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Motion Analysis of Elderly People Based on Fall Detection Algorithm

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A fall is mainly due to faint (or) syncope so on performing the faint detection we can decrease the rate of bone being fractured in elders. Also falls are a major public health problem among older people; the number of systems aimed at detecting them has increased dramatically over recent years. This work can be done by means of invasive as well as non-invasive technique. Invasive technique includes the measurement of blood glucose. Hence the novelty lies as non-invasive technique which presents the usage of accelerometers for fall detection along with pressure sensors and heart rate monitor to determine the reason for the fall. There are two modules one is measuring unit and another is the detecting unit. The measuring unit measures the continuous heart rate and blood pressure thereby to determine the fall and to give a self-alarm. Accelerometer sensor has been used to record and analyze difference between fall and normal motion. It aims to be a supportive device for the elderly people. We have also identified challenges regarding performance under real-life conditions, usability and user acceptance as well as issues related to power consumption, real-time operations, sensing limitations, privacy.

Key words: Accelerometer, sensing, detection, syncope.

According to the World Health Organization approximately 28-38% of people aged 65 and over, fall each year increasing to 32-42% for those over 70 years of age. The frequency of falls increases with age and frailty level. Falls exponentially increase with age-related biological changes which are leading to a high incidence of falls and fall related injuries in the ageing societies[1] If preventive measures are not taken in the immediate future the number of injuries caused by falls is projected to be a 100% higher in 2030[2].

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In this paper fall detection algorithm using 3-axis acceleration is proposed. the fall features are Blood Pressure, Heart Rate and Blood Glucose[3], digital measuring unit & cuff. The pressure sensed is given to the PIC microcontroller as high level analog output signal & then to 2x16 LCD for displaying the Systolic & Diastolic pressure. Heart Rate is measured in the fingertip using a clip type Infra-red sensor the signal which is in the form of pulses is then amplified and filtered suitably and is fed to a PIC microcontroller & then for the display on the 2x16 LCD[7]. Fall is being detected with the ADXL335 MEMS Accelerometer sensor. The values for x, y and z-axis have been displayed in the LCD. They are connected to the PC for processing using MATLAB Software and to set the threshold values. After fixing the peak value data acquired is displayed using DATALOGGER Software & then processing is done in MATLAB

Software [9] where Alert Box will display the message whether the Fall has been detected or not A TMEGA 16 microcontroller[5] is used for its low power consumption and inbuilt RISC Architecture.MAX232 IC is used to set TTL logic operation from RS232 signal voltage.

Methodology

Description

The reason for the fall is determined by measuring 3 important parameters: First, Blood Pressure & secondly Heart Rate & the third component is the Blood Glucose (invasive method-if required). Blood pressure[8] kit includes: MP3V5050-Pressure sensor, digital measuring unit & cuff. The pressure sensed is given to the PIC microcontroller as high level analog output signal & then to 2x16 LCD for displaying the Systolic & Diastolic pressure[6]. Heart Rate is measured in the fingertip using a clip type Infra-red sensor, the signal, which is in the form of pulses is then amplified and filtered suitably and is fed to a PIC microcontroller & then for the display on the 2x16 LCD[12]. Fall is being detected with the ADXL335

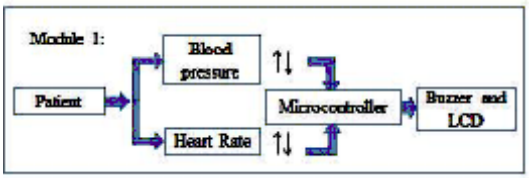

Fig.1. Block diagram of Fall detection

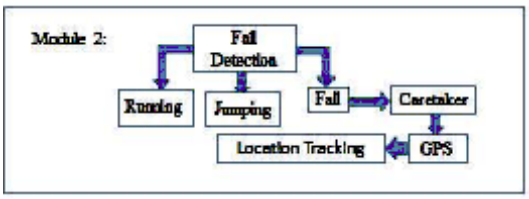

Fig. 2. Motions related fall detections

MEMS Accelerometer sensor that can be worn on the waist of the user. Wearable technology is the most important technologies on home tele-care and tele-rehabilitation in the near future, it has the advantages of continuity, low-cost, and easy to be used[11]. The values for x, y and z-axis have been displayed in the LCD. They are connected to the PC for processing using Data logger Software & to set the threshold values. ATMEGA 16 microcontroller is used for its low power consumption and inbuilt RISC Architecture. MAX232 IC is used to set TTL logic operation from RS232 signal voltage.

Data aquisition

We analyze the change of acceleration along with three typical actions of humans: walking, jumping and fall. Then we compare the actions of weightlessness, the impact, and the overturning of the body with the acceleration characteristics that are being fixed with the threshold value. Because the waist is the center of gravity in the human body, our system is used more effectively when we place the Accelerometer at the waist. We also analyze the three different accelerations in space to infer the fall direction of the user.

