



REMOTE EMPLOYEE ANXIETY MONITORING AND CARE PREDICTION USING IOT TECHNOLOGY

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ABSTRACT

The danger of stress-related health problems among online workers has increased in the era of digital workspaces due to extended display time and sedentary lifestyles. This project suggests an Internet of Things (IOT)-based system that allows for the real-time monitoring of critical health metrics, like body temperature and heart rate, in order to gauge stress levels and anticipate care requirements. The system uses a NodeMCU module that is integrated with a buzzer, LCD display, Dallas temperature sensor, and heartbeat sensor to collect and analyze data in order to promote preventive healthcare and offer timely alarms. By enabling remote tracking, the IOT technology guarantees early intervention and improved worker health management. By keeping users aware of their bodily conditions and assisting them in staying informed while working continuously, this system improves both productivity and well-being.

Keywords: Internet of Things, Remote Monitoring, Health Alerts, Stress Monitoring, and Online Workers.

I. INTRODUCTION

Online professional interaction and remote work have become commonplace across various industries in today's technologically advanced world. While this shift has improved accessibility and work flexibility, it has also contributed to a significant rise in health-related concerns, particularly among individuals who spend prolonged hours in sedentary computer-based environments [5], [6]. Employees engaged in remote occupations such as data analysts, software engineers, digital marketers, and online educators are increasingly susceptible to stress-related conditions including burnout, insomnia, mental fatigue, elevated heart rate, and reduced job satisfaction [5], [6], [7]. If left unaddressed, these conditions may not only deteriorate individual well-being but also result in long-term health complications and decreased productivity [6].

The integration of the Internet of Things (IoT) within the healthcare domain has enabled continuous remote monitoring, analysis, and management of physiological and psychological stress indicators [1], [4], [7]. IoT-based systems leverage smart sensors, wearable devices, and

embedded microcontrollers to collect real-time physiological data, allowing early detection of abnormal health conditions and timely intervention [2], [3]. Such systems are particularly beneficial for remote employees who often delay seeking medical assistance until symptoms intensify [7]

This research presents a comprehensive IoT-based stress monitoring system specifically designed for online and remote workers. The proposed system employs a NodeMCU microcontroller, which is Wi-Fi enabled and supports seamless data transmission to cloud platforms for continuous monitoring and analysis [1], [3]. Physiological parameters closely associated with stress—such as body temperature and pulse rate—are captured using a Dallas temperature sensor and a heartbeat sensor, respectively [1], [8]. These readings are displayed in real time using an LCD module and are continuously analyzed to identify anomalous patterns indicative of stress, fatigue, or exhaustion [2]. To ensure immediate user awareness, a buzzer alert mechanism is incorporated to provide audible notifications when predefined threshold values are exceeded, prompting preventive actions such as taking rest breaks, hydration, or reducing screen



time [4], [8]. Furthermore, the collected data is uploaded to an IoT cloud platform, enabling remote access by healthcare professionals, organizational managers, or the users themselves for trend analysis and personalized care recommendations [1], [2]. This facilitates early identification of stress patterns and supports proactive health management strategies.

Overall, the proposed IoT-based stress monitoring framework emphasizes the importance of integrating health awareness into modern digital workspaces. By empowering remote workers with real-time health insights and timely alerts, the system promotes sustainable work practices, improved well-being, and healthier organizational behaviors in technology-driven environments [5], [7].

II. LITERATURE SURVEY

1. A Real-Time Heartbeat Monitoring System Based on Arduino and IoT, M. Al Emran et al., 2020

This work proposes a low-cost and basic cardiac monitoring system using Arduino and Internet of Things platforms such as ThingSpeak. The system continuously measures heart rate in real time and stores the data for further analysis. The study demonstrates that early detection of stress-related cardiac abnormalities is feasible using simple sensor-based systems and cloud connectivity. These findings support the fundamental working principles of modern stress monitoring frameworks that rely on real-time physiological data acquisition and remote access [1], [3]. Similar approaches have also been validated in later studies focusing on wearable and IoT-enabled stress detection systems [2], [8].

2. IoT-Based Stress Monitoring and Management System, S. Sharma, A. Rani, 2021

This study discusses the application of IoT technologies to monitor stress indicators such as elevated skin temperature and pulse rate. A

basic decision-making model is employed to determine stress levels based on sensor data, and alert mechanisms are used to notify users when abnormal readings are detected. The authors emphasize the importance of combining continuous health monitoring with alarm-based feedback to promote timely behavioral adjustments. This aligns closely with recent research highlighting the effectiveness of real-time alerts and preventive interventions in IoT-driven healthcare systems [1], [4]. Similar stress analysis and notification strategies have also been explored in wearable-based stress monitoring solutions [2], [8].

