Fall Detection and Alert System

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Abstract

The most common cause of injury among the elderly is a fall. According to statistics, the majority of senior persons (those over 75 years old) fall at least once a year, with 24 percent of them suffering serious injuries. Hence, this is a serious public health issue that has a significant influence on health and healthcare expenses. Our fall detection and alert system aims to detect if such an event occurs and immediately alert the surroundings, the concerned people, and the healthcare providers. Along with detection, we try to predict the chances of a fall by monitoring a health parameter, leading to the prevention of a fall. The location of the device is also tracked and reported along with the alert if a fall is detected. We develop this system in the form of a wearable that is user-friendly, accurate, and affordable.

1. Introduction

Fall is an event which can prove to be highly dangerous for the elderly, and it can even be fatal if not addressed immediately. The risk of falling is especially high among populations with balance issues, such as the elderly, amputees, and those suffering from neurological diseases. Alzheimer's disease patients are three times more prone to falling. Indeed, due to age-related biological changes, falls increase exponentially, resulting in a high frequency of falls and eventually injuries due to falls among the elderly. If no preventative measures are adopted in the near future, the incidence of falls-related injuries is expected to increase by 100 percent by 2030. The cost and hardship of caring for such people, especially the elderly, is growing all the time.

If necessary help is not supplied in a timely manner, falls or loss of consciousness in elderly persons can be fatal. Furthermore, the elderly's fear of falling restricts their freedom of movement and requires them to always be accompanied by a caregiver. Fear of falling can result in decreased functional mobility, which can lead to sedentary lives, depression and, indirectly, increased mortality. People who do not have access to a personal caregiver are compelled to leave their homes and relocate to care facilities.

As a solution to the problem described above, we've concentrated on building a reliable fall detection and alarm system that can aid in detecting falls and informing family members or the nearest healthcare practitioner for help and support as a solution to the problem outlined above.

This device detects a person's fall using an accelerometer and a gyroscope sensor and alerts the surrounding area through a buzzer. It makes use of cloud computing to establish an IoT-enabled environment that sends a message notification to emergency contacts over WiFi (Manet), coupled with location information (provided by a GPS module). A pulse sensor is also included in the device, which will inform a nearby healthcare practitioner if the person's health status becomes serious. This function aids in the prevention of falls by alerting the user whenever a health indicator indicates a risk of falling. The cloud incorporated will store all the data which can be helpful in further analysis.

Because an event such as a fall requires immediate medical intervention, the fall detection logic is implemented on the edge device to get rid of any delay in communication to the cloud. However, once the message of a fall being detected is sent to the cloud for further actions. The fall detection logic uses threshold values that are correctly adjusted to distinguish a fall from other daily activities. We sought to make the system as user-friendly, cost-effective, and long-lasting as possible.

Our project makes use of the concept of the Internet of Things and inculcates all the essential elements that are required by an IoT system. They are:

- Sensing: To detect a fall, we need the values of acceleration and angular orientation of the subject. Hence to obtain these values we use the MPU6050 sensor which is a three-axis accelerometer and gyroscope. To have a simultaneous check on health as well, we make use of a pulse sensor. Further, a GPS sensor is used to find the location of the device.

- Processing: For the task of processing, we make use of the NodeMCU ESP8266 module which executes our main logic of fall detection. We preferred it over Arduino because ESP8266 also provides WiFi connectivity for communication. Here also comes the role of edge computing in our project.

- Actuation: There’s a buzzer which beeps once a fall is detected, to alert the surroundings. Virtually, an alert message is generated on fall detection which may also be considered as an actuator.

- Connectivity: Our NodeMCU helps in connectivity too, establishing a WiFi communication over which the alert messages are sent to the concerned people.

Over any other communication technology, WiFi has the advantage of enabling long range communication and hence makes our device portable.

- Cloud: While the fall detection logic is implemented on the edge, the cloud plays the role in storing the history of falls and regular pulse data. It acts as a link between the client device and the devices of the concerned people.

While the world is seeing exponential growth in the healthcare sector, there's still a lack of awareness about the fall detection technology, especially in the developing countries. Our aim is:

- To be able to detect falls accurately through a system which is user friendly, durable and cost-effective. 'Divergence' acts as an IoT enabler for our system, so that our system is affordable and feasible to be used by any person of any sector of our society. By saying 'accurate', we aim to have as few false alarms as possible, so as not to confuse a fall with other daily life activities.
- To be able to monitor and analyze the pulse rates during or before a potential fall and a normal activity so that our system is not only able to detect, bur also prevent falls.
- We hope that our system enables our elders to be independent and confident, get rid of the fear of falling and being helpless, or feeling suffocated of always being accompanied by a caretaker.

This paper consists of 7 sections, section 1 is the introduction, section 2 describes some studies of previous related literature, section 3 talks about the methodology and approach employed in our system, section 4 describes the experimental setup and the analysis of the results, section 5 explains the observations, section 6 concludes our study and overview on work of our system, and section 7 talks about the potential future improvements. The paper ends with the acknowledgment and references.

