A Project Report

on

Remote Patient Monitoring

Submitted in partial fulfillment of the
requirement for the award of the degree of

B.Tech C.S.E

GALGOTIAS UNIVERSITY
(Established under Galgotias University Uttar Pradesh Act No. 14 of 2011)

Under The Supervision of
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CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the project, entitled **"REMOTE PATIENT MONITORING"** in partial fulfillment of the requirements for the award of the Bachelor of Technology in Computer Science and Engineering with Specilisation in Internet of Things and Bachelor of Technology in Computer Science and Engineering submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of July,2021 to December and 2021, under the supervision of Dr K.M. Baalamurugan (Assisstant Professor), Department of Computer Science and Engineering, of School of Computing Science and Engineering , Galgotias University, Greater Noida

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

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This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Supervisor Name

Designation

CERTIFICATE

The Final Project Viva-Voce examination of Aryan Mehortra,18SCSE1130002 and Eshanshi Tyagi,18SCSE1010181 has been held on 18-12-2021 and his/her work is recommended for the award of Bachelor of Technology in Computer Science and Engineering with Specialization in Internet of Things and Bachelor of Technology in Computer Science and Engineering respectively

Signature of Examiner(s) **Signature of Supervisor(s)**

Signature of Project Coordinator **Signature of Dean**

Date: December, 2021

Place: Greater Noida

Abstract

Healthcare is one of the field which needs to be advanced technologically as well because in covid outbreak everything which we had was less as compared to the level of outbreak. Devices for remote monitoring of patients have much greater advantage not only in these cases but normal cases of Surgeries as well. Following Any Surgical procedure, patients stay in ICU for some days for proper monitoring and once they are stable, they are shifted to normal ward. Where they are kept for further recovery. Usually the monitoring in these wards are not continuous and so there are chances of getting somethings not been taken care of. The paper is based on a low cost portable modular Internet of things device's prototype which can be used to offer continuous remote monitoring, for faster and better medical treatment in case of emergency or distant patients. It uses low cost sensors such as pulse sensor, temperature sensor and can be modified to use other sensors such as SPO2 sensor BP monitoring and movement too. It has a web based interface using RestFul APIs which provides easy extensibility and multi platform use of the devices. It will prompt the authority automatically if the health of patient degrades or any abnormality is detected, it will also save the reports for further future evaluation.

The Telemedicine system comprises of both hardware and software components at both the patient and doctor ends A leading field for application of telemedicine is in the field of cardiology where ECG is the major tool for diagnosis. The proposed project in this paper provides an image based techniques to acquire and analyse a constant streaming of ECG signal through digital camera for image capturing. information extraction and analysis performed using MATLAB tools as well as data sending system based on internet network. The method captures the vital signs and parameters from the ICU monitoring machine using a webcam and transmits the image through the internet. This original image is then availed to the consulting doctor via an ANDROID cell phone. In case of anomaly a notification is send to the doctor's phone. The paper proposes a method to capture, compare and generate alert regarding the patient's condition using the heart rate and make the captured image be available to the physician.

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Acronyms

B.Tech.	Bachelor of Technology
M.Tech.	Master of Technology
BCA	Bachelor of Computer Applications
MCA	Master of Computer Applications
B.Sc. (CS)	Bachelor of Science in Computer Science
M.Sc. (CS)	Master of Science in Computer Science
SCSE	School of Computing Science and Engineering

CHAPTER-1

Introduction

The main objective is to design a Patient Monitoring System to diagnose the healthcondition of the patients. Giving care and health assistance to the bed ridden patients atcritical stages with advanced medical facilities have become one of the major problems inthe modern hectic world. In hospitals where a large number of patients whose physicalconditions have to be monitored frequently as a part of diagnostic procedure the need for acost effective and fast responding alert mechanism is inevitable. Proper implementation of such systems can provide timely warnings to the medical staffs and doctors and their servicecan be activatedin case of medical emergencies. Present!day systems use sensors that are hardwired to a Patient to the bed. The use of sensors detects the conditions of the patient and the data is collected and transferred using a microcontroller. Doctors and nurses need to visit the patient frequently to examine his/her current condition. In addition to this use of multiplemicrocontroller based intelligent system provide high level applicability in hospitals wherea large number of patients have to be frequently monitored. For this here we use the idea of network technology with wireless applicability,providing each patient a unique system bywhich the doctor can easily identify the patient and his/her current status of health parameters. (sing the proposed system data can be sent wirelessly to the Central PatientMonitoring System) allowing continuous monitoring of the patient. Contributing accuracy in measurements and providing security in proper alert mechanism give this system a higher level of customer satisfaction and low cost implementation in hospitals. Thus the patient can engage in his daily activities in a comfortable atmosphere where distractions of hardwired sensors are not present. Physiological monitoring hardware can be easily implemented using simple interfaces of the sensors with a Microcontroller and can effectively be used for healthcare monitoring. This will allow development of such low cost devices based on natural human computer interfaces. The system we proposed here is efficient in monitoring the different physical parameters of many number bedridden patients and then in alerting the concerned medical authorities if these parameters bounce above its predefined critical values. Thus remote monitoring and control refers to a field of industrial automation that is entering a new era with the development of wireless sensing devices.

CHAPTER 2

LITERATURE SURVEY

Daily monitoring of health condition at home is important for an effective scheme for earlydiagnosis treatment and prevention of lifestyle!related diseases such as adiposis diabetesand cardiovascular diseases. 2hile a number of commercially available devices for homehealth care monitoring are widely used those are actually cumbersome in terms of self!attachment of biological sensors and self!operation of them. &rom this viewpoint we have been developing a non!conscious physiological monitoring system without attachment of anysensors to the human body as well as any operations for the measurement. 2e developedsome devices installed in a toilet a bath and a bed and showed their high measurement precision by comparison with simultaneous recordings of ordinary biological sensorsdirectly attached to the body. In order to investigate those applicability to the healthcondition monitoring we developed a monitoring system in combination with all of themonitoring devices at hospital rooms and previously carried out the measurements of patients3 healthcondition. &urther in this study the health conditions were measured in +4 patients withcardiovascular disease or sleep disorder. &rom these results the patients3 health conditionssuch as the body and e#cretion weight in the toilet the 1"G during ta'ing the bath and the pulse and respiration rate during sleeping were successfully monitored in the hospital room demonstrating its usefulness for monitoring the health condition of the subjects withcardiovascular disease or sleep disorder.

2.1. Development and Clinical Evaluation of a Home Healthcare System Measuring in Toilet, Bathtub and Bed without Attachment of Any Biological Sensors

Daily monitoring of health condition at home is important for an effective scheme for early diagnosis, treatment and prevention of lifestyle-related diseases such as adiposis, diabetes and cardiovascular diseases. While a number of commercially available devices for home health care monitoring are widely used, those are actually cumbersome in terms of self- attachment of biological sensors and self-operation of them. From this viewpoint, we have been developing a non-conscious physiological monitoring system without attachment of any sensors to the human body as well as any operations for the measurement. We developed some devices installed in a toilet, a bath, and a bed and showed their high measurement precision by comparison with simultaneous recordings of ordinary biological sensors direcdy attached to the body. In order to investigate those applicability to the health condition monitoring, we developed a monitoring system in combination with all of the monitoring devices at hospital rooms and previously carried out the measurements of patients' health condition. Further in this study, the health conditions were measured in 10 patients with cardiovascular disease or sleep disorder. From these results, the patients' health conditions such as the body and excretion weight in the toilet, the ECG during taking the bath and the pulse and respiration rate during sleeping were successfully monitored in the hospital room, demonstrating its usefulness for monitoring the health condition of the subjects with cardiovascular disease or sleep disorder.

2.2 INTELLIGENT WIRELESS MOBILE PATIENT MONITORING SYSTEM

Nowadays, Heart related diseases are on the rise. Cardiac arrest is quoted as the major contributor to sudden and unexpected death rate in the modern stress filled lifestyle around the globe. A system that warns the person about the oset of the disease earlier automatically will be a boon to the society. This is achievable by deploying advances in wireless technology to the existing patient monitoring system. This paper proposes the development of a module that provides mobility to the doctor and the patient, by adopting a simple and popular technique, detecting the abnormalities in the bio signal of the patient in advance and sending an alert sms to the doctor through Global system for Mobile(GSM) thereby taking suitable precautionary measures thus reducing the critical level of the patient. Worldwide surveys conducted by World Health Organization (WHO) have confirmed that the heart related diseases are on the rise. Many of the cardiac related problems are attributed to the modern lifestyles, food habits, obesity, smoking, tobacco chewing and lack of physical exercises etc. The post-operative patients can develop complications once they are discharged from the hospital. In some patients the cardiac problems may reoccur, when they start doing their routine work. Hence the ECG of such patients needs to be monitored for some time after their treatment. This helps in diagnosing the improper functioning of the heart and take precautions.. Some of these lives can often be saved if acute care and cardiac surgery is provided within the so-called golden hour. So the need for advice on first hand medical attention and promotion of good health by patient monitoring and follow-up becomes inevitable. Hence, patients who are at risk require that their cardiac health to be monitored frequently whether they are indoorsS or outdoors so that emergency treatment is possible. Telemedicine is widely considered to be part of the inevitable future of the modem practice of medicine.

2.3 The real-time monitoring system for in-patient based on Zigbee

The paper introduces a real-time monitoring system for in-patient. The system is made up of two sub-systems: patient physical states data acquisition and communication system based on Zigbee technology, and hospital monitoring and control centre. The patient physical states data acquisition and communication system monitors the main physical parameters and movement status continuously. The information from data acquisition system is sent too hospital monitoring centre by Zigbee wireless communication module. The monitoring centre receives the information from each patient and save them to database, and then judges the states of patient by fuzzy reasoning. The data from patient can be displayed as graph or numeric on monitor if it is necessary, and then the doctor can diagnose the patient according to the recorded continuous data. Wireless sensor network is made up of a large quantity of wireless sensors based on Zigbee technology. The Zigbee technology provides a resolution for transmitting sensors data by wireless communication. Zigbee technology can transmit data with a rate of 250kbps, and then it is enough for the physical parameters of patient. The communication distance of Zigbee node can be over 200 meters, and can be spread by add route node, and then Zigbe technology is suited to short distance wireless sensors network. Zigbee technology owns many virtues, such as low power consumption, low cost, small size, free frequency, etc. To know the physical states of in-patient, the physical parameters need to be monitored real-time. The traditional medical test instrument s large size and connected by wire often, and the patient is required to be quiet during test. In most of hospítal, the medical instruments need to be read by doctor or nurse, and the physical parameters are tested and recorded one or two times each day, the real-time monitoring is expensive for most of patients, and can be only acquirable for ICU by nurse. For this reason, the worsening of patient can't be found in time, and then the patient can't be helped in time. For most of patients can be monitored real-time in hospital, we should find new method. Consider that the movement of patient is limited in hospital, we adopted the Zigbe and wireless sensors network to acquire the physical parameters of patient.

