SUMMER INTERNSHIP REPORT

on

Patient Health Monitoring System

Duration: June 24, 2024 to August 2, 2024

Under Supervision Of

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July, 2024

Certificate

This is to certify that the internship project entitled **"Patient Health Monitoring System"** was successfully completed by the following students from various colleges in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology (B.Tech)** under the internship program at **AICTE IDEA Lab-Guru Gobind Singh Indraprastha University**, New Delhi - 110078.

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Declaration

We hereby declare that the project work presented in this internship report, entitled **"Patient Health Monitoring System"** is entirely our own work and has not been submitted for any degree or diploma from this or any other institute for partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology (B.Tech)**.

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Abstract

The Patient Health Monitoring System is designed to provide continuous monitoring of critical health parameters, including heart rate, oxygen level (SpO2), electrocardiogram (ECG), body temperature, environmental temperature, and humidity. This system aims to enhance patient care by offering real-time data collection and analysis, ensuring timely medical interventions.

The system integrates multiple sensors to gather comprehensive health data, which is displayed on a user-friendly interface. Additionally, an alarm system is incorporated to remind patients of their medication schedules, thereby improving adherence to prescribed treatments. The device is suitable for both hospital and home use, promoting proactive health management.

Key results demonstrate the system's accuracy and reliability in monitoring vital signs, with user feedback indicating high satisfaction due to its ease of use and effectiveness. Future enhancements may include integrating wireless data transmission and expanding the range of monitored parameters.

Contents

1 Introduction

In the modern healthcare landscape, technological advancements play a crucial role in enhancing patient care. The Internet of Things (IoT) based Patient Health Monitoring System is an innovative approach designed to continuously monitor the health parameters of patients through an interconnected network of sensors and microcontrollers.

This project employs a microcontroller as the central unit, interfacing with various sensors to gather real-time health data. Key components include heart rate sensors, temperature sensors, blood pressure sensors, and SpO2 sensors. These sensors collect vital signs and transmit the data to a central system for continuous monitoring and analysis.

The primary goal of this project is to provide a reliable, efficient, and remote health monitoring solution. Its use cases span across hospitals, elderly care facilities, and home healthcare, ensuring prompt responses to any detected abnormalities. By leveraging IoT technology, healthcare providers can deliver superior care and improve patient outcomes.

This report also discusses the future aspirations of the project. Future enhancements include integrating advanced machine learning algorithms for predictive analysis and expanding the system to support a wider range of health parameters. These improvements aim to enhance the accuracy, reliability, and overall effectiveness of the system.

In summary, this report details the system architecture, components, implementation, and results of the Patient Health Monitoring System. Additionally, it explores potential future developments to further improve the system's capabilities and impact on healthcare.

