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Wearable Technology in Jacket for Tracking Person Health and Safety using IoT

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Abstract

This study presents the development of a smart wearable jacket designed for continuous health and safety monitoring using Internet of Things (IoT) technology. The system integrates multiple sensors to track vital parameters such as heart rate and body temperature, along with environmental factors like humidity and harmful gas presence. An ATmega328P microcontroller is used to process the collected data and evaluate it against predefined safety thresholds. To enhance emergency response, the system incorporates GPS and GSM modules, enabling real-time location tracking and instant alert transmission. When abnormal conditions are detected, the system triggers local alerts through a buzzer and simultaneously sends an emergency message with location details to predefine contacts. The proposed solution is compact, cost-effective, and user-friendly, making it suitable for industrial workers, elderly individuals, and outdoor users. Overall, the system offers a practical approach to improving personal safety through real-time monitoring and rapid response mechanisms.

Keywords: Wearable Technology, Internet of Things (IoT), Smart Safety Jacket, Health Monitoring System, Environmental Monitoring, Embedded Systems, Real-Time Monitoring, GSM Communication, GPS Tracking, Sensor Integration, Emergency Alert System

I. INTRODUCTION

Recent advancements in wearable technology combined with IoT have significantly improved the ability to monitor human health and environmental conditions in real time. Modern wearable systems equipped with sensors and communication modules allow continuous tracking of physiological signals and surrounding environmental factors. These systems are particularly valuable for individuals working in hazardous conditions, elderly people requiring constant supervision, and those exposed to unpredictable outdoor environments.

Despite these advancements, conventional monitoring systems still face several challenges. Many existing solutions are bulky, lack portability, and do not support continuous real-time monitoring. Additionally, most systems are designed to focus on a single parameter, such as either health or environmental conditions, rather than providing a comprehensive solution. This limitation increases the risk of delayed detection of critical situations, which may lead to severe consequences.

Therefore, there is a need for an integrated and efficient system that can simultaneously monitor multiple parameters and provide immediate alerts during emergencies. The proposed smart wearable jacket addresses these limitations by offering a compact, multi-functional, and real-time monitoring solution.

II. LITERATURE REVIEW

Sakhare et al. [1] introduced a smart safety jacket aimed at enhancing worker protection in hazardous environments. Their work emphasizes the limitations of traditional wearable devices, which often fail to handle multiple types of data simultaneously. The proposed solution integrates various sensors into clothing to enable real-time monitoring of both physiological and environmental parameters. However, the system lacks efficient emergency communication capabilities.

Ahmed et al. [2] proposed a workplace safety jacket equipped with LED indicators and a mobile application to improve communication between workers and supervisors. The system supports real-time tracking and alert generation during emergencies. While it enhances coordination and safety awareness, it does not include detailed health monitoring features.

Zinjad et al. [3] developed a safety jacket primarily focused on women's security. The system uses GPS technology for location tracking and includes an emergency alert mechanism. It also features audio recording for evidence collection and supports message

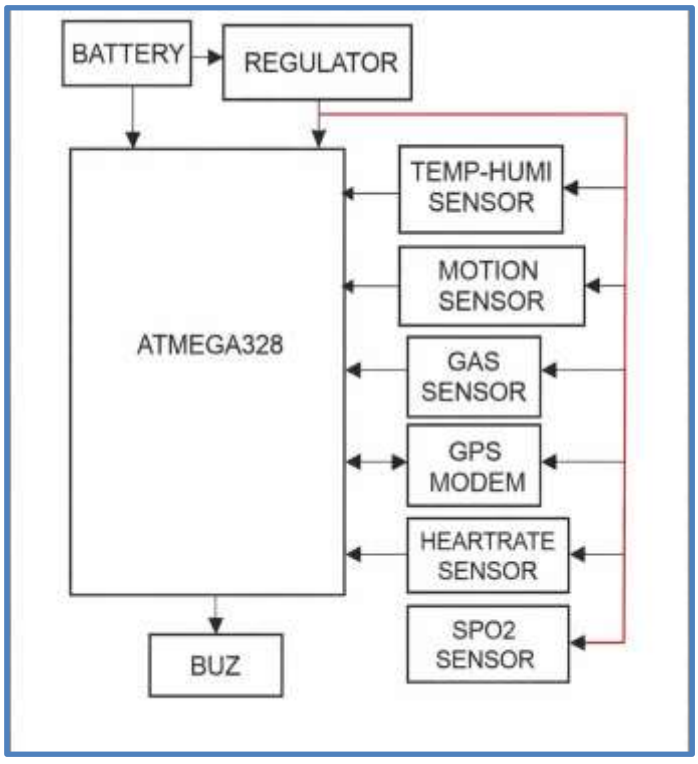
storage during network failures. However, the design does not consider environmental monitoring or continuous health tracking.

