

## Wearable Fall Detection System For Elderly People Using Iot

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### Abstract

*Each year an estimated 6,46,000 individuals die from falls globally of which over 80% are in low- and middle-income countries. Older people have the highest risk of death or serious injury arising from a fall and the risk increases with age. In our paper, we proposed the fall detection system that monitors the older people in a real time. The system has two major components one is wearable device and another one is mobile phone. Here we used wearable device, pendant to detect the fall. Once the wearable device detects the fall, it generates sound to alert the nearby people and sends an alert message to the user defined contacts. The wearable device has the capability of communicating with a mobile phone using Wi-Fi. So that we can avoid the need of carrying the mobile phone. Therefore, the quality of life of older people can be improved by using automatic fall detection systems.*

**Index Terms** — elder people, fall detection, fall

### I. INTRODUCTION

The paper “An IOT Based Fall Detection System” is used to detect the fall of the elder people. This system is mainly focused for the fall detection of the elder people. The people in our world are facing so many falls not only because of faint that may be because of their medical condition too. Falls occurring at the older age are mainly considered as a reason for death. If the older people are with their caretaker means then there is not a problem. If the desired people is far away means we can't monitor them regularly. Falls need to be addressed immediately and the only way to monitor them is sensing method. In our proposed system, if a fall is detected for an older people we can be able to convey the alert message to their loved ones via two communication modes. One is sending the alert message to their contacts and if they are far away means we can alert the nearby people using piezo-buzzer. This generates sound and alerts the nearby people. Hence we can help them immediately and can make the quality of their life better. It is more economic and beneficial method to avoid the risk of death of our beloved ones. The system is built with some checkpoints that avoids the false alarms and makes the system more efficient. This results in the increase of efficiency of the system.

### II. MOTIVATION

The World Health Organization states that “More than thousands of people are dead due to fatal fall almost a year”. By considering this statement we make an attempt to design an IOT based Sensor device which helps them to live for more years. It can be applicable for elder people who needs more attention. By using sensors such as Arduino Uno, Accelerometer we can get the data about the person's

acceleration and angular position in each axis. By using these data, we can calculate the parameters like net acceleration, pitch, roll, yaw. By using these parameters we can be able to get the results by comparing the values. This system continuously senses the person's angle and acceleration. If there is a fall happens, the system waits for another 20 seconds and this waiting time helps us to evaluate whether they need some serious attention or not. If the person doesn't get up the signals are passed and the piezo buzzer starts to alert the nearby people and sends an alert message to the desired people. This system also maintains the database about the particular person's fall values that can be used to predict the future fall using various algorithm.

### III. LITERATURE REVIEW

#### 1. A High Reliability Wearable Device for Elderly Fall Detection

This fall detection system uses accelerometer, gyroscope, magnetometer, MEMS and MARG sensor. It performs well on a large scale machines. It has the accuracy of 89-91%, sensitivity of 60-90% and the specificity of 98-100%

#### 2. Privacy Preserving Automatic Fall Detection for Elderly in Home Environment

It detects fall using RGBD cameras. The RGBD is a 3D camera and it produces 3D model of the environment and algorithms analyses the video each second to detect the various types of fall. It uses computer vision algorithms.

#### 3. Testing of A Long Term Fall Detection System

It uses a special fall sensor comprises of accelerometer, battery, microprocessor (ATMEGA328) and Bluetooth module. The algorithm is very simple which has the sensitivity of 90-95% and the specificity of 91-93%. They have a formula to calculate specificity and sensitivity.

