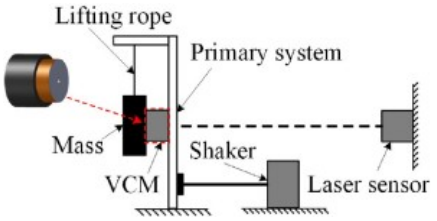
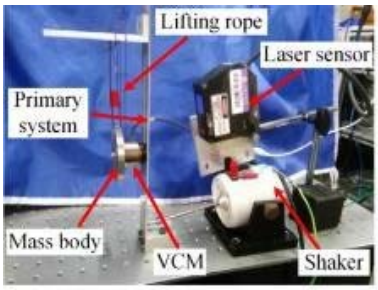


Fig. 3. Typical (a) uncontrolled and (b) controlled walking time histories. [9]

In another study, transient vibrations are adjusted. They are introduced by the stimulation of impulse. The study into active dynamic vibration absorbers (ADVAs) provides a non-linear convergence technique.



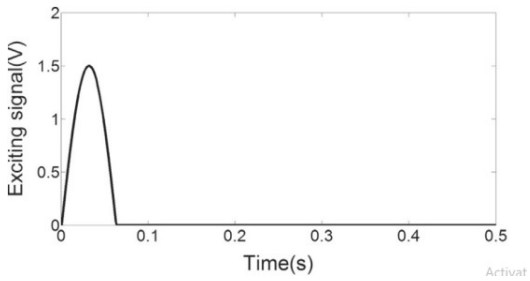
(a)



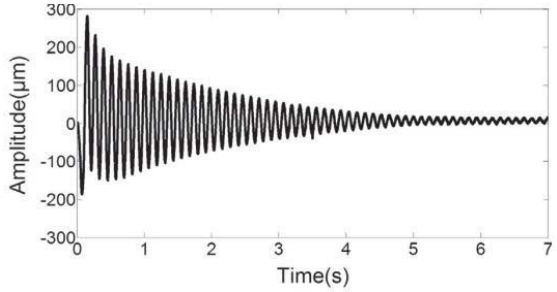
(b)

Fig. 4. The experimental setup (a) Schematic diagram of the experimental set-up (b) Photograph of the experimental set-up [10]

The main system's exciting signal as well as experimental transient response are shown in Figure 5. Starting at more than 200 μm, the vibrational amplitude steadily diminishes. The main system's natural frequency eventually also determines the frequency of the transient response.



(a)



(b)

Fig. 5. (a) Exciting signal of the shaker (b) Transient response of the primary system [10]

A voice coil motor (VCM) is added and its function is to continuously dampen the transient reaction of the prime system, also serving as a magnetic muffler (Fig. 4a). The results of the studies show that the nonlinear ADVA can reduce the convergence time by 70% compared to the linear ADVA (Fig. 4b) 95% of the uncontrolled transient vibration at 1.5 s is eliminated thanks to the cooperation between the nonlinear ADVA and VCM magnetic damper [10].

In the case of Active Mass Dampers (AMDs) accelerometers are used as sensors to measure vibrations, and additional components include AC servomotors and an unfixed mass that is attached to the motor through a ball-screw mechanism. The Negative Acceleration Feedback (NAF) control method is utilised, which takes the acceleration signal directly and provides the appropriate displacement for the active material. This occurs while taking into account the capabilities of the AC servo motor that is able to follow the ideal displacement effectively. A system with a single degree of freedom was used to theoretically demonstrate the effectiveness of the NAF control (SDOF). It was discovered that the intended natural mode can have its damping efficiently increased with the NAF control while avoiding instability in the low frequency range. The MultiModal NAF (MMNAF) control is presented to stifle the numerous inherent ways of Multi Degree of Freedom (MDOF) systems utilising a single AMD according to the theoretical conclusions of the SDOF system. The ability of the MMNAF control to reduce MDOF system vibrations has been demonstrated in theory and practical experiments. [11].

Since controlling vibration and displacement in structures subjected to seismic stimulation is quite challenging, there has been a lot of interest in developing a structural control system to ward off disruptions. The application of the bees algorithm to change gains of a traditional PID controller for active vibration management of a building-like structure with two stories under Northridge Earthquake stimulation is the main emphasis of this study. The Bees algorithm

is a versatile strategy that ensures a successful result for controller optimization when employing traditional trial-and-error design techniques. The main goal of this work is to improve the PID controller by optimizing KP, KI, and KD gains utilizing the bees technique in order to lessen floor vibrations during earthquake excitation. The PID controller is offline tuned using the mathematical model of the system after the system and its algorithm have been defined. The performance of a system-implemented genetic algorithm (GA), an established optimization method, will also be contrasted with that of the BA. The article uses the experimental findings from the structural system to illustrate how well the tuned PID controller works. The functioning and effectiveness of the tuned PID controller are thus studied and empirically verified. Much less movement and acceleration occurs on the flooring and in the cart. The experimental responses of the system are displayed graphically [12].

In the following study, skyhook dampers are used to actively regulate high-frequency vibration. For active vibration control to be implemented successfully, the selection of the damper gain and its ideal location are essential. Certain sensor/actuator placements are preferred in vibration control to lessen structural vibration with the least amount of control effort. A strong modelling technique to forecast the performance of the controller is required in order to optimize a general built-up structure to manage vibration. For effective response predictions at medium to high frequencies, the current work uses a hybrid modelling approach that combines the finite element method (FEM) and statistical energy analysis (SEA). Here, the hybrid method is used to explore a number of generic control design problems for a broad network of plates connected by springs. The best positions and gains for the skyhook dampers are obtained by combining the hybrid technique with numerical optimization utilizing a genetic algorithm. Results from a deterministic modelling method are contrasted with those from the hybrid method's optimal controller gain and location findings. The results from the two methods show good agreement, but the results from the hybrid method are obtained in a vastly shorter period of time [13].

In order to suppress vibrations of a device that are low-frequency while the device is fitted on pant-tilt platform, active control methods with visual feedback are developed where the vibrations are caused by disturbances to the support. In the principal axes of rotational control, the yaw and pitch handled are by placing the pan/tilt platforms in a robot's head, an antenna, surveillance system for vision, etc. However, in a moving system- turbulences -caused by the road or sea waves- could potentially significantly compromise the alignment control of the piece of equipment installed at the top of the tilt platform as a result of its inherent low-frequency vibration in the base.

For the attenuation of vibration, the adaptive sliding control (ASC) technique is developed. In some finite linear combinations of the orthogonal basis, the unknown disturbance is represented using a function approximation technique.

Thus, the pan/tilt system dynamics are demonstrated as steady first-order filter propelled by the errors of a function's estimates. Additionally, the theory of Lyapunov stability is used to derive the adaptive updating law. Second, the effectiveness of vibration suppression will be evaluated using the often-applied feedback active vibration control (AVC) with filtered-x LMS algorithm and compared to that of adaptive sliding control. For independent single axis excitation, experimental testing of the control algorithms reveals that the ASC and feedback AVC, correspondingly, have yielded average single-frequency disturbance attenuations of roughly 25.14 and 23 dB. The vibration attenuations caused by the two approaches for dual-frequency excitation are approximately 20.77 and 12.73 dB, respectively. ASC and feedback AVC provide corresponding 17.57 and 15.18 dB reduced vibration under single-frequency disruptions for simultaneous two axes excitations. Thus, the two active control approaches for reducing low-frequency vibration of the device on the pan/tilt platform are proven to be legitimate and effective [14].

In order to lessen the influence of the equipment's self-excitation on the automobile body, a parallel connection of a negative stiffness unit is connected in a parallel connection to a positive linear stiffness spring which results in developing a high static stiffness as well as on the other end it also forms a low dynamic stiffness - written in short form as HSLDS -

vibration isolator. Since the stiffness is not linear therefore it satisfies the parameter required to design such as of the curve of any target stiffness. The acceleration produced by the under-chassis parts is tested using a vibration test. A stiff yet bendable dynamic model with several parts of a high-speed train is created based on the test findings and incorporates both the self-excitation of the under-chassis machinery and the elastic vibration of the car body. Various connection methods for the under-chassis equipment are used, and the end results on the vehicle body with reference to the quality of ride (transience) and vibration are examined. These methods include rigid hanging, vibration isolation theory (VIT) hanging, dynamic vibration absorber (DVA) hanging, and HSLDS hanging. The simulation outcomes demonstrate the effectiveness of the proposed HSLDS vibration isolator. [15]

There is now more interest in designing and erecting extremely tall structures as a result of the population development in big cities and towns, as well as building regulations. Demands for tightness rather than power often influence the structural appearance of constructions. Super-tall buildings now have more flexibility and insufficient natural damping due to advancements in construction technology, procedures, and material quality. When there is a lot of wind, the major worry for buildings is occupant discomfort. Extreme vibrations brought on by wind gusts are a key problem in the design and building of supertall buildings. This method consists of an inner or basic structure made up of two top and reduced components, as well as a structural outer tubular framework. Within the top component, the exterior and essential structures are kept apart. In this part, damping devices are used to restrict the relative bending movement involving the outside and core framework and to get a grip on the wind-induced movements of the building by dissipating the vitality that is vibrational. This functional system's control performance is contrasted with that of a structure controlled by a tuned mass damper (TMD). The outcomes reveal that the self-acting system that is structural effectively reduces wind-induced vibration in super-tall buildings and enhances occupant comfort under strong wind excitation This method, which combines an exterior tube with a core structure, is composed of two lower and higher halves. By restricting the overall movement of the outer and core framework and absorbing vibrational energy, the damping products utilized in this area regulate the wind-induced vibration of the building [16].

A floor design may regularly change for functional structural reasons, lengthening the calculating process. For structural engineers working under time constraints, an effective yet precise approach of immediately forecasting maximum flooring reaction is critically needed. A particularly useful technique for predicting the structure's maximum reaction to heavy loads is the response range approach. For the specified load, it is a plot of the maximum reaction that reflects the inherent abundance of several single-example linear oscillators. The reaction spectrum has a well-known application in measuring the top response of structures to earthquakes. It is really used to anticipate floor reactions caused by passenger bouncing. In order to find the correct acceleration reaction spectrum, experiments on single-step loads produce recordings that are later applied to a single level of freedom system with a range of frequencies and damping ratios. These data are statistically analyzed to provide a representative range, which is then used to establish a spectrum analytical design bent [17].

The simulation results demonstrate the ideal installation places for an inertial drive that operates regularly. Effective control of time-varying excitations of vibration machines on a floating watercraft is made possible through the use of a control that is automatically centered on real-time dimension associated with cost function and searches automatically for the inertial actuator's most effective mounting position. To the best of our knowledge, this is the moment when an automated control system is used first to quickly go to an actuator and manage a time-varying excitation. This work proposes a linear shaft motor, a DSP system, two tachometers, four-speed sensors, an inertial actuator placed on an accelerometer, a moving vibration that is an active system, and a regional feedback cycle. The ideal mounting location for the inertial actuator is sought after using an algorithm that is in line with real-time measurement and the expense function. The smallest force transmission from the vibrating goods to your adaptable foundation within the drifting motorboat will be the requirement for the best installation place.

It is confirmed that there are considerable differences between the shows for the inertial drive in various mounting tasks. For a drive that is inertial on a regular basis, mounting jobs work best. For the inertial actuator installed permanently in situ, the inertial actuator commonly obtains the vibration control performance that is superior in a very constrained regularity range. To achieve broadband performance, a linear shaft motor enables you to move an actuator that is inertially possessing a time-varying excitation [18].

Base isolation technologies are a widely established and reliable method to reduce unwanted and dangerous vibrations in a variety of purposes and to protect bridges, buildings, and other essential pieces of civil infrastructure from destruction that would result from activity of seismic waves. Conventional base isolations, however, cannot adjust to environmental changes or vibration sources since they are essentially passive, which reduces their efficacy and longevity and, in certain situations, has unwanted impacts. Based on the structure's alleged characteristics as well as the size and frequency of expected earthquakes, an effective foundation is a compromise design. This research describes the stiffness-softening performance of a magnetorheological elastomer (MRE) in a scaled-down building that is three stories, with the goal of protecting building structures from unpredictable events like earthquakes; however, the stability of the structure and usage is still upheld. The results of the modeling and experiments show that the MRE stiffness-softening isolator should be able to sufficiently damp vibrations if controlled through fuzzy logic [19].

In fact, advances in design and building techniques have produced floor constructions that are more susceptible to vibration because they are thin and light. The current trend toward creating more open architecture makes this worse. In addition to other structures, samples of considerable vibration brought on by human-induced excitation have been discovered in footbridges and open floors. It has been demonstrated that Active Vibration Control (AVC) using inertial mass actuators significantly lowers response levels and enables otherwise excessively live constructions to comply with vibration serviceability requirements open-plan flooring systems and light-weight footbridges are examples of civil constructions that can respond to high levels of vibration caused by human activity. Utilizing inertial mass actuators and accelerometers to execute direct velocity in practice, this concept involves minimizing the performance index that includes all key practical issues [20].

Due to possible architectural limitations, it is usually not possible to use non-structural features to improve damping and tightness, such as full-height walls. As a passively adjusted mass damper, the PTMD is used. The equations of motion for the linked PTMD-floor system are derived using a single degree of freedom that is created to be equal to the PTMD. An optimization approach is used to identify the PTMD that is the best design. Investigated are the effects of PTMD tuning on its reaction caused by variations in floor mass. Additionally, PTMD may or may not be able to function well in terms of the number of dynamic interactions that are human structure when it is placed through tuning due to changes in flooring real-time lots [21].

The wind generating system's productivity is impacted by vibration, which lowers efficiency. While a system's vibration might not be harmed, it can be paid off or converted into electricity by using procedures that are acceptable. A vibration control system enhances the responsiveness of the turbines' structure and dependability, which has a direct impact on the component lifespan. Lowering the system's vibration amplitude will result in reduced noise, ensure user and operator comfort, and continue to maintain excellent production efficiency. These will help the machine increase the lifespan of a piece of industrial machinery. It offers applications for vibration control that is passive, active, and semi-active for structures, particularly for wind turbines. Damping devices have already been implemented extensively in wind generators for increasing their effectiveness by mitigating vibration [22].

Traditional vibration dampers, such as a traditional tuned mass damper, might not be successful in controlling the seismic reaction in high-rise structures at the same time. The Multi-Tuned Liquid Column Damper-Inerter (MTLCDI), a novel passive vibration control device, is developed in this work to manage the seismic response of nearby high-rise structures. To

examine the seismic performance of MTLCDI, two distinct designs with this system—inter-story MTLCDI (IS-MTLCDI) and inter-building MTLCDI (IB-MTLCDI)—have been designed. Both ISMTLCDI and IB-MTLCDwe outperform individual TLCDIs between buildings as well as other vibration dampers for the management of seismic vibration of absolute acceleration and displacement that is inter-story whenever two structures have different normal frequencies. IS-MTLCDI reduces reactions more than IB-MTLCDI at the typical frequency at which it operates. However, using IB-MTLCDI may be better if there are considerable discrepancies when taking into account the natural frequencies of nearby structures because of its positive effects that may be mitigated and the convenience of installation [23].

The study use a brand-new rocker system with liquid viscous dampers to reduce vibration. Three parts make up this control system: viscous fluid dampers, struts, and rockers (FVD). The reinforcing components are solely subjected to tensile force in this manner. This makes the strut buckling issue insignificant. This advantage is beneficial for metal bars used as reinforcing parts. Long steel bars can be used for bracing between movable members and tiny framework connections in numerous stories by launching prestress into the bars. The suggested method has the advantage of allowing the employment of lengthy steel bars as stiffeners between swing system users and moment framework connections above selected levels. This research presented a novel vibration system that takes into account a rocker mechanism with fluid viscous dampers. Brace, Seesaw, and Fluid Viscous Damper make up the proposed Energy Swing Dissipation (SEDS) system (FVD). Long steel bars may be used as bracing and can be installed in numerous stories by including prestressing into the bars [24].

Industrial applications of the methods include proportional-derivative (PD) and proportional-integral-derivative (PID) controllers. Industrial applications trust PID control. PID control could be the controller that is most immediately beneficial in real-time applications without model understanding. The fact that PID controls are straightforward and truly have physical implications that are obvious sets them apart from other types of control. Although theoretical PID control algorithm research is widely known, it has not yet perhaps advanced enough in the field of structural vibration control. a straightforward control that is proportionally applied to reduce wind-induced building drift. To reduce structural motion brought on by earthquakes, an integral is utilized as the proportional controller with AMD. These control solutions are insufficient, nevertheless, because it is challenging to adjust the PID gains to provide desirable results for phenomena like rising time, overshoot, settling time, and steady-state error. The lyapunov theory is used to demonstrate the stability of AMD PD/PID control for building structures, and stability that is enough for tweaking PD/PID gains is determined. Fact that stability analysis is the technological advancement behind the PID systematic tuning technique [25].

Seismic vibrations increase the structure's anxiety, thus the vibrations they produce aren't seen to be healthy for the structure's health. As a result, there is a reliance on technological techniques to reduce vibrations. Structural inspection is one of the most often used inspection techniques. By employing external control devices such as passive, active, hybrid, or semi-active in the control associated with the structure, the seismic vibrations are decreased by applying a sufficient counterforce established by the control law. The constant recurrence of events causes harm to buildings. Undoubtedly, one strategy that is well-liked for this injury is structural examination. The main goal of structural control is to constantly offer a sufficient counterforce. An effective control algorithm determines the necessary counterforce. To provide a sufficient counterforce, this optimized and adaptive control system modifies the quasi-bang-bang control algorithm. Particle Swarm Optimization is used to optimize the constant output loads used in the modified quasi-bang-bang controller for the optimum performance under dynamic loads such as earthquakes (PSO). After that, the regulator is used on a three-story fixed MR damper form. A variety of seismic performance assessments were performed on this architecture. The most efficient trimmed optimum linear quadratic Gaussian (LQG) controller, a quasi-bang-bang, and a modified controller that is quasi-bang-bang contrast the results so produced. The findings show that the PSO-modified controller reduces structural responses, such as relative

displacement, inter-story displacement, and absolute accelerations, more effectively than the other controller. The voltage comparison also reveals that the controller that is suggested to attain greater performance uses less power [26].

Modern super-tall buildings are particularly susceptible to wind-induced vibrations because of their innately high flexibility and little damping. An aerodynamic alteration that reduces wind-induced vibrations is to taper a structure's cross-section. Another control method to reduce structural vibrations is tuned mass (TMD). In exceptionally tall structures, the effects of using the tapering method and TMD system on wind-induced vibration are being researched. Utilizing frequency domain analysis, the along-wind and reactions to crosswinds are assessed for various taper and TMD mass ratio values. The findings show that for tapered constructions, as the taper ratio rises, the natural frequency of the residence increases. The tapering method is unable to successfully lower the acceleration response because the acceleration is proportional to the square of the natural regularity. When compared to displacement, TMD offers better acceleration control performance. The acceleration and displacement reactions can be successfully managed by combining the two control systems, which will also help meet the convenience and security needs of the occupants of extremely tall structures. The fact that the TMD system offers better acceleration control performance than displacement response is without a doubt one of the key benefits of employing it. Tapered tall structures have higher normal regularity than non-tapered tall structures because they have a smaller effective modal mass and more stiffness. Due to their lower effective modal mass and increased stiffness, tapered tall buildings exhibit higher normal regularity than non-tapered tall structures. As a result, it is challenging to effectively reduce the acceleration reaction when it is proportional to the square of the natural tapering frequency. In the wind-induced vibration of extremely tall buildings, the combined effect of these two control techniques, namely the tapered cross-section and TMD system, is investigated. This type of control is effective in decreasing building drift caused by the wind, but it is less effective in reducing the overall magnitude of the acceleration reaction. This kind of control works well to reduce wind-driven building drift, but it works less well to reduce the overall size of the acceleration reaction [27].

The TMD solution incorporates additional mass with an operational spring, damping elements, and other elements for damping of the main building. The detuning effect and the excessively long TMD stroke constitute two basic problems in the current TMD systems, despite the fact that conventional linear TMD is well known. The two primary issues with TMD systems are the detuning effect and excessive TMD lift. Variable Stiffness TMD (RVS-TMD), a brand-new semi-active TMD, is utilised to boost TMD systems' performance. An undamped TMD plus a changable stiffness device, that can have varied stiffnesses, make up the RVS-TMD (RVSD). By manipulating the changeable element, the RVSD hysteretic loops may reach all parts in the graphs of the force-deformation diagram, increasing energy dissipation [28].

In recent decades, numerous significant incidents and breakdowns in the marine and offshore industries have been attributed to vibration, which poses a safety concern to offshore maritime facilities and impairs their structural serviceability. It is difficult to manage vibration in coastal marine structures generated by self-excited nonlinear forces, hydrodynamic huge deformations, and very nonlinear responses. Traditional vibration control techniques can be divided into passive, active, semi-active, or hybrid categories. An excellent example of the structural addition of (usually) viscoelastic damping layers is the passive approach, which involves a hysteresis loop of cyclic stress and deformation of the layer that is damping vibrational power. Active methods forces, which need sensors and a feedback loop, can create the structural actuators used to minimize vibration. Hybrid systems include active and passive damping, whereas semi-active control methods modify or regulate the mechanical characteristics of the element damping the vibration control unit [29].

