INTERNSHIP REPORT

30th NOVEMBER 2023 - 30th DECEMBER 2023

PREPARED BY

NITHIKA A

ACKNOWLEDGEMENT

I express my sincere gratitude to Senior Scientist Dr. Robert Sam, the Scientist In-Charge of CSIR-CSIO, Chennai complex for establishing such a great internship program and providing me an opportunity to take part in the same.

I am heartfully indebted to my mentor cum supervisor, Dr. G S Ayyappan for giving step-by-step insight on engineering and related technologies. A deepfelt respect for allowing me to participate and for sharing his opinions. I appreciate his insightful advice.

I am overwhelmed with gratefulness to the CSIR-CSIO campus for helping me come up with ideas and innovations. I am truly thankful to the research institute for being my instrumental platform to learn and showcase talents.

A special thanks to my parents for helping me gather lots of information about this opportunity.

This internship period has served to be my first scope of industrial and research related knowledge.

INTERNSHIP DESCRIPTION :

THE COMPANY :

CSIR-CSIO (Council of Scientific and Industrial Research- Central Scientific Instruments Organisation) is a Central Government organization in India, dedicated to advancing scientific knowledge and fostering innovation for industrial development. CSIR was established on September 26, 1942 and currently has a wide network of 37 national laboratories that copes up with every aspect of engineering and its related technologies. CSIR holds the 7th rank in Asia and leads the country at the first position in the research and development sector.

CSIR is involved in a wide range of research areas, including but not limited to:

- Chemistry and Materials Sciences
- Biological Sciences
- Environmental Sciences
- Aerospace and Engineering Sciences
- Information Technology and Electronics
- Pharmaceuticals and Drug Development
- Energy and Sustainability

Some of the prominent CSIR laboratories include the Indian Institute of Chemical Biology (IICB), National Chemical Laboratory (NCL), and Central Electronics Engineering Research Institute (CEERI), among others.

ABSTRACT :

IOT BASED ESP32S AIR QUALITY MONITORING SYSTEM

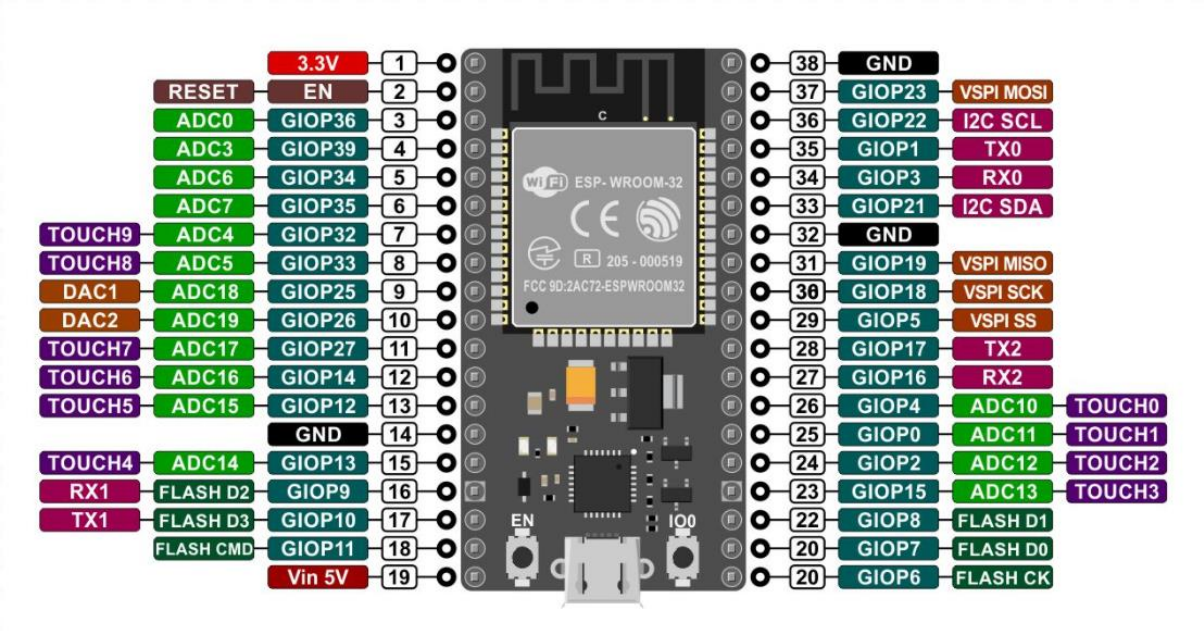
AND APP FOR MINING INDUSTRIES

Objective:

Exploring, studying and implementing an IoT based air quality monitoring system using Bluetooth and Wi-Fi enabled NODE MCU ESP32s in Arduino software and a Bluetooth app using MIT app inventor.