2.4. Development and Clinical Evaluation of a Home Healthcare System

Daily monitoring of health condition at home is important for an effective scheme for early diagnosis, treatment and prevention of lifestyle-related diseases such as adiposis, diabetes and cardiovascular diseases. While a number of commercially available devices for home health care monitoring are widely used, those are actually cumbersome in terms of self- attachment of biological sensors and self-operation of them. From this viewpoint, we have been developing a non-conscious physiological monitoring system without attachment of any sensors to the human body as well as any operations for the measurement. We developed some devices installed in a toilet, a bath, and a bed and showed their high measurement precision by comparison with simultaneous recordings of ordinary biological sensors direcdy attached to the body. In order to investigate those applicability to the health condition monitoring, we developed a monitoring system in combination with all of the monitoring devices at hospital rooms and previously carried out the measurements of patients' health condition. Further in this study, the health conditions were measured in 10 patients with cardiovascular disease or sleep disorder. From these results, the patients' health conditions such as the body and excretion weight in the toilet, the ECG during taking the bath and the pulse and respiration rate during sleeping were successfully monitored in the hospital room, demonstrating its usefulness for monitoring the health condition of the subjects with cardiovascular disease or sleep disorder.

CHAPTER-3
EXISTING SYSTEM

In the existing system, we use active network technology to network various sensors to single PMS. Patients' various critical parameters are continuously monitored via single PMS and reported to the Doctors or Nurses in attendance for timely response in case of critical situations. Our NWSPMS has the following basic components:

- Various sensors attached to the body of the patient.
- Microcontrollers for analog signal interface
- Wireless transmitting and receiving system for data transfer.
- A functional wireless network for different patients with their unique ID.
- A Central Patient Monitoring System (CPMS) observing unit basically a PC.

The sensors are attached to the body of the patients without causing any discomfort to them. In this NWSPMS we monitor the important physical parameters like bodytemperature, ECG, heart beat rate and blood pressure using the sensors which are readily available. Thus the analog values that are sensed by the different sensors are then given to a microcontroller attached with it. The microcontroller processes these analog signal values of health parameters separately and converts it to digital values using ADC converter. Now, the digitalized values from more than one microcontroller are sent to the CPMS. Each of the entire sensors attached microcontroller with a transceiver will act as a module which has its own unique ID. Each module transmits the data wirelessly to the gateway attached to the PC of the CPMS. The gateway is attached to the PC i.e. CPMS which is situated in the medical center, is capable for selecting different patient IDs and allowing the gateway to receive different physical parameter values the patient specified by the ID. The software designed using Graphical User Interface (GU) can operate on different physical parameters of each patient, consecutively with a specified time interval for each patient. At any time any of the doctors or nurses can log on the CPMS and check the history of the observed critical parameters of any of the patient attached to the network. A wireless sensor mote is attached to the sensor set attached to each of the patients. The gateway of the Wireless Sensor Network is attached to the CPMS.

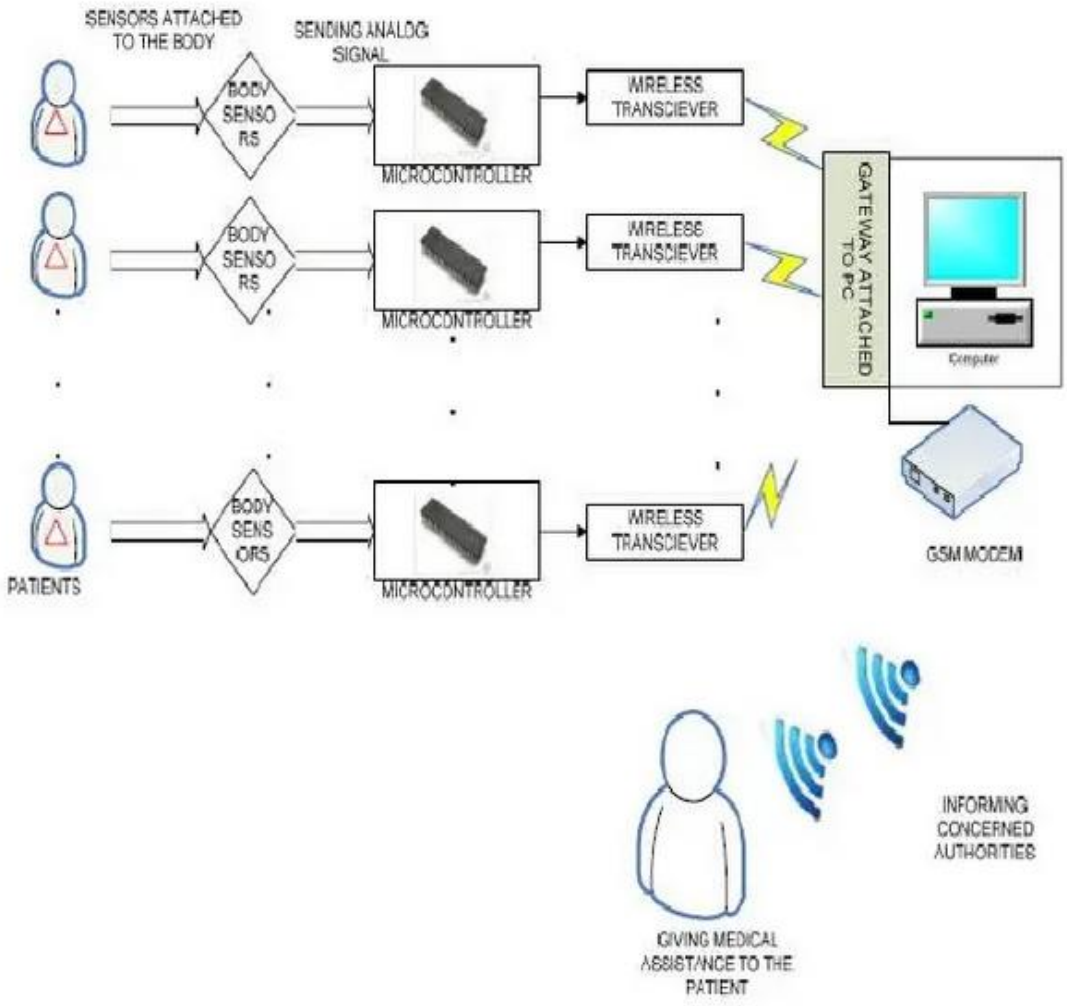

Fig 1 : Block Diagram of Existing System

In case of a critical situation which requires immediate attention of the doctors or nurses for any of the patients, the custom software will instruct the CPMS to enable the GSM modem to send an SMS with the patient ID. A voice call is also made to the doctors and the staffs of the hospital. The SMS also consists of current status of the patient's physical condition.With the help of the patient ID, the doctor can easily identify and attend to the patient situation. Fig 2. shows the flow chart for NWSPMS algorithm.

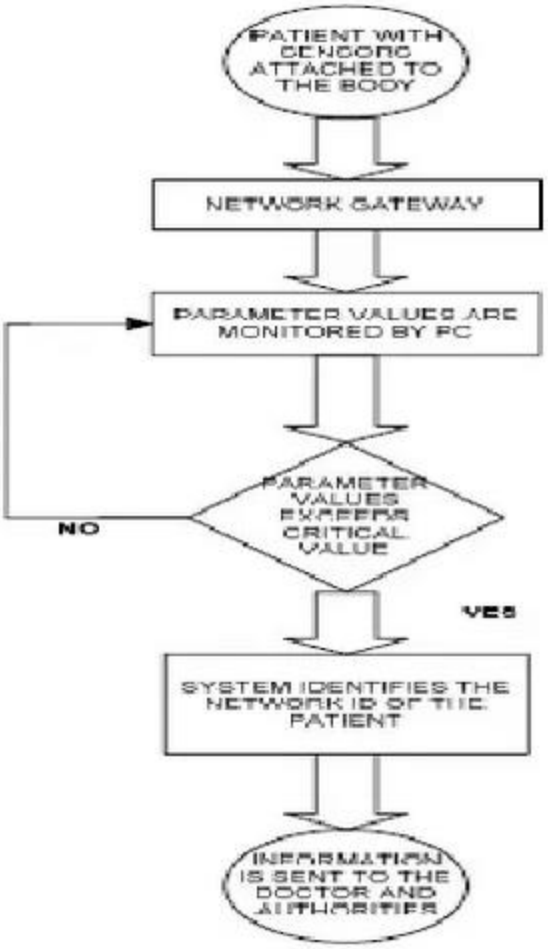

Fig 2. Existing System Flow Chart

3.2 SENSORS AND PARAMETERS

To implement the network based multiple-patient monitoring and alert mechanism, we use the following technologies and methodologies which will provide an active and user- friendly environment for the working of the system. Each technology we used are discussed in detail below.

A. Sensor Microcontroller Module

The Sensor Microcontroller module consists of four sensors which could measure parameters like

1) **Body Temperature:** Temperature sensors in the medical field have been used from time immemorial to measure the body temperature and monitor the medical condition of patients. With a temperature sensor attached to the body of the patients, measurement of absolute.
2) **Heart Rate:** Heart rate is the number of heartbeats recorded per minute typically recorded as Beats per Minute (BPM) as in [7]. In the proposed system, we make use of a technique called Photoplethy smography (PPG). PPG is a simple and low cost optical technique that can be used to detect the blood volume changes in the micro vascular bed of tissues. In this technique, a bright led and a LDR is enmployed to detect the blood flow at the finger tip or any other peripheral part of the body. The light from the bright led gets reflected from the tissues in the body parts and the amount of light reflected determines the volume of blood flowing. If more blood flows through it, more light is reflected back. We have to amplify the signal and remove the unwanted noise signals. For this purpose we make use of operational amplifiers, LM3S8. The circuit is shown below

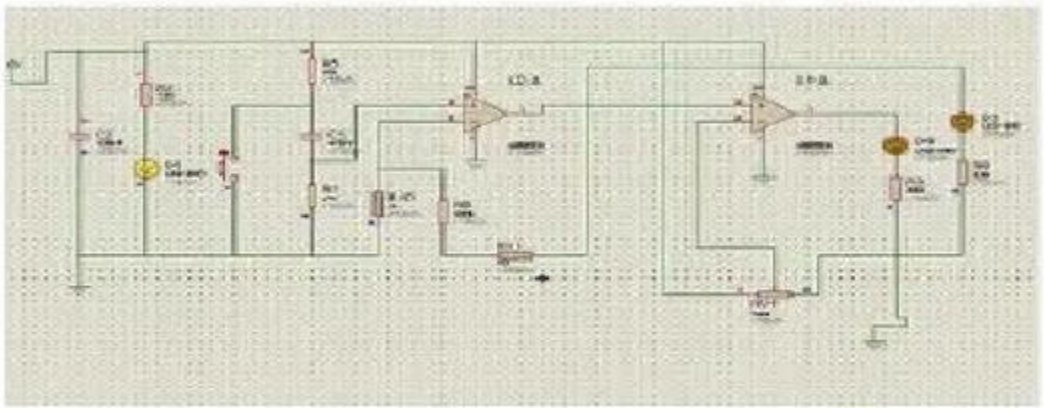

Fig 3. Circuit Diagram of Heart Sensor

CHAPTER - 4
PROPOSED SYSTEM

The main objective is to design a Patient Monitoring System with two way communication i.e not only the patients data will be sent to the doctor through SMS, but also doctor can send required suggestions to the patient, which will be displayed on Device.