Vibration is a significant problem affecting the accuracy and surface quality of workpieces during ultra-precision machining. Direct payload interference and ground vibration interference were challenging to eliminate concurrently with traditional negative-stiffness active damping techniques. The efficacy of

traditional anti-vibration technologies to avoid direct payload disruptions is degraded, and low-frequency residual vibrations severely restrict further advancements in machining precision. Use is made of a novel absolute displacement feedback active vibration control method that combines infinite and zero stiffness. The equivalent stiffness is between the isolated payload and the reference point, and between the isolated payload and the reference point between, which tends to infinity and zero, respectively. This stiffness is determined by connecting the positive and negative stiffness in series and parallel. While successfully suppressing direct payload disturbances and low-frequency (2Hz) ground vibrations, it provides smooth and tight blending control. Finally, using an array of infinite and zero stiffness, we experimentally validate the efficacy of the active damping approach. The accuracy and surface quality of workpieces made with extreme precision may be produced in a manner that is both reliable and outstanding. The active vibration management approach suggested in this article offers a practical means of enhancing the functionality of ultra-precision machine tools [30].

3. MODELING AND SIMULATION

A mass damper system is essentially how a floor's vibration control is accomplished. The control system modelling to reduce disruptions brought on by human presence is presented in the research. Both frequency domain and temporal domain modelling were carried out. The outcomes of testing the final transfer function with additional inputs and discussing them were discussed. According to stability criteria, plots have been judged on how well they adhere to the input instruction.

The control system is very important because there is a growing demand for the design and construction of extremely tall structures as a result of the population development of big cities and the availability of restricted building space. High-rise building structural design is frequently dictated by stiffness needs rather than strength requirements. Super-tall structures are more flexible and lack natural damping as a result of advancements in construction technology, procedures, and material quality. These structures' major worries during strong wind occurrences are the discomfort of the occupants, such as physical motion sickness symptoms or emotional reactions like worry. Supertall skyscraper design and construction are very concerned about excessive vibrations brought on by wind loads.

The block diagram of the system is presented below:

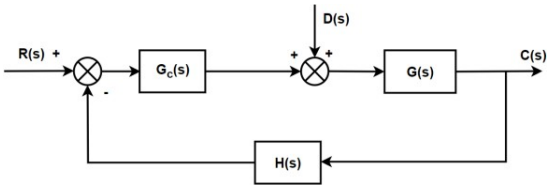


Fig. 6. The block diagram used to find the system characteristics.

The terminologies used in this paper are:

Table 1. Terminologies

k: Spring constant
fv: Damper coefficient
M: Mass
$x(t)$: Position of the mass in the time domain
$f(t)$: Force input in time domain
X(s): Position of the mass in the Laplace domain
$F(s)$: Force input in Laplace domain
Gc(s): Controller transfer function
R(s): Input variable of T(s) (Command)
C(s): Output variable of T(s) (Position of the manipulator)
T(s): Equivalent transfer function
G(s): Plant transfer function
s: Laplace variable

Fig. 7 shows the dynamics of a floor vibration control system, which is a damper and a spring grounded from one side

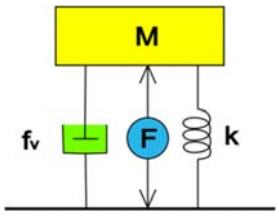


Fig. 7. Schematic diagram of floor vibration controller.

Using governing equations,

$$\sum F = ma \quad (5)$$

$$f(t) - f_v\, v(t) - kx(t) = ma(t) \quad (6)$$

Take $F = Cu(t)$

$$Cu(t) = m\ddot{x}(t) + f_v\dot{x}(t) + kx(t) \quad (7)$$

Converting to Laplace domain,

$$CF(s) = (Ms^2 + F_vs + K)X(s) \quad (8)$$

Rearranging:

$$\frac{X(s)}{F(s)} = \frac{C}{Ms^2+F_vs+K} \quad (9)$$

The transfer function becomes:

$$G(s) = \frac{C}{Ms^2+F_vs+K} \quad (10)$$

By assumption of some values as: C = 5, M = 1, Fv = 11.31 and K = 5 (these values are assumed as such, that they will give us a stable transfer function), we get

$$G(s) = \frac{5}{s^2+11.31s+5} \quad (11)$$

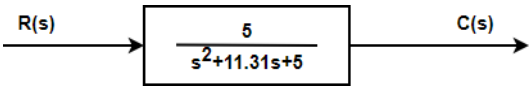


Fig. 8. Open loop block diagram.

Now, for the modeling in time domain

$$\frac{C(s)}{R(s)} = \frac{5}{s^2+11.31s+5} \quad (12)$$

$$s^2C(s) + 11.31sC(s) + 5C(s) = 5R(s)$$

Taking Laplace, we get

$$\ddot{c} + 11.31\dot{c} + 5c = 5r \quad (13)$$

Let $x_1 = c$, $x_2 = \dot{c}$ so, $\dot{x}_1 = x_2$

$$\dot{x}_2 = -5x_1 - 11.31x_2 + 5r \quad (14)$$

And the output is position, so

$$y = x_1 \quad (15)$$

In vector-matrix form:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix} = \begin{bmatrix}0 & 1\\ -5 & -11.31\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}r \quad (16.1)$$

$$y = \begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} \quad (16.2)$$

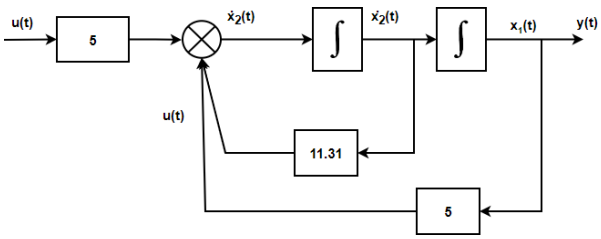


Fig. 9. Gain/ Signal attenuation diagram.

Adding the feedback and converting open-loop into closed-loop transfer function.

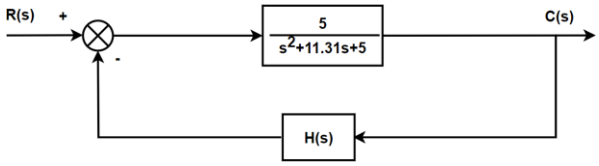


Fig. 10. Unity feedback block diagram.

With a unity feedback, the equivalent transfer function becomes:

$$T(s) = \frac{G(s)}{1+G(s)} \quad (17.1)$$

$$T(s) = \frac{\frac{5}{s^2+11.31s+5}}{1+\frac{5}{s^2+11.31s+5}} \quad (17.2)$$

$$T(s) = \frac{5}{s^2+11.31s+10} \quad (17.3)$$

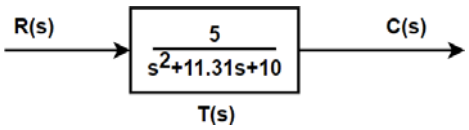


Fig. 11. Equivalent Transfer function block diagram

I. IMPLEMENTATION

For the modeling, designing, and characteristics of our system, we have used software like MATLAB and SIMULINK.

A. Time Response of the System

$$G(s) = \frac{C(s)}{R(s)} = \frac{5}{s^2+11.31s+5} \quad (18)$$

For a step input, $R(s) = \frac{1}{s}$

We get,

$$C(s) = \frac{5}{s(s^2+11.31s+5)} \quad (19)$$

Using partial fractions:

$$C(s) = \frac{A}{s} + \frac{B}{s^2+0.461} + \frac{C}{s+10.85} \quad (20)$$

Calculating values of constant

$$C(s) = \frac{1}{s} + \frac{-1.044}{s+0.461} + \frac{0.044}{s+10.85} \quad (21)$$

After Laplace inverse, it can be written as:

$$c(t) = 1 - 1.044e^{-0.461t} + 0.044e^{-10.85t} \quad (22)$$

We know that the transfer function for a second order system can be written in form of natural frequency, ωn and damping ratio, ζ as:

$$G(s) = \frac{{\omega_n}^2}{s^2+2\zeta\omega_n s+{\omega_n}^2} \quad (23)$$

By comparing with our transfer function, we get

$$\omega_n = \sqrt{5} = 2.236 \quad (24)$$

And,

$$2\zeta\omega_n = 11.31, \zeta = \frac{11.31}{2\sqrt{5}}$$

$$\zeta = 2.528 \quad (25)$$

Since ζ>1, the system is overdamped.

Using MATLAB step input:

Table 2. Performance parameters

Rise Time	4.7710
Settling Time	8.5828
Settling Min	0.9003
Settling Max	0.9993
Peak	0.9993
Peak Time	15.3880

4. RESULTS

Now, the system is tested against multiple inputs. All the responses will be plotted and for each response, will be discussed the pros and cons.

1) Step Input:

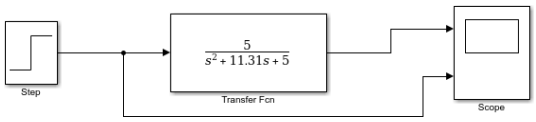


Fig. 12 SIMULINK block diagram for Step input.

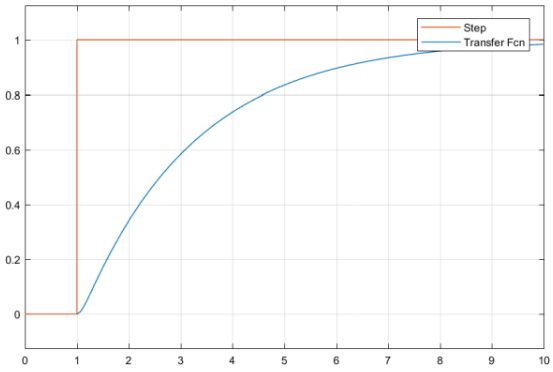


Fig. 13 Response plot of Step input.

The system's response is very stable and follows the step input very precisely yet, has some steady state error.

2) Ramp Input:

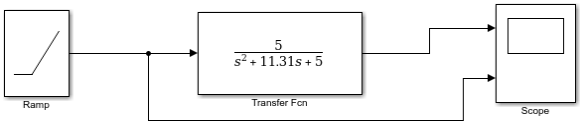


Fig. 14 SIMULINK block diagram for Ramp input.

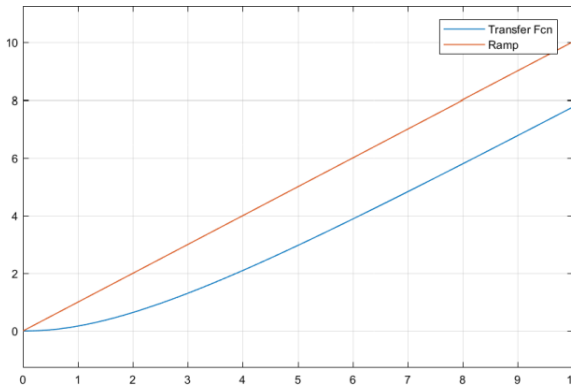


Fig. 15. Response plot of Ramp input.

The system's response is very stable and follows the ramp input but takes a long time and has some steady state error.

3) Parabolic Input:

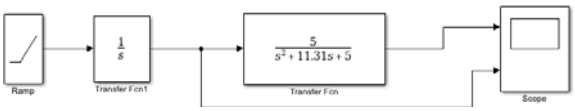


Fig. 16. SIMULINK block diagram for Parabolic input.

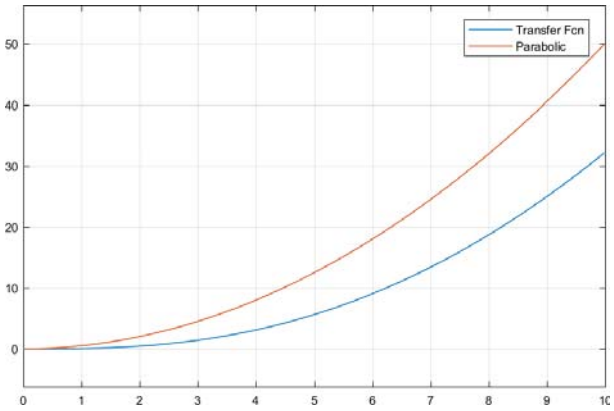


Fig. 17 Response plot of Parabolic input.

The system's response is very stable and follows the ramp input but takes a long time and has some steady state error.

B. Stability of the System

From all the above plots, we concluded that our system is stable and only a few alternations are required (which will be done by implementing either of the P, PD or PID controller) to make it suitable for our application.

The open loop transfer function with P controller gain K and the unity feedback system, in a block diagram is:

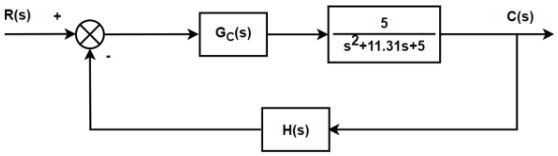


Fig 18. P controller in unity feedback general block diagram.

For the intended system, a P-controller is implemented with a unity feedback system.

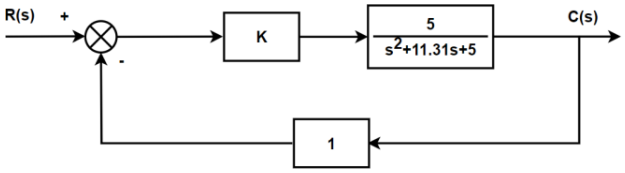


Fig 19. P controller in unity feedback in system block diagram.

The following system can be reduced to get equivalent transfer function T(s).

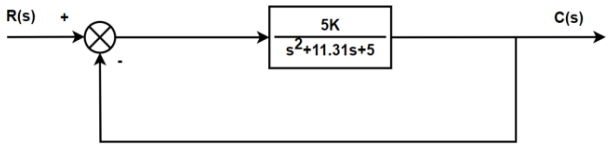


Fig 20. Equivalent transfer function block diagram.

Using:

$$T(s) = \frac{G(s)Gc(s)}{1 + G(s)Gc(s)}$$

$$T(s) = \frac{5K}{s^2+11.31s+(5+5K)} \qquad (26)$$

With the help of Routh Hurwitz technique, we can determine the stability of the system and the range of the P-controller gain K for which the system is stable.

Table 3. Routh Hurwitz Table:

s2	1	5+5K
s1	11.31	0
s0	$-\frac{\begin{vmatrix} 1 & 5+5K \\ 11.31 & 0 \end{vmatrix}}{11.31}$	0
	5+5K	

For a stable system, there should be no sign changes in the first column. So, the term 5+5K must be greater than zero, $5 + 5K > 0$.

The limit for the gain is $K > -1$.

II. Error Analysis of the System

A. Steady State Error

The steady state error for the system against multiple inputs is be tested and the results are discussed below:

$$G(s) = \frac{5}{s^2+11.31s+5} \qquad (27)$$

1) Step Input:
Using the simplified form of final value theorem:

$$e_{step}(\infty) = \frac{1}{1+\lim_{s\to 0} G(s)} \quad (28)$$

$$e_{step}(\infty) = 0.5 \quad (29)$$

Where,

$\lim_{s\to 0} G(s)$ is the Position constant K_p.

2) Ramp Input:
Using the simplified form of final value theorem:

$$e_{ramp}(\infty) = \frac{1}{s\lim_{s\to 0} G(s)} \quad (30)$$

$$e_{ramp}(\infty) = \frac{1}{0} \quad (31)$$

$$e_{ramp}(\infty) = \infty \quad (32)$$

Where,

$\lim_{s\to 0} G(s)$ is the Velocity constant Kv.

3) Parabolic Input:
Using the simplified form of final value theorem:

$$e_{para}(\infty) = \frac{1}{s^2\lim_{s\to 0} G(s)} \quad (33)$$

$$e_{para}(\infty) = \frac{1}{0} \quad (34)$$

$$e_{para}(\infty) = \infty \quad (35)$$

Where,

$\lim_{s\to 0} G(s)$ is the Acceleration constant K_a.

Since the system was a Type 0 system, as expected, for ramp and parabolic input the steady state error is infinite. And for the step input, the error is 1.

Finally plotting the root locus using MATLAB. Root Locus is a powerful method of analysis and design for stability and transient response.

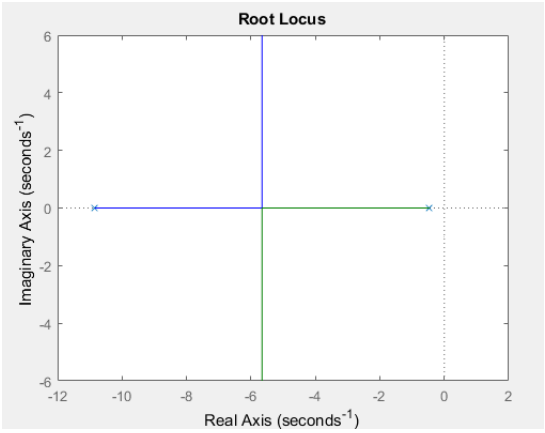


Fig 21. Root Locus.

From the plot, we conclude that root locus starts at the poles of the system and ends at infinity. Note: This is the plot of the system itself with no controller.

A PI controller was implemented:

Table 4. Controller Parameters

	Tuned
K_p	6.6491
K_i	3.6631
K_d	n/a
T_f	n/a

The block diagram of the controller is presented below:

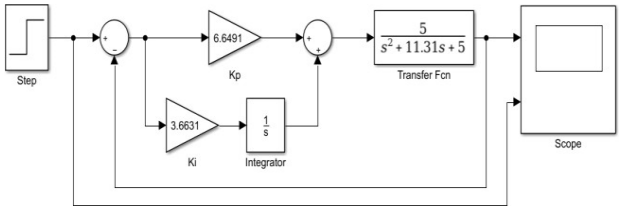


Fig 22. Block diagram of controlled system

This gave us the following response:

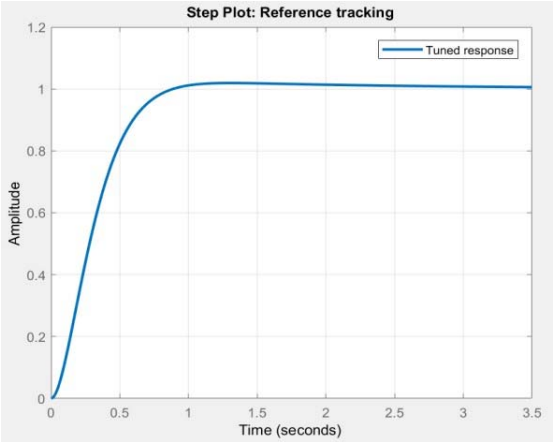


Fig 23. Step Plot diagram of Amplitude against Time

We can see that the steady state error had been minimized and the settling time has been reduced.

5. CONCLUSIONS

In the following article we have modelled an active system for control of floor vibrations and designed a PI controller for it. After which the transfer function was tested with different inputs and the responses were plotted. The system's response showed long settling time and steady state error. A PI controller was implemented to improve the conditions. Different values of Kp and Ki were used until the conditions were corrected. We also made a root locus which showed two poles on real axis and the asymptotes were lying on vertical axis showing the upper value of K as infinite. To provide reactive damping, tuned mass dampers (TMDs) are commonly mounted to the floor. Because of its low weight penalty, low cost, and ease of installation, TMDs are the most practical, economical, and least disruptive floor vibration control alternative for both new and existing floor systems. It is critical to incorporate damping into the design of a floor if you want it to be light, open, and vibration-free while also meeting current serviceability standards. There are several types of floor vibrations that cause structural damage over time. In structures that are targets of medium to high frequencies, there is a speedy reaction to any predicted predictions. Most passive damping systems have limitations such as large mass of inertia requirements and low efficiency in transient waves, particularly when there is a change in structure or mass. The active controlled tuned mass damper reduces and increases the effectiveness of the damping system, while expanding over a wider spectrum of transient phase frequencies. The sturdiness and operating standards, the smallest instability of closed loops, and the greatest stroke and overloading of actuators are some significant criteria for creating and building AVCs that must be carefully considered.