3. Design and Development of an IoT-Based Wearable Device for Monitoring Physiological Parameters, M. Thomas, 2022

This project presents the design and development of an IoT-based wearable device using a NodeMCU microcontroller, a temperature sensor, and a heart rate sensor to monitor employee health. Although the primary application scenario focuses on industrial workers experiencing physical workload stress, the system architecture is highly relevant to online and remote workers who primarily face mental and cognitive stress. The study concludes that wearable IoT technology is cost-effective, efficient, and practical for continuous health monitoring. These findings are consistent with recent studies that emphasize the scalability and affordability of IoT-enabled wearable systems for stress detection and workload monitoring [1], [7].

4. IoT-Based Health Monitoring for Remote Workers, A. Gupta, S. Jain, 2021

This study specifically addresses health concerns arising from sedentary work environments common among remote and online workers. The authors associate prolonged screen time and lack of physical



activity with increased stress, fatigue, and abnormal physiological parameters. The proposed solution integrates temperature and pulse sensors with cloud-based data storage and recommends periodic health assessments through digital platforms. This work strongly supports the necessity of IoT-based health monitoring in modern digital workspaces and reinforces the growing consensus that continuous remote monitoring is essential for early stress detection and intervention [5], [6], [7]. Similar conclusions have been drawn in studies examining the impact of remote work and electronic monitoring on employee stress and well-being [5], [6].

III. EXISTING SYSTEM

Existing systems for remote employee monitoring, such as Teramind, Hubstaff, EmpMonitor, and Insightful, predominantly emphasize productivity tracking through behavioral and activity-based metrics, including keystroke logging, screenshot capture, application usage, and website monitoring. While these tools enable real-time managerial oversight, they lack integration with physiological sensing technologies necessary for detecting stress, anxiety, or health-related abnormalities [5], [6], [7]. As a result, such systems focus more on performance surveillance than employee well-being, often raising privacy and ethical concerns due to intrusive monitoring practices [6].

In contrast, wellness-oriented platforms such as Headspace, BetterHelp, and Ginger provide mental health support through meditation programs, counseling services, and self-reported emotional check-ins. However, these platforms rely heavily on voluntary user participation and subjective inputs, lacking automated data acquisition through IoT-enabled sensors or continuous physiological monitoring [4], [8]. Furthermore, they do not incorporate real-time wearable data analysis or machine learning techniques for early stress detection and predictive health forecasting [1], [2], [3]. Consequently, the absence of an integrated framework that combines continuous IoT-based

physiological monitoring with intelligent analytics highlights a significant research gap, which the proposed IoT-based anxiety and stress monitoring system aims to address [1], [7].

IV. PROPOSED SYSTEM

The proposed IoT-based system introduces an integrated framework for real-time anxiety monitoring and care prediction among remote employees, leveraging wearable devices such as smartwatches for physiological data like heart rate variability (HRV), galvanic skin response (GSR), and movement patterns, combined with environmental sensors in home offices and behavioral metrics from computer usage. Data streams via Bluetooth and Wi-Fi to a cloud-edge server for preprocessing, where machine learning models including LSTM networks for time-series analysis and Random Forest classifiers detect anxiety episodes with high accuracy and forecast escalation 24-48 hours in advance. The prediction module triggers personalized interventions like virtual counseling alerts or relaxation prompts through a mobile app and employer dashboard, ensuring privacy via federated learning and encrypted transmission while providing aggregated insights to enhance mental health proactively without invasive surveillance.

V. SYSTEM ARCHITECTURE

1. Wearable Sensors (Edge Devices)

Secure wearables including smartwatches (e.g., Fitbit/Apple Watch equivalents) with HRV sensors, GSR electrodes, accelerometers, local microcontroller (ESP32 or Raspberry Pi Zero), camera for facial analysis (optional), NFC for user authentication, haptic feedback vibrator, and tamper detection.

Runs local firmware for real-time data capture, basic liveness checks (e.g., motion validation), and immediate safety alerts like vibration warnings.

2. Edge Processing & Security

Lightweight signal preprocessing, anomaly detection, and feature extraction occur at the edge to minimize latency and bandwidth (e.g., HRV filtering, GSR normalization). Only encrypted feature vectors or templates are sent to cloud — raw



physiological data retained locally with AES-256 hardware encryption if policy allows.

3. Network & IoT Gateway

Secure TLS 1.3 channel (mutual authentication via certificates) between wearables and cloud gateway. MQTT over WebSockets or HTTPS APIs for telemetry, anxiety alerts, and remote commands. Supports offline mode: devices enforce local thresholds (e.g., high-anxiety lockdown with self-help prompts) if connectivity fails.