2. Literature Review

We studied some previous works related to the concerned applications and noted down the features. Each paper had some distinct significant features added in the system, and their analysis helps us to incorporate the best of all into our project.

2.1 Cloud-based fall detection system with GSM Module [1]

This paper presents a fall detection system for patients of all ages. The system detects the fall of a person through an accelerometer and a vibration sensor and alerts the surrounding environment. This system provides an IoT enabled environment involving cloud computing, which automatically sends SMS, audio alert, and location to the emergency contacts through GSM. Since the system is a wearable device, it does not require the person to carry the cell phone everywhere.

Cloud computing is used to store, retrieve and analyse data. The medical history of the person can also be shared. This will help doctors to provide appropriate treatment. In case the message is not acknowledged by the guardian within the specified time limit then the continuous audio message alerts the guardian even if his/her mobile is in silent mode.

This system can be extended further. Multiple sensors and modules can be integrated which provide various health parameters. Parallel analysis of heartbeat before and after fall along with motion pattern tracking can be implemented. In case of critical conditions, the person's location can be shared to the nearby ambulance so the necessary treatment is given without any delay.

2.2 Fall detection system as a waist band, with false alarm button [2]

This paper presents a fall detection system which can be worn on the waist. Choosing waist over wrist produces less false alarms as hands are more involved in dynamic tasks. The system uses an accelerometer and GPS/GSM module. SIMCom's SIM908 module is used to integrate the GPS and GSM communication functions. The device is designed to be a wearable and each hardware component of the system works under low voltage. Also, the algorithm avoid any hectic calculations so that the power consumed by the system is less.

The wearable is worn by the person on the waist which detects the falling by a threshold-based algorithm. The thresholds are based on sum acceleration and change in angular orientation information. On a fall, an alert is sent along with the person's geographic position to family members. Further the device reminds the person through vibration to tell whether it's a false alarm or not. If there wasn't a fall, the person can stop the alarm by pushing the button. The device will return to the default state and a notification regarding the false alarm will be sent to the guardians. When a fall is detected, an alert SMS containing a URL of the location in the map is sent to the concerned member.

2.3 Wheelchair based Fall Detection System [3]

In this paper, a fall detection system was built using a microcontroller, Wifi module, load sensing element, accelerometer, and a gyroscope that measures the person's speed, orientation, and weight and uses these metrics to detect a fall. Threshold values are pre-determined and set. Whenever there is any abruption in the data and the threshold breaks, the concerned people are notified through the alarm system.

To deal with false alarms, an additional facility of safety button is provided, so even if a false alarm is generated, the person gets some time to switch the alarm off and the message is prevented to be sent to the concerned guardian. The device is primarily designed to be fixed on the wheelchair and additionally the device can be turned into a wearable device as well as per the requirement.

2.4 AD8232 module Based Fall Detection System with Health Check [4]

This paper proposes an IoT based fall detection system for elderly people as a wearable device. It mainly uses an accelerometer sensor to detect a fall and other sensors for health checks such as body temperature, pulse rate, ECG etc. The system detects and reports the falling incident to the contact person and also to the concerned hospital via an auto generated message so that necessary medical treatment can be provided at the earliest.

The components used are an arduino microcontroller, triaxial accelerometer, a temperature sensor (people who fall will definitely experience temperature variation), an AD8232 module (which measures the electrical activity of the heat. It records the victim's ECG variations), a buzzer as an alarm, a wifi controller to transfer the data through IoT and GPS to identify the location.

The system monitors the movement of the human body and when the acceleration exceeds the threshold value, the fall is detected and health checks are followed. Subsequently an alarm is generated along with a message to the patient's guardian as well as the hospital. The system is power efficient and does not interfere in the daily activities or privacy of the person unlike other vision based or pressure sensor-based systems.

2.5 Ensemble Machine Learning based Fall detection system [5]

The method suggested in this research uses machine learning algorithms to detect a fall rather than threshold values. It uses an accelerometer incorporated in a 6LowPAN device in a wearable setup to capture real-time data on a person's motions. In this study, four classification-based ML algorithms: logistic regression, decision trees, ensemble algorithms, and Deepnets are examined on the basis of AUC ROC evaluation metrics as well as training and testing time to get good efficiency in fall detection.

The system goes through three stages of development: feature extraction and dimensionality reduction, training and testing, and validation. From a publicly available dataset, the sliding-window and SMA approaches are employed to extract the features representing the raw signals of the person's motions. These attributes are saved in a new dataset, and these machine learning methods are trained and tested using k-fold cross validation to select the best model. The chosen model is then validated using the acceleration readings obtained from the sensor in order to determine the system's true performance. The ensemble ML technique emerges as the best model for this application after going through all of these steps.

A wearable device (with sensors), a long range wireless network, Cloud services and an IoT gateway are the four major components of the system. The wearable gadget detects the acceleration of body movements and sends them over the network to the IoT gateway. The IoT gateway processes and analyses data at the network's edge to quickly identify falls and respond by providing real-time alarm messages to the healthcare professionals involved

3. Methodology

This section talks about the components used in the project, the approach employed and the algorithm designed.

