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# Wearable Fall Detection, Monitoring And Alert System

A.Jinish Bobby, B.Karthika, R.Savitha, Dr. M.Caroline Viola Stella Mary

(Dept. of IT, UG Scholar, Francis Xavier Engineering College, jinishbobby@gmail.com )

(Dept. of IT, UG Scholar, Francis Xavier Engineering College, karthika2197@gmail.com )

(Dept. of IT, UG Scholar, Francis Xavier Engineering College, savithayamini97@gmail.com )

(Dept. of IT, Professor, Francis Xavier Engineering College, carolsam67@gmail.com )

**Abstract**: Loss of consciousness and fall-induced injury is one of the leading problems faced by the elderly. They are the leading cause for the transfer of senior citizens from the comfort of their residence to assisted care environments. They also account for 40% of injury related deaths and lack of timely action can prove fatal. On the personal side, such sporadic events stifle the independence of the individuals, requiring a caretaker to maintain constant surveillance. Our aim is to design a system to sense and alert doctors and nearest of kin of falls and other related incidents of distress. It is also to provide the functionality of a pedometer, to constantly monitor and relay the activities of the individual. The device mustn't be cumbersome, but rather wearable, so as to remove any social stigma related to the possession of such a device. It must have a high degree of reliability and differentiate activities of daily life from genuine falls. This would require a signal plotting and thresholding based approach to arrive upon a fall-detection algorithm. With the dawn of the IoT (Internet of Things) era, it is ideal that such a device be constantly relaying data via such a wireless network. This ensures seamless connectivity between the patient, doctor and relatives – and swift response.

## I. INTRODUCTION

We are living in a generation that is pressed for time and that, arguably, has a lack of compassion. As a result of this negligence, the old and infirm are unfortunately forgotten. The institutions of assisted care environments mushroomed as a result of this alarming trend. Along with a rapid growth in aging population there is also a decrease in the population of caretakers.

In India for example, there is a tremendous increase in the elderly population, with a current estimate of 90 million over the age of 60. This is a result of a disproportionate growth among age groups, with the 60+ population increasingly far more rapidly than the 15-60 age groups. The age dependence ratio of the country is now at a perilous0.58. Studies show almost a quarter of such elders have poor health conditions, as one could expect.

This means that an approximate 22.5 million individuals are at risk from occasional health complications. To quote from the World Health Organizations 'Aging in India' report: "The UN defines a country as 'ageing' where the proportion of people over 60reaches 7 percent. By 2000 India will have exceeded that proportion (7.7%) and is expected to reach 12.6% in 2025."This poses an alarming disadvantage to the elderly from a societal point of view.

India has a long and cherished culture of respect and devotion towards elders.

However, with the dawn of the nuclear family era, some communities find it hard to fully commit to the senior citizens. This has heralded the growth of NGO's and senior care centers such as Help Age India. But still, this begs the question- is it possible to attend to our elders, regardless of the time? No, that is a far more pressing issue. It is indeed time India took to caring for senior citizens 24/7 by embracing technology.

Elderly people's falling percentage is higher because their body become weaker and their physical strength also become lower. Once they fall down they may not be able to stand up themselves or become unconscious they need helps from others. Falling can cause a serious injury or death especially incident that happened on human head part. Fall detection sensor system is the solution to solve this problem. The paper describes a system that is able to detect the falling of elderly people and send an emergency SMS to the contact person stored in the system to request help.

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## II. FALLS AND ITS IMPACTS

Falls are o1ne of the most prominent causes of unintentional injury. They are coded as E880-E888 in International Classification of Disease-9 (ICD-9), and as W00-W19 in ICD-10, which include a wide range of falls including those on the same level, upper level, and other unspecified falls. For the sake of it, we shall even define it according to WHO literature-"Inadvertently coming to rest on the ground, floor or other lower level, excluding intentional change in position to rest in furniture, wall or other objects".

Falls are responsible for 40% of all injury related deaths and need immediate Medical attention. The reason for a fall may be heart problems, loss of consciousness, fatigue, exhaustion, diseases and loss of balance. Although falls occur through all age groups, the major chunks of incidents are those of senior citizens.

