FALL DETECTION SYSTEM

SMART HEALTH CARE

19CSE446-INTERNET OF THINGS-USE CASE

Submitted by

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ABSTRACT

This project is an IOT-based Fall Detection and alarming system. This system helps people especially of age 65 and above, where injuries caused by fall can sometimes be fatal. Hence, our goal is to design a system with NodeMCU8266 which is a microcontroller, an accelerometer which is used to get data from a person's movements, and buzzers. If a fall is detected, notifications are sent to the group of people who are concerned with the person. Hence, a fall detection system will help in the reduction in the fear of falling and the rapid provision of assistance after a fall.

PROBLEM STATEMENT AND DELIVERABLE

Problem Statement

Fall detection system detects when a person falls and sends notification to the concerned person which will be pre-decided. This is mainly for old people. So, when a fall is detected an SMS will be sent to the concerned person and that person can call back or reply accordingly.

Deliverable

a. Hardware
   - NodeMCU ESP8266
   - MPU6050 Accelerometer
   - Buzzer
   - Connecting Wires

b. Integration Part
   - Cloud

c. Analytics
   - BigData

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CHAPTER-1

INTRODUCTION

The idea of a fall detection system has been inspired due to the fact that elderly people are dying and getting critically injured due to falling. According to the WHO, approximately 30% of the people over 65 accidentally suffer one or more falls per year, and for the people over 80 years this rate increases to reach 50%. Most of the elderly people are suffering from joint pain, back pain, knee pain etc. Moreover, some of them are confined to bed as they are not able to walk. The falling of elderly people is becoming more common when their power decreases due to aging. So, we have planned to design a system which would be helpful in such a situation. It can be mounted on persons hand or wheelchair for detection. The sensor is connected to a microcontroller in order to constantly transmit the acceleration data. Now the system keeps monitoring for fall detection and abrupt movement changes in person. A sudden abrupt change with jerk in the system is treated as a fall. Our objective is to build a system which detects the sudden fall of a person, and sends a message to the concerned person so that they can take action immediately. The project is to use an accelerometer for the problem statement, detect the fall and notify the concerned group of persons.

CHAPTER-2

LITERATURE SURVEY

Paper 1: FALL DETECTION SYSTEM FOR ELDERLY PEOPLE USING IOT AND BIG DATA

Falls represent a major public health risk worldwide for the elderly people. A fall not assisted in time can cause functional impairment in an elder and a significant decrease in his mobility, independence and life quality. In that sense, the present work proposes an innovative IoT-based system for detecting falls of elderly people in indoor environments, which takes advantage of low-power wireless sensor networks, smart devices, big data and cloud computing. For this purpose, a 3D-axis accelerometer embedded into a 6LowPAN device wearable is used, which is responsible for collecting data from movements of elderly people in real-time. To provide high efficiency in fall detection, the sensor readings are processed and analyzed using a decision trees-based Big Data model running on a Smart IoT Gateway. 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. Finally, the system provides services built on the cloud. From a medical perspective, there is a storage service that enables healthcare professionals to access falls data to perform further analysis. On the other hand, the system provides a service leveraging this data to create a new machine learning model each time a fall is detected. The results of experiments have shown high success rates in fall detection in terms of accuracy, precision and gain.

Paper 2: AN IoT- BASED WEARABLE FALL DETECTION SYSTEM

Falls are a major public health problem. We know that falls are dangerous, especially for older adults. Although it is not possible to prevent all falls it is possible to take actions that will reduce the chances of a bad fall. So, an IoT based patient specific fall detection prototype system for elderly people is proposed. This is a wearable device that mainly uses

a single triaxial accelerometer sensor attached to the person's body to distinguish between the activities of daily living and fall events. Other sensors used in the device also measure some vitals of the person such as body temperature, pulse rate, ECG etc., The design and implementation of the product combines both hardware and software that work continuously in detecting and reporting a fall. The system is able to detect and report the falling incident to the contact person and also to the concerned hospital via an auto generated message so that necessary medical treatment can be provided to the injured person as soon as possible. The Accelerometer can measure the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock or vibration. ADXL335 is a 3-axis analog output accelerometer with a ±3g measurement range. It contains predetermined threshold axis values. Whenever the acceleration of the body exceeds this threshold value, the fall is detected. It reads off the x, y and z acceleration as analog voltages. The Temperature Sensor LM35 device is related to operating over a -55ºc to 150ºc temperature range. People who fall will definitely experience temperature variation. The LM35 detects that variation. The AD8232 module is a neat and little chip used to measure the electrical activity of the heat. It records the fall victim's ECG variations. The Wi-Fi module, ESP8266, is used in this device that helps to transfer the data through IoT. A Buzzer is used in this device in order to produce an alarm if a person fell down and this alarm produced will help the person to be noticed by nearby ones, getting noticed is important to the fallen person that he will get external help from others, hence he can avoid a dangerous situation.