Existing technology:

- Hardware:
    - NODE MCU ESP 32s



The NodeMCU-32S is a versatile development board built around the ESP32 microcontroller. This report provides an in-depth analysis of its features, capabilities, applications, and its significance in the world of IoT (Internet of Things) and embedded systems.

It is based on Tensilica Xtensa LX6 microcontroller operating at 32 bits and containing dual core processor

Technical overview:

Hardware architecture: ESP32 microcontroller, memory, GPIO pins, and power supply.

Connectivity: contains built-in Wi-Fi and Bluetooth capabilities of the ESP32, enabling seamless communication and connectivity.

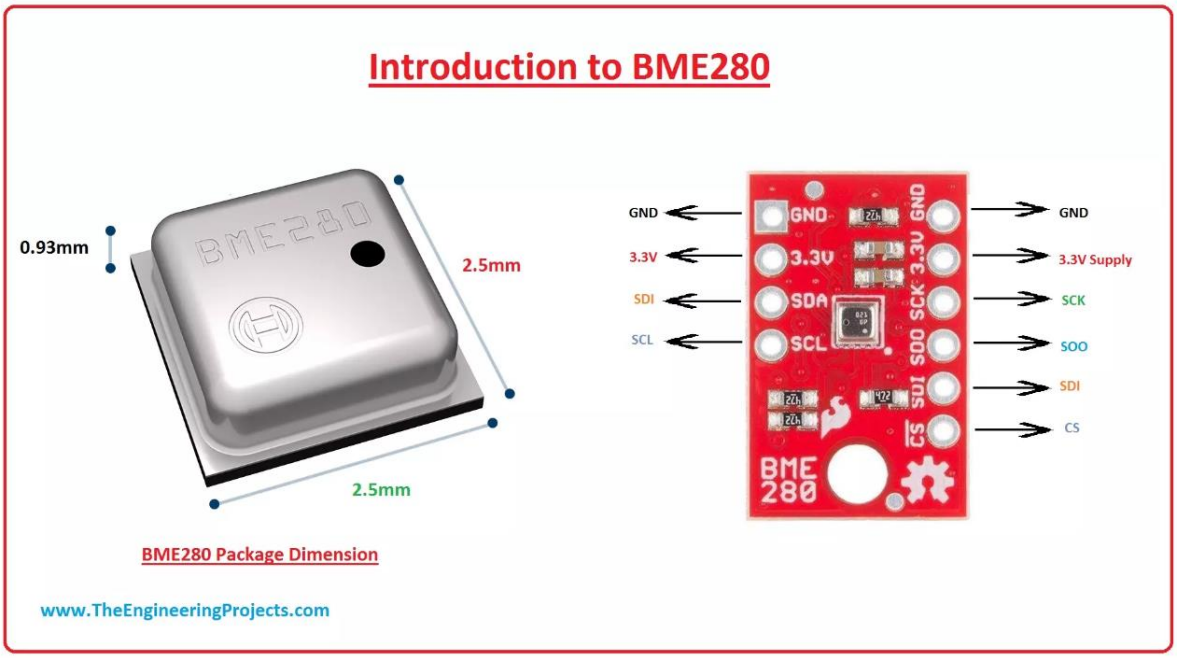
Programming language: lua and C++

Integrated Development Environment (IDE): Arduino IDE

- Sensors:

I. BME280:

It is used to measure Barometric Pressure, Moisture(humidity) Environmental Temperature and altitude of air. It communicates with with microcontrollers and protocols such as I2C and SPI.



Accuracy:

Humidity: 3%

Pressure: 1hPa

Temperature: 1 C

Altimeter: 1m

II. CCS 811

It is used to measure the carbon dioxide (CO2) count in ppm and total volatile organic compounds (tvoc) count in ppb.

