

Analysis living and non-living things fall detection and prevention using wireless network & IoT

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Abstract: “In the fall of the aging people and paralysis patient always lead to serious health issues as the decline of their physical fitness. Cleavage is the most common slash in fall of an aging people and there is also a certain possibility to get coma, brain trauma, and paralysis patient. About to the fall situations, the fall process is the main source of tear because of the high influence. But sometimes, late medical reclaim may be depressed the situation. That means the faster the reclaim comes, the less threat the aging human beings will face. Thus the paper progress a fall detection system based on a suitable device. The system monitors the movements of human body, recognizes a fall from day to day activities by an effective quaternion algorithm, and automatic sends request for help to the cared with the patient’s location. In the fall detection algorithms plan based on the option of acceptance features. According the acceptance feature, fall detection algorithms, classified as gateway based and machine learning based. Gateway based method; gateway of recognition feature is set by the designer before appeal which makes the algorithm have rapid response and less resource consumption. In the machine learning based design, the grouping of fall and day to day activities is available with the assistance of technologies such as support vector machine (SVM) and neural network.”

Keywords: DC Motor, GSM Modem, Support Vector Machine, Tri-Axis Accelerometer

I. INTRODUCTION

Due to gravitational force, all objects have the acceleration of gravity towards the earth’s surface, thus, the stress direction of each limb of the body may be different. For example, when sitting, the gravity directions of leg and trunk are different; when in motion, each limb has different acceleration when sustaining different force. Past studies on fall accidents of the elders reported that single three-axe acceleration sensor cannot provide sufficient data, thus can only provide judgment with limited conditions, and cannot provide correct data of falling stances and impacted parts. Therefore, this study aimed to provide sufficient data to make judgment on fall accident, and differentiate the behavioral event and falling accident. This study used these features on the research of joint sensing of several three-axe acceleration sensors. When a fall accident occurs, the first impacted part suffers the maximum injury, especially at head or vertebra, thus, the body stance during the fall and whether the important position is impacted can be detected. The proposed method has also reduced operation complexity, thus, it is relatively easy to achieve real-timeliness in the embedded system. Testing results showed that the proposed method has high accuracy in judging impacted parts, and can provide data on possible impacted parts in fall accident for medical personnel as judgment reference for rescue.

II. LITERATURE REVIEW

Many previous and current research projects use medical sensor networks to identify and track human activities in daily life. With the purpose to successfully detect falls, there are primarily three types of fall detection methods for elderly people, namely wearable device based methods, vision based methods, and ambient based methods.

1. Wearable Based Methods

Wearable based methods often rely on smart sensors with embedded processing. They can be attached to the human body or worn in their garments, clothing or jewelry.

Abbate et al: Proposed a Smartphone based fall detection system with consideration of the acceleration signal produced by fall-like activities of daily lives.

2. Vision Based Methods

Vision based methods are always related to spatiotemporal features, change of shape, and posture.

Yu et al: Proposed a vision based fall detection method by applying background subtraction to extract the foreground human body and post processing to improve the result. To detect a fall, information was fed into a directed acyclic graph support vector machine for posture recognition. This system reported a high fall detection rate and low false detection rate.

3. Ambient Based Methods

Ambient based methods usually rely on pressure sensors, acoustic sensors or even passive infrared motion sensors, which are usually implemented around caretakers’ houses.

Popescu et al: Developed an acoustic-based fall detection system which used an array of acoustic sensors. The fall detection sensors are linear arrays of electrets condensers placed on a pre-amplifier board. In order to capture the information of the sound height, the sensor array was placed in the z-axis. The limitation of this method was that that only one person was allowed in the vicinity.

III. BLOCK DIAGRAM

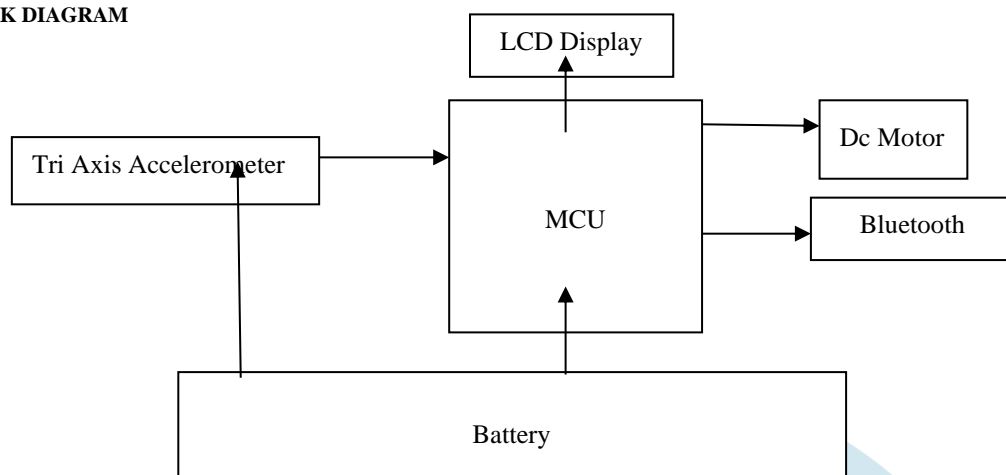


Fig.1 Block Diagram

IV. METHODOLOGY

- I. Accelerometer measures the acceleration due to person's fall
- II. Alert message is issued to android mobile
- III. A local alarm is initiated
- IV. If the alarm is not diffused over a specified time delay, alert messages are forwarded to remote mobile phones.

