iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** XII **Month of publication:** December 2022

DOI: https://doi.org/10.22214/ijraset.2022.48022

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue XII Dec 2022- Available at www.ijraset.com

IOT Based Health Monitoring System

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Abstract: ***Applications for MHealth (Mobile Health) and E-Health (Healthcare assisted by ICT) enable many ordinary people to improve, support, and aid their health. This paper offers another online platform for periodically checking a person's health metrics. This gives doctors and other medical professionals the chance to monitor a patient's health using variables like body temperature, blood pressure, etc. Additionally, these data (the parameter readings) can be retrieved and stored. One's information is recorded upon registering (creating an account) on the website, and health measurements are tracked as and when the user logs in, delivering a personalised medical history. The website also has a function that allows users to periodically update their profile information, such as their height, weight, and age. The Arduino IDE, ESP8266, sensors, Arduino Uno, Django Python Web Framework, HTML, CSS and Bootstrap were used to construct the project.***

Keywords: Arduino, Django, IoT, Patient monitoring, Sensors, ThingSpeak

I. INTRODUCTION

Food choices, physical inactivity and alcohol consumption, among other things, are all contributing to an increase in the number of people with chronic diseases today. The symptoms, development and treatment choices for chronic diseases are diverse. If not diagnosed and treated early enough, some of these diseases can be fatal. Body temperature and high blood pressure are two of the most common chronic conditions that can be controlled and tracked. Patients usually take a long time to adjust to and accept the reality of their illness due to their impairment. The reason for this is because people with these conditions require regular monitoring by their doctors in order for them to review their status and identify the best treatment options.

The increasing usage of mobile technology and smart gadgets in the realm of health has had a huge impact on the world. Health professionals are increasingly utilising the benefits that these technologies give, resulting in significant advancements in clinical and non-clinical health care. Similarly, many ordinary people benefit from MHealth (Mobile Health) and E-Health (Healthcare supported by ICT) applications to improve and assist their health. Because of their user-friendly interface, these applications have functioned as a safe refuge for these users. The internet of things is making it easier to link devices to the internet and transmit real-time patient health information to professionals who can help.

II. LITERATURE SURVEY

Several research papers related to the IOT based health monitoring system were reviewed for this project.

This paper elaborates an IOT-enabled health monitoring system that uses wearable sensors to measure EMG, ECG, temperature, blood glucose levels and muscle activity. For storage, cloudlet computing and processing were used, as well as pattern recognition and machine learning algorithms.[1]

A patient monitoring system for doctors that benefits both the patient and the hospital has been elaborated in this paper. The doctors are provided with the patient's heart rate and patient's body temperature remotely through IOT.[2]

This paper elaborates on an IoT-enabled health monitoring system. The system utilised various sensors to measure pulse rate, body temperature, as well as surrounding humidity and temperature and displayed these parameters on a LCD.[3]

This article details the creation of an architecture based on an ontology capable of monitoring patient health and recommending fitness routines to patients with chronic conditions.[4]

The objective of this research is to connect IoT technology with health monitoring in order to make it more personalised and timely. This research aims to look into a variety of wearable health monitoring modules that people can use to track their heart rate, blood pressure, pulse, body temperature, and other physiological data. To enable real-time monitoring, the data is integrated through IoT for processing, linking, and computing.[5]

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This paper analyses parameters such as body temperature, blood pressure, pulse sensor, and GPS to track the patient's current location in this project using Arduino where the collected data is sent to Arduino and analysed.[6]
The various ML methods that can be implemented to analyse IOT healthcare data such as supervised, unsupervised and regression techniques are discussed in detail in this research paper.[7]
This paper describes a machine learning model that is a multi-layer feed-forward neural network and it needs many machine's input parameters for model training. This paper introduces 17 different models to diagnose the health of the machine.[8]
The system described in this research paper introduced smart healthcare to monitor the basic important signs of patients like heart rate, body temperature, and some measures of hospital room condition such as room humidity, the level of CO and CO2 gases.[9]
This paper outlines a patient monitoring system with the goal of developing a system capable of monitoring important health metrics comprising heart rate, pulse oximetry and body temperature. The data is sent to the cloud platform using MQTT connection.[10]
The goal of this study is to create a monitoring system that will allow clinicians to monitor asthmatic patients from afar. Patients will be able to use several sensors to detect oxygen saturation (SpO2), heart rate, body temperature, humidity, volatile gases, room temperature, and electrocardiogram (ECG) and have the results displayed in an app.[11]
This paper describes a system that monitors and tracks different vital signs of patients in healthcare facilities and automatically detects anomalous conditions. The design, implementation, preliminary testing and analysis of the system are presented.[12]