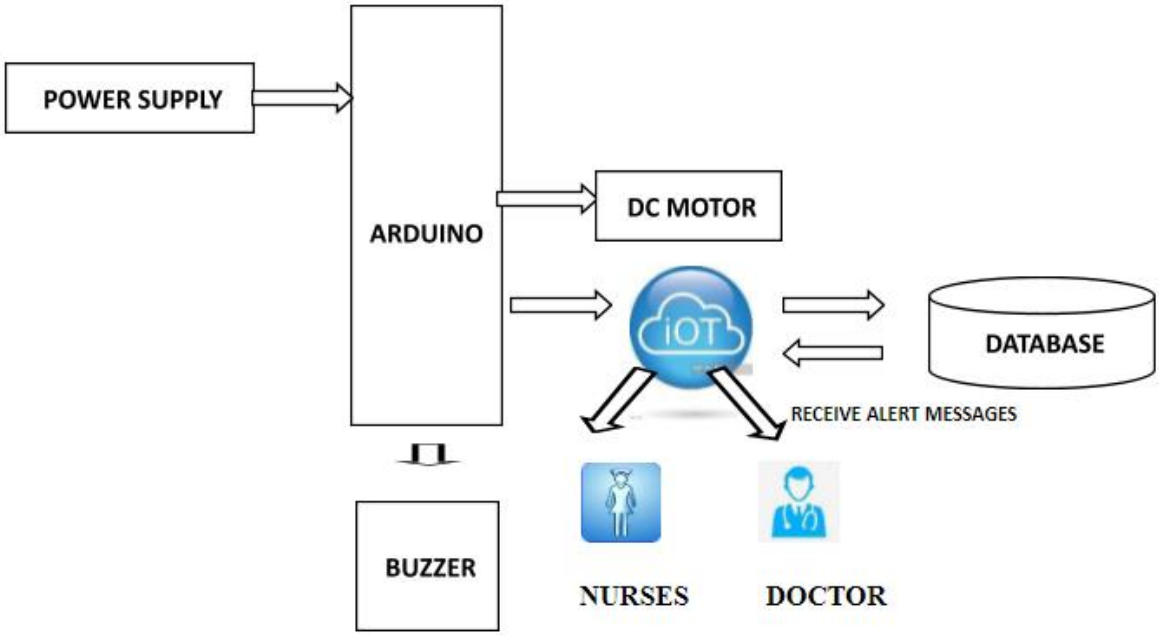

Fig 4 : Block Diagram of Proposed System

Various physiological signals such as body temperature, heartbeat and oxygen level are continuously monitored with this system.Various types of transducers are used to sense these bioelectrical signals. To sense the body temperature we have used LM35 of national instruments because it is cheap in rate and its size is small enough to fit on patient's body.Heart beat sensor is one type of sensor which monitors the heart beat pulses for every minute. It will check the heart beat pulses and the same data will be given to AT mega 328. This heart beat sensor is designed to give digital output of heat beat when a finger is placed inside it. This digital output can be connected to AT mega 328 directly to measure the Beats per Minutes.All the signals from transducers are weak signals hence these signals are processed and amplified to desired level with the help of signal conditioner and computer display and then compares these values with thehard coded values given to AT mega 328.These values arestored in memory of controller. If measured values cross the limit of reference values then AT mega 328 sends SMS to a particular mobile number stored in memory through GSM modem.AT mega 328 continuously displays these variables on the computer screen. The output of instrumentation amplifier is given to analog to digital converter. These converted digital signals are then fed to ATmega328 which displays these respective values on computer display and then compares these values with the hard coded values given to AT mega 328. These values are stored in memory of AT mega328. 1f measured values cross the limit of reference values then ATmega328 sends SMS to a particular

mobile number stored in memory through GSM modem. ATmega328 contimuously displays these variables on the computer Display. Also if the person wishes to send his report, he can do so on a regular basis by specifying his choice through keyboard.A Tmega328 continuously does this work, thus providing a real time monitoring of heart beat, body temperature and blood pressure of the patient.

4.1 WORKING OF THE SYSTEM

In the first step, we sense the heart rate and body temperature using respective sensors. Then, convert the analog data to digital using on chip ADC and compare the sensor values with the reference value using AT meag328. Next step is to send message through GSM to mentioned mobile number. This mobile will be connected with the computer in hospital. The normal and abnormal conditions will be identified through the use of red and green circular objects on the screen. Meanwhile the data will also be stored on the patient side.