Paper3: IOT-BASED HUMAN FALL DETECTION SYSTEM

Human falls are an issue that especially affects elderly people, resulting in permanent disabilities or even in the person’s death. Preventing human falls is a social desire, but it is almost impossible to achieve because it is not possible to ensure full prevention. A possible solution is the detection of human falls in near real-time so that help can quickly be provided. This has the potential to greatly reduce the severity of the fall in long-term health consequences. This work proposes a solution based on the internet of things devices

installed in people's homes. The proposed non-wearable solution is non-intrusive and can be deployed not only in homes but also in hospitals, rehabilitation facilities, and elderly homes. The solution uses a three-layered computation architecture composed of edge, fog, and cloud. A mathematical model using the Morlet wavelet and an artificial intelligence model using artificial neural networks are used for human fall classification; both approaches are compared. The results showed that the combination of both models is possible and brings benefits to the system, achieving an accuracy of 92.5% without false negatives.

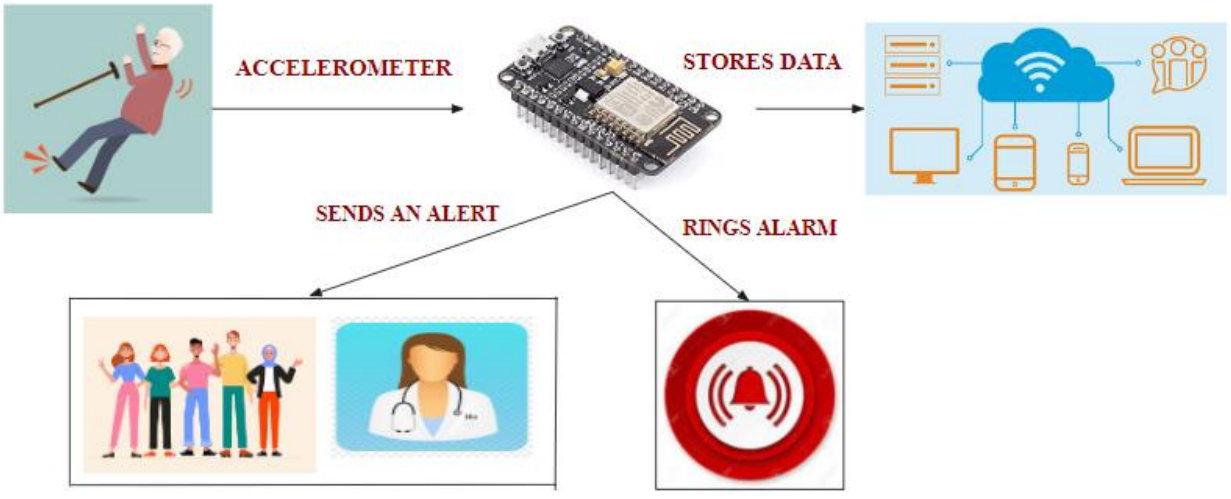
S.No	Hardware	Sensors used	Integration part (cloud, etc..)	Analytics	If any remarks
Paper1	A wearable device, wireless communication network	3D-axis accelerometer,	Cloud	Big Data	-
Paper2	A wearable device, Atmega2560, ESP8266	Triaxial Accelerometer (ADXL335), LM35, AD8232,	Cloud	Big Data	-
Paper 3	A wearable device, ESP32	MPU-9250 accelerometer, a GY-521 accelerometer, and an HB-100 Doppler sensor	Cloud	Big Data	-

