LOW COST FALL DETECTOR FOR ELDER

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Abstract : **Falls in elderly people have been recognized as a major health problem in aging population. Falls are identified as a major health risk not only for the elderly but also for people with neurodegenerative diseases, such as epilepsy, and are considered as a major obstacle to independent living. Fast detection of falls would not only decrease the health risks by enabling quick medical response; but also make independent living a safe option for the elderly. In this paper we propose e-Fall detector consists of the development of an accurate, accelerometer based fall detector. The device worn on the leg uses a fall detection algorithm, which senses the body orientation of the wearer. An Inertial Measurement Unit (IMU) consist of an accelerometer, a gyroscope and a magnetometer. There are distinct kinematics characteristics during falls, accelerometer sensor senses the different patterns of fall and gyroscope detects the orientation change of the body when the patient's body fails to get aligned with the sensor. The combined use of an accelerometer and gyroscope helps in distinguishing the sudden fall from the normal day-to-day activities which could be achieved by a single sensor with the appropriate kinematics measurements and detection algorithms. A microcontroller interface allows the setting of threshold values after prior calibration of the accelerometer. When the orientation change of the patient is detected, the percentage of fall is calculated from the readings of the accelerometer. Once it exceeds the threshold value, the microcontroller initiates an alarm to represent the elderly patient's fall. This helps the caregivers to prevent unnecessary injury of elderly people**

IndexTerms **– Elder, e-fall detector, accelerometer, microcontroller.**

I. INTRODUCTION

In around 35 years and by 2050, it's estimated that more than one in each group of five people will be aged 65 or over. In this age group, falling is one of the most serious life-threatening events that can occur, as approximately one-third to one-half of the population aged 65 and over (mostly aging care centers residents) experience falls on a yearly basis and half of these elderly do fall repeatedly [1]. Falls can have severe consequences such as injury or death; in 2010 in the United States, 21,649 older adults died from fall related injuries So, the automatic detection of falls would help reducing the time of arrival of medical caregiver, and accordingly reducing the mortality rate [2]. Falls are the leading cause of injury in elderly people and the leading cause of accidental death in those 75 years of age and older [3]. Also, more than 90% of hip fractures occur as a result of falls in persons aged 70 years and over [4]. Even if a fall does not result in a physical injury, it can often produce fear of falling resulting in a decrease in mobility, participation in activities, and independence.

Fall detection technologies enable rapid detection and intervention for individuals who have experienced a fall. This ability could reduce the physical and mental damage caused not only by the fall but time after a fall before discovery. These technologies will help to reassure those at a risk of falling as well as their caregivers and family. This devices can help physical therapists and other clinicians to clearly understand not only when the person experienced the fall , but also circumstances surrounding the fall, allowing for better treatment of the individual in question. . This paper brings the concept of elderly fall detector consist of accelerometer, gyroscope and magnetometer. When the subject fall there will be change in angle of inversion and eversion of Foot. If this change in angle is measured that can be used to avoid the fall by indicating with alarm.

II. METHODOLOGY

The developed system consist of MPU6050 sensor, microcontroller and alarm system as shown in block diagram. The Inversion and eversion angle change due to the movement of ankle is measured using the MPU6050 sensor which is interfaced with microcontroller. The maximum inversion and diversion angle is fixed as threshold in microcontroller. If the threshold exits the alarm will be fired.

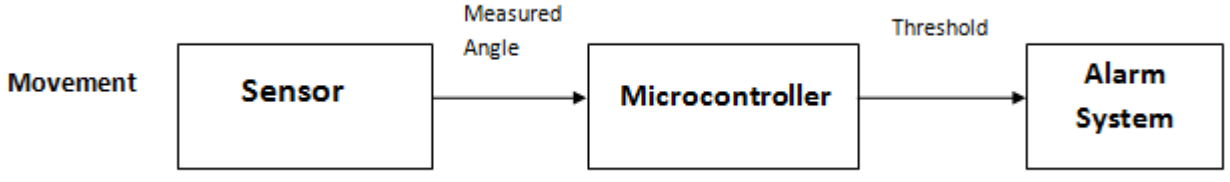

Fig: 1 Block Diagram

2.1Design of Measurement Unit

Measurement Unit consist of MPU6050 sensor interfaced with microcontroller is used for data acquisition. The MPU-6050 is the integrated 6-axis Motion Tracking device that combines a 3-axis gyroscope, 3-axis accelerometer, and a Digital Motion Processor (DMP).I2C sensor bus directly accepts inputs from an external 3-axis compass to provide a complete 9-axis Motion