Processing

The center of gravity is the balance point for any object. When people are standing up, the body's center of gravity is near the waist. As the accelerometer in the generates power to move and rotate, research with respect to the center of gravity is very useful. The wearing position is the setting at the waist. Another reason why we are not wearing the Accelerometer on a hand or a foot is because the acceleration value would change intensely. Before analyzing the daily actions we must learn the relationship of the position between the smart phone and the space axis. When the Accelerometer right side faces the ceiling, the acceleration value of the X-axis is -9.81m/s, of the Y-axis0 m/s and of the Z-axis 0 m/s. When the Accelerometer top faces the ceiling, the acceleration value of the X-axis is 0 m/s, of the Y-axis +9.81 m/s and of the Z-axis 0 m/s. When the Accelerometer front faces the ceiling, the acceleration value of the X-axis is 0 m/s, of the Y-axis 0 m/s and of the Z-axis +9.81 m/s. These data tell us that the Accelerometer right side is equal to the positive X-axis and its left side is equal to the negative X-axis in the space axis. Its top and bottom are likewise equal to the positive and the negative Y-axis in the space axis while its front and back sides are equal to the positive and the negative Z-axis in the space axis.

Interfacing

We have used DB9 for interfacing. By coding we made connection to the microcontroller. When we execute the MATLAB coding the values for x, y and z-axis have been displayed in the LCD. They are connected to the PC for processing using MATLAB Software and to set the threshold values.

After fixing the peak value data acquired(X,Y &Z Axis) is displayed using DATALOGGER Software & then processing is done in MATLAB Software where Alert Box will display the message whether the Fall has been detected or not.

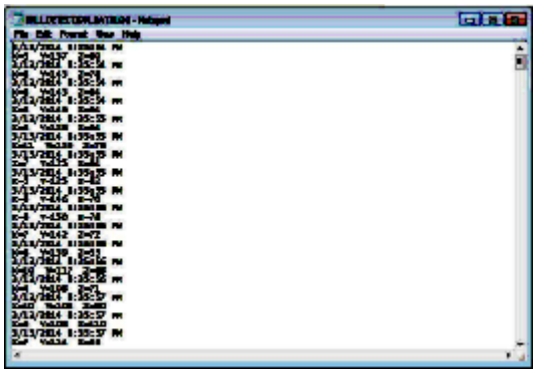

Fig. 3. Program description of fall detection

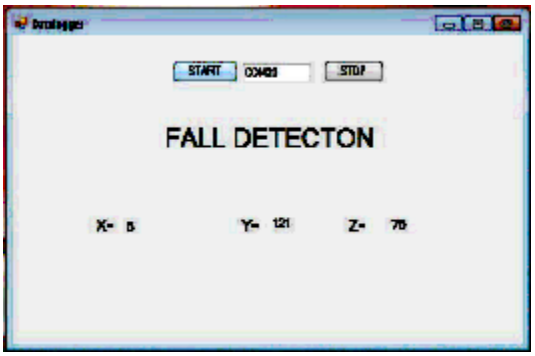

Fig. 4. Axis detection of fall

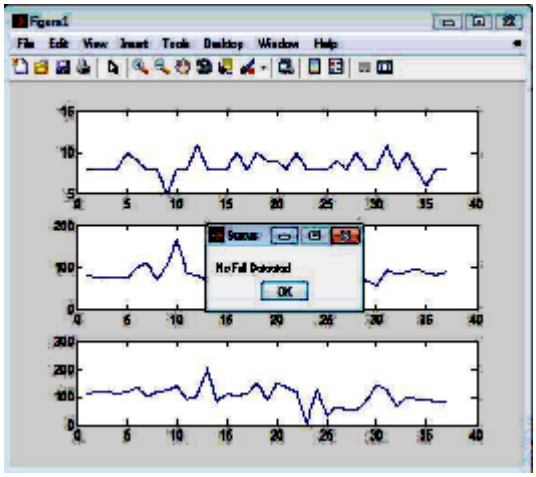

Fig. 5. Detection of fall occurred

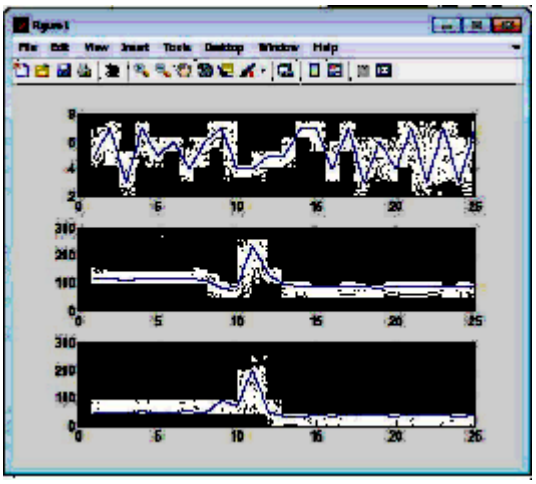

Fig. 6. Graphical out of the module

RESULTS AND DISCUSSIONS

Fall detectors are essential in order to provide a rapid assistance and to prevent fear of falling and their adverse health consequences. This work provides a classification for fall (walking, jumping & fall) & determines the reason for fall from the analysis of blood pressure, heart rate & blood glucose level. It will examine evolution over time, and ultimately identifies the challenges in fall detection. This fall detection technique is novel and useful than the existing techniques where the patient safety is given prior importance and since fall detection is a complex process for which currently there is no standardized solution and this solution can prove helpful in monitoring the elderly

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