2 Hardware Used

2.1 Architecture used

2.1.1 Arduino UNO

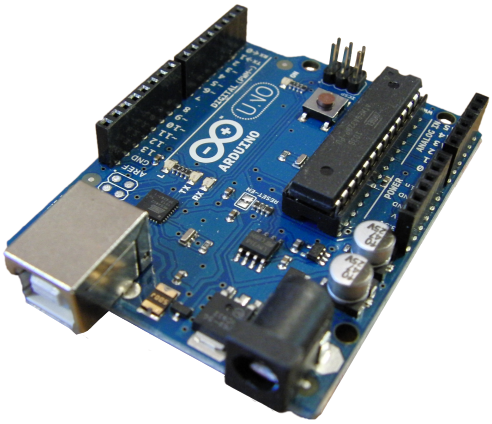

Figure 1: Arduino UNO R3

2.1.2 Description

The Arduino UNO R3 is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

2.1.3 Pin Diagram

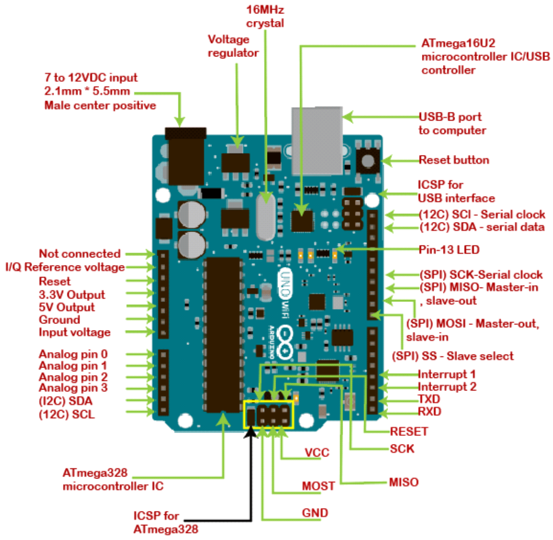

Figure 2: Arduino UNO R3 Pin Diagram

2.1.4 ESP32

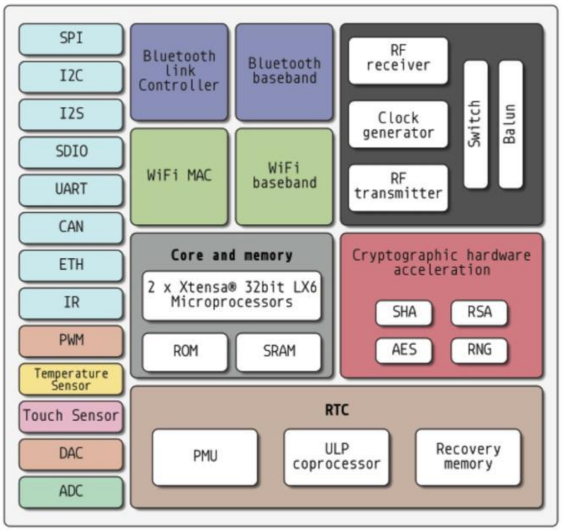

Figure 3: ESP32

2.1.5 Description

The ESP32 is a low-cost, low-power system on a chip (SoC) series with Wi-Fi dual-mode Bluetooth capabilities. It is designed for mobile devices, wearable electronics, and IoT applications. It integrates a CPU, memory, networking, and a wide range of peripherals.

2.1.6 Pin Diagram

Figure 4: ESP32 Pin Diagram

2.2 Sensors used

2.2.1 MLX90614

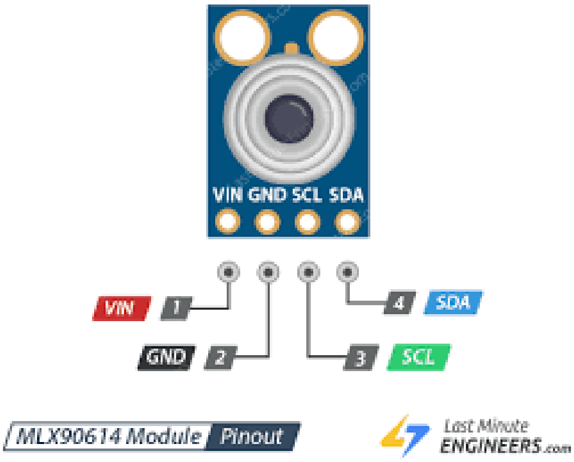

Figure 5: MLX90614

2.2.2 Description

The MLX90614 is an infrared thermometer for non-contact temperature measurements. It is factory calibrated in a wide temperature range: -40 to 85°C for the ambient temperature and -70 to 380°C for the object temperature. The measured value is the average temperature of all objects in the Field of View of the sensor.

2.2.3 DHT11

2.2.4 Description

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed).

2.2.5 AD8232

2.2.6 Description

The AD8232 is an integrated signal conditioning block for ECG and other biopotential measurement applications. It is designed to extract, amplify, and filter small biopotential signals in the presence of noisy conditions, such as those created by motion or remote electrode placement.

