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DEVELOPMENT OF ARDUINO BASED HUMAN AIRBAG SYSTEM TO REDUCE INJURY

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Abstract-Every 11 seconds, an older adult is treated in the emergency room for a fall; every 19 minutes, an older adult is injured from a fall. Falls are the leading cause of fatal injury and the most common cause of non-fatal trauma- related hospital admissions among older adults. If the elderly fall, it will be difficult for them to request for help. The main objective of this project is to design a fall protection sensor system at affordable cost for the elderly. The system can acknowledge a free fall such that the fall can be protected by an inflated air bag. The implementation combines both hardware and software that work seamlessly in detecting and protecting a fall at home. The input from the 3-axis sensor accelerometer (ADXL335 orADXL345) and gyroscope will be fed to the microcontroller which will detect the fall and further input to the driver circuit to inflate the air bag according to the algorithm coded using EMBEDDED C

***Key Words*:** Fall detection, accelerometer, gyroscope,Airbag

1. INTRODUCTION

Older people frequently fall. This is a serious public health problem, with a substantial impact on health and healthcare costs. Considering elder individual's hip fractures account for most of the deaths and costs of all fall-induced fractures. Here we are implementing a "Human Airbag System for Fall Protection", which inflates suddenly when accidental fall is about to happen. The main aim of human airbag system is to reduce impact force on hips. Our area of focus is on the geriatric patients, where it acts as a life supporting system[6]. The implementation combines both hardware and software that work seamlessly in detecting and protecting a fall at home. The input from the 3 axis sensor accelerometer (ADXL335 or ADXL345) and gyroscope will be fed to the microcontroller which will detect the fall and further input to the driver circuit to inflate the airbag according to the algorithm coded using EMBEDDED C[6]. Different approaches and technologies have been used for fall detection. Firstly, wearable devices and technologies for environment sensing, further divided in devices that provide immediate detection and devices that detect unusual behavior[3]. Wearable devices are designed to be worn by the user and to monitor his/her activity, using different technologies, like accelerometers, gyroscopes, barometric pressure sensors. These devices, that usually come in the form of MEMS are small, have low cost and low power consumption, so they are suitable for a mobile system used for fall detection[2].

2. PROBLEM STATEMENT

In a year, 1 out of 3 people over the age 65 suffers grave injuries due to a fall. Most of these incidents either go unnoticed or lack immediate care. The devices currently in the market, for example the Automatic Fall Detection by PHILIPS, focuses on alerting the emergency department after a fatal fall has occurred. Then came the need of the hour, the Fall Protection Device, where immediate protection will be implemented before the fall has occurred or during the initiation of the fall. The device will sense a fall and inflate the airbag installed as a belt over the waist. It is impractical to employ an airbag as an entire body suit. Hence, an inflation at the waist will protect the hips, the back and reduce the impact on the head.

3. OBJECTIVE

To design and create a Fall Detection System for the elderly that will protect them from hip andback injuries. The system has to be wearable and capable of detecting a fall before the impact. The device has to be able to detect dangerous tilt and if a fall has occurred, must inflate the airbag within a few milliseconds. In the event of a fall or a dangerous tilt, the device has to be able to bevery sensitive to the motion and differentiate between ADL's. Throughout the process, the algorithm must continuously collect data and implement the threshold algorithm when needed.

4. PROPOSED SYSTEM

The idea is to design and create a Fall Protection System for the elderly. The system has to be wearable and capable of detecting dangerous tilt and if a fall has occurred. In the event of a fall or dangerous tilt, the device had to be able to sense motion and the different measurable qualities involved with motion. Sensing in the device begins with a digital tri- axis accelerometer, which measures acceleration along the three coordinate axes[1]. To use these sensors to detect falls, the sensor readings have to be outputted to a microcontroller for processing and application to algorithms. For this to occur, first the sensor readings areconverted from an analog voltage

signal to a discretized bit value for the microcontroller to be able to use them. This is accomplished by passing the sensor outputs through an Analog to

Digital Converter (ADC) before entering the microcontroller[1]. The microcontroller has to take the discretized bit data from the ADC and apply different formulas and conversion factors to calculate the necessary factors (accelerationmagnitude, angle change, angular velocity). Using these factors, the microcontroller feeds them into an algorithm, comparing the inputs with various threshold values, initiating triggers when certain thresholds are met or exceeded. Upon detecting dangerous tilt, the microcontroller has to initiate a signal which will turn on the motor driver to inflate an airbag strategically placed at the waist. Throughout the process of sensor readings the algorithm tries to detect a fall.

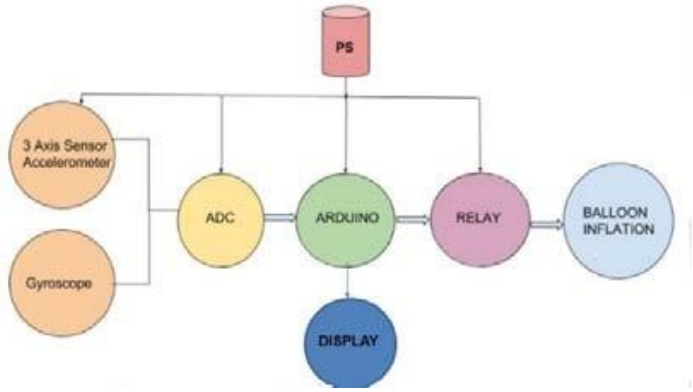

Fig.1: The basic block diagram of a fall detector

6. ARDUINO INTERFACING

6.1 ACCELEROMETER INTERFACING

The three output pins of accelerometer give analog output and should therefore be connected to the analog input pins of your Arduino. Let us take A0, A1 and A2. Now, look at the power pins. Connect the VCC pin of the accelerometer to the 5V pin of the Arduino. Connect GND of accelerometer to the GND of Arduino.