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TABLE 2. Literature Review Summary

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
[1]	M. J. Hudson and P. Reynolds, "Implementation considerations for active vibration control in the design of floor structures."	2012	• DOFB controllers	Moderation of Vibration in floors produced by human activity
[2]	T. Engle, H. Mahmoud, and A. Chulahwat, "Hybrid tuned mass damper and isolation floor slab system optimized for vibration control."	2015	• separating the masses and using as a translational tuned mass damper • on a curved support	Buildings with seismic loads have reduced vibrations. Proves that it is possible to cut the movement and multi level drift by up to 45% compared to constructions made of normal slabs made from composite materials.
[3]	T. A. Sakr, "Vibration control of buildings by using partial floor loads as multiple tuned mass dampers."	2017	• using a few TMDs at the highest story of building to apply sinusoidal dynamic loads at various frequencies,	Decreases all structures drift, acceleration, and force response The use of extra storeys improves the response of structures to earthquakes.
[4]	S. Thenozhi and W. Yu, "Advances in modeling and vibration control of building structures."	2013	• technical aspects of structural controlsystems and building modeling	The most often utilised control mechanism is mr dampers. Stability is a crucial consideration in the design of controls. A central computational unit, which typically implements structural control, may malfunction at the behest of an earthquake. The most accurate data used for seismic events are acceleration signals.
[5]	D. Ning, Z. Jia, H. Du, W. Li, and N. Zhang,	2019	• VI device • VD device	Vivd suspension has A better vibration control performance than the conventional

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
	"A variable inertance and variable damping vibration control system with electric circuit."			Vd suspension. Proposed vivd device has the same mechanical structure as the conventional electromagnetic vd device and different electric circuits
[6]	C. Camacho-Gómez, X. Wang, E. Pereira, I. M. Díaz, and S. Salcedo-Sanz, "Active vibration control design using the Coral Reefs Optimization with Substrate Layer algorithm."	2018	• algorithm with reference to coral reefs	Compared to a siso avc for the given application example, which is a truly complicated floor structure, significantly increases the vibration reduction.
[7]	G. Jiang and L. M. Hanagan, "Semi-active TMD with piezoelectric friction dampers in floor vibration control."	2006	• MDOF floor models • SAVTMD controlled floors	Control annoying floor Vibrations at fundamental mode Aided by spillover of the control force
[8]	J. Baader and M. Fontana, "Active vibration control of lightweight floor systems."	2017	• TMD, velocity or acceleration feedback and the disturbance estimation	Good damping efficiency Mitigate even varying resonance frequencies
[9]	D. S. Nyawako and P. Reynolds, "Observer-based controller for floor vibration control with optimization algorithms."	2017	• compared the vibration mitigation performances of two sets of controller schemes implemented in a single-input single-output (SISO) set-up: • (1) a PI controller	The best solution here is regarded as one that offers the greatest vibration mitigation performance amongst the solutions identified

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
			• (2) a series of reduced-order-observer controller	
[10]	X. Wang and B. Yang, "Transient vibration control using nonlinear convergence active vibration absorber for impulse excitation."	2019	• nonlinear convergence ADVA to control the transient vibration	Can help shorten the convergence time of transient vibration suppressing and achieve faster decrements for transient oscillation attenuation.
[11]	D.-H. Yang, J.-H. Shin, H. Lee, S.-K. Kim, and M. K. Kwak, "Active vibration control of structure by Active Mass Damper and Multi-Modal Negative Acceleration Feedback control algorithm."	2017	• MMNAF control generates the proper position for the active mass using the acceleration signal	Instability in the low frequency region Can successfully suppress multi natural modes of structures.
[12]	M. Arif Şen, M. Tinkir, and M. Kalyoncu, "Optimisation of a PID controller for a two-floor structure under earthquake excitation based on the bees algorithm."	2018	• PID controller • Bees algorithm	The bees algorithm parameters, together with the goal function and the optimisation range, may all be altered to optimise pid controller performance. To enhance controller performance for structural systems under the influence of various genuine earthquakes, several types of intelligent, adaptive controllers will be developed in future research.
[13]	A. G. A. Muthalif and R. S. Langley, "Active control of high-frequency vibration: Optimisation using	2012	• hybrid modelling method	Skyhook damper gain and location is found with excellent accuracy in just a fraction of time compared to the traditional deterministic modelling techniques

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
	the hybrid modelling method."			
[14]	Y.-C. Chang and J. Shaw, "Low-frequency vibration control of a pan/tilt platform with vision feedback."	2007	• feedback pan/tilt platform • feedback AVC method	Obtain good vibration attenuation Transient response Is poor as compared to that by the adaptive sliding control.
[15]	Y. Sun, J. Zhou, D. Gong, W. Sun, and Z. Xia, "Vibration control of high-speed trains self-excitation under-chassis equipment by HSLDS vibration isolators."	2019	• HSLDS vibration isolator based on target • stiffness curve is proposed	Hslds hanging, the time domain amplitudes of vertical and lateral vibration accelerations of carbody and the Psd are the minimum among all four hanging modes involved.
[16]	H. E. Kalehsar and N. Khodaie, "Wind-induced vibration control of super-tall buildings using a new combined structural system."		• Combines an exterior tube with a core structure • Is composed of two lower and higher halves. • By restricting the overall movement of the outer and core framework and absorbing vibrational energy, the damping products utilised in this area regulate the wind-induced vibration of the building	The outcomes reveal that the self-acting system that is structural effectively reduces wind-induced vibration in super-tall buildings and enhances occupant comfort under strong wind excitation
[17]	M. Setareh, J. K. Ritchey, A. J. Baxter, and T. M. Murray, "Pendulum tuned mass dampers for floor vibration control."		• PTMDs	The intesities of floor vibrations can be greatly reduced when ptmds are correctly tuned. The intesities of floor vibrations can be greatly reduced when ptmds are correctly tuned. The ptmd

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
				might or might not be out of tune if human activity is the cause of extra live load. The floor reaction may be reduced if a human-structure interaction phenomenon is present.
[18]	J. Chen, G. Li, V. Racic, H. E. Kalehsar, Khodaie, and N.R, "Seismic performance of optimal Multi-Tuned Liquid Column Damper-Inerter (MTLCDI) applied to adjacent high-rise buildings."		• MTLCDI	In terms of seismic vibration management of absolute acceleration and inter-story drift ratios, the results show that when the two buildings have separate natural frequencies, both is-mtlcdi and ib-mtlcdi outperform inter-building single tlcdi as well as other vibration absorbers.
[19]	J.-D. Kang and H. Tagawa, "Seismic performance of steel structures with seesawenergy dissipation system using fluid viscous dampers."		• Seesaw energy dissipation	Reduces the reaction to a seismic event
[20]	E. Pereira, I. M. Díaz, E. J. Hudson, and P. Reynolds, "Optimal control-based methodology for active vibration control of pedestrian structures."		• Control system	The suggested methodology's feasibility is confirmed by experimental findings acquired on an in-service indoor walkway.
[21]	S. Thenozhi and W. Yu, "Stability analysis of active vibration control of building		• PD/PID	Numerical simulations and a two-story building prototype are used to validate the theory's results. These findings validate our theoretical analysis.

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
	structures using PD/PID control."			
[22]	J. Chen, G. Li, and V. Racic, "Acceleration response spectrum for predicting floor vibration due to occupants jumping."		• design-oriented acceleration response spectrum	Vibration response found at the highest state while people jump Test floor and thene a real floor were used
[23]	R. Kandasamy *et al.*, "A review of vibration control methods for marine offshore structures."		• Semi-active control • methods	Control as well provide modications in the damping methods of structures located at offshore marines
[24]	J. Yang *et al.*, "Development of a novel multi-layer MRE isolator for suppression of building vibrations under seismic events."		• Multi layer MRE	Fuzzy logic is the best method to implement mre
[16]	H. E. Kalehsar and N. Khodaie, "Wind-induced vibration control of super-tall buildings using a new combined structural system."		• Wind-induced controller	Provide an Appropriate flexibility in the architectural and structural design of supertall Buildings based on the proposed structural system
[25]	G. Kumar, A. Kumar, and R. S. Jakka, "The particle swarm modified quasi bang-bang controller for seismic vibration control,"		• Quasi bang controller	The findings show that the pso modified quasi bang-bang controller outperforms the other controller in terms of minimizing structural reactions such as relative displacement, inter storey drift, and absolute accelerations.
[26]	Z. Wang and C. M. Mak, "Application of		• movable active vibration control	Excitation resulting from an actuator with a shaft that can be

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
	a movable active vibration control system on a floating raft,"		system consists of a linear motor with a shaft, a DSP system, • two tachometers, four velocity sensors, and an inertial actuator connected to an accelerometer by	used to provide broadband perfomance
[27]	L. Wang, J. Li, Y. Yang, J. Wang, and J. Yuan, "Active control of low-frequency vibrations in ultra-precision machining with blended infinite and zero stiffness,"		• Ultra precision machining	This research proposes an active vibration control strategy for improving the performance of ultra-precision machine tools.
[28]	N. J. J. o. W. E. Khodaie and I. Aerodynamics, "Vibration control of super-tall buildings using combination of tapering method and TMD system."		• Tampering • TMDS	To reach desired transient state the crosswind and structural design needs to be improved by providing control to change inherent characteristics.
[29]	Q. Wang, H. Qiao, D. De Domenico, Z. Zhu, and Y. Tang, "Seismic performance of optimal Multi-Tuned Liquid Column Damper-Inerter (MTLCDI) applied to adjacent high-rise buildings."		• Multi tunes liquid colum damper	In terms of seismic vibration management of absolute acceleration and inter-story drift ratios, the results show that when the two buildings have separate natural frequencies, both is-mtlcdi and ib-mtlcdi outperform inter-building single tlcdi as well as other vibration absorbers.
[30]	J. Byzyka, M. Rahman, D. A. Chamberlain, and M. Malieva,		• Asphalt • heating	It is determined that preheating a pothole excavation with infrared heat before to filling and compaction enhances the

Ref No	Authors, Paper Title	Year	Techniques Used	Findings
	"Performance enhancement of asphalt patch repair with innovative heating strategy."			bonding strength and endurance of the repair interface.

AUJoGR-24201

The Determinants of Incremental and Radical Creativity: An Interactionist Perspective

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Abstract
The current study is aimed at studying the determinants of employee creativity at a multi-dimensional level. The creativity of employees in an organization has a direct impact on its success, profitability and sustainability of competitive advantage, particularly for the organizations in the creative industry, therefore it is the aim of the managers to select and retain employees with personal resources that are crucial in exhibiting higher level of creativity. The personal resources along with the organizational factors impact the employee creativity in any organization, thus an interactionist perspective was adopted for this study. It was proposed that organizational climate for creativity acts as a moderator between personal resources and work engagement whereas work engagement mediates the relationship between the personal resources (openness to experience, divergent thinking attitudes, emotional intelligence, proactive personality and self efficacy) and employee creativity. The two dimensions of creativity; incremental and radical creativity, have been considered in this study at this level for the first time, in the past studies creativity has generally been researched as a uni-dimensional construct which led to inconclusive and incomplete results with reference to a number of antecedents of creativity. This study followed a quantitative approach whereby survey was conducted among the employees working in the creative departments in advertising agencies of Rawalpindi & Islamabad, through structured questionnaires. The collected data from 277 respondents on a three wave time-lagged basis was analyzed through AMOS and SPSS PROCESS Macro by Hayes (2013). The results provided empirical support to 17 out of 27 proposed hypotheses and it was found that the personal resources (openness to experience, divergent thinking attitudes, emotional intelligence, proactive personality and self-efficacy) had a relationship of greater magnitude with radical creativity than with incremental creativity. The mediating mechanism of work engagement was proved significant between the personal resources and radical creativity while with incremental creativity, the mediation was non-significant; moreover work engagement predicted both the forms of creativity significantly. It was found that organizational climate for creativity significantly moderated the relationships between personal resources and work engagement however the direction of the relationships was negative. The findings can be of immense help to HR managers working in the advertising sector in particular and creative industry in general, for hiring and selecting employees with the right personal resources and also in retaining them by keeping them engaged and through creation of a suitable organizational climate for creativity. The study also highlights future recommendations for research followed by managerial implications of the findings.

AUJoGR-24202

Re-conceptualizing the Impact of Political Skill on Positive Behaviors and Job Embeddedness

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Abstract
Political skill is the essential requirement for the individuals to survive in the political arenas of organization and is gaining much recognition in terms of managing the interactions within the organizations. The present study investigates the role of political skill in generating helping behavior, compassion, knowledge sharing and job embeddedness in the presence of mediating mechanism of organization based self-esteem, interpersonal trust, and personal reputation. It also highlights the interaction effect of

political will on the relationship among political skill and its outcomes. A quantitative approach was employed involving responses from 219 managers serving in banks of Islamabad and Rawalpindi using a questionnaire. The data was analyzed using structural equation modeling and process macro. In particular political skill is found to have a significant direct effect on positive behaviors and job embeddedness. Political skill also revealed a significant and positive relationship with organizational based self-esteem, interpersonal trust and personal reputation. Moreover results revealed that organizational based self-esteem, interpersonal trust and personal reputation partially mediated the relationship between political skill and positive behaviors and job embeddedness. Political will was not found to be a moderator between political skill and its outcomes. The study involves self-report measures that may lead to common method variance. The sample size is also small and reduces the generalizability of results to a larger extent. Political skill will help the managers to deal with the tough competition, technological advancements and demanding jobs and to cultivate a positive environment at workplace by promoting positive behavior of helping colleagues, showing a compassionate response, engaging in knowledge sharing behavior and being more well connected to job. Managers should be trained to develop political skill in their personality as it will help them to enhance self-esteem, add to their repute, help to develop trust in colleagues. The study was the first to address the unexplored areas of research regarding political skill's impact on positive behaviors and job embeddedness in the presence of specified mediators and moderator.

AUJoGR-24203

Examining the nexus between organizational configuration and organizational performance: A parallel and serial multiple mediation analysis

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Abstract

An unattended question waiting scholarly attention is that which organizational configuration leads to better organizational outcomes. Right organizational configuration is an optimal mix of strategy, structure and environmental alignment which gives rise to better financial, social and environmental implications. The concept of organizational configuration has been utilized more frequently in organizational performance-related publications, receiving widespread recognition in organizational research but becoming even more specialized in strategic management. Due to contradictory empirical findings indicating both support and failure, this relationship has been a central and rather controversial topic of study. These contradictory results may be attributable to the configuration theory concept that organizations are complex and interdependent in nature, such that fit and competitive advantage depend not on a single quality but rather on the interaction and complementary between numerous attributes. Two groups of scholars have emerged as a result of the intensified debate regarding the significance of organizational configuration theory development: those who advocate for its dissemination and its proponents. This study aimed to advance knowledge by evaluating the impact of organizational configuration on organizational performance. The study acknowledged that the high performance HR practices have an impact on the results of this relationship. Overall, the purpose of the study was to assess the mediating effect of high performance HR practices and employees well-being on the association between organizational configuration and organizational performance in the organizations situated in export processing zones of Pakistan. The particular aims of this study were to investigate the impact of environment and structure linkage, and establish the impact of environment and strategy linkage on organizational performance. This research examines the organizational configuration as an antecedent of firms' performance relative to other competitors. In doing so, human resource related factors that may connect the performance and well-being output to organizational configuration are also studied as mediators through survey research strategy. This study followed the quantitative survey based research strategy with multi-stage sampling technique. 594 Middle level managers serving currently in 101 export processing zones' firms of Pakistan constituted

the sample of the study survey from these managers. For this explanatory research, the current study assessed the measurement model and multiple mediation regression analysis was done for mediators by Hayes (2017) process model. Based on cross sectoral survey of employees working in the firms at export processing zones firms, this research confirms that the firms that have organic organizational structure, differentiation strategy and better high performance work practices would yield more well-being for employees and better organizational performance in Pakistani context. In addition, the current study represents various implications and future recommendations.

AUJoGR-24204

Ownership Structure and Firm Growth:
Evidence from Manufacturing Sector of Pakistan

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Abstract

Firm growth has been an area of interest since the seminal work by Gibrat, (1931). Current study aims to examine in detail the impact of ownership structure on the growth of manufacturing firms listed on Pakistan Stock Exchange, from 2006 to 2016. Growth is measured by sales growth and asset growth with empirical departure from the earlier literature by separating high growth and low growth firms. The ownership dimension includes: concentrated ownership, family ownership, managerial ownership, institutional ownership, foreign ownership and state ownership. The moderating effect of managerial ownership (insider control), and institutional ownership (outsider control), is checked under different concentrated ownership types. The optimal level of managerial and institutional ownership is also determined under each concentrated ownership type. Most of the firm growth literature has emerged from developed countries, whereas research from developing countries especially Pakistan is sparse. The novelty of this work lies in the extension of firm growth literature from ownership perspective and providing theorizing from Agency Theory and Penrose Theory (1959). Methodology of this research is based on the proposition that ownership structure is a corporate governance tool that can reduce agency problems within a firm and align the interests of an agent with the firm owner such that resources are utilized efficiently and this helps the firm to grow. Panel data estimation technique is used and to address the endogeneity of ownership variable and Generalized Method of Moments (GMM) is applied. Results of the study reveal that concentrated ownership by and large exerts significant negative impact on the growth of the firms in Pakistan. Family ownership positively impact firm growth but where these owners lack interest those firms show low growth and are constrained. Managerial ownership is very useful for firm's sales growth as managers get rewarded on achieving sales targets; this however has a negative influence when it comes to asset growth. Institutional ownership adversely affects firm growth and show monopolistic behavior for being fund providers to the firm. On contrary to expectations foreign ownership is not helping local firms in their growth rather they get themselves entrench and expropriate firm's wealth out of the country. In the case of low growth firms, however, foreign investors exercise strict monitoring and control and show improvement. State owned firms are run by the managers therefore they perform well for sales growth but not for asset growth. Moderating role of managerial ownership and institutional ownership is mix and varies in different concentrated ownership types and their high and low growth categories. The optimal level of managerial ownership and institutional ownership is different in each of the different concentrated ownership types. This also varies within both high and low growth firms. This research concludes that ownership structure of a firm has a significant impact on firm growth and corporate governance policies should consider the combination of governance tools to curb opportunities behavior of the managers or concentrated shareholders. The optimal and minimal level of insider and outsider ownership calculated in this dissertation can help policy maker to check on the concentration of ownership and its deterrent effects and would mark a step in improving investor protection environment in Pakistan. Manufacturing firm's managers should invest in versatile resources and should train and

motivate the managers to come up with new productive opportunity sets that can pave the way for firm growth. Lastly it is immensely important to delineate the concept of firm growth before making firm growth policies. This is more vital as different measures of firm growth have varied determinants and high growth and low growth firms have diverse dynamics.

AUJoGR-24205

Governance Mechanism and the Evaluation of Islamic and Conventional Mutual Funds: Evidence from Pakistan

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Abstract

Mutual funds, that pool money of investors, seek to offer a higher return to them. This requires ensuring better performance of the fund on a consistent basis with a strong dividend payout. A low-risk fund is likely to perform better on a consistent basis. Performance, risk, and dividend payout are interrelated and all three heavily depend upon corporate governance practices employed at the fund. This study aims to analyze the impact of corporate governance characteristics on the performance, risk, and dividend payout policy of mutual funds in Pakistan. The study also provides a comparative analysis of the risk exposure of Islamic and conventional mutual funds. The study uses mutual fund performance, risk (including total and idiosyncratic risk), and dividend payout policy as dependent variables while the corporate governance characteristics including; board size, board independence, director ownership, institutional ownership, and overall quality of corporate governance (CG), are used as explanatory variables. The study uses the dynamic panel model for analyzing the impact of corporate governance characteristics on performance, risk, and dividend payout policy of mutual funds in Pakistan. The models are estimated using the system generalized method of moment (GMM). The results suggest that board independence, institutional ownership, and overall governance quality positively affect the performance and dividend payout while these variables negatively influence the risk of both Islamic and conventional mutual funds. These results are in line with the predictions of agency and resource dependence theories. Finally, the comparative analysis of various kinds of risks involved in both Islamic and conventional mutual funds shows that Islamic mutual funds have lower risk exposure compare to their conventional counterparts, which makes them more attractive, especially for Shariah- compliant investors.

AUJoGR-24206

Governance Examining Mediating effect of Human Capital and Individual Absorptive Capacity between Knowledge-based HR Practices and Employee Innovative Behavior

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Abstract

With the growing body of literature in knowledge-based HR practices, it is necessary to examine its significance in this globalized era. Organizations have started realizing knowledge creation to enhance the capabilities of their employees and adopting new strategies for gaining a competitive edge. Service industries are now focusing on the application of related knowledge for improving competencies. Education sector specifically universities possess potential resource to enhance innovative behavior of employees. Faculty members are fundamental pillars for universities with their updated knowledge, skills and abilities. It helps to absorb and exploit knowledge for improving performance. This study is based on established relationships and underlying framework as practices-resources-uses-performance. This linkage is still questionable due to the dearth of knowledge. Therefore, the study is being conducted on faculty members of universities (public and private sector of Islamabad and Rawalpindi). According to the response rate, 374 was the sample size for this study. The data collected with a Likert scale comprised of 1-5, in

which one represents strongly disagree, five depicts strongly agree, and three depicts as neutral. The quantitative approach has been utilized for this study based on self-reported measures using the survey method. The technique used for data analysis is smart PLS 3.2 7 (Partial Least Square). This study concluded that knowledge-based HR practices are crucial for improving the innovative behavior of faculty members. This study highlighted that knowledge-based training and development enhances human capital (faculty members) and impacts individual absorptive capacity and employee innovative behavior through sequential mediation. Other factors depict insignificant results in the current study due to service industries or mainly the education sector not focusing on such dimensions. These dimensions need to be explored in further studies as universities are adopting a "new wave" and shifting from administrative policies to strategic concerns in the private and the public sector.

AUJoGR-24207

Asset Allocation during Uncertainties: Investigating the Role of Non-Traditional Assets during Acute Market Conditions and Political Uncertainties in Pakistan

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Abstract

With the Political events, happening more frequently across nations and their negative effects on economic activities have illuminated the need to investigate the role of different assets during such uncertainties to find some safe investment options for diversification. Pakistani investors have to face such uncertainties more frequently because Pakistan is among one of the highest politically instable economies in world, so they require safe investment options more critically. Hence in order to explore safe alternative investment options, current research aims at exploring the behavior of some non-traditional assets like gold, real estate, sub asset classes; growth stocks, value stocks, large stocks, small stock, and sectoral stock during political uncertainties and market downturns. All these assets are investigated in different aspects like; the impact of political instability on these assets, hedge and safe haven characteristics of these assets during market downturns and during political uncertainties, the presence of leverage effect and persistence of volatility of these assets, and inter relationships of these assets, to investigate which of these could provide diversification benefits to investors during such uncertainties. Event study analysis, ARDL, EGARCH; Volatility modeling incorporating quantile dummies and time dummies is employed. The study reports significant impact of political uncertainties on stock market, most of its sectors, sub-asset classes and to some extent gold as well. While political uncertainty is not found to influence real estate. Moreover, despite having the influence of political uncertainties, gold is found to act as a hedge and safe haven for stock market, sub asset classes and most of its sectors, hence indicating the diversification potential to cope with market downturns and political uncertainties in Pakistan. Similarly real estate is also found to have the potential of providing diversification benefits to investors by indicating no significant relationship with stock market and other non-traditional assets under study. Current research contributes well to literature because sub-asset classes and real assets like gold and real estate has never been studied during political uncertainties. Moreover, the interrelationship of sub-asset classes and real assets has never been studied in the past literature. So it contributes significantly to literature by filling these huge gaps. Moreover, it contributes significantly to the knowledge of Pakistani investors and investment managers by providing safe investment options for their asset allocation strategies to cope with uncertainties.