$SPECIFICITY = (TN / (TN + FP))$ ;  $SENSITIVITY = (TP / (TP + FN))$

### IV. PROPOSED MODULES

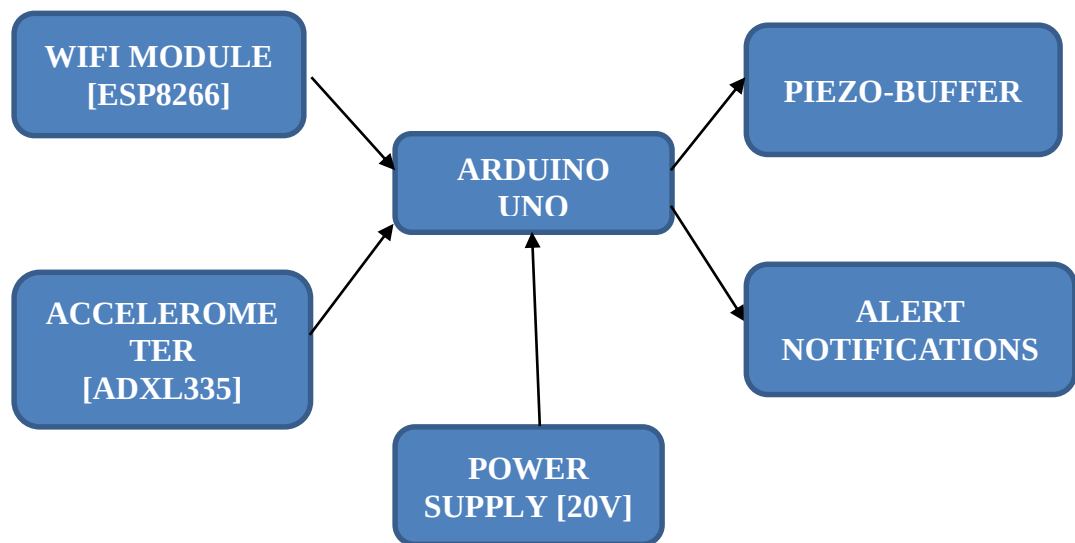


Fig 4.1 Proposed System

#### 4.1 ARDUINO UNO

It is an open source microcontroller developed by Arduino cc. Its easy usability and its capability makes the system to be interfaced to various boards. It is designed on the basis of ATMEGA38P microchip. This board consists of digital and analog pins and a programmable arduino IDE. Power supply can be given using USB Cable or Battery. It also includes 32kb flash memory with nearly 16 MHz clock speed.



**Fig 4.2: ARDUINO UNO**

#### 4.2 ACCELEROMETER

It is a 3 axis accelerometer. It is used to find the net acceleration and angular position. It senses 3 axis (x-axis, y-axis and z-axis). It also works on low power. It is good temperature resistance. It is



small and compact packaging.

**Fig 4.3: ACCELEROMETER**

#### 4.3. WIFI MODULE

It has been developed by ESP8266 SDK and it is an open source IOT platform. It I easily programmable. Low cost and simple to implement. It is Wi-Fi enabled.



**Fig 4.4: WIFI MODULE**

#### 4.4 PIEZO-BUZZER

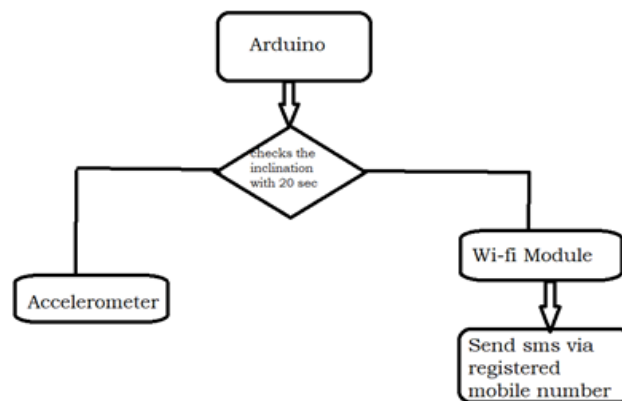
It is used to generate sound by using piezo electricity and its frequency can be given by the user.



**Fig 4.5: PIEZO-BUFFER**

### V. SYSTEM ARCHITECTURE

The Net acceleration should be decrease to a threshold value i.e., less than 0.8g. When the fall commences, the net acceleration results in a sudden increase of greater than 1g. Along with this, the pitch and roll values gets higher than threshold value above 60. These things happens in a very short amount of time which is nearly a difference in milliseconds. It results in the fall and now the system checks for the inclination along the X and Y axis for about 20 seconds this helps to evaluate whether the person needs a serious attention or not. If the person gets up, the alarm is not triggered and if the person doesn't get up, then the signals gets passed and the piezo buzzer starts its work to generate sound. Even after the time given there is no response means, the alert message is passed to the desired contacts by using a cloud service named Temboo. It is an API acts as a framework for machine to machine communication. Twilio is a cloud based communication protocol for sending a SMS to the user defined contacts.



**Fig 5.1: System Architecture for Fall Detection System**

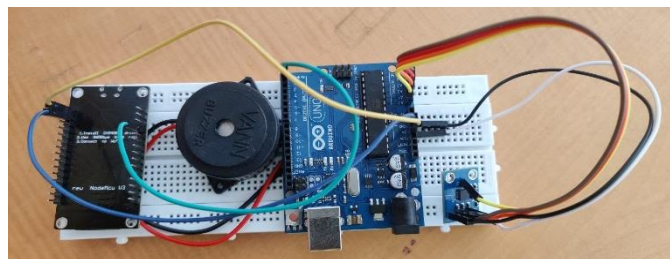
### VI. EXISTING SYSTEM

In the existing system, the people used wearable fall detection method to detect the fall. These methodologies works very well in a small scale environment. They used various sensors for analyzing the acceleration and angular position of a person in each axis. It produced various good results in sensitivity, accuracy and specificity. It also has some disadvantages so that the system suffered from the rate of accuracy. Usage of Bluetooth module results in the low communication range. It should be used within the range specified. It becomes the major drawback in the usage of Bluetooth module. In another research, the wearable device gets placed in one's pelvis it becomes the uncomfortable one to that particular person. Sometimes the sensors that detects the motions of a people is placed in the user's mobile phone. They have to wear it for their whole life. It becomes the disadvantage. They need to

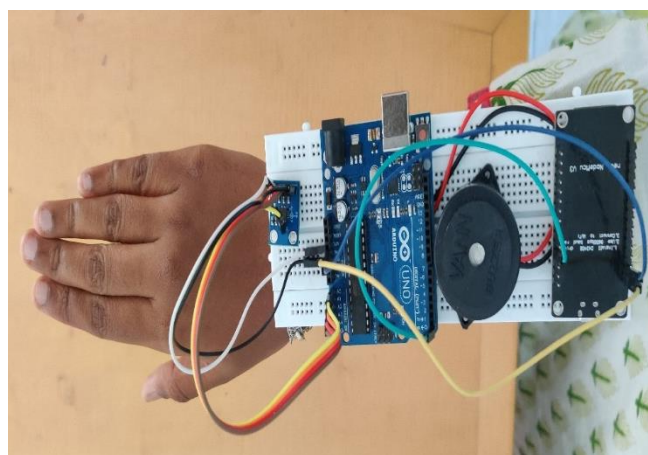
carry their mobile phone every time. In another paper, GSM is used to send messages to the contacts. But it is high cost, bulky, power hungry module. We can use alternate method such as IOT service to send and receive messages.

## VII. PROPOSED SYSTEM

Our system “An IOT Based Fall Detection System” is used to detect the fall of the elder people. This system is mainly focused for the fall detection of the elder people. The people in our world are facing so many falls not only because of faint that may be because of their medical condition too. Falls occurring at the older age are mainly considered as a reason for death. If the older people are with their caretaker means then there is not a problem. If the desired people is far away means we can't monitor them regularly. Falls need to be addressed immediately and the only way to monitor them is sensing method. In our proposed system, if a fall is detected for an older people we can be able to convey the alert message to their loved ones via two communication modes. One is sending the alert message to their contacts and if they are far away means we can alert the nearby people using piezo-buzzer. This generates sound and alerts the nearby people. Hence we can help them immediately and can make the quality of their life better. By using sensors such as Arduino Uno, Accelerometer we can get the data about the person's acceleration and angular position in each axis. By using these data, we can calculate the parameters like net acceleration, pitch, roll, yaw. By using these parameters we can be able to get the results by comparing the values. This system continuously senses the person's angle and acceleration. If there is a fall happens, the system waits for another 20 seconds and this waiting time helps us to evaluate whether they need some serious attention or not. If the person doesn't get up the signals are passed and the piezo buzzer starts to alert the nearby people and sends an alert message to the desired people. This system also maintains the database about the particular person's fall values that can be used to predict the future fall using various algorithm.



**Fig 7.1: System Connection**



**Fig 7.2: Wearable device**

## VIII. CIRCUIT DIAGRAM

Here we connected the Arduino board to the battery and other hardware to the Arduino UNO. It is the circuit diagram for our system representing all the connections.

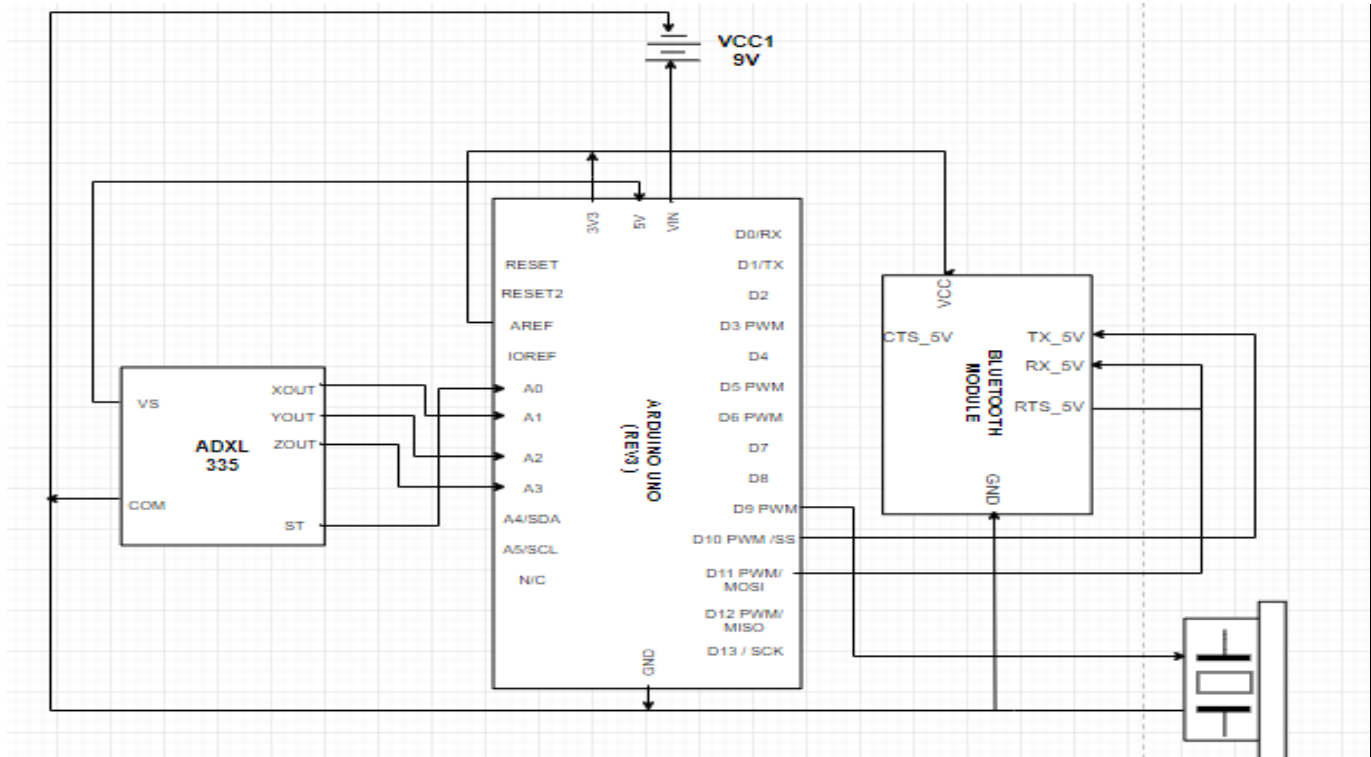


Fig 7.1: Circuit Connection for Wearable Device

## VII.CONCLUSION

We have given a complete solution of fall detection for elderly. This safeguard most of the people's life and helps them in critical situation. This can also be implemented for infants. Elderly can be monitored and serviced 24/7. This acts as an assist when they are helpless. Once an elderly fall down and if they lost their conscious the SMS is send to the registered mobile number, even if he/she is unable to reach they can make others to help them.

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