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Smart Wearable Safety Jacket

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Abstract: *Technology is now pervasive; it surrounds us and ingrains itself into our daily lives. By balancing usefulness and the joy that fashion brings, the Internet of Things (IoT) paradigm and its supporting smart wearables and IoT-based clothing have the potential to make a significant impact. In order to develop technologies that can predict wants and desires, smart garments seek a balance between fashion, engineering, interaction, user experience, cybersecurity, design, and science. These days, seamless and widespread integration of sensors into textiles as well as the creation of conductive yarn are made possible by the fast-moving convergence of textiles and electronics. Potential for processing biometric data such as heart rate, temperature, breathing, stress, movement, acceleration, or even fingerprints using smart fabrics that can interact with smartphones. hormone levels, suggests the dawn of a new shopping era. This article discusses the primary need for creating smart, Internet of Things-enabled clothing and illustrates the potential long-term effects of smart clothing on business models. The basic types and components of smart IoT wearables and clothes are described, their key needs are examined, and some of the most current smart clothing applications are evaluated. Additionally, a worldwide IoT architecture is offered. This article examines the history and current state of smart clothing in order to offer recommendations for the designers of a network that will connect clothing to other IoT devices in the future: Smart Clothing on the Internet.*

Keywords: Internet of Things, e-textiles, electronic textiles, Industry 4.0, biometrics, sensors, smart clothes, smart garments, and wearables

I. INTRODUCTION

In several fields nowadays, technology possibilities are expanding. People are becoming more intelligent as a result and beginning to look for the most practical and technologically advanced products in daily life. Electronic components are being put into textiles and clothes to make life easier as a result of the advancement of intelligent technologies in traditional manufacturing [1]. Technological features and cutting-edge electronic devices are being incorporated into garments by businesses like KYMIRA, Thread in Motion, Prevayl Limited, and Myontec [2–5]. These businesses concentrate on developing wearable biosensor monitoring devices and smart textiles that incorporate flexible electrical systems into useful and comfortable apparel for remote diagnosis and remote monitoring in professional sports and healthcare. The development of technology that can not only protect and cover the human body but also gather and process data on the body's state and responses to various situations has been a significant accomplishment for the garment industry [6–9]. A brand-new body-worn bioelectrode that constantly records electrocardiograms and heart rate when the wearer is covered by clothing was created by Nakashima et al. [10]. A wearable device that uses semiconductor technology to analyze and forecast health was reported on by Li et al. [11]. In order to lower the risk of damage and improve performance, this technology also makes it possible to identify physiological conditions and physical performance [11–12]. The body's reactions are shown through the feedback process, which can aid in reorganizing. Certain patterns of human movement and behavior can be reorganized and adjusted with the aid of the feedback process, which displays bodily reactions. By gathering precise data over extended periods of time, it enables

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the observation of lifestyle behaviors [13]. In this succinct review, the current state of smart clothing development is discussed, along with applications in the sports, workwear, healthcare, military, and fashion industries. Future trends and obstacles are also analyzed and explained. This study's primary sources are current experimental research and literature reviews.

The Internet of Things (IoT) has generated a lot of hype in recent years as one of the most cutting-edge technologies. IoT technology's quick development and adoption have created new opportunities for technical advancement in a variety of areas of life. IoT uses low-cost computing, inexpensive sensors, cloud services like Microsoft Azure and Amazon AWS, big data, networking, and mobile and wireless technologies to connect a variety of physical devices to the internet and transform them into digitally intelligent objects and communication technology. The sensors built into the gadgets accomplish this by continuously transmitting information about their operational state and the environment in which they are used [1]. Users now find it easier to communicate with various devices over the internet, which makes for richer experiences. IoT is exploding in every aspect of our life as a result of this quick digitalization, including smart cities, industries, pollution control, energy efficiency, and more. The Internet of Things (IoT), which places a significant emphasis on machine-to-machine (M2M) connectivity, big data, and machine learning, enables businesses and industries to operate more efficiently and reliably [2]. The fashion industry is one such booming sector that is about to realize the full potential of IoT. Connected smart apparel is offering up new possibilities for highly desired wearables like wristbands, eyewear, and clothing. Smart wearables are electronic gadgets that can be conveniently worn on, inside, or close to the surface of the body. They track, process, and communicate data like biometrics or ambient data in real-time [3]. The user receives this information over the internet. On the basis of their contact with the body, wearable devices can be characterized as accessories, textiles, patchable devices, or implantable wearables. These gadgets are equipped with electronics, software, sensors, and connectivity to enable automatic data exchange with users or other connected devices over the internet [4]. These intelligent wearables are incorporated into the clothing to create intelligent clothing.