3.1 The Components

3.1.1 ESP8266

The ESP8266 module is a low-cost Wi-Fi enabled microcontroller, also called as a self-contained SOC (system on a chip). It's most commonly used to create embedded IoT applications. It possesses a powerful on-board processing and storage capability so as to be integrated with sensors with minimum loading time. The ESP8266 has 2.4 GHz WiFi, analog-to-digital conversion, general-purpose input/output, and UART capabilities. The ESP8266 has a 3.3V operational voltage.

Figure 3.1 ESP8266

3.1.2 MPU6050

The MPU6050 sensor module is used to measure motion related features like velocity, angular orientation, acceleration, displacement etc. It consists of a 3-axis accelerometer and a 3-axis gyroscope. It also includes a Digital Motion Processor (DMP).

DMP helps in performing complex calculations, so as to sense and output the values correctly. There's also a temperature sensor present on the chip. It can interface as well as communicate with microcontrollers and various other sensors like magnetometer, pressure sensor etc.

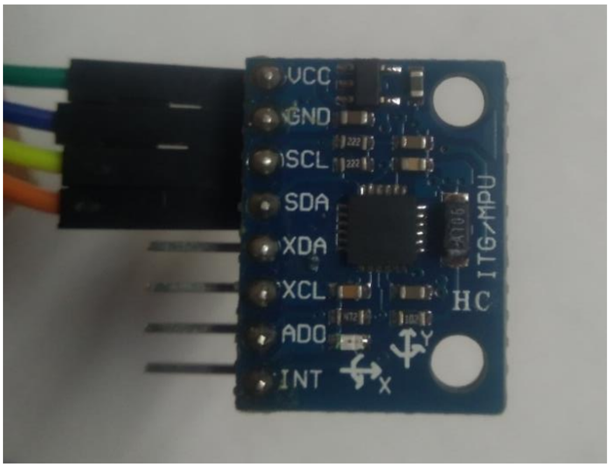


Figure 3.2: MPU6050 Sensor

3.1.3 Pulse Sensor

A pulse sensor is an optical heart-rate sensor that measures the heart rate values of a person from the blood flow in the vein of the body of the person.

The sensor's first face is connected to a green LED with an ambient light sensor, while the other face is connected to circuitry. This circuit aids in noise cancellation as well as amplification. The LED is put in contact one the top of a vein in the human body. The LED creates a beam of green light that hits the vein directly. Blood begins to circulate through the veins throughout the body as the heart begins to beat. As a result, if we look at blood flow, we can also look at heartbeats. In the event when the blood flow is detected, the a light sensor will get more light.

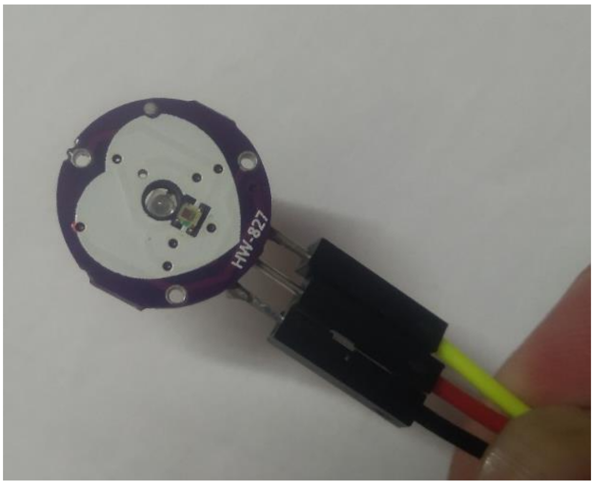


Figure 3.3 Pulse Sensor

3.1.4 GPS Module

The Global Positioning System (GPS) module is used to track or find the location of the device by receiving data from the satellites through radio-frequencies. It contains tiny processors and antennas through which it measures and calculates its position on the Earth. The GPS receiver module outputs longitude, latitude, altitude, time, and other parameters.

The GPS system can provide very precise location, time and velocity information. This is because the module operates upon the data received from 24 satellites (or their subset) that orbit the earth once every 12 hours. The exact position can be identified by calculating the distance between the satellites.

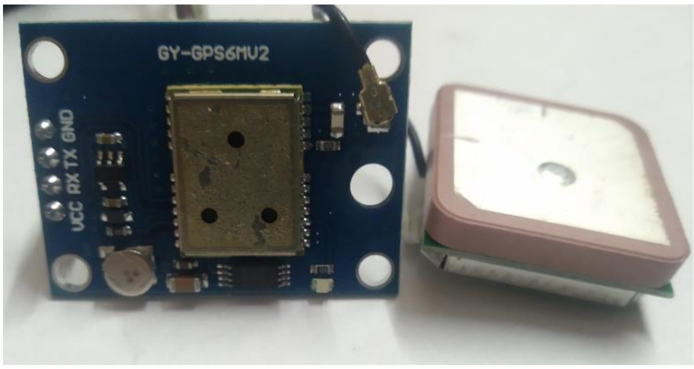


Figure 3.4 GPS Module (Ublox Neo-6M)

3.1.5 Other Components

Other components include the piezo buzzer, power supply circuit and 9V battery. Though ESP8266 has an on-chip voltagae regulator that enables it working under a 9V battery, to ensure that it draws enough current for the sensors to work properly, the power supply circuit is used as an interface between the battery and the microcontroller.