AUJoGR-24208

Impact of Big Five Personality Traits on Training Transfer with Mediating Role of Motivation to Transfer and Moderating Role of Perceived Support from Supervisor and Perceived Organizational Politics

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Abstract

Billions of dollars are spent around the world for training and development of employees within organizations, but the actual transfer of these learned knowledge and skill is very low. The purpose of this study is to develop and test an integrated model of Training Transfer with context to big five personality traits of employees. Current study lays its foundations on the training transfer model given by Baldwin and Ford in specific context of banking sector in Pakistan. The study aims at finding that how different personality traits of employees affect the transfer of training at work through motivation to transfer. Moreover, how perceived support from supervisor and perceived organizational politics as part of environment moderate this relationship. Banking sector being the part of service industry is taken as population. It was difficult to get access to the data of respondents and due to Covid-19 situation; non-probability, convenience sampling technique was used. Data was collected through self- administered questionnaires that were adopted from previous literature. Training, being the basic factor of this research respondent was asked if they had taken any training in last 6 months then they may proceed to fill the questionnaire. A total of 800 questionnaires were distributed among the potential respondents and 404 questionnaires that were complete in all aspects were qualified for further analysis. Data was analyzed by using SPSS software Version 26 and AMOS Version 24. At first, descriptive statistics is analyzed and then statistical analysis including exploratory factor analysis (EFA), confirmatory factor analysis and structural equation modeling were performed on the data. Results indicated that employees higher in trait conscientiousness and trait agreeableness are more inclined towards motivation to transfer training and training transfer at their workplace than those of trait extroversion and trait openness to experience. Moreover organizational politics and supervisor support are important moderating variables that should be considered while selecting and imparting expensive trainings programs. Implications for academics, practitioners and methodological concerns are discussed. Finally, suggestions regarding future research and limitations of the study are presented.

AUJoGR-24209

Identifying The Nexus between Employees' Cyber loafing Behaviour and Supervisor's Phubbing Behavior

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Abstract

The proliferation of the Internet and information and communication technologies (ICTs) has resulted in workers devoting an increasing amount of their workday to digital activities that are not directly relevant to their jobs. There is a significant body of research that has been done that focuses on the possible negative effects of engaging in such activities in the form of cyberloafing. The non-work-related internet use at the workplace is known as "cyberloafing" (V. K. Lim, 2002). According to (Aku, 2017) between 60% and 80% of employees' non-work-related Internet use occurred during working hours. Moreover, according to the International Data Corporation, between thirty and forty percent of employees utilize the internet provided by their companies for activities that are not linked to their jobs (Y. Li et al., 2018). Another study conducted by (Sheikh et al., 2015) reported that the personal internet use of workers poses a risk to businesses in the form of low productivity, security issues, sexual harassment, and waste of company resources. Due to growing concerns about the cyberloafing phenomena and the potential repercussions of this trend, the present study aims to provide important insights into the cyberloafing phenomena in terms of its antecedents. The study contributes to the existing body of literature by explaining the contextual nature of employees' cyberloafing and examining lesser investigated supervisors' phubbing behavior concerning employees' cyberloafing behavior by using the Social Cognitive Theory (SCT) as its theoretical foundations and employed a multi- method approach to investigate the moral disengagement process at the heart of the supervisor's phubbing behavior and to determine how it relates to the employees' perceived

normative conflict and predicts the employees' cyberloafing behavior. The quantitative approach permits the measurement of the processes that promote cyberloafing activity in connection to supervisor's phubbing behavior through the mediating influence of perceived normative conflict and moral disengagement. Data were collected from 526 employees working in the banking sector of Pakistan. Results from serial mediation analysis reported that the supervisor's phubbing behavior influenced employees' cyberloafing behavior via perceived normative conflict and moral disengagement. Moral disengagement alone mediated the effect of the supervisor's phubbing behavior on employees' cyberloafing. However, employees perceived normative conflict alone failed to mediate the relationship between the supervisor's phubbing behavior and employees' cyberloafing behavior. In addition, employees' first-hand accounts, heard in their own words offer perspective on the matter that is being researched. The qualitative investigation showed that banking industry employees were routinely phubbed by their bosses, which prompted them to detach morally and indulge in cyberloafing. which further provides important insight into the understudied phubbing phenomena. As a cultural phenomenon, the normalization of phubbing raises severe concerns; yet, phubbing has repercussions that extend beyond the phubber or the victim to yet another generation of humans (Thabassum, 2021). The findings of this study add significantly to the existing body of literature on cyberloafing phenomena and have practical implications. By gaining insight into the factors that contribute to cyberloafing, businesses may better craft policies and guidelines that go to the bottom of the problem. In addition, the present research assist businesses in gaining the insight they require into the causes of cyberloafing so that they can better educate their staff on the importance of adopting appropriate online behavior. Business leaders can also use the results of this study to develop rules and initiatives that discourage phubbing and cyberloafing among their managers and staff. The results of this research are an important contribution to the literature on cyberloafing and have theoretical implications as well. Understanding the factors that lead to cyberloafing can provide light on the nuanced connection between humans and machines. It delves into the ramifications for enterprises in managing their technical resources, as well as the ways in which the availability and accessibility of technology affect employee behavior and productivity.

AUJoGR-24210

Does A CEO'S National Culture Affect Corporate Social Responsibility and Financial Performance of a Firm?

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Abstract

An established stream of the research shows that managerial characteristics affect the overall functioning of a firm. This assertion is based on the upper echelons theory, which maintains that organizational outcomes are partially determined by its top management. Scholars mutually agree that the chief executive officer's (CEO) characteristics determine the firm's policies, for example, corporate social responsibility (CSR) initiatives and financial performance. One such characteristic is the CEO's national culture. Despite the increasing importance of the cultural background of CEOs, studies exploring the relationship of the CEOs' national culture with CSR are virtually non-existent. This study aims to fill this research gap by exploring the impact of the CEOs' culture on CSR. This study also tests the impact of the CEOs' culture on the financial performance of the firms. This study employs an extensive data set of United States companies—from 1996 to 2015 with 12,218 observations—to provide the first-ever evidence on the effect of the cultural background of CEOs on CSR. In this study, 1,787 firms listed on Standard & Poor's 1500 are included in the analysis. I employ pooled cross-sectional time-series regressions with a cross- section of clusters at the firm level. The explanatory variables include six cultural dimensions, five firm-specific control variables, as well as the year and industry fixed effects. In the analysis, all of Hofstede's cultural dimensions—individualism vs collectivism, power distance, masculinity vs femininity, uncertainty avoidance, long-term orientation vs short-term orientation, and indulgence vs restraint—have been included. Likewise, seven

components of CSR, i.e., community, diversity, employee relations, environment, human rights, product characteristics, and corporate governance have been included. Our findings suggest that those CEOs who belong to individualistic and masculine cultures have a higher propensity to undertake CSR initiatives. More importantly, they indulge more in community and environment-related activities. It is also observed that CEOs who belong to masculine cultures are highly likely to undertake related to corporate governance-related activities. It is worth mentioning that Hofstede's latest two cultural dimensions, namely long-term Orientation / short-term orientation and indulgence/restraint, have positive coefficients. The results also show that individualism and masculinity also have positive coefficients with CSR and its components. The importance of CEOs who belong to a masculine culture cannot be ignored. I find that the masculinity dimension is the most influential. It is not only positively and significantly related to CSR, but also the financial performance of the company. These results suggest that the CEO who belongs to a masculine culture ought to be preferred by the majority of stakeholders as they support those CSR activities that are positively and significantly related to the firm's financial performance. I also find that four of the six cultural dimensions are significantly related to firms' financial performance; that is, masculinity, uncertainty, and long-term orientation are positively related, while indulgence is negatively related to firms' financial performance. The results are related to real-life as well; for example, the firms that focus on the future are better served by CEOs who belong to a long-term oriented culture. These results make a significant contribution to the body of knowledge on cultural finance. The findings of this study have significant policy implications for all stakeholders, including firms' management, shareholders, investors, creditors, and employees. This study recommends that firms should select those CEOs that are most suitable for them. For example, a firm that is highly committed to CSR ought to hire a CEO who belongs to an individualistic or a masculine cultural background. Similarly, firms that intend to execute a CSR agenda and achieve better financial performance need to put masculinity oriented persons in as the CEOs because they are positively and significantly related to CSR as well as to firms' financial performance. According to the results, masculinity oriented CEOs fulfil the requirements of a majority of stakeholders.

AUJoGR-24211

The Return and Volatility Transmission among Commodities, Forex and Stock markets: Implication for Portfolio Diversification and Hedging Strategies

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Abstract

This study examines the information transmission (return and volatility spillovers) among commodities (energy, agriculture, metals), stock markets (conventional, islamic), and forex markets (developed, emerging, frontier). Moreover, it calculates the optimal weights, hedge ratio, and hedging effectiveness for the different portfolios during the global financial crisis, the European sovereign debt crisis, and COVID-19. The information transmission is investigated using daily data by employing the spillover index of Diebold and Yilmaz. At the same time, optimal weights, hedge ratios, and hedging effectiveness are calculated using the DCC-GARCH model. The study has the following empirical findings. This study estimates the return and volatility spillover among commodities and stock markets during different periods and found a higher spillover during COVID-19 than during the global financial crisis and the European sovereign debt crisis. A strong return and weak volatility spillover are observed among energy commodities and emerging stock markets. In addition, weak information transmission is found among agricultural commodities and stock markets (emerging and frontier) during different periods. A strong return and weak volatility spillover are found among commodities and Islamic stock indices that increased during COVID-19. A weak connectedness is found among commodities (energy, agriculture, metals) and exchange rates (developed, emerging, and frontier) during the different periods. A strong spillover is found among stock markets (developed and frontier) and

exchange rates (developed, emerging, and frontier) that is highest during COVID-19 than GFC and ESDC. A weak spillover is examined among emerging stock markets and exchange rates of emerging and frontier countries. Moreover, it also finds a strong connectedness between Islamic stock market indices and exchange rates of developed and frontier countries. The spillover among Islamic stock market indices and exchange rates of emerging countries is weak during the different sample periods. In addition, these spillovers peaked during COVID-19 than the global financial crisis and European sovereign debt crisis.

AUJoGR-24212

Wellbeing at Work: An Integrated Framework of Wellbeing Oriented HRM Practices and Performance

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Abstract

Scholars have associated human resource management with performance, reputation, and communal relationships but the influence of well-being-focused human resource management is rarely explored. To fill this literary gap, the current study examines the relationship between wellbeing oriented HRM practices (WBHR), adaptive performance, internal reputation, and organization-employee communal relationship by developing and testing a moderated mediation model. This study also investigated whether emotional culture mediates these relationships and whether ego resilience moderates the mediation of emotional culture. Data were collected from 655 employees of public and private hospitals operating in Islamabad, Rawalpindi, and AJK. The theorized relationships were tested utilizing structural equation modeling (SEM) in AMOS. Findings showed that WBHR practices positively affect adaptive performance, internal reputation, and organization-employee communal relationship. Moreover, the conditional indirect effect of WBHR practices via emotional culture on organizational-employee communal relationship, and internal reputation was significant. However, the conditional indirect effect of WBHR practices via emotional culture on adaptive performance was not significant. This study contributes to the domains of WB-HRM, adaptive performance, internal reputation, and organization-employee communal relationship.

AUJoGR-24213

Intimate Co-creation: Scale Development and Validation

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Abstract

In the available literature on human resource management, intimate co-creation is a nascent concept that explores the formation of value resulting from the simultaneous psychosocial engagement of employees. However, no measurement scale was available for intimate co-creation, and this research has filled that literature gap. Before this study, the concept of intimate co-creation stood only on conceptual grounds without empirical validation. In this study, using an exploratory sequential design, the first-ever measurement scale for intimate co- creation was developed having four dimensions and 14 items. The ten-step approach of Carpenter (2017) was followed for the new scale development. This is the first-ever measurement scale on intimate co-creation that has significantly added to the existing body of knowledge in the field of human resource management. In the second phase, a new research model having intimate co-creation as the dependent variable was tested. Using the conceptualization of Jena & Pradhan (2020), three dimensions of workplace persuasion, including individuals' intent for cooperation, reciprocation, and consensus were used as the independent variables, and their direct and indirect effect on intimate co-creation was measured. Team-member exchange was a mediating variable and ethical climate was used as a moderating variable. Both the moderating and mediating variables had shown a significant effect. Psychological contract theory and social exchange theory were the supporting theories for both the phases of this research. The current study claims a significant empirical and theoretical contribution to the existing body of knowledge.

AUJoGR-24214

Extreme Connectedness among BRICS Stock Markets, Islamic Cryptocurrencies and Oil Returns: Portfolio Implications

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Abstract

The purpose of this research is to investigate the return spillover among the BRICS stock markets, oil and Islamic cryptocurrencies. The study uses the quantile vector auto-regression method on daily data spanning from August 2018 to September 2023. The quantile analysis demonstrates the net transmitters/receivers turn in net receivers/transmitters at different quantiles. The results of the study indicate that having a thorough understanding of asset behavior and market dynamics is the best way to manage risk. Our findings furnish policymakers with crucial insights regarding the return spillover connectivity among oil, Islamic cryptocurrencies, and BRICS stock markets. The study's results may be used to establish pertinent policy measures that would preserve market stability in the face of return spillover. The findings of the study are also useful to investors/portfolio managers in developing a well-diversified portfolio. The study identifies the relationship among the selected markets for the first time. Previous literature highlights the spillover among crypto currencies but it is the first time that the spillover is examined among Islamic cryptocurrencies, BRICS stock markets and Oil. The result indicates asymmetric response with highly sensitive market conditions (bullish and bearish market). Meanwhile, the connectedness in the different quantile varies from time to time, highlighting how the dependent structure at the extreme tails evolves. Particularly, in the return spillover analysis indicates that Brazil and Oil as net transmitters while Russia, China, X.8.X and Hello Gold are the net receivers among the selected markets.

AUJoGR-24215

Customer Value Co-operation Behavior: Role of High Performance Work Practices, Psychological Capital, Work Engagement, Job Embeddedness and Employee Innovative Behavior

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Abstract

Considering the importance of front line service employees role in motivating the customers to engage and participate in value co-creation, the present study examined customer value co-creation behavior antecedents and intervening mechanism through which high performance work practices lead to customer value co-creation behavior. Psychological capital, job embeddedness, work engagement and employee innovative behaviors were studied for their mediation effect. Using judgmental sampling technique, information was obtained on socio-demographics and study variables using six questionnaires. Data were collected from 819 FLSEs and customers dyads from hotels in Pakistan. Data were analyzed using SPSS and PLS-SEM. Preliminary data analysis was carried out to ensure the reliability and validity of data. Mediation analysis was conducted to test the study hypotheses. The study findings suggest that in the context of HPWPs (selective staffing, training, rewards, empowerment, and career orientation) front line service employees are more attached with their organization, become highly engage in performing work roles, exhibit innovative behaviors motivating customers to become engage and exhibit value co-creation behavior. Current study contributed to the value co-creation research by examining the forces that can encourage and motivate customers to exhibit and display value co-creation behaviors through employee role. The hotel management should benefit from HPWPs strengths to enhance the FLSEs attachment with their service organizations for exhibiting innovative work behaviors which will in turn motivate the customers to exhibit VCC behaviors.

AUJoGR-24216

Nexus between Competition, Risk, and Performance in Banking Industry: A Multifaceted Study

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Abstract

Using balanced panel data from 2011 to 2019 current research investigated the influence of bank competition and risk on profitability in the banking sector of Islamic countries (Bahrain, Turkey, Malaysia, Lebanon, Saudi Arabia, Kuwait, Bangladesh, and Pakistan). To manage unobserved heterogeneity and the dynamic influence of profitability in its estimate, this research employed the Generalized Method of Moment (GMM) system estimator. This research employs balanced panel data from eight Islamic nations (one by one) to determine the influence of bank rivalry and risk on profitability, as well as a few control factors, at the individual country level. The Lerner Index and the HH-index are used to gauge bank competitiveness, whereas credit risk, liquidity risk, and insolvency risk (measured by z-score) are used as bank risk indicators. In six nations, the findings of this investigation suggest that bank rivalry has a detrimental influence on profitability. The findings show that banks with higher market power (or lower levels of competition) have higher profitability; this finding is consistent with the Structure-Conduct-Performance (SCP) model, whereas the findings show that competition has a positive impact on profitability in Bahrain but not in Kuwait. In the same way, risk factors provide varying outcomes in various nations. This research analyses data from two separate samples in order to fulfill its goals. The first sample includes three oil-exporting nations (Saudi Arabia, Kuwait, and Bahrain), whereas the second sample includes five non-oil- exporting countries (Pakistan, Bangladesh, Lebanon, Malaysia, and Turkey). In OECs, competition, credit risk, and liquidity risk all have a negative impact on bank profitability, but in NEOCs, competition and credit risk have a considerable positive impact on bank profitability. In the banking sectors of OECs and NEOCs, the Z-score shows a substantial positive relationship with profitability. The study's findings offer the Central Bank and other regulatory agencies a comprehensive framework for implementing micro and macro prudential policies that are consistent with the financial system's stability.

AUJoGR-24217

Effects of Culture through Promotive Voice on Advisers' Salience: A Comparison of Growth and Non-growth Firms

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Abstract

The stakeholders of a firm, which are entities that can either impact or be impacted by the objectives of an organization, hold significance due to their ability to exert both positive and negative influence over the organization, its members, and its deliverables. Therefore, comprehending the salience of stakeholders, which refers to the extent to which managers prioritize the competing demands of stakeholders, is a crucial field of study. The current body of literature on stakeholder salience is limited in its focus on group-level salience, neglecting the within-group salience of individual stakeholders. One particular group that warrants attention is the advisors associated with the firm, whose significance has not been examined in prior scholarly works. Considering the reputation of advisers for their vocal abilities, the manner in which they modulate their voice could potentially influence the perception of managers towards them. Various elements, including values, conventions, presumptions, and traditions, have the potential to influence the development of an individual's voice. Culture embodies all of these aspects but has yet to be completely acknowledged in selecting advisers' voices. This study used Hofsted (2001)'s five dimensions of culture—individualism, power distance, masculinity, uncertainty avoidance, and long-term orientation—to show how culture affects adviser salience through promotive voice, using the theory of planned behavior. Furthermore, COVID-19 has divided enterprises worldwide into high-growth and low-growth firms. This study examined the strength of proposed factor relationships

in two firms using this stark difference. The current study also examined how homophily moderates promotive voice and advisers' salience. This study used a large cross-sectional, cross-country, and cross-sectoral data set with 790 growth sample observations and 858 non-growth sample observations from Amazon Mechanic-Turk. The data was analyzed using SPSS and AMOS. The study found that the promotive voice mediated cultural dimensions and adviser salience, except for masculinity. The study also found that attitudinal homophily moderates promotive voice and adviser salience. The study sheds light on cultural, voice, and salience literature. The recent investigation revealed many ramifications and future research paths.

AUJoGR-24218

Dynamics of Jump-Diffusion Phenomenon of Stock Return Volatilities And its Linkages with Aggregate, Sectoral and Firm's Stock Returns: Evidence from Pakistan

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Abstract

This study is aimed at examination of dynamics of jump diffusion phenomenon of stock return volatility. Comparative insight of aggregate stock market, sectoral and firm level stock returns and volatility in response with diffusive risk, jump risk, return asymmetry and total volatility measures of jump diffusion model are provided in this research. Moreover, impact of jump diffusion components of stock return volatility based on different stock return measures on firm performance and various measures of capital structure is also analysed here. Idiosyncratic volatility and its lead lag effect on stock returns of aggregate market and firms are also examined. This study is based on the data of non-financial firms listed in PSX formerly in KSE during the period of 2006 to 2018. This research uses panel data quantile regression model with fixed effect estimates for statistical results. The results indicate that realized jumps have significant positive impact on stock returns volatility of aggregate market. But sectoral and firm level stock return volatility provides negative linkages with realized jumps. Jump diffusion components of volatility confirmed the significant impact of jump risk, diffusive risk, return asymmetry and total volatility on stock returns of aggregate market, sectoral and firms with non-linear positive and negative estimates at various quantiles. Moreover, jump diffusion components of volatility shows significant impact on firm performance and various measures of capital structure. Furthermore, idiosyncratic volatility results proved negative linkages with capital structure. There is also significant lead lag effect of idiosyncratic volatility on stock returns and volatility of stock market and firms confirmed. Therefore, non- linearity of jump-diffusion components of volatility with significant impact on stock returns and volatility is concluded in non-financial sector of PSX. This research is significant in terms of providing deeper insights of managing stock performance of the firms by managing firm specific factors. The findings of this research are also useful for the investors in managing their investing decisions in different sectors and firms. All these three insights of aggregate market, sectoral and firm level analysis also useful for portfolio managers and institutional investors for making efficient investment and managing risk.

