Mini Project Report

on

Hedy MCU

Submitted to

Department of Electronics and Telecommunication Engineering

Shri Sant Gajanan Maharaj College of Engineering, Shegaon

Submitted by

Krunal Bobade[55]

Under the Supervision of

Dr. R.S.Dhekekar

Department of Electronics & Telecommunication Engg. Shri Sant Gajanan Maharaj College of Engineering, Shegaon – 444 203 (M.S.)

(Spring Semester 2022-2023)

CERTIFICATE

This is to certify that the mini project report entitled

Heart Rate Sensor Using Hedy MCU

Submitted by

Krunal Bobade[55]

is in partial fulfillment of the requirements for third year six semester of Electronics and Telecommunication Engineering by Sant Gadge Baba Amravati University, Amravati and this work carried out and completed under my supervision during the Spring Semester 2022- 2023.

Dr. R.S.Dhekekar	Dr. M. N. Tibdewal
(Supervisor)	(Head of Department)

Department of Electronics & Telecommunication Engineering Shri
Sant Gajanan Maharaj College of Engineering,

Shegaon – 444 203 (M.S.)

TABLE OF CONTENT

1. ABSTRACT

The Hedy MCU is named after Hedy Lamarr, an inventor and actress who co-developed the frequency hopping spread spectrum technology used in modern wireless communication. The board is designed to be easy to use.

The HEDY MCU is a microcontroller board that combines the processing power of an ESP32 microcontroller with various sensors and components. This project report describes the design, development, and testing of the HEDY MCU, including the selection of components, PCB design, assembly, and testing.The HEDY MCU is designed to be a flexible and versatile platform for developing innovative electronic systems. The board is equipped with Bluetooth and Wi-Fi connectivity. The board is designed with a compact form factor to make it suitable for portable and wearable applications.

The PCB design of the HEDY MCU is optimized for performance and manufacturability. The board is designed with multiple layers to reduce noise and signal interference, and the component placement is optimized to minimize signal paths and improve heat dissipation. The assembly process is carefully controlled to ensure high quality and consistency, with automated assembly techniques used for the surface-mount components and manual assembly for through-hole components.

The HEDY MCU project demonstrates the potential of microcontroller-based systems for developing innovative electronic systems for various applications. The project showcases the design and development process of a microcontroller board from component selection to testing, and it provides a platform for developing new applications and projects. The HEDY MCU can be used for various applications, including IoT devices, medical and fitness equipment, and robotics. Overall, this project report provides insights into the design and development of microcontroller-based systems and the potential for innovation in the field of electronics.

2. OBJECTIVES

The objective of the HEDY MCU project is to design and develop a versatile and flexible microcontroller board that combines the processing power of an ESP32 microcontroller with various sensors and components. The board is designed to be suitable for portable and wearable applications and can be used for various applications, including IoT devices, medical and fitness equipment, and robotics.

The primary objectives of the project report are as follows:

- To provide a detailed description of the design and development process of the HEDY MCU, including the selection of components, PCB design, assembly, and testing.

- To discuss the challenges faced during the design and development process and provide solutions and guidelines for future projects.

- To showcase the potential of microcontroller-based systems for developing innovative electronic systems for various applications.

- To provide insights into the design and development of microcontroller-based systems and the potential for innovation in the field of electronics.

- To provide a platform for developing new applications and projects using the HEDY MCU.

Overall, the objective of the project report is to demonstrate the potential of microcontroller-based systems for developing innovative electronic systems and to provide a detailed description of the design and development process of the HEDY MCU.

3. INTRODUCTION

Hedy MCU is an open-source firmware and development board based on the ESP8266 microcontroller. It is designed to make it easy for developers to create Internet of Things (IoT) projects quickly and easily.The Hedy MCU board includes built-in Wi-Fi connectivity, making it an ideal platform for IoT projects that require wireless connectivity. It can be programmed using Lua scripting language or Arduino IDE, making it accessible to a wide range of developers with different programming skills.

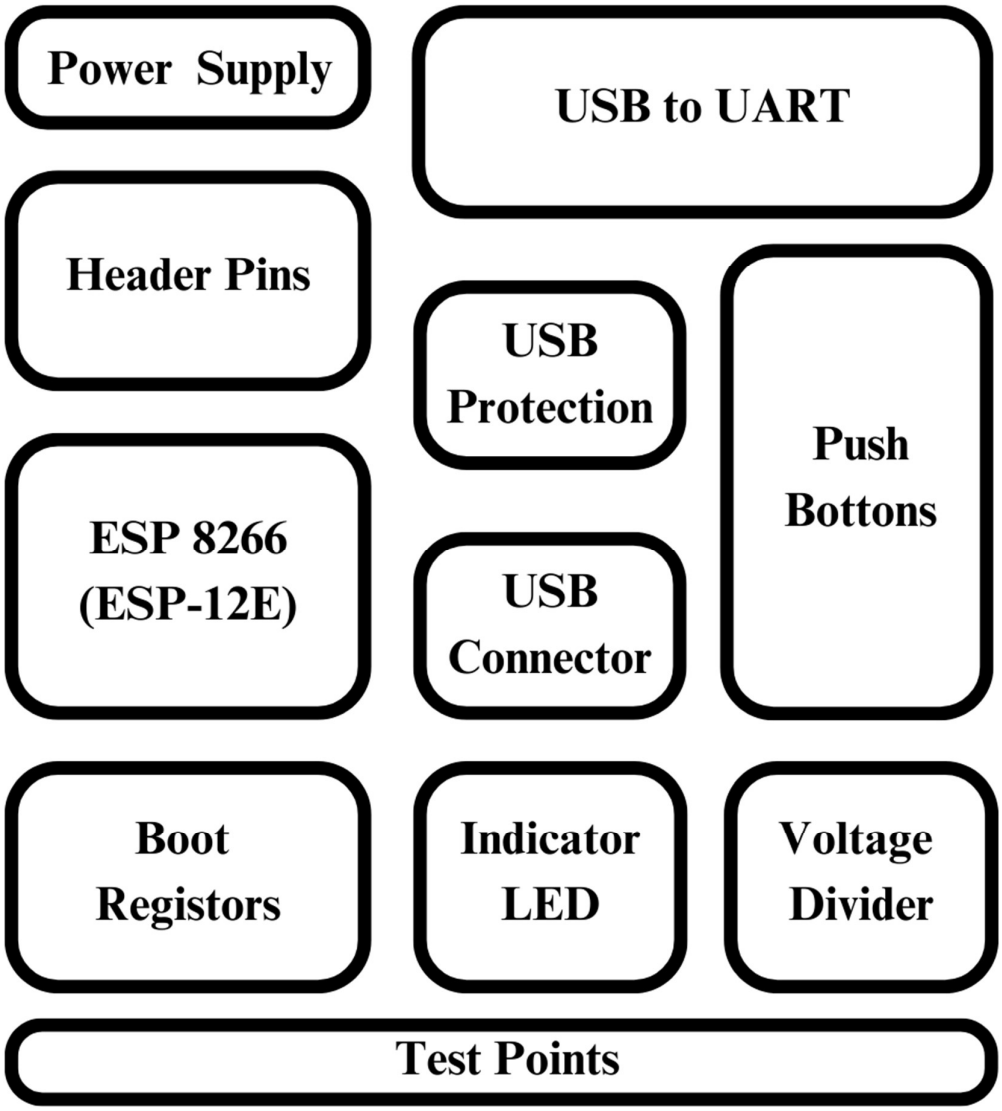
Hedy MCU features a USB-to-serial interface that allows developers to upload new app and communicate with the board. It also includes GPIO pins that can be used to connect to sensors, actuators, and other electronic components.

