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Heart Attack Detection by Heart Beat Sensing

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Annotation: Nowadays numerous persons are mislaying their life owing to heart attack and shortage of medical attention to patient at correct stage. Hence, in this project we are implementing heart rate monitoring and heart attack recognition system using IoT. The patient will carry hardware having sensors with android application. The heartbeat sensor will allow checking heart beat readings and transmit them over the internet. The user may set the high and low level of heartbeat limits. Once these limits are set the system can start monitoring the patient's heartbeat and as soon as the heart beat readings goes above or below the limit set by the user the system will send an alert about high or low heartbeat as well about chances of heart attack. Keywords Heart rate sensor, Monitor, Detect, IoT, Android smart phone.

Heart attack can occur when the flow of blood to heart is blocked. Owing to late diagnosis of heart attack we are inadequate to save the lives of many humans. In this paper, we suggest a system that will detect heart attack by monitoring the heart rate based on IoT (Internet of Things). For a healthy adult, ordinary heartrate is 60 to 100 bpm (beats per minute). Athlete's heart beat generally range from 40 to 60 bpm depending upon their fitness. If a person's heart rate is constantly over 100 beats per minute then the person is said to be

having higher heart rate which is also notorious as tachyarrhythmia. It can diminution the efficiency of heart by letdown the amount of blood pumped through the body can result in chest pain and lightheadedness. With the advancement in technology it is easy to monitor the patient's heart rate even at home. IoT is dexterity of network mechanism to intellect and gather information from world ubiquitously us then share the information athwart internet anywhere it can be managed for some tenacity.

1-1 INTRODUCTION:

Heartbeat is the number of heart beats per unit of time which is generally expressed in beats per minute (bpm). Heart beat can change as the body needs to absorb oxygen and release carbon dioxide. It alters during exercise or at rest. The measurement of heart beat is mostly used by medical professionals as a primary test to help in the diagnosis and tracking of the medical conditions.

Heartbeat and body temperature are very important parameters that are routinely measured whenever a patient arrives in a hospital which makes heartbeat one of the very significant property of cardiovascular system. The heart rate of a healthy adult at rest is around 72 bpm [4]. Athletes normally have lower heart rate than less active people which leads us to the fact that the persons who are more excessively involved in exercise or physical training are more likely to have less heart rate than those who are not involved in intense exercise. Small babies tend to have much higher heartbeat (120 bpm) in comparison to older children (90 bpm). Heart rate increases during exercise while it returns back to normal rate slowly after the exercise is finished. The rate at which the heart rate returns back to normal value is an indication of the fitness of a person. If the heart rate is lower than the normal heart rate, then it is normally an indication of bradycardia while if the heart rate is higher than the normal heart rate, then the condition is known as tachycardia.

Similarly, the body temperature also changes from one person to another and varies throughout the day. The body temperature is found to be lowest in the early morning while it is highest during the early evening. It is necessary to monitor the changes regularly. An average human adult has normal body temperature of around 37oC or 98.6oF.

However, it is difficult to define an accurate value of body temperature as it varies according to daytime, age and physical state of a person. So, the normal body temperature of a healthy person can be 36.1oC (97oF) in the early morning and can rise up to 37.2oC (99oF). Hence, normal range of body temperature of a healthy adult varies between 97oF and 100oF or 36.1oC and 37.8oC. The temperature sensor used here is LM35. This temperature sensor generates an analog output voltage that is proportional to the temperature. So, this temperature sensor requires an analog to digital converter to convert the analog output voltage to a digital form. For this reason, a microcontroller is used to convert the analog value to a digital form.

1-2 Objective

1- To develop health monitoring system i.e. it measures body temperature and heart rate.

2- To design a system to store the patient data over a period of time using database management.

3- To do analysis of collected data of sensors.

1-3 Applications of Heart Rate Monitor using Arduino

1- A simple project involving Arduino UNO, 16×2 LCD and Heartbeat Sensor Module is designed here which can calculate the heart rate of a person.

2- This project can be used as an inexpensive alternative to Smart Watches and other expensive Heart Rate Monitors.

