

IoT Based Heart Defect and Monitoring System

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ABSTRACT: The Embedded technology has entered almost in all aspects of day-to-day life, and the healthcare field is no exception for that the requirement for fully-equipped hospitals and diagnostic canthers growing day by day as people are becoming more unaware of their health problems. An ECG signal can trace various physiological and abnormal conditions of the heart. This is monitoring system also helps to inform the person whether he/she has any heart diseases or not. This is done by checking the heart beat level. In this system ATMEGA controller is used to scan ECG signal and search for pattern in common range, if the pattern will be in normal range then it gives the report of being normal if it is found that it is not in normal range then the person is suffering from some kind of heart disease. The following result is sent as an alert message on IOT.

1. Introduction

The advent of embedded technology has revolutionized various industries, and healthcare is no exception. As the demand for fully-equipped hospitals and diagnostic centers increases, there is a growing need for advanced systems that can monitor and diagnose health issues efficiently. One such innovation is the IoT-based heart defect monitoring system, which leverages the power of the Internet of Things (IoT) to enhance heart health management. This system focuses on monitoring ECG signals to detect any physiological or abnormal conditions of the heart. By analyzing the heartbeats, the system can determine whether an individual has any heart diseases. The core of the system is an Atmega controller, which scans ECG signals and searches for patterns within the normal range. If the patterns are normal, the system reports a healthy status. However, if any irregularities are detected, it indicates a potential heart defect. The results of the analysis are transmitted as alert messages via IoT, ensuring timely intervention and medical assistance. This proactive approach helps in early

detection of heart diseases, ultimately saving lives and improving patient outcomes. The integration of IoT in heart defect monitoring represents a significant advancement in healthcare, offering a reliable, efficient, and userfriendly solution for continuous heart health monitoring.

2. Methodology

2.1 Heartbeat Sensor

A person's heartbeat is the sound of the valves in his/her's heart contracting or expanding as they force blood from one region to another. The number of times the heart beats per minute (BPM), is the heart beat rate and the beat of the heart that can be felt in any artery that lies close to the skin is the pulse.



2.2 Existing Method

- The oldest method for monitoring heart defects is the Electrocardiogram (ECG or EKG).
- This technique measures the electrical activity of the heart and has been in use since the late 19th century.
- Early ECGs involved puncturing the heart muscle with wires to measure electrical activity

3. Proposed Method

- A proposed system that integrates both ECG and Heartbeat sensor can provide comprehensive heart monitoring.
- This system comprises several components, including ECG sensors that measure the electrical activity of the heart to detect abnormalities, and heartbeat sensor that monitor the heart rate in real time.
- A microcontroller processes the data from both sensors, while a wireless module (such as Wi-Fi) transmits the data to a cloud server.
- The data can be displayed on a web interface, allowing for real-time monitoring and alerts if any irregularities are detected.
- By combining ECG and heart rate data, this system offers a more complete picture of heart health.
- It also facilitates remote access, enabling healthcare providers to monitor patients from a distance, and aids in the early detection of heart issues, potentially preventing serious conditions and improving patient outcomes.

3.1 System Requirement

3.1.1 Atmega 328 Microcontroller

ATMEGA 328 microcontroller, which acts as a processor for the Arduino board. Nearly it consists of 28 pins. From these 28 pins, the inputs can be controlled by transmitting and receiving the inputs to the external device. It also consists of pulse width modulation (PWM). These PWM are used to transmit the entire signal in a pulse modulation.

Input power supply such as Vcc and Gnd are used. These IC mainly consists of analog and digital inputs. These analog and digital inputs are used for the process of certain applications.



Figure 1: *ATmega328 Microcontroller*

3.1.2 ECG Sensor

The AD8232 ECG sensor is a commercial board used to calculate the electrical movement of the human heart.

