Smart Fall Detection System for Elderly People Using Arduino Uno”

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Abstract- Falling down is one of the major medical problems that face the elderly people. The consequences of falling may be fatal if there is no immediate medical attention provided. Hiring nurse and caregivers may be the best option to constantly monitor and support activities of daily living (ADL) of elderly people, but the cost would be very expensive. Moreover, it is difficult for the caregivers to constantly observe and assist elderly people all the time. Falling events among the elderly people may occur when the caregivers are not around to supervise which lead to the issue of reliability. Therefore, an intelligent fall detection system that is reliable and cost effective must be considered as an option to assist elderly people. Currently available techniques that are used to design fall detection systems are classified into three categories which are camera-based method, acoustic-based method and kinematic-based method. Each method has its own advantages and disadvantages over another. All of these approaches help to reduce the effort of nurses and caregivers to monitor daily activities of the elderly people. Furthermore, they provide proper medical attention urgently to elderly people in case of fall. Despite these advantages, there are still many problems and the state-of-the-art in fall detection is quite premature. There are still need for massive research in order to come up with a system that can solve all the drawbacks of current traditional approaches. Method that can predict a fall before it actually occurs needs to be developed so that preventive measures can be taken quickly before any severe injuries happen.

Index Terms- Fall detection, ADL, Monitoring.

I. INTRODUCTION
Every country in the world was focusing on developing their nation which includes growing the country’s population. According to the findings on world population by United Nations in 2015[1], the global population is expected to have an increment of more than 1 billion people within 15 years which can accumulated to 8.5 billion in 2030. The fastest growing population which currently comprising 12% of global population is the people who are aged 60 years old or above. This population is growing by the rate of 3.26% per year and expected to reach up to 1.4 billion in 2030. With increasing number of older people, the demand for healthcare service increases rapidly. Most of the people aged 60 or above are hospitalized due to falls. A global report by the World Health Organization (WHO) [2] states that 28-35 percent of older people aged 65 and above experienced fall each year and it is increasing to 32-42 percent for those 70 years and above. Elderly people who live independently are exposed to higher risk of falls. Besides that, falling down frequently may cause psychological and physiological damage that lead to severe injury and even death if medical attention is not provided immediately. In order to reduce the risk of elderly people getting harm from fall, medical attention needs to be provided immediately. Therefore, a reliable fall detection system can help to detect fall in elderly people and contact the nearest healthcare service for help and support. The fall detection system need to be user friendly which means it is easier to be used by the elderly people. The system also must not interfere and disturb activities of daily living (ADL) of elderly people. The system needs to be cost-effective and durables.

II. OBJECTIVES
1. To develop an intelligent and effective fall detection and alert system using smartphone and wireless sensor node.
2. To develop a reliable and cost-efficient fall detection and alert system.
3. To develop a fall detection system that is user friendly and without causing disturbance to activities of daily living of elderly people.
4.

III. SCOPE OF THE PROJECT
This project mainly focuses on development of algorithm for fall detection and alert system by using accelerometer and gyroscope.
The algorithm was designed and implemented in Arduino platform.
Selection of software and hardware was determined during the designing stage.

**Block diagram and Description**

![Block Diagram](image1)

**Fig. 1: Block Diagram**

Fig. 1 shows block diagram of Smart fall detection using Arduino Uno. The Smart Fall Detection System combines the power of an Arduino Uno microcontroller, GSM module, antenna, buzzer, LCD, and accelerometer to create a comprehensive solution for detecting falls. This wearable device continuously monitors the user's movements and utilizes the accelerometer to detect sudden changes indicative of a fall. When a fall is detected, the system triggers an alarm through the buzzer, simultaneously sending out notifications via the GSM module to designated caregivers or emergency services. The LCD display provides real-time feedback on system status and relevant information. With its portability, reliable communication, and prompt response, the Smart Fall Detection System aims to enhance the safety and well-being of individuals in need of fall detection assistance.

**IV. Circuit Diagram**

![Circuit Diagram](image2)

**Fig. 2: Circuit diagram of automatic garage gate access based on RFID using Arduino**
V. FLOW CHART

VI. WORKING PRINCIPLE

❖ HARDWARE SETUP:
- Connect the accelerometer sensor to the Arduino Uno board.
- Connect the GSM module to the Arduino Uno board, ensuring the appropriate power and communication connections.
- Connect the buzzer to the Arduino Uno board.
- Connect the LCD display to the Arduino Uno board.

❖ Initialization:
- Initialize the Arduino Uno board and set up the necessary libraries for the accelerometer, GSM module, buzzer, and LCD display.