CHAPTER 3
PROPOSED WORK

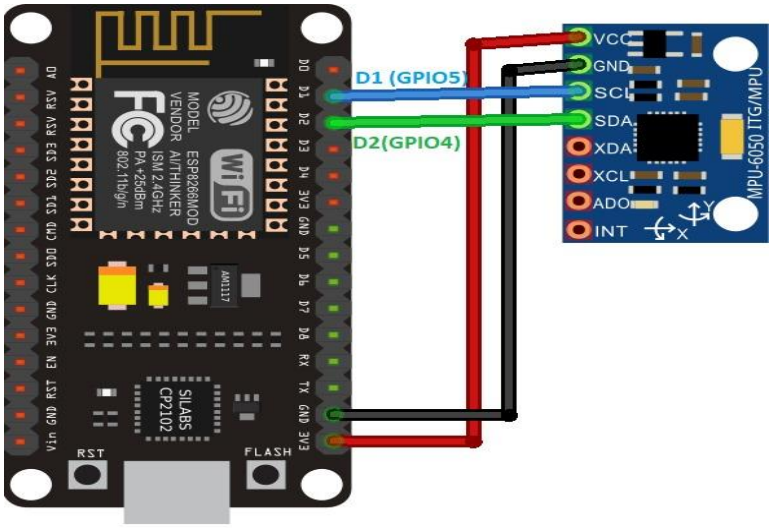
A. Problem Definition

The problem of elderly or sick people's fall will be detected in the project. A fall can be fatal at times. It is a serious issue. We solve this problem with the use of IOT devices like ESP8266, MPU6050 and some connecting wires. An accelerometer to detect the fall, send data via ESP8266 and receive notification via IFTTT-Webhooks.

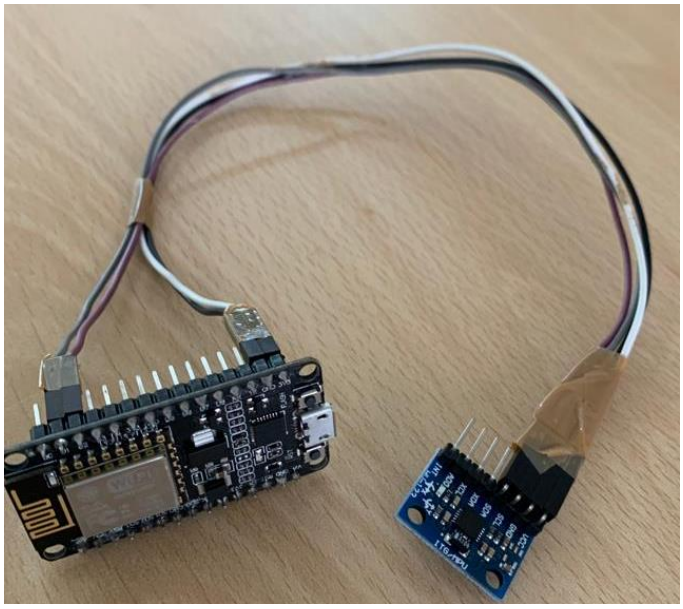
B. Architecture Diagram



C. Schematic Diagram



D. Proof of Concept Design Diagram



Our IOT project follows the **Level-2 System.**Since it is based on cloud and Local system monitoring.

CHAPTER 4

RESULTS AND INFERENCES

We developed a fall detection system based on a single triaxial accelerometer based wearable device. There is no special requirement of the device's mounting orientation because the algorithm does not claim the axes of the accelerometer to be fixed strictly. The system has a low power consumption hardware design and highly efficient algorithm which could extend the service time of the wearable device. Both the hardware and software designs are suitable for wearable and outdoor applications.

As the normal activity of resting also has a similar rotation as falling, it may trigger a fall alarm when the body hits the ground heavily. So the choice of is quite important to distinguish falling from heavily lying activity. Sufficient sample numbers collected from subjects with different age and gender will improve the reliability and robustness of the threshold.

CHAPTER 5

CONCLUSION AND FUTURE ENHANCEMENTS

We have built a fall-detection system which detects a fall and sends a message and calls the corresponding phone number which they have registered.

Future Enhancements:

We can also include a buzzer and make a miniature version so that it can be embedded into a watch or a belt. We can also include a GPS tracking facility in it using ThingSpeak. It can be a wearable product which is portable everywhere.

CHAPTER 6

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