Hedy MCU has ease of use, affordability, and versatility. It can be used for a wide range of applications, including home automation, sensor networks, robotics, and more.

With Hedy MCU, developers can quickly and easily prototype and deploy IoT projects without the need for extensive hardware or software knowledge. Its open-source nature also encourages collaboration and innovation within the development community.

4. THEORY

- **Block Diagram**



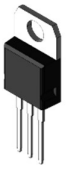
The HEDY MCU also includes a set of peripherals that are used to interact with the external world. These peripherals include GPIO (General Purpose Input Output) pins that can be used to connect to external sensors, actuators and other devices. These pins can be configured as inputs or outputs to read data from or write data to external devices. Additionally, the HEDY MCU includes an ADC (Analog to Digital Converter) that can be used to read analog signals from sensors and convert them into digital signals that can be processed by the processor core.

Overall, the HEDY MCU is a compact and simple microcontroller unit suitable for various small-scale embedded systems and IoT projects. Its low cost and simplicity make it an attractive option for beginners, while its GPIO and ADC capabilities provide flexibility and expandability for more complex projects.

- **Components**

1. **ESP8266 Microcontroller:** This is the heart of the HedyMCU board. It is a low-cost, low-power Wi-Fi microcontroller with built-in TCP/IP protocol support.

2. **Voltage Regulator:** HedyMCU includes a voltage regulator that allows the board to be powered by a USB port or external power supply. It regulates the voltage to a stable level that the other components on the board can use.



3. **Reset Button:** HedyMCU includes a reset button that can be used to restart the board or enter programming mode.

4. **Crystal Oscillator:** A crystal oscillator is used to generate an accurate clock signal for the microcontroller

.

5. **Capacitors:** Capacitors are used for various purposes on the board, such as decoupling and filtering.

6. **Resistors:** Resistors are used to limit current flow, provide pull-up or pull-down resistors for the GPIO pins, and other purposes.

7. **Diodes:** Diodes are used for voltage regulation, rectification, and protection.

8. **Integrated Circuit (IC) for USB Interface:** This IC is used to interface the USB port with the microcontroller.

9. **Flash Memory (4MB):** The on-board flash memory is used for storing firmware, app, and data.

10. **Micro-USB Connector:** This connector is used to provide power to the board and to program it through the USB port

.

11. **Push Button Switches:** These are used for various functions on the board, such as entering programming mode, resetting the board, or toggling GPIO pins.

12. **Soldered Jumper Pads:** These are used to connect or disconnect various parts of the circuit, depending on the configuration needed.

13. **Voltage Divider Circuit:** This circuit is used to measure voltage using the analog input pins.

14. **Linear Regulators:** These are used for voltage regulation and stabilization.

15. **MOSFET:** This component is used for switching high currents or voltages with low power signals.

16. **Light Emitting Diodes (LEDs):** LEDs are used for indicating the status of the board, such as power, Wi-Fi connectivity, and programming mode.

17. **Ferrite Beads:** These are used for filtering high-frequency noise from the power supply.

18. **Electrolytic Capacitors:** These are used for filtering and decoupling

19. **Printed Circuit Board (PCB):** This is the physical board that holds all the components together and provides connections between them.

20. **LED Indicators:** HedyMCU includes multiple LED indicators that provide status information, such as power, Wi-Fi connectivity, and programming mode.

21. **GPIO Pins:** HedyMCU includes multiple General Purpose Input/Output (GPIO) pins that can be used to connect to other electronic devices, such as sensors, motors, and LEDs.

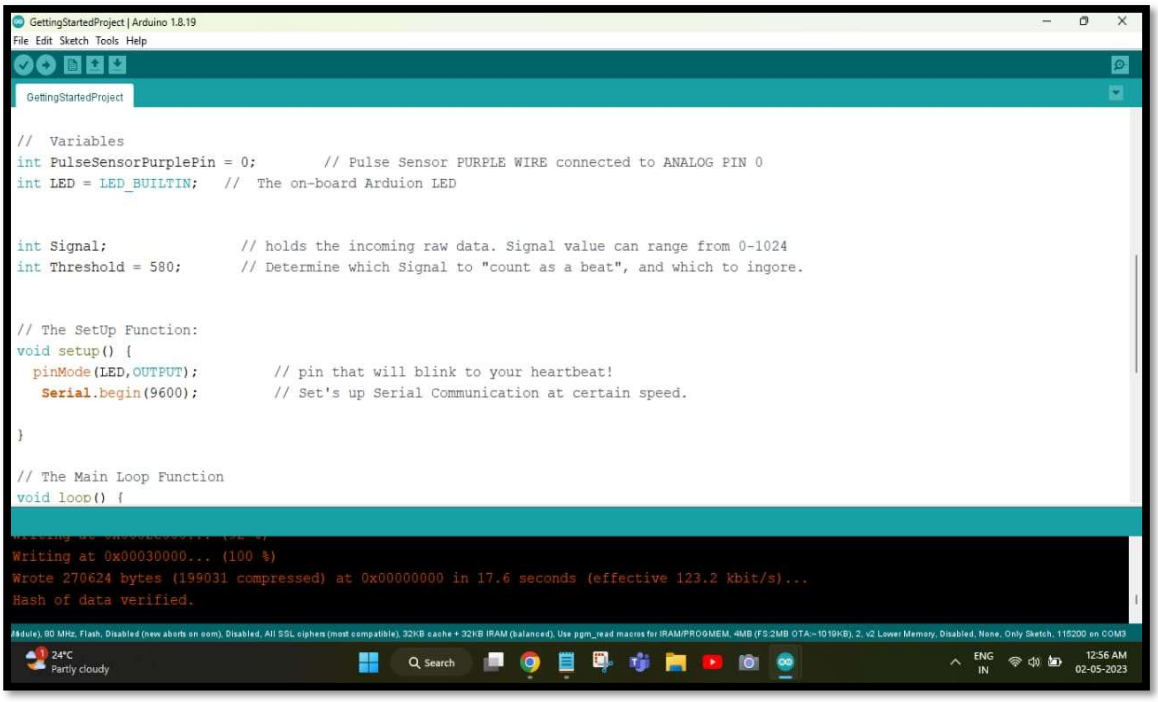
- **Software**

1. **Arduino IDE**

- The **Arduino IDE** is a cross-platform software application that provides a app editor, compiler, and uploader for programming Arduino boards. It is free and open-source software that supports Windows, Mac OS X, and Linux operating systems. The IDE is easy to use and comes with a simple user interface, making it a popular choice among beginners and advanced users alike.

- The Arduino IDE supports the C and C++ programming languages and provides a library of pre-written app, called "sketches," that can be used to quickly build projects. The IDE also has a built-in serial monitor that allows you to view and debug data from the Arduino board. Additionally, the IDE supports third-party libraries and tools, providing a flexible environment for developing Arduino projects.

Overall, the Arduino IDE is an essential tool for programming Arduino boards and is widely used by hobbyists, students, and professionals alike.