Fusion output.. Mpu6050 interfaced with microcontroller ATmega328. Forward Euler's Integration method is used to find the angle as shown in Eq. 3.1.

$$\theta_{gyro_x}(Tn) = (angular\ velocity_x) * T + \theta gyrox(Tn + 1) \quad (3.1)$$

As shown in Eq.3.2 angle is calculated using the accelerometer

$$\theta\text{accel}_x = \tan^{-1} \frac{accel_x}{\sqrt{accel\_y\hat{}2 + accel\_z\hat{}2}} \quad (3.2)$$

The measure angular velocity will be converted into angle using the formula. The developed Measurement unit which consist of sensor interfaced with microcontroller and alarm is shown in fig.2

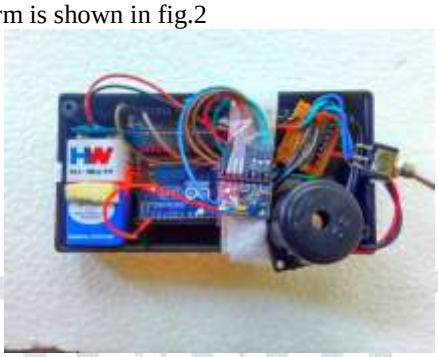

Fig: 2 Developed Measurement Unit

2.2 Calibration of system

Calibrating the gyroscope and accelerometer (MPU6050) is very important to acquire accurate angle. It is required to place the x and y axes of the MPU6050 chip horizontal and z axis perpendicular to the ground while performing this calibration as shown in the fig. Moving the hardware during the calibration process will reduce the accuracy of the calculated offsets.

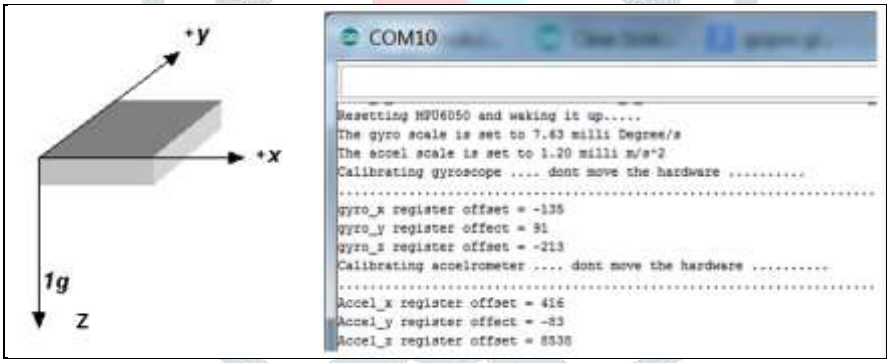

Fig: 3 Calibration of the Unit

III. RESULTS AND DISCUSSION

Initially the threshold value given to the microcontroller is found out by placing the measurement unit in anterior part of leg and made test trails. And it has been inferred that threshold angle for Inversion is 15 deg and eversion is 30 deg. The measurement unit is tested with subjects as given in table 1.

Table 4.1 Acquired data

Category	Male	Female
Control Group	12	6
Elder	10	7

The Measurement unit is placed in subjects and asked to perform during inversion and eversion action is shown in Fig 4 and Fig 5.And it has been noted that the alarm fires when the angle excided the threshold angle.

Fig: 4 During Eversion

Fig: 5 During Inversion

III. CONCLUSION

In this paper the Measurement Unit (IMU) consist of an accelerometer, a gyroscope and a magnetometer is developed and interfaced with microcontroller. The developed measurement unit is tested for various control group and elders with best result. In future the system can be developed as wireless unit and interface with mobile for better information to the caretakers.

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