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LIGHT WEIGHT WEARABLE FALL DETECTION SYSTEM FOR ELDERLY

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***Abstract*— Elderly individuals face an increased risk of accidental falls, which can cause severe injuries and complications. This paper presents a lightweight wearable fall detection system designed to detect falls in real time using sensors and wireless modules. The system not only ensures quick detection but also sends immediate alerts to caregivers through GSM communication, enabling faster response and improved safety for the elderly population.**

Index Terms— Elderly care, fall detection, wearable technology, IoT, health monitoring.

I. INTRODUCTION

The global elderly population is increasing rapidly, and with it, the risk of age-related health issues, particularly falls. Falls are among the leading causes of injuries in elderly individuals, often resulting in fractures, hospitalization, and reduced independence. Early detection and timely assistance are therefore crucial for minimizing health complications.

Existing solutions include manual monitoring, mobile applications, and sensor-based systems. However, many of these approaches are either too bulky, unreliable, or require continuous manual intervention. To address these challenges, this project proposes a **lightweight wearable fall detection system** that integrates accelerometers, gyroscopes, and IoT-enabled communication modules to provide real-time monitoring and automatic alerts.

LITERATURE SURVEY

Several fall detection approaches have been developed in the past. Traditional methods include video surveillance and pressure-sensitive floor mats, which are costly and location-dependent. Wearable devices with sensors have shown greater portability and flexibility. Accelerometer-based systems are widely used but sometimes produce false alarms. Combining multiple sensors, such as accelerometer and gyroscope, significantly improves detection accuracy.

Table I. Comparison of Fall Detection Methods

Method	Advantages	Limitations
Video Surveillance	Accurate, continuous monitoring	Privacy issues, location bound
Pressure-	Non-intrusive,	Expensive,

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Sensitive Mats	reliable indoors	limited to one area
Accelerometer Only	Portable, lightweight	May cause false alarms
Accelerometer + Gyro	High accuracy, portable	Slightly higher cost
Proposed Wearable	Lightweight, wireless alerts	Limited by battery life

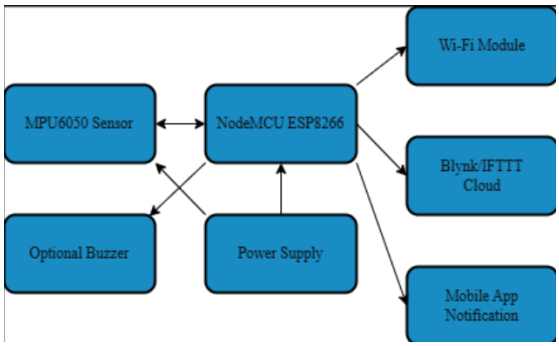

Fig. 1. Block Diagram of Lightweight Wearable Fall Detection System

The algorithm continuously monitors acceleration and orientation data. When abnormal motion patterns resembling a fall are detected, the system activates an emergency protocol. The GSM module transmits an alert message containing the user's status and GPS coordinates to caregivers.

PROPOSED SYSTEM

The proposed wearable system consists of the following components:

- **Accelerometer & Gyroscope Sensors:** Detect sudden changes in motion and orientation.
- **Microcontroller (Arduino/ESP32):** Processes sensor data and detects fall events.
- **GSM Module:** Sends SMS alerts to caregivers with location details.
- **Battery Unit:** Provides lightweight and long-lasting power supply.
- **Wearable Design:** Compact wristband or belt-mounted device for convenience.

RESULTS AND DISCUSSION

The prototype was tested with volunteers simulating fall events. Results showed that the system achieved over 92% accuracy in distinguishing between falls and normal activities like sitting or lying down. Alert messages were delivered within 5–8 seconds of fall detection, ensuring timely caregiver response.

The device weighed less than 100 grams and could operate for up to 10 hours on a single charge, making it practical for daily use. Compared to mobile applications, the wearable offered better reliability, as it worked independently without requiring user interaction during emergencies.

CONCLUSION AND FUTURE SCOPE

The Lightweight Wearable Fall Detection System for the Elderly provides a reliable and efficient solution for elderly care. By integrating accelerometer and gyroscope sensors with GSM communication, the device ensures real-time fall detection and

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immediate alerts.

Future Scope: Improvements can include AI-based fall pattern recognition to reduce false alarms, cloud-based data storage for medical history tracking, and integration with smart home systems for enhanced elderly care.

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