Nag [4] designed a safety jacket for coal miners to monitor environmental conditions such as gas concentration and temperature. The system helps in early detection of hazardous situations, but it does not include health monitoring or advanced communication systems.

Kumar et al. [5] presented an IoT-based health monitoring system that records parameters such as heart rate and body temperature and uploads data to a cloud platform. Although effective for health tracking, the system is not integrated into a wearable safety solution and lacks environmental hazard detection.

Sharma et al. [6] developed a wearable IoT device capable of monitoring vital signs and generating emergency alerts through wireless communication. While the system supports real-time health monitoring, it does not incorporate environmental sensing features, limiting its usability in hazardous workplaces.

III. BLOCK DIAGRAM



IV. PROJECT OBJECTIVES

Real-Time Health Monitoring

The system is designed to continuously keep track of the user's health, such as heart rate and body temperature, using built-in sensors. It helps in identifying any unusual changes at an early stage so that timely action can be taken before the situation becomes serious.

Environmental Monitoring

Along with health, the jacket also monitors the surrounding environment. It measures temperature, humidity, and checks for harmful gases. This is especially useful for people working in risky environments where unsafe conditions can affect their health.

Hazard Detection and Safety

The system can detect dangerous situations like gas leaks, extreme environmental conditions, or even sudden movements such as falls. Whenever such risks are identified, it quickly alerts the user, helping to ensure their safety.

Real-Time Location Tracking

To make emergency response faster, the jacket includes a GPS feature that tracks the user's exact location. This location can be shared with others during emergencies, making it easier to find and assist the user.

Emergency Communication

The system uses a GSM module to send emergency messages. If any problem is detected, it sends an SMS with important details and the user's location to pre-selected contacts, ensuring quick help is available.

Comfortable and User-Friendly Design

The jacket is designed to be lightweight, compact, and comfortable to wear. It allows users to go about their daily activities without any difficulty, making it practical for regular use.

Affordable and Energy Efficient

Another important aim is to keep the system low-cost so that it can be used by more people. It is also designed to consume less power, ensuring longer usage with efficient battery management.

V.WORKING PRINCIPLE

Data Collection

The process starts with collecting real-time data using sensors built into the jacket. A heart rate sensor monitors the user's pulse, while the DHT11 sensor measures temperature and humidity in the environment. A gas sensor checks for harmful gases like LPG, methane, or smoke. All these sensors work continuously, ensuring that the system is always monitoring the user without interruption.

Data Processing

The data collected from these sensors is sent to the ATmega328P microcontroller, which acts as the brain of the system. Since some sensors produce analog signals, the microcontroller converts them into digital values using its built-in converter. It then processes this data to calculate useful information, such as heart rate in beats per minute (BPM), and compares the results with pre-set safe limits.

Condition Monitoring

The system constantly checks whether the values are within a normal range. If everything is normal, it simply continues monitoring. However, if something unusual is detected—like an abnormal heart rate, high temperature or humidity, harmful gas presence, or even a sudden fall—it recognizes this as a dangerous situation.

Alert System

As soon as an abnormal condition is detected, the system immediately alerts the user. A buzzer sounds an alarm, and an LED light turns on to give a visual warning. This helps not only the user but also people nearby become aware of the situation.

