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Article

IoT-Infused Stress Analysis and Recommendation System for Humans Through Sensor Data Monitoring

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Abstract: This research conducts a thorough examination of the physiological reactions to stress, particularly in the setting of remote work and virtual learning environments, in light of the heightened stress levels observed among workers and students during the COVID-19 pandemic. The study carefully examines several factors that affect stress levels in both remote workers and students, recognising the importance of understanding these responses. The research used a multidisciplinary methodology, integrating perspectives from psychology, physiology, and technology, to elucidate the principal elements that exacerbate stress in these populations. The suggested approach has significant effects on occupational health because it provides remote workers with access to tools and resources that can improve their work environments. Similarly, the system can enhance the health of students learning online by providing them with essential support during the challenges of remote learning. Additionally, this technology can be applied in areas beyond these. It is useful in telemedicine and helps create technology-based solutions for managing stress and improving health. We aim to help individuals manage the stress of working from home and learning online by leveraging new technologies and a deeper understanding of psychology. Ultimately, our goal is to help people become more resilient and healthy in the face of these new challenges.

Keywords: Stress Management, Remote Workers, Students, Mental Health, Physiological Responses, Technological Innovations, Embedded Systems, Real-Time Operating System (Rtos)

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1. Introduction

The COVID-19 pandemic has created unprecedented issues for individuals globally, with workers and students especially vulnerable to heightened stress levels due to the sudden transition to remote work and virtual learning [71]. This research begins a critical examination of stress management solutions designed to meet the specific needs of communities significantly affected by this global crisis on mental health [59]. In the midst of the turmoil brought on by the epidemic, it is essential to comprehend the physiological reactions to stress. Both remote workers and students are facing new sources of stress, including feeling more isolated, struggling with technology, and pressure to excel academically [97]. To effectively address these issues, it is crucial to thoroughly investigate the causes of stress and identify actionable solutions that promote well-being in the face of adversity [90]. The goal of this project is to integrate psychological insights with new technologies to create a comprehensive approach for remote professionals and students to manage stress [99]. The project aims to develop a comprehensive system that provides personalised advice and suggestions tailored to each individual's needs and preferences, leveraging innovative concepts in psychology and technology. The ramifications of this research transcend the domains of occupational health and instructional technology [70]. The study's contribution to the development of technology-driven solutions for stress management suggests potential applications in telemedicine, as well as the enhancement of overall health and well-being [83].

Stress is a normal response of the body and mind to perceived dangers or expectations [84]. During the COVID-19 crisis, many people were under a lot of stress because they were unsure about the future, their daily routines were disrupted, and they were always at risk of getting sick. Remote workers experienced a dissolution of conventional distinctions between professional and personal lives, leading to prolonged working hours and perpetual connectedness. Students faced increased academic stress due to online tests, unreliable internet connections, and fewer opportunities to seek help from their peers [54]. In both groups, the lack of physical engagement and supportive social situations heightened the perception of isolation, worsening feelings of anxiety and sadness. Research has demonstrated that prolonged stress results in the overactivation of the hypothalamic-pituitary-adrenal axis, leading to dysregulation of cortisol, which adversely affects concentration, decision-making, and emotional stability [73]. These physiological impacts demonstrate the importance of implementing organised interventions that mitigate the negative effects of stress and help individuals learn to cope with it healthily [96].

Mindfulness, physical activity, relaxation techniques, and therapy remain effective ways to manage stress. However, during the pandemic, their usefulness was limited by rules on travel, social distancing, and the inability to attend in-person treatment or group activities [62]. This restriction highlights the importance of integrating digital technology and embedded systems to develop innovative methods for providing mental health support remotely. Smartphones, wearable devices, and sensor-enabled platforms are ubiquitous, which means there is ample opportunity to create systems that continuously monitor physiological indicators such as heart rate variability, galvanic skin response, and sleep patterns [82]. By utilising AI algorithms to analyse these indicators, individuals can receive real-time feedback and guidance to help them manage stress before it escalates.

Embedded systems are an ideal platform for these kinds of applications because they can operate independently, analyse data quickly, and integrate seamlessly with other digital systems [95]. An embedded system is a controller programmed and controlled by a real-time operating system, with a specific purpose within a larger mechanical or electrical system. This is generally done in real-time, which means that the embedded system must deal with computing limits [81]. It is built into a complete gadget, which typically includes both hardware and mechanical components. Embedded systems control numerous items that people use daily. Ninety-eight per cent of all microprocessors are designed to be part of embedded systems [60]. When compared to general-purpose computers, embedded computers are typically smaller, consume less power, operate in harsh conditions, and cost less per unit. This comes at the cost of restricted processing resources, which makes programming and interacting with them significantly more challenging [85]. However, by leveraging the intelligence of the hardware, utilising existing sensors, and capitalising on a network of embedded units, you can optimise the existing resources and introduce new features that extend beyond current capabilities [98].

When it comes to managing stress, embedded systems can be used to monitor situations and intervene when necessary, without disrupting users [69]. For instance, wearable devices equipped with biosensors can continuously monitor physiological stress indicators throughout the day and transmit the information to a central embedded controller for processing [94]. When stress levels rise, the system can then provide individualised suggestions, such as guided breathing exercises, reminders to take breaks, or alerts about poor sleep habits [63]. Embedded systems ensure low latency and dependable responsiveness by operating in real-time and utilising lightweight computational models [80]. These traits are especially important for managing stress, as acting quickly can stop things from getting worse and help people feel better emotionally.

Additionally, embedded systems enable you to combine multiple smart strategies that enhance their performance [76]. For example, power management is crucial for wearable gadgets because prolonged use can quickly drain their batteries. Smart embedded algorithms can reduce power consumption by only activating sensors when necessary, utilising effective data compression, or employing edge computing strategies that minimise the need for continuous cloud connectivity [56]. Adaptive learning systems can also create more customised stress management plans by analysing past data and identifying patterns unique to each user. The system becomes increasingly effective at predicting stressful occurrences and suggesting the most effective ways to deal with them over time [91]. This individualised approach is consistent with psychological theories of stress management that highlight variations in coping mechanisms and resilience among individuals.

Embedded systems can be used for stress management in more than just individual users; they can also be used in larger social settings. As more companies transition to hybrid or fully remote work models, remote workers become an increasingly important group of individuals [61]. Embedded systems can be utilised in workplace health programs to monitor employees' health and well-being, helping them avoid burnout. For instance, businesses might provide their workers with wearable gadgets that connect to built-in platforms, which collect anonymous data and display patterns of stress within groups [89]. Organisations can use this information to create initiatives that support their employees, such as adjusting workloads, introducing wellness programs, or enhancing digital collaboration tools [79]. At the same time, strong rules about privacy must be followed to protect personal information and provide employees discretion over how their information is used.

Likewise, students can gain advantages from embedded devices designed for educational environments [75]. During the epidemic, students were stressed due to schoolwork, the inability to socialise, and uncertainty about their future career paths. Smart devices that integrate with learning platforms could provide students with tools to monitor their stress levels and alert them when mental fatigue is hindering their learning [64]. Embedded systems could potentially be connected to internet counselling services or peer support networks, making it easier to access emotional help when needed [86]. As education continues to embrace digital change, incorporating stress management techniques into learning technologies offers significant potential for enhancing both academic achievement and psychological well-being.

Another essential consideration is the role of embedded systems in telemedicine and remote healthcare delivery [77]. The epidemic accelerated the adoption of telehealth services worldwide, demonstrating how digital technologies can help people access the care they need. Healthcare professionals can utilise wearable devices and mobile apps integrated into embedded systems to develop remote stress monitoring platforms that support patients. These technologies can securely send data to doctors, allowing them to continuously monitor mental health markers without needing to visit the office [55]. Utilising blockchain-based frameworks and secure communication protocols can help safeguard and maintain the privacy of health data. This ensures that people trust the system and feel confident about using it in their daily lives [92].

