

Intelligent system for Fall Detection of physically challenged people

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Abstract: Falls have been the major cause of accidental deaths especially among the old/physically challenged people. Hence it is necessary to monitor for their safety. The technology has made it possible to provide immediate help to such people. We have designed Intelligent system for Fall Detection of physically challenged people which is based on tri-axial accelerometer embedded in gyroscope interfaced to the microcontroller. The principle behind the system is continuous monitoring of the data from the gyroscope in all the three axes for the determination of fall. Once the fall has been detected, the alert message as well as call is sent from the GSM module to relatives/ nearby hospital which can provide immediate medical attention. The Bluetooth module controls the movement of the wheelchair which can be operated from the android device. To get the wheelchair in the desired place in the house, we have designed a house map which is based on the IR sensor to count the revolutions to move the wheelchair from one place to another. This prevents us from using GPS module which fails to give the accurate location inside the house.

Keywords: GSM, IR Sensor, Gyroscope, fall detection system, Bluetooth module

1. INTRODUCTION

The risk in falling of old people/ people with disability has increased immensely over the years. In most of the cases, falls result into minor as well as fatal injuries. Supervising and monitoring the health and safety of old aged people is of utmost importance. In order to curb this issue, an intelligent fall detection system is proposed. The system monitors the data in real time and the abnormalities (if any) is detected, then safety measures are taken. Systems available in market are expensive and out of reach for a common man unlike ours. The proposed system is inexpensive and economically stable. There are number of fault detecting systems which include camera based

fault detector, community alarms etc. The one implemented in the project is [1] automatic wearable fault detector which does not require to be activated manually. It has a inbuilt accelerometer which increases the accuracy.

2. LITERATURE SURVEY

The fault detection system has seen many related works over the recent years.

In [1], the proposed system uses a stick to prevent the fall. The stick has a support mechanism built in which gets activated to prevent the fall. As the fall is detected, then LCD displays an alert message and an alert message is sent with the location of the fall to the relative.

In [2], the system detects the vibrations which are emitted by the floors when fall occurs. There is a different frequency of vibrations emitted when a person walks, runs or falls. The system detects only those vibrations which are related to the falls. The alarm is activated when the fall occurs to get immediate help.

In [3], Zhang, Ren and Shi proposed a system named honey (Home Healthcare sentinel system) which basically involves three main components namely accelerometer, audio, image and video clips. The accelerometer detects the fall and sends an alert message immediately, the video of the fall is recorded and is uploaded to the network for further analysis. It can be mounted on the hand of the person .

In [4], the system comprises UV sensor, accelerometer, front and rear camera. With the help of data from accelerometer, if the fall is detected alert message is sent to the respective person who can in turn access the live streaming video of the fall.

3. COMPONENTS USED

3.1 ARDUINO UNO

It is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital I/O pins among which there are 6 PWM output pins,

a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The Arduino UNO is the heart of the project as all the below mentioned components are interfaced with Arduino. Arduino UNO is a very user-friendly component in which codes can easily be written according to the user.

3.2 GYROSCOPE

The gyroscope consists of inbuilt MEMS accelerometer module. It has 16-bit analog to digital converter for each channel because of which it is capable of capturing the data of all the three axes namely x, y, z at the same time. It works on the concept of angular momentum and can be used to determine the orientation of an object. The gyroscope uses earth gravity to determine the data of three axes. The accelerometer detects based on the rate of change of movement.

3.3 BLUETOOTH MODULE(HC-05)

The Bluetooth module, HC-05 works on serial communication (USART). The android app is designed to send the serial data to the Bluetooth module when a particular button is pressed. The Bluetooth module on the other hand, receives the data and send it to the microcontroller through the transmitter pin of HC-05. The code fed to the microcontroller analyses the received data, compares and takes action accordingly.

3.4 IR SENSOR

The IR sensor basically consists of two circuits namely IR transmitter and IR receiver. The transmitter section used IR led and receiver section uses a photo diode. The LED in the transmitter section transmits the infrared light to an object and the photo diode in turn receives the light which is bounced back from the object and converts it into electrical voltage. It is also useful for white and black line tracking.

