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Research Paper

ADVANCED IOT BASED REMOTE HEALTH MONITORING SYSTEM USING WIFI AND ARDUINO

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ABSTRACT

Nowadays, automation and Internet of Things are changing the world. The day-by-day development of the Internet of Things causes a revolution in modern technology, which makes our life easier and automated. Internet of Things has provided a much easier solution for remote real-time health monitoring of patients from the hospital as well as home. Sensors acquire the data of various parameters regarding patients' health, and the Internet of Things stores that data and displays through the website, which provides access for remote monitoring. Use of Sensor reduces the human error, and the size of the system reduces the occupied space of the room. The unique part of this proposed solution is generation to provide the prescribed medicine to the patient in time. The other beneficial area of the system is the scheme of sending the notification through APP alert if any of the health parameters crosses the threshold value.

As elderly population increases day by day this automatically increases caretaking demands. Hence patient health monitoring systems are gaining importance in our day to day life. The system proposed in this paper is an advanced solution for monitoring the patients. We have designed and developed a genuine, patient monitoring system. It is capable to send parameters of a patient in a real time. It enables the doctors or a user to monitor patient's health parameters such as temperature and max3012, in real time. The current proposed system is using different sensors which are connected to the Arduino board. And the data received is then sent to the server using Ethernet shield which is attached to the Arduino board. If any of the parameters goes beyond the threshold value an alert is given to the doctor using WIFI module attached to Arduino board and the patient immediately from anywhere.

Keywords: microcontroller, Temperature sensor, pulse sensor, spo2, wifi.

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I. INTRODUCTION

1.1. INTRODUCTION TO THE PROJECT

In today's era, health problems are increasing day-by-day at a high pace. The death rate of 55.3 million people dying each year or 151,600 people dying each day or 6316 people dying each hour is a big issue for all over the world. Hence it is the need of hour to overcome such problems. We, therefore, proposing a change in wireless sensors technology by designing a system which included different wireless sensors to receive information with respective human body temperature, blood pressure, saline level, heart rate etc. that will be undoubtedly further transmitted on an IoT platform which is accessible by the user via internet.

An accessible database is created about patient's health history which can be further monitored & analyzed by the doctor if necessary. The data storage can be saved on the

server permanently or can be reset via the software. This project proposes a health monitoring system which is capable of detecting multiple parameters of our body such as blood pressure, temperature, heart rate, ECG & further transmitting this information on an IoT server through 2G/3G/4G GSM technologies. Also in case of emergency, automatically generating alerts will be sent to doctors and family members if any unusual activity is detected by or near the patient. A continuous record of body health parameters can be used to detect the disease in a more efficient manner. Now-a-days, people pay more attention towards prevention & early recognition of disease.

In addition to it, new generation mobile phones technologies & their services provides an important impact on the development of network varieties (3G, Bluetooth, wireless LAN, GSM) etc. Various sensors have been used like AD8232 ECG sensor for remote ECG monitoring, blood pressure sensor (4811) is used to measure systolic pressure and diastolic pressure & pulse rate for few seconds. LM35 temperature sensor is used to measure surface temperature of skin. Satisfactory work is done in health monitoring by using raspberry pi as well as IoT, but this project gives embedded concept of both the platform. By using combination of these, the proposed structure will be more effective. In this project, we investigated recent projects related to health monitoring systems & IoT. IoT is nothing but an advanced concept of ICT (Information Communication Technology).

IoT is the interconnecting of devices and services that reduces human intervention to live a better life. This project as showing the advancements in health care management technology, it would save patients from the future health problems that would arise and would also help doctors to take an appropriate measure or action at a proper time regarding patient's health.

IoT is the combination of embedded systems, sensors, software and this can be also referred to as internet of everything. A combination of embedded system, software and sensors is referred as Internet of Things. Since everyone is prone to health issues, a continuous health monitoring system in name of IoT can be used. The Home automation mainly focuses on comfort, security and to reduce man power. It includes centralized control of appliances, ventilation, lighting, heating and air conditioning, resource management systems such as energy and security systems. Since everyone is prone to health issues, a continuous health monitoring system in name of IoT can be used. As health is one of the most important issues nowadays, IoT could be utilized in the health industry as a continuous health monitoring system. At the same time, the internet is now easily available for mobile technologies, which makes remote observance in everything more popular. In this proposed system, patient's heart rate, body temperature, pulse rate and saline levels are measured. We have tried to develop a health monitoring system to acquire the data and share the information with the health units and relatives by remotely monitoring through the internet. For the security and safety issues, a role-based user authentication system is also available in the system to access the information. Also, the Arduino will be automatically controls the appliances according to the health condition of the patient.