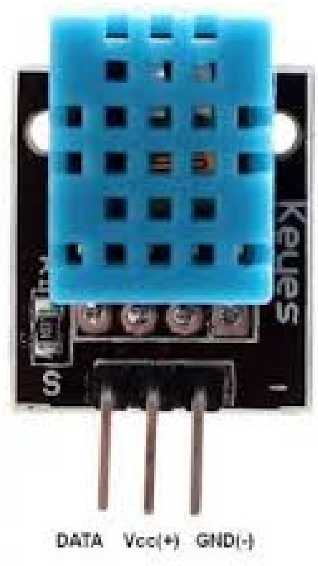

Figure 6: DHT11

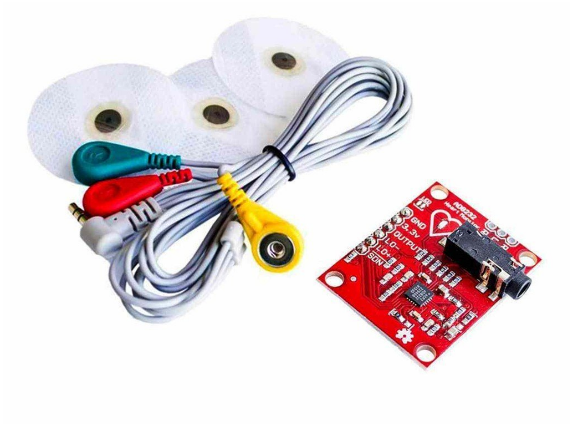

Figure 7: AD8232

2.2.7 Max30100

2.2.8 Description

The Max30100 is an integrated pulse oximetry and heart-rate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals.

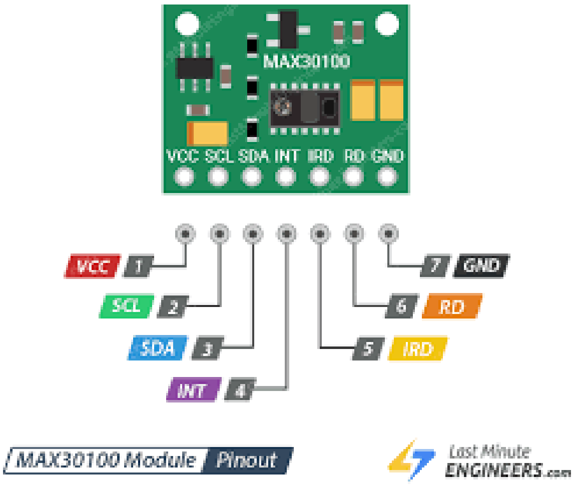

Figure 8: Max30100

2.3 Peripheral Components

2.3.1 LCD With I2C Module

2.3.2 Pin Description

Figure 9: LCD With I2C Module

2.3.3 Features

The LCD with I2C module is used to reduce the number of wires from 16 to 4. It makes the connection easier and more reliable. The I2C interface has 4 pins: VCC, GND, SDA, and SCL.

2.3.4 DS3231-RTC

2.3.5 Pin Description

Figure 10: DS3231-RTC

2.3.6 Features

The DS3231 is a low-cost, extremely accurate I2C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery input and maintains accurate timekeeping when main power to the device is interrupted.

2.3.7 Mini Buzzer

2.3.8 Pin Description

Figure 11: Mini Buzzer

2.3.9 Features

A mini buzzer is a small audio signaling device that is often used in alarm circuits and timers. It typically operates with low voltage and current and produces sound through mechanical, electromechanical, or piezoelectric means.

2.4 Other components

2.4.1 Push Button

A push button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal.

2.4.2 Jumper Wires

Jumper wires are used to make connections between the elements of a breadboard or other prototype. They are typically 22 AWG solid core wire and come in three varieties: male-to-male, male-to-female, and female-to-female.

2.4.3 Resistors

Resistors are passive two-terminal electrical components that implement electrical resistance as a circuit element. They are used to reduce current flow, adjust signal levels, divide voltages, bias active elements, and terminate transmission lines, among other uses.

2.4.4 Bread Board

A breadboard is a tool used for prototyping electronic circuits without the need for soldering. It allows for the easy and quick construction of circuits, making it ideal for experimentation and testing.

3 Software Used

3.1 Ubidots

For this project, we have used Ubidots, a comprehensive platform that provides tools for managing IoT devices and data. Ubidots offers real-time data visualization, device management, and powerful APIs to integrate with various IoT hardware and software solutions.