III. METHODOLOGY AND WORKING

The objective of this project is to determine the patient's body temperature, pulse rate and surrounding temperature, humidity and air quality and send all the real time data to a website.
For that purpose we have utilized MAX30102 Pulse Oximeter sensor to monitor the oxygen saturation (SPO2) and heart rate (BPM), DS18B20 Body Temperature sensor to monitor body temperature, DHT22 Temperature and Humidity sensor for monitoring surrounding temperature and humidity, MQ135 Air quality sensor to monitor the quality of the air in the surrounding environment, Arduino microcontroller to receive all sensor inputs both in analog and digital format and ESP8266 module to receive the data from Arduino and transmit it on the internet using its WiFi capabilities. The reason for using Arduino microcontroller is that Arduino has 14 digital and 6 analog pins for sensor inputs whereas ESP8266 has 16 digital inputs and 1 analog pin which was insufficient given that we needed 4 analog inputs for the project.
First, the circuit was designed in the proteus software. The connections were tested and finalised in the software before actually being put into practice. The real hardware was then set up according to the software design using breadboards, resistors and jumper wires along with sensors and microcontrollers. The next step is to properly read values from all the sensors. Arduino IDE has been used to code the hardware setup. Initially, the necessary libraries are imported that facilitate reading the sensor values as well as linking the Arduino and NodeMCU. In the void loop, 115200 baud rate is selected for reading value and pins for all sensors are defined. Variables are declared in the main loop that will store the sensor value data. In case the values are null, then the serial monitor prints failed to connect the sensor. Otherwise, the serial monitor will show the readings for the sensors.