II. LITERATURE REVIEW

Many researchers did their work on health monitoring system using IOT.M. Wcislik et al [2] monitors patient's body temperature, pulse rate, ECG wave and patient's body position using AR cortex M4F micro controller. Android app is created for monitor these values. Bluetooth connection is used for connecting microcontroller and Android phone. In my project monitor patient's body temperature,

Respiration rate, heart rate and body movements using Raspberry Pi board and sensors. Android app is support only android phones.

Bluetooth is very short distance for communication. It supports only within 100 meters. In my project webpage is created. Using IP address anybody can monitor patient's health status anywhere in the world.

Amir-Mohammad Rahmani et al [3] monitor ECG wave using panda board. Ethernet connection is used for connecting internet to the panda board. In my project monitor body temperature, Respiration rate, heart rate and body movements using Raspberry Pi board. Panda board is very difficult to operate compare to Raspberry Pi board. Ethernet connection is also very short distance. So i use USB modem for connecting internet to the Raspberry Pi board. Hoi Yan Tung [3] et al monitors body temperature, ECG, heart rate using DRZHG micro controller.

A Dual Radio ZigBee Homecare Gateway (DRZHG) has been proposed and implemented to support remote patient monitoring. The idea of remote patient monitoring is to simultaneously track the status of long-termpatients at home by using mobile medical sensors. The sensorscollect medical data from patients and feedback the data to thedoctors. Zigbee module is used for connected to the micro controller. Zigbee module is used for transfer the values to the receiver side. It is send data to only nearest place. But my project internet is connected to the Raspberry Pi board. So using IP address anybody can monitor patients health status anywhere in the world. Joao Martinhoa [4] et al describe the design and successful implementation of a remotely operated physiological monitoring device.

The prototype performs acquisition of three types of physiological measurements electrocardiography, finger photoplethysmography, and blood pressure plethysmography. Atmega 328 microcontroller is used for connecting these sensors. Wifi connection is used for connecting internet to the atmega 328 microcontroller. After connecting Wifi connection it will transfer the values. If wifi hotspot is no means it is not transfer the values. Wifi is also works on short distance. In my project USB modem is used for connecting internet to the Raspberry Pi board. So it is easily connect to the internet in any place

In the new era of communication and technology, the explosive growth of electronic devices, smart phones, and tablets which can be communicated physically or wirelessly has become the fundamental tool of daily life. The next generation of connected world is Internet of Things (IoT) which connects devices, sensors, appliances, vehicles and other "things". The things or objects may include the radio-frequency identification (RFID) tag, mobile phones, sensors, actuators and much more. With the help of IoT, we connect anything, access from anywhere and anytime, efficiently access any service and information about any object. The aim of IoT is to extend the benefits of the Internet with remote control ability, data sharing, constant connectivity and so on. Using an embedded sensor which is always on and collecting data, all the devices would be tied to local and global networks. The term Riot, often called Internet of everything, was 1st introduced by Kevin Ashton in 1999 who dreams a system where every physical object is connected using the Internet via ubiquitous sensors. The IoT technology can provide a large amount of data about human, objects, time and space. While combining the current Internet technology and IoT, provides a large amount of space and innovative service based on low-cost sensors and wireless communication. IPv6 and Cloud computing promote the development of integration of Internet and IoT. It is providing more possibilities for data collecting, data processing, port management and other new services. Every object which connects to IoT

requires a unique address or identification with IPv6. There are so many people in the world whose health may suffer because they do not have proper access to hospitals and health monitoring. Due to the latest technology, small wireless solutions which are connected to IoT can make it possible to monitor patients remotely instead of visiting the physical hospital. A variety of sensors which are attached to the body of a patient can be used to get health data securely, and the collected data can be analyzed (by applying some relevant algorithms) and sent to the server using different transmission media (3G/4G with base stations or Wi-Fi which is connected to the Internet). All the medical professionals can access and view the data, take decision accordingly to provide services remotely with the passage of time and development of society; people recognize that health is the basic condition of promoting economic development. Some people say that existing public health service and its supportability have been greatly challenged with respect to time.