Ubidots provides the following features:

- **Data Ingestion:** Supports various protocols such as HTTP, MQTT, and TCP/UDP for data ingestion from devices.
- **Visualization:** Offers customizable dashboards to visualize real-time data with widgets like charts, maps, indicators, and more.
- **Device Management:** Facilitates device configuration, monitoring, and management with user-friendly interfaces.
- **Event Management:** Enables setting up triggers and alerts based on data thresholds, helping in proactive monitoring and response.
- **Integration:** Provides APIs and webhooks for seamless integration with other systems and platforms.

With Ubidots, the Patient Health Monitoring System can efficiently handle and analyze the data collected from various sensors, providing valuable insights and timely alerts to healthcare providers.

3.2 Arduino IDE

For this project, we used the Arduino Integrated Development Environment (IDE) to program and control the hardware components. The Arduino IDE is an open-source platform that provides an easy-to-use environment for writing and uploading code to Arduino boards.

Key Features Used:

Code Editor: The IDE offers a simple code editor with syntax highlighting, making it easier to write and debug code. Libraries: We utilized various libraries for interfacing with sensors and peripherals, which simplified the coding process. Serial Monitor: The Serial Monitor tool was used for debugging and monitoring the data sent from the sensors. Sketch Uploading: The IDE allows seamless uploading

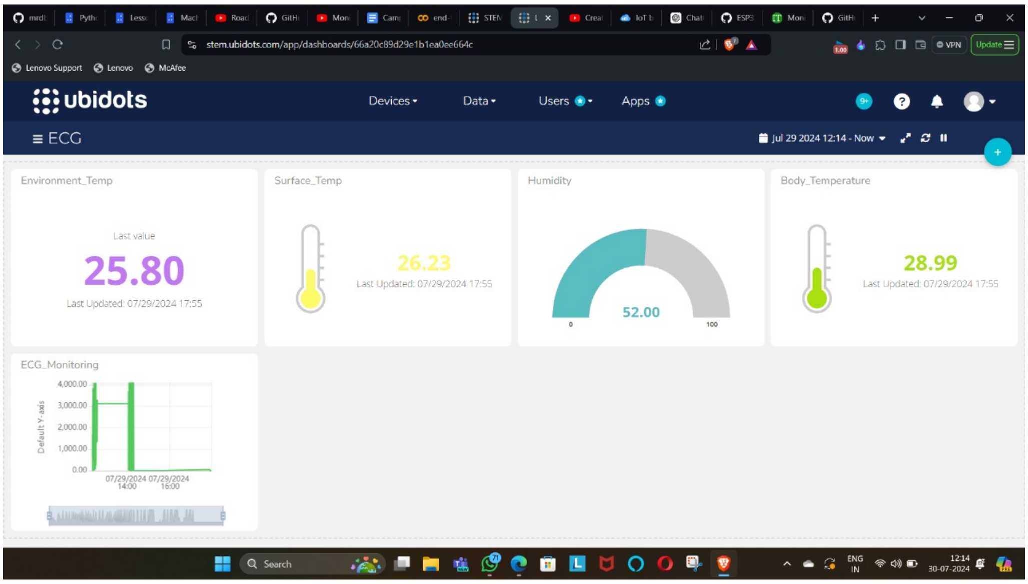

Figure 12: Ubidots

of sketches (programs) to the Arduino board via USB. By using the Arduino IDE, we were able to efficiently develop and test the Patient Health Monitoring System's code, ensuring proper functionality and integration of the different components.

