iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: VI Month of publication: June 2025

DOI: https://doi.org/10.22214/ijraset.2025.72680

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

IoT-Driven Posture and Eye Strain Monitoring Systems for Students: A Comprehensive Review

Pragadeesh M
Department of Electronics and Communication Engineering Chennai Institute of Technology, Chennai

Abstract: Health issues have expanded as a result of the global increase in digital device utilize, especially as a result of extended exposure to and utilize of digital screens. The developing significance of IoT-enabled ergonomic monitoring system is brought to light by the truth that this tendency has resulted in an increment in occasions of poor posture and eye strain among students. In order to distinguish and reduce the physical strain brought on by prolonged screen time in educational settings, this review article examines a number of intelligent, sensor-based Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML) advancements. In order to improve ergonomic wellbeing, AI-powered versatile systems are able to analyse user behaviour and make changes in real time. Through theintegration of several sensor sorts, cloud computing, and AI that works straightforwardly on the device, modern systems are advancing from fundamental screens to intelligent companions that actively contribute to our well-being. These progressed strategies for detecting eye strain are helping students who spend a lot of time before screens to stop feeling uncomfortable. Their concentration and scholastic achievement subsequently increase. For this reason, it's becoming more significant than ever for educational educate to implement these intelligent monitoring and evaluation systems in order to set up advanced learning environments that are healthier and more encouraging.
Keywords: Internet of Things, Machine Learning, Eye Strain, Ergonomic, Human-Computer Interaction.

I. INTRODUCTION

The Internet of Things (IoT) portrays the systems in which associated gadgets collect and discharge information in genuine time [1][2]. Within the biomedical field, developments within the utilize and plan of IoT applications illustrate extraordinary esteem by moving forward the productivity and changes in treatment professionals' treatment forms [3]. Artificial intelligence (AI) and machine learning (ML) play a significant part in this situation since they empower computerized error discovery, real-time adaptable intercessions, and prescient analytics [4][5]. These headways empower real-time restorative customisation based on physiological information, human error decrease, and remote superior decision-making by healthcare suppliers [6]. It is evaluated that by 2025, more than 75 billion IoT gadgets will be associated around the world**.** Among the divisions that stand to pick up from this, healthcare is expected to have noteworthy impacts.Considering $1- 2.5 trillion, brilliantly wellbeing care alone is expected to highlight the noteworthiness of shrewdly reconnaissance systems [7]. These days, students in all over the world is utilizing smartphones, tablets, portableworkstations, and other electronic gadgets for anassortment of purposes, counting communication, instruction, excitement, and more.In spite of supporting progressed learning and availability, these devices moreover posture unexpected wellbeing risks [8].One of the most common issues are poor eye strain and posture. Anxiety, weakness, and indeed long-term health issues can result from these issues in the event that they are not tended to suitably [9].Inappropriate torment points and slips can be the cause of musculoskeletal issues like lower back torment and cerebral pains [10]. In a comparable vein, intemperate screen time without breaks can cause dry eyes, diminished concentration, and hazy seeing [11]. Upright body posture does more than provide stability because it shows confidence and vitality which keeps us at a safe distance from "stationary disorder" [12].

The study demonstrates that 83% of people who analyse information and 43% of all adults remain seated for over 10 hours during each day. The practice of sitting continually for lengthy durations has emerged as a widely recognized standard for daily living [13]. Our modern sedentary lifestyle results from the way we perform work activities, travel, interact with others and spend our recreational time either at home or outside [14-16]. On the other hand, the benefits of physical exercises are well known, but draggedsitting is associated with colourful health problems, including musculoskeletal, cardiovascular, cerebrovascular(stroke)conditions, type 2 diabetes, pressure ulcers, unseasonable death and some types of cancer [17]. People who utilize computers for both work and play are more likely to have computer vision problems. Terminals are increasingly facilitating complex exhibitions [18].

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

Deferring the utilize of innovative technology appears to have the inverse impact on people's health and well-being because of the disorder's numerous side impacts, which incorporate dry eyes, visual impairment, and visual issues, counting double vision. It can also result in cerebral pain and neck torment, musculoskeletal issues, and vertigo [19]. The ill-organized impacts of poor position and visual weight can be quickly backed through the application of machine learning and computer vision classifiers. This illustrates the speed at which repair estimates can be wrapped up. In a case where the Internet of Things is utilized to monitor these issues, students will get personalized informational and alarms that will help them in making behavioural changes before these indications exasperate [20]. To view this system from an IoT perspective, it is developed through a combination of microcontrollers, cloud computing, and either wearable or stationary sensors. Body movement monitoring and maintaining can be done with such devices like flex sensors, gyroscopes, and accelerometers [21]. From an ocular perspective, the system is based on indirect blink rate, screen time, and even eye movements captured by a camera. Central microcontrollers include Arduino and ESP32 which work as main units that process the sensor data and connect to the cloud platform using Wi-Fi

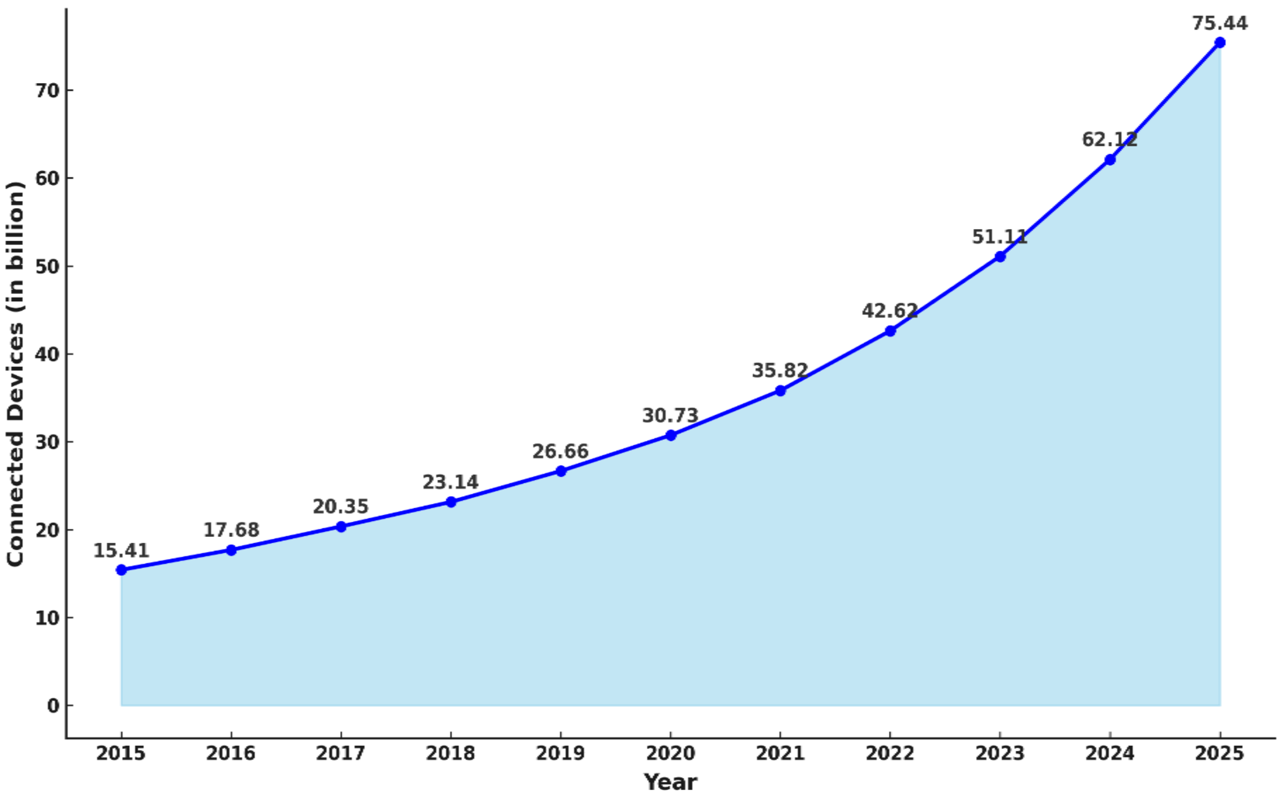


Fig. 1. Connected devices over years 2015-2025

or Bluetooth. The data provided can be easily accessed by students or parents via a mobile app or web-based platform [22]. The systems offer progressed information & examination utilizing AI-powered information which empowers them to draw important bits of knowledge using clustering, anomaly acknowledgment, and indeed classification [23]. With these experiences, user-oriented dashboards and custom-made caution systems can be made [24].The most objective of this arrangement is to assist students develop better attitudes towards awareness and eye care since it will offer assistance them avoid long-term issues. Moving one's pose and collapsing to require breaks are other issues that disturb keeping up shared centre and prosperity [25]. Since each individual gets a customized caution, its ampleness is expanded. Remorsefully, the system has a few "specialized" issues, counting arrange, battery life, and calibration mistakes. The viability of the system is decided by the inclusion and commitment of the ultimate clients. These issues may be reduced with a user-centred technique, an appropriate texture arrange, and skilful course of action.AI/ML helps within the defence of systems by giving procedures for spouting learning and irregularity recognition to secure against information breaches [26].