1-4 PRINCIPLE WORK:

The proposed system have eminence of detecting heart attack with help of observing heart rate based on internet of thing. Our method uses a pulse sensor, Arduino board and a Wi-Fi module. After setting up the system, the pulse sensor will start sensing heart rate readings and will display the heartbeat of person on LCD screen. Also, with the use of Wi-Fi module it will transmit the data over internet. System allows a set point which can help in determining whether a person is healthy or not by checking his/her heartbeat and comparing it with set point. After setting these limits, the system will start monitoring the heart rate of patient and immediately the heart rate goes above or below the certain limit the system will send an alert message. As a part of this project we are implementing an android application model that will track the heartbeat of particular patient and monitor it correctly and give the emergency message on chances of heart attack.

1-5 Advantages

- ✓ Portable system
- ✓ Save risk of heart attack as you can check it in home
- ✓ Affordable system
- ✓ Temperature and Heart beat monitoring by single device
- ✓ All Patient monitored by single person seating in Server room.
- ✓ This system also helps for Hospital monitoring system.

1-6 Disadvantages

- ✓ Unavailability of networks leads to failure in alerting ambulance and doctor
- ✓ Using Bluetooth power consumption will be more

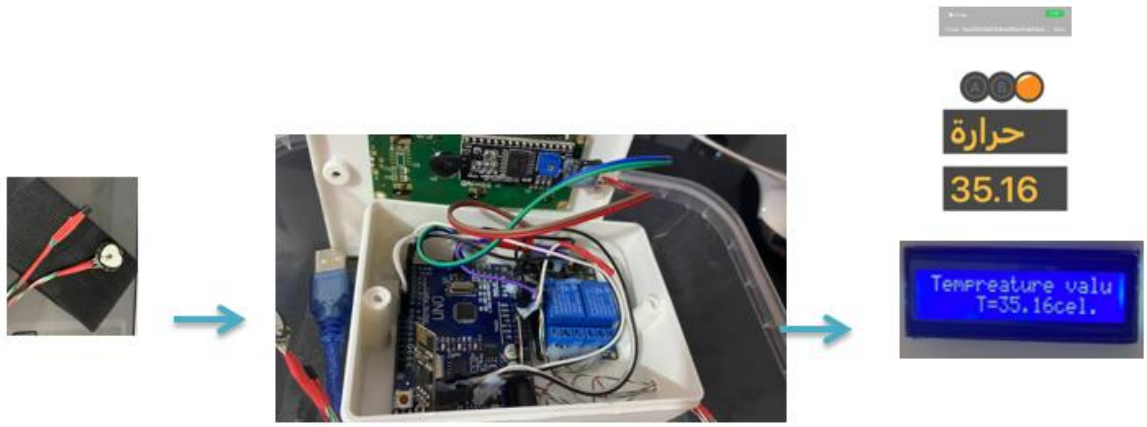

Figure (1-1): Project circuit

2-1 Historical Overview:

The history of coronary syndromes and sudden death, and apoplexy or stroke, goes back to antiquity and has been thoroughly treated by historians and experts from many disciplines. By the beginning of the twentieth century, a heart attack with myocardial infarction was well known to cause death, but comprehension of it as a syndrome that one might survive was much delayed. When that awareness finally came and diffused into the practicing community in the 1920s and after, it had a major effect on the recognition of coronary disease as epidemic after World War II, which, in turn, gave preamble and impetus to CVD epidemiology and preventive cardiology. Because coronary disease was newly epidemic, it was reasoned by a few pioneers that its causes, and conceivably its preventives, must therefore lie in changed environment.

John Hunter, a brilliant English physician of the eighteenth century, was probably the first in Western medicine to paint the clinical picture of chest pain, called angina pectoris, and sudden death. Noting that his own symptoms were aggravated by anger, he complained that his life was "in the hands of any rascal who chose to annoy or tease" him. He proved the case by dying abruptly after an argument with–we know not whether a rascal–a fellow member of his St. George's Hospital board (Liebowitz 1970, 102).

Part of the historical delay and confusion in recognizing heart attacks apparently lay in the Greek word, kardialgia, which could mean either abdominal or precordial pain. Biblical and Talmudic references abound, however, about chest pain of a life-threatening nature, and Hippocrates mentions sudden death related to an episode of chest distress (Leibowitz 1970).