AUJoGR-24219

Impact of Organizational Culture and Knowledge Governance Mechanisms on Knowledge Sharing Behaviors in Higher Education: An Ability, Motivation, Opportunity Prospective

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Abstract

This study aims to develop, examine and test the organizational and individual predictors of knowledge sharing behavior of teachers in higher education sector in Pakistan. Social exchange theory (SET) has been utilized to explain the premise of this research. This study uses survey design based on random sampling to measure KSB and its predictors including knowledge

governance mechanism and individual factors from motivation, opportunity and ability framework. Data is collected from 269 university teachers in Pakistan. Structural equation modeling is used to test the hypotheses. All the hypothesized relations were reinforced by data and hypothesized model is found a good fit to data. Data support the hypotheses but the contributions of the study should be acknowledged while allowing the limitations to be realized that lead to future directions. Several important research directions have been discussed to be examined in future. This study suggests that senior level managers should foster a culture in organizations that support knowledge governance mechanisms than in turn associate with the knowledge sharing motivation and opportunity to encourage knowledge sharing behavior. Practitioners and managers should re-consider the role knowledge governance mechanisms can play for creating synergy to upsurge knowledge sharing motivation and opportunities that contribute to improvement in knowledge sharing behavior. This study concludes that organizational culture promotes knowledge governance in higher education institutions and universities to provide employees with knowledge sharing opportunities and motivation that in turn enhance their knowledge sharing behavior at workplace.

AUJoGR-24220

Significance of Emotions at Work: A Multifaceted Model of Emotional Job Demands, Emotional Labor and Employee Well-Being

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Abstract

Emotional labor research has received ample attention given the significant impact it has on various organizational outcomes. However, the inconsistencies in the previous studies, specifically regarding the effects of emotional labor are quite noticeable. The study aims towards understanding the construct of emotional labor in terms of both its antecedents as well as its consequences; and addressing the inconsistencies by explicating its context. The study adds to the existing literature by explaining the contextual nature of emotional labor process, examining lesser explored well-being facets in relation to emotional labor, and adopting a mix method research approach to provide in-depth insights and experiences about doctors' emotional labor practices and subsequent outcomes. Choosing healthcare context, this study tests a serial mediation model of emotional job demands, emotional labor strategies, emotional exhaustion, and employee well-being. Furthermore, multigroup moderating effect of social and enterprising personality is also examined in relation to the research model. Data collected from 406 medical doctors working in both public and private sectors in more than 10 cities of Pakistan revealed that emotional job demands predict doctors' hedonic, eudaimonic and physical well-being via intervening role of emotional labor strategies and emotional exhaustion. Results from multigroup moderation analysis reported significant differences between doctors with low and high social and enterprising personalities with respect to the research model. The study further adopts phenomenology, a qualitative method of research to explicate the findings obtained from quantitative analysis. Explanatory sequential design is used for integration of quantitative and qualitative results, where latter compliments the former. Results from semi-structured interviews conducted during qualitative study reveal that experiencing high emotional exhaustion and low well-being by doctors is caused by huge volume of patients, patients/attendants' unappreciative behavior, inadequate compensation, difficult work routine, pressure of future academic prospects, lack of workplace safety, low work-life balance and poor mental and psychological health. These adverse effects can be lessened through positive public perception about medicine field and organizational support in the form of high compensation, workplace safety and security and relaxed working routines. Findings of this study make notable contribution to literature on emotional labor and well-being, in addition to assisting in bettering the working conditions of healthcare sector to improve doctors' ability to meet emotional job demands and improve their well-being.

AUJoGR-24221

Impact of Cognitive and Affective Factor on Online Compulsive Buying Behavior through mediating role Of Brand Engagement

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Abstract

The Stimulus-Organism-Response (SOR) model, in particular, has been used to conduct considerable study on compulsive buying behavior and its emotional components. More attention must be paid to cognitive and emotional factors that can be used to alter CBB, though. Our main goal is to explore the many cognitive and emotional aspects that significantly contribute to obsessive online buying behavior in this study. We want to learn more about how these elements ultimately influence consumers' purchase decisions by doing this. The objective of this study's empirical investigation is to offer a descriptive and demonstrative examination of how customers' purchasing intentions are influenced by their cognitive and emotional states. The positivist methodology used in this study is one that is built on measurement and observation. To quickly and effectively statistically evaluate the data and make inferences, a quantitative approach was used. The individual factors of interest are operationalized using a five-item Likert scale that has been previously established and verified. The study makes use of numerous methods to investigate the relationships and connections among young consumers' (N = 200) compulsive purchase behavior, cognitive elements, emotional components, and brand engagement. The statistical methods of SPSS were used to analyze the data. By employing and assessing the scales for measuring compulsive buying, cognitive elements, emotional components, and brand engagement, this study offers a methodological contribution. Additionally, it provides empirical understanding of the phenomena of compulsive buying. The applicability of this research in practice can be advantageous for marketing organizations. The study offers suggestions for addressing the connections between cognitive elements, such mood regulation behavior, and affective components, like emotional conduct, in order to reduce compulsive and obsessive behavior in customers. By skillfully controlling customers' emotions, marketers may change their behavior from obsessive to more fulfilling levels. The results of this study can help marketers decide how to improve consumer- brand interactions, thereby reducing or even eliminating the adverse impacts of compulsive buying. Marketing experts can create powerful campaigns that encourage customers to adopt good attitudes and behaviors while also outlining precise precautions to take in order to prevent undesirable traits like excessive spending.

AUJoGR-24222

Antecqedents and Outcomes of Career Optimism: A Serial Mediation Model

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Abstract

Career optimism is undoubtedly the most important aspect of an individual's career development. There is growing interest in the concept of career optimism, but there is a lack of empirical research on this construct. The purpose of this study was to examine career optimism as a state-like concept. This study examined the personal and contextual factors that contribute to the development of career optimism to fill the gap in the literature. These factors include core self-evaluation, work meaningfulness, and work-social support. In addition, the study sought to investigate the attitudes and behaviors associated with career optimism. Specifically, the study aimed to determine how career optimism may affect job performance and employee creative performance. This study is especially important because of a global pandemic that has had a big effect on businesses all over the world. Even in difficult situations, management seeks ways to boost employees' work performance and creativity. A quantitative approach was used in this study. The unit of analysis was a 535 dyad (supervisor/employee) professionals from various sectors (Education, financial institutes, Telecom, and technology) of Pakistan. The current study investigated the measurement model and used serial mediation regression analysis to analyze the data using SPSS 25 and AMOS 25. A longitudinal study was conducted on

employees working in Rawalpindi and Islamabad. The findings confirm that core self-evaluation, work meaningfulness, and supervisor support aid in the development of career optimism, which leads to an improvement in career commitment and, ultimately, employee job and creative performance. The study adds to the literature by demonstrating how career optimism influences employee performance and creative performance via career commitment as a serial mediator, as well as providing new insights into career optimism antecedents. It offers guidance to those who want to focus on career development and other types of performance in their organization. Furthermore, this study discusses the implications and future recommendations.

AUJoGR-24223

A Multifoci Approach to Study Team and Leader Member Exchange Relationships and Their Multifoci Outcomes

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Abstract

The present study searches out the potential effects on commitment incorporating social exchange theory. The literature in this vein, suggested that individual can have distinct social exchange with various partners, thus this distinctive exchange allows subordinates to maintain separate relationship with separate entities (organization/ supervisor/peers) and these relationships have unique outcomes. Following social exchange typology, this study engross the target similarity model to put forth the social exchange relationship framework by incorporating the foci specific social exchange, an exchange relationship a focal person develops with his or her organization, team members and supervisors. Grounded on social exchange theory, this study elucidates multifoci aspect of social exchange relationships and their outcomes. Thus, a theoretical framework is proposed modeled on the target similarity effect to fill the leaking bucket where an individual can develop and maintain a distinct relationship with different foci in organization and show commitment to the respective foci. Hence by doing so, the current study focuses on the importance of multifoci exchange relationships and their multifoci outcomes by addressing the significance of foci specific relationship through target similarity effect, which shows that leader member exchange and team member exchange allows individuals and team members to show commitment to their respective foci and involve in voice behavior accordingly. Hypotheses were tested using SPSS Process Macro for testing mediation. The sample consisted of 270 faculty members working in Private and Public universities of Islamabad and Rawalpindi. The hypothesized mediation model for the current study was supported. Few studies have explored the multifoci model incorporating mediating mechanism showing relationship between multifoci social exchange relationship and multifoci commitment through target-specific voice. Envisaged on social exchange theory and using target similarity model the current study broadens the research on multifoci social exchange relationship and multifoci commitment in the presence of target sensitive voice.

AUJoGR-24224

Determinants of Food Waste Reduction Behavior: Psychological and Social Media Marketing Perspectives of Young Consumers

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Abstract

The global population is expected to reach 800 million by 2024 and 1120 million by 2100. With this high population growth, the world is facing the challenges of more urbanization and waste. The major sources of waste in cities are consumers (like home, hotels, and restaurants), besides others. The UN has declared seventeen Sustainable Development Goals that will be achieved by 2030 for all developed and developing countries, and Goal 12.3 focuses on a 50% reduction in per capita food waste by 2030. Almost one-third of all food produced globally for human consumption is thrown out (1.3 billion tonnes per year) as well as ends up costing nearly $750 billion annually. There is a worldwide discussion on ways to decrease food waste in order to develop a more sustainable society.

Consumer FW in safe to eat, consumable form is a big concern with social, environmental, and economic ramifications (Lazell, 2016). Food waste pollutes the environment and causes greenhouse effects. Consumers' contribution is crucial to successful waste reduction, e.g. plastic and food (Khan, Ahmed, & Najmi, 2019; Russell, Young, Unsworth, & Robinson, 2017). Consumers' role in food waste is crucial and there is a need for a thorough understanding of the factors that shape consumers' perceptions and behavior about food waste (Aschemann-Witzel, Hooge, Amani, Bech-Larsen, & Oostindjer, 2015). A large part of food is squandered at last place of the FSC, like the food service sector (restaurants and hotels). However, limited restaurants were considering FW reduction and recycling, (Cuglin, Petljak, & Naletina, 2017). Getting a broader understanding of consumer FW behavior in restaurants might assist to reduce the main cause of FW (Coskun & Özbük, 2020). The consumer food waste behavior study aims to look into the causes of behavior since little detail was found in restaurants (Coskun & Özbük, 2020). Recently, though, there has been some interest in the food service business (Papargyropoulou et al., 2019; Huang & Tseng, 2020), but their main focus was on quantifying the waste Therefore, studies on the behavior of consumers to reduce food waste are still limited. This study used a quantitative approach by using convenience sampling, a survey questionnaire for data collection from Rawalpindi and Islamabad based on adapted items related to IVs and DVs, and used PLS-SEM for model analysis. The results of the study confirmed all the hypotheses used in the model. The suggested model's most important features were the social dimension (i.e., social norms), the cognitive dimension (i.e., awareness of consequences and environmental knowledge), and the emotional dimension (i.e., anticipated positive emotion), habitual factors, facilitating conditions, and social media marketing activities, which, when combined, shape young consumers' waste reduction behaviors at restaurants.

AUJoGR-24225

Tourist engagement and destination loyalty formation: The experiential perspective

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Abstract

The study proposed and tested a model, underpinned by the service dominant (SD) logic that depict value creation mechanism for tourists and its impact on destination loyalty. Specifically, the study investigated the importance of destination related factors (experience authenticity and experience quality) and tourist related factors (experience co-creation and tourist engagement) in creation of experiential value. The study also investigated the role of tourist engagement and experiential value in destination loyalty formation. The Researcher followed survey method and collected onsite data, using structured questionnaires, from 650 tourists visiting two districts (Swat and Chitral) of Khyber-Pakhtunkhwa province of Pakistan. Data were analyzed using partial least square (PLS) structural equation modeling (SEM) techniques. Results revealed significant positive impact of experience authenticity and experience co-creation on tourist engagement and experiential value. Experience quality significantly and positively affect experiential value, but its impact on tourist engagement was insignificant. Tourist engagement mediate the relationship of experience authenticity and experience co-creation with experiential value, but no mediation effect of tourist engagement between experience quality and experiential value was found. The impact of tourist engagement and experiential value on destination loyalty was positive and significant. Experiential value mediates the relationship between tourist engagement and destination loyalty. The study validated the importance of experience authenticity and experience co- creation as two critical elements of destination experience. thus contributes to the application of experiential marketing in tourism. The study also confirmed tourist engagement as central element for the value creation and loyalty formation, thus confirmed the importance of tourists' involvement in experience for the successful marketing of tourism destinations. A theoretical network was validated connecting destination experience, tourist engagement, experiential value and destination loyalty which can be characterized as the "Experience - Engagement -Value

- Behavior (XEVB) " logic chainmers' waste reduction behaviors at restaurants.

AUJoGR-24226

Assessing the Determinants of Banking Efficiency: Empirical Evidence from Pakistan

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Abstract

This study focuses on the Pakistani bank's efficiency measurement and its determinants over the period 2009 to 2019. The study adopts the non-parametric estimation technique based on the output-oriented CCR model through DEA to measure banks' technical, super, and overall efficiency scores and the GMM model to estimate overall efficiency determinates. The results revealed that the four banks CITI Bank NA Pakistan, Habib Metropolitan Bank Ltd, Industrial Development Bank Ltd, and MCB Bank Ltd, outperform all other DMUs in the ranking of technical efficiency score. These banks are set as the benchmark for the other DMUs. The results of average super efficiency and average overall efficiency score revealed that Industrial Development Bank Ltd outperforms all other DMUs, followed by CITI Bank NA Pakistan, which got 2nd rank, MCB Bank Ltd got 3rd. In essence Silk Bank Pakistan got the least rank and is considered the worst performer concerning average technical, super and overall efficiency scores. Among the overall efficiency score of Islamic banks, Meezan Bank Ltd outperforms the other DMUs while in essence, the Al Baraka Bank Ltd is considered the worst performer DMU. The results conclude that Conventional banks have more average overall efficiency than Islamic Banks in Pakistan. So, the DMUs having an efficiency score of less than 1 should follow the efficient utilization of resources as the benchmarked banks are utilizing to increase the overall efficiency. From the results of GMM, it is concluded that the bank-specific determinants that have a significant negative effect on overall efficiency in the case of Pakistan are leverage; however, solvency and ROA have a significant positive impact. Among the country-specific variables, GDP has a positive impact, while interest rate and regulatory quality have a significant negative effect on the overall efficiency of banks in Pakistan. This study will provide a guide for researchers and academicians to conduct research on Super efficiency. The findings of this study have important policy implications for regulators, bank managers, and investors in the process of their decision-making. Stakeholders can also take advantage from the result of this study. This study evaluates and compares different efficiencies (like technical, super, and overall) of banks, where super efficiency is first time calculated in the context of Pakistan based on a maximum of five input and output factors that gave more reliable estimates. Then based on technical and super efficiency, overall efficiency is calculated, and its internal and external determinants are evaluated for the first time in the context of Pakistani banks by utilizing the largest available data from 2009-2019.

AUJoGR-24227

The Cognito-Emotional perspective of Adaptive Performance using PsyCap: A Moderated Mediation Mechanism based on Broaden and Built Theory

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Abstract

The organizations always operate in challenging and unpredictable work environments. The expected uncertainty necessitates these organizations to acquire, develop, and retain a flexible and adaptable workforce that thrives in constantly changing business environment. The outbreak of Covid-19 pandemic significantly intensified the necessity of adaptable workforce adaptability for healthcare organizations. The healthcare professionals needed significant psychological resources, emotional stability, and cognitive capabilities to maintain their performance levels with respect to emergency and stressful cases during CoVID-19. Unfortunately, existing research largely ignored the role of psychological resources, emotional states, and cognitive capacities that could facilitate healthcare professionals in maintain an adequate level of performance according to the

challenging COVID-19 situations. This study has addressed this gap in existing research on adaptive performance from multiple perspectives. This study investigated a mechanism through which compassion, which is a positive emotion, affects adaptive performance of healthcare professionals through their creative cognition. In this line of inquiry I argue that health care professionals' adaptive performance in uncertain and challenging situations is based on their compassion that is highly subjective in nature and heavily depends on creative cognitive capabilities. In simple, creative cognition strengthens the positive relationship between compassion and adaptive performance of healthcare professionals. Psychological capital is one of the most critical positive personality traits which help individuals thrive in complex situations. Hence, I also tested if the relationship between compassion and adaptive performance is moderated by a personality factor i.e., psychological capital and its sub-dimensions. This study has also tested a moderated mediation mechanism explaining if the mediating role of creative cognitive between compassion and adaptive performance differs across different levels of psychological capital. Overall, this study has highlighted how different emotional, cognitive and personality attributes interact and facilitate healthcare professionals for maintaining a desired level of adaptive performance in stressful and challenging work settings. This study is quantitative in nature. The study used a cross-sectional survey to test the proposed research model of the study. The data were collected based on a non-random purposive sample of 431 respondents from healthcare professionals. The healthcare professionals participating in this study were serving in primary and secondary healthcare public sector hospitals. The response rate was 71% response rate. I tested basic assumptions of the data in SPSS (Statistical Package for the Social Sciences). However, I used covariance-based structural equation modelling with AMOS for convergent and discriminant validity of the measures used in the study. Further, SPSS process macro (Model1, Model 4, and Model 14) developed by Hayes was used to test different hypotheses of the study. The statistical results of the study revealed that compassion has a significant and positive relationship with creative cognition and adaptive performance. The results also revealed that creative cognition significantly mediated the positive relationship of compassion and adaptive performance. Furthermore, the results also revealed that the indirect effect of compassion on adaptive performance through creative cognition was significant and varied across all three levels of psychological capital. This study offers its original contributions to the existing literature on adaptive performance in several ways. For instance, this study is unique in its nature and confirmed the role of compassion in creative cognition and adaptive performance. Similarly, this study also tested the moderation mechanism explaining how psychological capital and its sub-dimensions moderate the role of compassion in creative cognition and adaptive performance as well as the role of creative cognition in adaptive performance. This study also confirmed these hypotheses in unique healthcare settings in Pakistan which is one of the most populated countries with collectivist culture. The study also offers its unique contribution to the existing literature on adaptive performance by testing a mediation mechanism that explains how the mediating role of creative cognition is between compassion and adaptive performance. Differs across different levels of psychological capital.

AUJoGR-24301

India's Growing Influence in the South Asian Region: Ramifications for Pakistan

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Abstract

The study delves into the multifaceted implications of India's burgeoning economic, political, and military influence in South Asia, with a particular focus on its effects on Pakistan and the broader regional dynamics. Rooted in the neoclassical realist framework, the research investigates the intricate interplay of internal and external factors that underpin India's ascension as a regional power and the ensuing ramifications. India's rise as a regional powerhouse is propelled by a confluence of domestic drivers, including robust economic growth, technological advancements, the projection of soft power, military capabilities, and its demographic dividend. Simultaneously, global shifts, most notably China's ascent and its ambitious Belt and

Road Initiative, have further magnified India's strategic significance on the world stage. The thesis emphasizes that India's expanding sphere of influence has substantial repercussions on neighbouring South Asian nations. This influence is manifested through opportunities generated by trade and investment, yet it also harbors concerns of economic dependence and potential exploitation. Within India, domestic politics and leadership transitions wield a profound impact on shaping the country's foreign policy, especially in its regional context. The research underscores the enduring security dilemma between India and Pakistan, which is exacerbated by historical conflicts and persistent concerns surrounding cross-border terrorism. Central to the analysis is the concept of the security dilemma, a core tenet of neoclassical realism, highlighting the potential for regional instability due to competitive arms races. India's external relationships, including its alliances with the United States and ongoing tensions with China, further exert influence on its regional role. The study unveils India's efforts to strike a delicate balance in its relationships with major powers such as Russia and Iran to preserve strategic autonomy. The research underscores that Pakistan's reaction to India's ascent is a complex interplay of domestic considerations, regional anxieties, and international constraints. Methodologically, this study predominantly adopts a qualitative research approach, drawing from an array of sources including academic literature, government reports, news articles, interviews, and document analysis. Employing an explanatory and descriptive research design, it leverages both primary and secondary data sources to comprehensively dissect India's expanding influence in South Asia. The significance of this research lies in its contribution to enhancing our comprehension of regional dynamics within South Asia. It sheds light on the causes and consequences of India's ascent and meticulously assesses its impact on regional stability, security, and the well-being of neighbouring nations. Ultimately, this study offers valuable insights and policy recommendations for decision-makers in India, Pakistan, and the broader region, aiding in the pursuit of stability, security, and cooperation in the complex milieu of South Asia.

