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WORKER'S HEALTH MONITORING SYSTEM USING IOT

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Abstract—**Occupational safety and health conditions are traditionally challenging in the construction and industrial sectors, where workplace accidents and poor ergonomic conditions often lead to worker absences and premature retirements. Safety is a significant concern for construction workers and those in other industrial roles. The primary objective of this proposed system is to develop smart wearable devices, such as bands and helmets, equipped with various sensors to monitor the health and safety of workers. These devices will utilize IoT technology to send SMS alerts regarding workers' conditions. The system will monitor blood pressure, SpO2 levels, heart rate, and temperature, and will alert higher officials to any abnormal health conditions. Wearable sensors will track workers' heart rates, SpO2 sensors will measure oxygen levels, and thermistors will monitor body temperature. All data will be collected by an Arduino and then uploaded to the IoT system. Once received by the gateway from the wearable sensors, the data will be forwarded to an IoT cloud for storage and accessed via an Android application. The main goal of this proposed study is to enhance the understanding of safety for industry employees.**

Keywords—**IoT, Heartbeat Sensor, SPO2, ARDUNIO, Temperature Sensor, Wi-Fi, LCD display.**

I. INTRODUCTION

The course of underground tunneling activity for human workers could be a very risky circumstance where the dangers increment with the ascent in separation from the underground. The more drawn out the mine, parcel recognized is the danger. The security estimations are staggeringly poor, especially inside the mine ventures. Coal is an important strength to every country. The outstanding vital business of coal is the development of many industry and nuclear energy, as a fuel for different applications. The coal mineshafts have dangerous opportunities that embrace outrageous temperature and stickiness, release of harming gases that form hazardous environmental elements for experts working there. Many staff starting their occupations in coal mineshafts or not in any way shape or form leaned to pick such jobs as mining. This makes stacks of difficulties inside the availability of staff for the coal mining exchange. The security of workers working in mine ventures is expanding step by step through advancements. The moderate development allows the mine awareness procedures to turn into a ton of refined, nonetheless, blasts in underground mine actually occur. This makes the need of involving mine checking frameworks at a significant level for coal mineshafts. The construction industry is a challenging domain from the perspective of occupational health and safety. Safety and wellbeing at work is a global priority. In addition to construction industries, public and government organizations are also working to encourage better safety and health in the construction industry. Digitalization presents great opportunities for the development of the construction industry. Building information modelling (BIM), wireless sensing, and data analytics have the potential to transform construction processes. [1] Moreover, adopting new technologies has many economic benefits for the construction industry including the enhancement of safety. Mainly IoT devices can be used to allow remote health monitoring and emergency condition will be notified through this system. [2] ,[3] These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fit bit electronic wristbands, or advanced hearing aids. Some hospitals have begun implementing "smart beds" that can detect when they are occupied and when a patient is attempting to get up [4]. It can also adjust itself to ensure appropriate pressure and support is applied to the patient without the manual interaction of nurses. The rise of the Internet of Things (IoT) and its accompanying technologies has increased interest in the construction industry, where benefits can be gained by either adding intelligence to buildings to boost [5]. The IoT can provide support for real-time decision making for managerial activities and improve the productivity of the construction industry. The wearable sensors are different subjects can interconnect with each other and transmit the data to a server through IoT platform with medical signal sensing network [6]. Once harmful environments are detected and, the sensor node will provide an effective notification and warning mechanism for the users. The wearable IoT sensor can be carried by humans and animals, their behavior will also become a part of the information. [7] Improving safety with IoT technologies will benefit from using sensors with workers at the

