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Smart Safety System for Physically Disabled Individuals Using IoT

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Abstract: ***This paper presents a Smart Safety System for Physically Disabled Individuals designed using Internet of Things (IoT) technology to enhance personal safety and independence. Physically disabled individuals often face challenges such as accidental falls, unexpected obstacles, and delayed emergency assistance. To address these issues, the proposed system integrates multiple sensors including MPU6050 for fall detection, ultrasonic sensor for obstacle detection, and MQ-3 for alcohol detection. An Arduino Uno is used as the central controller to continuously monitor sensor data and identify abnormal conditions using predefined thresholds. In case of an emergency, such as a fall or unsafe environment, the system automatically sends alerts to a predefined guardian through a GSM module. A GPS module is also incorporated to provide real-time location information, enabling quick and effective response. The system operates automatically without requiring manual intervention, making it suitable for users with limited mobility. The proposed solution is cost-effective, reliable, and easy to implement. It significantly improves response time during emergencies and enhances the overall safety and confidence of physically disabled individuals.***
Keywords: ***IoT, Smart Safety System, Assistive Technology, Arduino, GSM, GPS***

I. INTRODUCTION

The safety of physically disabled individuals is a major concern, especially when they attempt to perform daily activities independently. Due to limited mobility and reduced environmental awareness, they are more vulnerable to accidents such as falls, collisions with obstacles, and delayed access to help during emergencies. In many cases, the absence of real-time monitoring systems increases the severity of such incidents.

Traditional safety approaches rely heavily on manual assistance or supervision, which may not always be available. Therefore, there is a need for an intelligent and automated system that can continuously monitor the user's condition and provide immediate alerts in case of danger. With the advancement of Internet of Things (IoT) technology, it has become possible to develop smart systems that integrate sensors, process real-time data, and communicate effectively.

The proposed Smart Safety System for Physically Disabled Individuals aims to address these challenges by providing an integrated safety solution. The system combines multiple sensors and communication modules to detect abnormal conditions and send alerts along with location information to a predefined guardian.

A. Problem Statement

Physically disabled individuals are at a higher risk of accidents due to mobility limitations, lack of environmental awareness, and delayed emergency response. Existing safety systems are often limited in functionality and fail to provide real-time monitoring and communication. There is a need for a comprehensive and cost-effective system that can detect multiple unsafe conditions and provide immediate alerts to ensure user safety.

B. Objectives

The main objectives of the proposed system are:

- To design and develop a smart safety system using IoT technology
- To detect falls using motion sensors such as MPU6050
- To identify obstacles using ultrasonic sensors and prevent collisions
- To detect unsafe conditions such as alcohol presence
- To send real-time alerts to guardians using GSM module
- To provide location tracking using GPS module
- To improve the safety and independence of physically disabled individuals

C. Scope of the System

The scope of the proposed system includes the development of a wearable safety solution that monitors both physical and environmental conditions. The system is capable of detecting emergencies and providing instant alerts to guardians. It is designed for use in indoor and outdoor environments and focuses on affordability and ease of use. However, the current system is limited to sensor-based detection and does not include advanced predictive analytics.

II. LITERATURE REVIEW

A. Existing Research on Smart Safety Systems

In recent years, several researchers have explored IoT-based safety systems to improve user security and monitoring. Many of these systems focus on accident detection, health monitoring, or location tracking. However, most existing solutions are limited in functionality and do not provide a comprehensive safety mechanism.

A study by Kumar et al. (2024) introduced an IoT-based safety device that detects accidents using accelerometer data. While the system was effective in detecting sudden impacts, it lacked additional features such as obstacle detection and real-time communication with guardians.

Another system proposed by Sharma et al. (2025) focused on smart monitoring using IoT sensors. This system collected environmental data and monitored user activity, but it did not include emergency alert mechanisms, making it less effective in critical situations.

Patel et al. (2026) developed an assistive device that provided real-time tracking and emergency alerts. Although the system improved safety, it was expensive and not easily accessible for common users.

Most existing systems suffer from one or more of the following limitations:

- Lack of multiple integrated safety features
- Delayed or no real-time alert system
- High cost and complexity
- Limited accessibility for disabled individuals

The proposed system addresses these limitations by integrating multiple sensors and providing instant alerts using GSM and GPS technology. It ensures affordability, real-time response, and improved usability.

Table -1: Literature Survey of Existing Systems

Year	Author	System	Limitation
2024	Kumar et al.	IoT Safety Device	Limited features
2025	Sharma et al.	Smart Monitoring	No real-time alerts
2026	Patel et al.	Assistive Device	High cost

B. Limitations of Existing Systems

From the above studies, it is clear that existing systems have several limitations. Most solutions are designed for a single purpose, such as fall detection, obstacle detection, or location tracking, rather than offering a combined safety framework. Some systems are expensive and difficult to implement for student-level or low-cost applications. Others do not provide real-time alerts, which reduces their effectiveness in emergencies. In addition, many systems are not specifically designed for physically disabled individuals and therefore do not fully address their practical safety needs.