III. MICS 6814

The MiCS-6814 is a compact MOS sensor with three fully independent sensing elements on one package. It detects organic gases like CO, NO2, C2H5OH (ethanol), H2, NH3(ammonia), CH4(methane)

IV. Ozone sensor

V. PM2.5 sensor

This sensor is used to identify particulate matter upto 2.5 microns in diameter.

- Software:
  - Arduino Shield

    Arduino shields are specialized circuit boards that can be seamlessly attached to Arduino microcontroller boards to add specific functionalities. These shields simplify the process of expanding the capabilities of an Arduino by providing a standardized and stackable form factor.

    Arduino shields are designed to fit directly onto the Arduino's pin headers, creating a physical and electrical connection.

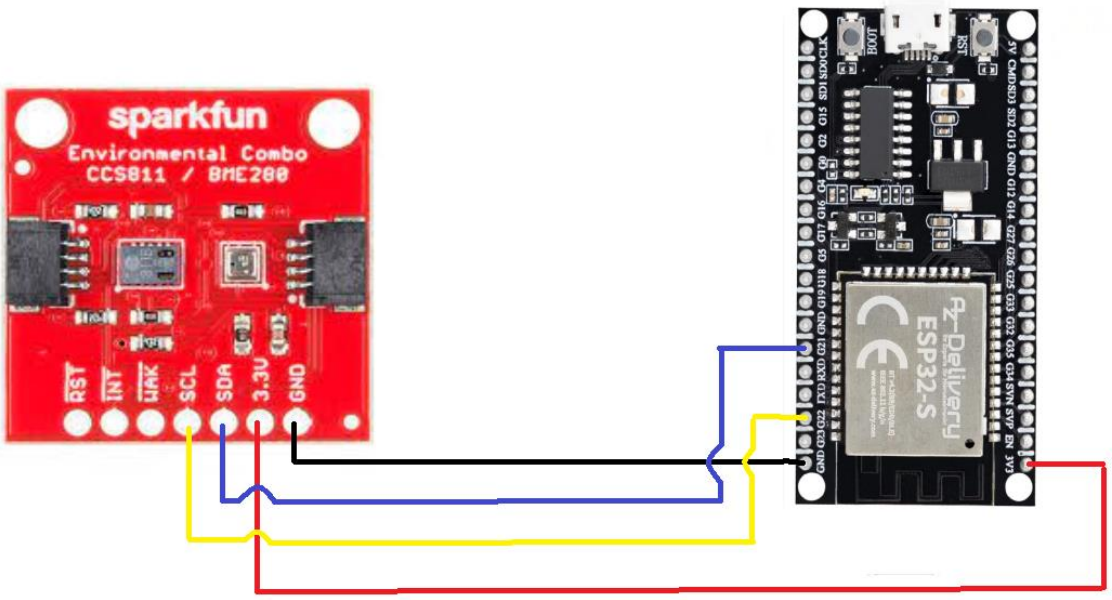
    Shields typically align with the Arduino's layout and use standard pins, making them easy to stack on top of each other.

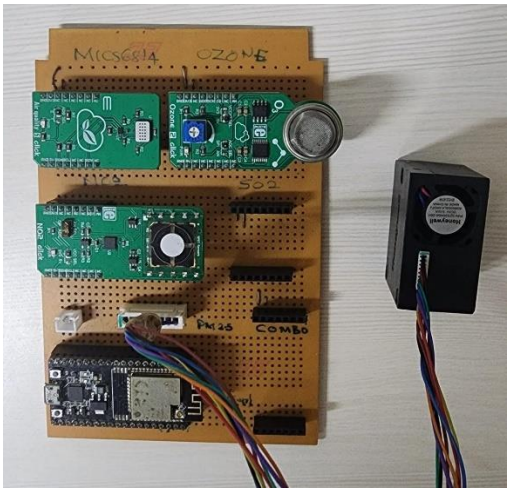
  - MIT app inventor

    MIT App Inventor is a visual programming environment for creating mobile applications (apps) for Android devices.