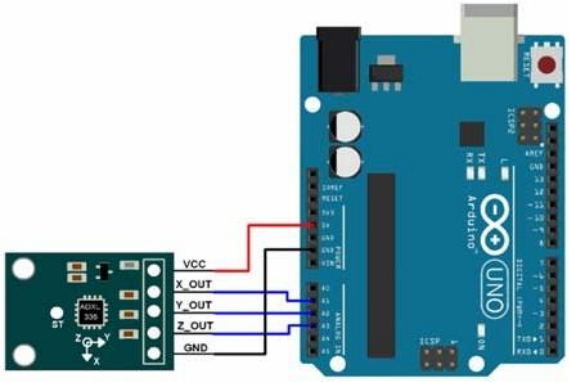

Fig.2: Interfacing Arduino with Accelerometer

To upload the code connect your Arduino to your PC using the USB connector and click on the upload button on the top of the Arduino IDEwindow. Click on the serial monitor icon on the top right corner and you can see the accelerometer readings.

6.2 GYROSCOPE INTERFACING

The interface between MPU6050 and Arduino must be implemented using I2C Protocol.

The circuit diagram**,** for interfacing MPU6050 with Arduino, is very simple here we have used an LCD and MPU6050. And here we have used a laptop USB power supply. In connection with MPU6050, we have done 5 connections in which we have connected the 3.3v power supply and ground of MPU6050 to the 3.3v and ground of Arduino. SCL and SDA pins of MPU6050 is connected with Arduino's A4 and A5 pin. And INT pin of MPU6050 is connected to interrupt 0 of Arduino (D2).

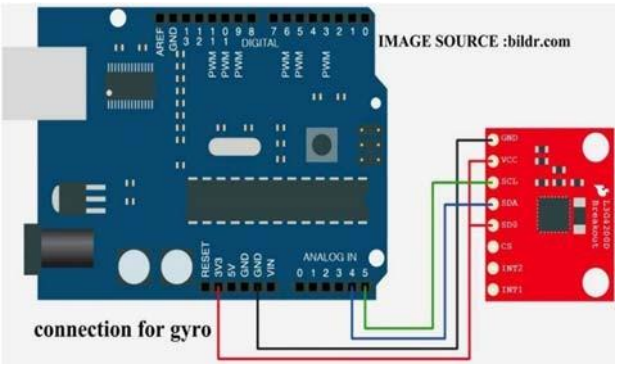

Fig.3: Interfacing Arduino with Gyroscope

The interface between MPU6050 and Arduino must be implemented using I2C Protocol. The circuit diagram**,** for interfacing MPU6050 withArduino, is very simple here we have used an LCD and MPU6050. And here we have used a laptop USB power supply. In connection with MPU6050, we have done 5 connections in which we have connected the 3.3v power supply and ground of MPU6050 to the 3.3v and ground of Arduino. SCL and SDA pins of MPU6050 is connected with Arduino's A4 and A5 pin. And INT pin of MPU6050 is connected to interrupt 0 of Arduino (D2).

7. PROPOSED ALGORITHM

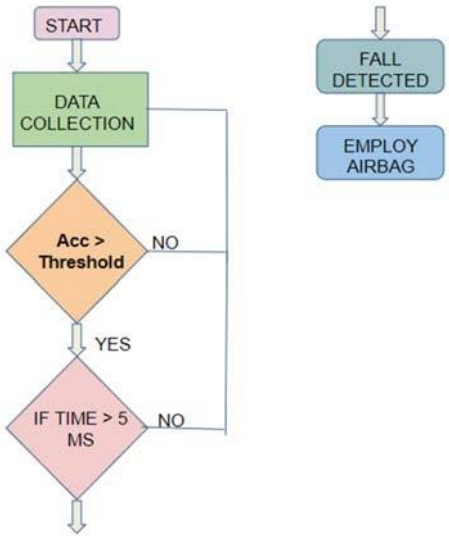

Fig.3: A flowchart depicting the algorithm

Initially we start with the acquisition of the data. In step 2 the accelerometer value is compared with the threshold, if accelerometer value is greater than desired threshold then moves to step 3, if not go back to step 2. Step 3 determines whether the fall happened by comparing with step 4.If the time is greater than 5 milliseconds that is if the patient will be in ground more than 5ms the fall is detected, if not moves to step2.Once the fall is detected then the airbag employs at the last step.

8. ADVANTAGES

The idea is to design and create a Fall Protection System for the elderly. The systemhas to be wearable and capable of detecting dangerous tilt and if a fall has occurred. In the event of a fall or dangerous tilt, the device had to be able to sense motion and the different measurable qualities involved with motion

1. Protects the user from hip and backinjuries.
2. Ideal for the elderly who live withminimal care
3. Cost effective
4. Lightweight and comfortable
5. Easy to wear belt with ease of use.

9. CONCLUSION

The use of the fall sensor and an airbag- equipped life jacket may also save lives and reduce injuries from falls at construction sites and other location. Also the jacket helps to protect the head when a person falls by automatically inflating an airbag that absorbs the shock of the fall and reduces the impact on the human body.

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