When you include embedded systems in stress management plans, it also brings up major ethical and technical

issues. It is crucial to ensure that physiological measurements are accurate, not to rely too heavily on technology, and to safeguard against biases in algorithms. Additionally, accessibility must be a top priority so that people from all walks of life, especially those living in rural or low-income areas, can afford and utilise technology [58]. If these systems aren't open to everyone, the benefits of integrated stress management systems could only accrue to some groups, exacerbating current disparities [87]. To address these issues and ensure that embedded technologies for stress management are safe, effective, and equitable, psychologists, engineers, data scientists, and policymakers must collaborate across disciplines.

In the future, advancements in artificial intelligence and machine learning are likely to further enhance embedded systems [67]. Deep learning algorithms on optimised integrated hardware can evaluate complicated physiological signals more accurately. Reinforcement learning models can also change intervention techniques based on real-time feedback [100]. Neuromorphic computing and quantum-inspired architectures are also emerging technologies that could make embedded systems more powerful without requiring increased energy consumption [74]. These new ideas will enable the creation of even more advanced stress management tools that seamlessly integrate into users' lives without being intrusive and adapt to their individual needs [93].

The combination of psychology, technology, and embedded systems presents an opportunity to make a significant impact on one of the most pressing problems of the post-pandemic era [72]. Creating embedded platforms for stress management not only helps with the immediate effects of the COVID-19 situation, but it also makes people more resilient to future problems [78]. Embedded solutions can be highly beneficial for mental health, reducing burnout, and enhancing quality of life in settings such as remote work environments, schools, and hospitals [65]. By utilising the advantages of embedded systems, society can move toward a more comprehensive view of health that recognises the relationship between mind, body, and technology.

The COVID-19 pandemic has highlighted the susceptibility of remote workers and students to heightened stress levels due to unparalleled disruptions to daily life. Conventional stress management techniques, although beneficial, proved inadequate in addressing the unique issues of this situation [68]. Embedded systems are a valuable tool for building technology-driven stress management solutions because they are efficient, flexible, and capable of monitoring things in real-time [88]. By merging psychological insights with smart, embedded platforms, we can create personalised, easy-to-use, and effective therapies that help people better manage stress. This strategy has effects that go beyond only recovering from the epidemic [57]. It will also have long-lasting effects on workplace health, educational innovation, and telemedicine. Through ongoing study, development, and ethical monitoring, embedded systems have the potential to change the way people perceive and manage stress, ultimately leading to a healthier and more resilient future [66].

Literature Review

During the COVID-19 pandemic, working from home (WFH) has led to increased stress among people. New data indicate that the issue has affected individuals who work or attend school online. Stress is the body's natural response to events that occur within and outside of it [2]. Stress is a normal part of life, but if you work online and are around stressors for a long time, it can cause major health problems if you don't do anything to control it. We have conducted numerous studies to identify the key factors associated with the stress levels of online workers. Our research led to the development of a desktop program that can tell you how stressed you are in real time [37]. The results showed that our system, as a whole, was able to produce outputs that were more than 70% accurate. It will make the best guesses on how to avoid health problems [22]. Our primary goal is to support individuals who work online in leading healthy lives. We will provide users with updates based on the input we receive from them in the future. In the future, our system will be the most valuable tool for online workers [42].

Mindfulness meditation has been practised by experts and young people for hundreds of years. Regular contemplation practice can help calm your mind and have a positive impact on your overall health [40]. Emotional intelligence, or EQ, is the ability to understand and manage your emotions effectively. Studies show that EQ is a better measure of growth and well-being than IQ. Job stress occurs when an employee's needs don't align with their skills, resources, or abilities. Studies indicate that "thought decrease" or "mental quietness" may exert specific effects on work-related stress and emotional well-being. Many people turned to the internet to continue meditating, as it was easily accessible and helped them, especially during the pandemic [8]. The primary objectives of this article were: 1) To examine the disparity between the experimental and control groups on the aspects of emotional intelligence. 2) To examine the disparity between the experimental and control groups for the aspects of Work Stress [51]. An empirical-analytical methodology was employed via a comprehensive evaluation of current literature and two established questionnaires to examine the Emotional Intelligence and Work stress levels of participants participating in online meditation. An experimental research design was utilised to gather data for this study. Stress and emotional health are closely related in their impact on a person's overall well-being.

Many research groups are paying close attention to how to make work better for people [50]. Digital transformation in human factors and ergonomics will especially give the next generation of the socio-technical workforce more influence [36]. The core of this digital transition is the employment of wearable sensors, collaborative robots, and exoskeletons, along with new technologies that can measure human ergonomics in real time. In this context, this study addresses the unresolved issue of calculating the contact wrench experienced at human extremities (e.g., hands), where direct sensor readings are impractical [39]. We call our method "non-collocated wrench estimation" because we want to find the wrench at known contact points without using any direct force-torque sensor readings at those points [52]. We accomplish this by enhancing the stochastic inverse dynamics framework for humans through the incorporation of a centroidal dynamics constraint, enabling a dependable non-collocated estimation of the interaction wrench and the joint torques (articular stress) resulting directly from the interaction [7]. Our method of non-collocated estimation has been rigorously tested for both payload estimation and articular stress estimation in validation and experimental situations involving dynamic human movements, such as walking [41].

In the upcoming Industry 5.0, people will play a crucial role in the human-cyber-physical system [1]. Inappropriate job materials cause stress and have negative impacts on human performance. To monitor workers' health while they are working, engineering apps detect physiological signals [21]. This way, the work content may be changed as needed [53]. The primary objective of this study is to determine whether heart rate variability (HRV) can serve as a reliable and accurate method for measuring acute work-content-related stress (AWCRS) in real-time when individuals are working in an industrial setting. Second, we intend to present a more extensive application of heart rate variability (HRV) as a stress indicator in this context. Ways: A search was performed in Scopus, IEEE Xplore, PubMed, and Web of Science from January 1, 2000, to June 1, 2022. Eligible articles are examined for study design, population, evaluation of AWCRS, and its correlation with HRV. Results: Fourteen studies fulfilled the inclusion criteria [4]. There was no randomised controlled experiment (RCT) to examine the link between AWCRS and HRV. Five observational studies were conducted. Nine other studies assessed both AWCRS and HRV, although their correlations were not examined [35]. Findings indicate that HRV does not completely represent the AWCRS during labour, and measuring the impact of AWCRS on HRV in a genuine manufacturing setting presents challenges.

Facial expressions show what people are thinking and feeling. It provides the spectator with numerous social cues, such as what to pay attention to, what they want to do, and how they feel. People think of it as a powerful way to communicate without words [9]. Examining these expressions provides a markedly deeper understanding of human behaviour. AI-based Facial Expression detection (FER) has emerged as a significant research area in recent years, with applications in dynamic analysis, pattern detection, interpersonal interaction, mental health monitoring, and numerous others [14]. However, because the COVID-19 pandemic has prompted people to use online platforms more frequently, there has been a strong need to develop a new FER analysis framework to keep pace with the increasing volume of visual data from videos and photos.

Additionally, the emotional facial expressions of children, adults, and older people differ, which must also be considered in the FER study [20]. Numerous studies have been conducted in this area. However, it lacks a comprehensive overview of the literature, which would provide insight into past research and suggest future directions. The authors of this study have done a thorough review of AI-based FER methods, covering datasets, feature extraction methods, algorithms, and current achievements in facial expression recognition [3]. This is the only review paper that discusses all aspects of FER for different age groups, and it will have a significant impact on the research community in the next few years [38].