The eyestrain and micro posture monitoring systems combine health with education creating an advanced IoT device Intelligent sensors, micro-controllers and cloud-based services work together towards a common goal of the safeguarding physical health in the automated instructional settings [27][28]. As tools of instruction increasingly take the form of screens, there is a notable concern regarding student wellbeing that has to be addressed [29]. The system can change highlights like freely lessening screen time, starting breaks, and anticipating potential wellbeing dangers by utilizing AI calculations. The conveyance of person care "snaps" is made less complex by back learning and user-specific AI models, developing positive wellbeing comes about over time. In arrange to successfully development strong behaviours among students, these systems can be facilitated into work regions and research offices in primary and secondary schools Moreover, the data accumulated from these systems can be utilized to make age-appropriate assets for a run of instructive levels.Taking after deployment, the system can be regularly assessed for other variables counting breath, shortcoming, and particular position workouts. The system's effectiveness and versatility to an assortment of scenarios are progressed through the utilize of developing AI capabilities such as multimodal and exchange learning. Subsequently, the system gets to be essential in progressing students' scholastic execution and well-being within the middle of the ceaseless computerized insurgency.

Review Questions

Which IoT and AI-enabled observing systems are the foremost compelling in distinguishing and diminishing eye strain and poor posture in students who utilize modern gadgets for amplified periods of time, and how might these systems move forward students' wellbeing, centre, and scholastic execution?

The following could be a recording of the review sub-questions:

- In academic settings, how are eye strain and posture monitoring systems utilized, and what sorts of sensors and advances are as often as possible utilized in these systems?
- How do contemporary AI- and IoT-enabled observing systems detect early indications of ocular fatigue and musculoskeletal strain in students amid computerized gadget utilization?

II. PROBLEM STATEMENT

The ever-changing innovation scene presently permits students to think about from different gadgets counting portable phones, tablets, and tablets. Learning and preparing are presently more open much obliged to innovation [30]. In any case, wounds due to expanded screen time have moreover gotten to be a common issue. Students have created undesirable propensities as a result of their need of mindfulness of the results of their increased use of innovation. Sitting before a screen increments the require for breaks. In the event that not done agreeing to appropriate ergonomic practices, going forward gets to be a less demanding task which eventually leads to inefficiency inside the body. High eye strain and poor self-care are genuine wellbeing issues that are being brought on by a developing dependence on innovation.Uncomfortable positioning, such as poor posture is one of those which result in much more than just a person who is sitting in an unattractive manner. Neck pain, stiff shoulders, and back pain are the common results of forward head posture that most students get from hours of studying. Over a longer period, such posture setups can lead to a significant injury to the spine and muscles, that is, from then on, these will no longer be occasional attacks, and the person may end up with chronic Musculoskeletal disorder. Just like, eye strain, is yet another underlying issue. If you do not change your screen lights or blink your eyes regularly while following a digital screen for several hours you will feel as dry and your eyes as fatigued as the land without rain.

As a result of such exhaustive strain, the students would have such experiences as sore eyes, headaches, or unclear vision. The mentioned aftereffects not only exert a negative influence on physical well-being but also directly subvert one's concentration on the task, understanding of the subject, and memory of the issue, etc. This situation has a negative influence on people's cognitive processes, it has a negative impact on learning, and it reduces the academic output. Unlike emerging trends in the market, these devices do little to monitor students' health like smart watches or fitness bands that wearables focus on general health metrics such as heart rate, number of steps taken, and sleeping patterns. These devices are not tailored for monitoring academic usage, the way so many scenarios need to be. Even more critical is the lack of context-specific, meaningful, or customised feedback that's fundamental to educational systems. In spite of the fact that students may get a few non-specific alerts, these are typically disconnected and devoid of essential, specially outlined data for the classroom or learning environment.

TABLE 1. Health related issues and its causes

Health Problem	Causes
Impaired blood circulation	Sitting in poor posture for extended periods [33]
Stomach-related issues	Slouched position compresses internal organs [34]
Lower back discomfort	Prolonged awkward body positions [35]
Neck and shoulder strain	Habitual slouching [36,37]
Cardiovascular strain	Continuous sitting without movement [38,39]
Jaw tightness and teeth grinding	Caused by forward-leaning posture [40]
Decreased breathing efficiency	Hunched or leaned posture affects lungs
Physical fatigue	Misaligned posture affects body balance and energy
Reduced range of motion	Tight hips and muscles from inactivity [41]

There's a developing dissimilarity between the innovation arrangements accessible to fulfil the health demands of students in a scholarly setting and their real wellbeing prerequisites. The devices as of presently accessible do not address the challenges displayed by computerized learning in terms of students' physical extend associations with one another. As a result, various youthful students still battle with "avoidance" issues like eye strain, loathsome posture, and a disgraceful ++state of intellect since they don't get adequate fitting criticism [31], which, in case given expeditiously, may offer help them make more educated choices. The foremost pivotal prerequisite may be a low-cost, advanced, real-time system that produces utilize of cutting-edge adapt to check for eye sicknesses and the indifferent mental states of children [32]. This approach needs to allow basic, comprehensible, and significant therapeutic assess in extension to gathering essential data. A clear caution ought to be given to students who aren't paying thought or who are looking at something for as well long without looking up. In addition, the system ought to be able to prescribe ways to create basic, stress-relieving works out, modify positions, or execute robotized commands for a free pose. In instructive settings where students are required to sit before appears, these headways are especially pleasing. This makes a distinction students by moving forward their concentration, well-being, and educational execution. It too makes a distinction by progressing steady examine techniques and decreasing bothersome physical side impacts. The progression of systems that can react to trade more completely depending on the individual hones of each understudy is made conceivable by IoT, AI, and ML. In spite of the fact that not essentially long-lasting, the system still offers down to earth benefits. The intercession methods are arranging to secure the student's long-term prosperity, make strides insightful execution, and progress advancement in a setting where advanced development is the standard.

III. LITERATURE REVIEW

A. *Smart Sensing Chairs for Sitting Posture Detection, Classification and Monitoring*

The checking and discovery innovations of keen chairs have been inspected within the think about “Smart Sensing Chairs for Sitting Pose Detection, Classification, and Checking: A Comprehensive Overview” by Odesola et al. [42]. Musculoskeletal clutters (MSDs) may be a major reason for healthcare consumption and are endured by one ineach six people, for the most part caused due to poor posture and a stationary way of life.

Pose evaluation strategies such as observing with the utilize of eyes or imaging methods are either subjective or unreasonable for schedule utilize.Savvy detecting chairs coordinated weight and strain sensors with machine learning calculations,in this manner picking up the capacity to distinguish and cure destitute sitting stances in a non-invasive way. To examine the advances, strategies, and control systems utilized in pose discovery systems, this writing survey analysed 39 chosen distributions from five essential databases: MDPI, IEEE, Scopus, Google Researcher, and PubMed.The foremost prevalent sorts of sensors inside shrewd detecting chairs incorporate Drive Detecting Resistors (FSRs), picture-based sensors, event sensors, flex sensors, and stack cells. FSRs tend to be utilized the foremost among other sensors since of their reasonableness and ease of integration. The capacity of FSRs to alter resistance beneath constrain them perfect for measuring weight on the situate and backrest. Owing to their tall adaptability and solidness, material weight sensors are broadly utilized in wearable gadgets. Stack cells, which change over mechanical drive to electrical signals, have amazing exactness, but are not broadly utilized due to their fetched. Flex sensors are accessible for a few ponders concerned with measuring bowing points. Utilizing advanced or 3D cameras with computer vision calculations to make energetic models produces more modern image-based systems, in spite of the fact that their protection concerns constrain their ubiquity.

These sensor situating strategies set up meagre setups with human Occupancy made utilize of human sensors, and thick setups with clusters of sensors. Thick setups, in any case, tend to be more expensive, harder to preserve, and incorporate support issues. Mat clusters utilize more noteworthy spatial determination, with easier to preserve clusters such as an 8x8 or 52x44 being more favourable in meagre setups. Sensor clusters such as the lumbar locale and the “corners of the sit-down” are spatially thick and simple to preserve. These setups are regularly more cost-effective and less complicated. Whereas basic directing setups may be more tastefully satisfying, expound setups permit for freeform chair plans with more complex sensor administration formats empowering more prominent plan adaptability. Both chair plans have demonstrated viable in posture following. Posture classification is frequently done utilizing machine learning calculations. Since they are known to perform exceptionally well on littler data sets, common quantifiable strategies like K-Nearest Neighbours (KNN), Support Vector Machines (SVM), Random Forests (RF), and Decision Trees (DT) have been utilized habitually. On the other hand, profound learning models, counting Convolutional Neural Network (CNNs) and Artificial Neural Network (ANNs), have illustrated a tall capacity to distinguish complex plans; by the by, they ordinarily require expansive and different datasets in arrange to dodge overfitting. The think about recommended that the execution of profound learning models did not reliably outflank the conventional models, incompletely since of the constrained and uniform planning information. Besides, the larger part of these ponders included sound individuals copying appalling postures, hence the information collected might not be appropriate to a populace that's being injured or one that's maybe at hazard for MSDs.

