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RF POWERED ID SENSOR BASED ACTIVITY RECOGNITION SYSTEM FOR ALERTING BEDRIDDEN PEOPLE

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Abstract: Falls have serious consequences and are prevalent in acute hospitals and nursing homes caring for older people Fall lead to many adverse consequences for the patients apart from physical injuries such as anxiety, depression and loss of independence. Technological interventions to reduce the risk of falling aim to monitor automatically monitor bed-exit events and subsequently alert healthcare personnel to provide timely supervisions. In that sense, the present work proposes an innovative IoT-based system for detecting falls of elderly people in indoor environments, which takes advantages of low-power wireless sensor networks and smart devices. For this purpose, we recognize the potential to employ a low resolution acceleration sensing modality in contrast to powering and sensing with a conventional MEMS (Micro Electro Mechanical System) accelerometer. A 3D-axis passive accelerometer with gyroscope embedded into a wearable sensor device is used, which is responsible for collecting data from movements of elderly people in real-time. The accelerometer data from the devices are continuously sent to a multithreaded server which hosts a pre- trained machine learning model that analyzes the data to determine whether a fall has occurred or not. Finally this system provides service built on cloud. If a fall is detected, an alert is activated and the system reacts automatically by sending notifications to the groups responsible for the care of the elderly people.

Index Terms **-** bed-exit events**,** 3D-axis accelerometer and gyroscope, IoT- based system, cloud.

I. INTRODUCTION

Approximately 30-50% of older people living in long-term care institutions fall each year [1]. The elderly make up a huge part of our society. Falling is the second leading cause of unintentional injury, death as an estimated 646,000 fatal falls occur over the world every year [2]. Falls are not caused by a single cause, 90% of them occurred from multiple factors. Additionally, people affected by Dementia and Parkinson have a higher risk to fall [3]. Human activity recognition (HAR) in the monitoring and tracking of human health is an interesting topic that has recently been growing within the research community, especially in the detection of falls among elderly people. Falls can cause injuries, bodily harm, fractures, etc. In fact, globally, falls are the second leading cause of unintentional injury and injury-related deaths among adults 65 years of age and older. There are many types of falls. That divides human falls by direction, namely, forward, backward and to the side [4]. Many of fall detection systems have been developed over the years. The developed systems can be divided into two categories: Surveillance-based fall detection and Wearable sensors-based fall detection. In Surveillance- based fall detection systems, cameras, depth cameras, range-Doppler radar, smart tiles, acoustic sensors, fiber optic sensors, infrared sensors, vibration detection sensors etc... have been used [4]. Mainly surveillance based fall detection system are complicated in installation process and have high storage device. Due to advances in micro electromechanical systems, various sensors such as accelerometers and gyroscopes have become very compact, and thus can be easily integrated into embedded systems and other portable devices [2]. The goal of this paper is to introduce a IoT based device-type invariant wearable fall detection system using an accelerometer that can provide real-time monitoring of a large population in a large-scale environment such as nursing homes, hospitals, retirement homes, etc [6][7].

II. RELATED WORK

We done the literature survey based on both surveillance based and wearable sensor based fall detection system, through this survey we identified both advantages and disadvantages of various models.

2.1 Vision based approach

The automatic recognition of human falls is currently an important topic of research for the computer vision and artificial intelligence communities [5]. In image analysis, vision-based approach for fall detection and classification systems due to the recent exponential increase in the use of cameras. It based on a 2D CNN inference method and multiple cameras. These techniques are considered robust and reliable solutions for detection and classification problems, mostly using convolutional neural networks (CNNs) [5]. Moreover, deep learning techniques have modernized vision-based approaches. The classic vision-based fall detection

and classification strategies consist of four phases shown in figure 2.1. The main disadvantage of vision based approach is required large storage device, difficult installation process and required high manufacturing cost. In the Privacy concern of old age people and women have more limitations.

