Elderly Fall Detection and Alert System

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Motivation

- Falls - a common cause of injury in the elders. In the worst case, it can lead to death
- Improved quality of life for the elderly and their caregivers - Impacts in a productive community
- Estimation - By 2030, 7 deaths by falls in one hour(*Source:National Council on Aging*)
- Existing Fall Detection Systems - Hinders the privacy of people and proves to be less accurate

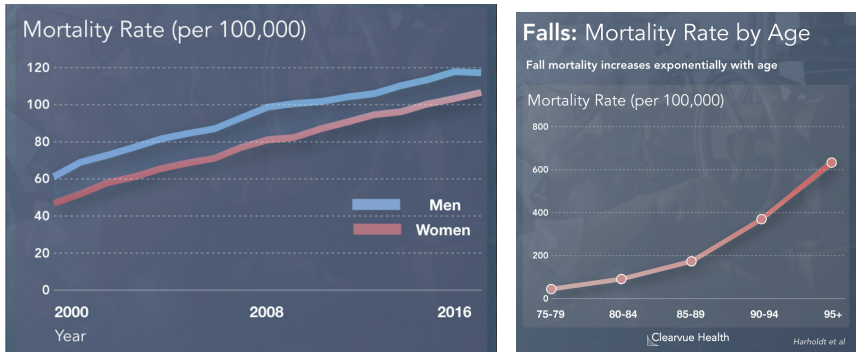

Figura: Fall Mortality Statistics, *Source:Clearvue Health*

Objective

- To design a fall detection and alert system to help detecting sudden unexpected falls in persons, especially in elders
- To aid elders in moving safely from one place to another
- To develop a system that focuses primarily on geriatrics
- To develop a product that is easy to use yet analyses data accurately
- Increase the life expectancy of people, resulting in a productive community

Methodology

- Literature Review: Review existing research and literature on elderly fall detection
- Data collection: Collect fall-related data using sensors and other sources
- Data Analysis: Analyse useful data from the sensors to develop an ideal algorithm for the proposed idea
- Fall detection algorithm development: Develop an algorithm to detect falls and simultaneously to generate alert
- Validation and testing: Validate the fall detection algorithm using models
- Deployment: Integrate the fall detection system and employ the alert system
- Evaluate the effectiveness of the system and refine the algorithm and sensors if needed

Literature Review

With the help of the following research papers on fall detection systems , we ended up with an ideal solution for the forementioned motivation :-

1). *Fall Detection System using IoT and Big Data - Diana Yacchirema et al.*

2). *Fall Detection for Elderly People using Machine Learning - Sejal Badgujar et al.*

3). *Review of Fall Detection Techniques: A Data Availability Perspective - Shehroz S Khan et al.*

Steps Involved - Obstacle Detection

The miniproject is split into 2 parts; An obstacle detection part and a fall detection cum alert part

When an object is in front, few elders may not know its presence and suddenly fall. This can be prevented by using a proximity sensor.
Steps for obstacle detection:-
1).The sensor detects an object in front
2).The sensor input is fed to the microcontroller
3).The input is processed in the microcontroller and gives output correspondingly
4). The output is connected to a buzzer system, which beeps whenever an object is in front
5). If the detected is not an obstacle, the beeping buzzer can be stopped using a push button

Steps Involved - Fall Detection and Alert

When a person suddenly falls, to know the extremity of the fall, we have used two sensors; an accelerometer and an EMG muscle sensor. The alert is give using buzzer and LED for the time being.

Fall Detection Algorithm:-

1).The accelerometer detects the orientation change of the person during a fall, while the EMG sensor indicates muscle contractions of the person

2).These sensor inputs are fed to the microcontroller

3).According to the algorithm developed, a fall is assessed whenever both the thresholds are crossed, and indication is sent to the GSM module

4). Close ones near the elder is notified by the beep of buzzer which is additionally included

5). If the detection is just a daily activity, the person can stop the alert by pressing a push button in the system

Components Used

1. Arduino Nano
2. 3-Axis Accelerometer
3. Ultrasonic Sensor
4. GSM Module
5. Buzzer
6. EMG Sensor
7. GPS Module
8. Push Buttons
9. Buck Converter