4. Cloud Backend

ML inference service (LSTM/Random Forest models), encrypted database for user profiles and historical patterns, tamper-evident audit logs (blockchain-backed ledger), predictive alerting engine (SMS/push notifications), and admin dashboard. Role-based access controls limit raw data views to authorized clinicians only.



Fig. 5.1: Structure of the Working Model

ESP32 Microcontroller:

The ESP32 is a powerful low-cost microcontroller family with integrated Wi-Fi and Bluetooth, ideal for IoT edge devices like wearables. It features dual-core Xtensa LX6 processors, up to 240MHz clock speed, 520KB SRAM, and multiple ADC channels for analog sensors (HRV, GSR). Unlike basic Arduinos, it supports secure boot, hardware encryption, and low-power modes for always-on monitoring. Programmed via Arduino IDE or ESP-IDF in C/C++, it connects via USB for flashing and runs standalone on battery. Key pins include:

- Ø Analog Input Pins A0-A19 (for sensors, 12-bit ADC)
- Ø Digital GPIO Pins 0-39 (input/output, PWM, I2C/SPI)
- Ø Wi-Fi/BLE Antenna (external/internal)
- Ø Power Pins (3.3V, GND, USB)

Ø Enable/Reset Pins

Analog Pins: Support 12-bit ADC for precise physiological readings (0-3.3V), configurable as digital I/O.

Digital Pins: General-purpose with pull-up resistors, up to 40mA per pin, supporting interrupts for real-time anomaly detection.

VI. IMPLEMENTATION

The created system's ability to monitor physiological stress indicators in online workers was tested under real-time working situations.

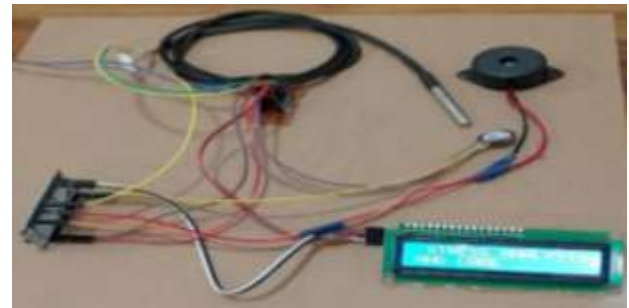


Fig. 6.1: Stress Analysis and Care – IoT Prototype Hardware Setup

When the user's physical condition changed, such as during times of rest or increased activity, the heartbeat sensor was able to collect pulse rates with reliable precision. Updates could be made almost instantly because the sensor's reaction time was between one and two seconds.



Fig. 6.2: Heartbeat Alert – IoT Stress Monitoring Prototype Display

With a $\pm 0.5^{\circ}\text{C}$ precision, the Dallas temperature gauge (DS18B20) accurately recorded body temperature. The device was able to accurately detect and log temperature variations brought on by extended screen time or physiological changes brought on by stress.



VII. CONCLUSION

The "Stress Assessment and Healthcare Prediction Systems for Online Professionals Using IOT" provides a timely and useful way to manage the growing anxiety and health issues among those who work a lot of digital labor. The device offers real-time tracking of physiological factors that are directly related to stress by combining Internet of Things (IOT) technologies with sensors such as the Dallas temperature sensor and heartbeat sensor. While the LCD screen and buzzer provide the user with instant feedback when abnormal values are detected, the Node MCU microcontroller enables smooth data transmission. The capacity to remotely monitor health issues encourages early intervention and empowers people to adopt prompt preventative measures, which may help avoid major health consequences. This system is a useful tool for improving the productivity and well-being of remote workers because it is small, affordable, and simple to implement. In summary, the experiment shows that in today's increasingly digital workplace, technologically driven fitness tracking can be extremely important for maintaining psychological as well as physical wellness.

VIII. FUTURE SCOPE

Future enhancements of the remote employee anxiety monitoring and care prediction system can focus on expanding sensor diversity, personalization, and large-scale deployment. Multimodal data from additional sources such as keyboard dynamics, mouse activity, voice tone, and facial expressions can be integrated with physiological signals to improve the robustness and accuracy of anxiety detection. Adaptive, privacy-preserving machine learning models can be developed to continuously learn each employee's baseline patterns and automatically recalibrate thresholds, reducing false alerts and tailoring interventions. Integration with corporate wellness platforms, HR systems, and telehealth services would enable seamless referral to psychologists or counselors, while policy-driven anonymization and edge-centric processing can strengthen trust, ethical compliance, and acceptance among remote workers.

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