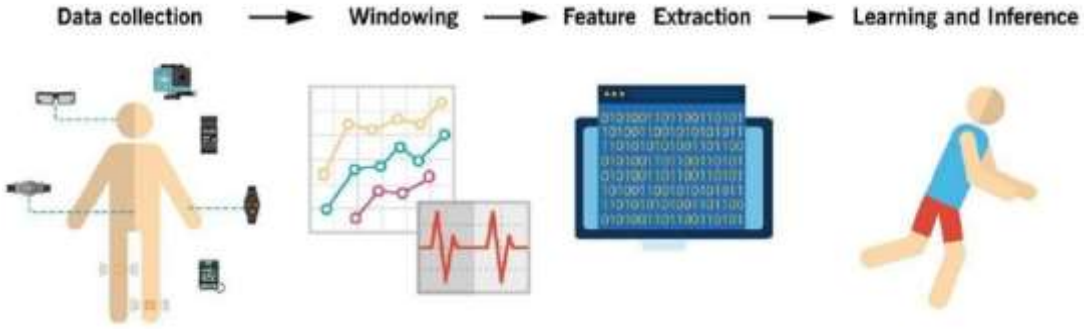

Fig 2.1 Traditional workflow for fall detection systems.

2.2 3D Skeleton for Deep Learning Technique

Compared with the traditional fall detection algorithm, the neural network method is more robust and has higher accuracy. In this paper, fall detection system in combination of the traditional algorithm with the neural network [9]. First, propose a skeleton information extraction algorithm, which transforms depth information into skeleton information and extracts the important joints related to fall activity. Also modified the skeleton-based method with seven highlight feature points. Second, proposed a highly robust deep convolution neural network architecture [9]. However neural network consumes a large amount of energy due to a lot of computations, and needs more memory to store parameters as compared to traditional algorithms. Figure 2.2. shows the over all method of 3D skeleton for deep learning technique.

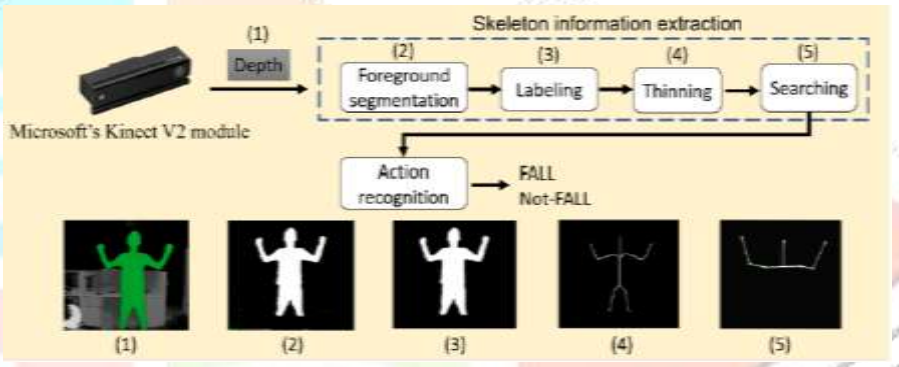

Fig 2.2. 3D skeleton for deep learning algorithm

2.3 Machine Learning Approach for Fall Detection Based on the Instantaneous Doppler Frequency.

This approach paves the way for the development of radio-frequency based fall detection systems, which do not require the user to wear any device and can detect falls without compromising the user's privacy [10]. Additionally, a novel method that accurately estimates the instantaneous Doppler frequency (IDF) from the complex path gain. Then, extract six features from the IDF and provide the feature vector as input to the classifier, which has to predict the user's activity. We assess the recognition accuracy of four different classification algorithms: K-nearest neighbors (KNN), decision tree, artificial neural network (ANN), and cubic support vector machine (SVM) [10]. It is very complex in algorithm of machine learning technique.

2.4 Proposed system

The fall detection system based on Embedded and IoT based Technology is proposed. 3-D accelerometer with gyroscope sensor used in the proposed system to detect the angle of position. Output of the sensor to the Node MCU microcontroller whenever the fall is detected. Controller output to the cloud and connected to smart phone of care taking persons and alerting them. Position of the patient can also be monitored periodically.

III. SYSTEM DESIGN

In this proposed system the block diagram (fig 3.1) shows the complete methodology of working.