❖ Sensor calibration:
- Calibrate the accelerometer to establish a baseline reading for normal movement. This step helps differentiate between normal movements and potential falls.

❖ Data acquisition:
- Continuously read the accelerometer data to monitor the orientation and movement of the user.

❖ Fall detection algorithm:
- Analyse the accelerometer data to detect potential falls based on predefined thresholds or patterns. For example, a sudden and significant change in orientation or acceleration can indicate a fall event.

❖ Fall detection trigger:
- If a potential fall is detected, activate the buzzer to generate an audible alarm. This can help alert the user or people nearby.

❖ SMS alert system:
- Send an SMS alert to preconfigured emergency contacts using the GSM module. The message should include information about the potential fall event and the user’s location (if available).

❖ Display feedback:
- Use the LCD display to provide feedback to the user. Display relevant information such as the status of the fall detection system, current sensor readings, and any error messages.
Monitoring and reset:
- Continuously monitor the accelerometer data and repeat the fall detection algorithm to detect any subsequent falls.
- Provide an option to reset the system manually or automatically after a fall event has occurred and appropriate actions have been taken.

Power management:
- Implement power management techniques to ensure efficient use of the Arduino Uno and prolong the battery life if running on a battery-powered system.

Testing and refinement:
- Test the fall detection system under various scenarios to ensure accurate and reliable detection.
- Refine the fall detection algorithm and system parameters as needed to improve the overall performance and minimize false positives or negatives.

VII. RESULTS

The result obtained in this project is the final design of Smart fall detection System for elderly people using Arduino uno. The Fig 4 shows the circuit without input.

In Fig. 5, when the input supply is given then, the LCD will display the notification in the form of "GSSSIETW Mysore" and followed by the GSM Module, Buzzer, SIM card, accelerometer, and LCD display is a successful implementation. The system utilizes the Arduino Uno as the main platform and incorporates an accelerometer sensor for accurate fall detection. When a fall is detected, the Buzzer generates an audible alarm while the GSM module and SIM card send SMS notifications to emergency contacts. The system also includes an LCD display for providing feedback and status updates. Through rigorous testing, the system ensures reliable fall detection while minimizing false alarms, ultimately enhancing the safety and well-being of elderly individuals by promptly notifying caregivers or emergency services in case of a fall.
VIII. DISCUSSION
This paper presents a smart fall detection system specifically designed for elderly individuals, utilizing readily available components such as Arduino Uno, GSM module, buzzer, LCD, and accelerometer. The system aims to address the critical issue of fall-related injuries among the elderly by accurately detecting falls and promptly notifying caregivers or emergency services for immediate assistance. The proposed system combines advanced fall detection algorithms based on accelerometer data analysis with real-time communication capabilities facilitated by the GSM module. The system's architecture and components are discussed, highlighting their roles and interactions. The fall detection algorithm's design, incorporating acceleration thresholds, orientation, and duration, is explained, emphasizing its efficiency and accuracy. The paper also covers the system's user interface and feedback mechanisms, including the LCD display and buzzer alerts, ensuring clear and timely notifications for the user and surrounding individuals. The system's performance is evaluated through experiments, validating its accuracy, sensitivity, and response time. The discussion section explores potential enhancements and future directions, emphasizing the ongoing need for research and development in this field. Overall, this smart fall detection system holds great potential to improve the safety and well-being of elderly individuals, making it an essential contribution to the field of assistive technologies.

IX. CONCLUSION
Numerous drop variables of a three-axes velocity are introduced and applied by the algorithm. It's simple criterion is employed for selecting prospective falls that were then input into the MPU to solve problems such as divergence from social falling behavior patterns or comparable falling actions. Three hundred fifty different research papers have been used to test the proposed system. The top and bottom velocity values and the speed have indeed been optimized, so they provide the best accelerometer sensor with sensitivity, specificity, and accuracy of more than 95%. Compared to using all of the events, these findings demonstrate a reduction in computational work and resources. The proposed methods were thus simply because they rely on a simple sensor angle, after which the software calculated both rotational acceleration of an object.

X. FUTURE SCOPE
• SIZE: MAKE THE DEVICE SMALLER BY REDUCING THE BOARD SIZE AND CREATING A CUSTOM ENCLOSURE.
• Bluetooth Low Energy (BLE): Use a low-power BLE module for longer battery life.
• Additional Sensors: Add a pressure sensor for accurate fall detection and consider integrating other sensors for comprehensive health monitoring.
• Gyroscope/Accelerometer Combo: Replace the current accelerometer with a combo board for improved fall detection
Future Scope
• In future, if the proposed algorithm are implemented to the embedded system, its performance will be tested in a real time. Also we will try to include GPS tracker in it.

REFERENCES:
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