III. DESIGN OF HARDWARE

This chapter briefly explains about the hardware implementation of health monitoring systems using iot and raspberry pi. It discusses the circuit diagram of each module in detail. For implementing the health diagnosis system, there is a need of essential components that are suitable and manipulate health problems. The components use generally includes temperature sensor LM-35, blood pressure sensor, heartbeat sensor, WIFI, BUZZER.

Heartbeat Sensor

It is used to measure the heartbeat of the patient. It gives a digital output of heart beat when a finger is placed on it. It is compressed in size. The working voltage of heart beat sensor is +5V DC. It works on the principle of light modulation by blood flow through finger at each pulse. Heart beat sensor is used to measure heart beat which normally lies between 60- 100bpm.

Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat LED flashes in unison with each heart beat. This digital output can be connected to microcontroller directly to measure the Beats Per Minute (BPM) rate. It works on the principle of light modulation by blood flow through finger at each pulse.

Features

- Heat beat indication by LED
- Instant output digital signal for directly connecting to microcontroller
- Compact Size
- Working Voltage +5V DC

FIG :Heart beat sensor

Pin Details Board has 3-pin connector for using the sensor. Details are marked on PCB as below. Pin Name Details 1 +5V Power supply Positive input, 2 OUT Active High output and 3 GND Power supply Ground.

Using the Sensor: Connect regulated DC power supply of 5 Volts. Black wire is Ground, Next middle wire is Brown which is output and Red wire is positive supply. These wires are also marked on PCB. To test sensor you only need power the sensor by connect two wires +5V and GND. You can leave the output wire as it is. When Beat LED is off the output is at 0V.Put finger on the marked position, and you can view the beat LED blinking on each heart beat. The output is active high for each beat and can be given directly to microcontroller for interfacing applications.

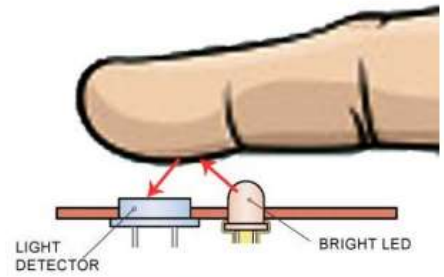


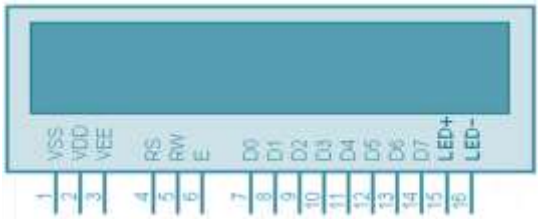
FIGURE 1 SENSOR PRINCIPLE

Fig: Sensor principle

Alphanumeric LCD

Liquid Crystal Display also called as LCD is very helpful in providing user interface as well as for debugging purpose. The most commonly used Character based LCDs are based on Hitachi's HD44780 controller or other which are compatible with HD44580. The most commonly used LCDs found in the market today are 1 Line, 2 Line or 4 Line LCDs which have only 1 controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2 HD44780 controllers.

Pin Description



Sending Commands to LCD

To send commands we simply need to select the command register. Everything is same as we have done in the initialization routine. But we will summarize the common steps and put them in a single subroutine. Following are the steps:

- move data to LCD port
- select command register
- select write operation
- send enable signal
- wait for LCD to process the command

Sending Data to LCD

To send data we simply need to select the data register. Everything is same as the command routine. Following are the steps:

- move data to LCD port
- select data register
- select write operation
- send enable signal
- wait for LCD to process the data

Arduino:

Arduino is an open source computer hardware and software company, project, and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form, or as do-it-yourself (DIY) kits.

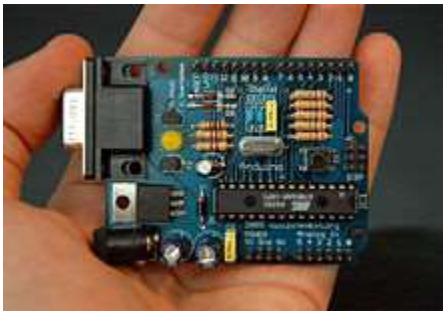
Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (*shields*) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus(USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

The Arduino project started in 2003 as a program for students at the Interaction Design Institute Ivrea in Ivrea, Italy,[2] aiming to provide a low-cost and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators.

Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduin of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

Although the hardware and software designs are freely available under copyleft licenses, the developers have requested the name *Arduino* to be exclusive to the official product and not be used for derived works without permission. The official policy document on use of the Arduino name emphasizes that the project is open to incorporating work by others into the official product.[22] Several Arduino-compatible products commercially released have avoided the project name by using various names ending in *-duino*.[23]



Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader.[28] Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic (TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips such as the FTDI FT232. Some boards, such as later-model Uno boards, substitute the FTDI chip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachable USB-to-serial adapter board or cable, Bluetooth or other methods. When used with traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-system programming (ISP) programming is used.

POWER SUPPLY:

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations or load variations is known as “Regulated D.C Power Supply”.

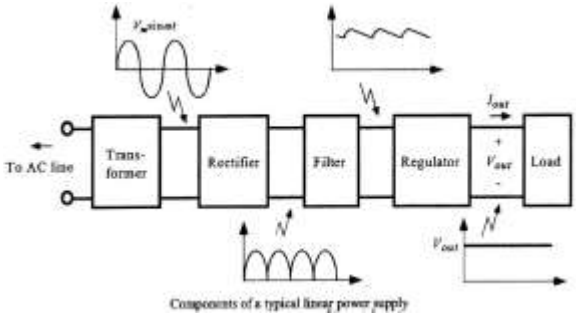


Fig: Block Diagram of Power Supply

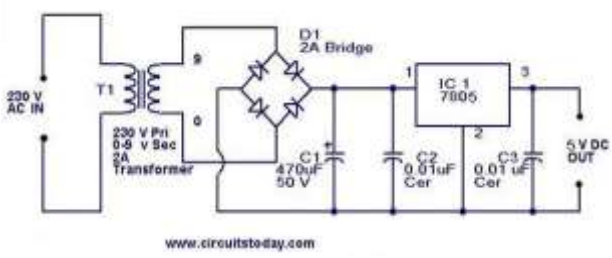


Fig: Schematic Diagram of Power Supply

TRANSFORMER:

A transformer is an electrical device which is used to convert electrical power from one Electrical circuit to another without change in frequency.

When AC is applied to the primary winding of the power transformer it can either be stepped down or up depending on the value of DC needed. In our circuit the transformer of 230v/12-0-12v is used to perform the step down operation where a 230V AC appears as 12V AC across the secondary winding.

RECTIFIER:

A circuit which is used to convert a.c to dc is known as RECTIFIER. The process of conversion a.c to d.c is called "rectification.

Bridge Rectifier:

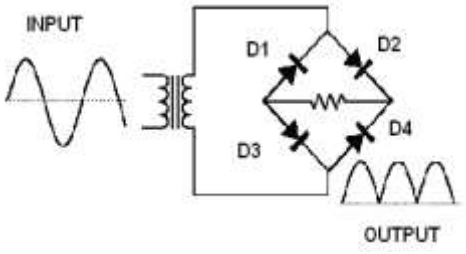


Fig: Bridge Rectifier

COMMUNICATION NETWORK

In health monitoring system, wireless network is used to forward measurement through a gateway towards cloud. The main network used here is IoT. The meaning of IoT is Internet of Things, simply called as Internet of everything. Different wireless communication technologies can be used for

(i) connecting the IoT device as local networks, and

(ii) connecting these local networks (or individual IoT devices) to the Internet. The connectivity technologies are NFC, Bluetooth, zigbee, cellular network etc. In this project, we use cellular network connectivity because of it has widespread mobile networks like 3G and LTE provide reliable high-speed connectivity to the Internet. However, they have a high power consumption profile and they are not suitable for M2M or local network communication [10].

ESP8266 WIFI

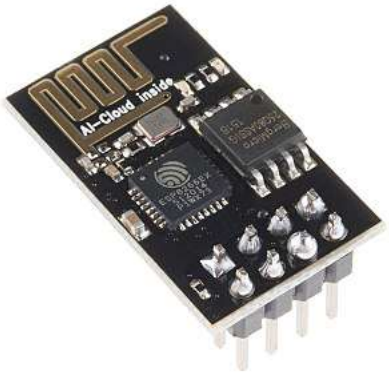
The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

The successor to these microcontroller chips is the ESP32.

ESP8266



ESP-01 module by Ai-Thinker

TEMPERATURE SENSOR (LM35):

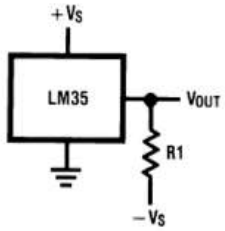
in order to monitor the temperature continuously and compare this with the set temperature preprogrammed in the microcontroller, initially this temperature value has to be read and fed to the microcontroller. This temperature value has to be sensed. Thus a sensor has to be used and the sensor used in this project is LM35. It converts temperature value into electrical signals.

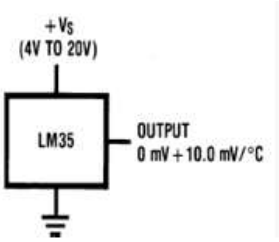
LM35 series sensors are precision integrated-circuit temperature sensors whose output voltage is linearly proportional to the Celsius temperature. The LM35 requires no external calibration since it is internally calibrated. . The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C over a full −55 to +150°C temperature range.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air.

Features

1. Calibrated directly in ° Celsius (Centigrade)
2. Linear + 10.0 mV/°C scale factor
3. 0.5°C accuracy guaranteed (at +25°C)
4. Rated for full −55° to +150°C range
5. Suitable for remote applications
6. Low cost due to wafer-level trimming
7. Operates from 4 to 30 volts
8. Less than 60 µA current drain
9. Low self-heating, 0.08°C in still air
10. Low impedance output, 0.1 W for 1 mA load





ROLE OF LM35:

In this project, the temperature is to be monitored continuously and if the temperature exceeds the set value preprogrammed in the microcontroller, a buzzer indication is provided in the circuit to alert the people in the industry to stop the process immediately. Thus the temperature sensor LM35 has to read the temperature continuously and the microcontroller has to compare this temperature value with the set temperature preprogrammed in it. When this temperature exceeds the set value, the microcontroller sends an indication to the buzzer which gives a loud noise.

IV. BLOCK DIAGRAM & WORKING

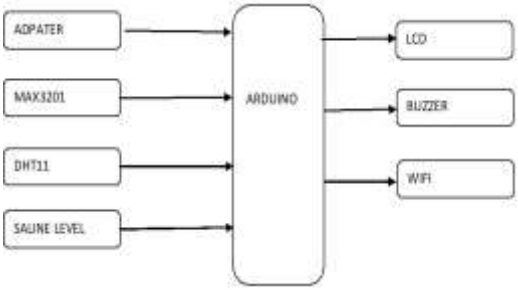


Fig: Block diagram

WORKING:

The system is classified into two parts, viz. Hardware & Software; whereas hardware unit consists of transmitter section and receiver section and software unit consists of software languages like C, c++, etc as well as their interfacing. Here we discuss IoT applications that are useful to health monitoring.

The general operation stages of an IoT application include

1) data acquisition,
2) data processing,
3) data storage, and
4) data transmission.

The first and last stages exist on every application, while the processing and storage may or may not exist in some applications [10].Here data acquisition is used as real-time raw data transmission, raw data transmission and real time on-board process. The energy consumption of data acquisition can be reduced with MEMS technology. Many IoT applications have the data sparsity property and can exploit the compressed sensing paradigm. In health monitoring applications and wireless body sensor network, compressed sensing has been investigated and studied extensively [12].

Energy efficiency in a processing unit can be achieved by

1) ultra-low power processors [13] and
2) efficiently customized co-processors [14].

An ultra low power near- threshold processor alongside with a high performance processor in addition to a task scheduling framework brings energy efficiency for IoT applications. Energy reduction in memory has received significant industrial and academic attention in embedded system design community [16], but there are some characteristics specific to IoT applications that can be exploited for further improvements in energy efficiency of memory in IoT embedded devices.