Communication and Location Tracking

At the same time, the system uses the GPS module to find the user's exact location. This location is then included in an emergency message. Using the GSM module, the system sends an SMS with the alert details and location to pre-set contacts. This ensures that help can reach the user as quickly as possible.

Manual Emergency Option

The jacket also includes a push-button for manual use. If the user feels unsafe but the sensors do not detect any issue, they can press the button to instantly send an emergency alert.

Power Supply

The entire system runs on a rechargeable lithium-ion battery.

VI. RESEARCH METHODOLOGY

System Design and Planning

The first step is to understand what the system needs to do and design its overall structure. The main goal is to create a wearable device that can monitor both health and environmental conditions at the same time.

During this stage, important decisions are made, such as choosing the right sensors, adding communication modules for sending alerts, keeping the system portable, and ensuring it uses less power. A block diagram is also created to show how all components—like sensors, microcontroller, and communication modules—are connected and interact with each other.

Hardware Implementation

In this stage, all the physical components are selected and connected to build the system.

Sensors are used to collect data—such as a heart rate sensor for pulse monitoring, a DHT11 sensor for temperature and humidity, and a gas sensor to detect harmful gases. The ATmega328P microcontroller acts as the brain, controlling all operations.

For communication, a GPS module is used to track location, and a GSM module is used to send emergency messages. A buzzer and LED are added to give immediate local alerts. The entire system is powered by a rechargeable lithium-ion battery.

All components are carefully connected using proper circuits, along with resistors and capacitors, to ensure stable and reliable performance.

Software Development

The system is programmed using Embedded C in the Arduino IDE. The software is responsible for reading data from sensors, converting signals into usable values, and analysing the information.

It also compares the data with pre-set safe limits and controls the alert system and communication modules. The program runs continuously so that monitoring happens in real time without interruption.

Data Processing and Decision Making

The microcontroller constantly checks the sensor data and decides whether everything is normal or not.

If the readings are within safe limits, the system keeps monitoring quietly. But if any unusual condition is detected—like an abnormal heart rate, high temperature, or harmful gas—the system recognizes it as a potential emergency. This decision-making process is handled using programmed conditions in the system.

Communication and Alert System

When a problem is detected, the system quickly takes action. The GPS module finds the user's current location, and the GSM module sends an SMS alert to emergency contacts.

The message includes details about the problem, sensor readings, and the user's location. At the same time, the buzzer sounds and the LED lights up to alert people nearby.

System Integration

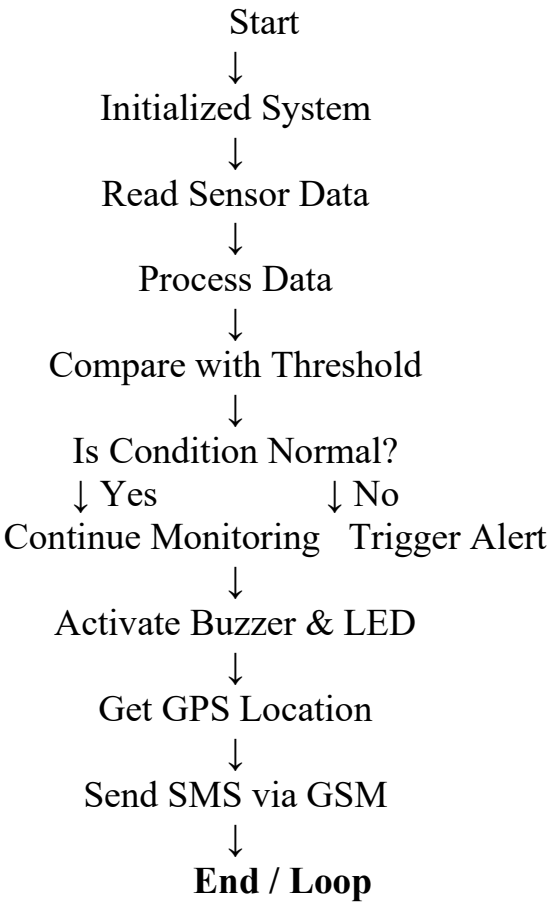
All the components are combined into a single wearable jacket. The sensors are placed within the fabric, while the electronic modules and battery are securely fitted to maintain comfort and ease of use.