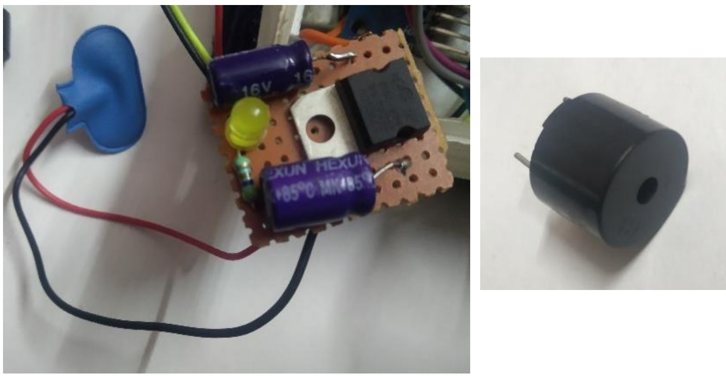


Figure 3.5 Power supply circuit, piezo buzzer

3.2 The Approach

All the different components present in our project are focused upon separately and then combined together to act as a whole unified system. Such modularity makes the implementation of the system much easier. The key component logics in our project are: The fall detection logic, the pulse check logic and the location finding logic. This is followed by connecting to the cloud and the backend implementation.

Fall Detection: When a true fall occurs, the impact of the human body with the ground produces a visible peak in the cumulative acceleration. The first step in distinguishing high-intensity motions from others is to determine their peak value.

Hence out of the many parameters that change when a fall occurs (temperature, pulse, acceleration, angular orientation etc), acceleration is a very suitable choice to be our prime parameter for fall detection. Acceleration values can be sensed through an accelerometer.

However, regular activities such as leaping or sitting can also yield peak acceleration values, necessitating the use of additional detecting characteristics. One such suitable parameter is the change in orientation of gravity with respect to the coordinates. This value is sensed by a gyroscope. Hence, we decided to use a MPU6050 sensor which consists of both a 3-axis accelerometer as well as a gyroscope.

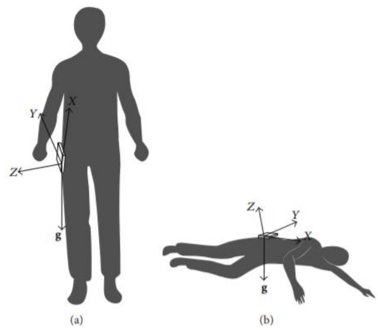


Figure 3.5 Change in angular orientation on a fall

Pulse Check: Pulse acts as a secondary parameter which is also helps in predicting chances of a fall, hence eventually preventing a fall. Pulse values are sensed in parallel with the acceleration values and sent to the cloud at regular intervals (20 seconds) and the corresponding processing happens at the cloud. Moreover, the pulse value is also immediately after the fall to check for a critical health condition. This may help in estimating the seriousness of the fall and contacting the healthcare providers accordingly.

Finding Location: Using a GPS Module, we keep a track of the location of the device and send it to the cloud as soon as a fall is detected. This location is calculated in terms of latitudes and longitudes. If these values are entered in Google Maps, the exact location of the person can be easily checked.

ESP8266 solely can provide the details of the location of the device without the use of any GPS module. This is because of its wifi functionality which can be exploited by location APIs to determine the location of the device from nearby networks. However, given that our use case is a real time application, using a GPS Module was more suitable as it is faster and more accurate in estimating the location.

3.3 The Algorithm

Our fall detection logic as well as pulse detecting logic is based on the thresholding-based methods. The readings gathered from the MPU6050 sensor are compared to a threshold value and if the threshold is broken, the fall is detected. Similarly with the pulse sensor, for predicting a potential fall. These values have been configured as per the particular device and on the basis of the analysis of previous literature work as well. Further, we use the functions provided in the TinyGPS library to find the location of the device, which is the library for interfacing with the GPS module.

The fall detection logic:

Firstly, the ‘net’ acceleration and angular velocity are calculated from the all three axes’ values:

$$Acc = \sqrt{(Ax)^2 + (Ay)^2 + (Az)^2}.$$

Ax, Ay and Az refer to the acceleration values in the x, y, z axes, respectively

$$w = \sqrt{(Wx)^2 + (Wy)^2 + (Wz)^2}.$$

Here Wx, Wy and Wz refer to the angular velocitess in the x, y, z axes, respectively.

These values are then scaled to standard values from the sensor’s scale.

To ensure low false alarm rate and high accuracy, our fall detection algorithm goes through three robust trigger checks, which step by step check for first acceleration and then change in angular orientation.