C. Need for the Proposed System

The literature survey shows the need for an integrated, affordable, and real-time smart safety system that combines multiple features in one device. The proposed system aims to overcome the limitations of previous research by integrating fall detection, obstacle detection, alcohol detection, alert messaging, and location tracking. This combination makes the system more suitable for physically disabled individuals, as it offers both preventive and emergency support. Therefore, the proposed work contributes toward a more practical, reliable, and user-friendly assistive safety solution.

III. METHODOLOGY

The proposed Smart Safety System for Physically Disabled Individuals is designed using Internet of Things (IoT) technology to provide continuous monitoring and real-time emergency response. The system integrates multiple sensors and communication modules to detect unsafe conditions and notify guardians immediately.

A. System Architecture

The system architecture consists of both hardware and communication components working together to ensure safety. The main components include:

- Arduino Uno: Acts as the central controller that processes input data from all sensors and controls system operations.
- MPU6050 Sensor: Used for fall detection by measuring acceleration and orientation changes of the user.
- Ultrasonic Sensor: Detects obstacles in front of the user by measuring distance and helps prevent collisions.
- MQ-3 Alcohol Sensor: Detects the presence of alcohol and identifies unsafe conditions.
- GSM Module: Sends SMS alerts to predefined contacts during emergency situations.
- GPS Module: Provides real-time location information of the user.
- Buzzer/Alert Unit: Gives immediate feedback or warning to the user.

In this architecture, all sensors are connected to the Arduino, which continuously collects and processes the data. When any abnormal condition is detected, the Arduino activates the alert mechanism and communicates with the GSM and GPS modules to send emergency messages.

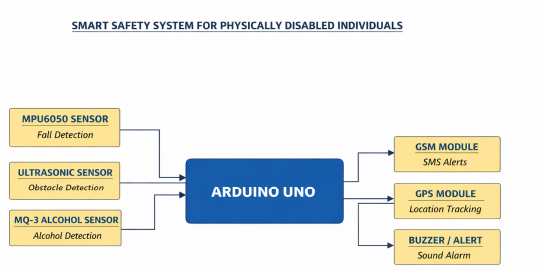

Fig -1: Block Diagram of Smart Safety System for Physically Disabled Individuals

B. Working of the System

The working of the system is based on continuous monitoring and real-time data processing. The steps involved are as follows:

- The system is powered on and all sensors are initialized.
- The MPU6050 continuously monitors motion and orientation data.
- The ultrasonic sensor measures the distance between the user and nearby obstacles.
- The MQ-3 sensor checks for alcohol levels in the environment.
- The Arduino processes all sensor inputs and compares them with predefined threshold values.

If any abnormal condition is detected:

- ➢ Fall Detection: If sudden acceleration or tilt is detected, the system identifies it as a fall.
- ➢ Obstacle Detection: If the distance measured by the ultrasonic sensor is below the threshold, an obstacle warning is triggered.
- ➢ Alcohol Detection: If alcohol levels exceed the limit, the system identifies it as an unsafe condition.

Once a critical condition is detected, the system performs the following actions:

- ➢ Activates the buzzer to alert the user
- ➢ Retrieves location data using the GPS module
- ➢ Sends an SMS alert to the guardian using the GSM module

The system operates automatically without requiring user intervention, making it suitable for physically disabled individuals who may not be able to react quickly during emergencies.