Project Description

The current digital stress management system differs significantly from conventional ones [15]. It requires a comprehensive approach to identifying, managing, and mitigating stressors in people's lives. The system utilises powerful sensors and data analytics to continuously monitor physiological signs of stress, including heart rate variability and sleep patterns [10]. It features an intuitive interface that is compatible with various devices. Obtaining this data in real-time enables the identification of the exact causes of stress, facilitating prompt intervention to mitigate it. Each user receives personalised advice on how to manage stress, including guided meditation sessions, breathing exercises, and physical activities tailored to their preferences and stress levels. Users can also set specific stress management goals and track their progress over time [6]. The system gives them visuals and information that help them understand their stress patterns. Timely reminders and notifications encourage consumers to take actions that help them manage stress [23]. At the same time, utilising external resources such as online wellness programs and mental health services can enhance overall health and resilience. In short, the digital stress management system provides people with a proactive, individualised, and long-lasting approach to managing stress, empowering them to take charge of their mental health and well-being in today's fast-paced environment.

The system also features tools that encourage people to engage in stress management activities on a regular basis [43]. Timely reminders and notifications encourage users to take actions that help them manage stress, which keeps them on track to achieve their goals. The system also integrates with external resources, including online wellness programs and mental health services, providing users with access to a wealth of information and support [11]. To summarise, the digital stress management system is a proactive, tailored, and long-term approach to managing stress [13]. The system empowers people to take control of their mental health and well-being in today's fast-paced environment by monitoring their physiological signs of stress, providing personalised advice, and tracking their progress toward their goals.

Proposed System

The proposed method aims to circumvent problems by providing a separate desktop application [19]. It has ECG sensors, control modes, and tailored treatments that help people manage their stress. It was designed to meet the unique needs of remote work during the pandemic, ensuring that everyone receives the support they need to stay healthy and productive [44]. We use a Convolutional Neural Network (CNN) technique to analyse ECG data in our study. Using deep learning, CNN quickly identifies complex patterns in ECG signals, which enhances the accuracy and utility of stress assessment in our stress management system [16].

Electrocardiography (ECG) is a valuable tool for monitoring the heart's electrical activity, which can help doctors diagnose heart conditions [29]. However, ECG signals can pick up noise, which can obscure critical parts, such as the PR and QT intervals. The AD8232 Single Lead Heart Rate Monitor is designed to solve this problem by serving as an operational amplifier (op-amp) to help obtain a clear signal from these intervals, even in the presence of significant noise [49]. This module is an integrated signal conditioning block for ECG and other bio-potential measurement applications. It has all the capabilities you need to connect to microcontrollers, such as Arduino [5].

There are a few important steps to making a Convolutional Neural Network (CNN) for AI to find sweat [34]. Initially, a heterogeneous dataset comprising both sweat and non-sweat scenarios is assembled to guarantee representation across different conditions [45]. After this, data preprocessing methods, including scaling, normalisation, and augmentation, are used to make the dataset more consistent and easier to learn from [30]. The dataset is carefully labelled to indicate whether perspiration is present, which serves as the basis for supervised learning. After that, the architecture of the CNN is built, using either a standard design, such as VGG or ResNet, or a proprietary one. To train the model, its weights are optimised across epochs on the labelled dataset. A separate validation set is utilised to stop overfitting [12]. Hyperparameters are adjusted to achieve optimal performance, and the model's effectiveness is evaluated on a separate test set using metrics such as accuracy, precision, recall, and F1 score. After being tested, the CNN may be used in real-world situations, whether it's in mobile apps, web services, or other platforms. Continuous improvement remains important, and regular updates and retraining ensure that the model can adapt to new situations and datasets [24]. When using AI models for sensing or monitoring applications, the ethical issues of user privacy and consent are crucial (Figure 1).

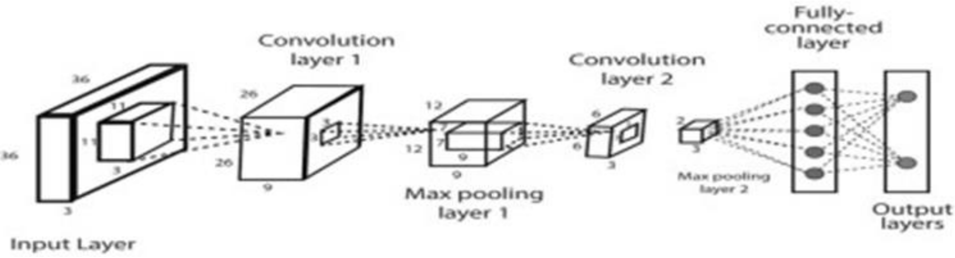

Figure 1. CNN Block Diagram.

There are several important processes and considerations to keep in mind when creating a Convolutional Neural Network (CNN) for AI to detect sweat. These steps include collecting and cleaning data, designing the model, training it, testing it, implementing it, and continually improving it over time. This step is crucial for creating a system that can reliably and effectively detect perspiration, which may be utilised in various industries [28]. This article goes into great detail about each step in creating a CNN to detect perspiration and the ethical issues that should be considered at every stage [46]. Convolutional Neural Networks (CNNs) have performed very well in numerous computer vision tasks, including image classification, object detection, and image segmentation. There has been considerable interest in employing CNNs for biomedical applications over the last several years. For example, they can be used to examine medical images and identify physiological signals [33]. One such use is detecting perspiration, which can provide important information about a person's health, hydration, and level of physical activity.

Collecting Data: The first step in creating a CNN that can detect sweat is to gather a variety of data that includes both sweaty and non-sweaty situations. This dataset should include pictures or sensor data that show diverse skin types, various lighting conditions, and different levels of activity. The dataset should be carefully curated to ensure it is balanced and accurately represents the group of people it is intended to represent [25]. Preparing Data: After gathering the dataset, it needs to be cleaned up to make it more accurate and useful for training the CNN. This could involve adjusting the size of pictures, ensuring that all pixel values are consistent, and adding more data to increase its size and diversity. Data augmentation methods, such as flipping, rotating, and scaling, can help the model perform better with data it hasn't seen before. Labeling. The next step is to mark each data point in the dataset to indicate whether it has perspiration on it [47]. For supervised learning to be effective, the labels must be accurate. This is because they provide the model's predictions with real-world examples to compare them to during training.

The structure of CNN. The success of the sweat detection system depends on choosing the right CNN architecture. Another option is to create a custom CNN architecture according to the task's needs. Training: After choosing the CNN architecture, the model needs to be trained on the labelled dataset. The model learns to identify patterns and features in the data that indicate sweat production as it is being trained [18]. The purpose of the training phase is to minimise a loss function that measures how far off the model's predictions are from the ground truth labels. To do this, the model's weights are optimised using gradient descent and backpropagation. Hyperparameter Tuning: The learning rate, batch size, and choice of optimiser are all hyperparameters that can have a significant effect on how well the CNN performs [27]. Experimenting with and validating these hyperparameters can help make the model more accurate and better at generalising.

Assessment: After training, a different test set is used to evaluate how well the CNN performs. You can use metrics such as accuracy, precision, recall, and F1 score to measure how well the model performs in detecting sweat. To make sure the model is strong and reliable, it should be tested on a wide range of test data. Deployment: After training and testing the CNN, it can be deployed in real-life applications [48]. For example, this could involve integrating the model into a mobile app, a web service, or another platform that can detect sweat. It is important to make sure that the model that is put into use fits the application's performance and ethical standards [17]. Always Getting Better: Developing a CNN that can detect sweat is an ongoing process that requires continuous improvement. The model can remain useful and relevant by receiving regular updates and retraining to keep pace with evolving situations and datasets. Things to think about when it comes to ethics [31]. When creating and using a CNN to detect sweat, ethical considerations should always take precedence. These include ensuring that the people whose data is being used have given their consent and that their privacy is protected, reducing bias in the dataset and model, and clearly explaining to stakeholders what the technology can and can't do.