The corresponding algorithms is as follows:

```
if (Acc<=4){ //LOWER THRESHOLD ACC (0.4g)
        trigger1=true;
         //TRIGGER 1 ACTIVATED
  }

 if (trigger1==true){
  trigger1count++;
  if (Acc>=6){ //HIGHER THRESHOLD ACC
        trigger2=true;
        //TRIGGER 2 ACTIVATED
         trigger1=false; trigger1count=0;
  }
 }

 if (trigger2==true){
  trigger2count++;
  if (angleChange>=80 && angleChange<=100){
        //ANGULAR ROTATION BETWEEN 80-100
         trigger3=true; trigger2=false; trigger2count=0;
        //TRIGGER 3 ACTIVATED
    }
  }
```

```
if (trigger3==true){
  trigger3count++;
  if (trigger3count>=4){
    if ((angleChange>=0) && (angleChange<=10)){
        //ORIENTATION REMAINS SAME
        //(ROTATION: 0-10)
        //FALL DETECTED
        trigger3=false; trigger3count=0;
        }
    else{
        //REGAINED NORMAL ORIENTATION
        trigger3=false; trigger3count=0;
        //TRIGGER 3 DEACTIVATED
    }
  }
}

if (trigger2count>=6){
        //allows 0.5s for orientation change
        trigger2=false; trigger2count=0;
        //TRIGGER 2 DEACTIVATED
 }

if (trigger1count>=6){
        //allow 0.5s for AM to break upper threshold
        trigger1=false; trigger1count=0;
        //TRIGGER 1 DEACTIVATED
 }
```

4. Result Analysis

This section discusses the performance parameters, i.e., the physical and software parameters on which our system's design as well as performance depends. We talk about the experimental setup and the result of the experiment.

4.1 Performance Parameters

The main parameters our system focuses upon to deliver the required service, with appropriate accuracy are acceleration values, the change in angular orientation, the pulse value and the location information received by the GPS system.

A sudden change in acceleration and gyroscope values is recognised when a fall is detected, and this is confirmed using the MPU6050 sensor. We've established three triggers, and the MPU sensor will only detect a fall if all three circumstances are met. To avoid false alarms, it's critical that this sensor provides accurate results with great performance while using minimal power.

The lower acceleration threshold corresponds to 0.4g (used in first trigger check) and the higher threshold corresponds to 3g (used in second trigger check), where g is the acceleration due to gravity.

For the change in angular orientation, first it is checked to be between 80-100 degrees for a fall to happen. This is checked in the third trigger check. Next, to check if the position of the person remains the same i.e. fallen, fall is detected. For this the values are checked to be between 0-10 degrees.

Further, as soon as a fall is detected, immediate health check is followed using a pulse sensor. If the values read by the sensor fall into the critical region, there can be chances of a fall, and hence the concerned people are informed about the potential disaster. Hence, here also, inaccurate values will produce false alarms and leave the system of no use. As per the scale of the values produced by the sensor, 550 was set as a threshold for a pulse to be detected. The below 550 region can be considered as a critical region. Similarly there is a critical region for the high values of pulses also.

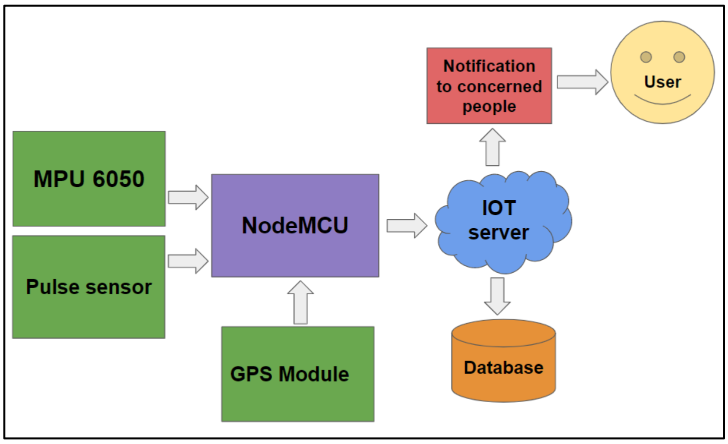
Regarding the Software Performance, the following observations were made and the code or design was hence changed accordingly:

- For data to be communicated successfully from the microcontroller to the Thingspeak cloud, it takes a minimum duration of 20 seconds.
- Stable internet connection is required for Thingspeak to receive the data and further for the notification alert.

4.2 Experiment Setup

NodeMCU which is the brain of our project is connected with MPU6050 sensor, pulse sensor as well as buzzer along with GPS module. The fall detection logic is uploaded on the edge while the pulse values are analyzed on the cloud. The whole circuit is powered using a 9V battery.