II. LITERATURE REVIEW

For many sectors, worker safety in dangerous surroundings is a top priority. Smart helmets, smart gloves, and smart eyewear are just a few examples of wearable technology that have been developed to improve worker safety. But the kinds of data they can gather and the amount of monitoring they can offer are constrained by these gadgets. The creation of smart clothing for worker safety is the result of recent developments in wearable technology. By incorporating multiple sensors into the fabric of the clothes, smart clothing can offer a more thorough monitoring system. This improves worker safety by enabling real-time monitoring of vital signs and environmental conditions. The Hexoskin smart shirt is one illustration of smart clothing technology for worker safety. Multiple sensors that can track movement, breathing rate, and heart rate are included in the Hexoskin shirt. A smartphone app that can allow real-time monitoring and analysis of the data is connected to the shirt. The Hexoskin smart shirt is one illustration of smart clothing technology for worker safety. Multiple sensors that can track movement, breathing rate, and heart rate are included in the Hexoskin shirt. The shirt is linked to a smartphone app that can monitor and analyze the data gathered in real-time. a cool head.

The DorsaViViSafe system is another illustration of smart garment technology for worker safety. A sensor belt and a smartphone app make up the system, which can track a worker's posture, movement, and muscle activity. The device is made to lessen the risk of accidents brought on by bad posture and repetitive motions. Because of its affordability and Wi-Fi connectivity, the NodeMCU microcontroller board is a popular option for Internet of Things (IoT) applications when it comes to the specific sensors utilized in the suggested smart worker safety cloth. While the pulse sensor and SPO2 sensor are frequently utilized in healthcare applications, the ultrasonic sensor is frequently employed in robotics and automation to measure distance. Projects involving home automation and environmental monitoring frequently use the DHT11 sensor.

III. COMPONENT

The smart worker safety shirt is made up of a number of parts, including sensors, a buzzer, a microcontroller, and a power source. Below are descriptions of each element.:

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3.1 Microcontroller NodeMCU

The ESP8266 system-on-chip (SoC) is the foundation of the open-source, Wi-Fi-enabled NodeMCU microcontroller board, which offers a platform for creating Internet of Things (IoT) applications. Due to its firmware's inclusion of a Lua interpreter and compatibility with the Lua programming language, NodeMCU makes it simple to create IoT applications without the need to learn new programming languages.With a potent processor capable of operating at up to 80 MHz and built-in Wi-Fi, NodeMCU can connect to the internet and conduct wireless communications with other devices. NodeMCU is adaptable and able to interface with a variety of sensors and actuators thanks to its assortment of input and output pins, which also includes digital input/output (I/O), analogue input, and pulse-width modulation (PWM) pins.The Lua programming language or the Arduino Integrated Development Environment (IDE) can be used to program the NodeMCU. The creation of cloud-based IoT applications is also made possible by a variety of frameworks and tools that make it simple to connect to cloud services like AWS, Google Cloud, and Microsoft Azure.

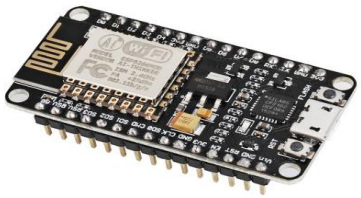

Fig 1. Microcontroller NodeMCU

3.2 Heat Sensor DHT11

Heat sensors are electronic tools that identify and gauge an object's or an area's temperature. The DHT11 temperature and humidity sensor can be utilized in the suggested smart worker safety cloth to gauge the surrounding environment's temperature. A cheap digital sensor called the DHT11 can measure temperature with an accuracy of 2°C between 0°C and 50°C. A thermistor's resistance, which varies with temperature, is used by the sensor to measure resistance. The resistance is next transformed into a digital signal that a microcontroller like the NodeMCU can interpret. Heat-related dangers, such as heat exhaustion or heat stroke, can be identified and warned of by using a heat sensor in the worker safety cloth. When a worker is exposed to extreme temperatures for an extended amount of time without enough cooling or hydration, certain problems may develop. There are various ways to include the heat sensor in the worker safety garment. The sensor might be positioned, for instance, on the worker's back or chest, where a spike in body temperature is most likely to be detected. When the temperature rises beyond a predetermined threshold, the sensor can be connected to a microcontroller, such as the NodeMCU, which can process the data and activate an alert, such as a buzzer or LED light.