AUJoGR-24302

Threats from Climate Change in Pakistan and Implications for Military Security

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Abstract

Climate change and its manifestations have grown in frequency and severity without a substantive policy shift to address it meaningfully or understand all its dimensions. The security focus in Pakistan has been traditional and military specific but has failed to incorporate emerging threats that may implicate the military. While climate change threats are explored for some security sectors Pakistan, other ones are neglected. This has led to serious sector specific threats and consequences to go unidentified such as the impact on military. Thus, the thesis has explored the linkage between climate change and military security of Pakistan through its hypothesis that climate change being a multisectoral threat has emerged as an existential challenge with serious consequences for Pakistan's military security. Through descriptive research, a deductive approach, use of quantitative and qualitative data, and primary and secondary sources, the linkage between the independent and dependent variable is studied; guided by the theoretical framework of Comprehensive Security and Environmental Security. The thesis has found that the climate change profile of Pakistan and resulting impacts have translated into multisectoral threats; economic, political, and societal. Resultantly, given the understanding of the environmental security theory, and as demonstrated via the case studies, intrastate conflict risk is heightened which negatively impacts military security. More directly, climate change threatens Pakistan's military by impacting operational readiness and force capacity, especially in strategically significant areas; Siachen, Sindh, and Punjab. The primary risks arise from severe flooding, sea level rise, cyclones, intense and recurrent warming patterns, and glacial melting. The increasing severity and frequency of extreme climate events damage military infrastructure, disrupt logistics, hinder troop movements and lead to force dilution due to extensive reliance on military for disaster relief which diverts it from its primary function of defending the state against adversarial actors. Military security is also impacted by exacerbation of interstate conflict risk through effect of climate change on the Sir Creek dispute. Weakened military security can be exploited by adversarial actors and provides incentive for them to take aggressive postures which further heightens conflict risk and cyclically threatens the military. A

joint services climate security risk assessment and subsequently a joint services climate security strategy is recommended to be conducted and produced, respectively, by the Ministry of Defence.

AUJoGR-24303

Militarization of Artificial Intelligence and the Future of Warfare: Implications for South Asian Strategic Stability

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Abstract

Artificial Intelligence (AI) is a revolutionary technology, and has already transformed society in various ways. Although current advancements in AI have largely been focused on the civilian sector, AI has tremendous transformative potential in the military domain as well. Major states have already begun the process of integrating AI for various military applications, such as decision-making systems, Lethal Autonomous Weapon Systems (LAWS), and autonomous defence systems. The US and China have both invested heavily in the militarization of AI, and significantly lead other states in terms of the research, development and deployment of AI systems within their respective militaries. The current global trend indicates that all states will eventually head towards the militarization of AI. This will impact the future of warfare tremendously. Future warfare will likely have a different character, greater speed, greater risk of escalation, and will be much more complex than modern warfare. One region which will be affected tremendously by AI is South Asia. The already volatile strategic stability between India and Pakistan will be stressed even further due to the militarization of AI. This study examines the current militarization of AI within the US, China, India, Pakistan and other major states. It predicts that the military adoption of AI would have a significant impact on the future of warfare and a number of implications for South Asian strategic stability. It also suggests that if Pakistan hopes to maintain strategic parity with India, it must increase its focus on AI and ultimately head towards the militarization of AI.

AUJoGR-24304

Militarization of the Indian Ocean Region through Maritime Silk Road Initiative and Indian Counter Measures

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Abstract

The presence of China in the maritime region is increasing with the launch of the Belt and Road Initiative (BRI) especially the Maritime Silk Road Initiative (MSRI). This increasing presence is worrisome for China's strategic rival, India. This study examines the militarization of the Indian Ocean Region through the Chinese MSRI and corresponding Indian countermeasures. It will analyse the political, economic, and regional implications of China's MSRI in an effort to understand its potential impact on regional stability, global trade, and geopolitical rivalries. Additionally, this thesis will evaluate India's response to China's increasing presence in the Indian Ocean region, both diplomatically and militarily. By exploring the various aspects of militarization in the Indian Ocean region, this thesis will provide a comprehensive understanding of how Chinese investment and influence have altered dynamics among countries in this maritime space under the lens of the Sea Power Theory by Alfred Thayer Mahan. Furthermore, it will investigate how India has reacted to this changing situation and whether such responses are effective enough to contain Chinese expansionism in an increasingly contested oceanic environment. Ultimately, this thesis aims to demonstrate that while Chinese investment in MSRI might lead to increased militarization in certain areas of the Indian Ocean region, India's strategic countermeasures are strong enough to ensure that it can maintain control over its own territorial waters as well as protect itself from any potential threats posed by China in the future. This qualitative research will explore above mentioned aspects using exploratory and descriptive methods using official reports and documents and researches conducted by analysts and scholars as primary source as well as books, news articles and journal articles as a secondary source. Semi-structured interviews have also been conducted with few experts for verification of hypothesis.

AUJoGR-24305

The Taliban Takeover of Afghanistan: Its Implications for the Region and Policy Options for Pakistan

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Abstract

Afghanistan is a geographically landlocked country situated in Asia, characterized by its multicultural composition. Throughout history, foreign entities have consistently sought to establish their dominance due to the advantageous geo-strategic location. Internal power struggles, foreign involvement, and tribal feuds have plagued Afghanistan for years. Four decades of instability in Afghanistan make long-term peace challenging to achieve. Multi-ethnic culture and the absence of a social covenant between stakeholders and the government make the state difficult to establish permanent peace, resulting in turmoil, uncertainty, humanitarian crises, and a weak state where powerful groups always dominate. Transnational terrorist organisations, proxy warfare, and international rivalry have been the distinguishing characteristics of the region. This study has been conducted to find answers to (a) how a paradigm shift after 2021 in Afghanistan would impact the regional security? (b) how Taliban takeover of Afghanistan would impact Pakistan's security? (c) what are the policy options available to Pakistan to deal with Taliban regime? The study is qualitative in nature. A descriptive and predictive approach to data analysis has been used. This research used theoretical perspectives of System Theory and Regional Security Complex Theory to examine the behavior, structure and organization of Taliban Regime and its implications on the region. The findings of research indicate that Taliban regime seems performing better than previous governments in many aspects. Taliban cannot succeed in isolation, their success could depend on outside support and acceptance at regional and international level. Regional support is curial to avoid any future arm conflict. Peaceful endeavors from China, Iran and Pakistan are very important. Pakistan should re-appraise its policy in relation to emerging dynamics in Afghanistan where Taliban are in full control of the Afghanistan's affairs. The fundamental tenets of non-interference and respect should serve as the defining characteristics of all political and diplomatic interactions with Afghanistan.

AUJoGR-24306

Implications of New Missile Technologies on South Asian Strategic Stability

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Abstract

South Asian strategic environment is characterized by the United States-China competition at the global level and its implications for the region and by the bilateral relations between India and Pakistan at the regional level. The relationship is marked by a history of animosities since its inception, four wars, political rivalry, the presence of nuclear weapons, Indian strategic partnership with the United States, Indian military modernization, development of advanced missile technologies, absence of any arms control framework and lack of trust between them. Both countries have extensive missile development programs involving a range of ballistic and cruise missile systems having diverse ranges, speeds and payload capacities. The introduction of missile technologies by India in the region has complicated the already stressed security environment of South Asia as India can use these technologies against Pakistan in a number of scenarios that can derail the strategic stability of the region. These missile technologies introduce complications such as enabling the state to carry out a preemptive strike on the other below the nuclear threshold, limiting time for the other state for decision-making, escalation in the event of any crisis and ambiguity in terms of target and payload add further layers of complexity. The thesis has discussed all these aspects in detail and through multiple scenarios elaborated that the development of missile technologies by India is derailing the strategic stability of South Asia. The Thesis used a qualitative research design with Structural Realism as a theoretical framework to delve deeper into the subject. The thesis concludes with recommendations and presented a way forward which explicates that the level of threat that can be reduced by taking a number of measures in terms of arms control, restoration of bilateral ties and support from the international community for the normalization of relations, as stability in South Asia is of paramount importance for the stability at the regional and global level.

AUJoGR-24601

Wearable Antenna Systems for 5G IoT Application

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Abstract

Body-centric wireless communication has been gaining significant attention in recent years, particularly with the rise of wearable technology. Body-centric wireless communication has become an indispensable part of future communication systems

because it deals with on-body and off-body radiations for 5G IOT applications. The emergence of 5G networks has the potential to further advance this technology and enable more advanced applications. 5G networks offer higher data transfer rates, lower latency, and greater capacity, which can enable more seamless integration of various devices and sensors and enable the creation of more advanced and personalized health and wellness solutions. Wearable antennas for wireless communication have become an interesting area of research. Our research focuses on a Wearable Antenna for 5G IOT applications having multiple layers and a flexible structure. Our proposed wearable antenna is made on jeans having relative permeability of 1.66 and thickness of 1 mm. It operates at the frequency of 3.8 GHz which results in higher bandwidth as well as increased signal strength ultimately making it suitable for future IOT applications. The performance parameters of our proposed antenna have been analyzed in proximity of human body. Our proposed antenna shows directional radiation pattern as well as omnidirectional radiation pattern which improves signal coverage and accuracy. Our proposed antenna is able to give different radiation patterns for different conditions i.e directional radiation pattern for off body communication and omnidirectional radiation pattern for on body communication. As our proposed antenna is a micro strip patch antenna, therefore it requires certain design and simulation constraints. High Frequency Structure Simulator (HFSS) software has been used to do simulation and design our proposed multi-layer wearable antenna. Our proposed antenna shows numerous advantages some of which are; lightweight, flexibility, low cost, low profile, easy integration, high performance etc. Our proposed antenna has numerous applications in different fields such as medical care, military, tracking, sports etc. our proposed multi-layer flexible antenna has all the potential to be used as the best candidate for future IOT applications and 5G communication system.

AUJoGR-24602

Reflect Array Intelligent Metasurfaces for Non-LOS Indoor Communication

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Abstract

In this communication we present a transmit-reflect array (TRA) antenna that utilizes a bidirectional beam approach, through the sparse array method. The proposed element consists of a three layer ring patch (HRP) structure, which enables both amplitude (0 or 1) and phase modulation. Using this element structure as the foundation, we fabricate a TRA with a shape measuring 125 mm × 125 mm. To achieve feeding we utilize a horn antenna resulting in two distinct beams on either side of the TRA. These beams are directed towards angles $\theta = 0^\circ$ and 170° ($\phi = 0^\circ$). When measured we observe that the transmitted beam achieves a gain of 21.4 dBi with a gain of 6.7% while the reflected beam achieves a maximum gain of 24.4 dBi, with a gain bandwidth of 9.3%. Notably this marks the instance where the sparse array method is employed in fed antenna design. The method being proposed offers a way to control the directions in which beams are pointed and the characteristics of their beam patterns. This makes it a promising option, for wireless communication applications.

AUJoGR-24603

Vitality Detection through Radar based Technique

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Abstract

The research of this thesis is based on SAR imaging using FMCW Radar. FMCW is a radar system that operates by emitting a CW signal whose frequency varies linearly over time. This technology is commonly employed in remote sensing and target detection applications. Recently, there has been growing interest in utilizing FMCW SAR for human detection, particularly by analyzing breath patterns. The process involves transmitting the modulated signal towards the target area and capturing the reflections. By analyzing the time delay between the transmitted and received signals, the system can ascertain the distance to the objects, known as range information. Humans breathe, causing subtle variations in the distance between the radar and the person's chest. These variations can be discerned in the range of information. Through sophisticated signal processing techniques like the FFT, the breathing pattern is isolated and analyzed. This pattern recognition step allows the system to identify specific breathing patterns associated with humans. The information is then visualized using SAR imaging, enabling the detection of human presence. While this concept holds promise for scenarios requiring non-contact human detection, such as in search and rescue or security applications.

AUJoGR-24604

Detection of Signals with Unknown Delay in TDD Systems for 5G and Beyond

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Abstract

In recent years, wireless communication has drawn a lot of interest since it offers a seamless and effective method of doing so. In this research, leveraging 5G and beyond technologies, we suggest a novel CNN-based method for establishing wireless communication with unpredictable delay in TDD systems. Our suggested method uses convolutional neural networks (CNNs) to wireless communication in the presence of additive white Gaussian noise (AWGN) channel, taking advantage of their effectiveness in learning and extracting features from raw input. First of all, a sequence of bits transmitted to the receiver over a channel and the channel add Noise and unknown Delay into the Input. Next, we develop a CNN-based receiver that tackles with delay and decode the information and produce estimate symbol which closely resembles the original symbol. Our proposed method overcomes the challenge of unknown delay in TDD systems, which developed because of wireless communication routes are dynamic. The performance of our proposed method is evaluated using extensive sets of simulations in AWGN channel. The simulation results show that our proposed method outperforms existing techniques at low Signal to Noise ratio (SNR) as well as in high Signal to Noise ratio (SNR) in terms of bit error rate (BER) and Binary cross entropy loss. In numerous real-world applications, including wireless communications, the Internet of Things (IoT), and autonomous vehicles, our suggested solution has the potential to dramatically increase the reliability and performance of TDD systems. It can also open the door for further study in this area.

AUJoGR-24605

Designing of Highly Efficient RGB/CMY Multi-layer Color Filter for Spectral Filtering Applications

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Abstract

With the benefit of being simple to integrate into any optical system, multi-layer thin film filters offer a wide range of potential in optical applications. The thesis aims at the development of multi-layer thin film color filters based on metal-dielectric-metal-dielectric layers (MDMD) and all dielectric material layers (AD) configurations. In general, multi-layer color filters consist of sequence of single layers, which are composed of different materials. These materials can have different thicknesses in nanometer scale. In this thesis, a multi-layer trans-reflective filter based on metal-dielectric-metal-dielectric layer and a multi-layer reflective filter based on all dielectric (AD) materials configurations is presented. The major function of these multi-layer color filters provide optimum response in terms of colors needed for different applications such as color display industry, contrast enhancement and imaging, in biomedical sector where they are used in medical equipment for diagnostics of various diseases. In order to meet the needs of a precise filter design, this thesis proposes the design of algorithms that can determine the optimal thickness of filter layer deposition with an accuracy of approximately 0.01. In order to forecast deposition rate or material layer thickness and its likelihood of success, this thesis develops an optimized method for creating multi-layer optical thin film filter with extremely pure colors. The proposed scheme performs better than the conventional random selection of material layer thickness that employed and the hit-and-trial method of determining material layer thickness. In comparison to earlier studies, the color purity test results for all three of the implemented filter designs exhibited better results.

AUJoGR-24606

Digital Signals Generation and Detection with Artificial Neural Network

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Abstract

This thesis provides deep insights into the application of CNNs in an end- to-end wireless communication system. The objective of our research is to compare the effectiveness of our system with traditional methods. The re- search design used a computational approach, and the Python programming language was used to implement the code. Random integers used to repre-

sent transmitted symbols were used to create synthetic communication data, which was subsequently one-hot encoded. A dataset with different com- munication and neural network settings was used to train the CNN model. Noise and channel distortions were successfully reduced by the CNN model, leading to increased communication dependability and quality. The model's robustness was further increased by its capacity to adjust to changing SNR situations. According to the results, it can be said that including CNNs in an end-to-end wireless communication system has many benefits. Utilizing CNNs improves system performance by enabling effective signal processing, noise reduction, and error correction. In conclusion, we are proposing an end-to-end wireless communication system using convolutional layers at both ends while using AWGN and Nakagami Fading as channel model.

AUJoGR-24607

Efficiency Optimization of Low Energy Bandgap Photovoltaic Cell by Solar Thermophotovoltaic Systems

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Abstract

Solar energy is an excellent source of renewable energy which is clean and environment friendly. It is a feasible alternative to the energy which is harvested from fossil fuels. Solar energy can be harvested by using thermal collectors and Photovoltaic (PV) cells. However the efficiency of single junction PV cell is still low and is limited by Shockley-Queisser limit which places an upper bound to the efficiency of single junction PV cell. Solar thermophotovoltaic (STPV) system is an attractive solution to overcome Shockley-Queisser limit. The performance of STPV system is dependent upon the design of solar absorber and thermal emitter. The absorber and the emitter should be thermally stable, polarization angle insensitive and as well as incidence angle insensitive. This research presents a broadband solar absorber made up of titanium carbide (TiC) and a platinum (Pt) based thermal emitter. Both the materials used in the design are reasonable candidate to use in STPV system because they have high melting points making them thermally stable. The absorber possesses pyramid shape as its top layer while the emitter has gratings on its top. Both components have Metal Insulator Metal (MIM) configuration which simplifies their design. The STPV system is optimized for lead sulphide based quantum dot PV cell which has a low energy bandgap of 0.41 eV. Quantum dot PV cell is an emerging technology which has several benefits over conventional PV cells like mass saving, area saving, low production cost etc. the absorber proposed in the design achieves an efficiency of 96% for broadband solar spectrum with high absorptance. The designed emitter achieves a PV cell efficiency of 35.2% for lead sulphide based quantum dot PV cell at the temperature of 1350 Kelvins.

AUJoGR-24608

Demand Response Management of grid connected Nano grid using Data Driven Algorithms

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Abstract

This dissertation examines how renewable e resources (RERs) can be included into current p systems in order to satisfy the demand for c affordable, and dependable electricity. The use of has drawn more attention in recent decades, extensive research has been conducted to deter how best to integrate them into the elec infrastructure in order to maximize their ben Managing demand response (DR), which e adjusting the burden to match the availability of R is one of the most difficult aspects of integrating R This thesis proposes a demand response optimiz technique based on real-time prices (RTP) for win solar-powered DC residences. The proposed str utilizes machine learning techniques incl Decision Tree Regressors, Random Forest, and L Regression on a multi-source, renewable e sources inclusive dataset to maximize profit via shifting. A novel approach to tune the hyperparam of machine learning algorithms with AntLion opti is used in this research to enhance their efficacy study compares the proposed RTP-based dyn pricing technique to conventional fixed pr strategies in order to determine its effectiveness simulation results indicate that the proposed m outperforms conventional fixed pricing strategies conclusion of the study compares how well implemented machine learning strategies perfor determine the most accurate model for de

response management. The findings of this study have important ramifications for the development of sustainable and efficient energy systems, and the proposed methodology offers potential for future research in the field of demand response optimization strategies.

AUJoGR-24501

Determining the Effect of Music on Mental Concentration Level using fNIRS-BCI

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Abstract

Listening to music is considered as a strong brain stimulant because it can stimulate numerous different brain networks. Different types and genres of music might affect a person's brain in various ways. The main objective of this study is to investigate the effect of music on brain concentration levels using fNIRS-BCI. To do so a cognitive test Sustained Attention to Response Task (SART) was selected to be performed. Instrumental music was selected for this study to be played while performing the test. Signals were acquired from the Prefrontal-cortex of twenty-one subjects. The results of the SART test and brain signals were being recorded simultaneously for both cases music and non-music to be compared later to check ones concentration levels. The results showed thirteen subjects showing increased concentration with music showing increased reaction time (RT) and high accuracy in case of SART test results and increased activation in $\Delta c\mathrm{HbO}(t)$ across all twenty channels for all subjects and even increased brain activation as per brain activation maps while the rest eight showed decreased concentration with music. Both the results were compared with each other for output validation and a p-value of less than 0.05 between both datasets for each subject shows the correctness of the datasets. This study successfully shows that brain concentration levels are increased while listening to music than without music.

AUJoGR-24502

Model Validation and Dynamic Responses Verification of Lower Limb Rehabilitation Exoskeleton using Simscape™

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Abstract

With the passage of time, there have been new advancements in modeling and simulation tools/ platforms that are based on different modeling techniques. These tools provide flexible, user-friendly scientific environment to researchers and enable them to analyze complex interdisciplinary systems efficiently. At the same time, the mathematical model obtained using one type of modeling technique should be similar to the one obtained using other modeling techniques. Simulation tools provide a better environment to model the system. These tools can therefore be employed to validate an existing system which is regarded as model validation. Moreover, the dynamic responses can be verified. In this research work, model validation and responses verification of an active three degrees of freedom lower limb rehabilitation exoskeleton (LLRE) is carried out. Firstly, the exoskeleton is modeled using the conventional modeling technique and bond graph. After that the system is modelled using MATLAB® Simscape™ which provides platform for modeling and simulation of complex physical systems, design optimization and performance analysis. It also helps in reduction of the cost of physical prototypes. Hence is used to validate the existing models very effectively. Secondly, the dynamic step, impulse and sinusoidal responses of different models are compared for verification. Comparative analysis has been carried out using certain performance parameters which include rise time, peak time and settling time. In this way, Simscape™ is used to validate and verify the dynamic responses of existing LLRE models. Also, through Simscape™ a physical model of the LLRE is obtained which is more effective in implementation of control strategies upon physical hardware. Future work includes comparison and verification of dynamic responses with actual hardware. It will further help in hardware implementation of different control strategies.

AUJoGR-24503

NON-Intrusive Load Monitoring for Energy Management Systems

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Abstract

Non-Intrusive Load Monitoring is gaining popularity due to its potential advantages. An efficient NILM algorithm allows to monitor and manage the energy consumption for the Energy Management System (EMS) at smart grid level. Energy management comprises of planning and operation of energy production and energy consumption. Objectives of energy management are resource conservancy, environment protection, capital saving, energy security and demand-side load management. Energy management requires accounting of energy consumption and Non-Intrusive Load Monitoring (NILM) may serve as an important tool for it. NILM is the process of disaggregation of energy consumption from total energy measured and recorded by a central smart energy meter. However good accuracy in complex systems, computational efficiency, system generalization, security and user's privacy are still the areas having problems whose solution is missing. This research proposes three novel NILM techniques to disaggregate the energy usage of multiple appliances accurately enough while taking a step further towards generalization, so that minimum training and user's input is required for NILM to perform. In the first phase, two novel techniques: the spectral cluster mean (SC-M) and spectral cluster eigenvector (SC-EV) methods are proposed. These methods use spectral clustering for extracting individual appliance energy usage from the aggregate energy profile of the building. In the second phase, combination of two earlier proposed strategies is proposed using voting-based consensus clustering in a way to achieve the benefits of both parent strategies. The voters in the consensus are taken to be the accuracies achieved using Spectral Cluster-Mean (SC-M) and Spectral Cluster-Eigen Vector (SC-EV) with different window sizes to achieve diversity. An ideal dataset, real-world REFIT and Ampds datasets are used to test the performance of these techniques. Performance of proposed techniques demonstrate that these techniques are competitive and viable, with advantages of low complexity, high accuracy, no training data requirement, and fast processing time. Henceforth, proposed techniques are suitable candidates for NILM and may open further avenues of research in this direction.

