Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 17412-17418
Received 25 April 2021; Accepted 08 May 2021.

AN IoT BASED INTELLIGENT FALL DETECTION AND HEALTH MONITORING SYSTEM

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ABSTRACT

The project is to design and construct AN IOT BASED INTELIIGENT FALL DETECTION AND HEALTH MONITORING SYSTEM for humas which is used for real time monitoring to monitor human life conditions such as heart rate, blood oxygen (SpO2) and ECG etc. The main objective of this project is to provide real time monitoring of the fall detection and health monitoring system. By using this device, we can notify our family members or concerned person whenever the device detects any fall, so that we can reduce the risk in delayed medical attention.

Keywords
Arduino IDE, Blynk Application

Introduction

According to survey conducted in india there were 103 million elderly people and in future it may grow up to 170 million. We can see most of the elderly people feel alone at their home because everyine will be busy with their work and doesn't check up on their health properly. Now a days many deaths of elderly people are due to disorder in blood circulation due to shock or fall and even death leads when there is no proper medical treatment given to them or due to negligence.There is an evidence that about one fourth of elderly people fall and feel sick and all of them are the people who leave alone at their home. There are more chances of admitting in hospitals or even death. To avoid these problems we must use early fall detection which prevents injuries and death. It immediately sends information to amublance and alerts police which can reduce deaths and severe injuries.

In today's world, IoT is one of the inclining technology used largely in all sectors, we have to say it became more important. Interestingly, IoT is succeeded in various health sectors to solve nowadays problems. We can see the growth and usage of smartphone which is faster wireless connection boots IoT.

Literature Review

A. Elderly Health

As age increases, it becomes more difficult to look of their health for elderly people. As we have seen 42% of total death is caused by Cardiovascular health related problems like blood circulation system disorder, heart attacks, etc. The major reason behind this health problems includes hypertension and heart failure. Some important indicators which monitor cardiovascular related health problems are temperature, blood pressure, heart rate, ECG, blood oxygen. The most common blood circulation disorder can be due to muscle cramps or due to high blood

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pressure. In such conditions we can provide the immediate medical treatment to that elder person. In case if the family members are not available, if no real-time information is provided then it leads to death, so there is need of real-time system to monitor the health condition.

B. Mobile Applications

Most of the people use two types of smartphones, Android and iOS. Application Programming Interface (API) is used as a mobile application development, it acts as intermediary which allows two applications to communicate to each other. There are many developing tools such as API and another technology in real-time cloud database, to provide real time access to different platforms and one of the advantage is that it can work offline and after reconnecting to internet it can store data in device memory. Google Firebase is one of the Example, it offers online data base for JSON data type in tree structure.

C. IoT (Internet of Things)

IoT is creation of innovative applications, it is internet connected objects which are used to collect and transfer the information or data through wireless network without any human involvement. IoT is describes the various network of physical objects that are embedded with sensors. IoT is used to exchange the data and collect data is the main thing which supports IoT development. IoT can be used in health sector where patient condition can be monitored and quick action could be taken. Through IoT in health sector we can improve organizational processes, safety and quality life of patient. IoT is used to build an smart home like if person is about to come home in 10-15 minutes, Air conditioners will be on and make the room temperature comfortable to the person. Here in the example according to persons tracking the devices at his home got activated, these all are connected through IoT.

Table 1. Health Indicator Analysis

Indicator	Explanation
Fall Detection	Fall is unpredictable, as the elderly people would be much affected, we need to be more careful. Fall- detector consist of integrated gyro with accelerator sensors can be placed anywhere on body. In health-monitor fall is major factor and it is one of the system functions for most of the studies related to elderly monitoring.
Heart Rate	Heart rate is a fundamental parameter to judge human body fitness, it is measure of the rate of heart-beat. Main objective of heart rate in this project is to monitor the risk of heart attack and also the regular checkup.
Blood Oxygen level	Blood oxygen level tells amount of oxy-gen circulating in the blood. The blood oxygen levels ranging between 75 and 100 milli

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	meters of mercury indicates normal condition.