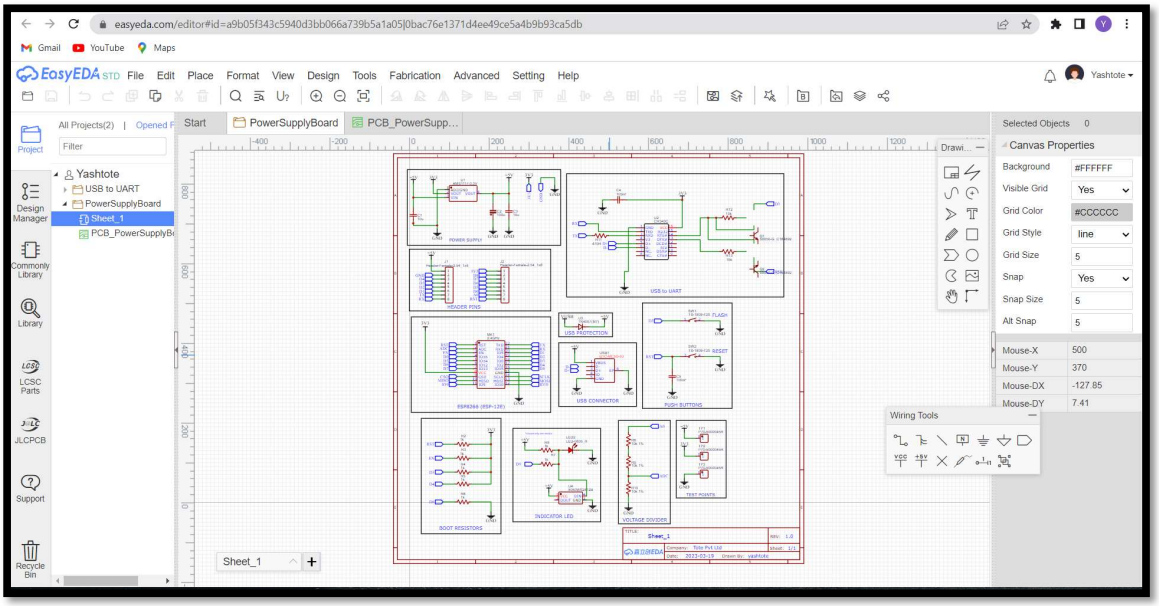
2. EasyEDA

- **EasyEDA** is a cloud-based electronic circuit design tool that provides a user-friendly interface for creating and sharing circuit designs. It is an online platform that allows users to design, simulate, and share electronic circuits with other users.

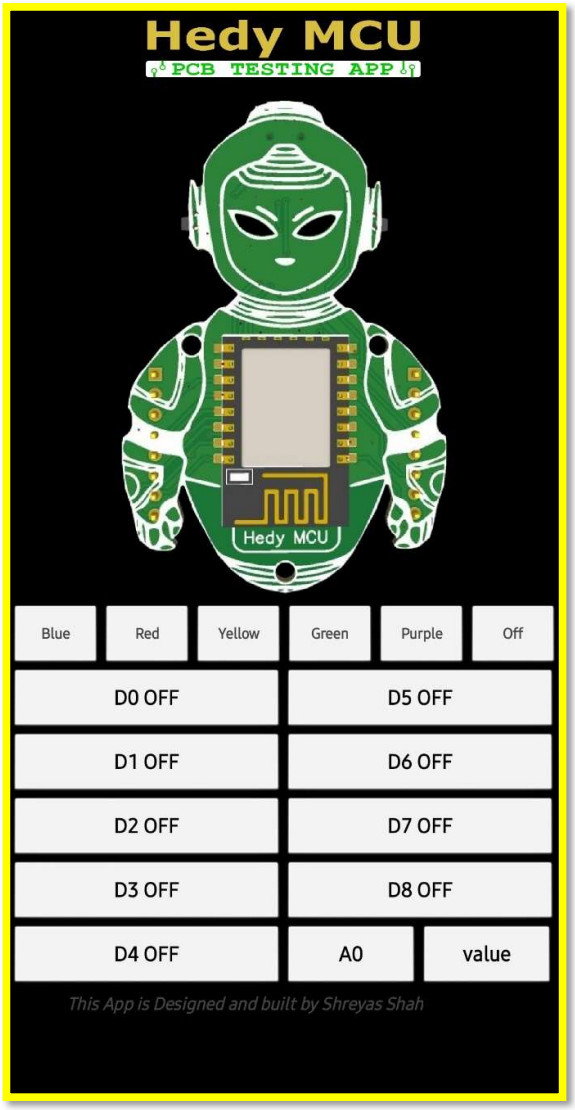
- EasyEDA provides a wide range of components, including resistors, capacitors, inductors, diodes, transistors, and more. These components can be easily placed and connected to create a circuit. The platform also includes a schematic capture tool and a PCB layout editor, allowing users to design both the schematic and the PCB layout in one platform.

- EasyEDA has a built-in spice simulator that can be used to simulate the behavior of circuits before they are built. This allows users to identify any potential issues and make changes before building the circuit. The platform also provides an online community where users can share their designs and collaborate on projects.

Overall, EasyEDA is a user-friendly and powerful platform for electronic circuit design, simulation, and collaboration. It is ideal for hobbyists, students, and professionals who want to quickly and easily create electronic circuits and share their designs with others.