AUJoGR-24504

Implementing fNIRS-BCI based Control of Exo-Ankle for Gait Rehabilitation

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Abstract

The ability to move freely is crucial for a standard quality of life. In old age or due to accidents, natural disasters, and conditions such as strokes, individuals may experience a loss of efficient mobility. An imbalance in the ankle can result in compromised walking gait patterns. This thesis explores the feasibility of using functional near-infrared spectroscopy (fNIRS) to control an exoskeleton for ankle assistance. This research involves the development of a novel fNIRS-based control system that could detect changes in the hemodynamic response of the brain associated with ankle movements. The assessment involve testing six distinct statistical features and their combinations using four different classifiers, including linear discriminant analysis (LDA), quadratic discriminant analysis (QDA), support vector machine (SVM), and k-nearest neighbour (kNN). The maximum accuracy of 90.4% is achieved by the kNN classifier when applied to the combination of all six features, which included mean, peak, variance, skewness, kurtosis, and slope. The value of optimal was determined for each subject to minimize overfitting. Then kNN algorithm is employed to generate distinctive control commands, which were subsequently applied to an exo-ankle by simulated online technique using overlapping windowing. This results in average of 93.3% online accuracy with the exo-ankle. The findings of this study suggest that fNIRS-based control of exoskeletons for ankle assistance is a promising avenue in the field of rehabilitation robotics.

AUJoGR-24401

Investigation of High Angle of Attack Characteristics of Blended Wing Body Configurations

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Abstract

Low aspect ratio wing-body configurations can achieve higher speeds with interesting aerodynamic characteristics at the stall and after the stall. A lot of research is put forth to study the highly turbulent area of a body at the stall or after the stall to understand

the complex flow and its effect on the air craft. One such study is the wing-rock motion of aircraft, which is coupled behavior of aerodynamic and inertial forces. Wing rocking is lateral self-excited oscillations that occur at low speeds and high angles of attack. Modern high-speed aircraft designs have been associated with this wing rock and post-stall flight operations. Moreover, this motion also has a great impact during the approach and landing phase, where the angle of attack is very high and the speed is low. Classical wind tunnel testing provides a great insight into this rocking motion but with the enhanced computing power, Computational Fluid Dynamic (CFD) approach has become a potent method to study the non-linear coupled aerodynamic characteristics of aircraft geometries. Wing rock is highly dependent on the configuration; various configurations and shapes show a different range of angle of attack, amplitude, and frequency of oscillation of wing rock motion. In this research three cases of different wing-body configurations (A-delta wing, B-delta wing with strakes, and C-doubled wing) were studied at thigh angles of attacks with 0.11 Mach No. using commercially available CFD tools. The aircraft was subjected to Free-To-Roll motion (FTR), a single degree of freedom rotation motion along the rolling axis using a User Defined Function (UDF). Static CFD analyses were carried out on all the configurations capturing a wide range of characteristics till 65° angle of attack. Similarly, transient analyses were carried out to capture the vortex flow pattern and wing rock motion of the configurations. These CFD analyses were carried out using the SST k-w turbulence model for detailed flow patterns and characteristics. For that matter, grid optimization and refinement were carried out to capture the vortex structure during the rock motion, as this motion occurs due to vortex shedding and flow interaction of the forebody with the wing body at high angles of attack. During the FTR motion analysis, the rolling motion builds up to the amplitude and frequency of the oscillatory limit cycle. The oscillatory frequency and amplitude motion for, case A (delta wing body configuration) at 40º angle of attack is around 4-degree roll oscillation with a frequency of 0.815 Hz, on rest of the angle of attack the rock motion does not appear to show stable behavior at long range of angles of attack. For case B (delta wing body with strake configuration) the rock motion appears from 40° to 50° with varying amplitude of ±12°. Whereas, for case C (double delta wing body configuration) the behavior of wing rock was not observed. Detailed roll motion is presented along with flow path lines to understand the physics contributing towards the wing rock motion at high angles of attack and its correlation with different configurations. Since the rock motion of the delta wing body with strake configuration shows a relatively better understanding of this motion, therefore analyses of the complete range of envelope are presented. The analyses confirm that a decrease in the rolling moment of inertia (lxx) increases the frequency of oscillation and vice versa. Similarly, an increase in velocity, while keeping the angle of attack and lxx constant also increases the frequency of oscillation.

AUJoGR-24402

Design, Development and Fabrication of a Multi-rotor UAV for Disaster Relief

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Abstract

Unmanned aerial vehicles (UAVs) have a diverse market nowadays ranging from toys to military use. Its global market was estimated to be 22.1 Billion USD in 2021. It is expected to reach 43.4 Billion USD by 2027 at a compound annual growth rate (CAGR) of 12.56%, which is the annualized average rate of revenue growth between two given years. Due to the limitless applications of UAVs, like geological surveys, mapping, delivering parcels, filmmaking, and surveillance and monitoring; they can be used in a range of different fields like forestry, archaeology, agriculture, industry, data collection, law enforcement, crime control, anti-terrorism, journalism, scientific research, and disaster relief. This research aims to design and fabricate a multi-rotor UAV that can carry a payload of up to 30 kg and has an endurance of up to 30 minutes. The payload and flight time are interconnected. It will be a slow-speed multi-rotor UAV with high maneuverability and hovering capability which is necessary to carry, deliver, and drop a payload at desired drop zones in areas inaccessible by land. This research aims to design and develop a multi-rotor UAV with CAD modeling for structural design and structural analysis for an optimized design. The component selection and component testing will include testing motors, propellers, controllers, etc. Ground testing and flight testing of the fabricated model may help to suggest changes for further modifications and optimizations of the design. It is an indigenous design for Pakistan as UAVs of this capacity are categorized se sensitive hence acquiring such parts is restricted Small but heavy-payload carrying UAVs are very effective for disaster relief. Pakistan lies on the junction of three tectonic plates i.e. the Eurasian, Arabian, and Indian

plates, making it very disaster-prone. In Pakistan, delays are caused in disaster relief efforts due to insufficient infrastructure which causes a lot of causalities. With a large number of people living off-road and a low road density, it is very difficult to access people trapped in a natural disaster. Areas that are accessible by land are also difficult to reach in natural disasters like earthquakes and floods. If permanent damage takes place to the infrastructure and the road networks, the affected areas become completely inaccessible by land, rendering aerial support imperative. Other important applications of multi- rotor UAVs in Pakistan include locust control, anti-terrorist applications, and disaster surveys.

AUJoGR-24403

A Study of Binary Fuel Cogeneration Power Plant Using Biomass Agricultural Residue as Alternate Fuel

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Abstract

The study was conducted to analyze the performance and economic feasibility of a binary fuel cogeneration power plant using biomass agricultural residue as an alternate fuel. A suitable binary fuel plant was selected, one that could be used to operate on both coal and biomass residue, and the performance of the plant was evaluated by comparing the efficiency of both fuels. The economic feasibility was also evaluated by analysing the fuel cost reduction achieved by using biomass residue as an alternate fuel. The performance analysis revealed that the efficiency of the power plant increased by 2% when biomass agricultural residue was used instead of coal. The increase in efficiency can be attributed to the higher calorific value of biomass residue and lower ash content, which resulted in better combustion characteristics. The use of biomass residue also resulted in lower emissions of harmful pollutants such as Sox, SOx, and particulate matter, which are major contributors to air pollution and global warming. The economic analysis revealed that the use of biomass agricultural residue as an alternate fuel resulted in a fuel cost reduction of 2 PKR/kWh compared to coal. This reduction in fuel cost was attributed to the lower cost of biomass residue compared to coal and the availability of biomass residue as a renewable and abundant source of fuel. The study concludes that the use of biomass agricultural residue as an alternate fuel in a binary fuel cogeneration power plant is a viable option, which can significantly improve the efficiency and economic feasibility of power generation. The use of biomass residue as an alternate fuel can also contribute to reducing greenhouse gas emissions and mitigating the negative impacts of fossil fuel-based power generation on the environment. Therefore, adopting biomass residue as an alternate fuel can be a sustainable solution to meet the world's growing energy demands while minimizing the negative environmental impacts of power generation.

AUJoGR-24404

Investigation of an Optimal Propulsion System and Mission Profile Design for Rocket-Scramjet Integrated Hypersonic Boost-Glide-Cruise Vehicle

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Abstract

The development of hypersonic sub-orbital vehicles (SOVs) has become a global trend, with several technologically advanced countries, including Russia, China, the USA, and India, either having already developed or currently in the process of developing such vehicles. The primary driving force behind this global trend is the quest for technological superiority and strategic advantage. Sub-Orbital Vehicles (SOVs) typically utilize rocket, ramjet, and scramjet propulsion systems during various phases of their mission profile. Two broader categories of SOVs which have been extensively researched in the recent years are Hypersonic Boost Glide Vehicles (HBGVs) and Hypersonic Cruise Vehicles (HCVs). HBGVs utilize heavy rockets to boost the vehicles (payload) to hypersonic speeds, these hypersonic vehicles then 'glide' aerodynamically on the upper atmosphere (~60 to 80 km altitude) without using any propulsion system of their own. These vehicles are typically investigated for application in a strategic role. In contrast, the HCVs are typically air-launched vehicles and they achieve desired hypersonic velocity by sequentially shifting their propulsion system from rockets to ramjet (or combined cycle engines) and finally to scramjet engines. These vehicles sustain hypersonic cruise in a relatively lower altitude range (20 to 40 km) by using hypersonic air-breathing propulsion (HAP) technology. Rocket-Based Combined Cycle (RBCC) and Turbine-Based Combined Cycle (TBCC) propulsion concepts are a few notable examples of HAP technologies utilized with these the vehicles Research and development of HCVs merit particular attention as they can be employed on a wide

variety of military roles ranging from tactical to semi-strategic. A Rocket-Scramjet Integrated (RSI) vehicle has been designed during this thesis work, with the aim to combine the advantages of HBGVs trajectory profile with low altitude operation and higher controllability of HCVs. The investigated vehicle utilizes the 'independent flow path' concept, whereby, the rocket stage acts only as a boost stage and it separates at the burn-out point (at rocket propellant exhaustion). The boosted vehicle then traverses on a pseudo-ballistic (dart) trajectory till it attains desired cruise altitude and Mach number. Subsequently, the vehicle traverses on a hypersonic cruise trajectory by utilizing scramjet propulsion system, before finally performing a dive maneuver and attempting a hypersonic impact. Based on the types of trajectories traversed by the designed HCV, its mission profile can be termed as a Boost-Dart-Cruise' profile. The final results and performance analysis of the designed hypersonic vehicle show encouraging results for its practical application. Furthermore, the applied design constraints allow the vehicle to be utilized with the existing set of SOVs available in Pakistan.

AUJoGR-24405

Investigation of Corrosion Effects on the Fatigue Life of SLM Processed SS316L

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Abstract

Selective Laser Melting (SLM) is a promising additive manufacturing (AM) technique that can produce complex and intricate structures with high precision and accuracy. Stainless steel 316L (SS316L) is a common material used in SLM due to its excellent corrosion resistance, high strength, and ductility. Recent advancements in AM technologies have resulted in a considerable rise in the utilization of AM parts in different sectors. However, the fatigue behaviour of SLM processed parts is one of the areas which attracts the attention of the many researchers due to its complex nature. The complexity of fatigue behaviour of AM processed parts comes from many factors such as the process mechanics and environmental factors to name a few. The current research is focused on understanding the effect of corrosion on the fatigue behaviour of SLM-produced SS316L parts. The objective of this research proposal is to investigate the effects of heat treatment and corrosion on the fatigue life of SLM-processed SS316L parts. The specific objectives area:

1. To evaluate the effect of heat treatment on the mechanical behaviour/performance (i.e., strength, microstructure and fatigue life of SLM processed SS316L parts).
2. To understand the corrosion mechanism in marine environment on SLM processed SS316L parts) and link it with process mechanics. Comparison with conventional processes if time permits.
3. To investigate the effect of corrosion on the fatigue life of SLM-processed SS316L parts.

The methodology for this research proposal will involve the following steps:

1. Fabrication of SLM SS316L parts at optimized process parameters from Texas A&M University, Qatar.
2. Tensile testing along with Stereo DIC of the as-built and heat-treated samples.
3. XRD of the samples to calculate residual stresses and microstructural characterization of samples using Optical Microscope.
4. Fatigue testing of the as-built and heat-treated samples will be carried out using a servo-hydraulic fatigue testing machine under different stress amplitudes and frequencies of KRL.
5. Froctographic analysis to understand the failure mechanism.
6. Exposure of SLM SS316L parts to marine atmosphere.
7. Identification of the corrosion products and mechanism through various compositional analysis.
8. Fatigue testing of the corroded samples.

This study will provide insights into the mechanical and corrosion properties of SLM-manufactured 316L stainless steel coupons. The results of this study will contribute to the understanding of the suitability of SLM for the manufacturing of 316L stainless steel parts and components. The findings of this study will also be useful in identifying the potential applications of SLM-manufactured 316L stainless steel in industries such as aerospace, automotive, and medical.

AUJoGR-24901

Opportunities and Challenges of Women Academic Leaders in Universities of Pakistan

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Abstract
Women are more than half of the total population of Pakistan and also in Islamabad the capital city of Pakistan. They played a significant role in all spheres of life. The focus of the current study was on women academic leaders in universities of Pakistan. To investigate women academic leaders three objectives were created. The objectives of this study were to pinpoint the role of women academic leaders at university level in Pakistan, to highlight opportunities for women academic leaders in universities of Pakistan and to investigate the challenges faced by women academic leaders in universities of Pakistan. To investigate these objectives, a qualitative research study using a phenomenological research design was used. The sample size for this research study is 14 study participants. 73 heads of departments and deans of universities in Islamabad made up the study's entire population. 12 women department heads and 2 women deans from universities in Islamabad provided the in-depth data for this collection the purposive sampling technique was used. These Universities of Islamabad's women academic leaders shared their personal experiences, which the researcher had gathered using a semi-structured interview technique. After data collection, this research study's data was analysed using qualitative data analysis approaches like coding and themes. The findings of this study revealed that women academic leaders in universities of Pakistan performed great role with their highest skills and abilities that they have. Although women academic leaders had some opportunities but these were limited and need more opportunities for professional development of women academic leaders. On the other hand, women academic leaders faced several challenges of social, cultural, personal and related to profession and professional development. Universities and educational institutions need to ensure that there is a supportive and equitable environment based on opportunities for women academic leaders.

AUJoGR-24902

Harnessing the Game Based Learning on Student's Engagement at Primary Level in Dera Ghazi Khan

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Abstract
The study investigated game-based learning impact on student engagement at the primary level. Four specific objectives were formulated to guide data collection and analysis, aligned with the study overall goals. The objectives of this study are, to harness the game based learning on student's engagement in science At primary Level in DGK to observe the influence of game-based-learning on student's engagement in science at primary level in DGK, to measure the effectiveness of the Game-based-learning on primary student's conceptual understanding in science in DGK, to identify the teacher's awareness towards the game based learning in Dera Ghazi Khan. A mixed-method approach was used and design of the study was quasi experiment. The study included 230 primary students and 31 primary teachers from one school. Purposive sampling was used to select the class 3, section A, which had 20 students and 13 teachers, and the sample of the study was 33. Two Checklists, 3 achievement tests, and a teacher questionnaire were utilized for data collection. The data was analyzed using thematic analysis, means and standard deviations, frequency, and percentage. The findings from both checklists revealed that students had shown an encouraging attitude towards the experiment, and game-based learning had positively influenced their learning. The mean scores for achievement Test 1, 2, and 3 were (M-8.7). (M-8.833), and (M=8.95), with low standard deviation (SD= 1.2503). (SD 1.3612) and (SD= 1.1687), respectively, revealing that game-based learning had improved the students conceptual understanding in science. Around (73%) of teachers found game-based learning effective, showing a preference for this approach. However, (20%) remained uncertain about its value, suggesting some lacked awareness of its importance, and (6.6%) believed games didn't always make a difference in teaching. The study found that game-based learning had the potential to transform primary education by increasing student engagement, knowledge, and the creation of a dynamic learning environment. Teachers had responded satisfactorily to the use of game-based learning and its effect on student engagement.

AUJoGR-24903

Digital Competence of Generation Z at the University Level

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Abstract
Generation Z is a cohort raised in the era of internet with widely available laptops, networks, smartphones and digital media. They are assumed as the most sophisticated and talented generation yet (Dolot, 2018). Pakistan is a developing country, facing

different challenges including unemployment caused by skill gaps. Gen Z is considered efficient in technology. This study assessed the digital competence of Gen Z at university level in Islamabad, Pakistan under the flag of Digital Competence Framework for learners by European Union, using the FINER criteria, invoked by Hulley et al. (2007) and validated by experts for use in Pakistan. For data collection two semi structured questionnaires were adopted from the Dig. Comp. wheel (online). The tools were used to identify the competence level in Gen Z, to investigate the gender-based differences of Gen Z in utilizing digital competency skills, to explore the prospects of Gen Z employability in social sector jobs and to measure the difference in digital competence level of Gen Z enrolled in the public and private universities of Islamabad territory. Final year students of social sciences department were the main universe and supporting universe was the faculty who has been teaching them and the potential employers where newly hired Gen Z employees are working. The research design was comprised of mixed method. The study analysis was done using SPSS for quantitative data and MAXQDA for qualitative data, Findings map evidences against the five major digital competencies and bring forth the facts for behavioral issues of Gen 2. The research strongly recommends engagement of business analysts for the job training sessions in universities and STEAM based capacity building of faculty members under the umbrella of dig comp.2 framework. The study is a valuable resource for policy makers, students, teachers and potential employers to see the digital competence of Generation Z in the universities of Pakistan.

AUJoGR-24904

Impulsivity, Sensation Seeking as A Predictor of Delinquent Behavior and Mediating Role of Emotional Neglect Among Pakistani E-Cigarette Users

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Abstract

The current study investigates the predictive role of impulsivity and sensation seeking in delinquent behavior among Pakistani e-cigarette users, while exploring the mediating influence of emotional neglect. Using a cross sectional approach, data was collected from a sample of 150 Pakistani e-cigarette using adolescents. The research employed questionnaires to gather quantitative data, including Barrats Impulsivity scale 11 (BIS-11), Brief Sensation Seeking Scale (BSSS), Emotional Neglect Scale (ENS), and Self-reported Delinquency Scale (SRDS-R) respectively. Statistical software (SPSS) was used to analyze quantitative data. The findings reveal that out of the total 150 participants, 30.7% (n=46) of the people were using e-cigarettes all the time, 24.7% (n=37) of the individuals were occasional users. 23.3% (n= 35) of users often used e-cigarettes and 21.3% (n=32) people sometimes used electronic cigarettes. A significant positive correlation between sensation seeking and delinquency (r=.22, n = 150, p <.001), however with delinquency, impulsivity had an insignificant, small positive relationship (r = .04). Moreover, emotional neglect was found to mediate the relationship between impulsivity and delinquent behavior. However, no mediation was found between sensation seeking and delinquent behavior. In conclusion, the current study provides valuable insights into the predictive role of impulsivity and sensation seeking in delinquent behavior among Pakistani e-cigarette users. The mediating role of emotional neglect highlights the complex interplay between individual characteristics and environmental factors in the context of e-cigarette use and delinquency. These findings have theoretical implications for understanding risk factors and practical implications for developing targeted interventions in Pakistan's e-cigarette user population.

AUJoGR-24905

Social Media Addiction, Appearance-Related Consciousness, and Social Physique Anxiety among Young Adults: Mediating Role of Self-Efficacy

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Abstract

The current study investigated the direct and indirect relationship of social media addiction with appearance-related consciousness and social physique anxiety through self- efficacy as a mediator among Young Adults. A cross-sectional research design was used. A convenient sample of 200 young adults who met the criteria of social media addiction were selected from different universities of Islamabad, Pakistan. Furthermore, to assess the study variables, Berger Social Media Addiction Scale (BSMAS), Appearance-

Related Social Media Consciousness (ASMC), Social Physique Anxiety Scale (SPAS), and Generalized Self Efficacy Scale (GSE) were employed. Findings revealed that the inter-correlations provided significant relationships between the study variables. Moreover, social media addiction significantly and positively predicted both appearance related consciousness and social physique anxiety. Whereas, self-efficacy negatively predicted appearance-related consciousness. Similarly, self- efficacy also significantly and negatively predicted social physique anxiety. Further mediation analysis proved that self-efficacy did not act as mediator between social media addiction, appearance-related consciousness, and social physique anxiety. Results of this study highlights how addictive use of social media can increase serious issues among today's youth. Awareness programs regarding social media use should be conducted in order to mitigate such concerns.