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construction site and there are some prototypes and many future visions about how IoT sensors could be integrated with protective clothing or helmets Although such sensor-integrated safety equipment and clothing could be provided by the employer, continuous monitoring of employee's activities raises many questions and trust between different stakeholders is needed [8]. Resistance to change in the construction industry highlights the need to investigate the underlying factors behind technology adoption also from the perspective of construction site workers [9]. Although studies investigating human aspects as part of technology acceptance in the construction industry are rare some studies have been conducted investigating technology adoption and factors affecting user acceptance of new technologies in the context of construction site safety and health. Some of these earlier studies have presented empirical models affecting user acceptance of new technologies, focusing, for example, on mobile computing devices scanner technologies and building information modelling [10]. In addition, some previous studies have examined customers' intentions to adopt wearable technologies and employee acceptance of wearable in workplaces [11]. Although there are many technology adoption and user acceptance related studies, research on employees' perceptions of emerging IoT technologies in the construction industry has remained limited [12]-[13]. Particularly, studies focusing on construction workers' perceptions concerning the use of measured personal data for promoting safety and wellbeing in the construction site environment are lacking [14]. The main objectives of this study were to enhance understanding about construction worker's attitudes towards IoT-based data-intensive work safety and wellbeing solutions and to identify factors that can promote technology adoption [15]. The remaining part of the manuscript is structured as follows; the first section describes the introduction of IoT and section 2 represents the existing system. The section three represents the proposed system for health monitoring and section four represents the hardware implementation and section five delivers conclusion & future work are presented in final section.

II. PROPOSED SYSTEM

Previous health and safety monitoring systems encountered several limitations due to outdated technology, manual processes, and inadequate integration. Emergency response mechanisms relied on manual alerts and communication, which often resulted in delayed and less effective responses during critical situations. Although these early systems provided a foundation for technological advancements, their shortcomings emphasized the need for more sophisticated, real-time, and integrated solutions. Issues such as improper calibration of sensors and devices (e.g., alarms, microcontrollers) further exacerbated these problems, hindering the ability to provide regular updates and maintain transparency in data handling practices, which is essential for building trust. The proposed system addresses these challenges through the implementation of advanced Internet of Things (IoT) technology. It focuses on monitoring workers' health conditions in real-time during work hours and in emergency situations. The system incorporates the following sensors; Heart Rate Sensor is monitoring the real-time cardiovascular activity. SpO2 Sensor is used to measure blood oxygen saturation levels. The thermistor is used to tracking body temperature variations and Piezo-Resistive Sensor is used to monitor pressure levels. Fig.1 illustrates the block diagram of the health monitoring system, demonstrating the integration of these sensors with a central processing unit for comprehensive data aggregation and analysis. This approach ensures enhanced accuracy, real-time monitoring, and improved emergency response capabilities. The entire proposed system will encourage the workers' health condition as well as their safety.

The system is designed to continuously monitor the health and environmental conditions of workers. In the event that any sensor detects an anomaly such as abnormal heart rate patterns, low blood oxygen saturation, elevated body temperature, or unusual pressure levels the system triggers an immediate alert. This alert is processed through the IoT platform and communicated via mobile phone. The emergency message is sent to the monitoring team, the on-duty medical personnel, and the worker's emergency contacts, ensuring a rapid and coordinated response to potential health threats.

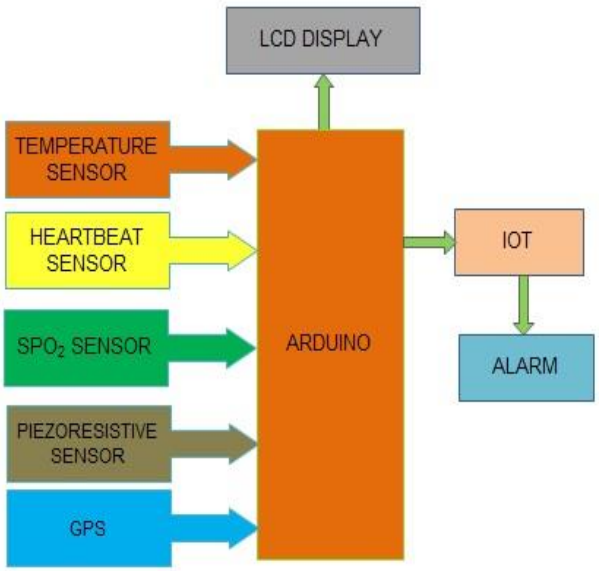

Fig.1. Block diagram of Health Monitoring system

All sensors data is initially captured and processed by a microcontroller unit, specifically an Arduino, which functions as the central data acquisition system. The Arduino collects data from various sensors, including heart rate monitors, SpO2 sensors, thermistors, and piezo-resistive sensors. This data is then formatted and transmitted to a centralized IoT server via a

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secure communication protocol (HTTP). The IoT server acts as a repository for the collected data, providing a platform for further analysis and integration with other system components. Upon receiving the emergency alert, the duty doctor or assigned medical staff can promptly access detailed data on the worker's condition through the IoT server or mobile application. This real-time data allows the medical team to make informed decisions, administer timely interventions, and provide accurate diagnoses. The immediate availability of critical health metrics facilitates efficient and effective medical responses, enhancing the likelihood of positive outcomes for the affected worker.