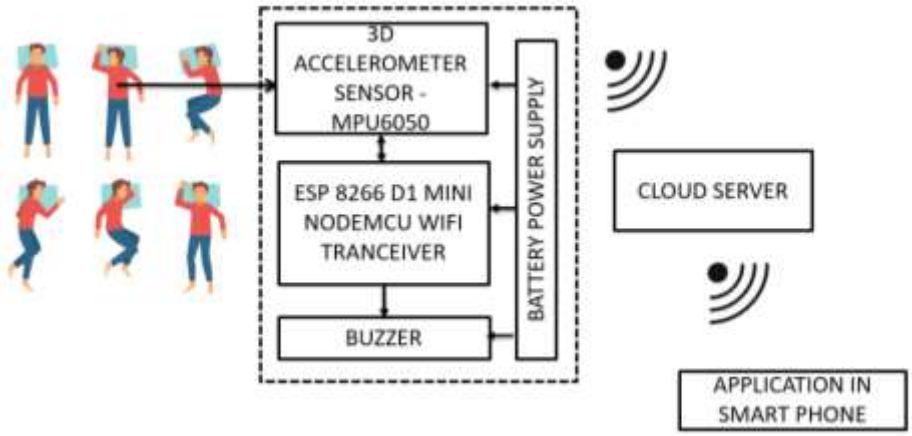

Fig 3.1

We recognize the potential to use a low resolution acceleration sensor to gather human motion information in contrast to powering and sensing with a conventional MEMS (Micro-Electro-Mechanical Systems) accelerometer[8]. An accelerometer is an electromechanical device which measures both gravity an motion or vibration. MEMS technology has modernized the original accelerometer applications, making them smaller, small power consumption and more accurate. MEMS accelerometers may be found not only in industrial and mobile applications, but also extended to safety critical aeronautical instruments, tactical guidance systems. MPU 6050 parts are the world's first motion tracking device is shown in fig 3.2

Fig 3.2 MPU 6050

This device includes both 3-axis accelerometer and 3-axis gyroscope sensor on the same silicon die, together with onboard digital motion processor, which process complex 6-axis motion fusion algorithms. The device can access external magnetometers or other sensor through an auxiliary master an auxiliary master I2C bus, allowing the devices to gather a full set of sensor data without intervention from the system processor.

NodeMCU Esp8266 D1 Mini NodeMCU Wifi Development Board (fig3.3) is an Arduino Compatible mini wifi board with 4MB flash based on ESP8266EX. The board is made of 11 digital input/output pins, all pins have interrupt or PWM or I2C one-wire supported(except D0) 1 analog input(3.3V max input) and a Micro USB connection. Through serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays etc.

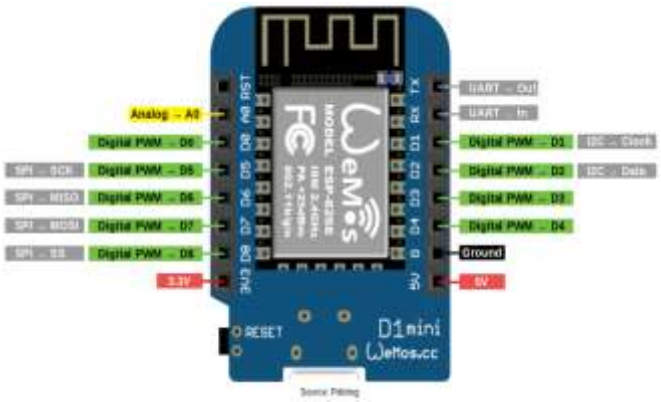

Fig 3.3 ESP 8266 D1 Mini NodeMCU wifi transceiver

It is another way of developing NodeMCU with a well-known IDE i.e. Arduino IDE. We can also develop applications for NodeMCU using Arduino development environment. It makes easy for Arduino developers than learning new language and IDE for NodeMCU. D1 mini is an ESP8266 development board that is small, versatile and easy to use in Arduino IDE.

XAMPP abbreviate as Cross-Platform (X), Apache (A), MySQL (M), PHP (P) and Perl (P). It is a simple and Apache distribution that makes it very easy for developers to create a local web server for testing purposes. XAMPP is a very easy to install for Linux, Solaris, Windows, and Mac OS X. The package consist of Apache web server, MySQL, PHP, Perl, a FTP server and phpMyAdmin. By using MySQL the database of the patient can analyzed .Android studio is the official IDE for google's android operating system.