4.2 Circuit Diagram

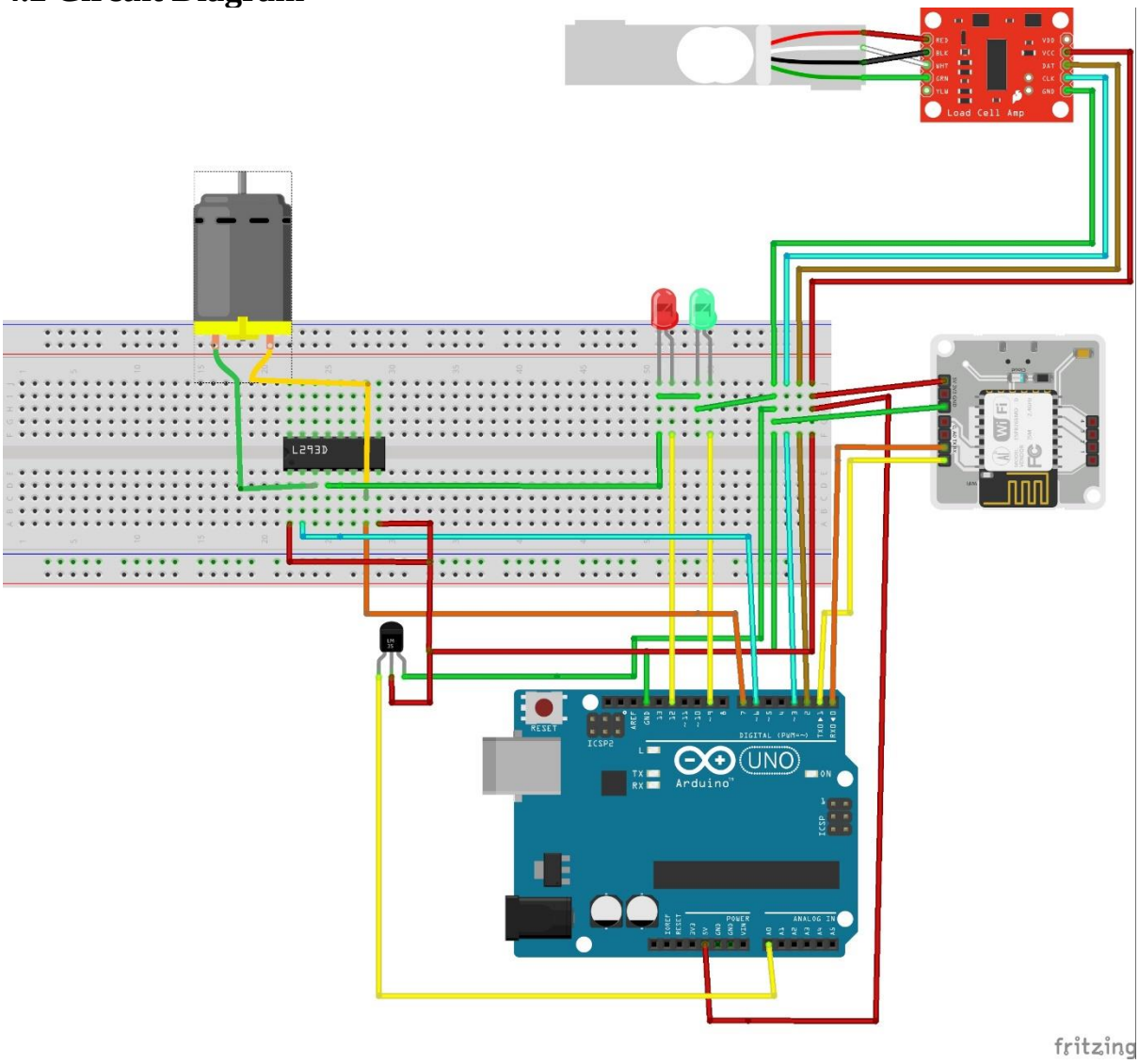

Fig 5: Circuit Diagram

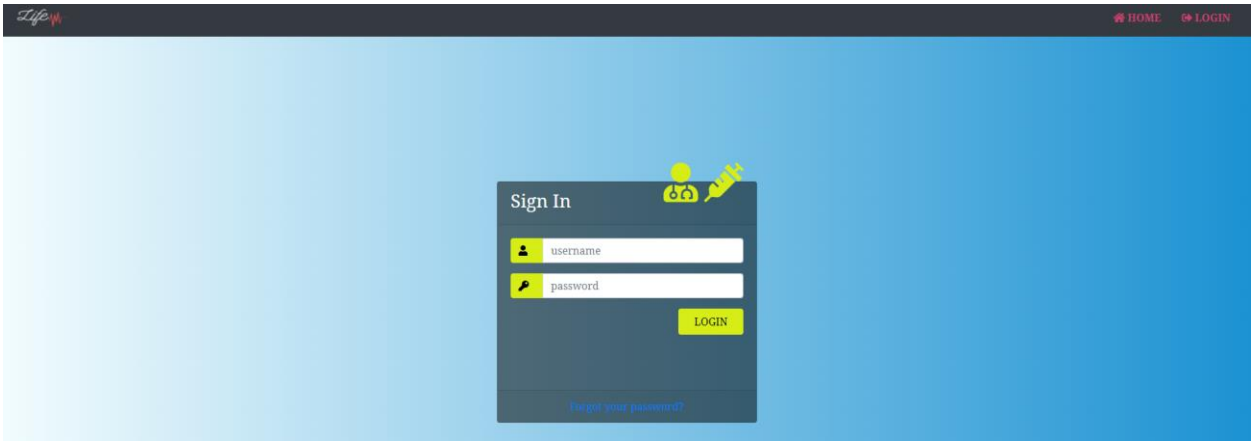

FIG 6 : WEB PORTAL

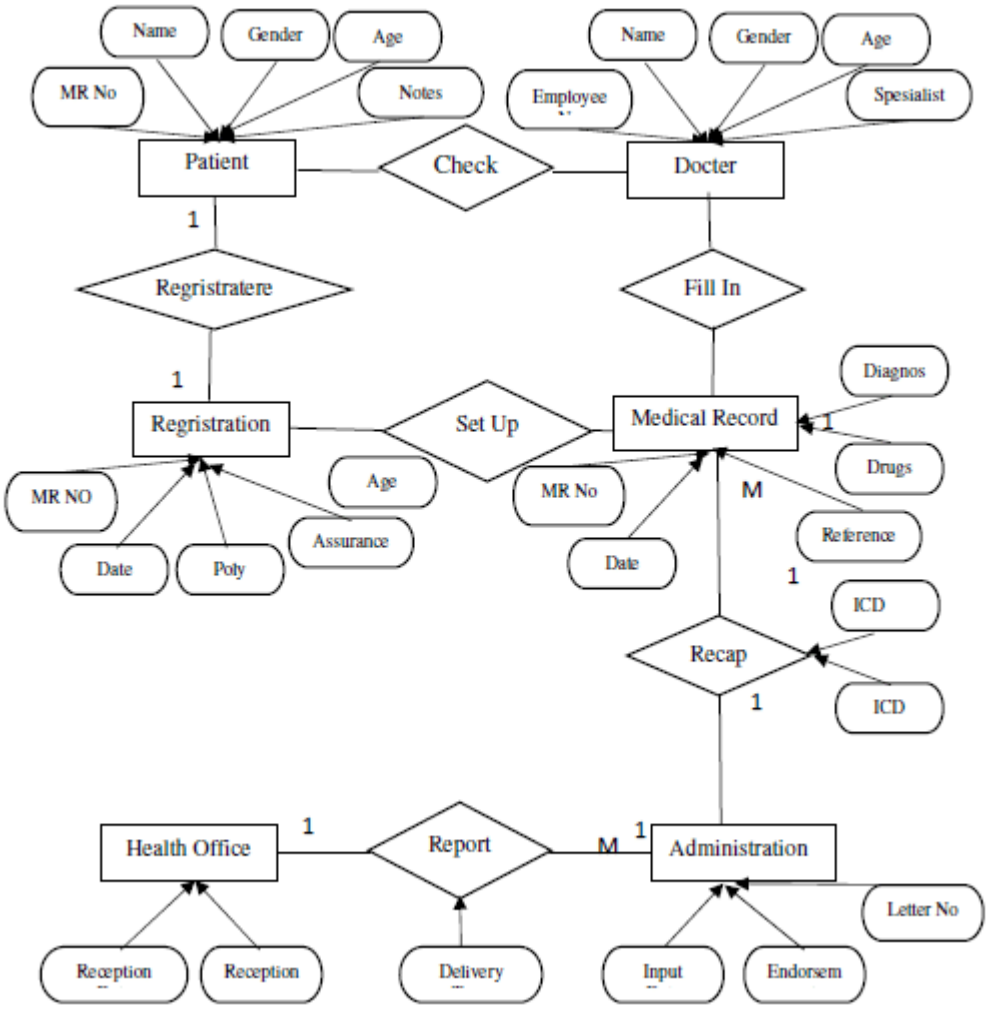

FIG 7 : ER Diagram

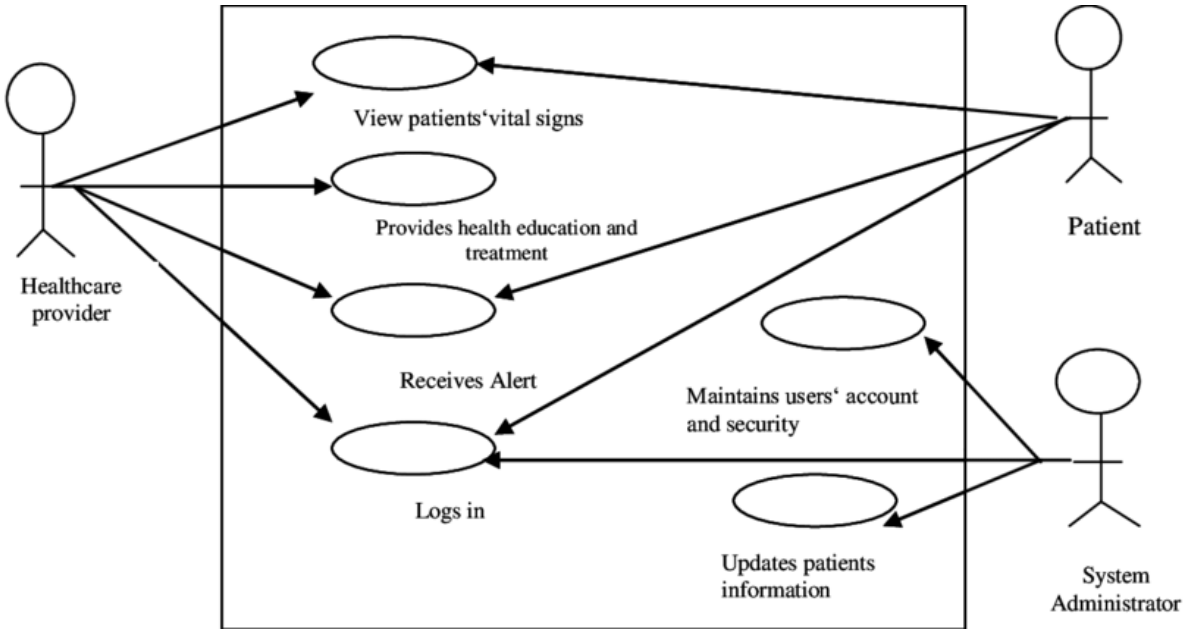

FIG 8 : UML DIAGRAM

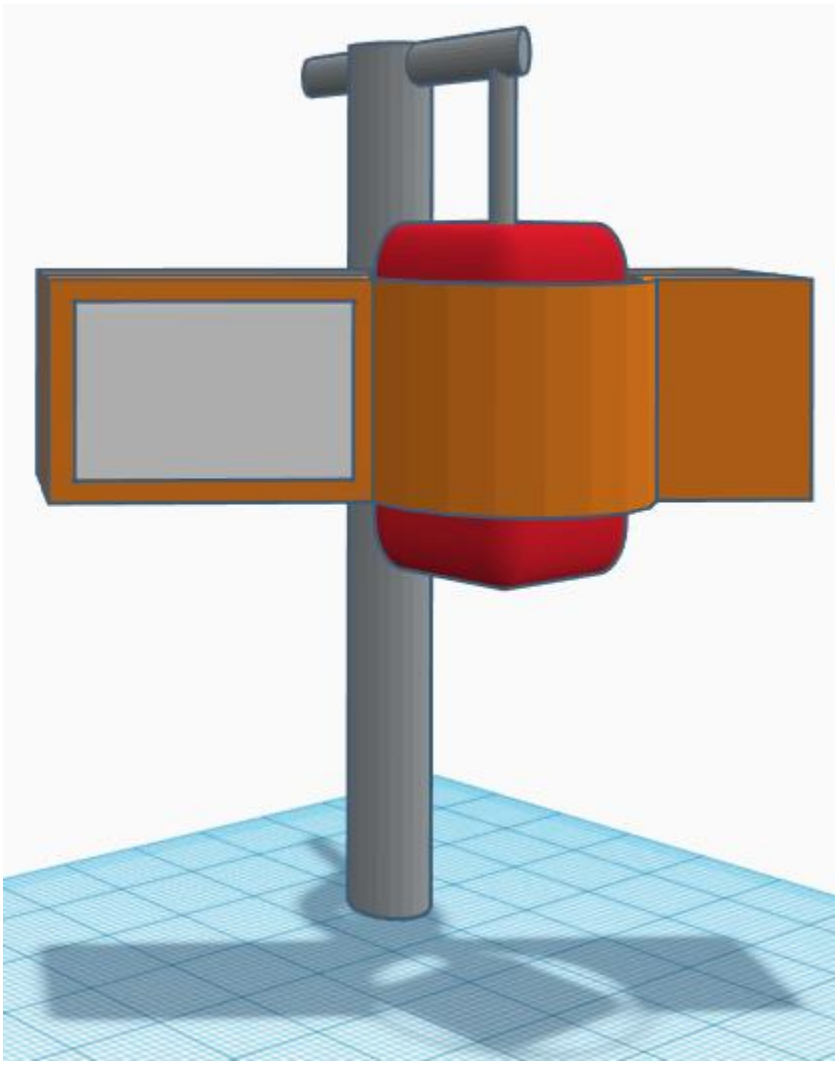

Fig 9 : Proposed Installation Mode

4.3 CODE SNIPPET

```
#include <BoltIoT-Arduino-Helper.h>
#include "HX711.h"
#include<BoltDeviceCredentials.h>
int loadpin1dout=2;
int loadpin2sck=3;
int motorPin1 = 7;
int motorPin2 = 6;
int redled  = 9;
int greenled= 8;
int button = 4;
int buz1 = 5;
int buz2=  10;
String command = "";
long val= 0;
float count=0;
int bell = 8;
long offAt = 0;
HX711 cell;
// Pulse Monitor Test Script
int sensorPin = A0;
double alpha = 0.75;
int period = 100;
double change = 0.0;
double minval = 0.0;

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(motorPin1,OUTPUT);
  pinMode(motorPin2,OUTPUT);
  pinMode(redled,OUTPUT);
  pinMode(greenled,OUTPUT);
  cell.begin(loadpin1dout,loadpin2sck);
  boltiot.begin(Serial);
  boltiot.setCommandString("LOADCELLVALUE",loadcellvalue);
  boltiot.setCommandString("FORWARD",forward);
  boltiot.setCommandString("BACKWARD",backward);
  boltiot.setCommandString("STOP",stopmotor);
  boltiot.setCommandString("BELL",bellring);
  pinMode(button, INPUT_PULLUP);
  pinMode(buz1, OUTPUT);
}

String loadcellvalue(String *data){
  String retval = "";
  int threshold = 0 ;
  count = count + 1;
  //val = ((count -1)/count)*val + (1/count)*cell.read();
  val = 0.5 * val + 0.5 * cell.read();
  Serial.println(round((val-125075)/-143109.0f * 525));
```

```
  retval=round(((val-125075)/-143109.0f * 525));
  return retval;

  // zero 140553
  //calibration value is -5050.0f * 12.5
}

String forward(String *data) {
  command = "FORWARD";
  digitalWrite(greenled,LOW);
  digitalWrite(redled,HIGH);
  digitalWrite(motorPin1, LOW);
  digitalWrite(motorPin2, HIGH);
  delay(4500);
  digitalWrite(motorPin2, LOW);
  digitalWrite(motorPin1, LOW);


  return "Success:Forward";
}
String backward(String *data) {
  command = "BACKWARD";
  digitalWrite(redled,LOW);
  digitalWrite(greenled,HIGH);
 digitalWrite(motorPin2, LOW);
 digitalWrite(motorPin1, HIGH);
 delay(4500);
 digitalWrite(motorPin2, LOW);
 digitalWrite(motorPin1, LOW);
  return "Success:Backward";
}
String stopmotor(String *data) {
  digitalWrite(motorPin1, LOW);
  digitalWrite(motorPin2, LOW);
  return "Success:Stop";
}
String bellring(String *data) {
  digitalWrite(bell,HIGH);
  return "Success:Done";
}


void loop() {
boltiot.handleCommand();

    static double oldValue = 0;
    static double oldChange = 0;

    int rawValue = analogRead (sensorPin);
    double value = alpha * oldValue + (1 - alpha) * rawValue;

    Serial.print (rawValue);
    Serial.print (",");
    Serial.println (value);
    oldValue = value;

    delay (period);



}
```

CHAPTER- 5
HARDWARE USED

5.1 ATmega328

The ATmega328 is a single chip micro-controller created by Atmel and belongs to the megaAVR series. The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose 1O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external internupts, serial programmable USART, a byte oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/DD converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughputs approaching 1 MIPS per MHz.The Ardu ino Uno is a microcontroller board based on the ATmega328 (datasheet). lt has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an 1CSP header, and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

5.1.1. Technical specifications

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital l/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per 1/0 Pin 40 mA
- DC Current for 3.3V
- Pin 50 mA
- Flash Memory 32 KB of which 0.5 KB used by bootloader
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz

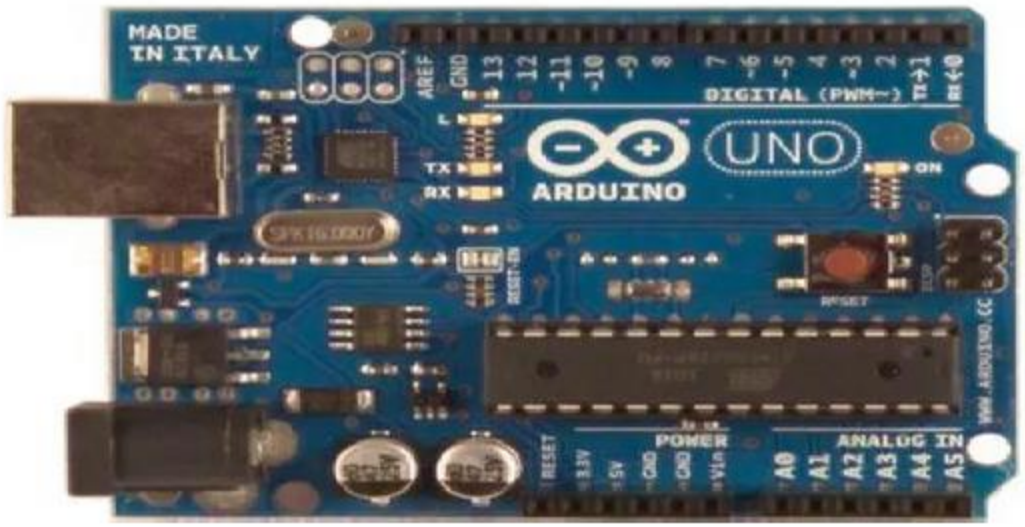

Fig 10 : ATmega328

5.2 Temperature Sensor (LM-35)

LM35 temperature sensor is used to measure the temperature and connected to MCU.This sensor unit works under low power DC input of 5V which is controlled by a mini transformer.