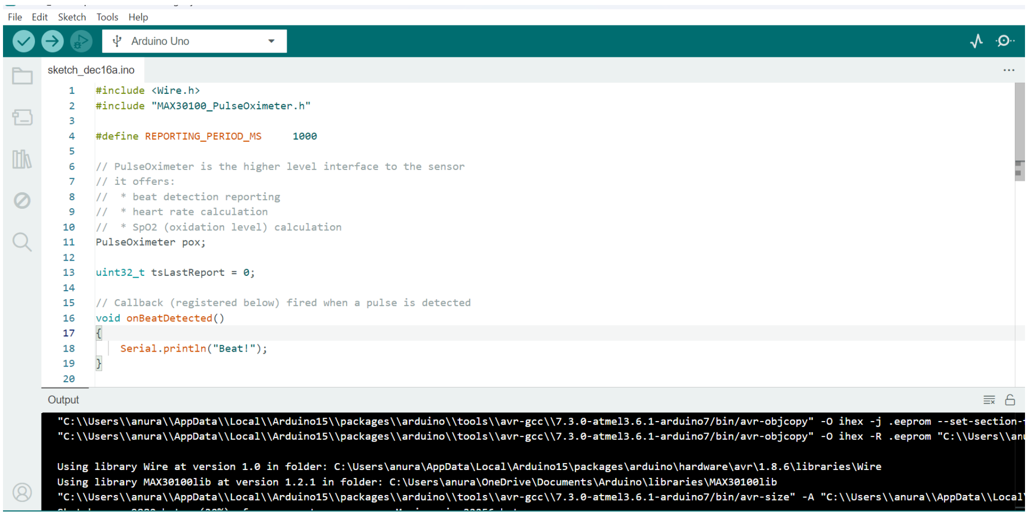

Figure 13: Arduino IDE

4 Final Project

4.1 Measuring Parameters and Vitals using ESP32

For measuring body temperature and surface temperature, we have used the MLX90614 sensor. This sensor provides accurate non-contact temperature measurements. For ambient temperature and humidity, we have used the DHT11 sensor, which is reliable and easy to interface. For ECG measurements, we have utilized the AD8232 sensor, which conditions the biopotential signals and provides a clear ECG waveform.