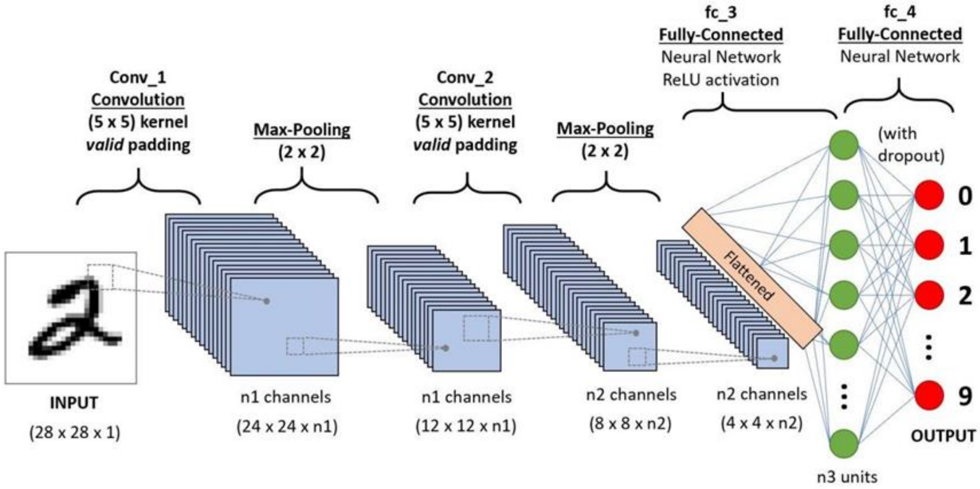

Figure 2. Layer Architecture of CNN.

To create an artificial intelligence system that can detect perspiration, several steps are required, including collecting data, cleaning it, designing the model, training it, testing it, utilising it, and continually improving it [26]. Researchers and developers can create reliable and useful systems for detecting sweat by following these procedures and considering the ethical implications of the technology [32]. These systems can be utilised in healthcare, sports science, and biometric verification applications (Figure 2).

Applications

Real-time Systems: Embedded C is a popular language for developing real-time systems, including medical devices, automotive electronics, industrial automation, and consumer electronics [107].

Programming Microcontrollers: The primary language used to program microcontrollers is Embedded C. Microcontrollers are tiny computers that operate independently and are utilised in embedded systems [103]. They typically lack sufficient computing power, memory, or means to send and receive data.

Peripheral Control: With Embedded C, developers can interact with hardware peripherals such as GPIO (General Purpose Input/Output) and UART (Universal Asynchronous Receiver/Transmitter).

Low-level programming: Embedded C programming often involves low-level tasks, such as modifying memory, manipulating bits, and accessing registers directly. For embedded systems with limited resources to function effectively, they require this level of control [104]. Handling Interrupts: Embedded C allows for interrupt-driven programming, which means that code can be stopped by events outside of the program, such as timer overflows, GPIO changes, or the receipt of serial data. These events are handled quickly with the help of interrupt service routines (ISRs).

Power Optimisation: Programmers who work with embedded C generally optimise their code to utilise less power, as many embedded devices run on batteries or require efficient energy usage [106]. To save power, sleep modes, clock gating, and low-power peripherals are used.

Embedded C is also used to create software for RTOS (Real-Time Operating Systems), which enable embedded computers to schedule tasks, run multiple tasks concurrently, and manage resources. RTOS enables the development of complex embedded applications that can execute multiple tasks concurrently. Embedded C is a powerful and flexible language for making software for embedded systems [101]. It provides precise control over hardware peripherals and makes efficient use of resources.

Safety-Critical Systems: Embedded C is widely used in safety-critical systems, such as those in the aerospace, defence, and medical fields, where dependability and fault tolerance are crucial.

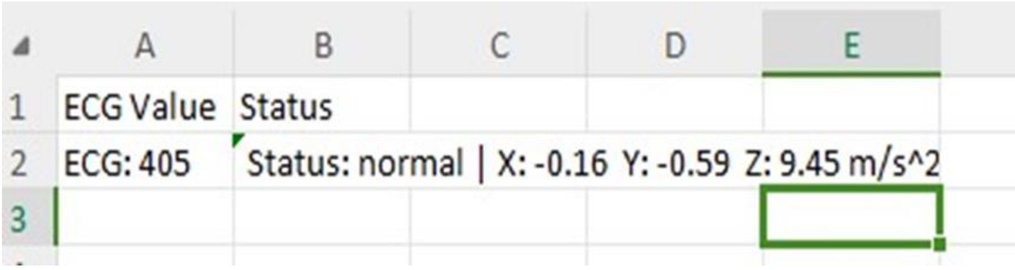

Figure 3. Sample Output.

In conclusion, our proposed approach represents a significant step forward in addressing the challenges of stress management, particularly in the context of working from home during the pandemic [108]. We aim to address the current issues by providing a specialised desktop app that integrates with ECG sensors, control modes, and individualised therapies. This will help people lead healthier and more productive lives. Adding a Convolutional Neural Network (CNN) algorithm to our system to analyse ECG data makes stress assessment more accurate and useful. Our method utilises deep learning to identify complex patterns in ECG signals efficiently, thereby enhancing the accuracy of stress monitoring and intervention strategies [105]. Our new method not only addresses the unique challenges of working from home, but it also lays the groundwork for effective stress management solutions in various situations. This will lead to better health outcomes and more productivity for individuals (Figure 3).

In conclusion, the IoT-Enclosed Stress Analysis and Recommendation System for Humans via Data Monitoring utilising the CNN project effectively established the feasibility of real-time stress monitoring and recommendation. By utilising ECG sensor data and IoT technologies, we were able to accurately assess the stress levels of individuals and provide them with timely suggestions for activities that would help them relax [102]. The results indicate that IoT and machine learning can help individuals feel better and manage their stress.

2. Conclusion

Adding machine learning techniques to the project could enhance its ability to analyse and predict data. We can develop predictive analytics tools that can estimate stress levels and suggest personalised therapies by training models on the data we have collected. Adding more sensors to the project could provide a clearer picture of how users' bodies react to stress. Adding other sensors, such as galvanic skin response sensors or temperature sensors, could provide a more comprehensive understanding of what causes stress. Making apps for mobile devices. If you created a mobile app that integrated with the project, people could use it to check their stress levels and access help while on the road. The software can provide users with real-time feedback, remind them to engage in activities that promote relaxation, and track their progress. This would make users more engaged and supported. Cloud Integration for Storing and Analysing Data: Using cloud-based solutions for storing and analysing data would make it easier to scale and access. By safely storing data in the cloud, we can make it easier to access it remotely, collaborate on research, and perform more complex analytics. To get the most out of the project's desktop or mobile app, you need to continually improve the user interface and experience. To make users happier, it will be crucial to conduct user testing and gather feedback to enhance the design and functionality of the interface. Our project primarily focuses on managing stress when working or attending school from home, but it may also be applicable in other areas. Examining how the project can be applied in healthcare, sports performance monitoring, or personal wellness could increase its impact and reach a broader audience.

REFERENCES

[1] Tirupachuri, Y., Ramadoss, P., Rapetti, L., Latella, C., Darvish, K., Traversaro, S. and Pucci, D., 2021. Online non-collocated estimation of payload and articular stress for real-time human ergonomy assessment, New York, USA, 2021.