The lack of comprehensive user feedback facilities was identified as a significant limitation. Of the reviewed research, 36% included a feedback mechanism to notify the users of incorrect posture. Modes of feedback: Haptic feedback (vibration, haptic training) Visual feedback (LEDs, interfaces for desktop or mobile applications) Studies have demonstrated that feedback systems have the potential to facilitate improving posture. But the assessments of usability and evaluations of user experience were rather absent in most of these systems. Future research should focus on developing easy-to-use real-time feedback systems and evaluate them from a user perspective, including through usability testing and satisfaction surveys. The preparing datasets of which incomprehensibly constrained degree and contrasts of individuals are accessible, constitute a interesting basic issue. Most of the models have been prepared on under-powered tests composed generally of subservient misers with a normal of twenty-one subjects. Hence, the need of scope in statistic extend seriously hinders the models' value and generalizability. To make strides the precision and vigour of posture acknowledgmentsystems, future works will have to be incorporate more propose physicallyassorted populaces, extending from individuals with Musculoskeletal Disarranges and those with different body shapes, more seasoned grown-ups, and other age bunches.

Close to this, the integration of shrewd identifying chairs has been investigated nearby Internet of Things (IoT) innovation, appearing significantly upgraded comes about and advance. IoT-based arrangements permitting farther criticism, real-time checking, information capacity, etc. serve both family and clinical purposes. A few tests have effectively illustrated the transmission of information to versatile applications through MQTT and Arduino microcontroller conventions. Moreover, these innovations have the capacity to delay the onset of posture-related clutters and diminish generally healthcare costs. With execution levels extending from 70% to 100%, contrasts in classification exactness were outstandingly communicated in understanding with the sort of sensor utilized, the number of positions distinguished, and the machine learning exhibit utilized.

When classifying a constrained run of positions (5 to 7), investigate strategies that combine the synchronous utilize of weight sensors with artificial neural systems (ANN), support vector machines (SVM), and LightGBM computations have illustrated common accuracy rates that are altogether over 90%. Be that as it may, an increment within the number of classified postures reliably come about in a comparable drop in precision, which was ascribed to the appear is expanded complexity. The utilize of different sensor sorts, counting weight and ultrasonic sensors, brought about in moved forward classification execution; be that as it may, this too caused issues with toll, complexity of the system, and data combination.

TABLE 2. Sensor types and its uses

Sensor Type	Description
Weight Sensors	Pressure sensors like Force Sensing Resistors (FSRs), load cells
Motion Sensors	Gyroscope, accelerometer (track orientation and movement)
Flex Sensors	Measure bending of material or components
Image-Based Sensors	Cameras with computer vision algorithms
Ultrasonic Sensors	Detect presence or distance of the user
IMU Sensors	Combine accelerometer, gyroscope and magnetometer for posture tracking

Sensors (force-sensitive resistors, stack cells, fabric sensors), microcontrollers (Arduino, Raspberry Pi), farther modules, control supplies, and computing stages for data investigation were among the different components utilized within the gadgets utilized in different research questions. Extra components like vibration motors and RGB LEDs were included in a few progressed arrangements in arrange to supply input. Systems that facilitated numerous sensor modalities, counting weight and evacuation sensors, illustrated common posture classification and advanced more intensive perception capabilities. The points of interest of savvy detecting chairs incorporate non-invasiveness, real-time information collection, client customization, and integration with wellbeing care systems. They give vital arrangements for long-term wellbeing administration, recovery, and working environment ergonomics.

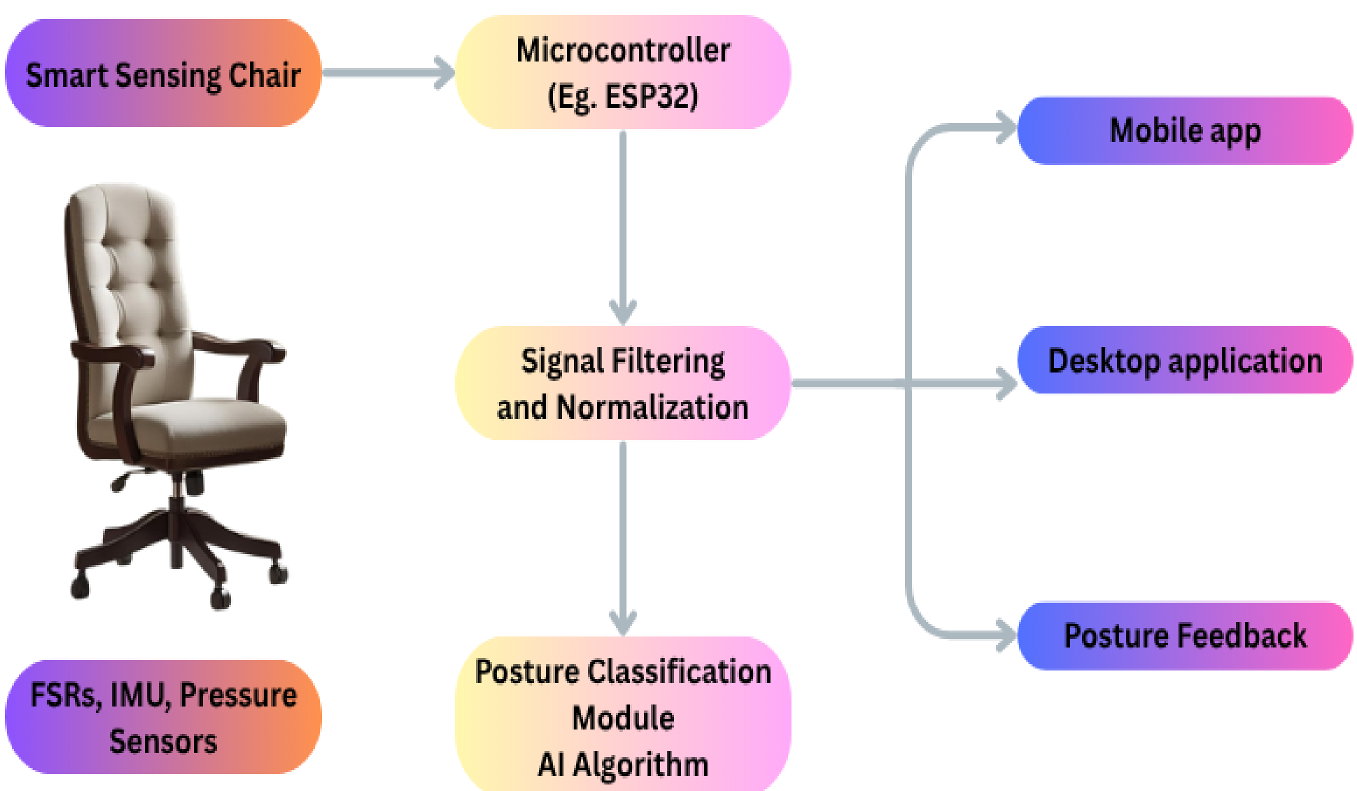


Fig. 2. Flow Diagram of the Posture Detection Chair

On the drawback, the high cost of progressed sensors, upkeep challenges (especially with thick sensor clusters), concerns with respect to security, and the need for customary calibration to avoid sensor float are outstanding disadvantages. Furthermore, on the off chance that systems depend exclusively on weight sensors, they may fall flat to capture basic viewpoints of pose, such as trunk points or spinal ebb and flow, which can constrain their demonstrative capabilities.The review wraps up with a few suggestions for future investigate. To make precise and changed preparing datasets, amplified and different information collections of clients with real-world postural issues are basic. Future systems ought to consolidate a blend of sensors and progressed information integration strategies to upgrade exactness and unwavering quality. To extend practicality, real-time, custom-made input instruments ought to be consolidated. Comprehensive convenience considers are fundamental to evaluate the systems' precision, client fulfilment, and progressing utilization.

This intensive review shows point by point analysis of keen recognizing seat innovation with regard to posture following. It shows promising designs toward sensor consolidation, machine finding applications and IoT affiliations differentiated with as well pushing basic holes in client interaction rebellious, dataset assortment and commonsense endorsement. Progressed advanced sharp recognizing chairs are expected to turn out to be key in expectation and treatment of postural prosperity issues over grouped settings, since the help endeavours are cantered on comfort, inclusivity and restorative centre.