- **Hedy MCU App**

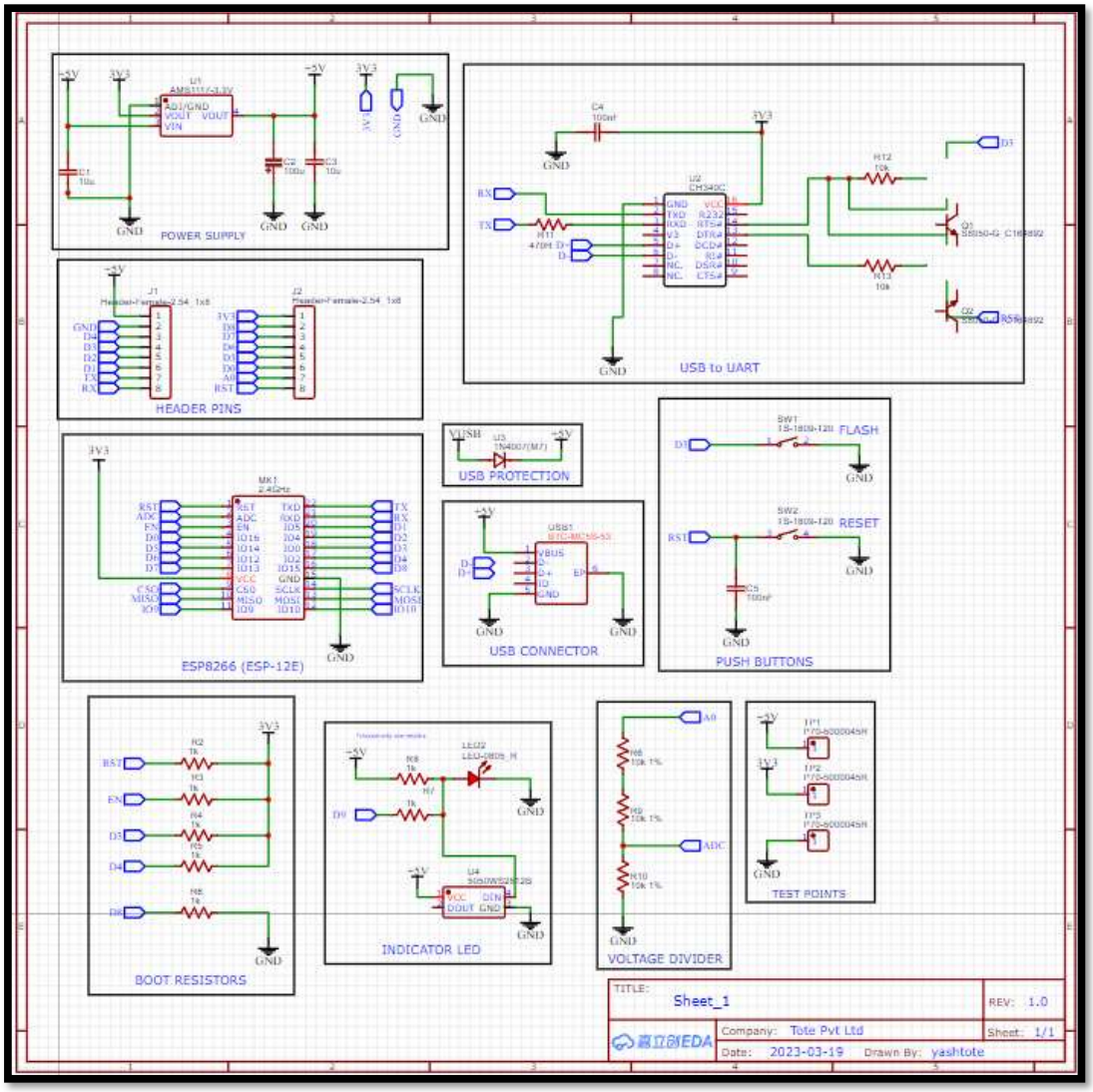


App allows you to control LEDs and read analog values through a web interface

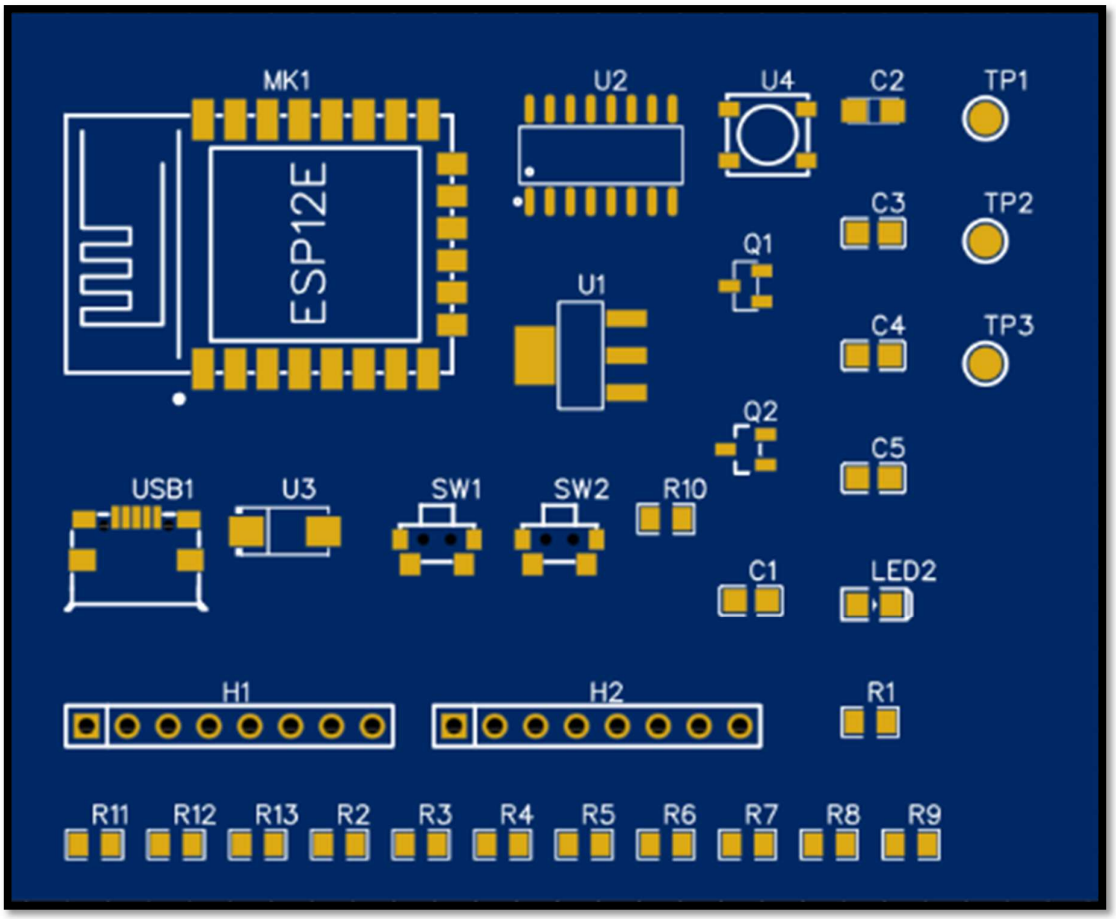
This app is for the ESP8266 microcontroller to control several LEDs over Wi-Fi using a web server. It includes a few additional features such as an analog sensor and a single WS2812B LED.

5. METHODOLOGY

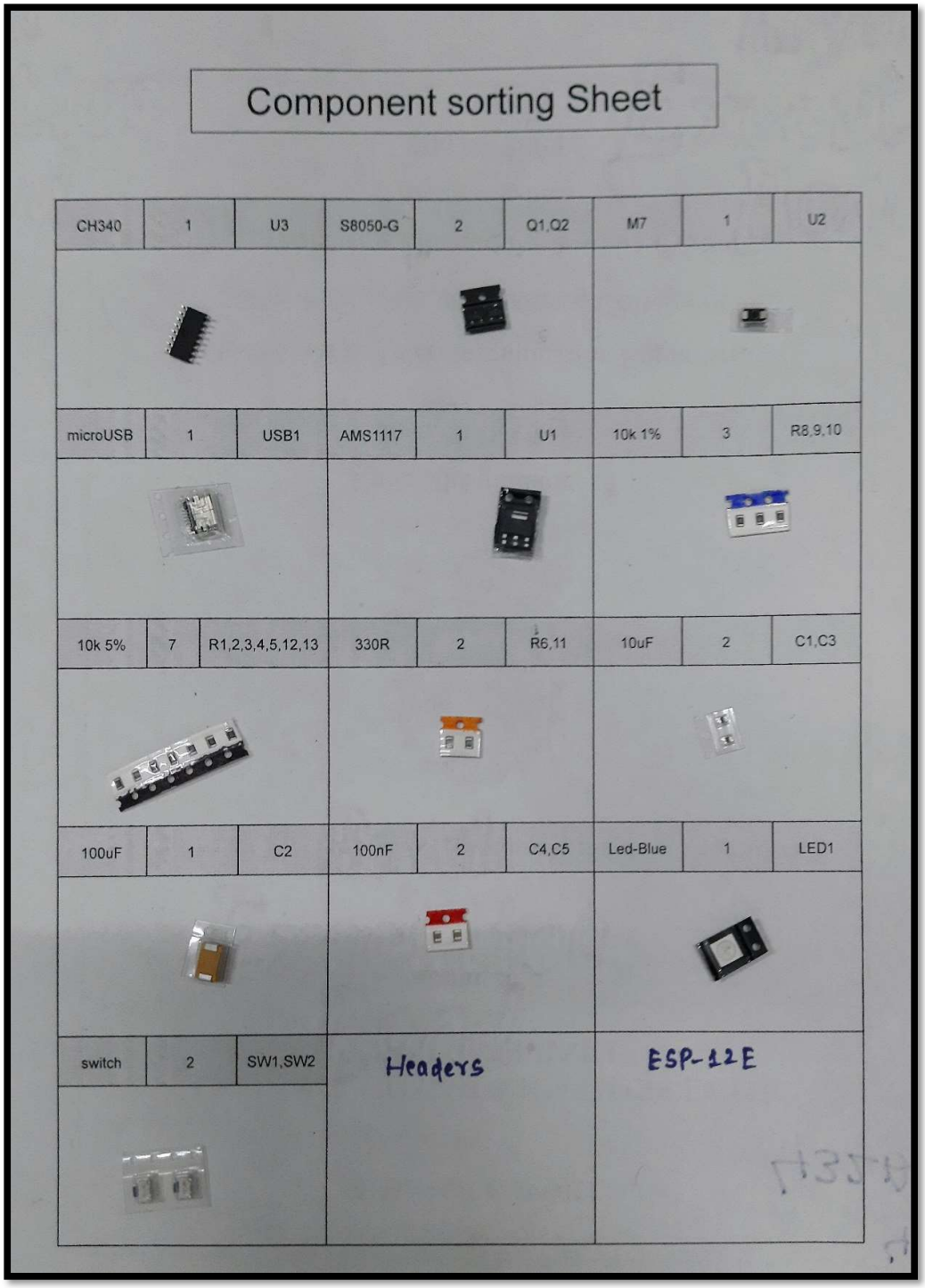
1. **Design the schematic and PCB layout:** First, you will need to design the schematic and PCB layout for the Hedy MCU. This involves using software such as Easy EDA or Altium Designer to place components, route signals, and optimize the board layout.