2-2 Theoretical Background

2-2-1 Arduino UNO:

The Uno is a huge option for your initial Arduino. It consists of 14-digital I/O pins, where 6- pins can be used as PWM (power jack, a USB connection and more. It includes everything required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give the supply to get started with a AC-to-DC adapter or battery.

2-2-2 Pulse sensor:

Pulse sensor has three pin and connection of it with Arduino is very easy. Connection is made through 5V supply provided by Arduino, the ground pin of the pulse sensor is connected to the ground of the Arduino and the signal pin to the A0 of

Arduino. Objective

- To develop health monitoring system i.e. it measures body temperature and heart rate.
- To design a system to store the patient data over a period of time using database management.
- To do analysis of collected data of sensors pulse oximeter measures the amount of oxygen in a patient's blood by sensing the amount of light absorbed by the blood in capillaries under the skin. In a typical device, a sensing probe is attached to the patient's finger with a spring- loaded clip or an adhesive band.

On one side of the probe is a pair of Light- Emitting Diodes (LEDs), and on the other side is a photodiode. One of the LEDs produces red light, and the other produces infrared light. Pulse oximetry depends on the optical characteristics of hemoglobin, the blood protein that carries oxygen. When hemoglobin is more highly oxygenated, it becomes more transmissive to red light and more absorptive to infrared light. When hemoglobin contains little oxygen, it becomes relatively more transmissive to infrared, and more absorptive to red light. This property means that by measuring the ratio of red light to infrared light passing through the patient's finger, the probe can produce a signal proportional to the amount of oxygen in the blood. In addition, the surge of blood on each heartbeat generates a signal representative of the patient's pulse rate(Dwivedi 2014).

Since the output of the photodiode is a low amplitude current, some signal conditioning must be applied before it can be used. Operational amplifier is an ideal choice for use in a resistor-feedback trans impedance amplifier configuration. This configuration is also used in other bioelectric sensing applications. The resulting output voltage is read by an analog-to-digital converter on a microcontroller micro controller calculates the ratio of red light to infrared light, and determines the corresponding oxygen saturation level using a lookup table. This value is then sent via serial communications link to a data acquisition system, or, in the care of a stand-alone pulse oximeter, displayed for the user. In this project we show that how we monitor the heart beat by pulse oximetry technique. In this project we use innovative technique to measure the heart beat measurement. This is achieve by pulse oximetry logic. We use this technique to get the pulse from body and to amplify the signal and display this data on the LCD .We use this technique

2-2-3 Temperature Sensor:

LM35 sensor is used for measurement of body temperature. Sensor is put in contact with body and it senses body temperature. It is calibrated linearly in Celsius. It has low self-heating capability. Also id doesn't require external

2-2-4 Wi-Fi Module:

The ESP8266 Wi-Fi module is a self-contained SOC with incorporated TCP/IP protocol stack that can offer any controller access to Wi-Fi network. It uses 802.11 b/g/n protocols. Standby power consumption is less than 0.1mW.

2-2-5 LCD Display Screen:

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. We are using 16x2 LCD display which has 2 horizontal lines comprising a space of 16 displaying characters.

2-2-6 Jumper Wireisan

Electrical wire or group of the min a cable with a connector or pin at each end.

2-2-7 I2C:

Stands for Inter-Integrated Circuit. It is a bus interface connection protocol incorporated into devices for serial communication. It was originally designed by Philips Semiconductor, and it is a widely used protocol for short- distance communication .

2-2-8 2 Channel 5V Relay Module

This is a LOW Level 5V 2-channel relay interface board, and each channel needs a 15-20mA driver current. It can be used to control various appliances and equipment with large current.

It is equipped with high-current relays that work under AC250V 10A or DC30V 10A. It has a standard interface that can be controlled directly by a microcontroller.