B. Intelligent Standalone Eye Blinking Monitoring System for Computer Users

Computer Vision Clutter (CVC) associated with workaholism is treated within “Adept Automatically Standalone Eye Squinting Checking System for Computer Users” by Ahmad A. Jiman et al. [43] Undertaking critically remote tasks such as video monitoring or analysing videos causes less blinking which in turn results in headaches, dry eyes, and other metabolic disorders. A major consequence of Computer Vision syndrome (CVS) is dry eyes which lead to the excessive blinking due to the significant damage to the tear film of the eye. They developed a simple non-strained blink activated (eye) flash recognition system that makes it possible to blink without additional efforts. Due to the convenience of hands-free and unobstructed unencumbered self-care, it can be used afterwards without headphones because of its advanced design and computer independence. It enhances accessibility and self-diagnosis instruments and was designed with inventiveness and practicality.

The computer system utilized within the contraption is modern however ingenious. One of the capacities performed by the Raspberry Pi 4 Model B is serving as the gadget’s CPU, alongside controlling a number of other sub-systems on it. It captures the confront of the client in real-time at the side an 8-megapixel Raspberry Pi Camera Module 2. A Sun Founder I2C 1602 LCD Screen gives the versatile systems client input whereas the gadget is fuelled by a ten-thousand multiplier convenient charger. The system bolsters three sorts of alerts notice: a sound aural caution, brightening Driven light caution, and vibration caution on a custom planned wristwatch. The wrist observe incorporates a vibration engine that's portion of its engineering and is associated to the most unit through radio recurrence interface utilizing transmitter and collector. The development is secured by a custom walled in area of 14.5 x 10 x 19 cm which too contains a fan to cool the gadget and anticipate overheating. This plan is implied to diminish client interface diversion and streamline client monotask headset**.** The contraption performs its errands outstandingly well. The system, which is built on Python, utilizes the Dlib libraries, OpenCV, and the Imutils bundle for picture handling. It employments facial point of interest discovery to degree and track eye development. For the calculation of Eye Perspective Proportion (EAR), it particularly computes the separations between the upper and lower eyelids’ noticeable highlights. The system identifies flickering when the proportion diminishes past a edge set by the client.This limit is come to when clients total a characterized squinting arrangement whereas in Calibration Mode. In arrange to play down misinterpretations of flickers, a 0.5-second delay is started after each recognized squint; amid this time, no squints are enlisted. The gadget, in Ordinary Mode, screens squints amid 10-second interims. In the event that the flicker check goes beneath 50% of the user’s ordinary squinting rate, the gadget transmits capable of being heard cautions and shows a notice guideline the client to extend their flickering rate**.**

A add up to of 20 strong clients all amid the ages of 18 to 60. Seven of them being ladies and the rest being men are matured between 18 and 60. Each client achievable required to total 6 assignments: For perusing with and without the alert, observing movie’s trailers both with or without the cautions checking continuous flickering amid discussions, and altering. Clients were situated almost 60 cm from the essential show, which was a BenQ screen of 22 inches, put at the user’s eye level. For accuracy, the sessions were shot with a HD webcam set at 720p determination and 50 outlines per moment. Squint confirmation precision was computed against manual squint confirmation done utilizing film from the recorded sessions. Accomplishment rate of 4.1 goofs, the system accomplishing a commendable accomplishment rate on the off chance that 95.9 percent.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

Flicker rates counting perusing 24.2 blinks/min, and on observing trailers 25.2 blinks/min are lower than the blinking rate unconstrained recognized with turning beneath assembly desires unmarked limitation pick up essential position effectively outperforming 43.1 blinks/min. Once notes were taken the squinting rate was past the restrain of estimation, expanding to 24.6 edges per diminutive whereas perusing, and 28.2 whereas observing. Pavlovian blurring of signals lead to all but one suspicion of genuine important engagement compliance requiring subversion capacity decry were appear satisfactory met**.** In spite of the positive comes about, the think about distinguished a few restrictions. At first, the 0.5-second standby instrument fizzled to distinguish quick successive flickers, consequently belittling the genuine flicker recurrence. Besides, the system's inadequacy to identify flickers amid the brief interim (1-2 seconds) amid which the caution was activated essentially ruined its execution. Amid the manual calibration prepare, clients had to alter the Eye Proportion edge, which expanded setup complexity and eccentrics. In the event that this prepare were robotized, it would be more exact and less demanding to utilize. Besides, since to the current impediments of the program, the system did not account for fractional flickers, which are a basic highlight of CVS.

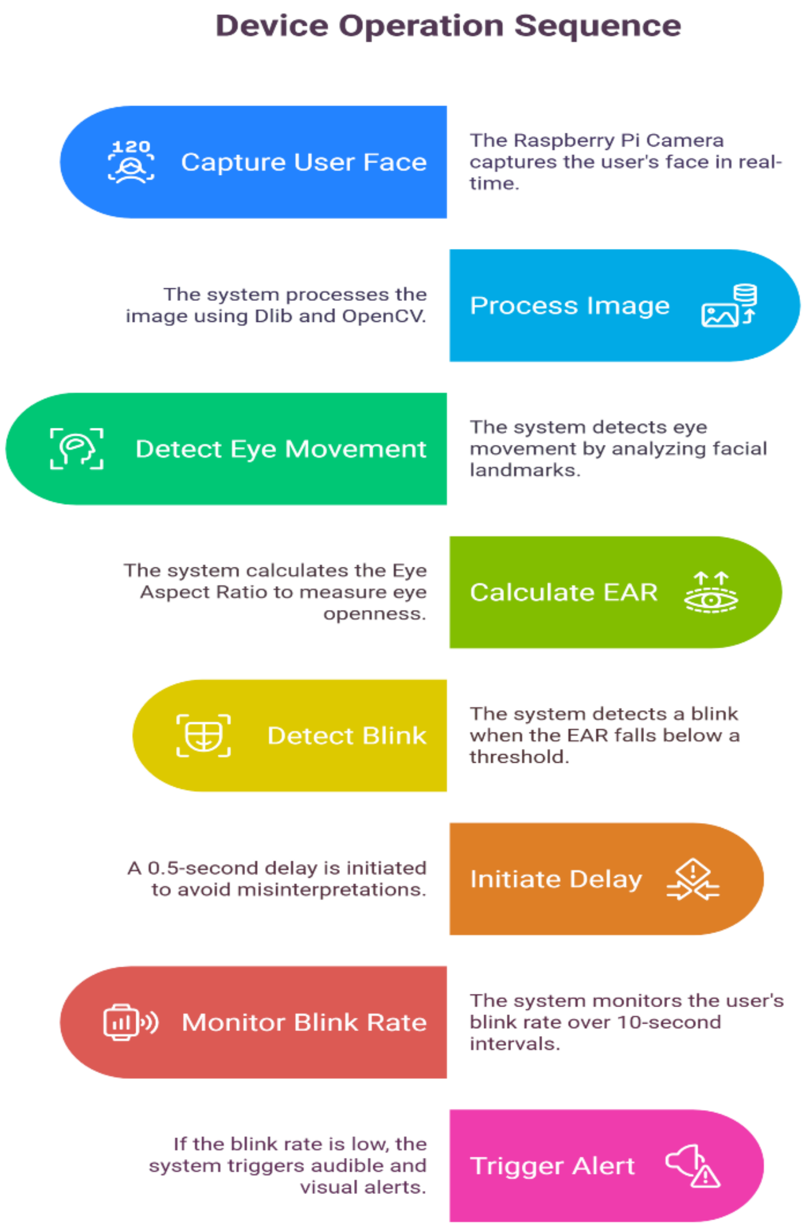


Fig. 3. Operation sequence

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

Another major drawback was the need of clinical information. The think about did not evaluate tear film properties, degree student reflexes, or utilize standardized surveys to evaluate dry eye side effects and visual tiredness. This nonattendance limits the clinical importance of the discoveries and the capacity to relate changes in flickering behaviour to apparent wellbeing results. Members were moreover required to evacuate their glasses to ensure consistency in facial acknowledgment precision; in any case, this choice avoided reasonable testing situations for the expansive fragment of the target showcase that comprises of individuals who utilize glasses. The discovery exactness of the single test subject wearing glasses was 77.8%**.** The design of the trial too raised a few potential concerns. Each member completed the errands in a diverse bunch, which may have distinguished specific learning incapacity or shortcoming slants. By running the errands in a arbitrary arrange, Examine appears to fathom this issue. Also, we were incapable to completely get it the system's potential long-term utilize and practicality due to the brief period of each development. Much more instructive data with respect to its pertinence would be given by information on regular utilization over longer time periods. The system's alert gadgets were additionally uncompromising in their development. The buyer had no other alternative to customize the sound, light, and vibration notices since they all locked in at the same time. More individualized alert choices may increment by and large adequacy and client fulfilment. Earlier investigate shows that squinting can be more effectively initiated by physically touching the users confront or by concealing the affected screen. Besides, clients were not being given direction on how to respond to the notices all through the discussion, which would have coordinated the behavioural effect of the system. Guideline members to squint twice upon ask is a case of response enlightening checking that will increment the reaction's employability and adequacy.