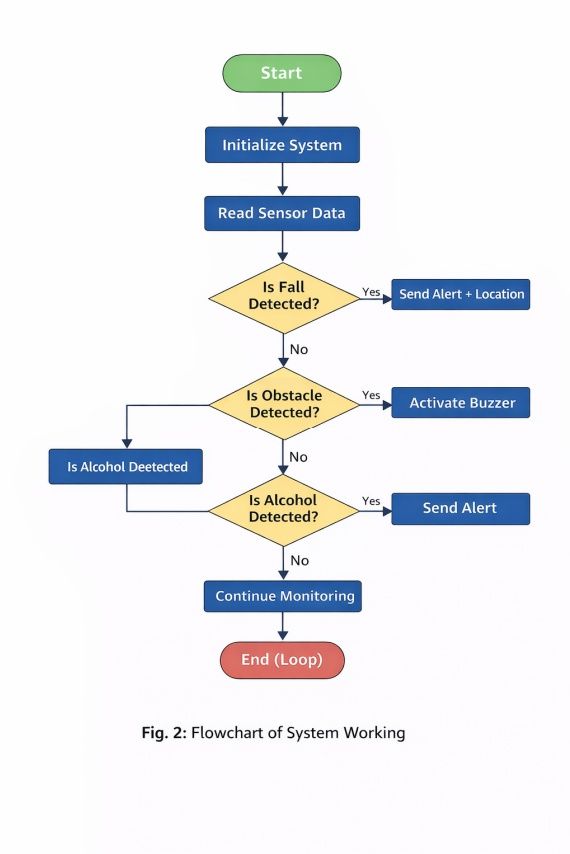

Fig -2: Flowchart of System Working

IV. IMPLEMENTATION

A. System Implementation

The proposed Smart Safety System for Physically Disabled Individuals was implemented using Arduino Uno as the central controller. The system integrates multiple sensors including MPU6050 for fall detection, ultrasonic sensor for obstacle detection, and MQ-3 sensor for alcohol detection. These sensors were interfaced with the Arduino using appropriate connections and programmed using Arduino IDE.

The MPU6050 sensor was configured to continuously monitor acceleration and orientation data. The ultrasonic sensor was connected to measure distance using trigger and echo pins, enabling detection of nearby obstacles. The MQ-3 sensor was calibrated to detect alcohol levels above a predefined threshold. Additionally, the GSM module was used for sending SMS alerts, and the GPS module was used for obtaining real-time location coordinates.

All components were powered using a suitable power supply, and the system was programmed to operate continuously. The integration of hardware and software ensured smooth communication between sensors and output modules.

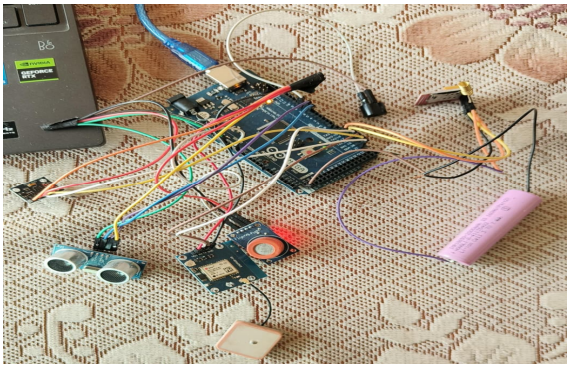

Fig. 3: Hardware Implementation of the Proposed System

B. Testing and Results

The system was tested under different simulated conditions to evaluate its performance. During fall detection testing, the MPU6050 sensor successfully detected sudden changes in motion and triggered emergency alerts. The ultrasonic sensor effectively detected obstacles within a specified distance and activated the buzzer to warn the user.

The MQ-3 sensor was able to detect alcohol presence accurately when exposed to alcohol-based substances. Upon detecting unsafe conditions, the system triggered alerts without delay. The GSM module successfully sent SMS notifications to predefined contacts, while the GPS module provided accurate location details in the messages.

The response time of the system was found to be minimal, ensuring quick communication during emergencies. The results demonstrate that the system is capable of performing multiple safety functions simultaneously.

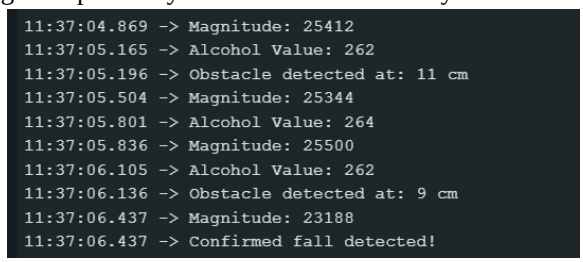

Fig. 4: Serial Monitor Output Showing Alcohol Detection and Obstacle Detection

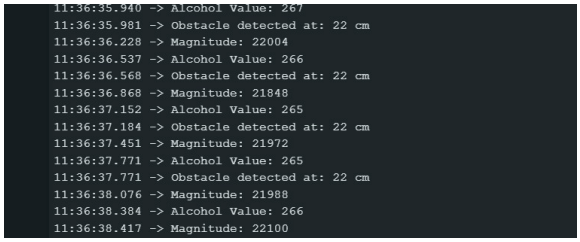

Fig. 5: Serial Monitor Output Showing Fall Detection with Sensor Readings

C. Performance Analysis

The performance of the system was evaluated based on accuracy, response time, and reliability. The sensors used in the system showed consistent performance during testing. The fall detection mechanism accurately identified sudden movements, while the obstacle detection system provided timely warnings.

The communication modules, including GSM and GPS, performed efficiently by delivering alerts and location information within a short duration. The system operates in real time and does not require manual intervention, which makes it suitable for physically disabled individuals.

Overall, the system proved to be reliable and effective in improving safety. The integration of multiple features into a single system enhances usability and provides both preventive and emergency support.

