Smart Wearable for Alzheimer's Safety

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***Abstract*—The paper proposes a safety system to be worn by people suffering from Alzheimer's disease and other cognitive disorders. These people are susceptible to hazards like falling, disorientation, and delayed emergency response, which all need to be monitored constantly. The proposed system monitors body movement using motion sensors to identify unusual situations such as unexpected falls, wandering towards unsafe areas or prolonged inactivity. The proposed approach focuses on reliability through local data processing and utilization of multiple communication means (GSM, Bluetooth, and Wi-Fi) for the timely delivery of alerts, unlike traditional systems, which are highly dependent on network connectivity. The system also has a manual panic option for immediate assistance. This work aims to improve patient safety at home and reduce caregiver burden.**

***Index Terms*—Alzheimer's disease, smart wearable device, alert, real-time monitoring, fall prevention**

I. INTRODUCTION

Alzheimer's disease is a slow, progressive disease that affects memory, thinking, and the ability to carry out everyday activities. The Alzheimer's progression may cause mental confusion; the patient may fail to recognize familiar surroundings and most probably may have frequent falls and eventually wander away from the designated area. Therefore, a careful supervision of Alzheimer patients is required for the safety and welfare of such persons, especially when they live independently or under minimized supervision.

Recently, wearable and IoT-based devices are emerging as promising technologies for patient monitoring, where sensors collect movement, position and other physiologic signals to relay real-time information to the caregiver. These devices have been successful in tracking patients, and detecting emergency situations thereby facilitating efficient monitoring and reducing caregiver strain.

But there are some common problems with several systems that exist currently. Many devices need constant access to the network which is not always available. Secondly many devices have been reported to detect the incident in retrospective way but does not provide early warning support for potential risk situations. Other problems have been reported with reliability, affordability and practical deployment.

To overcome these problems, this paper proposed a wearable system where reliability and early risk both have been considered with the use of motion sensors, that can detect unusual conditions such as falls and inaction with multi-mode of communication to ensure the alerts be delivered on time. It aims to develop an inexpensive and practical way to provide assistance to elderly people with the intention of improving safety and providing effective and reliable caregiver monitoring.

II. OBJECTIVES

- To develop a wearable safety system that can be worn by elderly people with Alzheimer's disease and similar cognitive impairment.
- The sensors will detect movements such as falls and abnormal activities through the use of a gyroscope and accelerometer.
- The development of reliable emergency alert system to alert the caregivers on time.
- The aim is to provide system reliability by using multiple communication methods like GSM, Bluetooth, and Wi-Fi
- To reduce false alarms by combining tilt, impact, and inactivity detection
- To propose a practical and cost-effective solution for real-world applications.

III. LITERATURE SURVEY

In recent years, much research has been done on wearable technology and Internet of Things-based systems for monitoring patients suffering from Alzheimer's disease for the welfare of patient by ensuring that all their body movements and location can be monitored on time to ensure safety. Different type of wearable equipment used the accelerometers, gyroscope and GPS modules which is necessary for activity tracking and alert notification. Some of the systems use an accelerometer for the detection of sudden change of body movement, which is followed by a GPS module to trace the person's location, and the alerts are sent through mobile app, SMS or cloud-based application to the caregiver.

However, most of the current wearable devices are associated with number of limitations. First, many systems depend solely on constant network access, which cannot be achieved in all areas of life. Many devices are of prototype nature; therefore, cannot be applied in real-world environments since there are numerous obstacles such as usability, bulkiness etc. One major challenge faced by systems is their reactive nature. Such systems typically only identify a particular incidence after it has taken place rather than providing preventive measures and anticipating future dangers.

To overcome such shortcomings, a highly reliable wearable system, which provides not only safety but also safety prevention, must be created. This system endeavours to use the motion sensor to provide alert at emergency situation for fall and inactivity while focusing on providing reliable alerts through multiple communication ways.

IV. PROPOSED METHODOLOGY

The proposed wearable safety system monitors the activity of user, detect any kind of emergency such as falls and abnormal inactivity through motion sensors and transmits it to the caregiver using multi communication approach.

The sensors are an accelerometer and gyroscope which measure the body tilt along multi-axes, the data collected is processed by the microcontroller to identify any irregular condition of human body and movement towards the predefined unsafe areas. The fall is identified when there is a sudden change in tilt and impact while there is no movement recorded after the incident has happened which in contrast with the single condition monitoring system provides greater efficiency in terms of reducing false alarms.

The functioning of the system can be broken into 4 major steps:

1. Collection of motion sensor data
2. Risk condition and activity analysis
3. Alert initiation at detected event
4. Alert transmission to the caregivers

The data processing is carried out locally on the wearable system thereby not dependent on network connectivity of the external system or servers. The system is designed to function effectively regardless of external issues; it also integrates with a panic button which can be used for alerting the caregiver for any assistance when fall is not identified.

V. TOOLS AND TECHNOLOGIES

The system we have proposed has both hardware and software tools which are required for monitoring, real-time detection and alert generation.

Hardware Components

Microcontroller (ESP32 Microcontroller):

Used as the main processing unit to read sensor data and control system operations.

MPU6050 Sensor (Accelerometer + Gyroscope):

Measures body movement, tilt, and acceleration to detect falls and abnormal motion.

GPS Module:

Provides the location of the user, which can be shared with caregivers during emergencies.

GSM Module (Optional):

Used to send SMS alerts to caregivers during network unavailability.

Battery:

Supplies power to the wearable device for continuous operation.

Communication Technologies:

Wi-Fi and Bluetooth:

Embedded through ESP32 for communication and alert transmission.

GSM Network:
Used as optional emergency fallback communication method.

Location Tracking:
Supported through smartphone assisted communication.

Software Tools
Arduino IDE / Embedded C:
Used for programming the microcontroller and implementing detection logic.

Mobile Application:
This would enable the caregiver to receive the alerts and user status.

Technologies Used
Internet of Things (IoT):
Connects the wearable device with other systems through a network and enables the monitoring and alert.

Sensor-Based Monitoring:
Continuously monitors the activity of the user through motion sensors.

VI. EXPECTED RESULTS

The wearable device expected to monitor the activity of the user and detect emergencies like fall or absence of movement for example when a patient lies down. This can be achieved using a motion sensor like accelerometer and gyroscope which can detect direction and impact. Multi-parameter detection is expected to result in lower rates of false alarms than single-condition monitoring, such as tilt.
Moreover, local data processing is expected to increase the efficiency of the system, which does not depend on continuous access to the Internet. Multiple communication channels, including GSM, Bluetooth, and Wi-Fi, will help ensure reliability since they will provide several ways to notify the caregiver about potential emergencies, as well as the location of the user. The caregiver will receive information immediately and act accordingly.
In conclusion, the proposed system is expected to be an affordable and convenient way to ensure safety for Alzheimer's patients and alleviate the burden on their caregivers.

VII. CONCLUSION

This paper proposes a wearable safety system to improve the surveillance and protection of patients who have Alzheimer's disease. The system will monitor abnormal activities like falls and lack of physical movements to identify emergency situations promptly. Through integration of multiple communication channels, the system guarantees high reliability by ensuring delivery of alert notifications under various networking conditions.
The proposed solution is not like other systems because the majority rely on connectivity to deliver their services and fail to predict emergencies before they happen. Moreover, the proposed system is affordable, simple, and easy to operate.
There are several improvements that could be made in the future to make the system better. Additional medical sensors could be included in the system to monitor other health parameters of the patient. Moreover, predictive analytics would be integrated to facilitate earlier identification.

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