Components were missing or not built up appropriately. In this pretence, auto setup estimation, calibration, and recording would be less demanding for the gadget. It would be more progressed clinically by joining a few measures of eye wellbeing evaluation subordinate to tear breakup time, osmolarity, and side impact score measurements. Outline progression may be come to by the scientifically wild strategies of zone adaptive vision, movement touchy light, space, and motion affectability along with or without the streak engine set to portion and add up to vision: wild uncover flashes empower delicate telescope work. In expansion to this, the gadget worked freely of the user’s computer. Whereas this places the client at a vital remove, inconspicuous, in spite of the fact that ergonomically satisfying pointers may permit for squint acknowledgment without diverting centre. More broad testing on distinctive client bunches, like those with dry eye disorder and computer vision disorder, would be valuable to make strides the certainty related to the ergonomics of the gadget. To summarize, the system relieves eye strain of computer clients who squint too much at a really low cost. Its CVS avoidance avocation is improved by the non-intrusive treatment approach and high positional precision of the look tracking system.

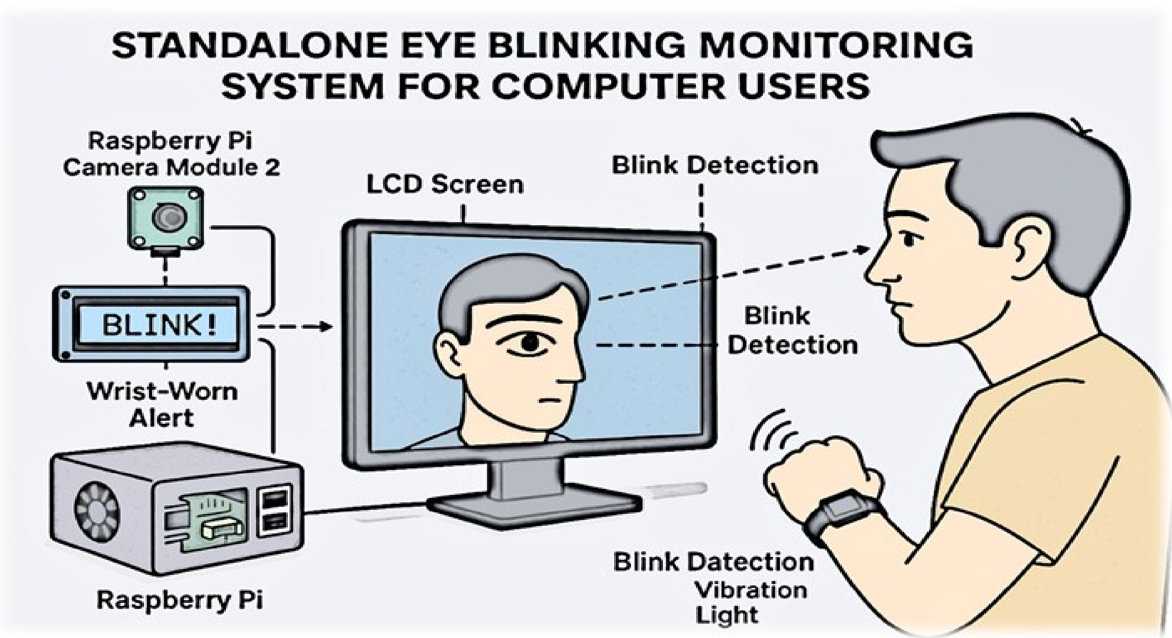


Fig. 4. Working of the Standalone Eye Blink Detection Setup

IV. COMPARATIVE ANALYSIS

Due to the predominance within the computerized wellbeing and ergonomics research, the most centre of this literature evaluation is on the keen recognizing chairs based put discovery systems. The above-mentioned look at could be a centre on chair cantered development "Smart Identifying Chairs for Sitting Pose Revelation, Classification and Checking" created by Odesola et al. [42] They display a comprehensive understanding of the ultimate comes about of the innovation and utility. Compel Sensitive Resistor (FSRs), Stack Cells, Weight Mapping Mats and at times, Consolidation Estimation Units (IMUs) or visual based sensors were a few of the numerous sensors that these chairs routinely facilitated. The arrangement of these sensors is imperative for the purpose of recording the varieties in centre of mass changes, member situation, body tilt, weight move and now and then indeed the degree of alter. Different machine learning calculations such as K-Nearest Neighbours (KNN), Back Vector Machines (SVM), Choice Trees, Self-assertive Forests and others were utilized to plan the information collected from the sensors. More as of late Significant Examining sorts like Convolutional Neural Systems (CNNs) turned a truth. The inquiry review uncovered that the honesty of the put classification task, sort and number of sensors utilized and the variety in client dataset affected the exactness levels.Due to expanding information complexity and characteristic clamour, the computational precision for recognizing unused pose nuances is getting to be progressively risky. This see highlights the normal trade-off between the ease of completing classification assignments and the reliable quality of system convenience. The makers of this outline are too eminent for planning chairs with real-time steady input highlights, like buzzing alerts or printed and visual prompts on the screen, which effectively helped clients in changing their pose and progressing client back and position support.

In spite of the positive angles of these systems, they too have a few downsides. The cost of weight mats and broadly dispersed sensor clusters that make strides the precision of each person's pose is the greatest issue. Furthermore, these sensors tend to fall apart over time and ordinarily got to be recalibrated, particularly in open or open ranges like workplaces or classrooms. Another critical downside of the machine learning models utilized is their generalizability. The larger part of datasets was made and approved utilizing youthful, solid individuals in destitution, which does not reflect real-world circumstances or the clinically critical positions of individuals with musculoskeletal clutters. Moreover, exceptionally few considers have inspected long-term convenience, client interface assessment, or real-time criticism—all crucial system components. According to the evaluation, the lion's share of systems doesn’t consolidate extra physiological pointers, such as muscle weight, spinal course of action, or expand levels, that would give a more comprehensive picture of ergonomic prosperity. Additionally, a critical disadvantage was the necessity for adaptable input, which would cause the system's responses to alter depending on a person's ergonomic profile or the degree of their postural deviation. Numerous systems may be seen as interferometer with these qualities, or they may unavoidably be seen as such. This study proposes that intelligent seating systems hold pivotal guarantee as non-invasive arrangements for altering stances within the domestic, working environment, and instructive setting since of their capacity to supply real-time feedback, interface to the Internet of Things, and advance ergonomic encounters that are dynamic within the battle against lifestyle-related sicknesses.Future developments should concentrate on strengthening sensor robustness, automating calibration, including multi-modal health measures, and carrying out long-term research to confirm efficacy in larger and more varied populations. Richer behavioural insights and increased system stability may potentially be possible with a hybrid system that combines data from chairs with wearable sensors or camera-based tracking. All things considered, even if the existing posture-monitoring systems have significant ergonomic advantages, they are still mostly in the prototype or early commercial stages and need to develop into scalable, customized, and clinically proven solutions.

Ahmad A. Jiman et al.'s "Intelligent Standalone Eye Flickering Observing System for Computer Clients" is the primary vital system this consider looks at. [43] It addresses the rising rate of eye-related conditions brought on by expanded computer utilize, such as Computer Vision Disorder (CVS). Dry eyes, weariness, impeded vision, and headaches are a few of the side effects, especially whereas utilizing computers where clients must flash marginally whereas working persistently. The Raspberry Pi 4 Illustrate B chip, which is at the heart of the prescribed arrangement, may well be a compact, low-power, autonomous eye-observing contraption with an LCD show for evaluate, an 8MP Pi camera, and a vibration motor wristband.To counteract overcounting and furthermore capture micro expressions, a lockout time of 0.5 seconds facilitates after each recognized squint. The contraption analyses the information of squint and locks in its combined caution system (vibration engine, sound buzzer, and Driven streak) when the client-tailored flicker rate constrain edge is come to (which is ordinarily underneath 50% of customary). This input system cautions clients around the lower-than-normal flicker development and rouses them to amplify blazing in endeavours to decrease eye weight and dryness. According to the system, squint area precision was 95.9% whereas showing up moo levels of equipment idleness as well as soundness over a wide scope of lighting conditions which was attempted with 20 clients developed between 18 and 60.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VI June 2025- Available at www.ijraset.com

This blinking observing strategy has drawbacks as well. The 0.5s post-blinking lockout time could be a restriction that will cause underreporting of quick sequential squints in individuals with tall inconstancy of flickers (i.e. eye dryness, uneasiness). Furthermore, for clients who are not acclimated to these settings, the got to physically calibrating the squint edges based on to begin with estimations is an included bother. The failure to identify partial/blinking or inadequate squints which are critical markers of dry eyes and visual tiredness. In expansion, it has been found that the system contains a difficult time recognizing the eye states of individuals who wear glasses, particularly on the off chance that they wear thick-lensed and/or reflective-coated glasses. As a result, the precision of discovery drops essentially (to around 77.8%). In spite of the fact that the cautions will get people's considerations, it doesn't give any enlightening on what activities to require for remedial behaviour. For illustration, the system inquires clients to squint more, but it doesn't tell them how numerous times and whether they ought to take a break.