III. HARDWARE IMPLEMENTATION

In this proposed health monitoring system, the following hardware implementations play an important role in workers' lives.

A. Heart rate Sensor:

The Heart Beat Sensor is designed to provide a digital output of the heartbeat when a finger is placed on it. Fig.2 represents the heartbeat sensor used in this proposed system. They typically operate using photoplethysmography (PPG), which involves shining light through the skin and detecting variations in light absorption due to blood flow, or through electrocardiogram (ECG) methods that capture the electrical activity of the heart.

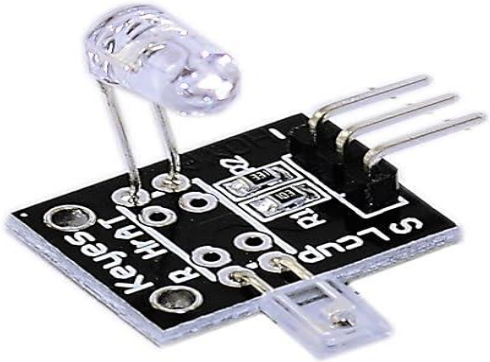

Fig.2. Heartbeat Sensor

This digital output can be directly connected to a microcontroller to measure the Beats Per Minute (BPM) rate. The sensor works on the principle of light modulation caused by blood flow through the finger with each pulse.

B. SpO2 Sensor:

SpO2 sensors measure the oxygen saturation levels in the blood, providing an indication of how effectively oxygen is being transported throughout the body. These sensors utilize photoplethysmography, where light is transmitted through the skin to distinguish between oxygenated and deoxygenated blood, thereby calculating the percentage of oxygen saturation. If a worker experiences difficulty breathing, the sensors will alert the monitoring team, ensuring timely intervention.

C. Temperature Sensor:

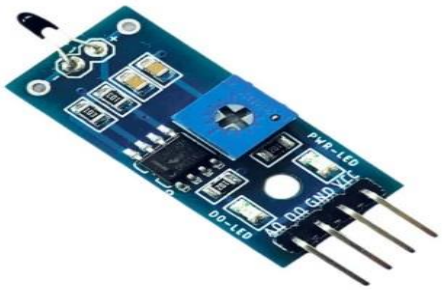

Fig.3. Temperature Sensor

Fig.3. illustrate the temperature Sensor. Temperature sensors are essential for monitoring and ensuring the health and safety of workers across various environments. They continuously track either the body temperature of workers or the ambient temperature of the work environment. By providing real-time data, these sensors help identify any deviations from normal temperature ranges, which could signal potential health issues or unsafe conditions. Connected to IoT networks, these sensors transmit temperature data to centralized monitoring systems. When temperature readings surpass predefined thresholds—such as detecting fever in workers or excessive heat in the environment—the system automatically sends alerts to supervisors, health and safety officers, or directly to the workers, prompting immediate action or intervention.

D. Arduino:

Fig.4. ARDUINO Board

In this proposed health monitoring system, the Arduino board functions as the central processing unit. Fig.4. shows the arduino board it plays a crucial role in integrating various sensors and managing data flow to ensure effective monitoring and communication. As the central controller, the Arduino coordinates the operation of sensors such as temperature, heart rate, and SpO2 sensors. It processes the data from these sensors, performs real-time calculations, and triggers responses based on predefined conditions. When interfaced with Wi-Fi module, the Arduino can send text messages

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(SMS) to users, supervisors, and medical personnel if certain thresholds are breached, such as if a worker's temperature exceeds safe limits. Additionally, it can activate alarms, turn on LEDs, and send notifications via the Wi-Fi module to ensure prompt intervention and prevent health issues. This setup enables workers and supervisors to quickly view critical metrics and statuses without needing additional devices.