This action can be chart 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 intervals simply. The AD8232 sensor is used for signal conditioning in ECG as well as other measurement applications of bio potential. The main purpose of this chip is to amplify, extract as well as

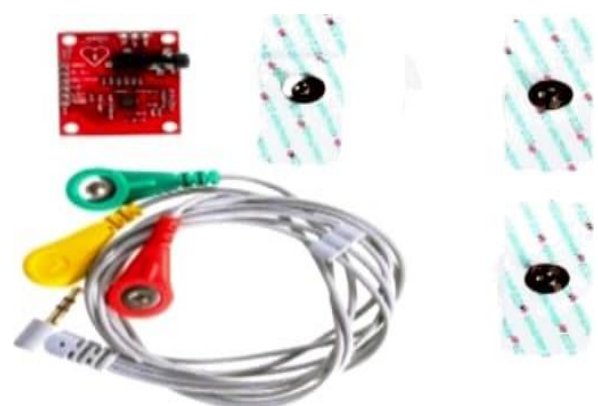


Figure 2: *ECG Sensor*

3.1.3 LCD Display

- LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits.

- A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.
- The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.
- The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

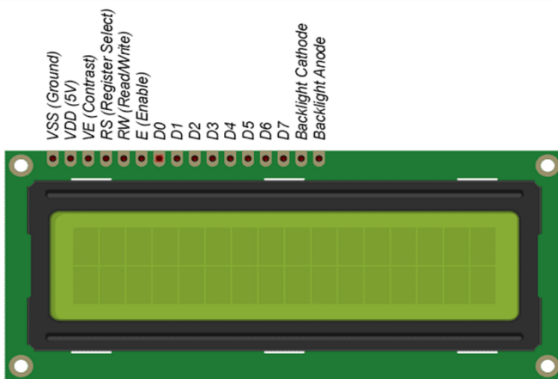
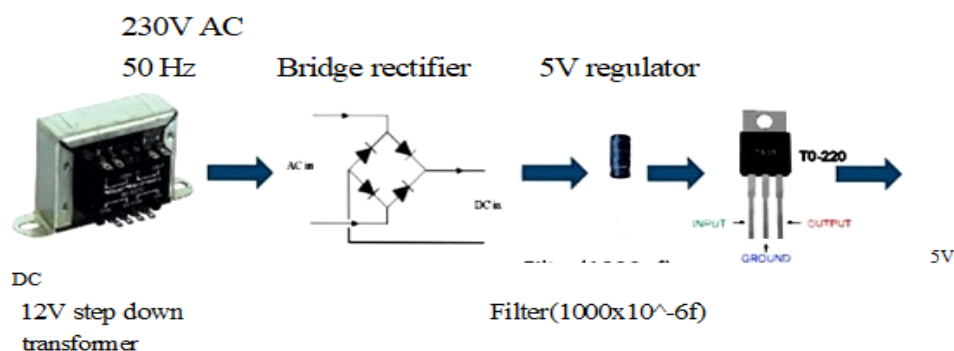


Figure 3: LCD Display

3.1.4 Specifications

- Can work on both 8-bit and 4-bit mode.

3.1.6 Power supply



- Transformer: Steps the household line voltage up or down as required.
- Rectifier : Converts ac voltage into dc voltage.

- It can also display any custom generated characters
- Available in Green and Blue Backlight
- Operating voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Consist of two rows and each row can print 16 characters
- Each character is built by a 5x8 pixel box

3.1.5 Cables & Connectors

The heart defect monitoring system employs a range of cables and connectors pivotal for data transmission between sensors, monitors, and recording apparatus. Typically, connectors encompass standard interfaces such as USB, HDMI, or proprietary connections tailored to specific device requirements. These essential components facilitate precise data transfer crucial for continuous monitoring and comprehensive analysis, as detailed in our published paper.



Figure 4: Cables & connectors

- Filter : Smooth the pulsating DC voltage to a varying DC voltage.
- Regulator : Fix the output voltage to constant value

3.1.7 Single Power Supply

Power supply gives supply to all components. It is used to convert AC voltage into DC voltage. Transformer used to convert 230V into 12V AC. 12V AC is given to diode. Diode range is 1N4007, which is used to convert AC voltage into DC voltage. AC capacitor used to charge AC components and discharge on ground.