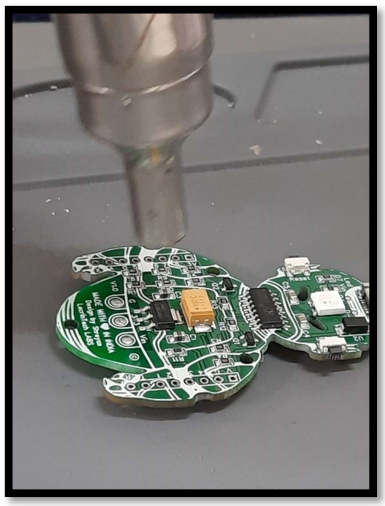
- **2 – D View Of Schematic**



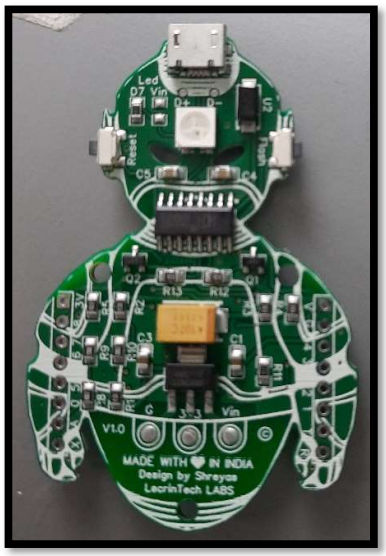
2. **Sourcing components**: Once the PCB design is completed, you will need to source the components required for the project. This may involve ordering components from suppliers or salvaging them from other devices.



3. **Preparing the PCB:** The PCB is then fabricated or etched to create the desired board design. This involves using specialized tools and chemicals to create the copper traces and holes needed to connect the components.

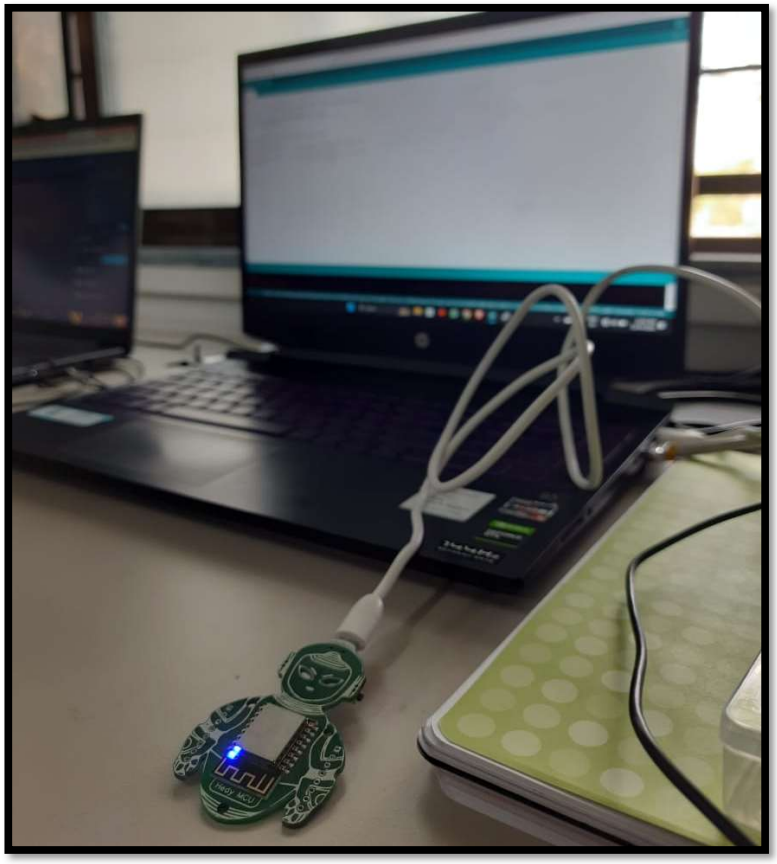


4. **Soldering components:** The components are then soldered onto the PCB using manual or automated assembly techniques. This may involve using a soldering iron, reflow oven, or other specialized equipment.