The final design is lightweight, portable, and simple to operate, making it suitable for everyday use.

Testing and Validation

Finally, the system is tested under different conditions to make sure it works properly. This includes checking sensor accuracy, testing GPS and GSM communication, verifying emergency responses, and evaluating battery performance. The testing results show that the system can accurately detect abnormal conditions, send alerts instantly, and provide reliable location tracking.

VII.FLOW CHART



VIII.PROBLEM STATEMENT

Keeping people safe and healthy—especially in dangerous environments—is still a major challenge. Most of the safety systems available today have several limitations. They are often bulky, difficult to carry, and cannot provide continuous real-time monitoring.

Another issue is that many existing solutions focus on only one factor, such as temperature or gas detection, instead of offering a complete system that monitors both a person's health and their surroundings. Because of this, important warning signs can be missed.

In addition, these systems usually lack proper emergency communication features. This can lead to delays in getting help during critical situations. The absence of real-time location tracking makes rescue operations even more difficult. Relying only on manual supervision is also not very dependable, as it can lead to human errors.

Because of these challenges, there is a strong need for a smart, wearable solution that is compact and easy to use. Such a system should be able to continuously monitor multiple parameters, quickly detect any abnormal conditions, and send immediate alerts along with the user's location.

IX. FUTURE SCOPE

The proposed smart wearable jacket offers a reliable approach for continuous health and safety monitoring in real time. However, there remains considerable opportunity to further enhance its performance and functionality. Future developments can focus on incorporating advanced technologies to improve accuracy, efficiency, and ease of use.

One important improvement would be the addition of a mobile application along with cloud support for storing and analyzing data in real time. This would enable users as well as healthcare professionals to review past records and observe long-term health patterns. Furthermore, the inclusion of Artificial Intelligence (AI) and Machine Learning (ML) techniques can help the system analyze data intelligently and identify possible health risks at an early stage.

The system can also be extended by integrating more sophisticated biomedical sensors such as ECG, SpO_2, and blood pressure monitors, allowing more detailed health assessment. Enhancing battery performance

Using energy-efficient components and alternative power solutions can support longer operation and better portability.

In addition, reducing the size of electronic components and using flexible materials can improve comfort and wearability. Connecting the system with IoT-based platforms and emergency services can help ensure faster response during critical situations. Overall, these advancements can make the system more efficient, adaptable, and suitable for practical, real-world deployment.

X. CONCLUSION

This project focuses on designing and developing a smart wearable jacket that helps in monitoring health and safety in real time using Internet of Things (IoT) technology. The jacket is equipped with different sensors that continuously track important health details like heart rate, as well as environmental conditions such as temperature, humidity, and gas levels.

At the centre of the system is the ATmega328P microcontroller, which processes all the collected data and makes decisions based on it. The system also includes GSM and GPS modules, which allow it to send emergency messages and share the user's real-time location whenever needed.

If any abnormal condition is detected, the system quickly alerts the user through a buzzer and also sends an SMS to emergency contacts. This ensures that help can reach the user as soon as possible.

The jacket is designed to be lightweight, portable, and easy to use, making it suitable for different situations like industrial work, elderly care, and outdoor activities.

Overall, this solution is reliable, affordable, and effective in improving personal safety and health monitoring, with strong potential for real-world use and future improvements.

XI.PROJECT VIEW AND RESULT

The smart wearable jacket works effectively by continuously monitoring both health and environmental conditions in real time. It can quickly identify any unusual or unsafe situations, such as changes in health parameters or harmful surroundings.

When something abnormal is detected, the system immediately alerts the user through a buzzer. At the same time, it sends an SMS along with the user's location details to emergency contacts, ensuring that help can reach quickly.

The system performs reliably, responds quickly to critical situations, and communicates information effectively. Because of these features, it is a practical and dependable solution that can be used in real-life situations to improve safety and protection.

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