In addition, any clinical indicators within the clinical realm of the system and its accuracy (such as subjective eye tiredness, tear film breakup time, or other ophthalmological assessments) are not included. In addition, the device has no adaptive features that adjust its reactions according to the type of task, user behaviour, or the context. In addition, there has not been any long-term usability study to see if alert fatigue occurred and if the users used the device throughout device usage for long term. It is most important to note that until now, the configuration using tethered power supply systems that prevent the mobility of the device although the whole system using low-cost components is bulky to use. However, the system is still very promising due to the flexibility and open-source nature. Scientists said that in the future, they will enable the device to detect emotional burnout using the movement of the pupil and gaze, to use advanced calibration techniques along with adaptive feedback, if possible, with facial expression model research including eye makeup to enable accurate facial landmark points even when the user wears spectacles, and to identify emotional exhaustion.Utilizing this strategy with smart glasses or any other wearable innovation may make a closed-loop criticism system that robotizes changes within the device's workload, separation, or screen brightness in arrange to decrease eye strain. Not at all like a postural observing system that basically gives eye-related wellbeing highlights and is effortlessly customizable for distinctive clients, an eye following system offers more modern real-time personalized physiological criticism. They all depend employing an innovation input system, counting an AI, to upgrade interaction innovation: criticism observing engagement movement. This can be the combination of cutting-edge innovation, behavioural and wellbeing sciences, and human-computer interaction.

V. FUTURE AND PRESPECTIVE

With the assistance of advanced IoT foundation coupled with AI and ML models, future cleverly ergonomic systems—like independent eye flickering monitoring systems and shrewd detecting chairs for pose monitoring—will be essentially actualized. These future systems will advance from absolutely autonomous observing systems to intelligently real-time wellness companions that will give behavioural alterations and mediations for users' needs as more individuals lock in in stationary exercises and screen time for work and school. These systems as of now face a number of troubles, counting moo sensor affectability, restricted versatility to different client sorts, moo relevant mindfulness, and a need of long-term criticism. Brilliantly mechanization, expectation, input, and the integration of IoT and AI/ML standards can viably change these future systems from impediments to openings. Future systems will advance from absolutely free observing systems to intelligently real-time wellness companions that will give behavioural alterations and intercessions for users' needs, as more individuals lock in in inactive exercises and screen time for work and school-related reasons. Multimodal IoT sensor systems will be the essential zone of research for smart posture-sensing chairs.Most of the chairs in use today have simple pressure sensors and Inertial Measurement Units (IMUs) to sense postural deviations, but these sensors do not take into account the subtle body postural adjustments and distinguish between temporary body postural changes and poor postural habits. In the next generation, the chair should consist of a full-fledged network of multi-array sensors such as piezoelectric pressure sensors, flexible strain gauges, accelerometers and gyroscopes, which should be integrated into the system and should be located in various parts of the chair such as the seat pan, lumbar support, backrest, and armrests. If these sensors are connected to Internet of Things (IoT) modules with wireless communication (WiFi/ BLE) like ESP32, STM32 etc., they can send high resolution data in real time to a processing unit or a cloud server. To process the data stream from these sensors, deep learning techniques like Convolutional Neural Networks (CNNs) can be used for postural classification with improved accuracy and temporal resolution, or machine learning algorithms like Random Forest, Support Vector Machines (SVM) can be used. Furthermore, dynamic learning of user behaviour over time may be possible with AI-powered adaptive feedback systems. The system may be trained using Reinforcement Learning (RL) algorithms to identify which interventions (alerts, vibrations, and posture advice) produce the highest user compliance in order to reduce discomfort or distractions.

The technology can provide proactive feedback rather than reactive correction in real life by recognizing poor posture patterns before they worsen. Additionally, by recording sequential dependencies in postural data using Long Short-Term Memory (LSTM) models, the system may identify long-standing negative habits and alert users when they are getting close to ergonomic risk boundaries. Because posture directly affects focus and physical well-being, this is particularly important in educational and professional settings.Additionally, by combining posture monitoring with environmental Internet of Things sensors (such as ambient light, temperature/humidity, and noise meters), it becomes easier to differentiate between environmental triggers and strain caused by posture. Edge computing can be used to aggregate the data on local microcontrollers or SBCs (such as the Raspberry Pi or Jetson Nano), which use lightweight AI models trained in PyTorch Mobile or TensorFlow Lite to reduce latency and protect privacy.

However, intelligent eye blinking monitoring systems need to be greatly improved in order to become complete eye-health solutions, even though they are good at identifying dry eye symptoms or decreased blink rates. The majority of existing implementations use landmark-based facial recognition or Haar cascades, which are simple image processing techniques, to count blinks from webcam feeds. These techniques are adequate for basic monitoring, but they have trouble detecting partial or irregular blinks, working with users who wear glasses, and in low light. Moving from static computer vision techniques to AI-driven gaze and blink analysis driven by sophisticated machine learning models is the direction of the future. Deep CNNs that have been trained on extensive facial datasets (such as MPIIGaze, EYEDIAP, and NVGaze) can be used to accurately identify slow blinking, pupil dilation, micro expressions, and gaze fixation loss. Such attributes are crucial in evaluating how well a user manages their digital life and cognition as well as their cognitive load and fatigue. The user's blink rate as well as the duration of their screen engagement can be used to implement IoT-based real time feedback loops to automate break reminders, blue-light filtering, screen dimming, and other functions. Response and so-called lower-level context such as response from smart lamps or smart monitors can be controlled over MQTT or CoAP protocols to enable management of these smart ambient systems.

Bringing together postures and eye following into one IoT organize happens in a tumultuous, comprehensive ergonomic arrangement. For this circumstance fair would one faraway absent central door or cloud centre be utilized. It would apply AI/ML calculations to create choices after downloading inputs from various sensors: at slightest camera feeds for eye information; situate sensors for position; and condition sensors for setting. Bound together learning may offer assistance prevail security concerns, because it would be utilized to prepare models with data from various clients without the necessity for centralized data stockpiling. By planning models over various clients, disorderly learning might donate help address security concerns, especially for corporate or direction organizations. Clients would relate with a desktop or flexible application that gives real time dashboards, irrefutable prosperity designs, and client-usable ergonomic bits of information. Clients can address the app through substance or voice through models facilitated into the app by implies of Natural Language Processing (NLP).For example, client may ask: How was my pose amid think about hours for this week?" and received a visual summary in return.Through cloud-based services such as Google Cloud Auto ML, AWS SageMaker, or Purplish-blue ML Studio, the AI models can be constantly communicated with, retrained, and updated with user data ensuring that soon the system will adjust and tailor the response to the user's needs.

From a hardware as well as a scalability point of view, this means that devices will be more portable, affordable and energy consuming. Flexible printed electronics and smart textiles will enable office and study space independent continuous posture tracking and thus the development of wearables and posture measuring garments that communicate with the smart chair [44]. Furthermore, portable eye tracking modules based on tiny infrared cameras that can be integrated into headbands or eyeglass frames will enable non-intrusive 24-hour blink monitoring. Based on the developed system, the system will be able to improve human machine interfaces (HMI) in autonomous driving and aviation, as well as for medical applications, elder care and in education.Besides only, by assessing the likelihood of a important fatigue and prescribing prophylactic procedures akin to rescheduling or enhancing the setting, prescient analytics fashions (e.g. ARIMA, Prophet, or actually LSTM-based time-series investigation) will be applied to foster a actually cleverly consumer expertise [45]. Future research and utilize will be advanced by ordering the standard gathering of ergonomic information and the creation of situate stamping gadgets to assess the practicality of such systems. Biomedical engineers, ophthalmologists, ergonomists, remedially orchestrated AI, and AI masters must collaborate and comprehend one another for ergonomic acknowledgment to ended up clinically worthy. On the off chance that these gadgets are expecting to be utilized for preparing or in proficient settings, they ought to be subject to the same kind of certification [46]. Furthermore, this would build up a kind of modern benchmark for wellness avoidance [47].

It makes sense that government organizations and commercial companies have a command or a rule they must take after to guarantee that assessment strategies are utilized to extend the adequacy of experts and students, decrease security costs, and expect long-term hurt [48].

As we've seen, ergonomic intelligence can be brought to life by configuring an environment that goes remote past inactive perception to cleverly observing, AI integrative, and dynamic AI expansion. This will be conceivable through smart IoT-enabled detecting innovations and machine learning models that can learn, adjust, and advance over time [49]. These innovations will not basically analyse issues but anticipate, anticipate, and comprehend the require for activity in connection to the energetic human body and advanced biological systems. AI fuelled IoT systems will give the much-needed preventative care and shrewd direction as well as the correct motivational prompts to lead to positive alter, whether it is an attention-challenged students whose eyes are strained or a worker totally bowed over in persistent back torment due to drooped pose [50]. Such approaches will guarantee the human prosperity is protected, which is attending to be a challenge towards the coming decades due to overpowering dependence on innovation.