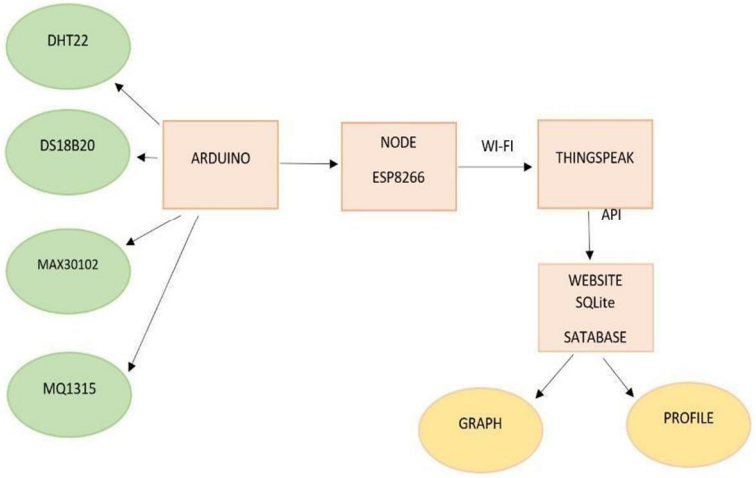


Fig 1.1 Block Diagram

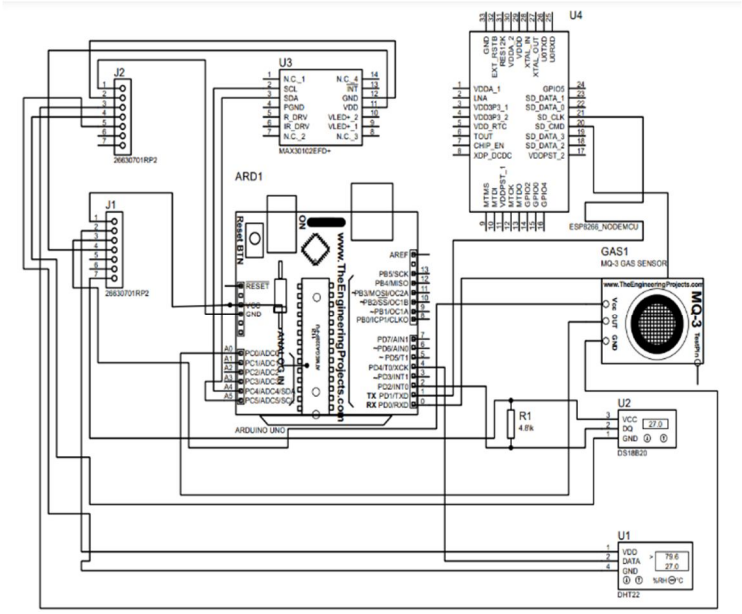


Fig1.2 Circuit Diagram

After reading the values from Arduino, the next task is to send data to ESP8266, hence the connections to the tx and rx port of the arduino for serial communication are made. The baud rate of NodeMCU is specified as 9600, so the data is sent from Arduino to NodeMCU by defining the baud rate of Arduino uno in myserial.begin() function. The data obtained is stored in a variable and converted to float datatype before sending it to the Thingspeak platform for cloud storage. For this purpose, Thingspeak and NodeMCU need to be connected. Firstly, a Thingspeak channel is created with the specified fields defined. Thereafter the libraries needed for the Thingspeak connection are imported, the channel ID is registered, and the API key is written. Once the Wi-Fi module is enabled, the values from the Arduino are converted to float datatype and sent to Thingspeak by using the setField() and writeFields() methods. The Wi-Fi connection of NodeMCU is established by providing the mobile data hotspot username and password.

This data is then downloaded from Thingspeak cloud and then checked and translated into the JavaScript Object Notation (JSON) format using Django, a full-stack Python web framework. The logged-in user gets connected to every record. Because of this account based architecture, only the user who is logged in can view the user specific health parameters and previous records. Additionally, each time the screen is reloaded, the database fetches data from the sensors connected to the user and new values and graphs are displayed on the website.

By clarifying the records based on the username, the user with his previous data can obtain these records. New users can register on the website by providing their username, first name, last name, sex, age, weight, height, blood group and password on the registration page. Also, one can add their profile picture for public display. Using the website's edit profile feature, these parameters can be modified later. The web pages for the website were designed using Figma design software and the entire frontend was created using HTML, CSS, JS and Bootstrap.

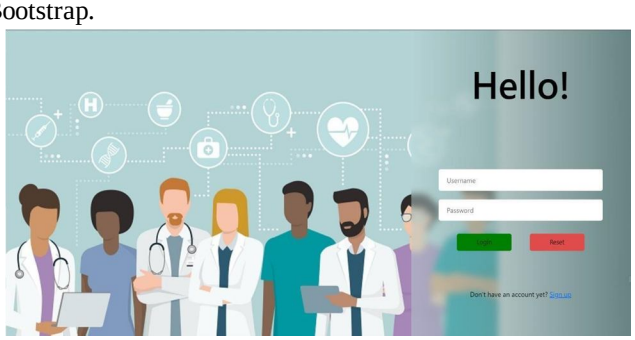


Fig 1.3 Login Page

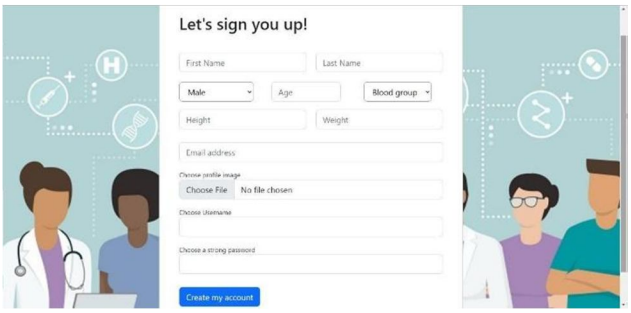


Fig 1.4 Register Page

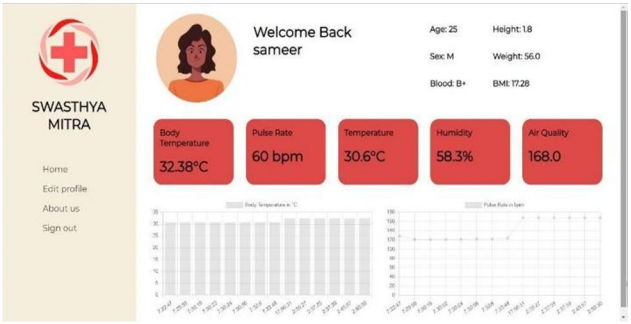


Fig 1.5 Home Page

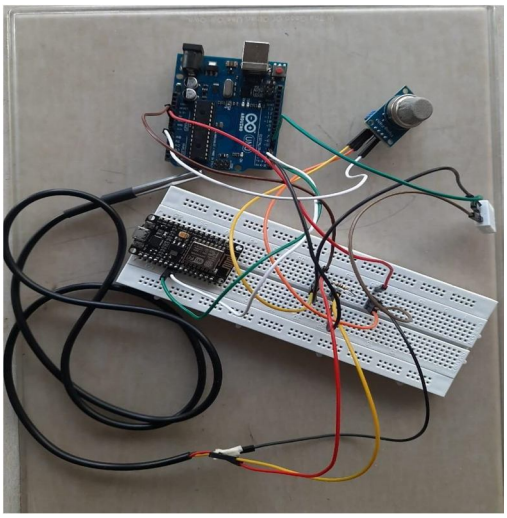


Fig 1.6 Hardware Setup

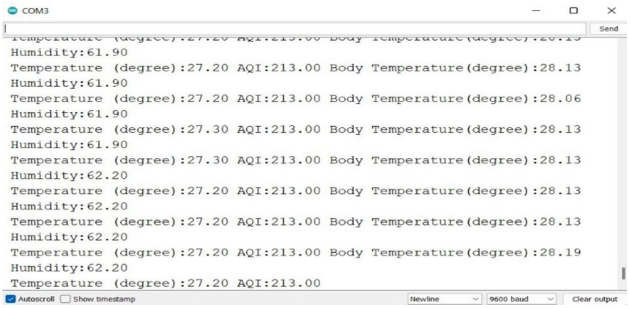


Fig 1.7 Serial Monitor output of NodeMCU

IV. RESULTS

A prototype of the proposed sensing system is shown in Fig. 1.6. An Arduino Uno microcontroller, a Esp8266 Wi-Fi module, a MAX30102 pulse oximeter sensor, a DS18B20 body temperature sensor, a DHT22 temperature and humidity sensor, and a MQ-135 air quality sensor are all included in this prototype's hardware. Using a laptop or power bank, the microcontroller and Wi-Fi module are powered. The Arduino Uno is connected to all of the sensors. The Arduino Uno is connected to sensors and the Wi-Fi module using jumper wires. To record their health parameters, users must first register on the website. The user must enter their name, gender, age, blood type, height, weight, email, profile picture, username, and password in order to create an account.

While not all fields are required, the username and password are. Whenever it's more convenient, the profile contents can be added through the website's "Edit Profile" page. The user must log in with the same username and password they used to create their account. The health parameters are detected as soon as one logs in. Through the Wi-Fi module, this sensed data is sent to the ThingSpeak cloud and saved in the SQLite database along with the timestamp. The Django website is used to access the data in this case, where it can be used to view graphs and visualisations as well as old records and the timestamp. Once the user logs in, these are displayed on the dashboard.

V. LIMITATIONS

Although the Internet of Things (IOT) has a lot of potential in healthcare, it still has a long way to go before it can be fully adopted. The following are the risks and drawbacks of employing linked devices in healthcare:

The risk of failure of hardware components is a major concern in the project. Many times the sensor stops working due to some internal faults, which is one of the drawbacks of this hardware project and due to this, one cannot be completely reliant. Another major issue with the project is the faulty readings by sensors, due to many factors like internal compensation, loose connection or default error of scale.

Integration with software and transferring of data can raise problems as well. Sometimes, the hardware connection is done properly but while integrating with software, one might face many issues, certain libraries are required to be imported before connecting with different sensors and the code must be written properly with respect to the pin connections. The system appears fragile, is not portable, and has loose connections, thus it is not durable.

VI. FUTURE SCOPE

This system is currently provided with only four parameters. In the future, more sensors could be added to obtain more data and hence provide more efficient analysis and be helpful for healthcare professionals. Different datasets could be utilised to predict the emergence of various diseases. By incorporating machine learning techniques, the created data in the database can be immensely useful in forecasting a person's future health conditions and any probability of diseases. Mobile application for this project can be created so that it can be easily accessible.

The option for downloadable personalised health profile can be added as well for presenting one’s profile to a health care professional. This may include the user’s profile with age, gender, height, weight, etc. along the current and some previous medical data. Also, this system could be developed to be more compact and user-friendly. This system's portability problem can be solved by permitting fixed connections and making the interface more durable.

The provision for a doctor's account can be added as well so that they may monitor the health of his or her patients in real-time. Additionally, the user's medical history option can be introduced so that the user may be able to view his/her previous check-up dates and the results during those check-ups as well.

During situations like a pandemic, patients' health could be monitored remotely. Personal health monitoring could be beneficial for those living in remote areas. Early diagnosis could be achieved.

VII. CONCLUSION

In the domain of health monitoring, the Internet of Things (IOT) is widely regarded as one of the most practical technologies for remote value tracking. An IoT based health monitoring system using different sensors has been developed in this paper. Various sensors were used to monitor body temperature, oxygen level, humidity, air quality index and temperature of the surroundings. These all values are sent to ThingSpeak and then with the help of API keys these health parameters are displayed on a user-friendly website. Hence, through this project we are able to take a step towards smart healthcare and help people monitor their health themselves with ease.