3.1 Introduction

Wireless sensors for heart rate and body temperature are incorporated in the proposed health monitoring program Arduino is the primary element that is convoluted in this project. This paper highlights the sensor health monitoring system which establishes a selection model for sensor automation to find the least informative, cost-effective sensor component and builds an energy-efficient, automated detection scheme based on the

3-2-1-3 Different Ways To Power An Arduino UNO Board

- **USB Powered Arduino**

The USB port of the Arduino Uno can be connected to an USB device or port that can provide a stable 5V output like a computer or power bank or USB charger, etc. By using the USB cable, you

can eliminate the need for an external power source, while debugging if your total circuit's current requirement is less than that of the computer's USB port can provide. Not only that, you can use it with any standard power bank which makes your project totally portable. A USB 2.0 port can provide current up to 500mA and it is more than enough for an Arduino UNO.

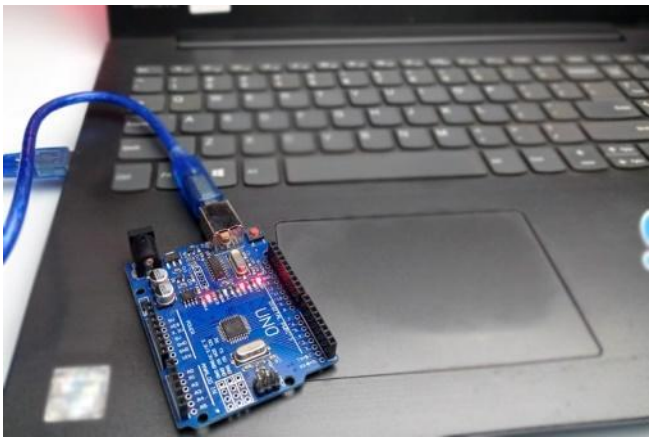

Figure (2-3): computer's USB port

- **Using Arduino Power Jack**

Arduino Uno and all many other big form factor Arduino boards are equipped with a standard 2.1mm DC power jack. Arduino Uno accepts 7-12V dec through this port and the onboard voltage regulator regulates it down to the required 5 and 3.3V. The centre pin is positive and the outer sleeve is grounded. You can use any 12V AC-DC adapter with proper out voltage and proper connector to power your Arduino board. It is more convenient when deploying your project where it's not constantly monitored.

Figure (3-3): Power Jack

You can also use a 9V battery to power the Arduino Uno, with the help of a snap-in connector with a DC Barrel Jack. This will allow us to use the Arduino as a portable device. It's Really helpful when there is no mains voltage available. And since the 9V batteries are cheap and easily available, this option will help to do projects that are meant to be operated in remote areas, Voltage(7-12 v) ,Current (800mA).

Figure (3-5): LCD

3-2-2 16x2 LCD Display

The term LCD refers to the liquid crystal display. It is one kind of electronic display module used in a wide range of applications such as various circuits and devices such as mobile phones,

calculators, computers, televisions, etc., these displays are mainly preferred for multi-segment light-emitting diodes and seven-segment LEDs. The main benefits of using this unit are inexpensive; Simply put, animation is programmable, there are no restrictions on displaying custom

The 16×2 LCD pinout is shown below.

- **Pin1 (Ground/Source Pin):** This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- **Pin2 (VCC/Source Pin):** This is the voltage supply pin of the display, used to connect the supply pin of the power source.

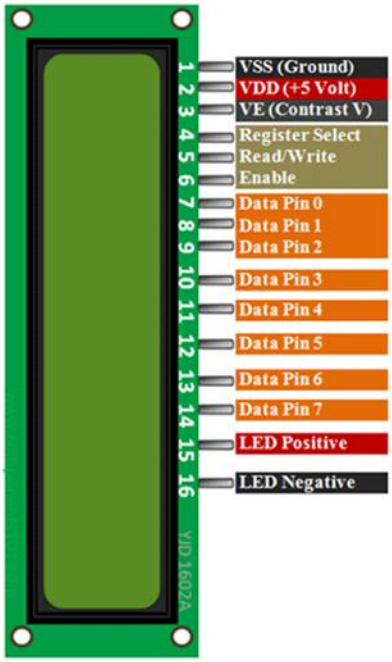

Figure (3-6): LCD 16× 2 Pin Diagram

- **Pin3 (V0/VEE/Control Pin):** This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- **Pin4 (Register Select/Control Pin):** This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- **Pin5 (Read/Write/Control Pin):** This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- **Pin 6 (Enable/Control Pin):** This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- **Pins7-14 (Data Pins):** These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- **Pin15 (+ve pin of the LED):** This pin is connected to +5V
- **Pin 16 (-ve pin of the LED):** This pin is connected to GND.

Features of LCD16x2

- ✓ The operating voltage of this LCD is 4.7V-5.3V

- ✓ It includes two rows where each row can produce 16-characters.
- ✓ The utilization of current is 1mA with no backlight
- ✓ Every character can be built with a 5×8 pixel box
- ✓ The alphanumeric LCDs alphabets & numbers
- ✓ Is display can work on two modes like 4-bit & 8-bit
- ✓ These are obtainable in Blue & Green Backlight
- ✓ It displays a few custom generated characters

3-2-3 Converter I2C - Display :-

I2C lcd adapter is a device containing a micro-controller PCF8574 chip. This micro-controller is a I/O expander, which communicates with other micro-controller chip with two wire communication protocol. Using this adapter anyone can control an 16x2 LCD with only two wire(SDA, SCL). It saves many pins of arduino or other micro-controller. It has an built in potentiometer for control lcd contrast. The default I2C address is 0x27. You can change this address by connecting A0, A1, A2.

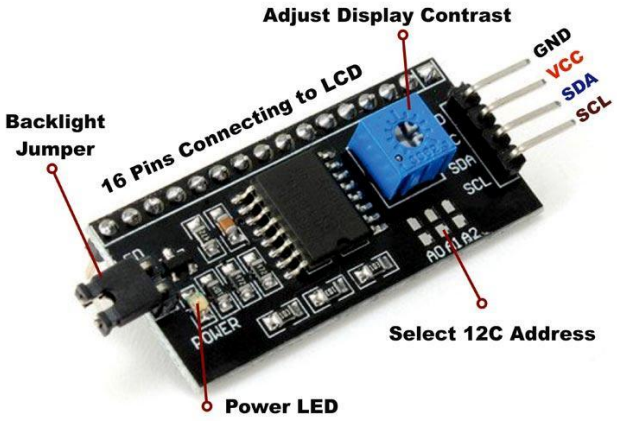

Figure (3-7): Details and Connections of I2C LCD Adapter

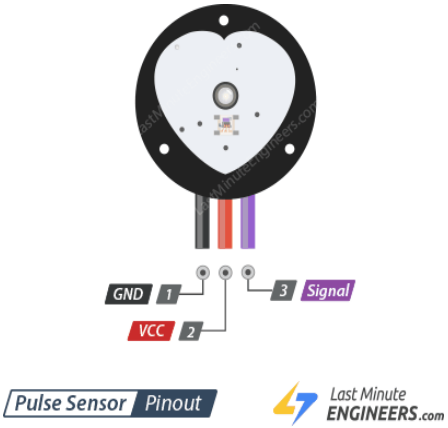

Figure (3-8): Pulse Sensor connection

3-2-4 Pulse Sensor

The Pulse Sensor is a plug-and-play heart-rate sensor for Arduino.

It can be used by students, artists, athletes, makers, and game & mobile developers who want to easily incorporate live heart-rate data into their projects. The essence is an integrated optical amplifying circuit and noise eliminating circuit sensor. Clip the Pulse Sensor to your earlobe or

fingertip and plug it into your Arduino, you can ready to read heart rate. Also, it has an Arduino demo code that makes it easy to use.

The pulse sensor has three pins: VCC, GND & Analog Pin, There is also a LED in the centre of this sensor module which helps in detecting the heartbeat. Below the LED, there is a noise elimination circuitry that is supposed to keep away the noise from affecting the readings.

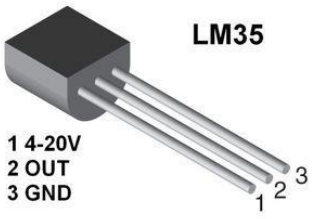

Figure (3-9): Lm35 connection

3-2-5 Lm35 Temperature Sensor:

The **LM35** series are precision integrated-circuit temperature devices with an output voltage linearly-proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°Cover a full −55°C to 150°C temperature range.

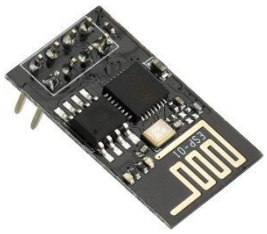

Figure (3-10): Esp8266

3-2-6 Esp8266:

The **ESP8266** is a very user-friendly and low-cost device to provide internet connectivity to your projects. The module can work both as an Access point (can create hotspot) and as a station (can connect to Wi-Fi), hence it can easily fetch data and upload it to the internet making the Internet of Things as easy as possible. It can also fetch data from the internet using API's hence your project could access any information that is available on the internet, thus making it smarter. Another exciting feature of this module is that it can be programmed using the Arduino IDE which makes it a lot more user-friendly.

The ESP8266 module works with 3.3V only, anything more than 3.7V would kill the module hence be cautious with your circuits. Here is its pins description.

Pin 1: Ground: Connected to the ground of the circuit

Pin 2: Tx/GPIO – 1: Connected to Rx pin of programmer/uC to upload program

Pin 3: GPIO – 2: General purpose Input/output pin

Pin 4 : CH_EN: Chip Enable/Active high

Pin 5: Flash/GPIO – 0: General purpose Input/output pin

Pin 6 : Reset: Resets the module

Pin 7: RX/GPIO – 3: General purpose Input/output pin

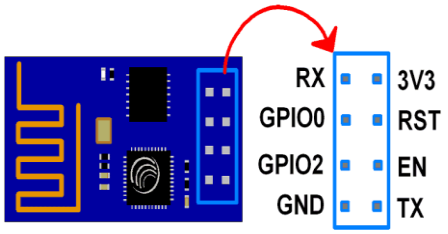

Figure (3-11): Esp8266 connection

Pin 8: Vcc: Connect to +3.3V only

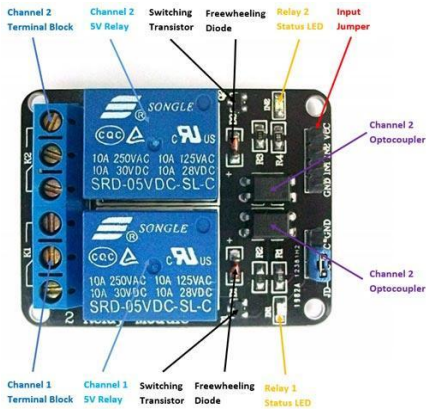

Figure (3-12): 5v Dual-Channel Relay

3-2-7 5v Dual-Channel Relay Module:

The dual-channel relay module is more or less the same as a single-channel relay module, but with some extra features like optical isolation. The dual-channel relamodule can be used to switch mains powered loads from the pins of a microcontroller.

Pin Number	Pin Name	Description
1	JD-V_{CC}	Input for isolated power supply for relay coils
2	V_{CC}	Input for directly powering the relay coils
3	GND	Input ground reference
4	GND	Input ground reference
5	IN1	Input to activate the first relay
6	IN2	Input to activate the second relay
7	V_{CC}	V_{CC} to power the optocouplers, coil drivers, and associated circuitry

Table 2. showing the 5v Dual-Channel Relay connection

Components present on a 5V Dual Channel Relay Module

The following are the major components that would find on a Dual channel Relay module, we will discuss them in detail further in this article.

5V Relay, Opt coupler, Diodes, Transistors, Resistors, LEDs, Male Headers, 3-pin Terminal connectors, etc.

- The dual-channel relay module contains switching relays and the associated drive circuitry to make it easy to integrate relays into a project powered by a microcontroller. On the left are two terminal blocks, which are used to connect mains wires to the module without soldering.
- Next, come to the two relays. As marked on the body of the relay, the relay coil is rated for 5VDC, and the contacts are rated for 10A at 250VAC or 30VDC, or 125VAC or 28VDC.

- The switching transistors amplify the signal from the inputs enough to drive the relay. *The freewheeling diodes prevent voltage spikes across the switching transistors. The status LEDs turn on when the relay is active and indicate switching.
- The opt couplers are used to provide additional isolation between the input and the relays. The isolation can be selected using the V_{CC}/JDV_{CC} jumper.
- The input jumper has two input and two power pins and can be easily used to connect to jumper wires and other microcontrollers and sensors.

The dual-channel relay module can be used to switch mains powered loads from the pins of a microcontroller. Since there are two channels on the same board, two separate loads can be powered. This is useful for home automation.

The loads can be connected as follows:

3.3 Connecting The Electronic Circuit

3-3-1 The Circuit Connection

For designing IoT Based Patient Health Monitoring System using ESP8266 & Arduino, assemble the circuit as shown in the figure below.

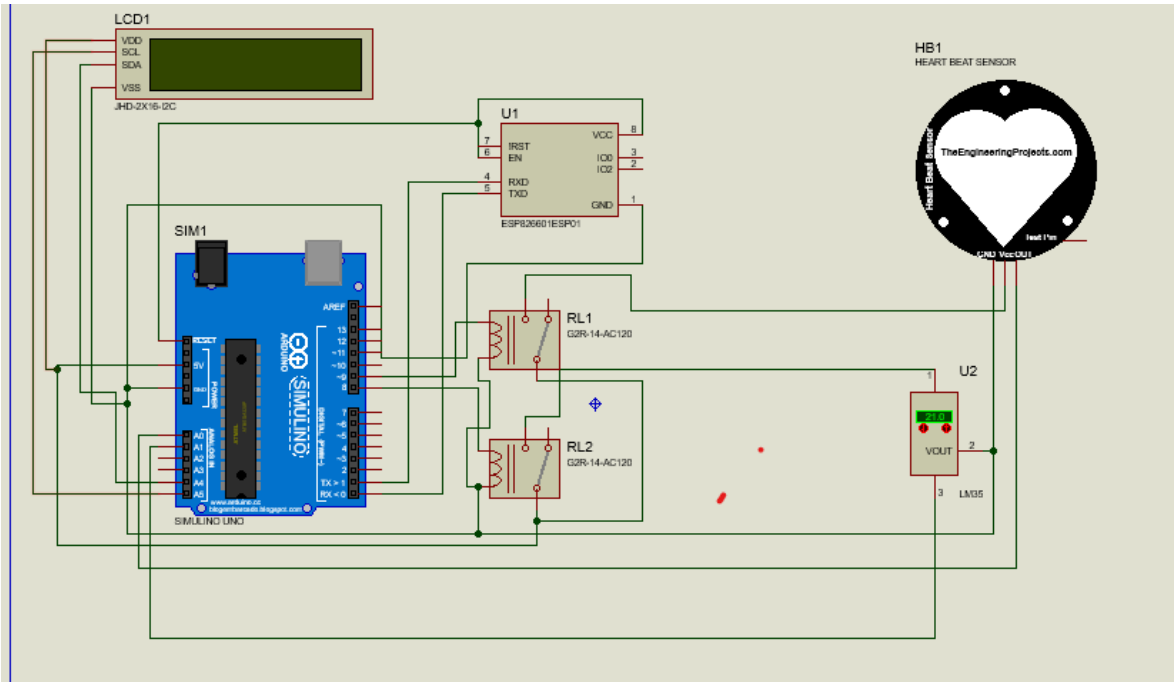

Figure (3-14): electronic circuit

3-3-2 Working Methodology

In this system uses two circuits.

1. Transmitting circuit

2. Receiver circuit

The system makes use of heart beat sensor to find out the current heart beat level and display it on the LCD screen. The transmitting circuit includes AVR family microcontroller interfaced to LCD screen and this transmitting circuit is powered by 12V transformer. Similarly, the receiving circuit includes AVR family microcontroller and RF receiver and also has a 12V transformer. The receiver circuit also includes LED light and a buzzer which are used to alert the person supervising the heartbeat rate of the patient and turns on the LED light and buzzer as soon as the heartbeat level of the patient does not fall within the normal heart beat level set. Now we make this system

universal for all the hospital rooms. Operator can seat in single place and able to monitor all the patients.