5.2.1 Why Use LM35s To Measure Temperature?

You can measure temperature more accurately than a using a thermistor. The sensor circuitry is sealed and not subject to oxidation, etc.

Memory: It has 32Kbytes of In-Systm Self-programmable Flash program memory, 1024 Bytes EEPROM, 2Kbytes Internal SRAM. Write/Erase Cycles: 10,000 Flash/ 100,000 EEPROM.

Clock: It can run at a frequency from 1 to 16 MHz. Frequency can be obtained from external Quartz Crystal, Ceramic crystal or an R-C network. Intemal calibrated RC oscillator can also be used.

More Features: Up to 16 MIPS throughput at 16MHz. Most of the instruction executes in a single cycle. Two cyele on-chip multiplication. 32 x 8 General Purpose Working Registers

Debug: JTAG boundary scan facilitates on chip debug.

Programming: Atmega32 can be programmed either by In-System Programming via Serial peripheral interface or by Parallel programming. Programming via JTAG interface is also possible. Programmer must ensure that SPI programming and JTAG are not be disabled using fuse bits; if the programming is supposed to be done using SPl or JTAG.

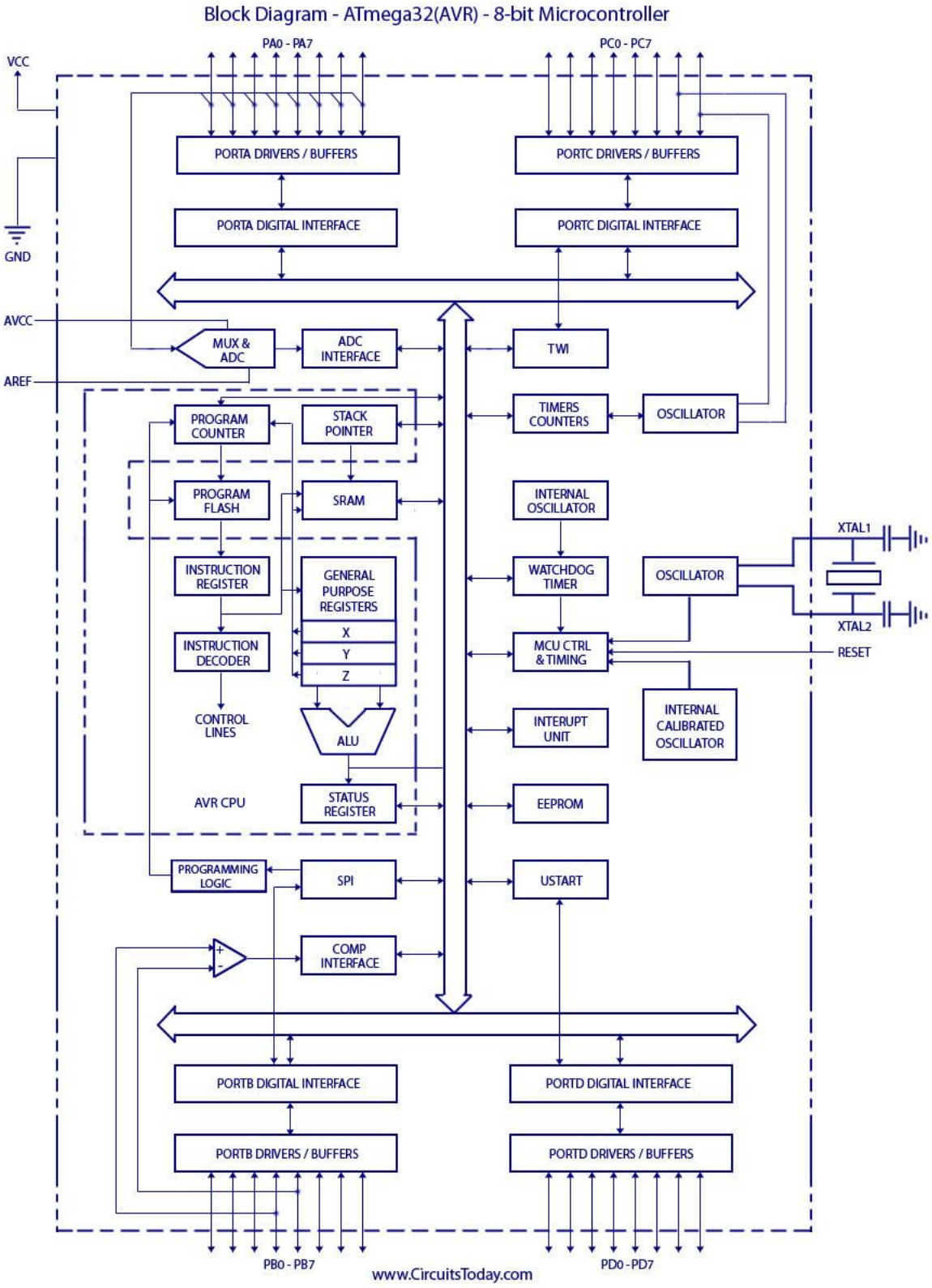

Fig 11 : Block Diagram of ATmega328

5.3 Arduino Digital and Analog I/O Pins
5.3.1 PIN Configuration

Power	Vin, 3.3V, 5V, GND	Vin: Input voltage to Arduino when using an external power source. 5V: Regulated power supply used to power microcontroller and other components on the board. 3.3V: 3.3V supply generated by on-board voltage regulator. Maximum current draw is 50mA. GND: ground pins.
Reset	Reset	Resets the microcontroller.
Analog Pins	A0 – A5	Used to provide analog input in the range of 0-5V
Input/Output Pins	Digital Pins 0 – 13	Can be used as input or output pins.
Serial	0(Rx), 1(Tx)	Used to receive and transmit TTL serial data.
External Interrupts	2, 3	To trigger an interrupt.
PWM	3, 5, 6, 9, 11	Provides 8-bit PWM output.
SPI	10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK)	Used for SPI communication.
Inbuilt LED	13	To turn on the inbuilt LED.
TWI	A4 (SDA), A5 (SCA)	Used for TWI communication.
AREF	AREF	To provide reference voltage for input voltage.

5.4 BOLT-IoT Module

Bolt is an IoT platform to easily and quickly build products and services. Bolt comes with a WiFi/GSM chip and a cloud platform which helps you connect your devices and sensors to the Internet. With Bolt Cloud you can control and monitor them over the internet, create personalised dashboards to visualise the data, monitor the device health, run machine learning algorithms and lot more. Build scalable IoT systems in just a days time.