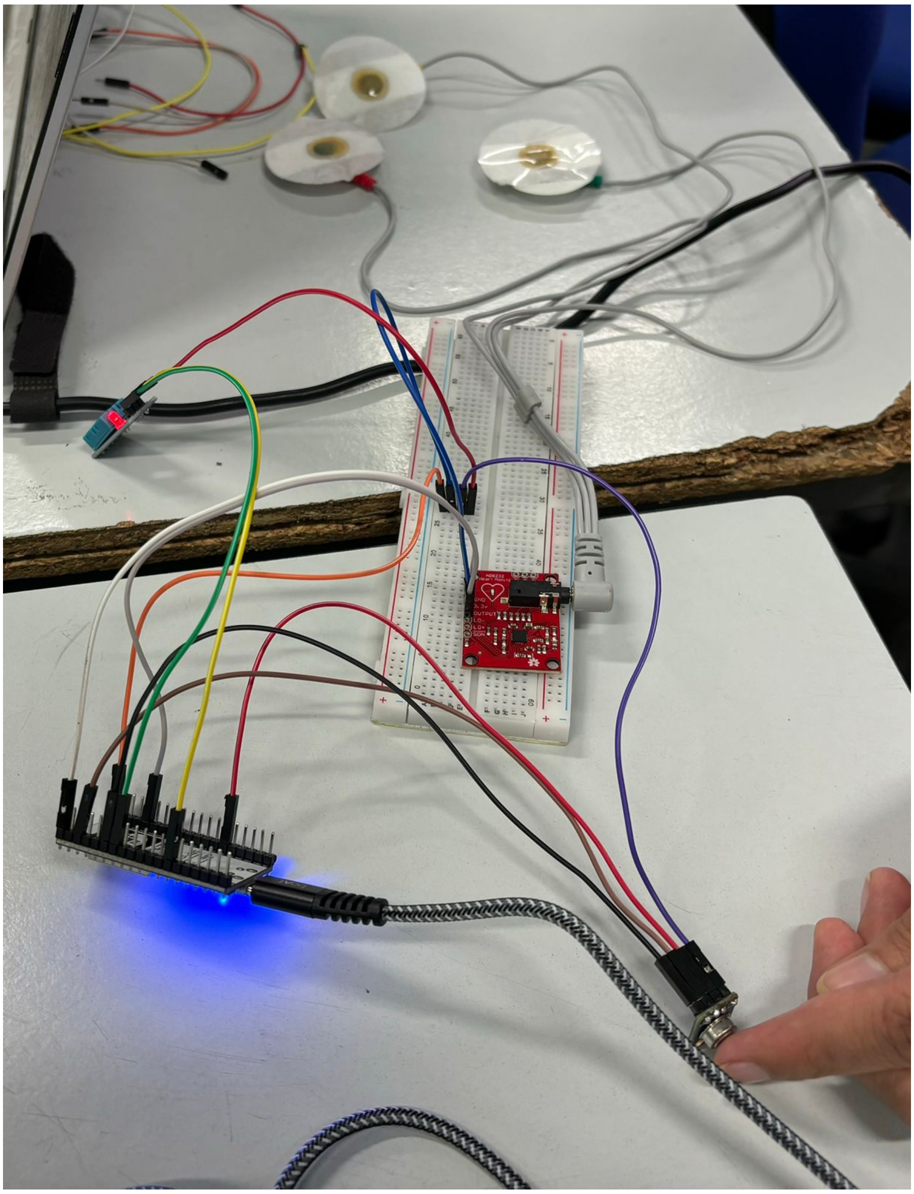

Figure 14: Project Setup

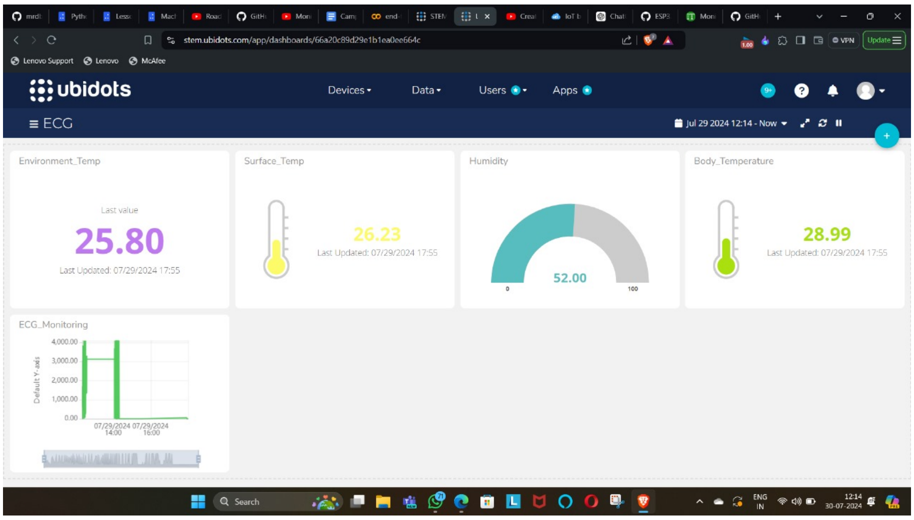

Figure 15: Output

4.2 Medication Alarm System

The Medication Alarm System is designed to assist patients in adhering to their medication schedules. We have used push buttons to adjust the timer, date, and time. This feature can be effectively used to set alarms for medications or regular scans, ensuring patients do not miss critical doses or check-ups. The alarm system is crucial for elderly patients who may have dementia and need regular reminders.

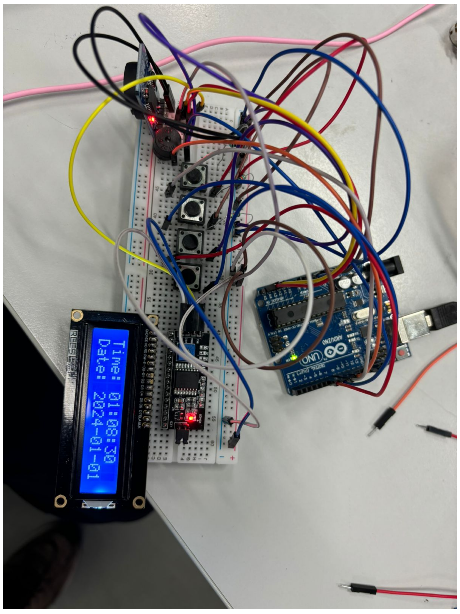

Figure 16: Medication Alarm System

4.3 Final Model

After carefully working and making the circuits we decided to make a combined model. We used laser engraver to design an enclosure for the prototype and also to limit the use of breadboards and for fixing the connections, we used soldering iron.