Fall Detection and Alert System - Block Diagram

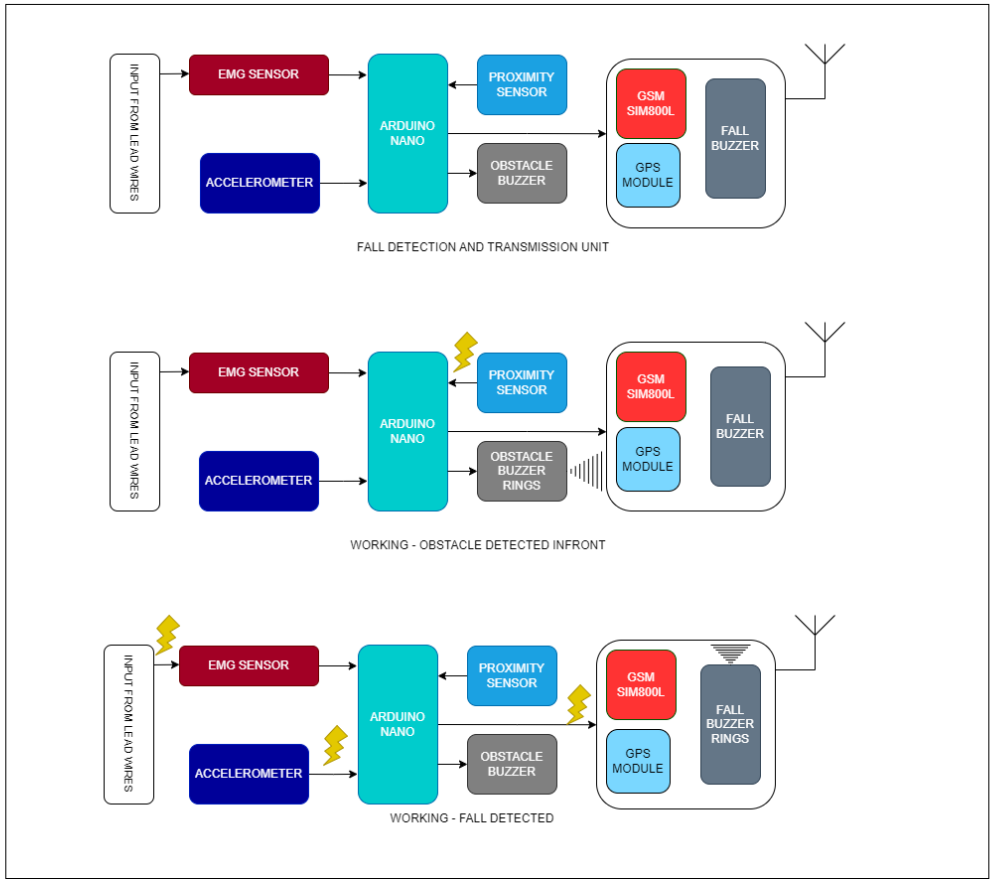

Figura: Block Diagram of the Proposed idea

Fall Detection and Alert System - Hardware Implementation

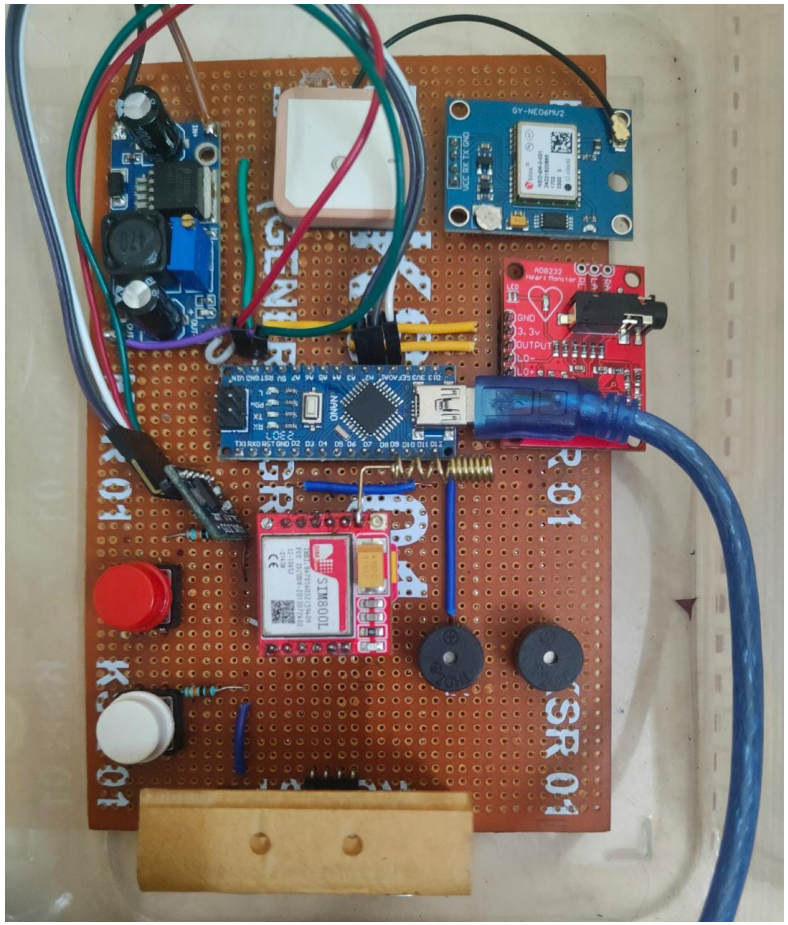

Figura: Hardware implementation of the system

Results

- Whenever the accelerometer threshold and the EMG threshold is surpassed - Fall is detected and after 30s, an alert is sent for timely assistance
- LED and Piezo buzzer beeps when a fall is detected
- Whenever an object comes infront of the system, the obstacle detection buzzer beeps
- The biopotential signals corresponding to muscle contractions and relaxations were visualized in the serial plotter