[2] V. K. R. Bandaru and D. S. Gondi, "Ensuring Data Privacy and Security in Health Tech: Challenges and Solutions in the Age of Digital Health," SSRN, 2020. [Online]. Available: https://ssrn.com/abstract=5112043

[3] D. Sai and H. Mashetty, "Enhancing Federated Learning Evaluation: Exploring Instance-Level Insights with SQUARES in Image Classification Models," J. Electrical Systems, vol. 20, no. 7s, pp. 2516–2523, 2024.

[4] K. Sathish, D. S. Gondi, V. K. R. Bandaru, K. K. Kumar, K. P. Rao, and M. Bhutani, "Artificial Intelligence and Machine Learning in Space Cyber Defense," in Advanced Cyber Defense for Space Missions and Operations: Concepts and Applications, pp. 61–84, 2025.

[5] D. S. Gondi, V. K. R. Bandaru, K. Sathish, K. Kanthi Kumar, N. Ramakrishnaiah, and M. Bhutani, "Balancing Innovation with Patient Privacy Amid Ethical Challenges of AI in Health Care," in Proc. Int. Conf. on Innovative Computing and Communication, Singapore, Feb. 2025, pp. 555–576.

[6] R. Raj, D. S. Gondi, S. R. Nitnaware, S. Banerjee, S. Athithan, and Arpita, "Remote Sensing–Based Food Processing for Changing Climatic Conditions," Remote Sensing in Earth Systems Sciences, vol. 8, no. 2, pp. 484–495, 2025.

[7] D. S. Gondi, "Designing Resilient and Scalable Systems for Green Healthcare IoT," in Development and Management of Eco-Conscious IoT Medical Devices, IGI Global Scientific Publishing, USA, 2026, pp. 155–182.

[8] D. S. Gondi, "Strategies for Implementing Sustainability Practices in Smart Hospitals," in Responsible Innovation in Smart Healthcare: AI, IoT, and Ethical Sustainability Practices, IGI Global Scientific Publishing, USA, 2026, pp. 307–338.

[9] S. G. K. Peddireddy, "Advancing Threat Detection in Cybersecurity through Deep Learning Algorithms," FMDB Transactions on Sustainable Intelligent Networks., vol.1, no. 4, pp. 190–200, 2024.

[10] S. G. K. Peddireddy, "Integrating AI for Proactive Network Defense against Emerging Security Vulnerabilities," FMDB Transactions on Sustainable Computer Letters., vol. 2, no. 4, pp. 232–241, 2024.

[11] S. G. K. Peddireddy, "Optimizing Resource Allocation in Multi-Cloud Environments for Cost Efficiency and Scalability," FMDB Transactions on Sustainable Computing Systems., vol. 2, no. 4, pp. 167–177, 2024.

[12] R. Rai, "A brief assessment of kiwifruit cultivation status in Nepal," J. Multidiscip. Sci., vol. 7, no. 1, pp. 46–55, 2025.

[13] A. Nepal, C. Joshi, N. Khatiwada, P. B. Chhetri, R. S. Chhetri, P. Kathayat, B. Mahara, and R. Rai, "Evaluation of the conversion of farming systems and scaling up of agroecological approaches in Nepal," J. Multidiscip. Sci., vol. 7, no. 1, pp. 11–25, 2025.

[14] A. Badarch, R. Rai, and J.-H. Kim, "Estimation and analysis of the impact of habitats and chromosomes on trichome variation in Lilium amabile Palibian," J. Multidiscip. Sci., vol. 7, no. 1, pp. 1–10, 2025.

[15] A. Nepal, K. Koirala, S. Rai, and R. Rai, "Agrobiodiversity integration in farming systems for income generation and livelihood options of smallholder farmers in Nepal: A case study of Bhimphedi Municipality," J. Exp. Biol. Agric. Sci., vol. 13, no. 1, pp. 29–49, 2025.

[16] S. Rai, A. Nepal, S. Basi, T. Dhakal, and R. Rai, "Present status, practices, limitations, and future prospects of organic fruit production in Nepal," J. Exp. Biol. Agric. Sci., vol. 13, no. 1, pp. 1–10, 2025.

[17] R. Rai and J.-H. Kim, "Heterosis and combining ability among promising single cross hybrids in Lilium formolongi Hort. for major growth and flowering traits," Academia Biology, vol. 2, no. 4, 2024.

[18] R. Rai, A. Shrestha, S. Rai, S. Chaudhary, D. K. Acharya, and S. Subedi, "Conversion of farming systems into organic bio-intensive farming systems and the transition to sustainability in agroecology: Pathways towards sustainable agriculture and food systems," J. Multidiscip. Sci., vol. 6, no. 2, pp. 25–34, 2024.

[19] S. Rai and R. Rai, "Advancements and practices in budding techniques for kiwifruit propagation," J. Multidiscip. Sci., vol. 6, no. 2, pp. 11–16, 2024.

[20] S. Rai and R. Rai, "Monkey menace in Nepal: An analysis and proposed solutions," J. Multidiscip. Sci., vol. 6, no. 1, pp. 26–31, 2024.

[21] A. K. Shrestha, S. Chaudhary, S. Subedi, S. Rai, D. K. Acharya, and R. Rai, “Farming systems research in Nepal: Concepts, design, and methodology for enhancing agricultural productivity and sustainability,” J. Multidiscip. Sci., vol. 6, no. 1, pp. 17–25, 2024.

[22] S. Rai and R. Rai, “Advancement of kiwifruit cultivation in Nepal: Top working techniques,” J. Multidiscip. Sci., vol. 6, no. 1, pp. 11–16, 2024.

[23] S. Chaudhary, A. K. Shrestha, S. Rai, D. K. Acharya, S. Subedi, and R. Rai, “Agroecology integrates science, practice, movement, and future food systems,” J. Multidiscip. Sci., vol. 5, no. 2, pp. 39–60, 2023.

[24] R. Rai, V. Y. Nguyen, and J.-H. Kim, “Variability analysis and evaluation for major cut flower traits of F1 hybrids in Lilium brownie var. colchesteri,” J. Multidiscip. Sci., vol. 4, no. 2, pp. 35–41, 2022.

[25] V. Y. Nguyen, J.-H. Kim, J.-Y. Kim, and K. N. Jong, “Ecogeographical variations of the vegetative and floral traits in Lilium amabile Palibian,” J. Plant Biotechnol., vol. 48, no. 4, pp. 236–245, 2021.

[26] R. Rai and J.-H. Kim, “Performance evaluation and variability analysis for major growth and flowering traits of Lilium longiflorum Thunb.,” J. Exp. Biol. Agric. Sci., vol. 9, no. 4, pp. 439–444, 2021.

[27] R. Rai, V. Y. Nguyen, and J.-H. Kim, “Estimation of variability analysis parameters for major growth and flowering traits of Lilium leichtlinii var. maximowiczii germplasm,” J. Exp. Biol. Agric. Sci., vol. 9, no. 4, pp. 457–463, 2021.

[28] R. Rai and J.-H. Kim, “Effect of storage temperature and cultivars on seed germination of Lilium × formolongi Hort.,” J. Exp. Biol. Agric. Sci., vol. 8, no. 5, pp. 621–627, 2020.

[29] R. Rai and J.-H. Kim, “Estimation of combining ability and gene action for growth and flowering traits in Lilium longiflorum,” Int. J. Adv. Sci. Technol., vol. 29, no. 8S, pp. 1356–1363, 2020.

[30] R. Rai, A. Badarch, and J.-H. Kim, “Identification of superior three-way cross F1s, its Line × Tester hybrids, and donors for major quantitative traits in Lilium × formolongi,” J. Exp. Biol. Agric. Sci., vol. 8, no. 2, pp. 157–165, 2020.