The sensor shines a light lobe (a small very bright LED) through the ear and measures the light that gets transmitted to the Light Dependent Resistor. amplified signal gets inverted and filtered, in the Circuit. In order to calculate the heart rate based on the blood flow to the fingertip, a heartrate sensor is assembled with the help of LM358 OP-AMP for monitoring the heartbeat pulses. When System powered On IR TX starts emitting Light with 100% intensity towards blood cells. Light reflect back to Rx with '' 100% - x '' from it. This 'x' value is our Heart beat rate. All data will send directly to server room so in case of any emergency fast action can be perform. Heartbeat sensor is a monitoring device that allows one to measure his or her heart rate in real time or record the heart rate for later study.

It provides a simple way to study the heart function. When the sensor is working, the beat LED flashes in units on with each heartbeat. This digital output can be connected to the microcontroller directly to measure the Beats per Minute (BPM) rate. Temperature sensor is analogue quantity with the range 0-135 degree. All the data can detected by sensor and give display which is LCD of 16*2. Simultaneously we these data goes on server and display on control room. We make this system universal for all the hospital rooms. Operator can seat in single place and able to monitor all the patients.

4-1 Results

First, we need to connect the pulse sensor to the wrist where it can detect the pulse easily like finger, ears, etc. Then select B from the application, and then the pulse sensor measures the change in blood volume, which occurs when the heart pumps blood each time. body. This change in blood volume causes a change in the intensity of light through that organ. The Arduino will then convert this change into heartbeats per minute (BPM).

second the lm35 is also connected on the wrist and choose c from the web app the ESP8266 will then communicate with the Arduino and will send the data to the remotes app, which can be made from designing a specific design on the app and putting the design code in the program code, the ESP8266 will connect Network to the router which will save in the code and will send the sensor data over the internet.

Figure (4-1): Result With P

Conclusion. Upload the code to Arduino Uno and power on the system. Arduino tells us to put the wrist into the sensor and press the switch. Based on the data received from the sensor, the Arduino calculates the heart rate and displays the heartbeat in beats per minute.

Figure (4-2): Result With LM35 Temperature

4-2 DISCUSSION:

One key point of all critical care for elderly patient is the continuous monitoring of their vital signs. The results prove that the mobility, usability and performance of our proposed system have impacts on the user's attitude, and there is a significant positive relation between the user's attitude and the intent to use our proposed system. This proposed system is expected to monitor the electrical activity of heart of the patient under critical care more conveniently and accurately for diagnosing which can be interfaced with ESP 8266-01 WI-FI to bring it under a network system widely for the doctor to monitor the patient's condition sitting in his own office without being physically present near to the patients bed. Wireless – networked embedded device includes signal conditioning circuitry, sensors and a PIC controller with a wireless Transceiver module. To measure or monitor human movements or activities, a graphical LCD display is selected for its low price, small size, capability of continuous measurement, and ease of integration.

5- CONCLUSIONS AND RECOMMENDATIONS:

This research led to the development of a system which measured heartbeat and temperature of a patient and sent it to a remote end by the use of a microcontroller at a reasonable cost with great effect. It utilized remote patient monitoring system technology which enabled the monitoring of patients outside of clinical settings and leads to increasing access to health care as well as decreasing the health care delivery costs. Nowadays, most of the systems work in offline mode. The research utilized two sensors for measuring heartbeat and temperature of a body. These sensors are controlled by the microcontroller. For measurement of heartbeat, we used wrist to measure it accurately. The device uses the optical technology to detect the flow of blood through the finger. The heart beat monitor in our research counts the heart beat rate in beats per minute (bpm) for specific interval and transfers the calculated rate via GSM module and sends it to a remote end where it displays the observed data in a mobile display. Optical sensor with combination of infrared light emitting diode (IR LED) and IR photodiode senses the pulse rate that produces weak output of analog signal. The signal is then amplified andfiltered and fed to the microcontroller input. The microcontroller processes the input and calculates heart beat rate in beats per minute. Thus, calculated heart beat rate is displayed in liquid crystal display (LCD). The data is also displayed on the screen of a mobile device by using ESP 8266-01 WI-FI MODUIE . LM35 is used as a temperature sensor in this project which measures the temperature of the body and the measured data is fed to the transmitter module.

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