LM 7805 regulator is used to maintain voltage as constant. Then signal will be given to next

capacitor, which is use filter unwanted AC component. Load will be LED and resister. LED voltage is 1.75V. if voltage is above level beyond the limit, and then it will be dropped on range. It gives positive polarity, negative polarity and ground potential. Some Op Amps need dual power source that is +Vcc and -Vcc (Positive and Negative polarity). It uses two types of voltage regulator ICs 7805 and 7905. 7805 is a positive voltage regulator whereas 7905 is a negative voltage regulator IC

4. Block Diagram

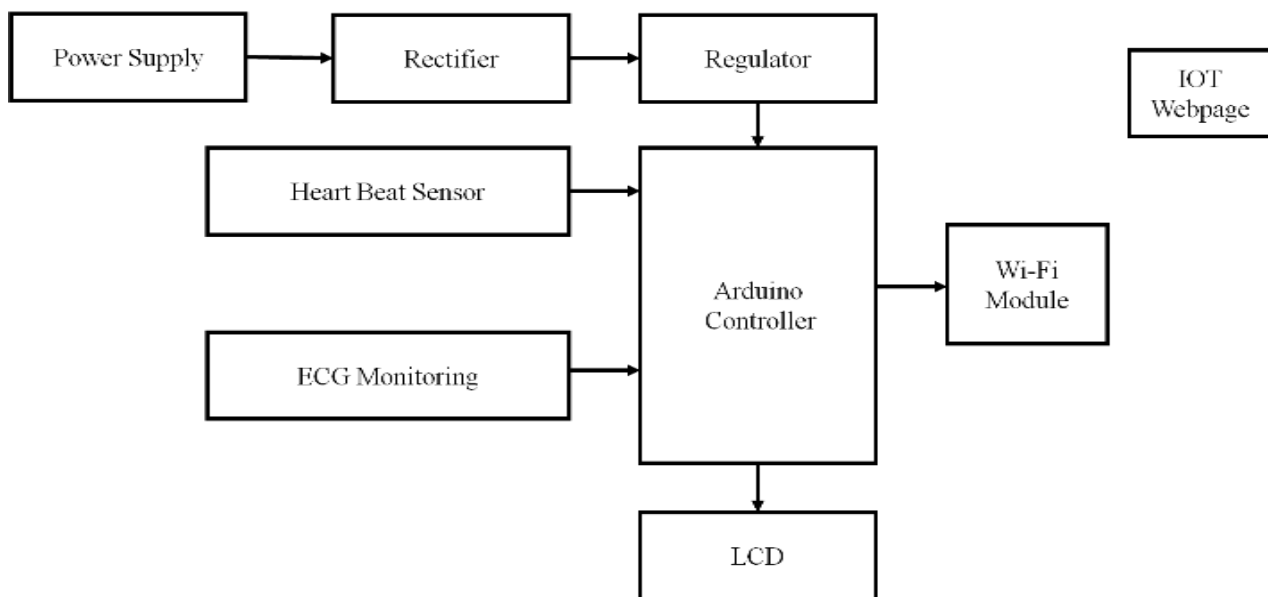


Figure 5: Block Diagram

4.1 Block Description

4.1.1 Power Supply

Provides the necessary electrical power to the entire system, ensuring all components are energized

4.1.2 Rectifier

Converts AC (alternating current) from the power supply to DC (direct current), ensuring a stable DC voltage.

4.1.3 Regulator

Maintains a constant output voltage, ensuring that the Arduino and other components receive steady power.

4.1.4 Heart Beat Sensor

Detects the user's heart rate and sends this data to the Arduino controller for processing.

4.1.5 ECG Monitoring

Measures the electrical activity of the heart and provides ECG data to the Arduino controller for analysis.

4.1.6 Arduino Controller

Central processing unit that receives data from sensors, processes it, and controls other components like the LCD and Wi-Fi module.

4.1.7 LCD

Displays the processed heart rate and ECG data, providing a visual interface for the user to monitor their heart health.

4.1.8 Wi-Fi Module

Enables wireless communication, sending the processed data from the Arduino controller to an IoT webpage for remote monitoring.

4.1.9 IoT Webpage

An online platform where heart rate and ECG data can be accessed remotely, allowing for continuous monitoring and data logging.