Figure 4.1: The System Architecture



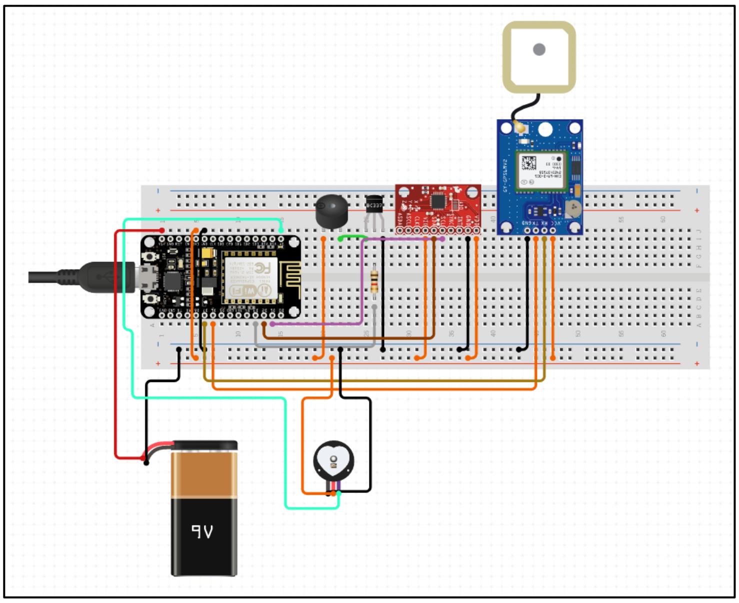


Figure 4.2: The Circuit Diagram

In the actual circuit, the battery is connected to the esp8266 through a power supply circuit which consists of capacitors and has to the capacity to store charge. Though esp8266 includes a voltage regulator so as to work even on a 9V battery, but this circuit is still required to ensure enough current is being supplied which is necessary for the sensors to work correctly. This enables our system to be portable.

The setup is covered properly inside a small box which is then attached on a wristband to make it wearable. Our prototype can be easily worn on the wrist without making any interference in one's day to day life activities. The circuit can be turned off by removing the connection to the battery. The pulse sensor is placed on the wrist from below once the band is worn.

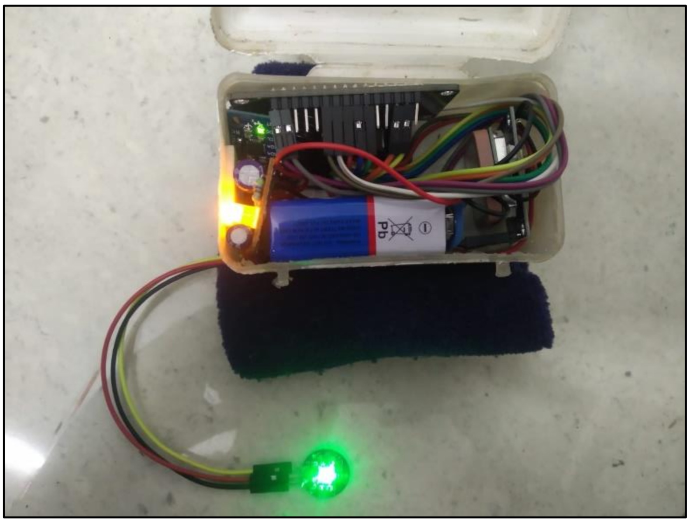


Figure 4.3: The Setup

Figure 4.4: The Wearable

As we needed a platform which can aggregate and analyze all our data along with sending alerts, we took the help of Thingspeak, an IOT platform service. We started with creating a channel on Thingspeak, using which we could visualize all our data like pulse values, location values- latitude and longitude, using various charts and diagrams.

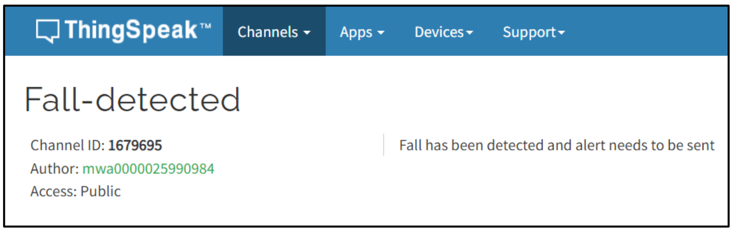


Figure 4.5: ThingSpeak Platform

Then we created an HTTP object using the ThingHTTP app and set up a React Application of ThingSpeak that monitors the pulse rate and location, and if the fall has been detected. It notifies the user to take a specific action when the value goes beyond a threshold with a push notification.

To send alerts and notifications to the concerned family members, we used Pushover application. It is a lightweight application and can be easily installed on any mobile device. The notifications are sent via Pushover when the condition is met and action is triggered by the React. Any device to which we want to send notifications can be easily added just with the help of a login id and password.

4.3 Experiment Result

When a fall is detected,

1.The buzzer is activated alerting the nearby people.

2.Notification consisting of location coordinates is sent to the concerned people.

3.Alerts are being sent in real time with no delay.

4.Values are being sent to the cloud and can be easily seen in the form of charts.