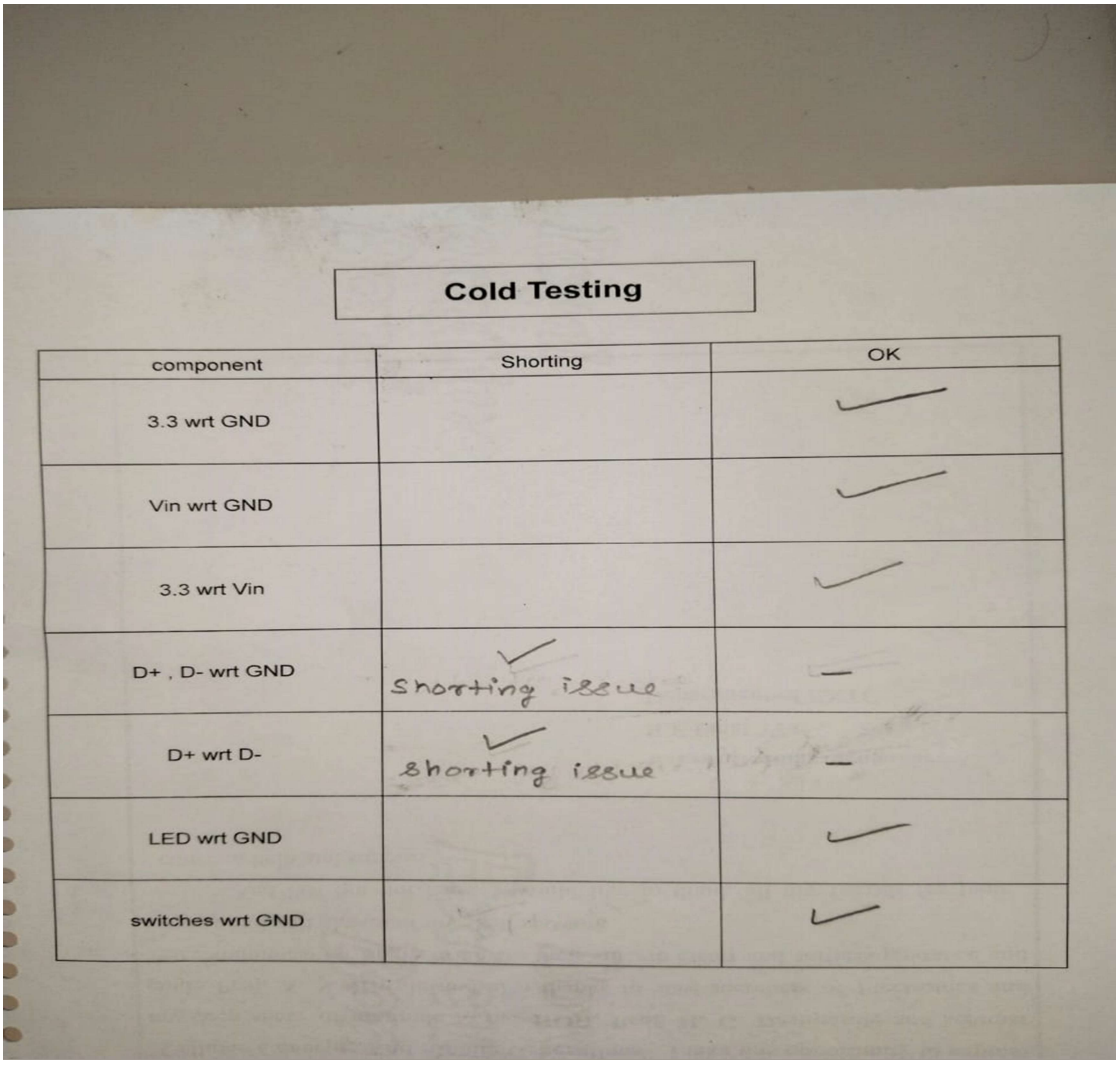
5. **Programming the firmware:** Once the components are soldered onto the board, the Hedy MCU is programmed with the firmware using the Arduino IDE or other programming software. The firmware provides the board with the necessary instructions to function as a microcontroller.

6. **Testing:** The Hedy MCU is then tested to ensure that it is functioning correctly. This includes testing the GPIO pins, the functionality of the microcontroller, and other features of the board. Any issues are identified and addressed before the project is completed.



7. **Quality control and troubleshooting:** Once the project is fully assembled, it undergoes quality control testing to ensure that it meets the required standards. This may include testing for stability, performance, and compatibility. Any issues that arise are identified and addressed through troubleshooting.

- **Cold Testing**



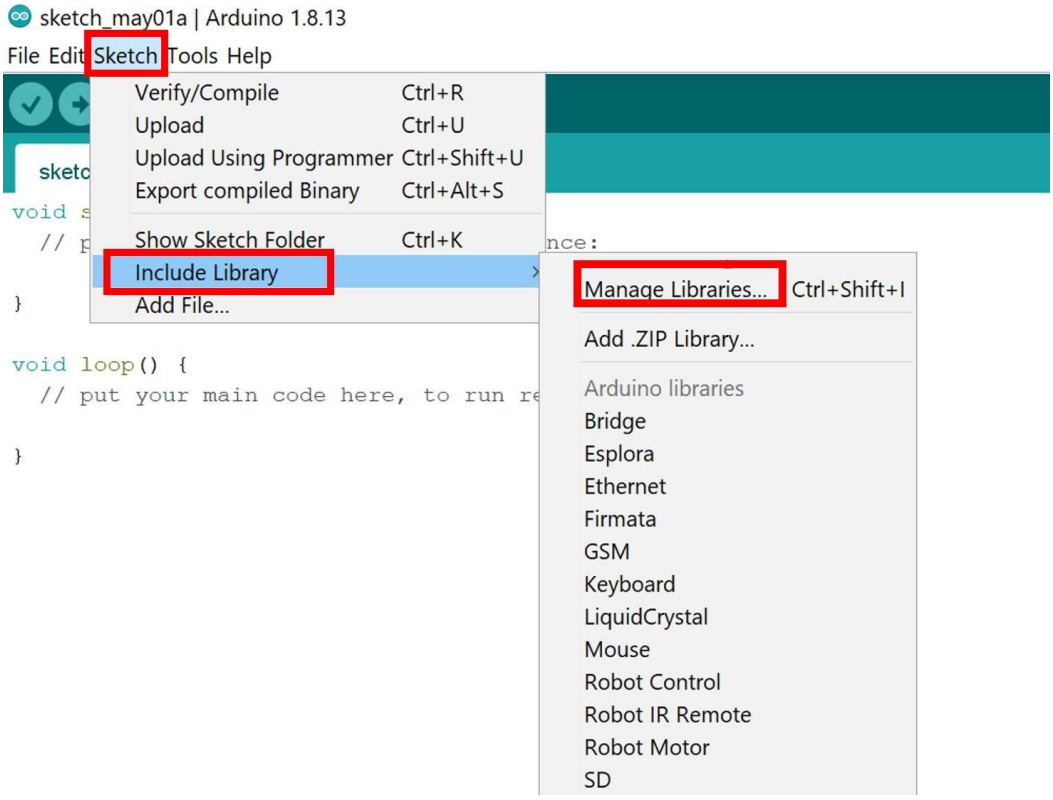
Cold Testing

component	Shorting	OK
3.3 wrt GND		✓
Vin wrt GND		✓
3.3 wrt Vin		✓
D+ , D- wrt GND	✓ shorting issue	—
D+ wrt D-	✓ shorting issue	—
LED wrt GND		✓
switches wrt GND		✓

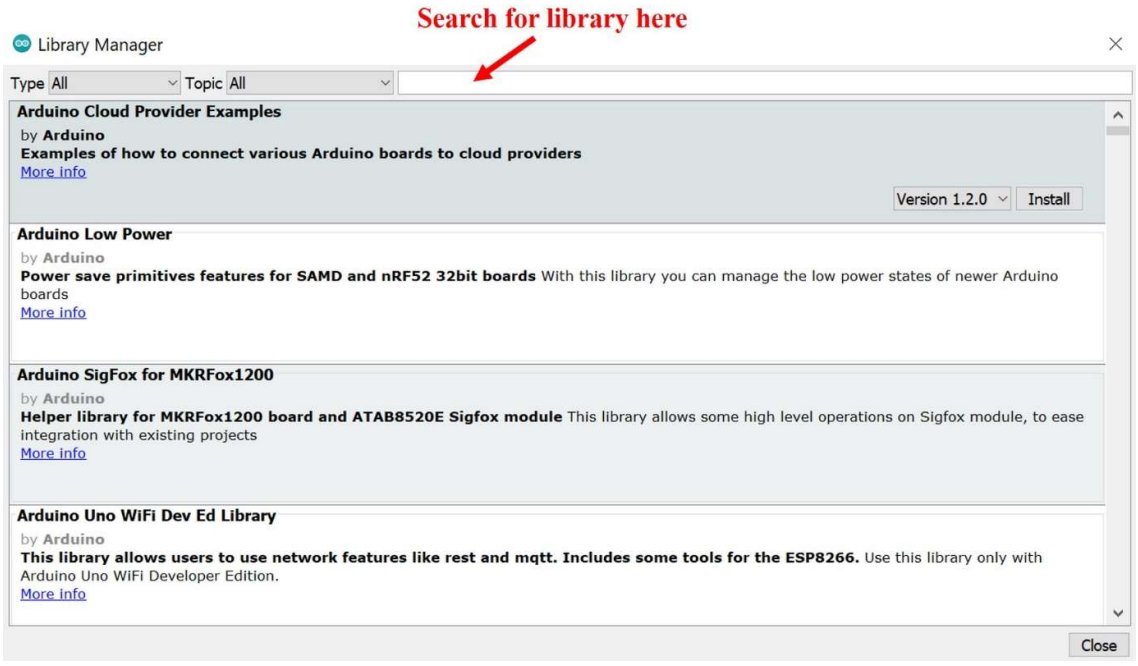
Components	Voltage	ok
3.3 wrt GND	5v	✓ (4.2v)
Vin wrt GND	3.3v	✓ (3.15)