It is available available for download on windows, macOS and Linux based operating systems. In this environment we can create a customized application for an android operating system

IV. WORK FLOW

The design model and work flow can be shown in flow chat fig 4.1

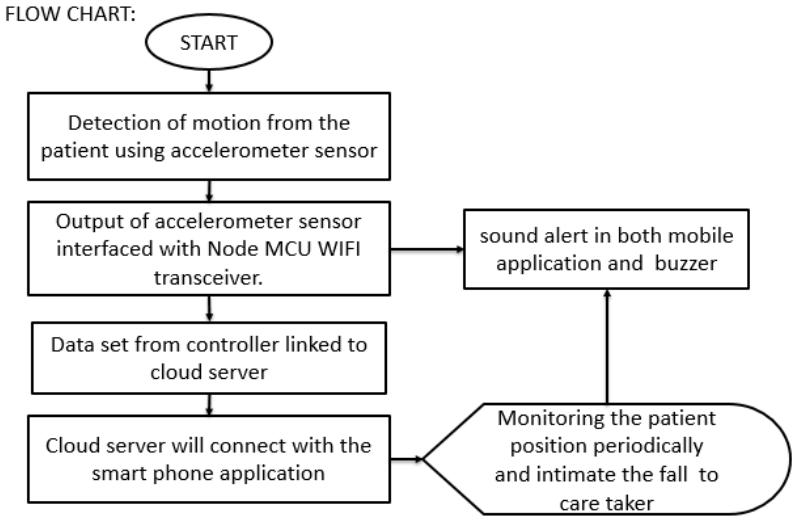

Fig 4.1

4.1 Collection of data

The position and acceleration of the people can be sense by MPU 6050 sensor. Sensor gives the output of angle and acceleration. Different position of the bed ridden can be sense placing the sensor in fixed position. According to different time interval angle and the acceleration can gets output.

4.2 Transmission of data

Raw data from the MPU 6050 Sensor can be interface with the ESP8266 D1 Mini NodeMCU wifi transceiver through I2C protocol. Using Internet transmission of data from the MPU 6050 to cloud server. ESP8266 can be able to interface with buzzer, magnetometer etc..

4.3 Creating the database in cloud server

Continues Different samples can be arranged into a database with the help of XAMPP MySQL module. Through that database threshold value of the angle and acceleration can be identified. Finally it involves IoT environment.

4.4 Alerting caretaking person

Android application can be developed in the android studio and customized according to continuous monitoring of the patient activity and it is shown is fig 4.2

Fig4.2

Once the acceleration reaches the threshold, alert is created as notification in the application. Sudden intimation can be created by the interface buzzer with NodeMCU. Through this integration we can safeguard the fall of bed ridden people.

V. HARDWARE IMPLEMENTATION

Connection of hardware components shows in fig 5.1

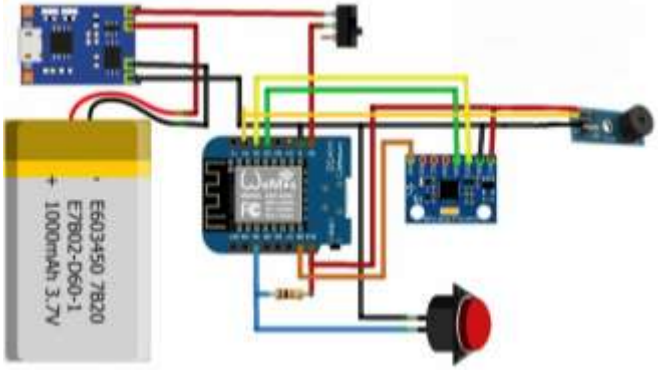

Fig 5.1 circuit connection diagram.

Initially the voltage can be given to all the hardware from the regulated power supply. The acceleration and angle is sense in MPU6050 by giving clock signal. The data can be transferred from MPU6050 to NodeMCU. The press button is interface to NodeMCU in the accidental situation. Normal switch is connected to initial power supply is to off the circuit. Buzzer is also interface NodeMCU module. Due to compact size of MPU6050 AND NodeMCU can easily fabricated in printed circuit board.

VI. OUTCOMES AND CONCLUSION

A compact, cost-effective and wearable RFID Tag based wireless fall detection system is designed for enhanced fall detection and preventive system. Patient data is transmitted in real time to the mobile or PC, thus enabling caretakers to remotely monitor patient status and receive notifications when falls occur. Once the notification is received, we can alert the caretaking person of the patient.

Due to compact size of components and easy fabrication, this module will be designed as prototype for smart device. It is mainly low power consumption, low frequency range, and adapt to any environment. This device is testing in the real world as well as the acceptability of these devices to older adults.

Applications

- This fall detection methodology can be mainly implemented for the bed ridden people.
- Hospitalized patient.
- Old age home people.
- Small children on bed.

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