5. The notification application required can be easily installed.

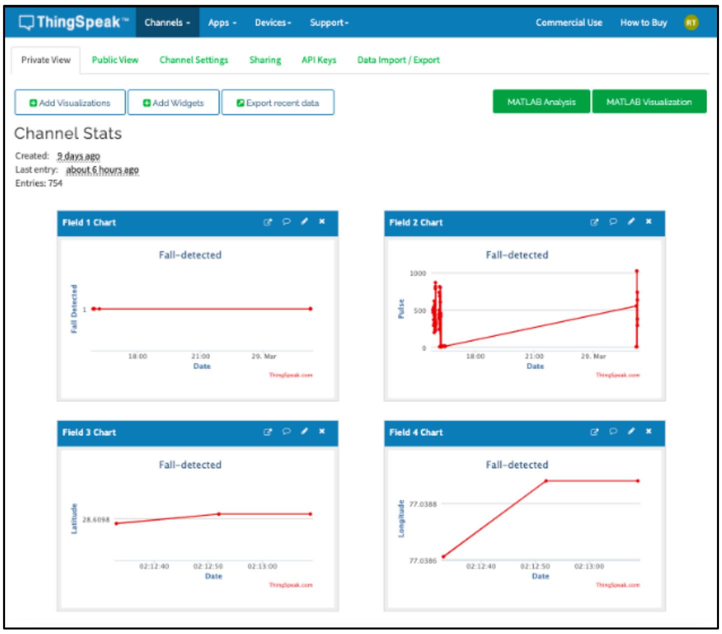


Figure 4.6: The Data on the Cloud (ThingSpeak)

In the above figure, various parameters being received from the device can be seen in the form of charts.

The pushover application can be easily installed by any person, and by just entering the credentials associated with that channel which will be provided when the device is bought, the person will start getting the notifications. The notifications also include the location coordinates of the person. There is a separate notification in case there is an abnormal pulse rate of the person.

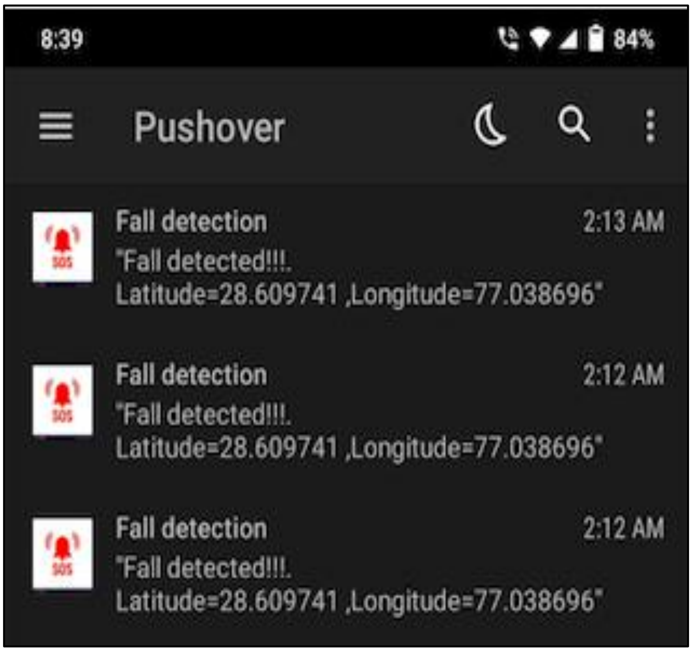


Figure 4.7: The alert notification on Pushover application

```
Acceleration value (scaled):11
Acceleration value (scaled):11
Acceleration value (scaled):11
Acceleration value (scaled):2
TRIGGER 1 ACTIVATED
Acceleration value (scaled):2
TRIGGER 1 ACTIVATED
Acceleration value (scaled):3
TRIGGER 1 ACTIVATED
Acceleration value (scaled):9
TRIGGER 2 ACTIVATED
73
73
TRIGGER 3 ACTIVATED
Acceleration value (scaled):11
Acceleration value (scaled):12
Acceleration value (scaled):12
2
2
FALL DETECTED
CHECKING PULSE AFTER FALL
Pulse Value: 1020
FINDING LOCATION
Latitude = 28.61
Longitude = 77.04
Channel update successful.
```

Figure 4.8: Fall Detected, printed on Serial Monitor

If the ESP8266 is connected to the Arduino IDE, the values, trigger checks and corresponding inferences can be seen on the serial monitor as well. As shown in figure 4.8, the fall check goes through 3 triggers, and once all the triggers are activated, fall is detected. The pulse is being checked independently at regular intervals. The pulse value is reported to the cloud too at regular intervals. Along with that, there's an immediate pulse check after a fall. The location is also calculated through the GPS system and all this data are reported to the cloud. The cloud then takes care of the further communication with the end devices.

There can also be cases when the triggers activate but due to satisfying the next trigger condition, they deactivate. Figure 4.9 describes the case when there is a huge change in acceleration values but during the further trigger checks, it fails to be detected as a fall, due to insignificant change in angular orientation. This may happen while doing any activity like running or jumping. Hence, these trigger checks make our system reliable and non-interfering with daily activities.