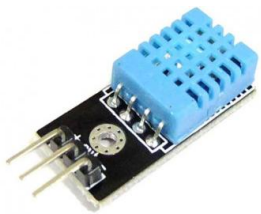

Fig 2. Heat sensor DHT11

3.3 SPO2 Pulse Oximeter

The oxygen saturation level in a person's blood can be determined using the pulse oximeter (SPO2) sensor, a form of the optical sensor. The SPO2 sensor can be utilized in the proposed smart worker safety cloth to continuously track the worker's heart rate and oxygen saturation level. The SPO2 sensor measures the quantity of light absorbed by the blood by flashing light through the skin. In order to determine the heart rate, the sensor can measure the pulsing of the blood vessels when the heart beats. The oxygen saturation level in the blood, a crucial sign of respiratory health, can also be measured by the sensor.

The inclusion of an SPO2 sensor in the worker's safety garment can offer insightful data regarding the worker's health and wellbeing. For instance, the SPO2 sensor can assist in identifying any variations in oxygen levels that may be

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harmful to the worker's health if they are working in a high-altitude or confined place. The sensor can assist in identifying any variations in the worker's heart rate that might point to a possible cardiac condition. There are various ways to incorporate the SPO2 sensor into the worker safety garment. The sensor, for instance, can be affixed to the employee's fingertip or earlobe so that it can track the pulse of the blood vessels. The sensor can be linked to a microcontroller, such as the NodeMCU, which can interpret the data and send out an alert if the heart rate or oxygen saturation level veers off-limits.

Fig 3. SPO2 pulse oximeter

3.4 Ultrasonic Sensor

An example of a proximity sensor that may be used to determine distance using sound waves is the ultrasonic sensor. The ultrasonic sensor can be utilized in the proposed. The ultrasonic sensor in the suggested smart worker safety garment can be used to find obstructions or potential dangers in the worker's path. The ultrasonic sensor operates by discharging high-frequency sound waves into the surroundings, which subsequently reverberate back to the sensor. The sensor can determine the separation between itself and an item by timing how long it takes for the sound waves to return. The ultrasonic sensor may be installed on the protective clothing for workers. smart worker safety cloth to find obstructions or potAn example of a proximity sensor that may be used to determine distance using sound waves is the ultrasonic sensor. The ultrasonic sensor can be utilized in the proposed helmet, the front of the clothing, etc. The sensor can identify risks or barriers in the worker's route as they travel through the environment, such as walls, equipment, or other workers. A vibration or buzzer sound can be used as an alarm if the sensor detects an obstruction within a certain range.

A change in the environment, such as a sharp rise in temperature or a fall in oxygen levels, can also be detected by an ultrasonic sensor. The worker or a safety supervisor may receive an alert if the sensor notices a change that could be harmful to the worker's health. A worker safety cloth that incorporates an ultrasonic sensor can serve to increase worker security and lower the chance of accidents or injuries. The sensor can aid in preventing collisions and other forms of mishaps by identifying hazards and impediments in the worker's path.

Fig 4. Ultrasonic sensor

3.5 Buzzer

An electronic gadget that produces audible sound is called a buzzer. The buzzer in the suggested smart worker safety garment can be utilized as an alarm to notify workers of potential dangers or safety concerns. There are numerous ways the buzzer might be incorporated into the worker safety garment. The buzzer, for instance, can be connected to a microcontroller, such as the NodeMCU, which can cause it to sound in response to particular events, such as a rise in temperature detected by the heat sensor or a fall in oxygen saturation level recorded by the SPO2 sensor.

The buzzer can be utilized to deliver additional alerts or notifications. To remind the worker to take breaks, drink water, or complete other safety-related chores, the buzzer could be set up to sound at regular intervals. The buzzer can also be used to signal the end of a certain operation or activity, such as when a safety inspection is complete. Including a buzzer in the worker, safety uniform can increase worker security and lower the chance of accidents or injuries. The buzzer can assist keep workers focused on safety and make sure they are aware of any hazards or safety issues by giving auditory alerts and reminders.