VI. CONCLUSION

The blending of Artificial Intelligence and Machine Learning innovations with the Internet of Things has the capability to revolutionize change checking and handling issues related to the abuse of innovation. Gadgets such as computers and tablets have ended up commonplace in classroom settings, declining pupils' pose and eye-strain. These wellbeing concerns may adversely affect learners' instructive results and by and large wellness. This review looks for arrangements requiring innovative approaches with dynamic input systems that proficiently address the depicted issues counting real-time checking.A promising improvement in reparative advancement may be the proposed Web of Things (IoT) based micro-posture and eye strain monitoring systems. In expansion to teaching students around the significance of legitimate pose and eye wellbeing, this proactive approach instructs students to develop the determination of more profitable inclinations that will lead to moved forward scholarly accomplishment. The literature survey in this research illustrates the adequacy of different IoT and AI-enabled observing systems in recognizing and treating eye strain and poor posture. For occasion, it has been illustrated that force-sensitive resistors and machine learning calculations empower savvy detecting chairs to recognize and adjust sitting positions in genuine time. At the same time, intelligent eye blinking checking gadgets have appeared guarantee in recognizing diminished.

VII.CONFLICT OF INTEREST

The author announce that they have no conflicts of interest with respect to the distribution of the paper. There were no budgetary, commerce, individual, and trade connections that can be considered a potential strife of interface within the setting of this ponder since this ponder was conducted without any exterior impact. All instruments and strategies utilized in this consider were chosen for their scholarly and logical merits without any exterior impact.

REFERENCES

[1] G. Yang et al., "A Health-IoT Platform Based on the Integration of Intelligent Packaging, Unobtrusive Bio-Sensor, and Intelligent Medicine Box," in IEEE Transactions on Industrial Informatics, vol. 10 (4), pp. 2180-2191, Nov. 2014, https://doi.org/10.1109/TII.2014.2307795

[2] A. Al-Fuqaha, M. Guizani, M. Mohammadi, M. Aledhari and M. Ayyash, "Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications," in IEEE Communications Surveys & Tutorials, vol. 17 (4), pp. 2347-2376, Fourthquarter(2015) https://doi.org/10.1109/COMST.2015.2444095

[3] Charalampos Doukas and Ilias Maglogiannis. 2012. Bringing IoT and Cloud Computing towards Pervasive Healthcare. In Proceedings of the 2012 Sixth International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing (IMIS '12). IEEE Computer Society, USA,922–926. https://doi.org/10.1109/IMIS.2012.26

[4] A. Esteva et al., "A guide to deep learning in healthcare," Nat. Med., vol. 25(1), pp. 24–29, Jan. 2019. https://doi.org/10.1038/s41591-018-0316-z

[5] L. Chen, J. Hoey, C. Nugent, D. J. Cook, and Z. Yu, "Sensor-Based Activity Recognition," IEEE Trans. Syst., Man, Cybern. C, vol. 42(6), pp. 790–808,Nov(2012). https://doi.org/1109/TSMCC.2012.2198883

[6] M. Mohammadi, A. Al-Fuqaha, S. Sorour, and M. Guizani, "Deep Learning for IoT Big Data and Streaming Analytics: A Survey," IEEE Commun. Surveys Tuts., vol. 20(4), pp. 2923–2960, 2018. https://doi.org/10.1109/COMST.2018.2844341

[7] Sheppard, Amy & Wolffsohn, James. (2018). Digital eye strain: Prevalence, measurement and amelioration. BMJ Open Ophthalmology. 3. e000146.https://doi.org/10.1136/bmjophth-2018-000146

[8] Loh, K. Y., & Reddy, S. C. (2008). Understanding and preventing computer vision syndrome. Malaysian Family Physician, 3(3), 128–130.https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4170366/.

[9] Straker, Leon & Pollock, Clare & Maslen, B. (2009). Principles for the wise use of computers by children. Ergonomics. 52. 1386-401. https://doi.org/10.1080/00140130903067789.

[10] American Optometric Association, "Computer Vision Syndrome (CVS) and digital screens," AOA Fact Sheet, 2020. [Online]. Available: https://www.aoa.org

[11] Rosenfield, Mark. (2016). Computer vision syndrome (a.k.a. digital eye strain). Optometry in practice. 17. 1-10.

[12] Peper, Erik & Lin, I-Mei & Harvey, Richard & Perez, Jacob. (2017). How Posture Affects Memory Recall and Mood. Biofeedback. 45. 36-41. https://doi.org/10.5298/1081-5937-45.2.01

[13] [N. Krause et al., "Physical workload, ergonomic problems, and incidence of low back injury," Am. J. Ind. Med., vol. 46(6), pp. 570–585, 2004. https://doi.org/10.1002/ajim.20094

[14] J.Y. Chau et al., "Are workplace interventions to reduce sitting effective? A systematic review," Prev. Med., vol. 51(5), pp. 352–356, 2010.https://doi.org/10.1016/j.ypmed.2010.08.012

[15] U. Ekelund et al., "Does physical activity attenuate or eliminate the detrimental association of sitting time with mortality?" Lancet, vol. 388(10051), pp. 1302–1310, 2016.https://doi.org/10.1016/S0140-6736(16)30370-1

[16] Biswas, Avi & Oh, Paul & Faulkner, Guy & Bajaj, R. & Silver, MA & Mitchell, Marc. (2015). Sedentary Time and Its Association With Risk for Disease Incidence, Mortality, and Hospitalization in Adults (vol 162, pg 123, 2015). Annals of internal medicine. 163. 400-400.https://doi.org/10.7326/L15-5134

[17] Ranasinghe, P et al. “Computer vision syndrome among computer office workers in a developing country: an evaluation of prevalence and risk factors.” BMC research notes vol. 9 150. 9 Mar. 2016,https://doi.org/10.1186/s13104-016-1962-1

[18] Reddy, S. C., Low, C., Lim, Y., Low, L., Mardina, F., & Nursaleha, M. (2013). Computer vision syndrome: a study of knowledge and practices in university students. Nepalese Journal of Ophthalmology, 5(2), 161–168. https://doi.org/10.3126/nepjoph.v5i2.8707

[19] Aggarwal, D., Sharma, D., & Saxena, A. B. (2022). Detection of eye strain due to usage of electronic devices: A machine learning based approach. International Journal of Health Sciences, 6(S1),11197–11207. https://doi.org/10.53730/ijhs.v6nS1.7707

[20] S. Patel et al., "A review of wearable sensors and systems with application in rehabilitation," J. NeuroEng. Rehabil., vol. 9(1), p. 21, Apr. 2012. https://doi.org/10.1186/1743-0003-9-21

[21] Faritha Banu, Jahir Hussain & R, Revathi & M, Suganya & N.R, Gladiss. (2020). IoT based Cloud Integrated Smart Classroom for smart and a sustainable Campus. Procedia Computer Science. 172.77-81 https://doi.org/10.1016/j.procs.2020.05.012

[22] M. A. Khan and K. Salah, "IoT security: Review, blockchain solutions, and open challenges," Future Generation Computer Systems, vol. 82, pp. 395–411, 2018. https://doi.org/10.1016/j.future.2017.11.022

[23] S. Alam, M. M. Rathore, and A. Paul, "Data fusion and IoT for smart ubiquitous environments: A survey," IEEE Access, vol. 5, pp. 9533–9554, 2017.https://doi.org/10.1109/ACCESS.2017.2708727

[24] American Optometric Association, "Computer Vision Syndrome," 2019. [Online]. Available: https://www.aoa.org

[25] J. Gubbi et al., "Internet of Things (IoT): A vision, architectural elements, and future directions," Future Generation Computer Systems, vol. 29(7), pp. 1645–1660, 2013. https://doi.org/10.1016/j.future.2013.01.010

[26] H. Alemdar and C. Ersoy, "Wireless sensor networks for healthcare: A survey," Computer Networks, vol. 54(15), pp. 2688–2710, Oct. 2010. https://doi.org/10.1016/j.comnet.2010.05.003

[27] L. Catarinucci et al., "An IoT-aware architecture for smart healthcare systems," IEEE Internet of Things Journal, vol. 2(6), pp. 515–526, Dec.2015. https://doi.org/1109/JIOT.2015.2417684

[28] Rosenfield M. (2011). Computer vision syndrome: a review of ocular causes and potential treatments. Ophthalmic & physiological optics: the journal of the British College of Ophthalmic Opticians (Optometrists), 31(5), 502–515. https://doi.org/10.1111/j.1475-1313.2011.00834.x

[29] Hasan, Dler. (2025). IoT-Based Smart Education: A Systematic Review of the State of the Art. Journal of Intelligent Systems and Information Technology.2.1-16. https://doi.org/10.61971/jisit.v2i1.106

[30] R. Coles-Brennan, J. Sulley, and D. Young, "Management of digital eye strain," Clin. Exp. Optom., vol. 102(1), pp. 18–29, 2019.https://doi.org/10.1111/cxo.12798

[31] S. C. Mukhopadhyay, "Wearable sensors for human activity monitoring: A review," IEEE Sensors Journal, vol. 15(3), pp. 1321–1330, 2015. https://doi.org/10.1109/JSEN.2014.2370945

[32] Nadeem, M., Elbasi, E., Zreikat, A. I., & Sharsheer, M. (2024). Sitting Posture Recognition Systems: Comprehensive Literature Review and Analysis. Applied Sciences, 14(18), 8557. https://doi.org/10.3390/app14188557

[33] Gupta, M.; Sharma, S.; Bhatia, M.; Gupta, N. Similarity index retrieval for school kids’ sitting posture identification. In Predictive Data Modelling for Biomedical Data and Imaging; River Publishers: Aalborg, Denmark, 2024; pp. 231–247.