The major talking point is the need for swift medical aid. 50% of all injury-type hospitalizations for the concerned age group are fall related. Thirty-two percent of elderly people aged over 75 years have ever fallen at least once a year, and among them, 24% have been seriously injured.

Approximately 3% of all fallers lie unattended for periods greater than 20 minutes, leading to insufficient medical action. An upsetting figure is that 40% of nursing home admissions are directly linked with incidents of falls. This highlights two major points

- Falls require immediate medical attention- and the only way one can establish that is by conceiving a sensing method.
- Falls greatly limit the independence of an individual. He or she will not have the confidence to venture or stay alone for extended periods of time. This is primarily due to the fear of medical complications surfacing.

## III. WORKING OF SYSTEM

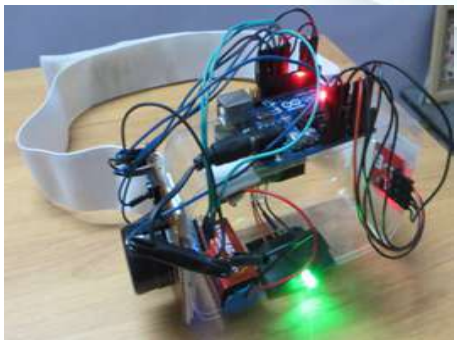

FIG.1.1.Sensors

We have highlighted the fall-detection algorithm that we shall use in the previous section. This has been translated into code (as you will see in the code section) and burned into the microcontroller. The other modules and components are integrated with the MCU.

**ADXL 335:**

Connected to the analog pins 0, 1, 2 and 3 of the Arduino. They receive the analog values of acceleration and necessary computation is performed on them. The unit is powered with the +5V and the GND pins. The unit is position perpendicular with the ground and fixed onto the inside of the wearable unit. It is calibrated in accordance to this position.

**1.HC-05 Bluetooth Module:**

It is connected to the pins 10 and 11, which function as software serial pins of the Arduino. One line transmits data to the module while the other line receives data. The module is powered by 3.3V pin and the GND.

To connect the Bluetooth module for serial communication, we must identify and open both the **incoming** and **outgoing** ports. For this project I have opened the outgoing port with **Tera Term** while the Processing sketch handles data from the incoming port.

**2. RGB 3-color LED:**

It consists of 4 pins, with one being a common cathode, while the other three power the red, green and blue LEDs respectively. We connect digital pin 2, 4 and 5 to R, G and B respectively. By using the **digitalWrite** functions we can change the colour of the LED based on the state. Thus it is green when the user is table, blue when fall is sensed and red when fall is confirmed.

**3. Piezo Buzzer:**

The buzzer is connected between the pin 9 and ground. We use the tone () function to generate a pwm pulse of specified frequency at that pin. When a fall is first sensed,we activate a 250Hz pulse and when confirmed, a 4000Hz pulse.

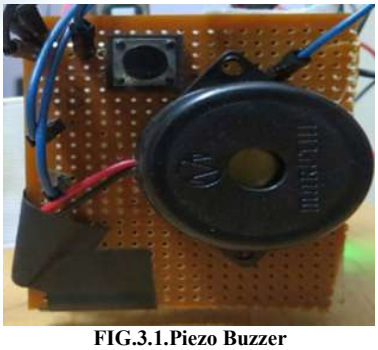

FIG.3.1.Piezo Buzzer

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**4. Push Button:**

It is wired between pin 12 and ground, and pulled up by default. When it is pressed, the pin is grounded- triggering an event. The event in this case is the false alarm signal.

## IV. STAGES OF PROCESS

The function Run Send SMSChoreo() initiates the response with the text I have supplied (In this case being a fall alert).