Some the hardware and software which are used to develop this system are

1.Node MCU
Node MCU is a single-board microcontroller, it is a low-cost IoT platform. It is built-in ESP8266 and has 11 digital and 1 Analog pin, 128k bytes memory, 4Mbytes of storage. The Node MCU is of 48.3mm x 25.4mm dimension. It operates with power source 3,3V, 10uA~170mA, with clock speed of 80-160MHz.

2.MAX30100
This sensor integrated with pulse oximeter and heart-rate detector. It operates with power supply ranging between 1.8v and 3.3v, it is having 5.6mm x 1.2mm tiny dimension with 14-pin system in package. By using combination of infrared, red LEDs and photodetector we can detect pulse and heart signals.

3.ECG Sensor
Electrocardiogram (ECG) is used in non-invasive test for diagnosis of cardiac rhythm, irregular heart rhythm of heart beat measured in terms of Heart Rate Variability.

4.Tilt Sensor
This sensor is an electronic device which used to detect the object orientation. It is mercury switch based module and operates with DC input of 5v. It has three terminals input, output and ground. Based on the object orientation the output would be high or low.

5. Pulse Oximeter
Pulse Oximeter is used to measure oxygen saturation level in our blood, it is mainly used to check how good our heart pumping oxygen. This device can be attached to body part, like toes and earlobe. It is small, clip-like device most commonly put on a finger.

6.GPS
Global Positioning System (GPS) is used to track the local of the patient or the person, in our case the person whose fall has been detected. GPS is a Satellite based radionavigation system, so that we can easily detect the person where ever on the earth.

7. Arduino IDE
The Arduino tool is used to make and upload suitable program in to an Arduino micro controller, it is a single-board microcontroller. This tool is having direct Connectivity to online library, serial monitor, text editor. The micro controller can programme using languages like C and C++.

Cloud.8
Blynk app IoT platform is customized with private cloud, mobile apps and device management analytics dashboard. By just adjusting sliders, buttons, graphs and alternative widgets on screen

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we can easily design an dashboard on Blynk app for an IoT project. In our project patients heart rate, blood oxygen level and temperature change is monitored continuously wherever we are.

9. Display

Here we are using OLED display module to display the person blood oxygen level, heart rate. All these hardware and software are used to implement the system.

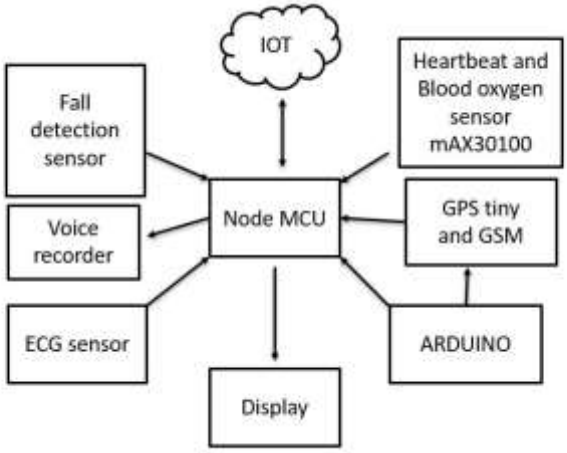

Figure 1. Hardware Design

Results and Discussion

A. Wearable Device

In the past decade years ago, we can see there is a rapid increase of people using wearable devices. We can predict up to 324 million in 2015 to 900 million in 2020. It became the most popular of wearing wrist watches. The most common sensors inside wrist watches is 3-Axis Accelerometer, which can be found in almost all trackers. They are also suitable for various applications. Humans perform many physical activities such as eating, jogging, studying, work, climbing steps etc, these all activities can be shown in wrist watches. This information is stored in cloud and displays on mobile when connected to wearable device.