Data transmission can be improved by integrating radio transceivers into SoCs, providing low power multi-radio chips, etc. In order to reduce the amount of data to be stored or transmitted, new data compression techniques, especially for the streams of data, are needed [17]. Figure 2 shows a general architecture of the main components of an IoT SoC platform [16]. An IoT embedded device has many - if not most– of these components, e.g. at least one RF component for the connectivity.

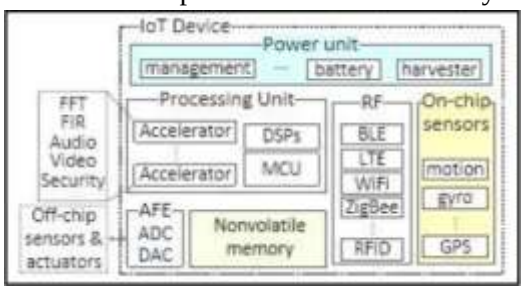


Fig. Architecture of IoT device

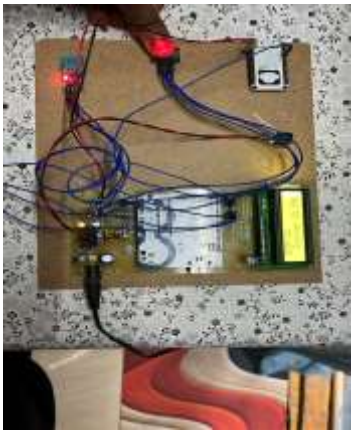
The system is divided into hardware and software section. Software is responsible for better working of the system, also for interfacing. Both sections work in parallel process. Hardware is again classified into transmitter section and receiver section. Implementation of transmitter is important part, because transmitter section is directly attached to the patient or human body.

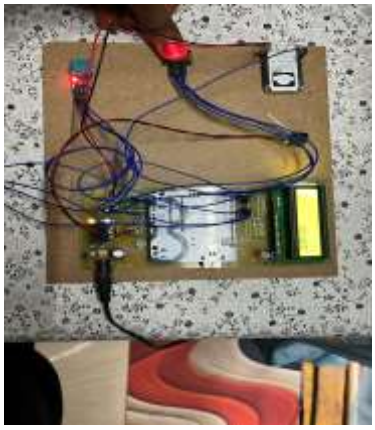
Arduino is a master device in proposed system; all the other devices like different sensors are connected to it. A DC power supply of 5V is provided for working of raspberry pi. IoT server is attached to the system; it allows the connectivity for data exchange with other devices. IoT allows connected objects to identify and control remote access across network. The

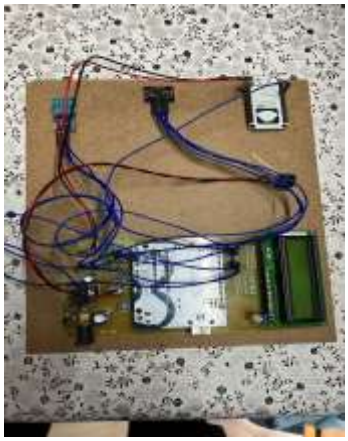
output of temperature sensor and heartbeat sensor is displayed on LCD at user end too. The output of ECG is sent to the receiver or doctor end. All the information is first acquired, processed and stored at memory of raspberry pi. The stored information is then transferred to the receiver by means of IoT server.

In this project, we have used an Arduino UNO microcontroller board to interface all the sensors. To measure the patient's vital parameters, temperature sensor (DHT11) and pulse rate sensor (KY039) are used. The data is collected by the sensors and passed to the microcontroller which is programmed to store the same onto the cloud. A WIFI module is used to send APP SMS alerts to the patient's doctor or guardian's smart phone in case of emergency. The data can be retrieved from the cloud for future treatment which is considered as the past history of the patient.

V. HARDWARE RESULTS







VI. CONCLUSION

In this project, we have analyzed ARDUINO based health monitoring system using IoT . Any abnormalities in the health conditions can be known directly and are informed to the particular person through WIFI technology or via internet. The proposed system is simple, power efficient and easy to understand. It acts as a connection between patient and doctor. The hardware for the project is implemented and the output results are verified successfully.

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