AUJoGR-24906

Social Networking Sites as Tool for Collaborative Learning at University Level

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Abstract

Social networking sites are online services that let users build profiles, connect with others, and engage in many types of digital communication, like texting, commenting, and posting material. This paper determine the potential of SNS as a transformative tool for enhancing collaborative learning experiences among university students. Drawing from a comprehensive review of the literature, this research highlights the challenges associated with using SNS for collaborative learning in higher education. The researcher adopted a quantitative research and descriptive study was used by targeting the public universities in Islamabad where education, psychology and IR department is present. The simple random sampling technique was used to select a sample from the entire population. The data was gathered using the close ended questionnaire five point Likert scale. The researcher personally visited the universities to collect data from teachers and students. The collected data was analyzed by percentage, frequency and descriptive statistics. The findings of the study revealed that SNS serve as vibrant hubs for collaborative learning and knowledge sharing. Students actively collaborate with peers on academic assignments, spending an average of 3.16 hours per day on these activities. Additionally, they invest time in participating in online discussions to collectively solve academic assignments, spending an average of 3.16 hours per day on these activities. Additionally, they invest time in participating in online discussions to collectively solve educational problems, dedicating around 3.12 hours per day on average. This finding underscores the role of SNS in facilitating direct and timely communication between students and educators. However, it is crucial to acknowledge the challenges and concerns associated with SNS usage in academia, including content exposure, distraction and privacy issues. Institutions should develop clear and comprehensive guidelines outlining the responsible and safe use of social networking sites for educational purposes. These guidelines should address privacy concerns, appropriate content sharing, respectful interactions, and strategies to manage potential distractions.

AUJoGR-24907

Role of Appearance Anxiety of Health Related Quality of Life among Burn Patient in Pakistan: Mediating Role of Coping Styles

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Abstract

Burn injuries have a significant impact on patients, their families, and society as a whole, affecting them physically, psychologically, and financially. The majority of burn injuries occur In low-and middle-income countries, where the burden is especially high. Living with burn scars in a society that emphasizes beauty can be challenging for individuals affected by these injuries. Burn scars often lead to functional impairment and disfigurement, significantly impacting daily activities and social interactions. To cope with the distressing situation, individuals employ various coping mechanisms. This study aimed to investigate the coping styles utilized by bum patients to manage appearance anxiety and identify potential targets for psychological interventions that can enhance their quality of life. The study included 92 patients who had been discharged from the Burn Care Centre (PIMS) in Islamabad and were followed up. These patients had visible scars resulting from burn injuries. Data collection involved the use of the Brief

COPE Questionnaire (BCOPE), Health Related Quality of Life Questionnaire (HR-QOL), and Social Appearance Anxiety Scale (SAAS). Data were evaluated using percentage and regression analyses. The average age range of the participants was 27.5+32.5. Through mediation analysis, it was found that social appearance anxiety had a non-significant direct impact on health-related quality of life. These findings highlight the importance of emotion- focused coping strategies in mitigating the impact of social appearance anxiety on the quality of life of burn patients. They also provide valuable insights for the development of psychological Interventions aimed at improving the well-being of individuals living with visible differences resulting from burn injuries.

AUJoGR-24908

Effect of PCOs on Health Related -Quality of Life among Young Adults: Moderating Role of Proactive Coping Strategies

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Abstract

Polycystic Ovary Syndrome (PCOS) is a major endocrine disorder in young age women affecting their quality of life (QoL) and their mental well-being as well. Prevalence rate of PCOs in Pakistan is more than 50% and it is increasing day by day. Therefore, the aim of our study was to examine the effect of PCOs on HR-QoL among young adults and to explore the moderating role of practive coping strategies between PCOs and Health Related Quality of life. A group of n-200 outdoor diagnosed patients of PCOs were selected by using purposive sampling techniques, from different hospitals in Islamabad. They asked to fill out three questionnaires, namely, PCOS symptom questionnaire, WHOQOL-BREF, for measuring Health Related Quality of Life and Proactive Coping Inventory. Percentage and Regression analyses was performed to assess effect of PCOs on health related quality of life and the moderating role of proactive coping strategies. The mean ago range of participants were 22.04. Majority of them are above matriculation 60.5 (n=121) and are employed 79.5 (n-159), Most of them are living in a joint family system 75.5 (n-151). Following Regression Analysis, PCOs had a significant negative impact upon HR-QoL p<.05. Findings revealed that high score on PCOs symptom checklist are negatively affect the Health Related Quality of Life as (3.030, p>.05). Results also revealed that proactive coping strategies and reflective coping strategies had insignificant role in PCOs as p<.05 but Strategies Planning. Preventive Coping play a significant moderating role between PCOs and Health Related Quality of Life as p>.05. Overall, PCOs has a negative impact on the HR-QoL of young adults with the condition, Psychological and social functioning appeared to be most affected rather than areas of physical functioning.

AUJoGR-24909

Somatic Symptoms In Individuals with Health Anxiety: Effectiveness of Eidetic Therapy

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Abstract

Anxiety is a feeling of excessive worry, Health Anxiety Disorder (HAD) means a person having serious concerns about their health or getting ill. In HAD the physical concerns are thought to be psychological in nature. In addition to other pharmacological and psychological treatments, Eidetic Psychotherapy (EP) is also believed to have a positive impact on different disorders. The present study attempts to study the effectiveness of Eidetic Psychotherapy for Patients with health anxiety disorder through Pre and Post Assessment. This research aimed to find the effectiveness of therapy in improving patients' physiological primarily somatic symptoms of HAD after having intervention based on Eidetic Psychotherapy. In present multiple case study sample of 6 participants (3 males and 3 females) was selected through purposive sampling technique. It was conducted in hospitals and private clinics in Islamabad, and the age range of was 18-55 years. Participants were assessed for Health Anxiety Disorder through Health Anxiety Inventory (HAI), and somatie symptoms were rated through Somatic Symptom Seale (SSS-8). This study was conducted in three phases. In phase one, participants were screened out for HAD symptoms and after the detailed Intake Interview, HAI and SSS-8 were administered in second phase treatment was applied in various sessions using Eidetic Psychotherapy and a proper management plan was followed. In the last phase post assessment was done two weeks after therapeutic intervention Identifying effectiveness of Eidetic Psychotherapy in symptoms reduction of participants. The data analysis revealed that score of patients in pre

assessment phase were lower in both males and females, as on scale HAI (M-75.9, SD=15.6) and on SSS-8 (M-26.6, SD-3.25) then scores in post assessment on scale HAI (M-59.3, SD-14.2) and on SSS-8 (M-21.5. SD-2.70), and t4,42, p=.001. From above analysis it was concluded that Eidetic Psychotherapy is effective for the treatment of Health Anxiety Disorder as in present case studies clear differences in symptom reduction of participants were observed in the Post Assessment Phase of Therapy. The present study also shed light on importance of Eidetie Psychotherapy, the therapy for the treatment of Health Anxiety Disorder.

AUJoGR-24910

Effect of Flipped Classroom Strategy on Student's Academic achievement in English at Secondary Level in Azad Jammu and Kashmir

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Abstract

This study was designed to investigate the effect of the "Flipped Classroom strategy" on Students" academic achievement in English at the secondary level. This study was experimental and it was delimited to the Girls Public secondary school students of Balooch Azad Kashmir. Only, 50 students of the 9th class were randomly selected from said school for this experimental research. Only four units of English were selected to teach during the experimental process. This study was experimental, therefore an experimental design i.e., "The Pre-test-Post-test Equivalent Groups Design" was used. Sample students were classified into two equivalent groups i.e., experimental and control groups based on pretest. A self-developed structured instrument English Achievement Test (EAT) was used for data collection from the participants. There was a total of 50 MCQs in the said achievement test carrying 100 marks in total. Before the conduction of the experiment, formal permission was taken from the head of the school. The experiment was continued for about six weeks. After completion of the experiment, a post test conducted among the participants to examine their level of academic achievement. After the collection of data, it was properly organized, and analyzed based on proper descriptive statistical tools i.e., standard deviation, mean, and inferential statistical tools i.e., independent samples t-test through (SPSS) version 23. The findings showed that there is a significant Effect of Flipped classroom strategy on the students' academic achievement scores in the subject of English. Conclusively, the Flipped classroom strategy is improving students' academic achievement in the subject of English at Secondary school level.

AUJoGR-24911

Role of Religiosity in Psychological Well-being and Subjective Happiness among Transgender taking Social Support as a Moderator

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Abstract

Religiosity refers to people's tendencies to commit to religious beliefs and activities. Although abundant of researches have established a clear association between religion and psychological well-being, with religion having both positive and negative implications depending on the way religion is used and inferred. However inquiries into positive transgender development are specifically important, yet scarcely done, given the high rates of gender-based victimization and limited health resources. Moreover, transgender Muslims may encounter multiple forms of minority stress such as gender minority and ethnic minorities as well. This research was designed to examine both bivariate and multivariate associations between Psychological Well-being, Subjective Happiness and Social Support, and the possible positive role of religiosity for them. For this purpose, 100 transgender people were taken from different communities in Pakistan through snowball sampling. The Index of Religiosity (IR), Ryff's Seales of Psychological Well-being (RSPWB), Multidimensional Scale of Perceived Social Support (MSPSS) and Subjective Happiness Scale (SHS) were used to collect data, SPSS was used for data analysis. The mean age of participants was 27 years. The results revealed that Subjective Happiness and Psychological Well-being were correlated among transgender. Furthermore it was found that, those who have more religious practices, tend to have better Psychological wit being however Social Support was not found to have any impact on the relationship. As for Subjective Happiness, Religiosity was also found to be significant predictor along with a significant moderating role of Social Support. This indicated that Religious practices can be used as a significant mean to promote and better the well-being of transgender community.

AUJoGR-24912

Management of Stress in Transgender with Trauma of Sexual Assault: Effectiveness of Edietic Psychotherapy

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Abstract
The present study aimed to investigate the effectiveness of Eidetic Psychotherapy on Transgenders with Stress due to Trauma of Sexual Assault. It was hypothesized that Eidetic psychotherapy will significantly reduce Stress symptoms. The data was collected from 10 Transgenders that scored high on Stress due to trauma of sexual assault. The data was collected from different organizations working in Islamabad, Pakistan. Depression Anxiety Stress Scale (DASS; Lovibond, 1995) was administered before and after the intervention and scores were maintained. After intervention, Stress symptoms scores (M 5.80, SD 3.70) are significantly less than the scores before intervention (M 22.00, SD = 4.52). The findings of the study revealed that Eidetic Psychotherapy significantly reduced the symptoms of Stress. The results indicated that Eidetic Psychotherapy is beneficial in the symptom reduction of stress.

AUJoGR-24913

Effectiveness of Eidetic Psychotherapy on Adults with Health Anxiety Symptom

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Abstract
The present study aimed to investigate the effectiveness of Eidetic Psychotherapy on Transgenders with Stress due to Trauma of Sexual Assault. It was hypothesized that Eidetic psychotherapy will significantly reduce Stress symptoms. The data was collected from 10 Transgenders that scored high on Stress due to trauma of sexual assault. The data was collected from different organizations working in Islamabad, Pakistan. Depression Anxiety Stress Scale (DASS; Lovibond, 1995) was administered before and after the intervention and scores were maintained. After intervention, Stress symptoms scores (M 5.80, SD 3.70) are significantly less than the scores before intervention (M 22.00, SD = 4.52). The findings of the study revealed that Eidetic Psychotherapy significantly reduced the symptoms of Stress. The results indicated that Eidetic Psychotherapy is beneficial in the symptom reduction of stress.

AUJoGR-24914

Exploring the Opportunities and Challenges Faced by Transgender in Education, A Case Study of Rani Khan Institute

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Abstract
The thesis undertakes a comprehensive exploration of the challenges faced by transgender students in the Pakistani educational landscape. Grounded in a qualitative research approach, the study investigates the multifaceted experiences of transgender individuals attending the esteemed Rani Khan Institute. The research design employs a qualitative case study methodology, offering a nuanced understanding of the intricate dynamics within transgender students' educational environments. The investigation reveals a myriad of issues, with a primary focus on eight themes: stigmatization and discrimination, lack of inclusive policies, mental health and well-being, supportive educators and peers, community resilience, visibility and advocacy, intersectionality and complex identities, and the crucial role of family support. Each theme is critically analyzed, drawing on a rich body of literature and empirical evidence from interviews with transgender students at the Rani Khan Institute. The findings highlight the pervasive stigmatization and discrimination faced by transgender students, both overt and subtle, contributing to their exclusion from social networks and hindering academic engagement. The absence of inclusive policies emerges as a significant barrier, amplifying feelings of alienation and identity dismissal. Mental health concerns are identified as a direct consequence, with transgender students reporting heightened levels of anxiety and stress due to discriminatory practices. Despite these challenges, the study uncovers the positive impact of supportive educators and peers, emphasizing the importance of understanding and acceptance in fostering an inclusive educational environment.

Community resilience emerges as a key theme, showcasing the strength and support networks within the transgender community. Visibility and advocacy efforts are identified as catalysts for change, challenging societal norms and promoting inclusivity. The study also delves into the complex intersectionality of identities within the transgender community, emphasizing the need for a nuanced understanding of the varied challenges faced by individuals. The pivotal role of family support is explored, illustrating its significance in buffering against external challenges and empowering transgender students to navigate their educational journeys. This thesis contributes valuable insights to the discourse on transgender education in Pakistan. The identified themes provide a foundation for informed policy recommendations aimed at creating a more inclusive and supportive educational environment for transgender students. The study advocates for a holistic approach that addresses societal attitudes, policy gaps, and the pivotal role of familial and community support in ensuring the right to education for all.

AUJoGR-24915

Role of Trait Emotional Intelligence and Social Desirability on Suicidal Self Injury among Adolescents

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Abstract

Non-suicidal self-injury (NSSI) is the intentional and acute harm done to one's body without the intention of committing suicide. Suicidal behavior (SB) non suicidal self-injury (NSSI) are the two primary health issues affecting adolescents. In spite of increasing attention to such issues, very little work is done regarding this topic in Pakistan. The objective of this research was to determine the incidence of non-suicidal self-harm in adolescents and to find an Association between non-suicidal self-injury and traits of emotional intelligence and social desirability in Pakistani adolescents who made up a typical sample of the general community. For this purpose, 195 participants were selected from different hospitals and areas of Ishamabad. The non-suicidal self-injury student questionnaire, the trait emotional intelligence questionnaire (TEIQue-SF) and the social desirability scale (SDS-17), were used to collect data. According to the findings, people who are more socially desirable and have lower emotional intelligence traits are more likely to engage in NSSI. Mental health practitioners can improve their capacity to recognize and assist people who are experiencing NSSI, thereby supporting their wellbeing and recovery by developing a deeper understanding of these aspects. The result of this research provide insight into the intricate interactions among these factors and how they affect NSSI.

AUJoGR-24916

Study the Effectiveness of Cloud Based Educational Platform on Students Performance at Elementary Level in Public Institutions of Islamabad

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Abstract

This study was based on the cloud based educational platform (CBEP) used to evaluate the student's performance in science at elementary level education. The objectives were, to determine students achievement in a science subject through post-tests in a traditional classroom at the elementary level, to determine students' achievement in a science subject through post-tests in a traditional cloud-based classroom at the elementary level and to compare students performance through the cloud-based educational platform and the traditional way of learning at the elementary level. This research methodology employed a quasi-experimental structure. It made use of a post-test-only arrangement: Students of IMCG Bhadana Kalan Ternoul in Islamabad were the population of the study. The current study's targeted population, 104 students in 8th Grade at the elementary level were targeted. A group of 40 primary school pupils were randomly chosen for the study, employing e straightforward sampling approach. The investigator constructed four examinations (T1, T2, T3, T4), ensuring alignment with the 8th Grade General Science curriculum. The construction of these tests were guided by Armstrong's modified Bloom's taxonomy. The trial group was surrounded by visual aids on the classroom boards and had access to activity corners. Conversely, the control group experienced conventional lectures, with no visual aids or hands-on tasks. Both groups had identical average scores for knowledge and application, however, the control group demonstrated a decline in scores for comprehension, analysis,

synthesis, and evaluation. On the other hand, the experimental group, which was taught using a cloud-based learning platform, showed an increase in average scores across all cognitive domains, including knowledge, comprehension, application, analysis, synthesis, and evaluation. A significant difference was observed in the knowledge, comprehension, application, analysis, synthesis, and evaluation levels between the control and experimental groups, post-exposure to traditional lecture methods and cloud-based instruction.

AUJoGR-24917

Effectiveness of Eidetic Therapy in Reducing Guilt and Shame Proneness and Treatment of Cannabis use Disorder without Psychotic Features

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Abstract

This study aimed to investigate the Effectiveness of Eidetic Therapy in reducing Guilt and Shame Proneness in individuals with Cannabis Addiction. The inclusion criteria maintained the usage for less than 2 years without psychotic features, with mild, moderate, and severe levels of drug abuse. Purposive sampling techniques were used to approach a population of 25 participants from different cities in Pakistan. The sample was assessed using the Drug Abuse Screening Test (Skinner, 1982), the Positive and Negative Syndrome Scale (Opler, 1987), and the Guilt and Shame Proneness Scale (Cohen, 2011). A sample of three participants received eidetic therapy as an intervention and post-treatment testing concluded a significant reduction in the usage of drugs and Guilt & Shame Proneness. The data was analyzed using paired sample T-test.

AUJoGR-24918

The Effect of Perfectionism and Self-Compassion on Positive and Negative Affect and Appearance Anxiety among Adolescents

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Abstract

Perfectionism is unquestionably ingrained in our daily lives and can be found in a variety of contexts, including work, school, relationships etc. While self-compassion entails being compassionate and understanding towards oneself in the face of perceived failures or weaknesses, perfectionism manifests itself by setting unreasonably demanding standards for self and being unduly critical of one's own performance. Through a comprehensive review of existing literature and quantitative research, this study examines the effect of perfectionism as well as self-compassion on appearance anxiety and positive and negative affect. For this purpose, 240 Pakistani students were selected. The Frost Multidimensional Perfectionism Scale (FMPS), The Self Compassion Scale (SCS), Appearance Anxiety Inventory (API) and Positive and Negative Affect Schedule (PANAS) were selected to collect the data. It is hypothesized that there will be a significant positive relationship between perfectionism and appearance anxiety data. It is hypothesized that there will be a significant positive relationship between perfectionism and appearance anxiety and negative affect, as well as significant negative relationship between perfectionism and positive affect. Furthermore, self-compassion will have significant positive relationship with positive affect and significant negative relationship with appearance anxiety and negative affect.

AUJoGR-24919

Childhood Emotional Abuse, Subjective Happiness and Emotion Regulation in Individuals with Substance Abuse

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Abstract

Childhood emotional abuse has profound and enduring consequences on an individual's overall well-being, encompassing both physical and mental health. This study sought to investigate the relationship between childhood emotional abuse, subjective happiness, and emotion regulation among individuals with substance abuse. A total of 150 participants undergoing substance abuse treatment in Rawalpindi and Islamabad aged between 17 and 40 years, were selected as sample of study. Data collection was done

using the Urdu-translated versions of the Emotional Abuse Questionnaire, Subjective Happiness Scale, and Emotion Regulation Questionnaire. The data was analyzed using SPSS 26 in two distinct phases. The initial phase involved translating and validating the Emotional Abuse Questionnaire, while the second phase focused on hypothesis testing. Confirmatory Factor Analysis confirmed good reliability and validity of the Urdu version of the Emotional Abuse Questionnaire. The findings revealed that childhood emotional abuse exhibited a significant negative correlation with subjective happiness, indicating that individuals who endured emotional abuse during their formative years tended to report lower levels of subjective happiness. Notably, childhood emotional abuse displayed a significant positive association with emotion regulation. Subjective happiness was positively predicted by emotion regulation. Furthermore, mediation analysis revealed that emotion regulation acted as mediator between childhood emotional abuse and subjective happiness. In essence, the study demonstrated that a history of childhood emotional abuse could lead to heightened emotion regulation abilities, which, in turn, enhanced an individual's subjective happiness.

AUJoGR-24920

Critical Thinking Skills in Science Learning at Elementary Level. (A Comparative Study of Public, Private Schools and Madrassas

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Abstract

Critical thinking skills in science learning at the elementary level is a topic of significant importance in educational research and practice. The problem addressed in this research is to determine whether science learning fosters the development of critical thinking skills among elementary-level students in various educational streams within Pakistan's capital city, including private schools, public sector schools, and madrasas." This remark emphasizes the essential problem of whether critical thinking skills are adequately nurtured in students from varied educational backgrounds through science study. This study aims to look into the relationship between science learning and the development of critical thinking skills in the defined educational streams in the provided geographical setting. This study aims to see if there are differences in the level of critical thinking skills produced by science instruction across multiple educational streams, the value of this study resides in its ability to influence educational practices, promote fairness in education, and develop research in the field of critical thinking skills among elementary-level kids. The significance of the study extends beyond the research context. The findings can inform educational policy and practice by providing evidence-based recommendations for integrating critical thinking skills within science education at the elementary level. By enhancing critical thinking skills among elementary science students, the study contributes to the development of future generations equipped with the cognitive abilities critical for scientific literacy, problem-solving, and informed decision making.