Installing Pulse Sensor Library

1. Open Arduino IDE and click on **Sketch > Library > Manage Libraries**



2. The following window will open up.



3. Type ‘pulsesensor’ in the search bar and press enter. Install the latest version of the library.

After installation of the library, restart your IDE.

6. APPLICATIONS

HedyMCU is an open-source firmware and development kit that is based on the ESP8266 WiFi module. It is designed for building IoT applications and can be programmed using the Arduino IDE or Lua scripting language. Some of the common applications of HedyMCU include:

1. Home automation: HedyMCU can be used to build home automation systems that can control lights, fans, and other appliances from a smartphone or tablet. The WiFi connectivity of HedyMCU makes it easy to integrate with other smart home devices.

2. Internet of Things (IoT) devices: HedyMCU is widely used in building IoT devices such as temperature sensors, motion detectors, and door/window sensors that can be monitored and controlled remotely over the internet.

3. Robotics: HedyMCU can be used in building robots that can be controlled wirelessly using a smartphone or tablet. The small size and low power consumption of HedyMCU make it ideal for building compact and energy-efficient robots.

4. Industrial automation: HedyMCU can be used in industrial automation applications such as monitoring and controlling machines and processes in factories. It can be used to collect data from sensors and send control signals to actuators.

5. Wireless sensor networks: HedyMCU can be used to build wireless sensor networks that can be used in a wide range of applications such as environmental monitoring, agriculture, and healthcare.

6. Education: HedyMCU is an excellent tool for teaching programming and electronics to students. Its simple interface and low cost make it an ideal platform for introducing students to the world of electronics and programming.

7. Smart energy management: HedyMCU can be used in building smart energy management systems that can monitor and control the energy usage of appliances and devices in a home or office. This can help in reducing energy costs and improving energy efficiency.

8. Security systems: HedyMCU can be used in building security systems that can detect motion, sound, or other events and send alerts to a smartphone or email. It can also be used to control locks and access points.

9. Environmental monitoring: HedyMCU can be used in building environmental monitoring systems that can measure temperature, humidity, air quality, and other environmental parameters. These systems can be used in agriculture, weather monitoring, and other applications.

10. Wearable technology: HedyMCU can be used in building wearable technology devices such as smartwatches, fitness trackers, and health monitoring devices. Its small size, low power consumption, and wireless connectivity make it an ideal platform for building these devices.

11. Entertainment systems: HedyMCU can be used in building entertainment systems that can control music, lights, and other components using a smartphone or tablet. It can also be used to build interactive installations and exhibits.

12. Education and research: HedyMCU can be used in educational and research settings to build prototypes and proof-of-concept systems. Its low cost, open-source nature, and easy programmability make it an ideal platform for experimentation and innovation.

In summary, HedyMCU is a versatile platform that can be used in a wide range of applications. Its flexibility, low cost, and wireless connectivity make it an ideal choice for building IoT applications, prototyping, and research.

7. IMPLEMENTATION USING HEART SENSOR

- **Objectives**

i. Detecting Abnormal Heart Rhythms: A heart rate monitoring system can also be used to detect abnormal heart rhythms, such as arrhythmias. This can be particularly useful for individuals who have a history of heart problems.

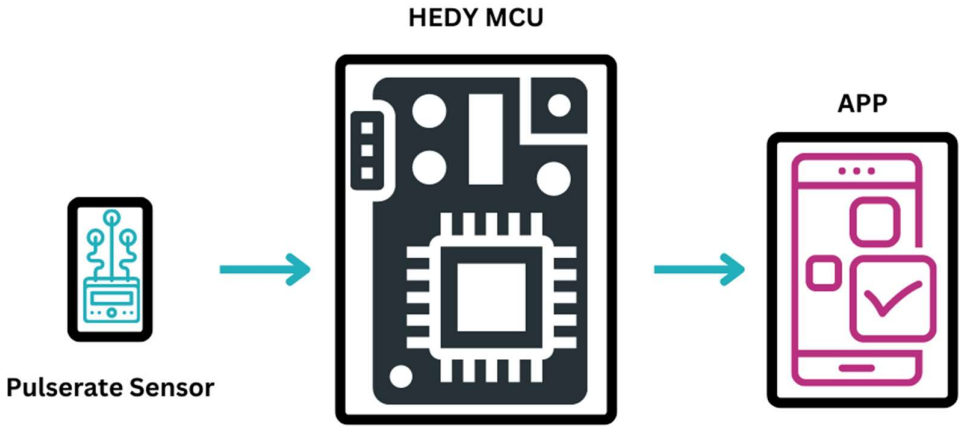
ii. Tracking Progress: A heart rate monitoring system can also be used to track progress over time. By monitoring changes in heart rate during exercise or throughout the day, users can assess their progress and make adjustments to their fitness routine as needed**.**

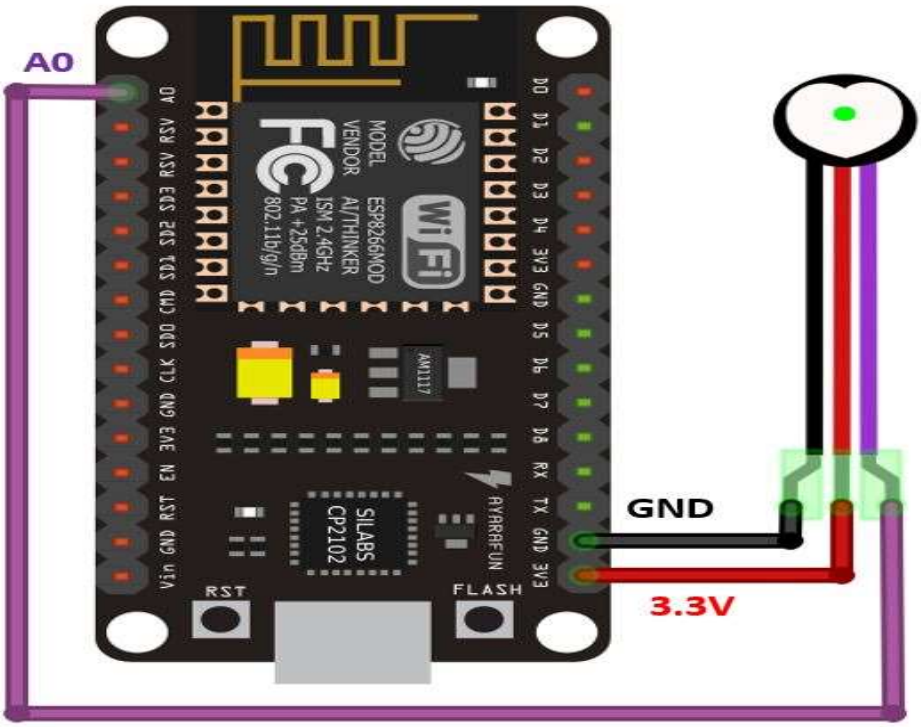
iii. Managing Health Conditions: For individuals with certain health conditions, such as hypertension or diabetes, monitoring heart rate can be an important tool for managing their condition. By tracking changes in heart rate, users can make adjustments to their lifestyle or medication as needed.