[31] R. Rai, J. Shrestha, and J.-H. Kim, “Line × Tester analysis in Lilium × formolongi: Identification of superior parents for growth and flowering traits,” SAARC J. Agric., vol. 17, no. 1, pp. 175–187, 2019.

[32] R. Rai, J. Shrestha, and J.-H. Kim, “Combining ability and gene action analysis for quantitative traits in Lilium × formolongi,” J. Agric. Life Environ. Sci., vol. 30, no. 3, pp. 131–143, 2019.

[33] T. X. Nguyen, S. I. Lee, R. Rai, N. S. Kim, and J.-H. Kim, “Ribosomal DNA locus variation and REMAP analysis of the diploid and triploid complexes of Lilium lancifolium,” Genome, vol. 59, pp. 1–14, 2016.

[34] T. X. Nguyen, J.-Y. Kim, R. Rai, J.-H. Kim, N. S. Kim, and A. Wakana, “Karyotype analysis of Korean Lilium maximowiczii Regal populations,” J. Fac. Agric. Kyushu Univ., vol. 60, no. 2, pp. 315–322, 2015.

[35] N. J. Maiti, S. Ganguly, K. Choowongkomon, S. Seetaha, S. Saehlee, and T. Aiebchun, "Synthesis, in vitro Anti-HIV-1RT evaluation, molecular modeling, DFT and acute oral toxicity studies of some benzotriazole derivatives," J. Struct. Biol., vol. 216, no. 2, p. 108094, 2024.

[36] N. J. Maiti and S. Ganguly, "Synthesis, spectral analysis, antimicrobial evaluation, molecular modelling, DFT, TD-DFT and SAR studies of novel 4,5,6,7-tetrabromo-1H-benzo[d][1,2,3]triazole derivatives," ChemistrySelect, vol. 9, no. 36, p. e202401746, 2024.

[37] N. J. Maiti and S. Ganguly, "Some new benzotriazole derivatives: Synthesis, antimycobacterial evaluation, antimicrobial efficacy, ADME studies, and molecular docking studies," Indian Journal of Heterocyclic Chemistry, vol. 33, no. 3, pp. 385–392, 2023.

[38] N. J. Maiti, S. Ganguly, B. Sarkar, and R. Saha, "New benzotriazole derivatives: Synthesis, biological assessment, in vivo oral toxicity analysis, docking studies, molecular dynamics, and ADME profiling," Indian Journal of Heterocyclic Chemistry, vol. 33, no. 4, pp. 489–497, 2023.

[39] N. J. Maiti, "A comprehensive review on analytical techniques for the quantification of pharmaceutical compounds in biological matrices," Journal of Cardiovascular Research, vol. 15, no. 9, 2024.

[40] N. J. Maiti and S. Ganguly, "In silico studies of some novel benzotriazole derivatives against the NNIBP of HIV-1 RT," Journal of Pharmaceutical Chemistry, vol. 8, 2022.

[41] N. J. Maiti, Al Rashid, Md Harun, and A. Banerjee, "The queen of herb with potent therapeutic constituent in various disease states: A reappraisal," International Journal of Phytomedicine, vol. 5, no. 2, pp. 125, 2013.

[42] N. J. Maiti, G. N. K. Reddy, V. V. S. R. Prasad, and P. K. Maharana, "Development and validation of a stability indicating UPLC method for determination of moxifloxacin hydrochloride in pharmaceutical formulations," Pharm. Anal. Acta, vol. 2, no. 142, 2011.

[43] N. J. Maiti, B. K. Sahoo, and N. Parwen, "Pharmacological and traditional uses of Paederia foetida Linn: A review," Int. J. Pharm. Eng., vol. 6, no. 4, pp. 839–844, 2018.

[44] V. S. A. Anala, A. R. Pothu, and S. Chintapalli, "Enhancing Preventive Healthcare with Wearable Health Technology for Early Intervention," FMDB Transactions on Sustainable Health Science Letters., vol.2, no.4, pp. 211–220, 2024.

[45] V. S. A. Anala and S. Chintapalli, "Scalable Data Partitioning Strategies for Efficient Query Optimization in Cloud Data Warehouses," FMDB Transactions on Sustainable Computer Letters., vol. 2, no. 4, pp. 195–206, 2024.

[46] Md H. Rahman, T. Islam, Md E. Hossen, Md E. Chowdhury, R. Hayat, Md S. S. Shovon, M. Alamgir, S. Akter, R. Chowdhury, and A. R. Sunny, "Machine Learning in Healthcare: From Diagnostics to Personalized Medicine and Predictive Analytics," J. Angiother., vol. 8, no. 12, pp. 1–8, 2024.

[47] R. Chowdhury, Md A. H. Fahad, S. M. S. Alam, M. I. Tusher, Md N. U. Rana, E. Ahmed, S. S. Akhi, and Md R. H. Mahin, "Database Management in the Era of Big Data: Trends, Challenges, and Breakthroughs," Pathfinder Res., vol. 1, no. 1, p. 15, 2020.

[48] Md R. H. Mahin, E. Ahmed, S. S. Akhi, Md A. H. Fahad, M. I. Tusher, R. Chowdhury, and Md N. U. Rana, "Advancements and Challenges in Software Engineering and Project Management: A 2021 Perspective," Pathfinder Res., vol. 2, no. 1, p. 15, 2021.

[49] Md A. H. Fahad and R. Chowdhury, "Evolution and Future Trends in Web Development: A Comprehensive Review," Pathfinder Res., vol. 3, no. 1, p. 13, 2022.

[50] M. R. Donthi, S. R. Munnangi, K. V. Krishna, R. N. Saha, G. Singhvi, and S. K. Dubey, "Nanoemulgel: A Novel Nano Carrier as a Tool for Topical Drug Delivery," Pharmaceutics, vol. 15, no. 1, p. 164, Jan. 2023.

[51] M. R. Donthi et al., "Formulating Ternary Inclusion Complex of Sorafenib Tosylate Using β-Cyclodextrin and Hydrophilic Polymers: Physicochemical Characterization and In Vitro Assessment," AAPS PharmSciTech, vol. 23, no. 7, Oct. 2022.

[52] M. R. Donthi, R. Dudhipala, R. Komalla, D. Suram, and N. Banala, "Open Access Preparation and Evaluation of Fixed Combination of Ketoprofen Enteric Coated and Famotidine Floating Mini Tablets by Single Unit Encapsulation System," J Bioequiv Availab, vol. 7, no. 6, pp. 279–283, 2015.

[53] D. Mahipalreddy, D. Narendar, K. Devendhar, S. Dinesh, A. S. Kiran, and B. Nagaraj, "Preparation and Evaluation of Ketoprofen Enteric Coated Mini Tablets for Prevention of Chronic Inflammatory Disease," J. Pharm. Drug Deliv. Res., vol. 04, no. 02, 2015.

[54] M. R. Donthi, R. N. Saha, G. Singhvi, and S. K. Dubey, "Dasatinib-Loaded Topical Nano-Emulgel for Rheumatoid Arthritis: Formulation Design and Optimization by QbD, In Vitro, Ex Vivo, and In Vivo Evaluation," Pharmaceutics, vol. 15, no. 3, p. 736, Mar. 2023.

[55] M. R. Donthi, N. Dudipala, R. Komalla, and N. Banala, "Design and Evaluation of Floating Multi Unit Mini Tablets (MUMTS) Muco Adhesive Drug Delivery System of Famotidine to Treat Upper Gastro Intestinal Ulcers," vol. 3, no. 5, p. 179, 2015.