V. MATERIALS AND METHOD

1. Tri-axis accelerometer

Tri-axis accelerometers provide simultaneous measurements in three orthogonal directions, for analysis of all of the vibrations being experienced by a structure. Each unit incorporates three separate sensing elements that are oriented at right angles with respect to each other

2. PIC16F877A

The PIC16F family of devices is CMOS (Complementary Metal Oxide Semiconductor). CMOS technology offers a number of advantages over other technologies. For example, CMOS circuits consume very little power, operate over quite a wide voltage range and are quite forgiving of bad layout and electrical noise. The name PIC initially referred to "Peripheral Interface Controller".

3. BLUETOOTH - HC05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Blue core 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It can be easily interfaced with Arduino Board, Raspberry Pi, and Microcontrollers through serial UART interface. HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.

4. GSM Module

GSM module is used to establish communication between a computer and a GSM-GPRS system. Global System for Mobile communication (GSM) is an architecture used for mobile communication in most of the countries. Global Packet Radio Service (GPRS) is an extension of GSM that enables higher data transmission rate. GSM/GPRS module consists of a GSM/GPRS modem assembled together with power supply circuit and communication interfaces (like RS-232, USB, etc.) for computer. The MODEM is the soul of such modules.

VI. SOFTWARE TOOLS

1. MPLAB IDE

MPLAB Integrated Development Environment (IDE) is a free, integrated toolset for the development of embedded applications employing Microchip's PIC and dsPIC microcontrollers. MPLAB IDE runs as a 32-bit application on MS Windows®, is easy to use and includes a host of free software components for fast application development and super-charged debugging. MPLAB IDE also serves as a single, unified graphical user interface for additional Microchip and third party software and hardware development tools. Moving between tools is a snap, and upgrading from the free software simulator to hardware debug and programming tools is done in a flash because MPLAB IDE has the same user interface for all tools.



Fig.2 MPLAB IDE Software

2. PROTEUS Software

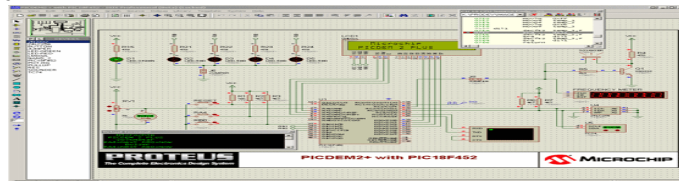


Fig. 3 Circuit Diagram

VII. RESULT

A true positive (TP) indicates correct detection of a fall, whereas false negative (FN) indicates incorrect detection. TP, TN, FP, and FN were used to calculate the accuracy, sensitivity, and specificity of the system. Sensitivity is the ability to detect a correct result when the activity (fall) is present and specificity is the ability to detect a correct result when the activity is absent. According to the formulas above, sensitivity, specificity, and accuracy were calculated to be 96.2%, 94.4%, and 95.3%, respectively.

Table of Sample Readings

Position	Trials	Expected results	TP	TN	FP	FN
null (still)	100	Negative	—	100	0	—
lying down	100	Negative	—	97	3	—
sitting up	100	Negative	—	96	4	—
standing up	100	Negative	—	93	7	—
Bending	100	Negative	—	86	14	—
fall (still)	100	Positive	100	—	—	0
fall (lying down)	100	Positive	98	—	—	2
fall (sitting up)	100	Positive	100	—	—	0
fall (standing up)	100	Positive	93	—	—	7
fall (bending)	100	Positive	90	—	—	10
Total	1000	—	481	472	28	19

VIII. CONCLUSION

The project “ANALYSIS LIVING and NON-LIVING THINGS FALL DETECTION and PREVENTION USING WIRELESS NETWORK & IoT” has been completed successfully and the output results are verified. The results are in line with the expected output. The project has been checked with both software and hardware testing tools. In this work “LCD, Microcontroller, Tri axis accelerometer, Bluetooth, GSM Module” are chosen are proved to be more appropriate for the intended application. The project is having enough avenues for future enhancement. The project is a prototype model that fulfills all the logical requirements. The project with minimal improvements can be directly applicable for real time applications. Thus the project contributes a significant step forward in the field of “Monitoring system”, and further paves a road path towards faster developments in the same field. The project is further adaptive towards continuous performance and peripheral up gradations. This work can be applied to variety of industrial and commercial applications.

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