4.1.10 Circuit Diagram

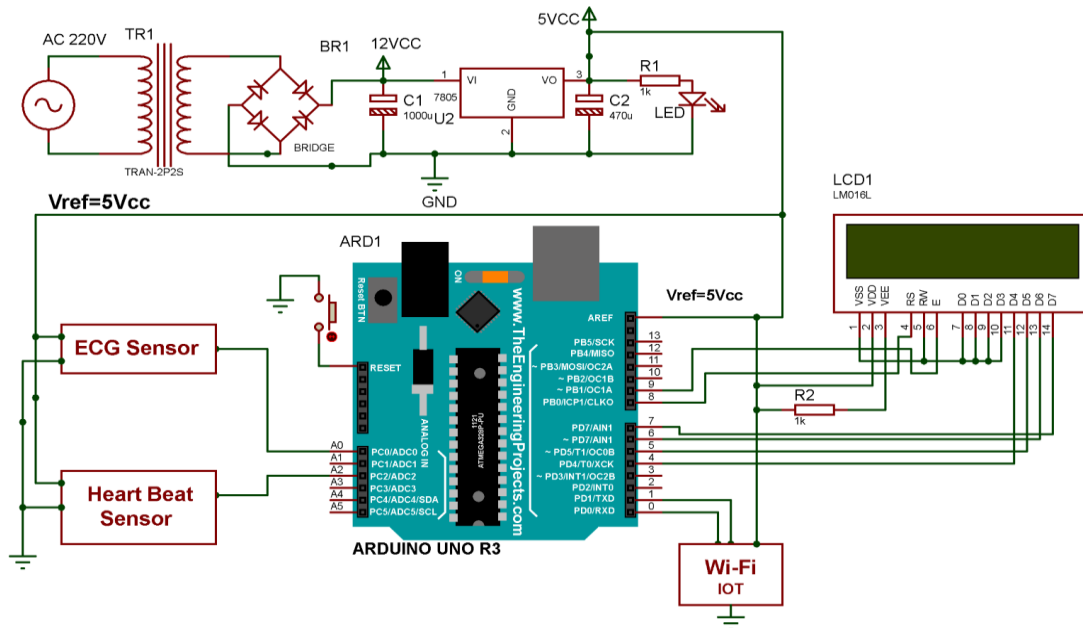


Figure 6: Circuit Diagram

4.2 Circuit Description

- The circuit diagram represents a health monitoring system, incorporating an Arduino Mega 2560 microcontroller, various sensors, and a power supply circuit
- The power supply circuit converts 230V AC to 12V DC using a transformer, bridge rectifier, and capacitor, and then regulates it to 5V DC using a 7805-voltage regulator.
- The 5V DC output powers the Arduino and Other components. The Arduino Mega 2560 acts as the central component, connected to an LCD display, a Wi-Fi module, a Heart Beat Sensor, and an ECG Sensor (ad8232).
- The LCD (LMO 161,) is used for displaying information, while the Wi-Fi module enables wireless communication. The Heart Beat Sensor monitors heart rate, and the ECG

Sensor (ad8232) captures electrocardiogram signals.

- Together, these components create a versatile health monitoring system with real-time data display and wireless communication capabilities, ideal for various health monitoring and IoT applications.
- The pin 4,5,6,7,8,9 of the controller is connected to the LCD module pin 14. The pin 18,19 of the micro controller is connected to the Wi-Fi TX, RX terminals.
- The pin A2, A3, A7 of the micro controller is connected to the ECG SENSOR (AD8232). Pin A0 is connected to the Heart Beat Sensor. At the Vcc pin the power supply is connected

4.3 Advantages

Advantages are Accuracy, Efficiency, Portability, Reliability, Non-Invasive, convenience

4.4 Applications

Applications are Diagnosis, Monitoring, Telemedicine, Rehabilitation, Emergency, Research

5. Result

It is designed to integrate the heart rate monitoring system controlled by microcontroller to the Think Speak through the ESP8266 Wi-Fi module. Thus, the heart rate of the patient can be automatically updated via the internet. This proposed system will display the Beat Per Minute (BPM) on the LCD. It is used to detect parameter like temperature, heart rate, saline water level, etc. It also displays messages regarding patient's health.

6. Conclusion

- The conclusion of this project is that this IoT-based heart defect monitoring system uses an ATmega controller to scan ECG signals and detect abnormalities in heartbeats.
- By continuously monitoring the heart's electrical activity and sending alerts via IOT, it helps in early detection and management of heart diseases, ultimately contributing to better healthcare and patient outcomes this project was successfully implemented.

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