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Fig 5. Buzzer

Fig 6. Smart cloth kit

IV. PROBLEM STATEMENT

When risky jobs, such as mining or construction, are involved for the workers, security will be crucial. Various accidents have occurred at the workplace as a result of the incapability of technical tools to cross-check factors like gases, worker health, and other activities. When employees are in dangerous locations, there are no security measures in place. Therefore, they require any such equipment that they can conveniently carry around with them at all times, wherever they are.

V. PROPOSED STATEMENT

In response to the aforementioned issue, we have developed a method that enables employees to communicate with supervisors and enjoy more security through a single jacket. We have a wearable garment with IOT capabilities that will assist farmers monitor their operations and notify them to potential risks. This may serve as a means of communication for employees and administrators during implementation.

VI. WORKING

To monitor changes in a worker's environment and health status, the smart worker safety cloth incorporates numerous sensors into the worker's clothing. Temperature, oxygen saturation, and the worker's distance from barriers are just a few of the vital indicators and environmental factors that the sensors continuously track. The microcontroller gets data from the sensors when they identify a potentially dangerous situation, such as a high temperature or the existence of an impediment, and it analyses it to determine whether the worker is at risk of injury. The buzzer is turned on to give the worker an auditory warning if the microcontroller determines that the worker is in danger.

For instance, the microcontroller may analyze the data to determine whether the worker is at risk of heat exhaustion or heat stroke if the DHT11 heat sensor detects a high temperature. The buzzer will sound to warn the worker to take precautions to avoid harm if the microcontroller determines that the worker is in danger.

Similarly, if the ultrasonic sensor detects an obstacle in the worker's path, the microcontroller may analyze the data to determine whether the worker is at risk of collision or injury. If the worker is at risk, the microcontroller will activate the buzzer to alert the worker to take action to avoid the obstacle. The smart worker safety cloth also includes an SPO2 pulse oximeter to measure the oxygen saturation level in the worker's blood. This sensor can detect changes in the worker's health status, such as hypoxia or carbon monoxide poisoning, which could indicate a hazardous work environment

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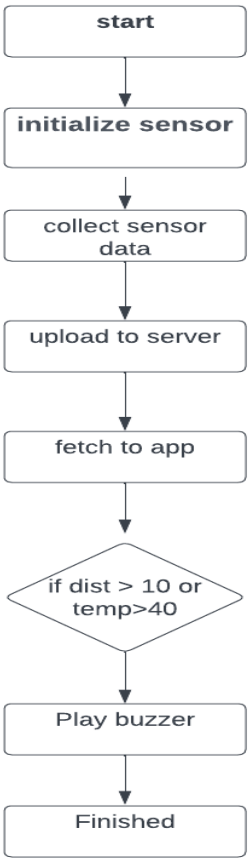

Fig 7. Flow chart of working

6.1 Backtesting

Backtesting can be used to recreate the system's operation under various circumstances in order to assess the efficacy of the proposed smart worker safety cloth. Backtesting includes evaluating a system or strategy's performance using data from the past. The system can be set up in a simulated environment, such as a virtual reality simulation or a real-world mock-up of a hazardous work environment, to undertake backtesting on the smart worker safety cloth. The system can then be evaluated under various circumstances, including varying temperatures, humidity levels, and oxygen saturation levels, as well as various barriers or dangers. Data about the system's performance, including the sensors' precision, speed, and dependability, can be gathered throughout the backtesting procedure of the warnings and alarms, as well as the system's overall success in averting mishaps or injuries. The system can then be improved in any areas that are found by analyzing this data.

Employees that used the smart worker safety cloth during the backtesting procedure can also provide feedback. This feedback can be used to find any problems or difficulties with the system as well as any ideas for enhancements or new features that could be implemented. The effectiveness of the suggested smart worker safety cloth can be assessed by backtesting, together with any necessary adjustments, to guarantee that the system offers the highest level of protection for workers in dangerous circumstances

VII. CONCLUSION

Smart clothing aids in understanding and identifying bodily changes brought on by the environment and physical activity. Through feedback mechanisms, modern clothes can assist the body in adapting to changes. It has gradually evolved into a product of multidisciplinary research as a result of the integration of biochemical technology, electronic information, human-computer interaction, and bionic technology with the advancement of science and technology.

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