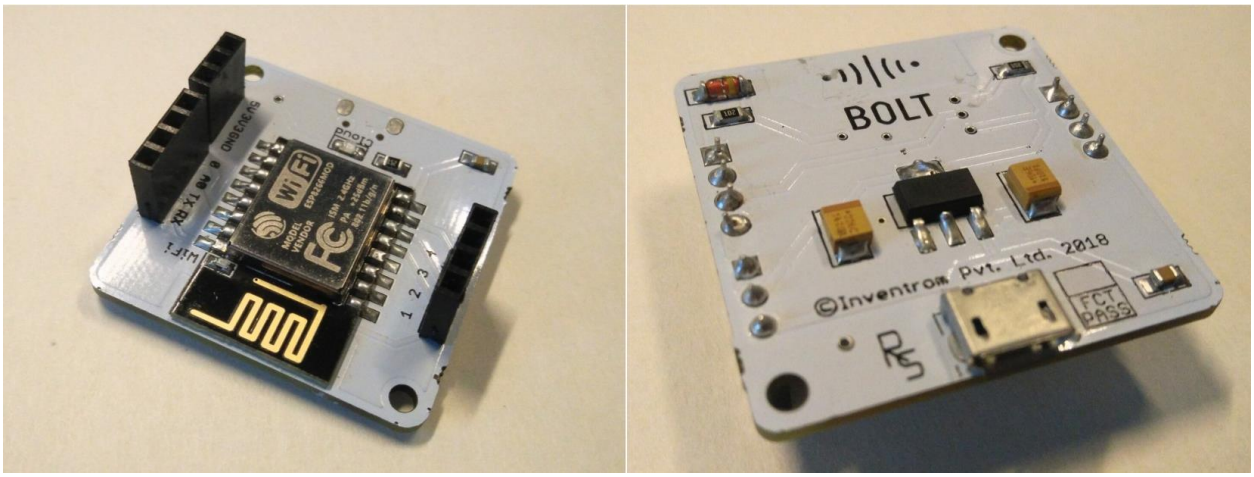

Fig 12. BoltIoT Module

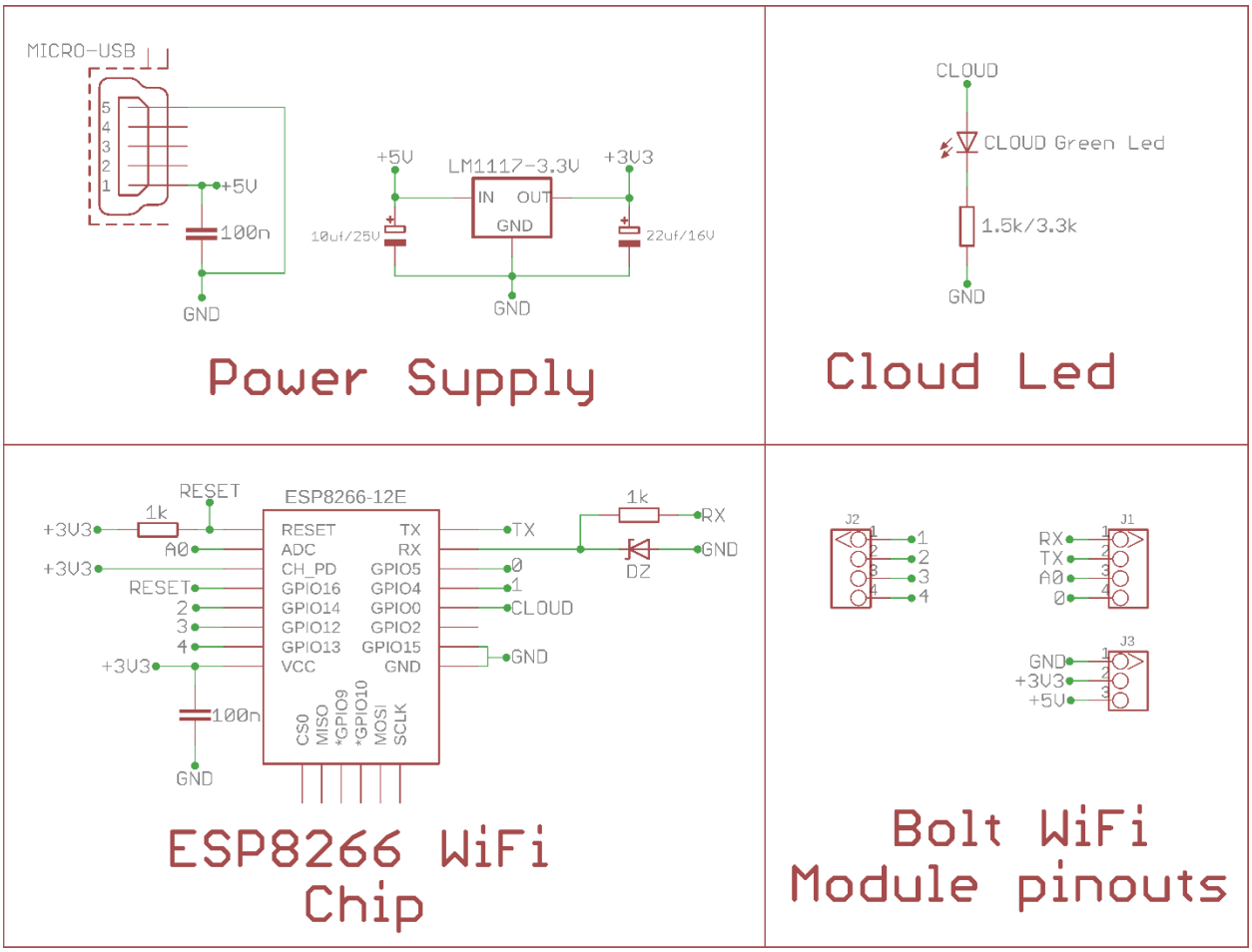

FIG 13 : BOLTIOT WIFI PIN DIAGRAM

5.4.1 TECHNICAL CONFIGURATION

Pin	Type	Description
A0	Analog Input	This pin comes with an ADC (Analouge to Digital Converter). This is the only pin to which we can connect an Analouge sensor. This is an input only pin i.e. it can only collect input. It does not give any output.
0 , 1, 2, 3, 4	Digital I/O (Input and Output)	You can only connect a digital sensor to this pin.
TX	UART Pin	
RX	UART Pin	
3.3V	Power pin which gives a value of 3.3 volts.	
5V	Power pin which gives a value of 5 volts.	
GND	Ground pin	Used to ground and complete any circuit connection.

5.4.2 Bolt Cloud

Bolt Cloud is the heart of the Bolt IoT Platform.In this session, I will share with you the specifications and terminologies used in the cloud.

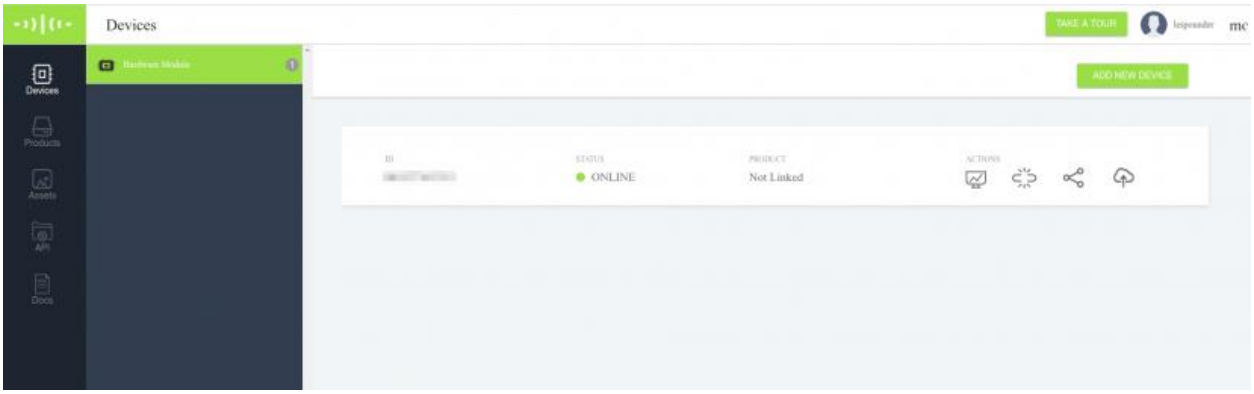

Fig 14. BolT Cloud Dashboard

Tab Name	Function
Devices	Here you will get a list of all the hardware devices connected to your Bolt Cloud account. In most cases, these hardware devices will be the Bolt WiFi Modules and devices you have built using them.
Products	A product is where you write your software code and configure a product or a project. Once your software code is ready, you connect a device to the product. The device will then take all the properties of this product. All the devices with the same product connected to them will behave in the same way.
Alerts	Here you can set up alerts for any product. These alerts are sent when the sensor data crossed a threshold value set by you. As of now you have the option of Email and Push Notification. Few countries have an option of sending SMS as well. Alerts are to be linked to a device.

Tab Name	Function
Assets	These are code files, data files (generally CSV) and images uploaded or created by you on Bolt Cloud.
API	The API contains the API key, the key that enables us to use the Bolt board to gather data or react to input remotely and this key works no matter what supported language we use with it.
Docs	The last section is Docs and there we can find the help that we may need.

5.5 Load Cell

A load cell is a transducer that is used to create anelectrical signal whose magnitudeis directly proportional to the force being measured. The various load cell typesinclude hydraulic, pneumatic, and strain gauge

5.5.1 Stain Gauge Load Cell

Strain gauge load cells are the most common in industry. These load cells are particularly stiff, have very good resonance values, andtend to have long life cycles in application. Strain gauge load cells work on the principle that the strain gauge (a planar resistor)deforms when the material of the load cells deforms appropriately. Deformation of the strain gauge changes its electrical resistance, by an amount that is proportional to the strain. The change in resistance of the strain gauge provides an electrical value change that is calibrated to the load placed on the load cell.A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one strain gauge (quarterbridge) or two strain gauges (half bridge) are also available.
[1]
The electrical signal output is typically in the order of a few millivolts(mV) and requires amplification by an instrumentation amplifierbefore it can be used. The output of the transducer can be scaled tocalculate the force applied to the transducer. Sometimes a high resolution ADC, typically 24-bit, can be used directly

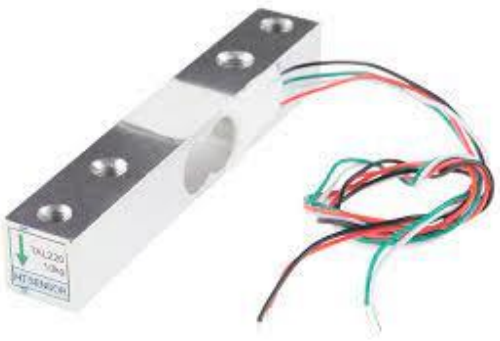

Fig 15 : Stain Gauge Load Cell

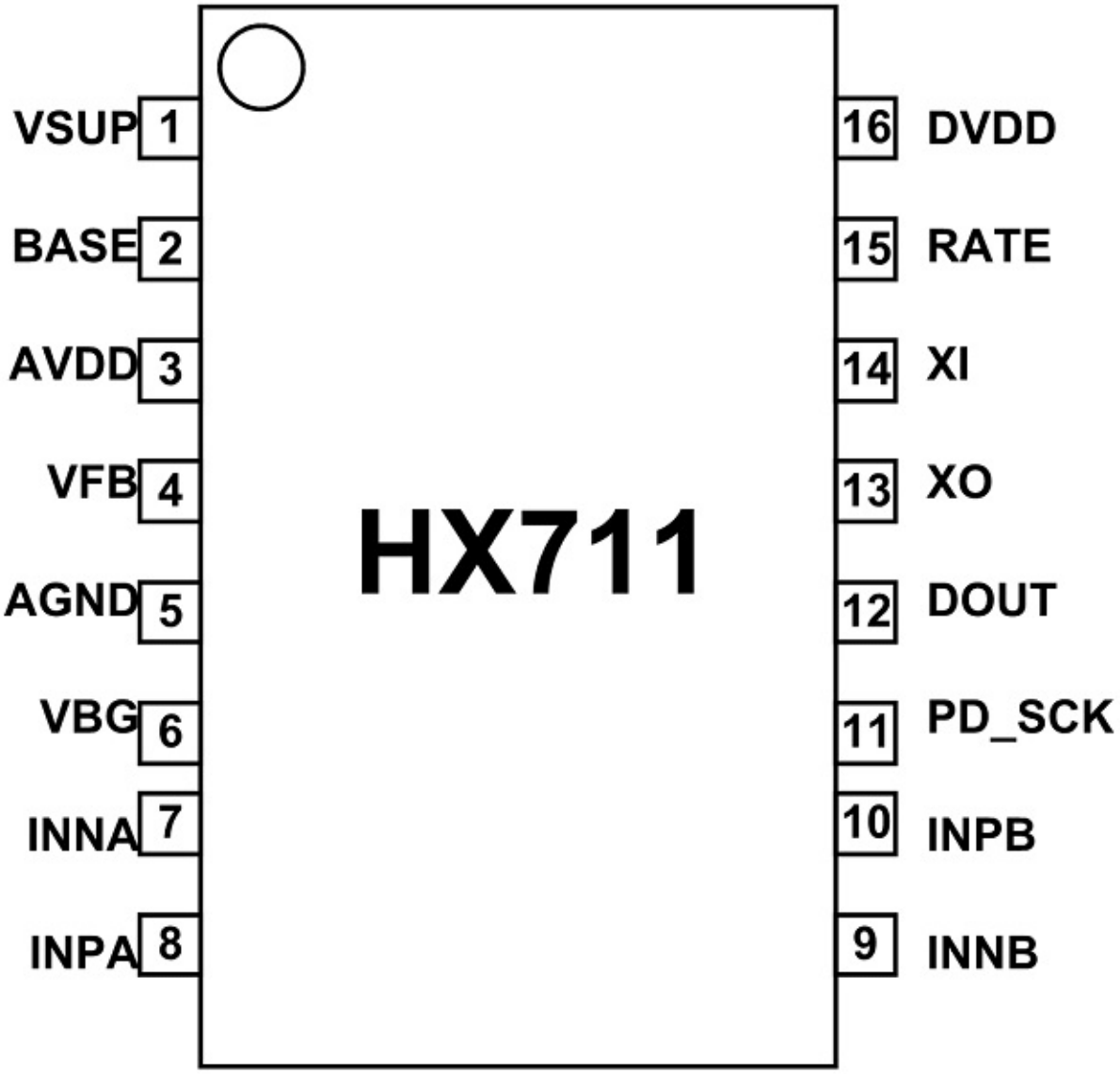

FIG 16 : LOAD CELL AMPLIFIER

5.5.2 Working Principle

Load cell is a sensor or a transducer that converts a load or force acting on it into an electronic signal. This electronic signal can be a voltage change, current change or frequency change depending on the type of load cell and circuitry used.

There are many different kinds of load cells.

Resistive load cells work on the principle of piezo-resistivity. When a load/force/stress is applied to the sensor, it changes its resistance. This change in resistance leads to a change in output voltage when a input voltage is applied.

Capacitive load cells work on the principle of change of capacitance which is the ability of a system to hold a certain amount of charge when a voltage is applied to it. For common parallel plate capacitors, the capacitance is directly proportional to the amount of overlap of the plates and the dielectric between the plates and inversely proportional to the gap between the plates.