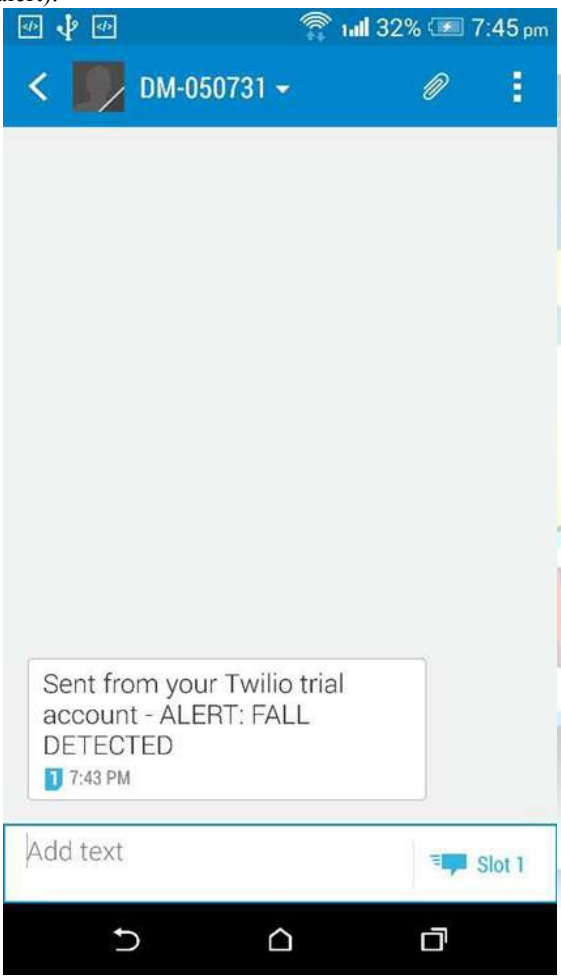


**FIG.5.SMS Alert**

## V. IMPLEMENTATION OF PROCESS

The processing sketch acts as the central monitoring unit for the patients. By Graphical means, we represent-

Graphs of pitch and roll and the angle data for the same.
Patient bio-data time and date.
Condition of patient
Number of steps taken (Pedometer)

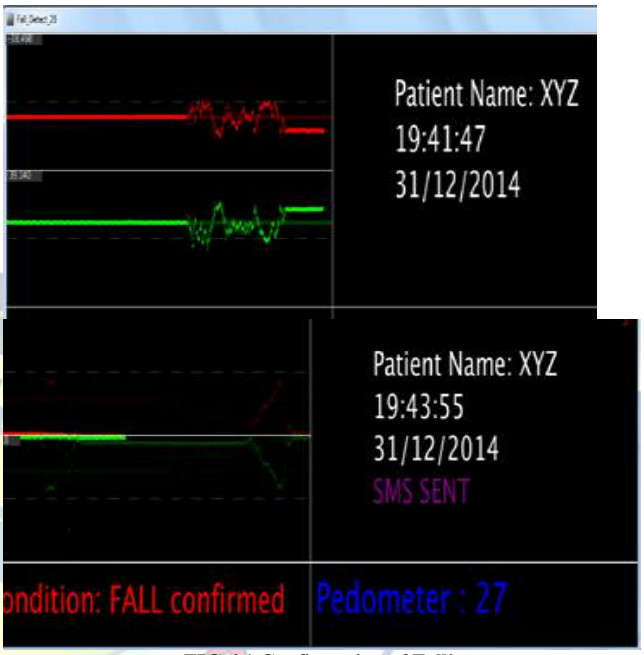


**FIG.6.1.Confirmation of Falling**

## VI. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we have demonstrated the feasibility of using a wireless sensor network to detect fall events. Interestingly, we observed that different activities have unique acceleration profiles. Also, amplitudes and frequencies of movement vary with the size and weight of the wearer, which suggest that the design can be improved by customization, whether for individuals or groups with similar activity levels. Which suggests that frequency analysis may be a possible tool to better distinguish between events. The threshold algorithm can also be tuned in software to more reliably distinguished falls from safe activity. While the system discussed in this paper works well for an indoor environment, it relies heavily on a fixed network to relay events. Current development involves building a sensor mote which can operate outside of such a network. For example, a GPS chip has been integrated with the current design to provide localization outside the home. We also hope to combine the sensor board with a cellular device so that wireless communication is possible outside a fixed network.

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