3.5 MOTOR DRIVER (L298N)

The L298N is a dual H-bridge motor driver which allows speed and PWM control of two dc motors simultaneously in any direction at the same time. The module can drive the DC motors that have voltages between 5 and 35V with a peak current up to 2A.

3.6 GSM SIM900A MODULE

The GSM stands for global communication for mobile communication. The idea of GSM was

developed at Bell Labs in 1990's. It is one of the widely used mobile communication system in the world. It is an open and digital cellular technology used for transmitting mobile voice and data services operating at 850 MHz,900 MHz,1800 MHz and 1900MHz frequency bands.

3.7 ULTRASONIC SENSOR

The ultrasonic sensors measure the distance by using ultrasonic waves. The sensor emits an ultrasonic radiation at a particular frequency and receives back the radiation from the object/target in front of it. They measure the distance by measuring the speed with which the wave travels and the time between the emission and reception.

4. PROPOSED METHOD

The present fall detection systems can be categorized into number of groups like floor, vibration-based fall detection, visual fall detection etc. the method proposed by us involves wearable sensors which has to be worn by the person on wheelchair. The sensor is a gyroscope with built in accelerometer which increases the accuracy by reducing the chances of false alarms. It is activated automatically, it does not require any human intervention.

5. WORKING PRINCIPLE

The different components are interfaced with the Arduino UNO. The block diagram is represented in Fig 1.

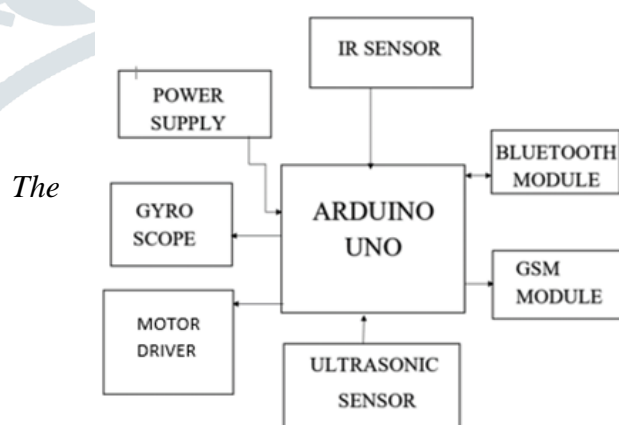


Fig. 1

GSM module, Arduino and the motor driver is given a common power supply from the battery. The code for the fall detection is fed to Arduino. Once the system is powered, the gyroscope continuously gives the data of all the three axes x, y and z according to the orientation of the

person on wheelchair. The person on the wheelchair uses the android device to send the serial data to the Bluetooth module by pressing a button for either moving forward, backward, right or left according to his/her wish. The Bluetooth module receives the data and sends it to the Arduino through transmitter pin of Bluetooth module. On reception of data by Arduino, the motor simultaneously drives two dc motors connected on the wheels in anticlockwise or clockwise direction according to the command from the Bluetooth module.

In the course of his/her movement if the person falls off from the wheelchair or wheelchair topples, there will be sudden change in the value of the one or more axes of the gyroscope which will be greater than the threshold value indicating a fall. Once the fall is detected, an alert SMS is sent from the GSM module to the relative/nearby hospital regarding the fall so that they can provide immediate help. This can be illustrated by the following flowchart in Fig.2

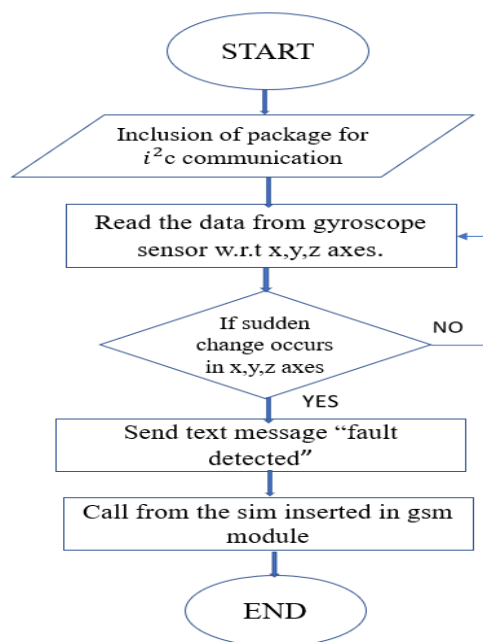


Fig. 2

The movement of the wheelchair can be made easy inside the house where GPS module fails to give the accurate location. In this proposed system, we have designed a map for a particular house so that it becomes convenient for the person to get the wheelchair at the desired place inside the house. The wheels of the wheelchair is provided with black strips which can be detected by the IR sensor to count the number of