[56] T. Alekya, D. Narendar, D. Mahipal, N. Arjun, and B. Nagaraj, "Design and Evaluation of Chronomodulated Drug Delivery of Tramadol Hydrochloride," Drug Res. (Stuttg)., vol. 68, no. 3, pp. 174–180, Mar. 2018.

[57] M. R. Donthi, A. Butreddy, R. N. Saha, P. Kesharwani, and S. K. Dubey, "Leveraging spray drying technique for advancing biologic product development–A mini review," Heal. Sci. Rev., vol. 10, p. 100142, Mar. 2024.

[58] R. Rajitha, D. Narendar, N. Arjun, B. Nagaraj, and D. Mahipal, "Colon Delivery of Naproxen: Preparation, Characterization and Clinical Evaluation in Healthy Volunteers," Int. J. Pharm. Sci. Nanotechnology (IJPSN), vol. 9, no. 3, pp. 1–10, 2016.

[59] S. Karnam, M. R. Donthi, A. B. Jindal, and A. T. Paul, "Recent innovations in topical delivery for management of rheumatoid arthritis: A focus on combination drug delivery," Drug Discov. Today, vol. 29, no. 8, p. 104071, Aug. 2024.

[60] M. Choudhari, M. R. Donthi, S. Damle, G. Singhvi, R. N. Saha, and S. K. Dubey, "Implementation of Quality by Design Approach for Optimization of RP-HPLC Method for Quantification of Abiraterone Acetate in Solid Dispersion in Forced Degradation Studies," Curr. Chromatogr., vol. 9, no. 1, pp. 78–94, Nov. 2022.

[61] G. Konnurmath and S. Chickerur, "An investigation into power aware aspects of rendering 3D models on multi-core processors," Procedia Computer Science, vol. 218, pp. 887–898, 2023.

[62] G. Konnurmath and S. Chickerur, "GPU shader analysis and power optimization model," Engineering, Technology & Applied Science Research, vol. 14, no. 1, pp. 12925–12930, Feb. 2024.

[63] G. Konnurmath and S. Chickerur, “Power-aware characteristics of matrix operations on multicores,” Applied Artificial Intelligence, vol. 35, no. 15, pp. 2102–2123, 2021.

[64] G. Konnurmath and S. Chickerur, “Real-time frame rate controlled dynamic voltage and frequency scaling for GPU power consumption optimization,” AIP Conference Proceedings, vol. 3131, no. 1, p. 020006, Sep. 2024.

[65] R. M. Badiger, R. Yakkundimath, G. Konnurmath, and P. M. Dhulavvagol, “Deep learning approaches for age-based gesture classification in South Indian Sign Language,” Engineering, Technology & Applied Science Research, vol. 14, no. 2, pp. 13255–13260, Apr. 2024.

[66] V. S. Jadhav, R. Yakkundimath, and G. Konnurmath, “Cervical cancer severity characterization using machine learning techniques,” Indian Journal of Gynecologic Oncology, vol. 22, p. 156, 2024.

[67] V. Yadav, “Machine Learning in Managing Healthcare Workforce Shortage: Analyzing how Machine Learning can Optimize Workforce Allocation in Response to Fluctuating Healthcare Demands,” Progress In Medical Sciences, pp. 1–9, Aug. 2023.

[68] V. Yadav, “Machine Learning for Predicting Healthcare Policy Outcomes: Utilizing Machine Learning to Forecast the Outcomes of Proposed Healthcare Policies on Population Health and Economic Indicators,” Journal of Artificial Intelligence & Cloud Computing, vol. 1, no. 2, pp. 1–10, Jun. 2022.

[69] R. Aravindhan, R. Shanmugalakshmi, K. Ramya and Selvan C., "Certain investigation on web application security: Phishing detection and phishing target discovery," 2016 3rd International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2016, pp. 1-10.

[70] R. Aravindhan and R. Shanmugalakshmi, "Comparative analysis of Web 3.0 search engines: A survey report," 2013 International Conference on Advanced Computing and Communication Systems, Coimbatore, India, 2013, pp. 1-6.

[71] Aravindhan, R., Shanmugalakshmi, R. & Ramya, K. Circumvention of Nascent and Potential Wi-Fi Phishing Threat Using Association Rule Mining. Wireless Pers Commun 94(3), 2331–2361, 2017.

[72] R. Aravindhan and R. Shanmugalakshmi, "Visual analytics for semantic based image retrieval (SBIR): semantic tool," International Journal of Latest Trends in Engineering and Technology, vol. 7, no. 2, pp. 300–312, 2016.

[73] R. Aravindhan and R. Shanmugalakshmi, "Multistage fuzzy classifier based phishing detection using LDA and CRF features followed by impersonated entity discovery," International Journal of Control Theory and Applications, vol. 10, no. 29, pp. 33–42, 2017.

[74] Selvan, C., Ragunathan, A., & Ashwinkumar, U. M. (2024). Mitigating phishing threats in unmanned aircraft systems (UAS) through multi-stage defense strategies. In Analyzing and Mitigating Security Risks in Cloud Computing (pp. 125–162). IGI Global.

[75] S. A. Milu, S. Akter, A. Fathima, T. Talukder, I. Islam, and M. I. S. Emon, "Design and Implementation of hand gesture detection system using HM model for sign language recognition development," J. Data Anal. Inf. Process., vol. 12, no. 2, pp. 139–150, 2024.

[76] S. S. Mahtab, R. A. Anonto, T. Talukder, A. Raihan, and I. Islam, "Etching Technologies in Semiconductor Manufacturing: A Short Review," in Proc. Int. Conf. Emerg. Appl. Mater. Sci. Technol., Cham: Springer Nature Switzerland, 2024, pp. 319–324.

[77] T. Talukder, "Scanning Magnetometry With a Low Cost NV Diamond Quantum Sensor Probe," M.S. thesis, Morgan State Univ., 2024.

[78] A. Dixit, N. H. Parekh, R. Anand, N. Kamal, A. Kumar, and B. K. Badiyani, “An online survey to examine the dental students' awareness, knowledge, prevention, and early detection of oral cancer,” J. Pharm. Bioall. Sci., vol. 15, pp. S984–S986, 2023.

[79] S. S. Kumararama, S. Patel, N. H. Parekh, P. Bhate, B. J. Kukreja, T. Hazra, et al., “Investigating how frequently dental professionals conduct oral cancer screenings during routine dental checkups and the methods they use,” J. Pharm. Bioall. Sci., vol. 16, p. S7835, 2024.

[80] Shaiva Thakar, Niraj Kinariwala, Dhrusha Pandya, Nirav H Parekh, Niravkumar K Patel, Aastha Patel “Awareness and constraints towards the implementation of green dentistry amongst dental students and private practitioners of West India,” J. Pharm. Bioall. Sci., vol. 15, pp. S1287–S1290, 2023.

[81] M. Ranjan, Tushar, N. H. Parekh, A. Dixit, P. Rakshit, B. P. Agre, et al., “Investigating how cultural and socioeconomic factors influence oral cancer prevention behaviors, screening uptake, and treatment outcomes,” J. Pharm. Bioall. Sci., vol. 16, pp. S786–S788, 2024.

[82] A. Dixit, N. H. Parekh, R. Anand, N. Kamal, B. K. Badiyani, A. Kumar, et al., “A study to assess the awareness of adults about precancerous and cancerous lesions and the associated risk factors,” J. Pharm. Bioall. Sci., vol. 15, pp. S977–S980, 2023.

[83] M. Ranjan, A. Vashisht, J. K. Savita, S. Duseja, A. Sethi, R. Mohanty, N. H. Parekh, and M. Mehta, “Evaluating the tightness of proximal contact between natural tooth and adjacent implant-supported prosthesis,” Bioinformation, vol. 20, no. 6, pp. 644–648, Jun. 2024.