Skills learnt:

I. Soldering
II. Basics on simulation for pcb (printed circuit board) design using proteus software
III. Arduino
IV. Connecting sensors to esp32

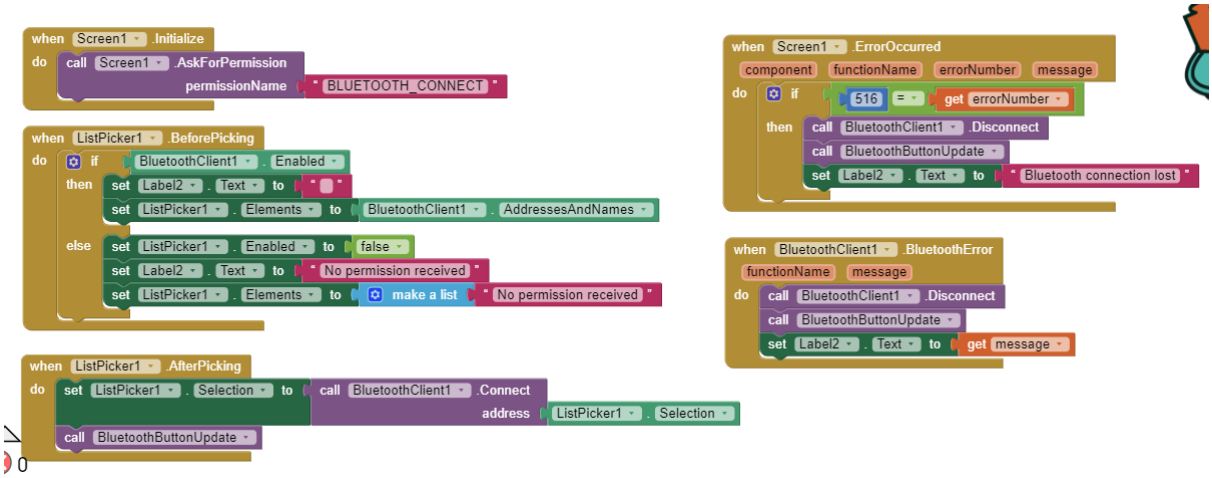




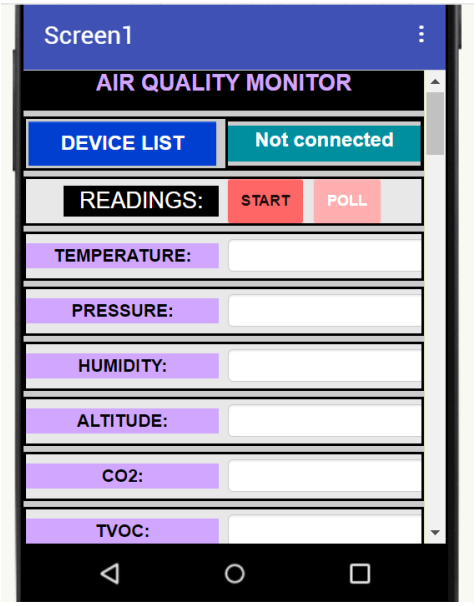
V. Building app using MIT app inventor

It consists of 4 stages:

Interlinking with Bluetooth

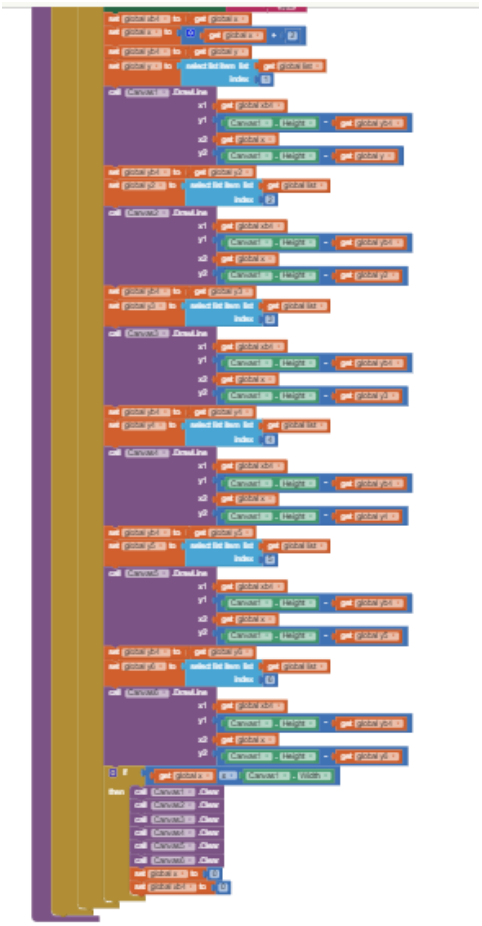


Designing app

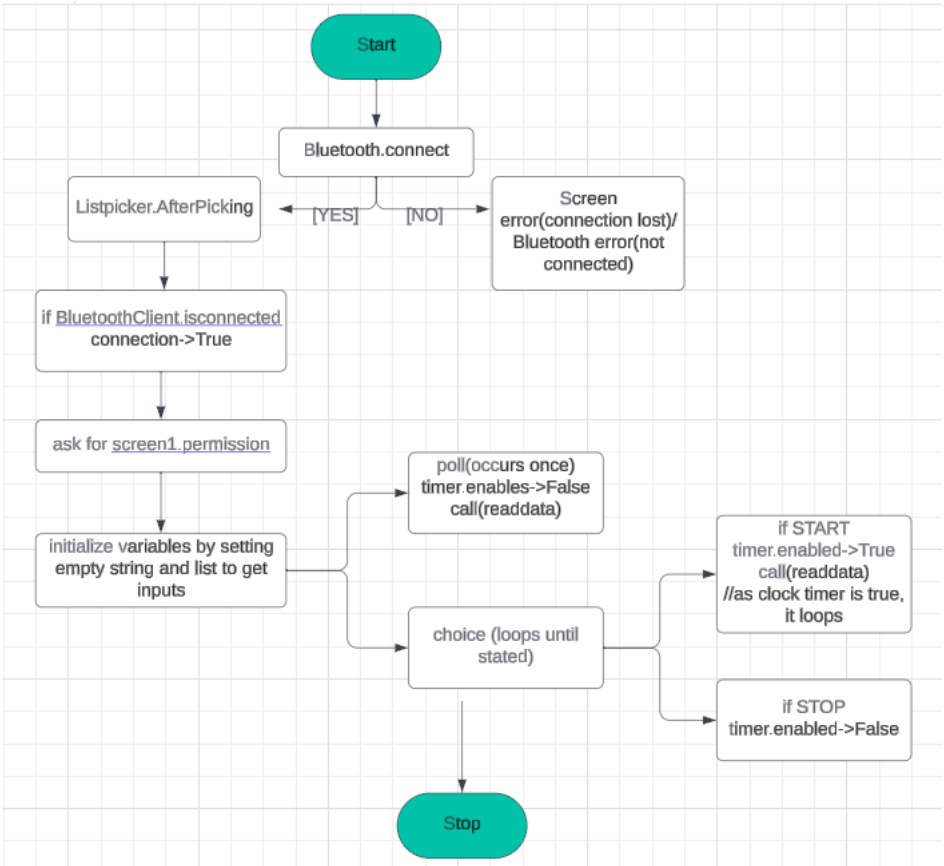


Getting integer values as input

Graphing the analog inputs



FLOWCHART:


Start
Bluetooth.connect
Listpicker.AfterPicking
[YES]
[NO]
Screen error(connection lost)/ Bluetooth error(not connected)
if BluetoothClient.isconnected connection->True
ask for screen1.permission
initialize variables by setting empty string and list to get inputs
poll(occurs once) timer.enables->False call(readdata)
choice (loops until stated)
if START timer.enabled->True call(readdata) //as clock timer is true, it loops
if STOP timer.enabled->False
Stop

Anticipation:

Constraints:

1. Transfer of data through Bluetooth is slow when compared to Arduino sensing
   Solution: invoke a delay that loops inside the clock so that it prolongs time before next input is received via Bluetooth
2. Bytes transfer of inputs rom Arduino
   Solution: get string inputs and convert it into integer inside the app
   Use big endian conversion techniques
3. Using more than one screen in app inventor
   Solution: import extensions such as TinyDB
4. Using inbuilt graphing components to present graphs
   Solution: using Canva instead