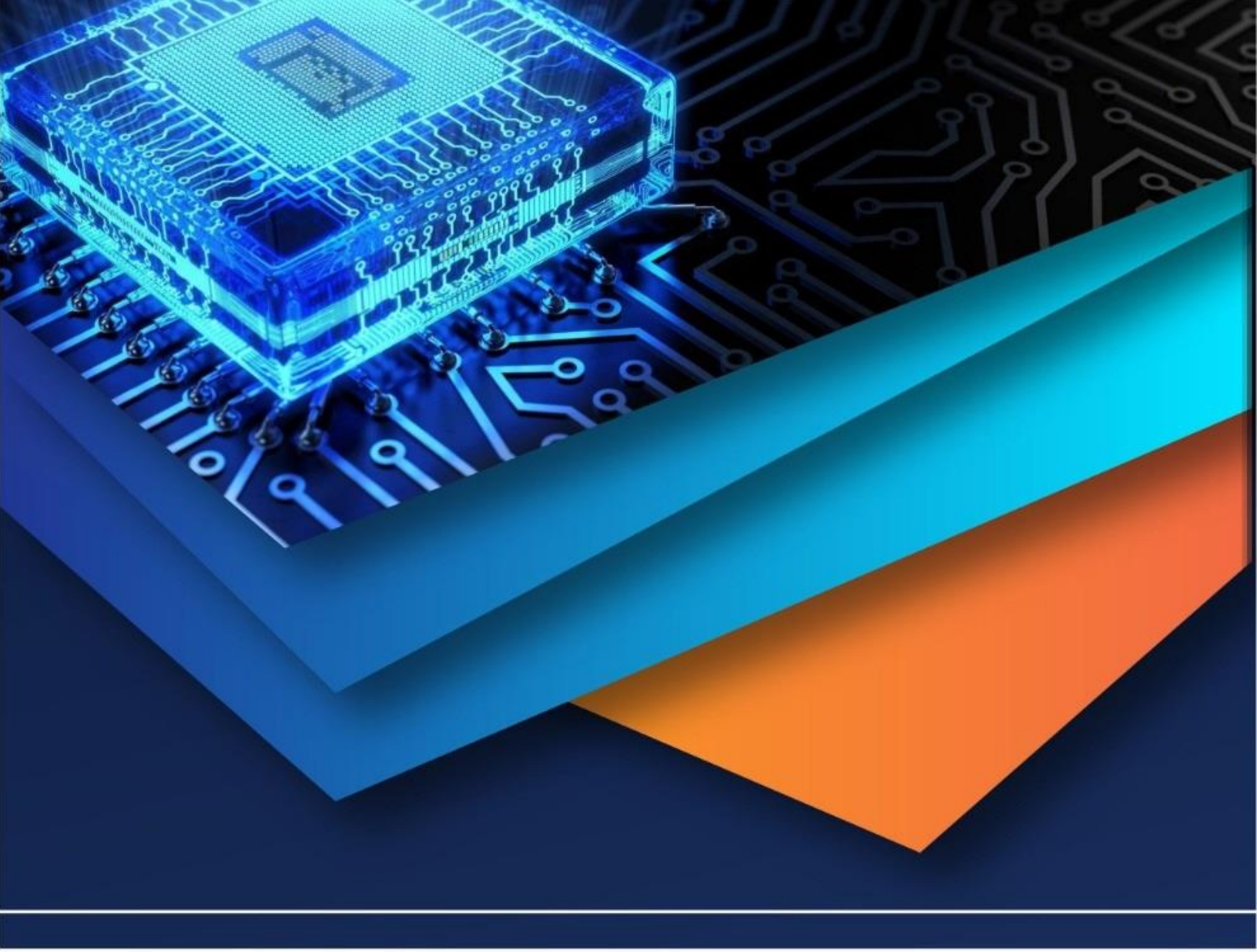
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VIII. ACKNOWLEDGEMENTS

We would like to express our gratitude to our respected Director Prof. (Dr.) R.M. Jalnekar, Vishwakarma Institute of Technology, Pune for their constant moral support and encouragement. We would also like to thank our project guide and HOD of Multidisciplinary Engineering Prof. Mukund Kulkarni Sir for his advice and helping us in successfully completing our project work.

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