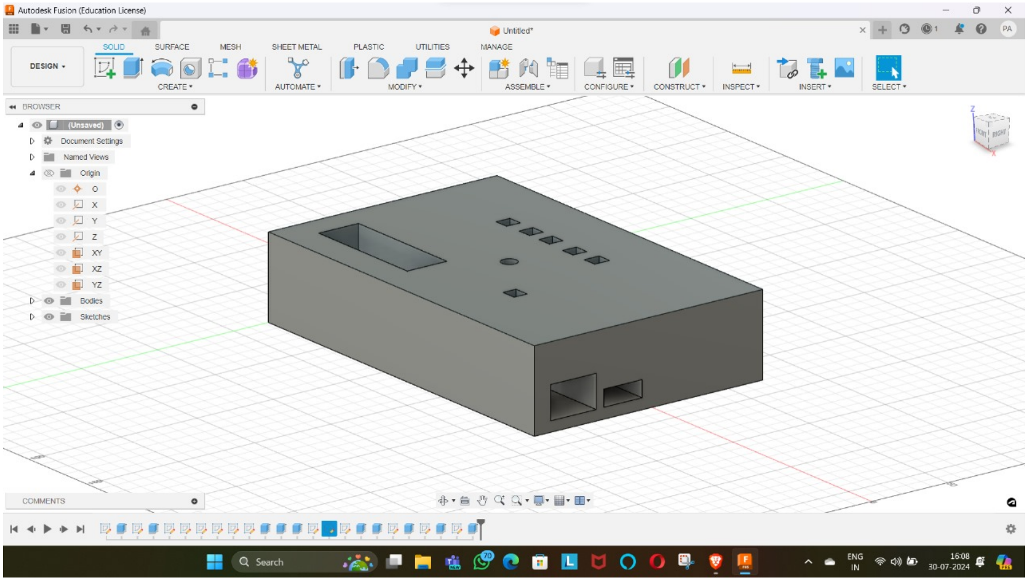

Figure 17: Cad Model

5 Use Cases and Future Goals

The Patient Health Monitoring System has various use cases, such as providing timely medication reminders to elderly patients who often develop dementia with age. The system can also be used in hospitals to monitor patients remotely, reducing the need for frequent in-person check-ups.

In a hospital environment, the system can monitor patients' vital signs remotely, reducing the need for frequent physical checks by healthcare providers. It allows for continuous monitoring and early detection of any anomalies, facilitating timely medical intervention.

For future goals, we intend to develop a wearable device, perhaps a wearable jacket, that can measure and monitor vital parameters continuously. If any vital signs fall into a danger zone, the system will send a notification to the patient's smartphone, alerting them and their healthcare provider.

Incorporate machine learning algorithms to analyze health data trends and provide predictive insights. This could help in anticipating health issues before they become critical, enabling preventive care.

6 Conclusion

The IoT-based Patient Health Monitoring System is a significant advancement in healthcare technology, providing continuous monitoring of vital parameters through a network of sensors and microcontrollers. This system offers numerous benefits, including timely alerts, remote monitoring, and better patient outcomes. With future enhancements and integration of advanced technologies, the system can become even more efficient and reliable, contributing to improved healthcare delivery.

This PHMS effectively monitors vital signs (temperature, humidity, ECG, heart rate, blood oxygen) using sensors and microcontrollers. The ESP32 microcontroller efficiently processes this data and transmits it to the Ubidots cloud platform for analysis. Simultaneously, the Arduino Uno, in conjunction with the RTC DS3231, ensures timely medication reminders, enhancing patient adherence.

By integrating the MLX90614, DHT11, AD8232, and medication alarm system, various health vitals are measured which is crucial for early detection of health issues and timely interventions.

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