Testing - Results

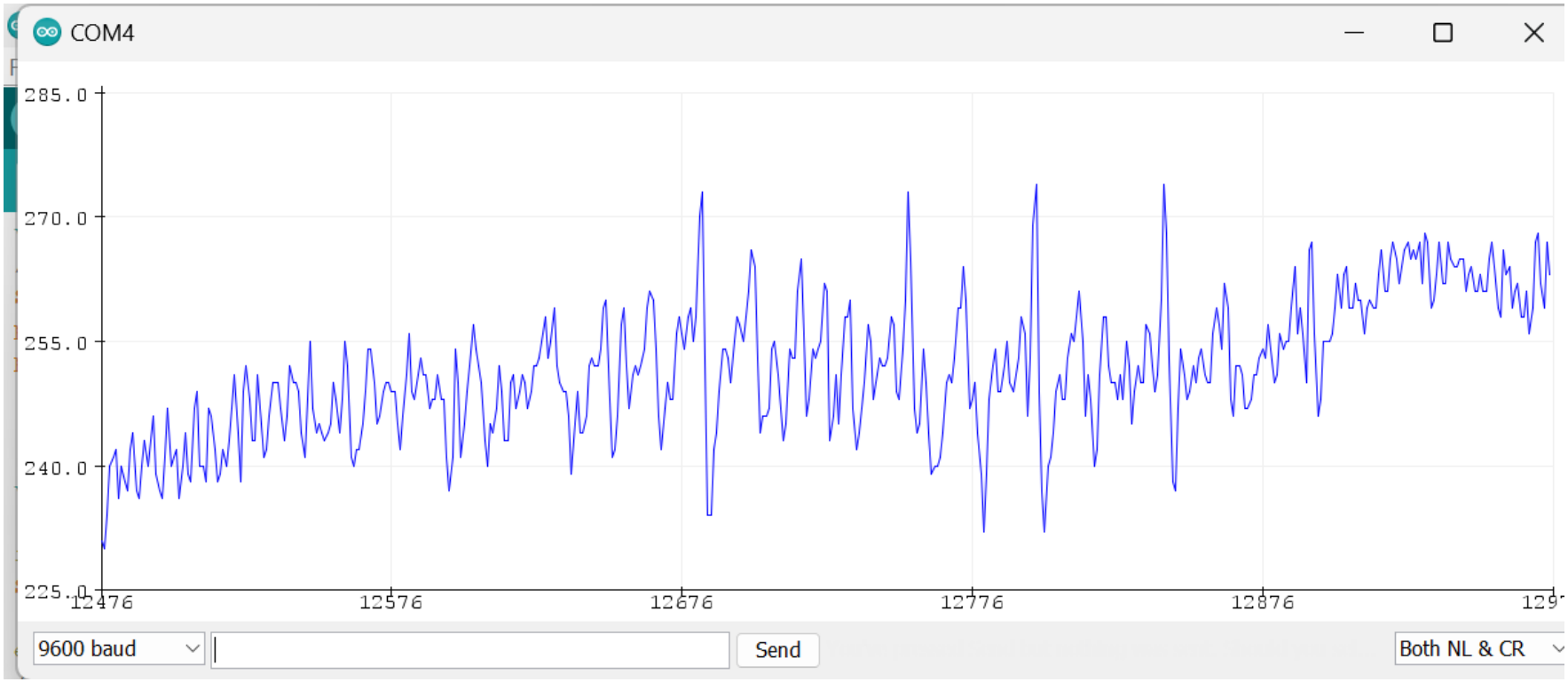

Figura: EMG Sensor Readings

Testing - Results

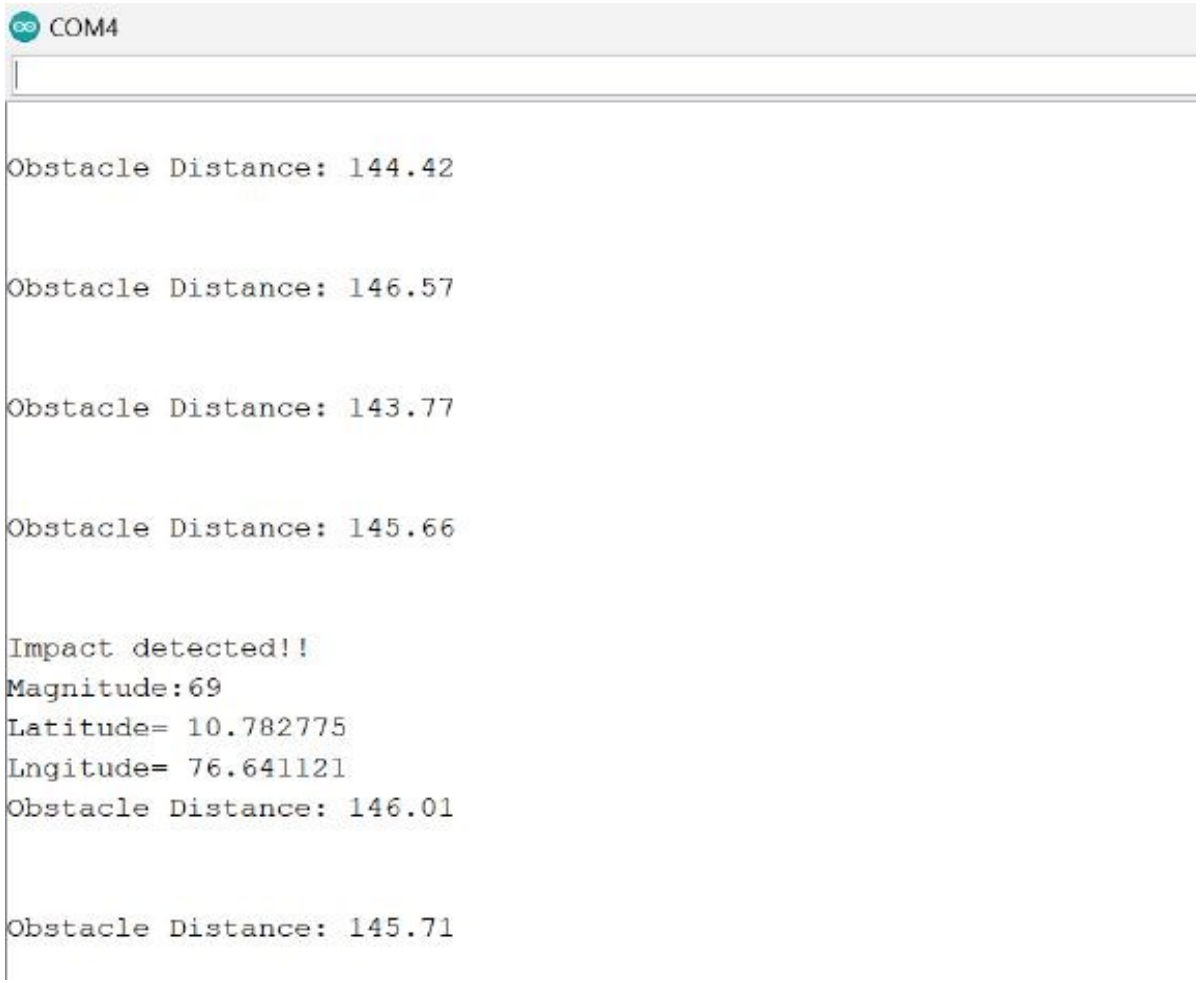

Figura: Alert Call Sent

Cost Estimation

Product	**Cost(in Rupees)**
Arduino Nano	500
ADXL 335 3-Axis Accelerometer	80
Ultrasonic Sensor HC-SR04	80
GSM Module SIM800L, GPS Module	460
EMG Sensor	390
Other Miscellaneous Costs	150
Total Cost	1700

Merits and Demerits

Merits

- Fast Fall Detection and Alert System
- Can decrease the number of sudden falls in elders
- Hassle-free and easy to use

Demerits

- Some daily life activities are detected as fall
- Sometimes persons are detected as obstacles; solved by implementing a button to control the buzzer as needed
- Less portable

Future Prospects

- Test the whole system for an ideal number of times and validate the results
- Develop the final prototype of the system and release as a wearable product
- Employ Machine Learning algorithms to improve the accuracy of the system
- Bring out innovation in the existing system by integrating more old age-friendly systems, by assessing their issues

Conclusion

- Prolonged effects of sudden falls in elders may lead to serious injuries or in the worst case, leads to death
- The system we presented is hence socially relevant and also economical
- It is estimated that the chances of falling will increase in the further years
- Implementing such a system will result in a fruitful life of the elders

References

[1] *Fall Detection System using IoT and Big Data - Diana Yacchirema et al.*

[2] *Fall Detection for Elderly People using Machine Learning - Sejal Badgujar et al.*

[3] *Review of Fall Detection Techniques: A Data Availability Perspective - Shehroz S Khan et al.*