[34] Ordean, M.-N., Oarcea, A., Stan, S.-D., Dumitru, D.-M., Cobîlean, V., & Bîrză, M.-C. (2022). Analysis of Available Solutions for the Improvement of Body Posture in Chairs. Applied Sciences, 12(13), 6489. https://doi.org/10.3390/app12136489

[35] Manlove, David & Milne, Duncan & Olaosebikan, Sofiat. (2020). Student-project allocation with preferences over projects: Algorithmic and experimental results. Discrete Applied Mathematics. 308. http://dx.doi.org/10.1016/j.dam.2020.08.015

[36] JDahlhamer, J., Lucas, J., Zelaya, C., Nahin, R., Mackey, S., DeBar, L., Kerns, R., Von Korff, M., Porter, L., & Helmick, C. (2018). Prevalence of Chronic Pain and High-Impact Chronic Pain Among Adults - United States, 2016. MMWR. Morbidity and mortality weekly report, 67(36), 1001–1006. https://doi.org/10.15585/mmwr.mm6736a2

[37] N.M. Daraiseh, S.N. Cronin, L.S. Davis, R.L. Shell, W. Karwowski, Low back symptoms among hospital nurses, associations to individual factors and pain in multiple body regions, International Journal of Industrial Ergonomics, Vol 40(1), 2010, Pages 19-24, ISSN 0169-8141,https://doi.org/10.1016/j.ergon.2009.11.004

[38] Dunstan, D.W., Dogra, S., Carter, S.E. et al. Sit less and move more for cardiovascular health: emerging insights and opportunities. Nat Rev Cardiol 18, 637–648 (2021). https://doi.org/10.1038/s41569-021-00547-y

[39] English C, Janssen H, Crowfoot G, et al. Breaking up sitting time after stroke (BUST-stroke). International Journal of Stroke. 2018;13(9):921-931. https://doi.org/10.1177/1747493018801222

[40] Y. Tomita et al., "Effects of sitting posture and jaw clenching on neck and trunk muscle activities during typing," J. Oral. Rehabil., vol. 48, pp. 568–574, 2021.https://doi.org/10.1111/joor.13152

[41] International Labour Organization (ILO), "Teleworking arrangements during the COVID-19 crisis and beyond," 2021.

[42] D. F. Odesola et al., "Smart Sensing Chairs for Sitting Posture Detection, Classification, and Monitoring: A Comprehensive Review," Sensors, vol. 24(9) p. 2940, 2024. https://doi.org/10.3390/s24092940

[43] A. A. Jiman et al., "Intelligent Standalone Eye Blinking Monitoring System for Computer Users," J. Eye Mov. Res., vol. 17(5), pp. 1–17, 2024. https://doi.org/10.16910/jemr.17.5.1

[44] X. He et al., "Flexible wearable sensors for human motion monitoring," Sensors, vol. 25(5), p. 1377, 2025. https://doi.org/10.3390/s25051377

[45] Patel, S.; Park, H.; Bonato, P.; Chan, L.; Rodgers, M. "A Review of Wearable Sensors and Systems with Application in Rehabilitation." J. NeuroEngineering Rehabil., vol. 9, p. 21, 2012. https://doi.org/10.1186/1743-0003-9-21

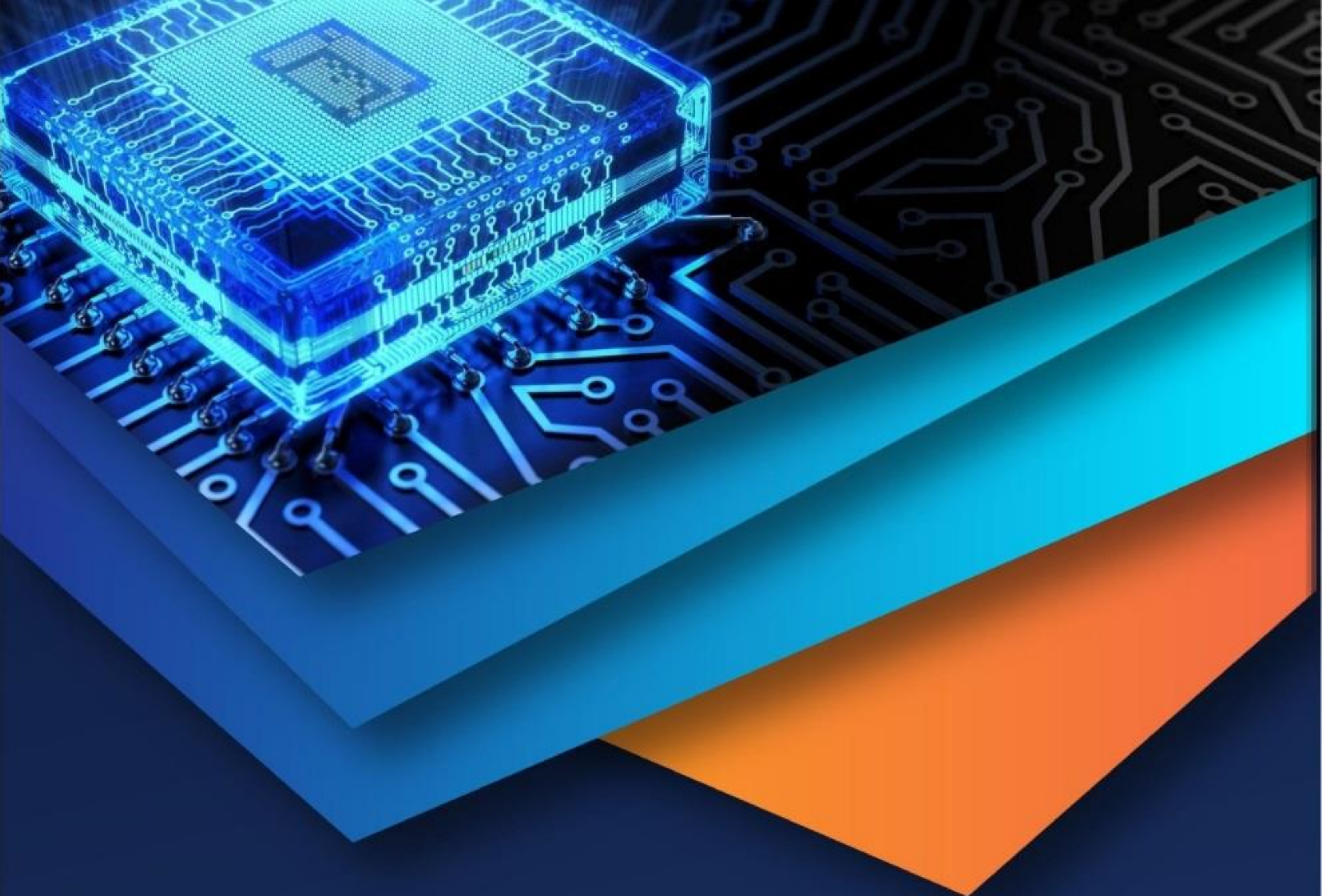
[46] Brownlee, J. Deep Learning for Time Series Forecasting: Predict the Future with MLPs, CNNs and LSTMs in Python; Machine Learning Mastery: 2018. Available online: https://machinelearningmastery.com/deep-learning-for-time-series-forecasting/

[47] International Organization for Standardization. ISO 13482:2014 Robots and Robotic Devices — Safety Requirements for Personal Care Robots; ISO: Geneva, Switzerland, 2018. Available online: https://www.iso.org/standard/53820.html

[48] World Health Organization. Global Action Plan on Physical Activity 2018–2030: More Active People for a Healthier World; WHO Press: Geneva, Switzerland, 2019. Available online: https://www.who.int/publications/i/item/9789241514187

[49] Occupational Safety and Health Administration. Ergonomics: The Study of Work; OSHA: Washington, DC, USA, 2021. Available online: https://www.osha.gov/ergonomics

[50] Tihomir, Opetuk; Dukic, Goran; Cajner, Hrvoje; Trstenjak, Maja. "Use of Artificial Intelligence (AI) in the Workplace Ergonomics of Industry 5.0." Tehnički glasnik, vol. 19, pp. 335–340, 2025.https://doi.org/10.31803/tg-20250105140152



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

TOGETHER WE REACH THE GOAL

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY