

Automatic Fall Detection and Monitoring Wearable Device for Elder People

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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 number of injury related deaths. On the personal side, such events stifle the independence of the individuals, requiring a caretaker to maintain constant surveillance. It is better to design a system to sense and alert doctors and nearest of kin of falls and other related incidents of distress. The device must not be cumbersome, but rather wearable, so as to remove any social stigma related to the possession of such a device. It should have a high degree of reliability and differentiate activities of daily life from genuine falls. This would require a signal plotting and threshold based approach to arrive upon a fall- detection problem.

Index Terms—Fall detection, elderly, GPS, GSM, Accelerometer

I.INTRODUCTION

Falls are the second leading cause of death by accidental or unintentional injuries throughout the world. Approximately, 420, 000 people die due to fall related injuries. But it is necessary that how can we know if an elder has fallen?

This paper presents a fall detection system for the elderly. The system is a wearable device that detects; using an accelerometer, if the user has got a fall, through GSM the information is sent to the predetermined number in case of emergency. The wearable device has the capability of detecting a fall sensing with the help of accelerometer. Therefore, this project measures the acceleration in 3-axes. In case of the falls, the system sends out an alarm to the response unit. The first part of the system includes a fall-detecting band for extracting and processing signals obtained from the tri axial accelerometer. Here these sensors will send the analog signals to the microcontroller for its logical manipulation for detecting the real time status of the body to the mobile phone after the three axes i.e. x, y, z will each produce a different acceleration value, If the acceleration achieves a defined threshold, the angular position is measured. Then, if a position threshold is achieved, a fall has been detected and the emergency protocol is activated. Threshold based techniques are the most frequently using technique, but these require some predefined values that should be adjusted regarding the target. The second part of the system having GSM that will be attached with the microcontroller for sending the message to the persons those are carrying mobile phone along with the location of user. After receiving a fall alert, it generates alarm.

II.BLOCK DIAGRAM

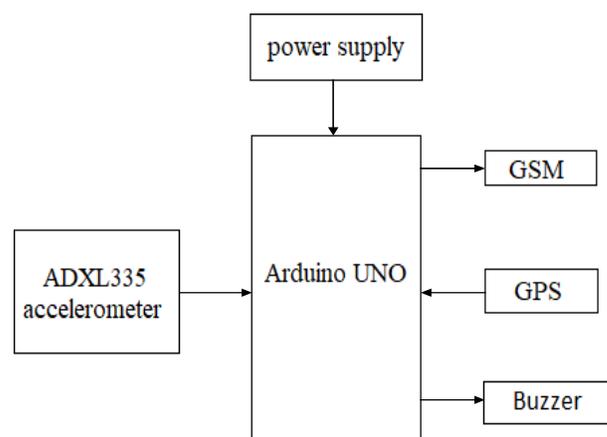


Fig 1. Block Diagram

The fall detection system is used for the patients and the elder people to detect the falls which are suddenly happened. This fall detection system is used to detect the falls with the exact location of the fall and the details of the fall are send to the relatives of the elder people or to the doctor of the particular patient.

This fall detection system uses Arduino UNO as a processor which performs all the operations and the ADXL335 (accelerometer) which is used to sense the motion the body and all the operations which are happened in the body. It continuously transmits the analog signals which are happened in our body. If there are

abnormal things which are taking place are also sensed by the accelerometer. When fall is occurred the signals are transmitted to the Arduino and from that Arduino the GPS module gets activated and the latitude and longitudinal coordinates are transmitted to the Arduino and at the same time the buzzer gets turned on and with that GPS coordinates a text message is generated with the patient or the elder details to the relatives who are located through worldwide with the exact location of the fall. The message will be sent through the GSM module.

1. Arduino UNO

In Arduino Uno some analog pins and also digital pins are used for connection. In this A0, A1, A2 pins are used for connecting the accelerometer. The purpose of these pins are used to convert the analog information into digital signals. The pin A0 is connected to XOUT pin which is presented in accelerometer sensor. The pin A1 is connected to YOUT pin and A2 is connected to ZOUT pin. These are used to produce analog signals from the motion of the body and this signal is given to Arduino and these signals are converted into digital signals and are used for further process.

D0, D1, D2 digital pins for connections and D10, D11 with PWM functionality. The D0, D1 pins are connected with GPS module for transmitting and receiving locations. D0 pin is connected to TX pin of GPS module. D1 pin is connected with RX pin. The D11 pin is connected to RX pin of GPS module and D10 pin is connected to TX pin of GSM module. The D2 pin is connected to anode of the LED and cathode is connected to D5. In between the cathode and D5 pin there is a resistor with 720 ohms is connected to improve the life of LED. D9 pin is connected to positive of the buzzer. The buzzer is used to produce sound when fall is occurred.

VCC and GND: Every VCC and GND pins are connected to the Arduino for accelerometer VCC is of 5V and for GPS also VCC is of 5V. The 12V supply is given for GSM module.

2. ADXL335 (Accelerometer)

The ADXL335 is used for sensing the motion of the body. The ADXL335 consists of 6 pins namely VCC, GND, XOUT, YOUT, ZOUT, ST. The VCC and GND pins are common for every sensor here the VCC is of 5V the accelerometer is the analog sensor which is used to produce analog signals. The XOUT, YOUT, ZOUT pins are of analog pins these also produce analog signals from the motion of the body. The XOUT pin connected to A0 pin of Arduino and YOUT and ZOUT to A1 and A2 pins of Arduino. These are used to produce analog output and these signals are given as input to the Arduino.

3. GSM

The GSM module is used for sending and receiving messages through worldwide. The GSM stands for Global Service for Mobile communication. The GSM module consists of 3 pins from these 3 pins 2 pins are of digital pins and 1 is the GND pin. The TX pin of

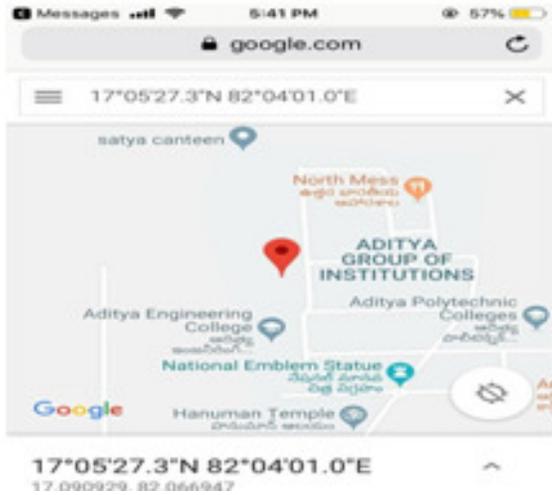
GSM module is connected to digital pin D10 of the Arduino and the RX pin is connected to D11 digital pin of the Arduino. The GND is connected to GND pin of Arduino. The supply voltage of GSM module is of 12V which is connected to Vin pin of the Arduino. When the position of the body is crossing the threshold value, fall is detected, message will send to relatives or care taker's mobile phone through GSM as shown in figure.



Fig 2. Result in mobile phone

4. GPS

The GPS module is used for tracking particular object or place with the exact location in the form of latitude and longitudinal values. The purpose of GPS module is to track the location through worldwide. The GPS stands for Global Positioning System. The GPS module consists of 4 pins from these 4 pins 2 pins are of digital pins and the remaining 2 pins are the VCC and GND pins. The GPS module consists of TX and RX pins. The RX pin is connected to digital pin D1 of the Arduino and TX pin is connected to digital pin D0 of the Arduino. The VCC is of 5V and the GND pin is connected



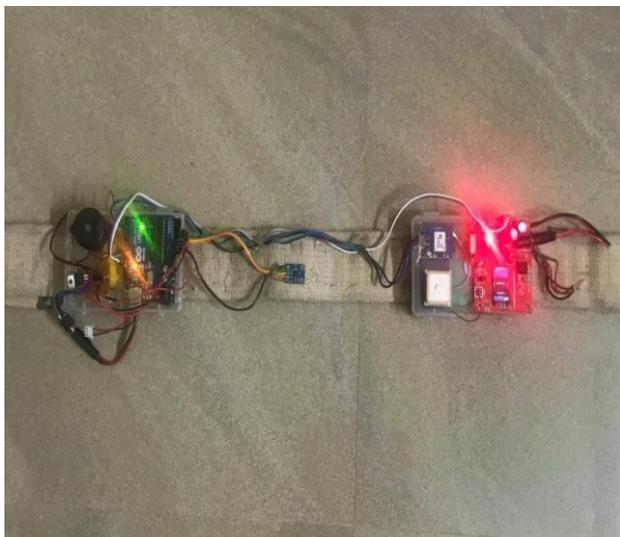
to the Arduino.

Fig 3. Gps location spotted

5. Buzzer

The Buzzer is an electronic component which is used to make an alarm sound. We call it as piezo buzzer because it is a piezo electronic component. It is a digital component. It has two polarities as positive and negative polarity. The positive polarity is connected to 5V supply and the negative polarity is given to the ground pin of Arduino. The main function of the buzzer is to make alarm sound when fall is occurred. It produces a beep sound when fall occurred.

Fig4. Wearable Fall detection System



III. FLOWCHART

This flowchart consists of every step of fall detection system. By seeing that we can know what is happening and the overall information about the fall detection.

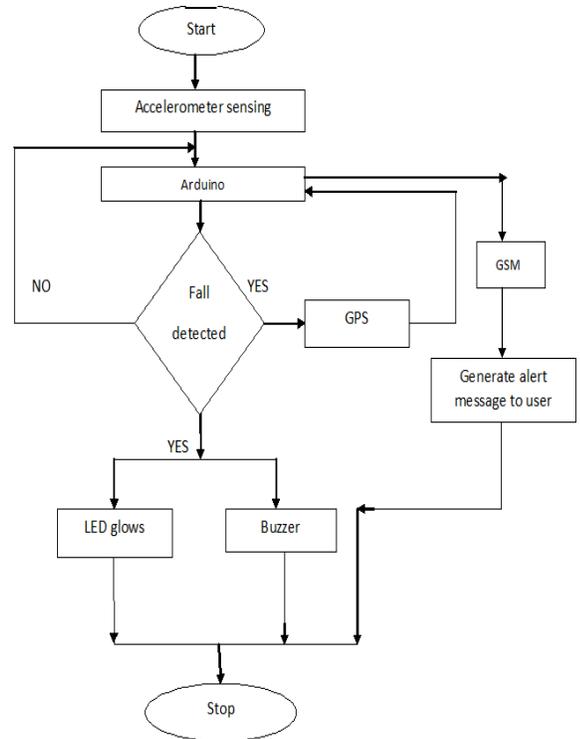


Fig 6. Flowchart of fall detection system

The following are the steps for a fall detection system:

Step1: Start

Step2: accelerometer is sensing the body position. If there is any change in the motion of the body, sends message to Arduino.

Step3: The Arduino UNO receives the values of the accelerometer continuously. Suppose if there is any change in the motion of the body then the Arduino uno responds immediately.

Step4: If fall is confirmed then the UNO generates signals to the buzzer and LEDs. By receiving that signals the buzzer and LEDs are turned on and at the same time the GPS will get on and it sends the location where the fall is occurred with the help of GSM a text message will be generated to the relative of the patient.

Step5: If fall is not confirmed then the accelerometer keep on sensing the motion body then it sends to the Arduino.

Step6: Stop

IV.CONCLUSIONS & FUTURE SCOPE

This system uses Arduino as a microcontroller to monitor real-time, and for data communication using GSM / GPRS network and provider card that serves to measure falling movement of the elderly person. And also sends the location related to the fall. The accuracy of sending notification data to the server is 100% and the accuracy of sending data to family notification in the form of SMS equal to 93.75%. The system successfully detects the direction of falling: forward, backward, left or right and able to distinguish between unintentional falling and conscious falling like a bow or prostrate position based on acceleration moment of falling.

Up to now there is a wearable fall detection device which is used to detect the unintentional falls in an elder person. In future we may develop it with air bag control system to reduce the damages which are happened when the fall is occurred. Not only has air bag controlled system we may also develop this with security camera for the continuous monitoring of the elder people. In future this can also be used in hospitals to monitor the patient. Wearable device is completely safe because it is worn on the outside of the body not inside the body.

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