[84] A. Dixit, P. Dhanalakshmi, P. T. Rameshchandra, K. S. Chachlani, B. J. Kukreja, Ananya, et al., “Effectiveness of online vs. in-person periodontal health workshops for public awareness,” J. Pharm. Bioall. Sci., vol. 16, pp. S777–S779, 2024.

[85] A. Katariya and B. J. Kukreja, “A modification of fenestration technique (MOFT) to increase vestibular depth: A case series,” Indian J. Dent. Res..

[86] A. Katariya, B. J. Kukreja, and S. C. Dinda, “A microbiological study to evaluate the effect of different concentrations of coenzyme Q10 in inhibiting key pathogens of periodontitis,” Eur. Chem. Bull., vol. 12, no. 10, pp. 5826–5843, 2023.

[87] A. Singh, I. Menon, V. Aggarwal, B. J. Kukreja, P. Kukreja, and R. P. Singh, “Evaluation of quality of dental care and patient’s perception for treatment received in dental institution in Moradabad, Uttar Pradesh,” Int. J. Oral Care Res., vol. 3, no. 3, pp. 10–40, 2016.

[88] D. Singhal, R. Mohan, K. Krishna, B. J. Kukreja, and A. Singh, “Genetics: Application in periodontal disease,” TMU J. Dent., vol. 4, no. 4, pp. 143–148, 2017.

[89] G. Yadavalli, P. Singhal, N. Gupta, B. J. Kukreja, B. Gupta, P. Kukreja, R. S. Makkad, and D. Mehta, “Evaluation of immunohistochemical markers in oral squamous cell carcinoma,” Bioinformation, vol. 19, no. 13, pp. 1399–1404, 2023.

[90] K. Arora, V. Dodwad, B. J. Kukreja, and S. Nagpal, “A comparative evaluation of the efficacy of glycine air polishing following scaling and root planing & scaling and root planing alone in the treatment of chronic periodontitis: A clinical study,” J. Dent. Specialities, vol. 1, no. 2, pp. 47–54, 2013.

[91] K. R. Anand, P. Kukreja, S. Kumar, B. J. Kukreja, and M. Sharma, “Nonsurgical treatment of ameloblastoma—Where are we?” Clin. Dent., vol. 7, pp. 26–28, 2014.

[92] M. Gera, S. Chaudhary, A. S. Dhillon, V. Dodwad, S. Vaish, and B. J. Kukreja, “Pink in, black out—a clinical study,” J. Dent. Specialities., vol. 4, no. 1, pp. 31–35, 2016.

[93] M. Kumar, M. Goyal, B. Jha, S. Tomar, and A. Kushwah, “An innovative procedure for lip lengthening in a patient with a short upper lip and high angle skeletal class II pattern: A case report,” J. Indian Orthod. Soc., vol. 30, pp. 1–8, 2021.

[94] M. Ray, B. J. Kukreja, A. Katariya, et al., “Evaluation of buccal pad fat combined with demineralized freeze-dried bone allograft in treatment of Grade II furcation defects: A clinical radiographic study,” World J. Dent., vol. 15, no. 6, pp. 459–467, 2024.

[95] M. S. Dua, A. Dua, B. J. Kukreja, V. Dodwad, A. S. Sethi, and P. Kukreja, “Periodontal disease and preterm low birth weight,” Int. J. Oral Care Res., vol. 2, no. 6, pp. 49–55, 2014.

[96] P. Kukreja, A. F. Qahtani, M. F. Qahtani, M. F. Qahtani, and B. J. Kukreja, “Use of stem cells in tissue engineering and reconstruction of the maxillofacial region,” Int. J. Res. Med. Sci., vol. 8, no. 7, pp. 2740–2745, 2020.

[97] P. Mishra, S. Jha, D. Pandey, A. Thakur, and B. J. Kukreja, “Clinical and laboratory predictors of chronic immune thrombocytopenia in children: A study of 25 cases and review of literature,” Int. J. Biomed. Adv. Res., vol. 10, no. 2, p. e5104, 2019.

[98] P. Tyagi, V. Dodwad, B. J. Kukreja, and P. Kukreja, “A comparison of the efficacy of scaling and root planing with application of pomegranate chip, pomegranate gel and scaling and root planing in sufferers with adult periodontitis - a prospective study,” J. Indian Soc. Periodontol., vol. 25, pp. 41–46, 2021.

[99] P. Verma, U. Gupta, V. Dodwad, B. J. Kukreja, and K. Arora, “Evaluation of the clinical efficacy of a new desensitizing toothpaste containing nano-crystalline hydroxyapatite in dentine hypersensitivity patients: A double-blind randomized controlled clinical trial,” J. Dent. Specialities, vol. 1, no. 2, pp. 42–46, 2013.

[100] R. Saleem, B. J. Kukreja, M. Goyal, and M. Kumar, “Treating short upper lip with ‘Unified lip repositioning’ technique: Two case reports,” J. Indian Soc. Periodontol., vol. 26, pp. 89–93, 2022.

[101] R. Sood, A. Gulri, U. Gupta, B. J. Kukreja, and V. Dodwad, “Efficacy of biodegradable xanthan-based chlorhexidine gel (Chlosite®) and 0.2% chlorhexidine irrigation following scaling and root planing for the treatment of chronic periodontitis,” Int. J. Oral Care Res., vol. 2, no. 6, pp. 1–7, 2014.

[102] S. Bansal, P. Kukreja, S. Kumar, M. Sharma, K. R. Anand, and B. J. Kukreja, "Anaesthetic efficacy of anterior middle superior alveolar nerve block for extraction of anterior maxillary anterior teeth," J. Dent. Specialities, vol. 2, no. 2, pp. 1–4, 2014.

[103] S. Gupta, K. K. G. Rangappa, S. Rani, R. Ganesh, P. Kukreja, and B. J. Kukreja, "Periodontal and dentition status among psychiatric patients in Indore: A descriptive cross-sectional study," J. Contemp. Dent. Pract., vol. 23, no. 12, pp. 1260–1266, 2022.

[104] S. S. Kumararama, M. Patil, B. J. Kukreja, M. Salkar, S. Verma, N. Pattnaik, et al., "Efficacy of antibiotics versus probiotics as adjuncts to mechanical debridement for the treatment of peri-implant mucositis," J. Pharm. Bioall. Sci., vol. 16, pp. S3389–S3391, 2024.

[105] T. Bera, B. J. Kukreja, C. Sharma, V. V. Gupta, P. Patel, P. Singhal, et al., "Relative contribution of trabecular and cortical bone to primary implant stability: An in vitro model study," J. Pharm. Bioall. Sci., vol. 16, pp. S3427–S3429, 2024.

[106] T. Mishra, B. J. Kukreja, R. Patel, M. Ghadage, P. Dalave, S. Kumari, et al., "In vitro evaluation of titanium exfoliation during simulated surgical insertion of dental implants," J. Pharm. Bioall. Sci., vol. 16, pp. S3383–S3385, 2024.

[107] Y. M. Talib, W. N. Albalushi, M. D. Fouad, A. M. Salloum, B. J. Kukreja, H. Abdelmagyd, "Bilateral inverted and impacted mandibular third molars: A rare case report," Cureus, pp. 2–9, 2023.

[108] S. Dahiya, U. Gupta, V. Dodwad, B. J. Kukreja, and P. Dasgupta, "The enzyme activity of alkaline phosphatase in gingival crevicular fluid of smokers and non-smokers with chronic periodontitis before and after phase I therapy," J. Pharm. Biomed. Sci., vol. 32, no. 32, pp. 1348–1353, Jul. 2013.