IV. HARDWARE SETUP

The hardware implementation of an IoT-based worker's health monitoring system begins with power supplies that step down 220V AC to a lower, safer voltage using a transformer. This voltage is then rectified to DC with a diode rectifier and smoothed by a capacitor filter. A voltage regulator ensures a stable DC output, providing reliable power to the system components. Central to the system is an Arduino board, which acts as the main controller, processing data from various sensors such as temperature sensors, heart rate monitors, and SpO2 sensors. These sensors continuously track vital health metrics and environmental conditions. The Arduino interfaces with communication modules (Wi-Fi), it sending SMS alerts or transmitting data to remote servers or cloud services. This setup allows for real-time monitoring and remote access to health data. Additionally, visual indicators like LEDs or alarms and displays such as LCD screens provide immediate feedback on system status and health metrics. The hardware is housed in a durable enclosure to withstand the workplace environment, ensuring the system's robustness and reliability in safeguarding worker health and safety. Fig.5. Shows the hardware setup for health monitoring system.

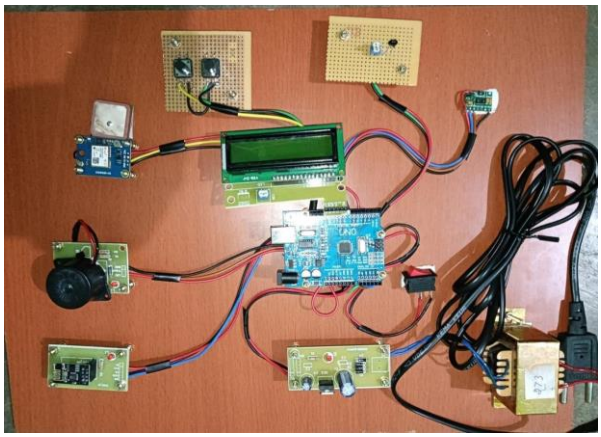

Fig.5. Hardware arrangement for health monitoring system

V. REAL TIME MONITORING SYSTEM RESULTS

In this real time health monitoring system, monitoring the worker's health during their work environment and send their data's to the control system as well as their parents and doctor.

Fig.6.Heartbeat rate 80 beats per minute

In this proposed heartbeat sensor, the worker's heart rate is detected at 80 beats per minute (BPM), which indicates a normal heart rate within the typical range (60-100BPM). This allows for ongoing health monitoring of the worker's as shown in Fig. 6.

Fig.7.Blood Pressure 106/79 mm/Hg

A normal blood pressure for a human is less than 120/80 mm Hg, with systolic pressure under 120 mm Hg and diastolic pressure under 80 mm Hg. Blood pressure lower than 90/60 mm Hg is considered low. In this proposed system, if the worker's blood pressure is 106/79 mm Hg, it is within normal values, as shown in Fig. 7, and will not trigger an alarm since it meets the threshold. However, if the worker's blood pressure is 150/90 mm Hg, an alarm will be sent to the control room and the doctor.

Fig.8.Teperature of worker 35.50°C

The average normal body temperature is generally accepted as 98.6°F or 37°C. In this proposed hardware setup, the temperature sensor measures the worker's body heat in degrees Celsius, as shown in Fig.8. If the worker's temperature becomes elevated, the buzzer system will alert the monitoring

team and the worker's parents. Such sensors are essential in environments like coal mining and steel factories, as they play a crucial role in protecting many lives.

VI. CONCLUSION

The Internet of Things (IoT) has recently gained widespread popularity due to its diverse applications, facilitating smoother, safer, and more convenient living. The proposed system is designed for individuals who, while not facing life-threatening conditions, require regular monitoring by healthcare providers or family members. This approach aims to safeguard many lives by enabling prompt assistance. The health monitoring system, based on research tailored to patient needs, provides quick results for ECG, blood oxygen levels, blood pressure, and temperature measurements in under a minute. By integrating multiple pharmaceutical data sensors into a single device, the system reduces complexity compared to traditional methods, decreasing both time and cost. This device focuses on essential parameters needed for the continuous safety of workers, helping to prevent sudden accidents. The smart safety device is cost-effective and efficient, rapidly accessing and transferring worker data to relevant departments and emergency services. The future scope of this system includes comprehensive monitoring of workers' healthcare, enhancing job satisfaction and loyalty to their workplace.

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