5.6 DC MOTOR

A DC motor is an electric motor that runs on direct current (DC) electricity.DC motors were used to run machinery, often eliminating the need for a local steam engine or internal combustion engine. The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets, and rotating electrical magnets. In a brushed DC electric motor generating torque directly from DC power supplied to the motor by using internal commutation, stationary permanent magnets. Torque is produced by the principle of Lorentz force, which states that any current-carrying conductor placed within an external magnetic field experiences a force known as Lorentz force.

5.6.1 Working Principle

Operation is based on simple electromagnetism.
A Current-carrying conductor generates a magnetic field. when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field.
The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

A simple 2-pole DC electric motor (here red represents a magnet or winding with a "North" polarization, while green represents a magnet or winding with a "South" polarization). The below diagram shows a common motor layout-with the rotor inside the stator (field) magnets.

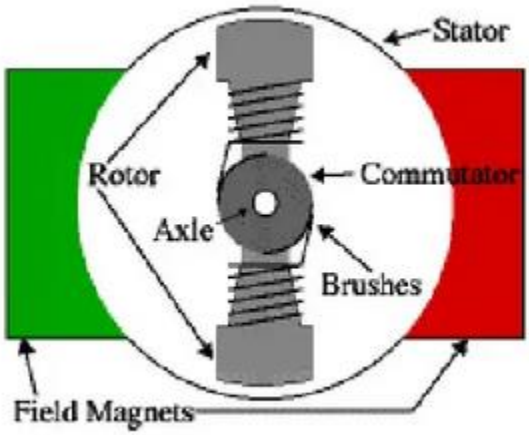

Fig 17: DC MOTOR

5.6.2 Parts of DC Motor

Every DC motor has six basic parts - axle, rotor, stator, commutator, field magnet(s), and brushes. In most common DC motors, the external magnetic field is produced by high- strength permanent magnets. The stator is the stationary part of the motor - this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor (together with the axle and attached commutator) rotate with respect to the stator.The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator.

CHAPTER – 6
SYSTEM REQUIREMENTS

System requirements are the configuration that a system must have for a hardware or software application to run easily and proficiently. If these requirements are not satisfied, they can lead to installation or performance problems. Installation problems may prevent a device or an application from getting installed. Performance problems may cause a product to malfunction or perform below expectation or even hang or crash.

6.1 Hardware Requirements

The section of hardware configuration is an important task related to software development, insufficient random-access memory may affect adversely on the speed and efficiency of the entire system. The process should be powerful to handle the entire operations. The hard disk should have sufficient capacity to store the file and application.

Processor : Intel Core i3 or more
RAM : 4GB or more
Hard disk : 10GB or more (depending on input file size)
Peripherals : Keyboard, Compatible mouse
Cache Memory : L2-1 MB
GPU : Intel HD Graphics or Nvidia chip for better performance
Monitor Resolution: 1024*768 or 1336*768 or 1280*1024

6.2 Software Requirements

A major element in building a system is the section of compatible software since the software in the market is experiencing in geometric progression. Selected software should be acceptable by the firm and one user as well as it should be feasible for the system.

This document gives a detailed description of the software requirement specification. The study of requirement specification is focused specially on the functioning of the system. It allows the developer or analyst to understand the system, function to be carried out the performance level to be obtained and corresponding interfaces to be established.

6.2.1 Python

Python Language Introduction

Python is a general-purpose, high level programming language. It was initially designed by Guido van Rossum in 1991 and developed by Python Software Foundation. It was mainly developed for emphasis on code readability, and its syntax allows programmers to express concepts in fewer lines of code.

Python is a programming language that lets you work quickly and integrate systems more efficiently. Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- **Python is Interpreted** − Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.

- **Python is Interactive** − You can actually sit at a Python prompt and interact with the interpreter directly to write your programs.

- **Python is Object-Oriented** − Python supports Object-Oriented style or technique of programming that encapsulates code within objects.

- **Python is a Beginner's Language** − Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

History of Python

Python was developed by Guido van Rossum in the late eighties and early nineties at the National Research Institute for Mathematics and Computer Science in the Netherlands.

Python is derived from many other languages, including ABC, Modula-3, C, C++, Algol-68, SmallTalk, and Unix shell and other scripting languages.

Python is copyrighted. Like Perl, Python source code is now available under the GNU General Public License (GPL).

Python is now maintained by a core development team at the institute, although Guido van Rossum still holds a vital role in directing its progress.

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Python Features

Python's features include −

- **Easy-to-learn** − Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.

- **Easy-to-read** − Python code is more clearly defined and visible to the eyes.

- **Easy-to-maintain** − Python's source code is fairly easy-to-maintain.

- **A broad standard library** − Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.

- **Interactive Mode** − Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.

- **Portable** − Python can run on a wide variety of hardware platforms and has the same interface on all platforms.

- **Extendable** − You can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.

- **Databases** − Python provides interfaces to all major commercial databases.

- **GUI Programming** − Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.

- **Scalable** − Python provides a better structure and support for large programs than shell scripting.

Apart from the above-mentioned features, Python has other good features, few are listed below:

- It supports functional and structured programming methods as well as OOP.

- It can be used as a scripting language or can be compiled to byte-code for building large applications.

- It provides very high-level dynamic data types and supports dynamic type checking.

- IT supports automatic garbage collection.

- It can be easily integrated with C, C++, COM, ActiveX, CORBA, and Java.

6.2.2 ARDUINO IDE

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. lIt consists of a circuit board, which can be programmed (referred to as amicrocontroller) and a ready-made software called Arduino IDE ([ntegrated Development Environment), which is used to write and upload the computer code to the physical board.

The key features are

- Arduino boards are able to read analog or digital input signals from diferent sensors and turn it into an output such as activating a motor, turning LED onoff, connect to the cloud and miany oner actons.

- You can control your board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (reterred to as uploading software).

- Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. Youcan simply use a USB cable.

- Additionally, the Arduino IDE uses a simplified version of C++, making it casier to learn program.

- Finally, Arduino provides a standard form factor that breaks the functions of the microcontroller into a more accessible package. After learning about the main parts of the Arduino UNO board, we are ready to learn howto set up the Arduino IDE. Once we learn this, we will be ready to upload our program onthe Arduino board.

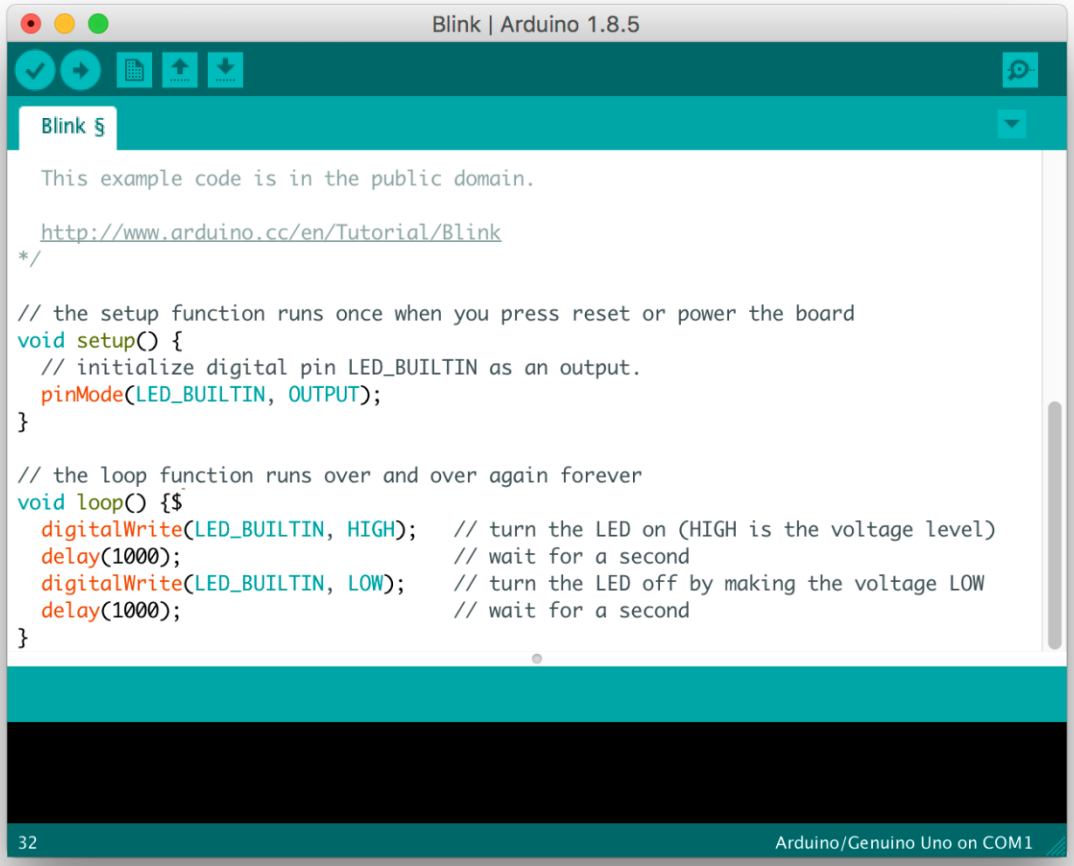

FIG 18: ARDUINO IDE

6.2.3 BOLTIOT API INTEGRATION

The Bolt Cloud API provides an interface for communication between the Bolt devices and any 3rd party system e.g. mobile application, web server, python programs etc. The API contains very intuitive control, monitoring, communication and utility functions for the Bolt Devices connected to your account. The Bolt Cloud API uses HTTP protocol for the communication and uses the HTTP GET and HTTP POST methods. Hence users can execute actions and retrieve information from Bolt devices programmatically using conventional HTTP requests.

Here are a few use cases of the API:

- Use the API in native apps on iOS and Android to control and monitor Bolt devices over the Internet.
- Pull collect sensor data connect to Bolt device, to any other cloud to run your custom AI algorithms and analytics.
- Connect Bolt Cloud to any VPS (Virtual Private Server) and run your code in any language of your choice. Refer sample codes.
- Remote Operating System: Using the API, Bolt devices can work like a board with an OS i.e. similar to Raspberry Pi or Beagle Bone, with the exception of the OS, which in this case, will reside on a remote VPS (Virtual Private Server). The Bolt will receive data from the sensors and push to the VPS with a Linux OS. The processing will take place on the VPS and it will push the commands to control motors, LEDs, and actuators to the Bolt device. You can use all the features of a Linux OS in this kind of a system.

6.2.4 VISUAL STUDIO CODE

Visual Studio Code combines the simplicity of a source code editor with powerful developer tooling, like IntelliSense code completion and debugging.

First and foremost, it is an editor that gets out of your way. The delightfully frictionless edit-build-debug cycle means less time fiddling with your environment, and more time executing on your ideas.