V. CONCLUSION

The proposed Smart Safety System for Physically Disabled Individuals presents an effective and reliable solution for enhancing personal safety and independence. The system integrates multiple sensors such as MPU6050 for fall detection, ultrasonic sensor for obstacle detection, and MQ-3 for alcohol detection, along with GSM and GPS modules for communication and location tracking. This combination enables the system to continuously monitor the user's condition and respond immediately in case of emergencies. The implementation and testing results demonstrate that the system is capable of accurately detecting unsafe situations and sending timely alerts to predefined contacts. The real-time monitoring and automated response reduce the risk associated with accidents and improve the chances of quick assistance.

The system is cost-effective, easy to implement, and suitable for real-world applications. It provides both preventive and emergency support, making it a valuable assistive solution for physically disabled individuals. Overall, the proposed system successfully meets its objective of improving safety, reducing response time, and enhancing user confidence in daily activities.

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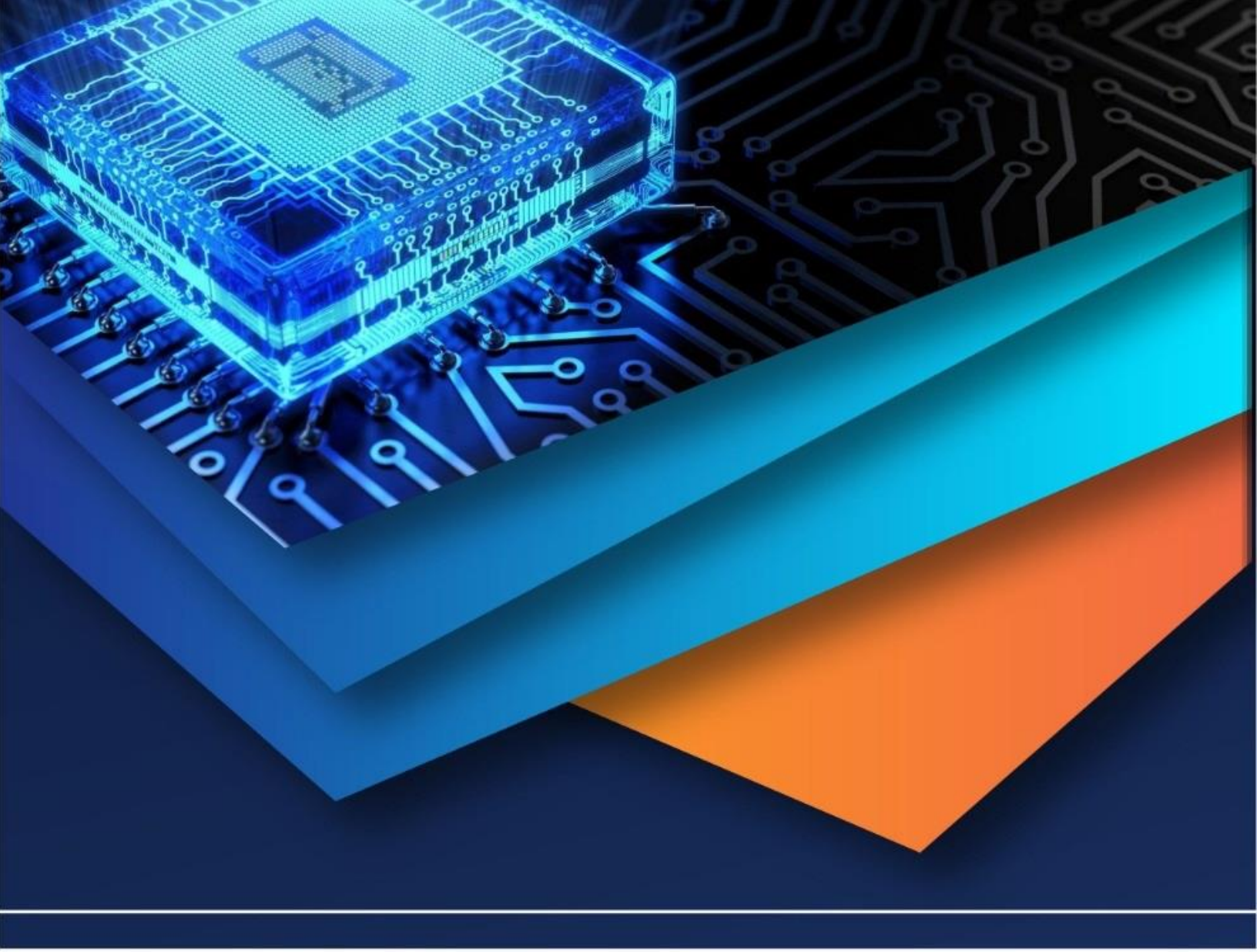

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