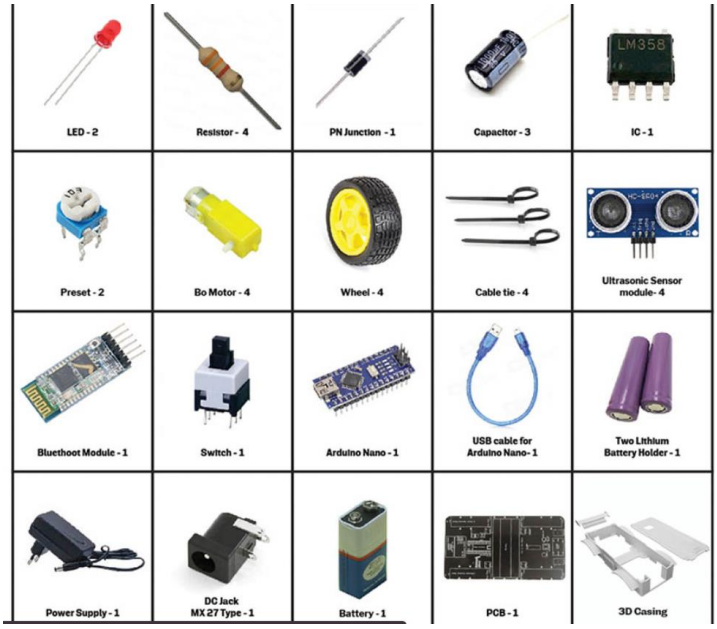
IOT ENABLED OBSTACLE DETECTION SYSTEM USING THINKERPLACE

Objective:

Exploring, analysing and implementing a pcb mounted battery-operated chargeable obstacle detection system to identify and alert users or automated systems about obstacles in a particular environment.

Skills learned:

I. Mounting elements on pcb and connecting it to a Bluetooth app using HC-05 module



II. Usage of HC-05 module

Bluetooth receiver unit -> receives command -> passes over to microcontroller unit -> controls motor(through motor driver IC) -> moves accordingly

Constraints:

1.Usage of round wheel does not promote motion at uneven surfaces

Solution: prefer usage of rotors bound to all-terrain wheels

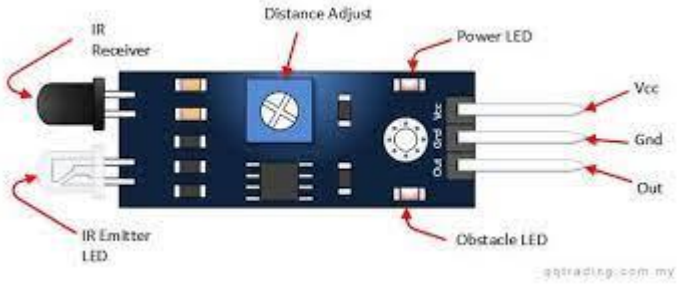
NEXT-GEN IOT-BASED VEHICLE DETECTION SYSTEM FOR ENHANCED EFFICIENCY USING INFRARED SENSORS

Objectives:

Exploring, designing and innovating an Arduino based vehicle detection system by transmitting and receiving infrared rays to count the number of vehicles entering and exiting an area.

Skills learnt:

I. Usage of infrared sensor with ESP32s



II. Arduino coding

Constraints:

1.To create an event-based delay rather than setting time-based delays

Solution: usage of interrupts

2. Accuracy in counting only vehicles

Other skills learnt:

I. Basic insights on control systems.
II. Team management for a group of 6 members.

III. Overview on PU-PEMS (Portable Universal Pump Efficiency Monitoring System) and PQA (Power Quality Analyzer)
IV. Attended a consultation meeting with research developers at IMM solutions.

Future scope and applications:

1.Mounting the air quality analyser on the obstacle detection robot system to send them into mines to sense the pollutions and air concentration in off-limit zones.

2.Using obstacle detection robot for military purpose to identify injured soldiers at crucial areas

3.Navy applications to calculate data at lower deck using obstacle detection system

4.Identifying the pollution content of our surroundings by mounting an air quality monitor

5.Obstacle detection systems can be replaced with rotors to climb uneven surfaces such as mountains and slopes to collect any types of data by extending it with Arduino shields

6.Infrared monitoring systems can be used to detect intruders and notify us through alarms

7.Infrared rays can be used to detect gas leakage, cracks in objects, distance between bodies