revolutions to be taken to move from one place to another. The number of revolutions is calculated manually once and then it is predefined in the code. The code is then fed to the microcontroller which allows the movements according to the commands from the android device.

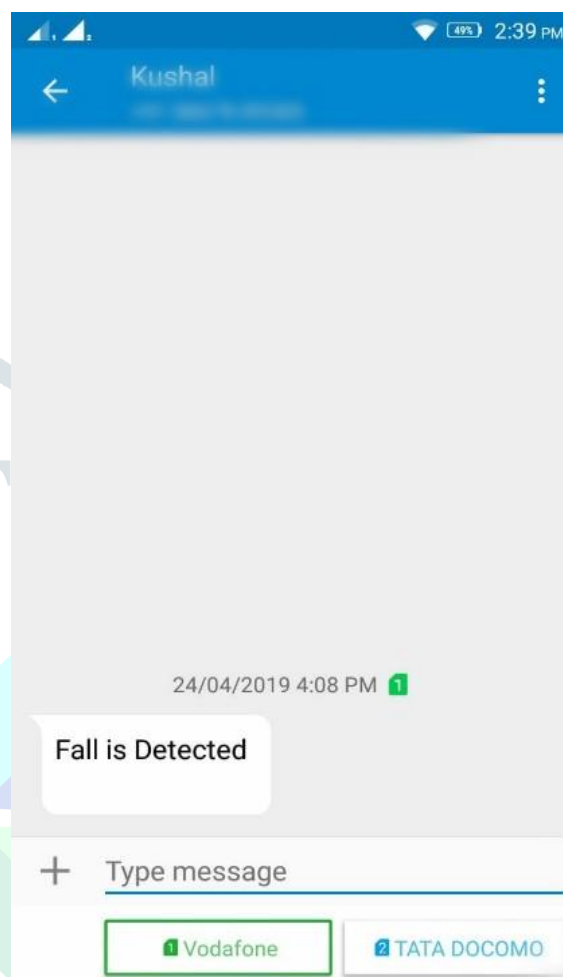


Fig 3.

6. SAILENT FEATURES

- It reduces human effort to drive the vehicle.
- Since it is eco-friendly it does not cause any harm to environment.
- It is adaptable to all weather conditions.
- .Decreases the severity of fatal injuries due to immediate medical help provided.

7. RESULTS

In order to evaluate the proposed system, the code is fed to the Arduino which is written in the Arduino IDE platform. After all the components are powered and if fall is detected, it can be

checked on the serial monitor window. SMS and call are sent to the respective number as shown in fig 3.

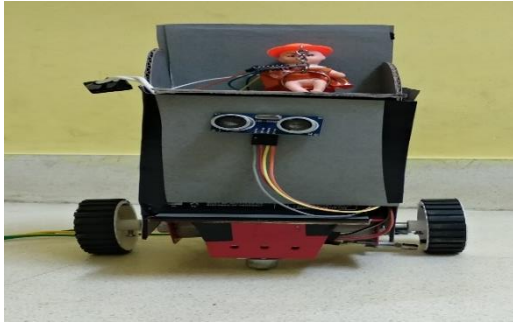


Fig.4

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8. CONCLUSION AND FUTURE SCOPE

The “Smart fall detection for old aged persons on wheelchair” is designed and developed successfully with a fabricated unit and the results are found to be satisfactory. Since this is a prototype of small scale, only two wheels are used. There are various fall detection systems which perform well for the detection, the proposed system will be a portable device for user, having sensors consisting of UV and IR sensors. The proposed fall detection system can be regarded as alternative device to the existing detection approaches, is less complex as compared to other devices, fast fall response and will be more accurate and economical.

9. REFERENCES

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