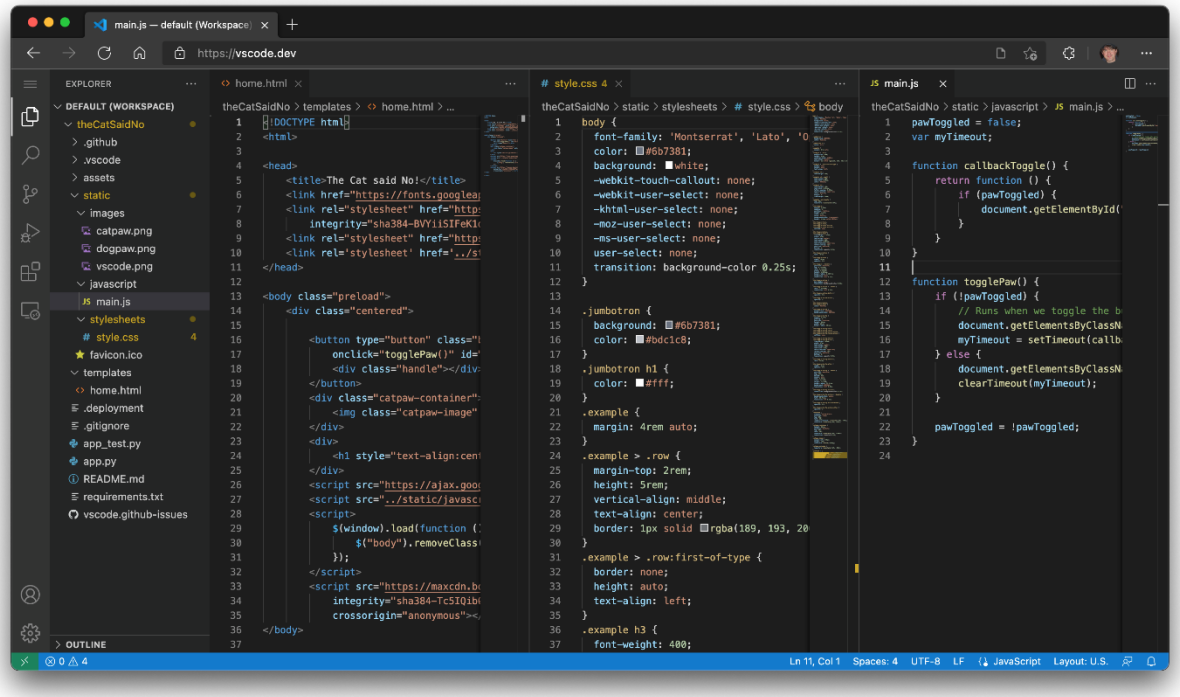

FIG 19 : VSCODE IDE

6.2.5 HTML

The **HyperText Markup Language**, or **HTML** is the standard markup language for documents designed to be displayed in a web browser. It can be assisted by technologies such as Cascading Style Sheets (CSS) and scripting languages such as JavaScript.

Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.

HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects such as interactive forms may be embedded into the rendered page. HTML provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items. HTML elements are delineated by *tags*, written using angle brackets. Tags such as `<**img** />` and `<**input** />` directly introduce content into the page. Other tags such as `<**p**>` surround and provide information about document text and may include other tags as sub-elements. Browsers do not display the HTML tags, but use them to interpret the content of the page.

HTML can embed programs written in a scripting language such as JavaScript, which affects the behavior and content of web pages. Inclusion of CSS defines the look and layout of content. The World Wide Web Consortium (W3C), former maintainer of the HTML and current maintainer of the CSS standards, has encouraged the use of CSS over explicit presentational HTML since 1997.[2] A form of HTML, known as HTML5, is used to display video and audio, primarily using the `<**canvas**>` element, in collaboration with javascript.

6.2.6 CSS

Cascading Style Sheets (CSS) is a style sheet language used for describing the presentation of a document written in a markup language such as HTML.[1] CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.[2]

CSS is designed to enable the separation of presentation and content, including layout, colors, and fonts.[3] This separation can improve content accessibility; provide more flexibility and control in the specification of presentation characteristics; enable multiple web pages to share formatting by specifying the relevant CSS in a separate .css file, which reduces complexity and repetition in the structural content; and enable the .css file to be cached to improve the page load speed between the pages that share the file and its formatting.

Separation of formatting and content also makes it feasible to present the same markup page in different styles for different rendering methods, such as on-screen, in print, by voice (via speech-based browser or screen reader), and on Braille-based tactile devices. CSS also has rules for alternate formatting if the content is accessed on a mobile device.[4]

The name *cascading* comes from the specified priority scheme to determine which style rule applies if more than one rule matches a particular element. This cascading priority scheme is predictable.

The CSS specifications are maintained by the World Wide Web Consortium (W3C). Internet media type (MIME type) text/css is registered for use with CSS by RFC 2318 (March 1998). The W3C operates a free CSS validation service for CSS documents.[5]

In addition to HTML, other markup languages support the use of CSS including XHTML, plain XML, SVG, and XUL.

6.7 Javascript

JavaScript,[10] often abbreviated **JS**, is a programming language that is one of the core technologies of the World Wide Web, alongside HTML and CSS.[11] Over 97% of websites use JavaScript on the client side for web page behavior,[12] often incorporating third-party libraries.[13] All major web browsers have a dedicated JavaScript engine to execute the code on the user's device.[14]

JavaScript is a high-level, often just-in-time compiled language that conforms to the ECMAScript standard.[15] It has dynamic typing, prototype-based object-orientation, and first-class functions. It is multi-paradigm, supporting event-driven, functional, and imperative programming styles. It has application programming interfaces (APIs) for working with text, dates, regular expressions, standard data structures, and the Document Object Model (DOM).

The ECMAScript standard does not include any input/output (I/O), such as networking, storage, or graphics facilities. In practice, the web browser or other runtime system provides JavaScript APIs for I/O.

JavaScript engines were originally used only in web browsers, but are now core components of some servers and a variety of applications. The most popular runtime system for this usage is Node.js.

Although Java and JavaScript are similar in name, syntax, and respective standard libraries, the two languages are distinct and differ greatly in design.

CHAPTER 7
RESULT AND CONCLUSION

In case of emergency and dangerous situations we have to alert the doctor immediately. Forthis we are using a GSM based network for doctor to patient communication in the hospital andeven to communicate and indicate the status of the patient through SMS. This way ofcommunication is actually done with the GiSM network. Each patient will be given this module and with the help of this module the patient health condition ismonitored and if there is any change in the condition of the health then it immediately sends thatchanged data through GSM to the local system where the main module is connected to thecomputer to maintain the status of the patient. The heart beat is monitored with the pulse rate of the body. The high intensity light sensorsenses the expansion and contraction of the heart with the help of the nerves. That beam willtransmit the signal to the receiver and the minute change in the pulse is noticed as the heartbeat.if there is any change in the pulses then it is noticed as the change in the heart and then thecontroller will get a disturbed pulse count which indicates the fault or mafunction of the heart. The controller is fixed for a n0. of pulses initially. If there is any change in the any of the pulsecount then it considers as a malfunction of the heart and then it transmits the pulse count with the patients ID to the doctor in the hospital and at the same to it sends a sms to a fixed number in themicrocontroller. This is convenient process to monitor the patients' health conditions form any ofthe distance we present. Since we are Using the networks lnke GSM this makesthe user to communicate tor internal system and as well as to the longer distances. Curently, the wireless body area sensor network for heart rate, blood pressure and temperature sensor monitoring system is successfully designed for applications as

1. Heartbeat sensor
2. Temperature sensor
3. oxygen

The "Patient Health Monitoring Sensor Network" detects various parameters of people and assists them to overcome the eritical health condition.

Advantages

- Doctor will get call when patients body temperature and heart beat rises so that he can takeprecautionary measures even though he will be in remote place.

- Patient care takers can monitor the equipment easily.

7.1 OUTCOME

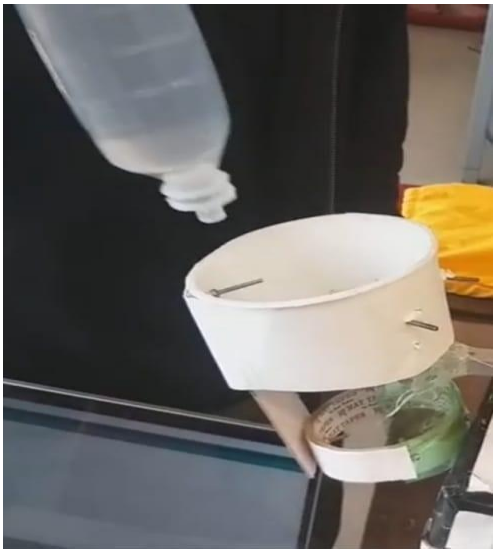

Fig 20: LoadCell

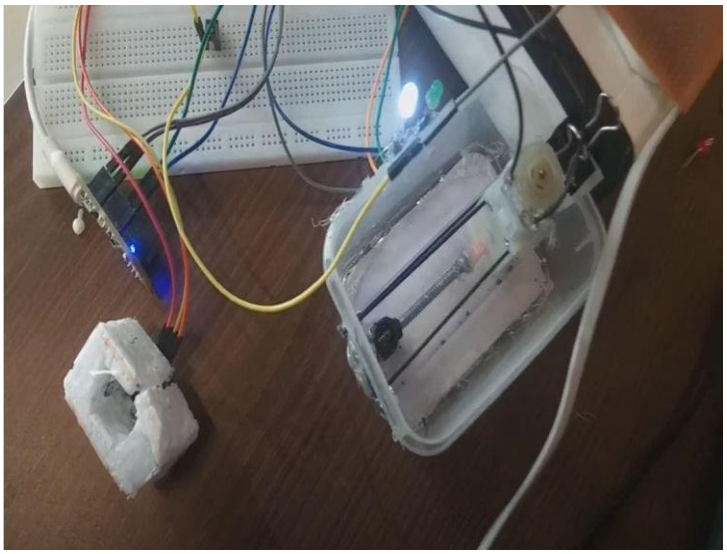

Fig 21:Flow Control

Fig 22 :Proof of Concept

7.2 FUTURE SCOPE

Monitoring the patient's condition can be done by using biomedical telemetry method where there is a mobile communication between microcontrollers. The temperature, heart beat and blood pressure are all sensed by using the appropriate sensors which are placed near the patient's body thatis under investigation. The biomedical telemetry system consists of temperature sensor, heart beatsensor, pressure sensor, A/D converter, signal conditioning circuit, microcontroller, data cable mobile phone, LCD display. The temperature sensor is used to sense the temperature value of thepatient's body.The sensed output is given to A/D converter where the analog signal is converted to digitalsignal. The digital output is given to microcontroller. The microcontroller delivers the signal formobile phone through data cable. Then the signal is transmitted to other mobile through GSMnetwork. The receiver mobile receives the signal and it is given fora PC. The signal from data cableis given to PC and the value gets displayed using monitor. The pressure sensor is used to sense the pressure value of the patient's body .The sensed output is given to A/D converter where the analogsignal is converted to digital signal. The digital output is given to microcontroller.The microcontroller delivers the signal for mobile phone through data cable. Then the signal istransmitted to other mobile through GSM network. The receiver mobile receives the signal and it isgiven for a PC. The signal from data cable is given to PC and the value gets displayed usingmonitor. Heart beat can be sensed by using heart beat sensor which is then given to a signalconditioning circuit. This unit delivers a train of pulses to microcontroller and the value getsdisplayed using Device.

7.3 CONCLUSION

We successfully completed this project "GSM BASED HEALTH MONITORING SYSTEM" under the guidance of our respected supervisor and group mates. We assure that all the equipments are purchased by our own and are 100% working.

The primary objective of this project is to develop a reliable, efficient and easily deployable remote patient monitoring system that can play a vital role in providing basie health services to the remote population and elderly patients. This project enables transmission of the system body parameters which is sensed from remote patient to the server PC by using wireless transmission technology - GSM. Using GSM, the doctor is notified and he will receive SMS on his mobile phone in case any parameter goes beyond the normal specified range. The main focus of this system is that the people can overcome the critical situation and be cautious of their health condition. This indeed is an easy, practical, inexpensive and yet veryeffective way for transmitting vital information to the healthcare staff and healthcare providers.

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