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IoT-Based Prediction of the Failure of Blood Pressure System

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Abstract: *Presents a wireless system that enables real-time health monitoring of multiple patient(s). In health care centers patient data such as heart rate needs to be constantly monitored. The proposed system monitors the heart rate and other such data of the patient's body. For example, heart rate is measured through Photoplethysmography. A transmitting module is attached which continuously transmits the encoded serial data using a Bluetooth module. A receiver unit is placed in the doctor's cabin, which receives and decodes the data and continuously displays it on a User interface visible on a PC/Laptop. This doctor can observe and monitor many patients at the same time. The system also continuously monitors the patient(s) data and in case of any potential irregularities, in the condition of a patient, the alarm system connected to the system gives an audio-visual warning signal that the patient of a particular room needs immediate attention. In case, the doctor is not in his chamber, the GSM modem connected to the system also sends a message to all the doctors of that unit giving the room number of the patient who needs immediate care.*

Keywords: Bluetooth, Health Monitoring, GSM, wireless

I. INTRODUCTION

Without doctors, the patient is unable to consult them, which could lead to an emergency. Each person's health is monitored on a given the increase of health issues in modern society, it is regarded as being extremely significant. General health is being severely harmed
by the increasingly stressed way of life. With longer wait times at hospitals and more patients, doctor fees have skyrocketed, which is particularly hurting those patients who cannot afford the fee or who are not experiencing serious illnesses but discover they are only after paying a substantial fee to the doctor.

II. AIM OF PROJECT

- Building a system that can offers the best of services - both in terms of man and machine.
- To give warning of early or dangerous deterioration.

III. PROJECT SPECIFICATIONS

1. 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
2. Gigabit Ethernet
3. USB 3.0 ports; 2 USB 2.0 ports.
4. Node MCU esp8266.
5. 2 × micro-HDMI ports (up to 4kp60 supported)
6. A good quality 2.5A power supply can be used if downstream USB peripherals consume less than 500mA in total.

Smart healthcare systems are receiving attention nowadays and are also providing socio -economical benefits in designing smart cities. IoT-based sensors and cloud computing combined have revolutionized the concept of a smart system. Smart healthcare systems include the remote monitoring of patients, the detection of disease, providing healthcare remotely, smart equipment, telemedicine, and remote medical operations. Such a system provides quick medical facilities in case of any emergency. In this setup, sensors are attached to the patient's body and provide real-time data on patients. Researchers

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designed a framework to handle the electronic records of the patients [5]. To monitor a patient's glucose level, the authors propose a smart healthcare system [6]. A smart ambulance controlled by robots was designed to provide an emergency health service to cardiovascular patients [3]. A data secure management system over the 6G network is proposed in [5]. Some studies have been performed to detect a forgery in the smart setup of healthcare systems. The authors discussed protocols and challenges of IoT.In recent times, ML has been applied to predic different cardiovascular diseases. Melillo et al. [3] proposed an automated system to separate high-risk heart failure patients from low-risk patients. They applied the Classification and Regression Tree (CART) and achieved a specificity value equal to 63% and sensitivity value equal to 93%. Guidi et al. [2] designed a decision support system to analyze heart failure patients. Authors compared different classifiers such as Support Vector Machine (SVM), Random Forest (RF), fuzzy rule-based CART, and Neural Network (NN). The RF and CART outperformed with 87% accuracy. Parthiban et al. [5] utilized SVM for the diagnosis of cardiac disease in diabetic patients and achieved 94% accuracy. Electronic health records are very useful for research and clinical purposes [6]. Minor errors in physical examinations of heart patients can be a danger for a patient's life while machine learning-based models have been effectively diagnosing heart diseases and reducing the death ratio [4].Shah et al. investigated different health condition.

IV. NEED OF PROJECT

The system allows user to share their symptoms and issues. It then processes users symptoms to check for various illness that could be associated with it. Here we use some intelligent data illnethat could be associated with patient's symptoms.

V. LITERATURE REVIEW

1."Internet of Thing Based HealthCare Monitoring System"

Author: 1. Shreyaasha Chaudhury, Debasmita Paul Publication Year: 2021 Advances in information and communication technologies have led to the emergence of the Internet of Things (IoT). IoT allows many physical devices to capture and transmit data, through the internet, providing more data interoperability methods. Nowadays IoT plays an important role not only in communication but also in monitoring, recording, storage, and display. Hence the latest trend in Healthcare communication methods using IoT is adopted. Monitored continually, aggregated, and effectively analyzed - such information can bring about a massive positive transformation in the field of healthcare. Our matter of concern in this project is to focus on the development and implementation of an effective healthcare monitoring system based on IoT.[1]

2."Blood Pressure Monitoring System using Wireless technologies "

Author: Bharat Singha, Shabana Uroojb, Sakshi Mishra, Surojeet Haldar Publication Year: 2016 This paper presents a simple solution for monitoring blood pressure in an economic and user-friendly method. Combining the concepts of the Internet of Things with an Arduino microcontroller and a pressure sensor a Blood Pressure Monitoring System using Wireless Technologies is developed. The project aims to set up a network so that concerned people can remotely access patients' blood pressure readings. Bluetooth and Wi-Fi technology is used to access results on handheld devices like mobiles, tabs, laptops, etc. The project also incorporates a prediction algorithm via MATLAB software program. Readings can be recorded over time manually and when the program such a data log is passed, it predicts possible blood pressure value for the patient and as well as suggest medical assistance like dosage of medicines.[2]

3."An IoT-Based Health Care and Patient Monitoring System Predict Medical Treatment using Data Mining Techniques"

Author: Aishwarya. B. ChavanPatil Publication Year: 2017 The majority of patients in the hospital are ambulatory and would benefit from the predictive and personalized monitoring system. Technology plays a major role in healthcare not only for sensory devices

but also in communication, recording, and display device. It is very important to monitor various medical parameters and post operational days. Hence the latest trend in Healthcare communication methods using IOT is adopted. The Internet of things catalyzes healthcare and plays a prominent role in a wide range of healthcare applications. In this project, the AVR-328 microcontroller(Arduino board) is used as a gateway to communicate to the various sensors such as the temperature

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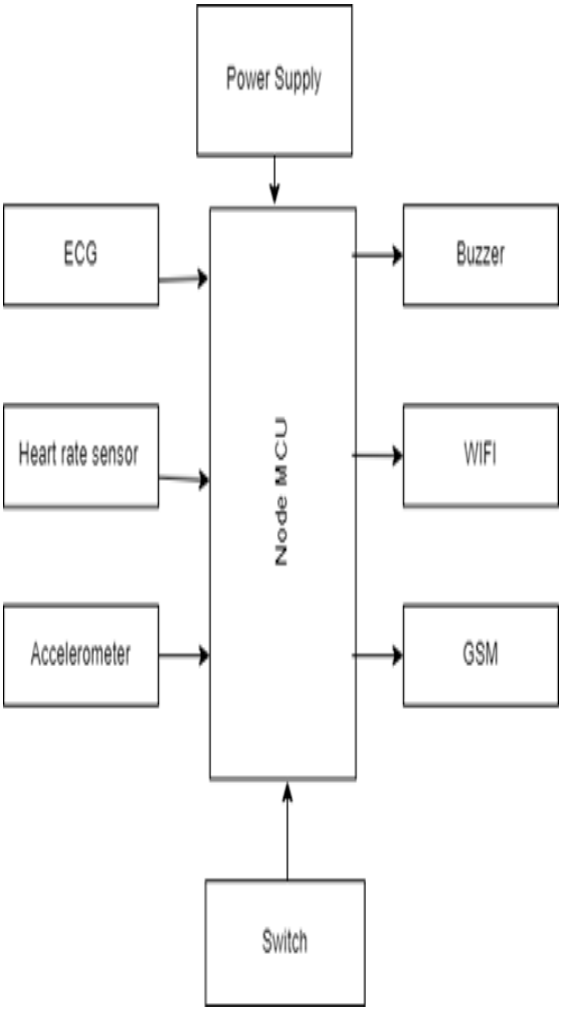
sensor, heartbeat sensor, ECG sensor, and sensor for keeping a track of drip levels(blood or saline). The microcontroller picks up the sensor data and sends it to the network through Wi-Fi and hence provides real-time monitoring of the health care parameters for doctors. The data can be accessed at any- time by the doctor. The controller is also connected to a buzzer to alert the caretaker about variations in sensor output. At the time of an extremity situation alert message is sent to the doctor through the android application connected to the cloud server. Hence quick provisional medication can be easily done by this system. Also, an ad- ditional subsystem is provided for the prediction of heart disease for the patient based on his/her health parameters. This system is efficient with low power consumption capability, easy setup, high performance, and time-to-time response.[3]

4. "Smart Health Care Monitoring System Using Android Application"

Author: Rameswari.R, Divya. N Publication Year: 2021 Innovation is changing the scene of the world and driving us towards a down-to-earth specialized world. The rising part of ICT and IoT has made an enormous effect on human services. It enhances the nature of care, builds patient security and information insurance, and limit working and regulatory cost. Me- dia transmission gadgets are easier to understand and utilized by everybody around the globe which has decreased the correspondence hole to a zero level. The paper clarifies a portion of the correspondence innovation and the particular conventions for moving the information in a protected way (i.e.,) how the imperative indications of patients are sent to the medical consultant for further treatment.[4]

VI. PROPOSED SYSTEM -

Fig 1 below shows the overall project's flow chart of the system.



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Major components

- Heart rate sensor
- Accelerometer
- WIFI Module
- ECG (Electrocardiography)
- GSM module
- NODE MCU
- Buzzer

1. Heart rate sensor-

PPG (Photoplethysmography) sensors use light-based technology to measure the blood volume controlled by the heart's pumping action. A heartbeat Sensor is an electronic device that is used to measure An optical heart rate sensor measures pulse waves, which are changes in the volume of a blood vessel that occurs when the heart pumps blood. Pulse waves are detected by measuring the change in volume using an optical sensor and green LED.

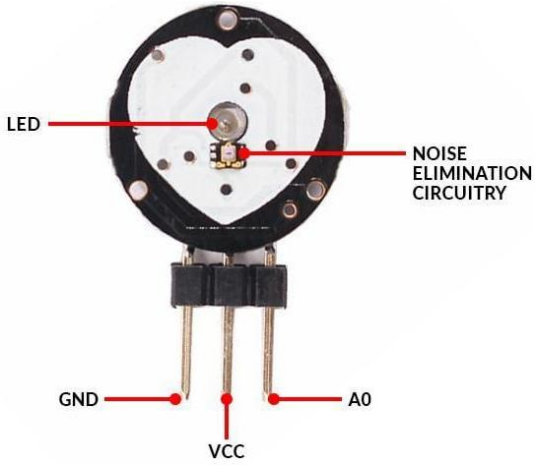

Figure (a):Heart Rate Sensor

Modern heart rate monitors commonly use one of two different methods to record heart signals (electrical and optical). Both types of signals can provide the same basic heart rate data, using fully automated algorithms to measure heart rate, such as the Pan-Tompkins algorithm and the of is ECG (Electrocardiography) sensors measure the bio-potential generated by electrical signals that control the expansion and contraction of heart chambers, typically implemented in medical devices. the heart rate i.e. speed of the heartbeat. Monitoring body temperature, heart rate, and blood pressure are the basic things that we do to keep healthy. To measure the body temperature, we use thermometers and sphygmomanometer to monitor the Arterial Pressure or Blood Pressure. Heart Rate can be monitored in two ways: one way is to manually check the pulse either at the wrists or neck and the other way is to use a Heartbeat Sensor. Pulse oximetry is used in this project to detect the heartbeat using fingers. When the heart expands (diastole) the volume of blood inside the fingertip increases and when the heart contracts (systole) the volume of blood inside the fingertip decreases. The resultant pulsing of blood volume inside the fingertip is directlyproportional to the heart rate and if you could somehow count the number of pulses in one minute, that's the heart rate in beats per minute (bpm). For this, an IR transmitter/receiver pair (LED) is placed in close contact with the fingertip. When the heart beats, the volume of blood cells under the sensor increases and this reflects more IR waves to the sensor when there is no beat the intensity of the reflected beam decreases. The pulsating reflection is converted to a suitable current or voltage pulse by the sensor. The sensor output is processed by suitable electronic circuits to obtain a visible indication (digital display).

Features:

• Biometric Pulse Rate or Heart Rate detecting sensor

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• Plug and Play type sensor
• Operating Voltage: +5V or +3.3V
• Current Consumption: 4mA
• Inbuilt Amplification and Noise cancellation circuit.
• Diameter: 0.625”
• Thickness: 0.125” Thick.

2. Accelerometer-

An accelerometer sensor is a tool that measures the acceleration of anybody or an object in its instantaneous rest frame. It is not a coordinate acceleration. Accelerometer sensors are used in many ways, such as in many electronic devices, smartphones, wearable devices, etc. An accelerometer sensor is a tool that measures the acceleration of anybody or an object in its instantaneous rest frame. It is not a coordinate acceleration. Accelerometer sensors are used in many ways, such as in many electronic devices, smartphones, wearable devices, etc.

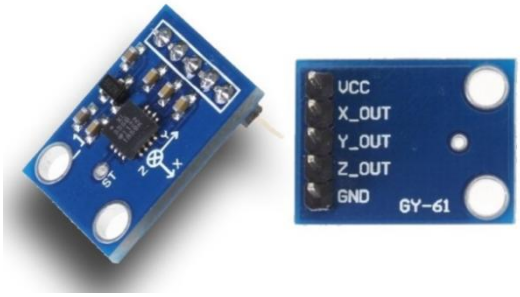

Figure (b): Accelerometer

An accelerometer is a tool that measures proper acceleration. Proper acceleration is the acceleration (the rate of change of velocity) of a body in its instantaneous rest frame;[2] This is different from coordinate acceleration, which is acceleration in a fixed coordinate system. For example, an accelerometer at rest on the surface of the Earth will measure an acceleration due to Earth’s gravity, straight upwards[3] of g 9.81 m/s2. By contrast, accelerometers in free fall (falling toward the center of the Earth at a rate of about 9.81 m/s2) will measure zero. Accelerometers have many uses in industry and science.Highly sensitive accelerometers are used in inertial navigation systems for aircraft and missiles. Vibration in rotating machines is the monitored by accelerometers. They are used in tablet computers and digital cameras so that images on screens are always displayed upright. In unmanned aerial vehicles, accelerometers help to stabilize flight.
When two or more accelerometers are coordinated with one another, they can measure differences in proper acceleration, particularly gravity, over their separation in space—that is, the gradient of the gravitational field. Gravity gradiometry is useful because absolute gravity is a weak effect and depends on the local density of the Earth, which is quite variable. Single- and multi-axis accelerometers can detect both the magnitude and the direction of the proper acceleration, as a vector quantity, and can be used to sense orientation (because the direction of weight changes), coordinate acceleration, vibration, shock, and falling in a resistive medium (a case in which the proper acceleration changes, increasing from zero). Micro machined microelectro mechanical systems (MEMS) accelerometers are increasingly present in portable electronic devices and video-game controllers, to detect changes in the positions of these devices.

3. WIFI Module

The ESP8266 WiFi Module is a self-contained SOC with an integrated TCP/IP protocol stack that can give any microcontroller access to your WiFi network. The ESP8266 is capable of either hosting an application or offloading all WiFi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can hook this up to your Arduino device and get about as much WiFi-ability as a WiFi Shield offers (and that’s just out of the box)! The ESP8266 module is an extremely cost-effective board with a huge, and ever-growing, community. The ESP8266 module is a low-cost standalone wirelesstransceiver that can be used

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for end-point IoT developments. It employs a 32-bit RISC CPU based on the TensilicaXtensa L106 running at 80 MHz (or over clocked to 160 MHz). It has a 64 KB boot ROM, 64 KB

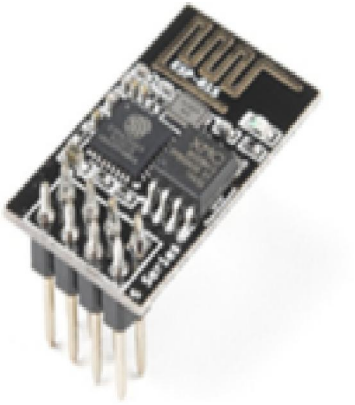

Figure (c): WIFI Module

instruction RAM, and 96 KB data RAM. External flash memory can be accessed through SPI. ESP-01 comes with 8 pins (2 GPIO pins) – PCB trace antenna. (shown in the above figure)

ESP-02 comes with 8 pins, (3 GPIO pins) – U-FL antenna connector. ESP-03 comes with 14 pins, (7 GPIO pins) – Ceramic antenna. ESP-04 comes with 14 pins, (7 GPIO pins) – No ant.

ECG (Electrocardiography)-

Lead wires are used to connect theelectrodes to the ECG device. The heart's electrical activity is then recorded, analyzed, and printed out. The body receives no electrical energy. The heart's various muscle contractions are coordinated by natural electrical impulses to maintain proper blood flow.

Figure(d):Electrocardiography

During an ECG, up to 12 sensors (electrodes) are attached to the chest and limbs. The electrodes are sticky patches with wires that connect to a monitor. They record the electrical signals that make the heartbeat. A computer records the information and displays it as waves

on a monitor or paper. Some wearable sensors ranging from wet electrode sensors to dry sensors, textile-based sensors, knitted integrated sensors (KIS), and planar fashionable circuit boards are used the in ECG measurement Electrocardiography or ECG is a technique for gathering electrical signals which are generated from the human heart. When someone experiences physiological arousal then the ECG sensor allows us to recognize the level, however, it is also used for understanding the psychological state of humans. So an AD8232 sensor is used to calculate the electrical activity of the heart. This is a small chip and its electrical action of this can be charted like an ECG (Electrocardiogram). Electrocardiography can be used to help in diagnosing different conditions of the heart. This article provides an overview of the AD8232 ECG Sensor.

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What is an AD8232 ECG Sensor?

The AD8232 ECG sensor is a commercial
board used to calculate the electrical movement of the human heart. This action can be charted like an Electrocardiogram and the output of this is an analog reading. Electrocardiograms can be very noisy, so to reduce the noise the AD8232 chip can be used. The working principle of the ECG sensor is like an operational amplifier to help in getting a clear signal from the in tervals simply. The AD8232 sensor is used for signal conditioning in ECG as well as other measurement applications of biopotential. The main purpose of this chip is to amplify, extract as well as filter biopotential signals which are small in noisy conditions like those formed through the replacement of remote electrodes as well as motion. AD8232 Pin Configuration The heart rate monitoring sensor like AD8232 includes the pins SDN pin, LO+ pin, LOpin, OUTPUT pin, 3.3V pin, and GND pin. So that we can connect this IC to development boards like Arduino by soldering pins. Additionally, this board includes pins like the right arm (RA), left arm (LA) right leg (RL) pins to connect custom sensors. An LED indicator in this board is used to indicate the heartbeat rhythm of humans. The AD8232 sensor comprises a function like quick restore, used to decrease the length of long resolving tails of the HPFs. This sensor is accessible in a 4 mm × 4 mm size, and the package of this sensor is 20-lead LFCSP. It operates from 40°C -to +85°C but the performance is specified from 0°C -to 70°C.

GSM module

Newline A GSM modem or GSM module is a device that uses GSM mobile telephone technology to provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. They use SIMs to identify their device to the network. A GSM modem or GSM module is a device that uses GSM mobile telephone technologyto provide a wireless data link to a network. GSM modems are used in mobile telephones and other equipment that communicates with mobile telephone networks. They use SIMs to identify their device to the network.

Figure(e):GSM module

GSM is a mobile communication modem; it stands for global system for mobile communication (GSM). The idea of GSM was developed at Bell Laboratories in1970. It is a widely used mobilecommunication system in the world. GSM is an open and digital cellular technology
used for transmitting mobile voice and data services operating at the 850MHz, 900MHz, 1800MHz, and 1900MHz frequency bands. GSM technology was developed as a digital system using the time division multiple access (TDMA) technique for communication purposes. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its
particular time slot. The digital systemcan carry 64 kbps to 120 Mbps of data rates.

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There are various cell sizes in a GSMsystem such as macro, micro, pico, and umbrella cells. Each cell varies as per the implementation domain. There are five different cell sizes in a GSM networkmacro, micro, pico, and umbrella cells. The coverage area of each cell varies according to the implementation environment. The time division multiple access (TDMA) technique relies on assigning different time slots to each user on the same frequency. It can easily adapt to data transmission and voice communication and can carry 64kbps to 120Mbps of data rate. Digital cellular technology like GSM (Global System for Mobile Communication) is used to transmit mobile data as well as voice services. This concept was implemented at Bell Laboratories using a mobile radio system in 1970. As the name suggests, it is the standardization group name that was established in the year 1982 to make a general European mobile telephone standard. This technology owns above 70percent of the market share of digital cellular subscribers around the world. This technology was developed by using digital technology. At present, GSM technology supports above 1 billion mobile subscribers around the world in the above 210 countries. This technology provides voice and data services fromfundamental to complex. This article discusses an overview of GSM technology.

Specification:

• Dual-Band 900/ 1800 MHz.
• GPRS multi-slot class 10/8GPRS mobile station class B. Compliant with GSM phase 2/2+
• Dimensions: 24*24*3 mm.
• Weight: 3.4g.
• Control via AT commands (GSM 07.07,07.05, and SIMCOM enhanced AT Commands)
• Supply voltage range: 5V.
• Low power consumption: 1.5mA (sleepmode).

NODE MCU-

Operating Voltage: 2.5 to 3.3V Operating current: 800 mA 3.3V 600mA on-board voltage regulation ESP8266 comes up with 2 switches one isreset and the other one is a flash button, Reset button is used to reset NodeMCU, and the flash button is used to download and used while upgrading the firmware. The board has a built in LED indicator which is connected to the D0 pin. The NodeMCU board also contains a CP2102 USB to UART module to convert the data from USB to serial so that it can be controlled and programmed via computer. The esp8266 has 4 power pins: One VIN pin for the input power supply and three 3.3V pins for the output power supply. Even if 5V regulated supply is given through VIN, the voltage regulator will decrease it to 3.3v during output. The esp8266 has 3 GND pins which indicate ground supply. Generally, the negative terminals are connected to these pins.

Esp8266 board also has I2C pins which can be used both as I2C master and I2C Slave. These pins are used to connect various I2C sensors and peripherals in your project. I2C interface functionality can be controlled via programming, and the clock frequency is 100 kHz at amaximum. Esp8266 NodeMCU has 17 GPIO pins which can be assigned to various functions such as UART, PWM, I2C, IR, and Button via programming. When configured as an input pin, the GPIO pins can also be set to edge-trigger or level trigger to generate CPU interrupts. ESP8266 NodeMCU has 2 UART interfaces, i.e. UART0 and UART1, which offer asynchronous communication and may communicate at up to 4.5 Mbps. TXD0, RXD0, RST0 CTS0 pins can be used for communication. It supports fluid control. However, the TXD1 pin features only data transmit signal so, it's usually used for printing logs. ESP8266 has two SPI in slave and master modes. These SPIs also support the following general features: 4 timing modes of the SPI format transfer. Up to 64-byte FIFO buffer. Esp8266 has a secure digital I/O interface which is used directly to control the SD cards. Esp8266 has 4 channels of Pulse width modulation (PWM). The output can be controlled
via programming and is frequently used for driving motors and LEDs. Thefrequency ranges from 100Hz to 1KHz.

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Figure(e):NODE MCU

There are three control pins on theesp8266: The enable pin (EN), the reset pin (RST), and the wake pin. The esp8266 chip works when the enable pin is high. When the enable pin is low, the chip
works on minimum power. The reset pin is used to reset the esp8266 chip. The wake pin is used to wake up the chip from deep sleep mode.

Buzzer-

A buzzer or beeper is an audio signaling device, which may be mechanical,electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke. A buzzer or beeper is an audio signaling device,[1] which may be mechanical, electrome
chanical, or piezoelectric (piezo for short). Typical uses of buzzers and beeperinclude alarm devices, timers, training, and confirmation of user input such as a mouse click or keystroke.

Specifications

- Operating Voltage 4 8 V
- Max Rated Current 32 mA

Figure(f):Buzzer

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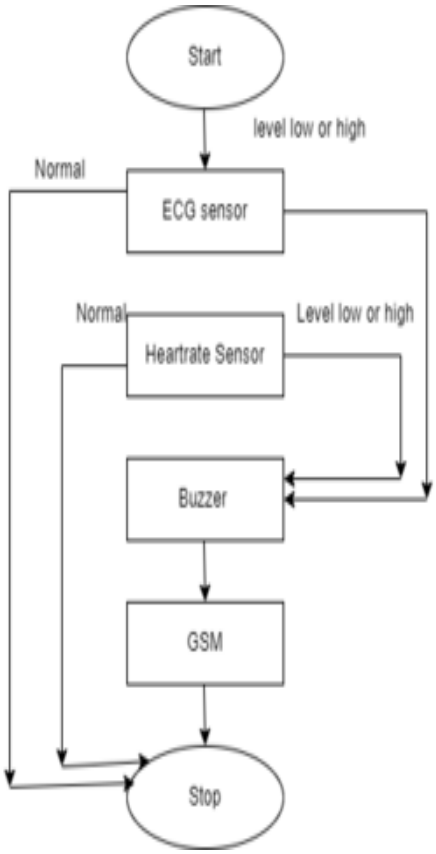
VIII. FLOW CHART AND DESCRIPTION



IX. SOFTWARE PLATFORM

Software Tools

- Proteus software
- Embedded 'C' language

Proteus Version 8.11:

This software is used to simulate thecircuit. In the Proteus Design Suite, schematic capture is employed during both the design phase of a PCB layout project and for the simulation of designs. By applying a hex file or a debug file to the microcontroller portion on the schematic, Proteus's microcontroller simulation functions.

X. EXPECTED RESULTS AND CONCLUSION

This project presents the design and development of "IOT-based prediction of the failure of blood pressure system". Results showed the system can send the data to Gmail or a mobile number application. The system has been designed and analyzed successfully. In the future, the connection between Node MCU and blood pressure detector can be made wirelessly so that the design looks more compact. Besides, the design could be extended to read other health items such as ECG. Furthermore, different types of wireless technologies such as WiFi, Multi-hop Wireless Networks (MWN), and Device-to-Device (D2D) communications can be incorporated into the system

XI. RESULT

Patient's heart rate, blood pressure and ECG are measured and all the data is understood by relatives or doctors through thingspeak at any location and also we can send this data to anyone.

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