- **Introduction**

Heart rate monitoring is an essential aspect of healthcare, fitness and sports. With the advancement of technology, heart rate monitors have become more accessible and affordable. The Hedy MCU is a low-cost Wi-Fi enabled microcontroller that can be used to build a heart rate monitor.

- **Block Diagram**





- **Working**

1. First, the heart rate sensor would be connected to one of the GPIO pins on the HEDY MCU. The sensor would typically be a photoplethysmography (PPG) sensor that measures changes in blood volume in response to a heartbeat.

2. The HEDY MCU would be programmed to read the analog signal from the heart rate sensor using the built-in ADC. The ADC would convert the analog signal to a digital signal that can be processed by the processor core.

3. The processor core would then process the digital signal to extract the heart rate data. This could involve filtering the signal to remove noise and interference, and then analyzing the signal to detect the heart rate peaks.

4. Once the heart rate data has been extracted, it can be displayed on a connected display or transmitted to a remote device for further analysis or storage.

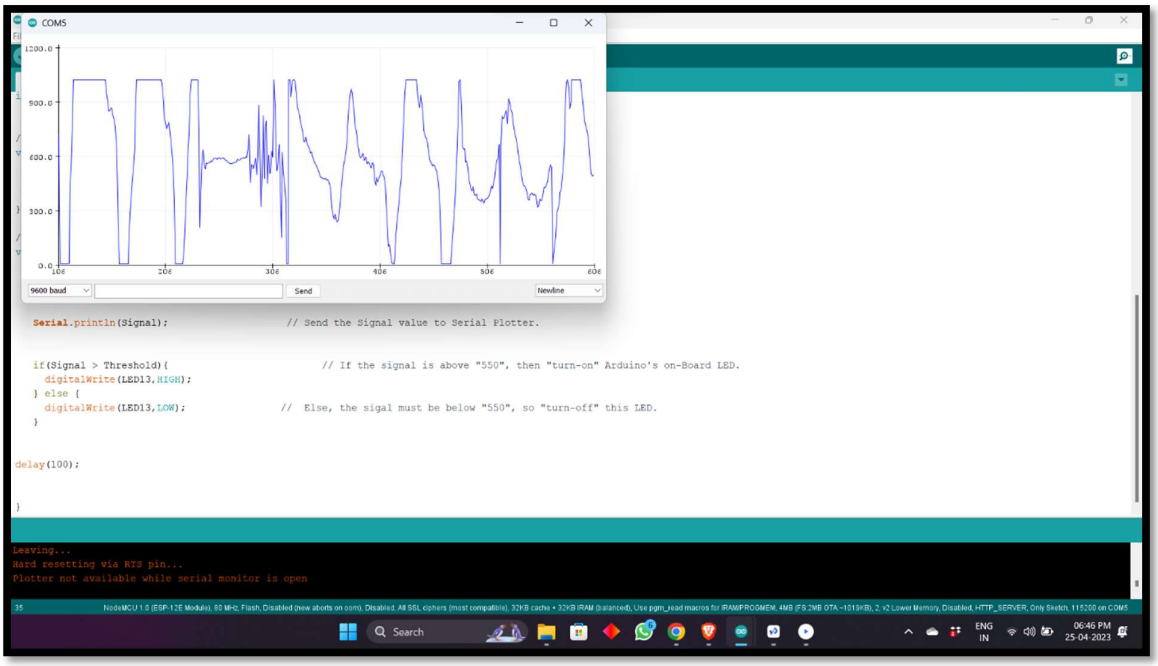
5. To ensure accurate heart rate readings, the system would need to be calibrated and optimized for the specific heart rate sensor being used. This may involve adjusting the sensor placement and sensitivity, as well as fine-tuning the signal processing algorithms.

Overall, a heart rate monitoring system using HEDY MCU would involve connecting a heart rate sensor to the MCU, processing the sensor data using the built-in ADC and processor core, and displaying or transmitting the heart rate data for further use. The system would need to be calibrated and optimized to ensure accurate and reliable heart rate readings.

- **Conclusion**

  In conclusion, the proposed system is a feasible solution for heart rate monitoring and can be used in various settings such as hospitals, clinics, and homes. It provides real-time heart rate data and can be accessed remotely through a web page. Additionally, the system is cost-effective and easy to set up, making it accessible to a wide range of users. However, it is important to note that the accuracy and reliability of the system may be affected by external factors such as signal interference or low battery levels. Further research can be conducted to improve the accuracy and reliability of the system.

- **Result**



8. RESULT & DISCUSSION:

The project report aims to achieve the primary objectives mentioned above. By providing a detailed description of the design and development process of the HEDY MCU, the report aims to provide a valuable resource for individuals and organizations interested in developing microcontroller-based systems for various applications.

The report also aims to highlight the challenges faced during the design and development process and provide solutions and guidelines for future projects. This could be helpful for other designers and developers looking to design similar systems and avoid common pitfalls.

Furthermore, the report aims to showcase the potential of microcontroller-based systems for developing innovative electronic systems for various applications. By discussing the HEDY MCU's capabilities, the report could inspire others to explore the use of microcontrollers in their own projects and applications.

The insights provided by the report into the design and development of microcontroller-based systems can also be valuable for students and researchers in the field of electronics. By understanding the design process and the potential for innovation, they can develop new and exciting projects using the HEDY MCU as a platform.

Overall, the project report aims to provide a comprehensive guide to the design and development of the HEDY MCU, showcase its potential for innovative electronic systems, and provide valuable insights into the design and development of microcontroller-based systems.

9. CONCLUSION:

The Hedy MCU is a microcontroller development board that is designed for use in a wide range of embedded system projects. The board was designed to optimize performance, minimize size, and simplify assembly. The components were carefully sourced from reliable suppliers, and the board was assembled and tested to ensure that it met the required standards. Overall, the design and manufacturing process for the Hedy MCU was successful, and the board is an ideal choice for IoT projects.

10.REFERENCES

- Real Time Health Monitoring Using GPRS Technology
  Published in: International Journal of Computer Science and Network (IJCSN) Volume 1, Issue 3, June 2012
  Author: Shubhangi M. Verulkar, 2Maruti Limkar

- IoT Based Wearable Smart Health Monitoring System
  Published in: Celal Bayar University Journal of Science Volume 14, Issue 3, 2018, p 343-350
  Author: Department of Electronics and Automation, Turgutlu Vocational School, Manisa Celal Bayar University, 45400, Turgutlu, Manisa, Turkey.

- ESP8266EX Hardware Design Guidelines - https://www.espressif.com/sites/default/files/documentation/esp8266_hardware_design_guidelines_en.pdf

- ESP8266EX Datasheet: This is the official datasheet from Espressif, the manufacturer of the ESP-12E module. It provides detailed information on the module's specifications, pinouts, and electrical characteristics.