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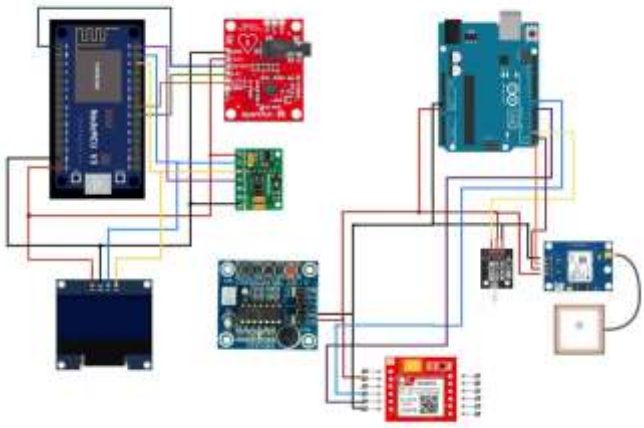

Figure 2. Wearable Device

Server and Dtatabase .B

Falling are of 5 types forward, backward, left-side, right side and center. Forward falling is the one which falls on front side with face down and hands in normal position. Backward falling is like fall to back with supine position. left falling falls on left side and ending up with sideways lying position where as right side falls on right side. Center falling points to center down direction. Each fall has 30sec interval in between them. Subjects also asked to do five kinds of activities so that there we can ensure that there is no false notification, the five kinds of activities are Sitting, Drinking, raising hands, Squat, Stretching arms.

C. Mobile Application

Application used is Blynk app it is build using Android studio, supporting libraries. Heart rate and blood oxygen levels are shown in this application. In the main page we can able to see the summary of health data and heart rate, along with this feature, by using this application if we detect any abnormal health condition, we can send notification as a sign.

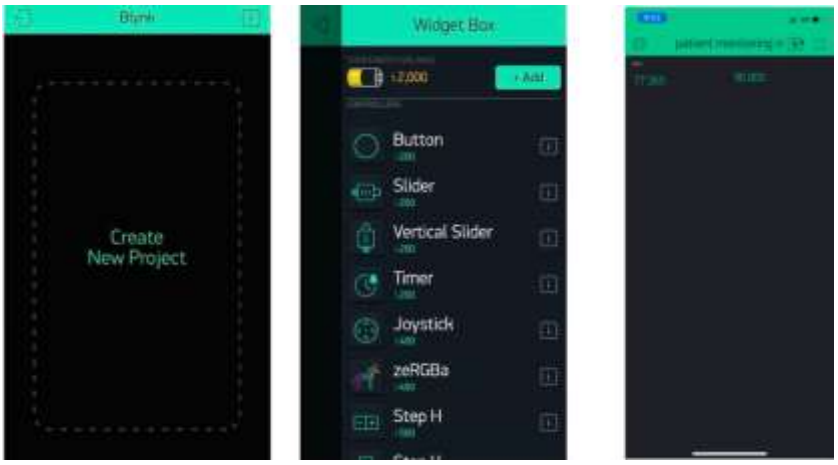

Figure 3. Mobile Applications

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D. Fall Detection Test Result

The test conducted in a room with 3x4 m dimension equipped by 120x200cm spring bed base for safety subjects during demonstrating fall conditions.

Table 2. Fall detection test result

Test Subject	Fall Detected	False Notification
1	3	3
2	5	5
3	7	7
4	10	10

E. Heart Rate Monitoring Test Result

For every 5 minutes test is conducted by using in sensor MAX30100. On the right wrist we are placing wearable device, on the left wrist we are placing IoT development kit.

Table 2. Heart Rate test result

No. Of Minutes	Pulse Rate	Blood Oxygen
1	81	96
2	95	96
3	77	98
4	83	96
5	73	98

Durability Testing .F

By performing Durability test we can calculate total time in which the system can stay online. If the average bpm ranges between 55-72 then it would be considered as quite stable. This device can be used for eight hours, within 6.5 hours this device can stay online and connected, it Achieves 81.25% targeted durability.

Conclusion

We provided methodology, procedure and algorithms regarding device like fall detection and health monitoring. This includes benefits like reducing clinical visits, length of stays in hospitals and sends alerts to elderly people. Using IoT, patient conditions are stored for further analysis. This research carried to develop an IoT based system which is used to monitor the elder people. Analysis, design, display, software implementation and testing all these stages are successfully done using IoT system development principles. The system has mobile application and OLED to

display the heart rate and blood oxygen levels and sends as notification of our health status. So that our family members gets notification, they can quickly respond. In this project we are monitoring Heart rate and blood oxygen levels.

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