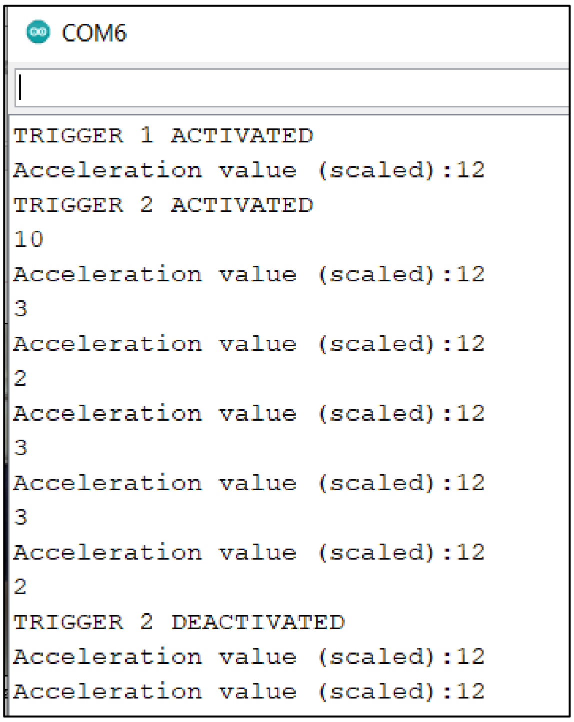
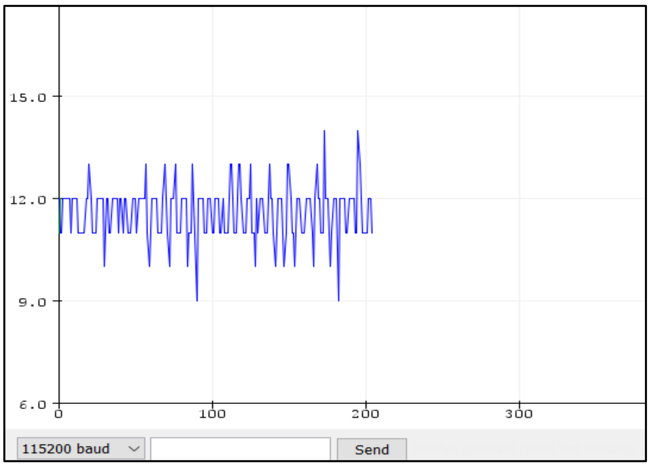


Figure 4.9: Trigger Deactivates

5. Observations

Some of the observations and insights made by us include:

1. Day to day life activities like running, exercising, shaking hands are not being recognized as fall.
2. The visualizations of pulse and location values can be clearly seen on the Thingspeak channel.
3. Pulse values are being calculated with good accuracy.
4. The location determined by the GPS module has a partial inaccuracy of about 10-20%.
5. Any new device can be easily added just using the credentials (login id and a password) associated with each device.
6. Sound of the buzzer is quite high and can be heard from a distance.
7. The following plots can be observed on the serial plotter in different scenarios:
   (The plots show net acceleration with respect to time)



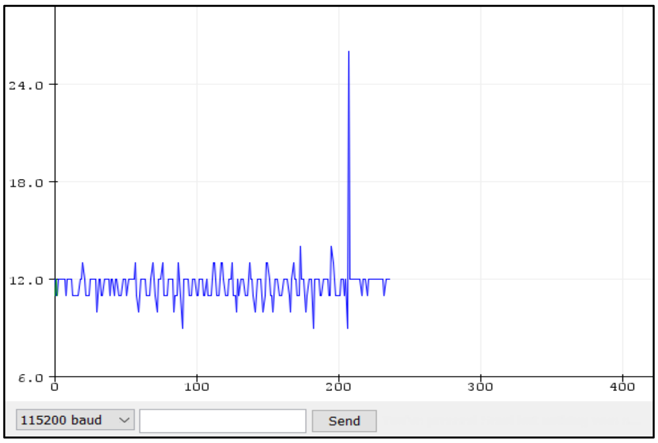


Figure 4.10 (a) and (b): Plot, with and without Fall

The first figure describes the motion of a person in a normal scenario and there's gradual change in the acceleration or angular orientation values.
The second figure however shows the case of a fall where there are sharp changes in the values and all the triggers set in the algorithm are triggered.

8. Conclusion

This paper provides an overview of our working prototype of the fall detector and alert system, which primarily focuses on the elderly. It talked about the increasing need of fall detector like automated healthcare devices, and our idea of an affordable, reliable and a wearable fall detector as a solution to it. Along with the feature of detection, this system inculcated a fall prevention ability too, along with tracking of real time location to reach the victim as soon as possible. The concerned people as well as the surroundings are alerted through appropriate means. To avoid any delays, processing was appropriately done on the edge and cloud accordingly. The paper describes the components, the working principle behind the detection logic and communication through WiFi, and ends with the results and key observations noted in the development and the usage of this system.

9. Future Scope

- Though the threshold values in the system ensure a low false rate, in case the fall is detected when it should not have been, an external button in the circuit can be employed to send a false alarm request to the concerned people.
- If the pulse values come out to be very critical after a fall is detected, nearby hospitals can be sent an alert as well using a respective API along with the concerned guardians.
- The sensors used in the system can be replaced with industry level sensors so as to increase the accuracy of the system. The thresholding-based method can also be replaced by a suitable ML method, given that there are a certain number of instances of fall to train the model.

Acknowledgement

We would like to express our sincere gratitude towards our professor, Dr Gaurav Singal, under whose time-to-time guidance we were able to implement our idea successfully, and come up with functionalities that just improved the efficiency of our system.

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