



R.M.K. ENGINEERING COLLEGE

(An Autonomous Institution)

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NEXT GEN INTELLIGENT HEALTHCARE SYSTEMS FOR EMERGENCY SERVICES

Your health, our priority. Compassionate care, innovative solutions because your well-being is the heart of my mission.

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ABSTRACT



In urban environments, delays in ambulance response times due to traffic congestion and unoptimized routes can significantly impact patient outcomes. This project addresses this critical challenge by integrating patient monitoring, AI-driven ambulance routing, and real-time traffic management integrating wireless sensor networks (WSN), artificial intelligence (AI), and cloud technologies to revolutionize emergency response systems. It comprises two modules.

- 1. AI-Driven Ambulance Routing and Patient Monitoring:** A real-time patient monitoring system is developed using IoT-enabled sensors to measure vitals like heart rate, oxygen levels, and body temperature. These data are transmitted to a cloud-based dashboard for hospital access. Simultaneously, AI algorithms optimize ambulance routing using real-time traffic data using API like Geoapify, Tom-Tom and OpenRouteService(ORS) to ensure the fastest path to the hospital.
- 2. Dynamic Traffic Signal Management:** Traffic density is analyzed to dynamically adjust traffic signals, prioritizing ambulance movement while minimizing overall congestion.

OBJECTIVES

To create an integrated system that improves healthcare response time by:

- Real Time monitoring Patient's vitals.*
- Dynamic ambulance routing with AI*
- Traffic signal management during emergency.*



LITERATURE SURVEY

S.NO	TITLE	AUTHORS	TECHNOLOGY USED	ADVANTAGES	DISADVANTAGES
1	Automatic Patient Monitoring and Alerting System based on IoT (2023)	<ul style="list-style-type: none"> Pola Anirudh G.A.E Satish Kumar R Phani Vidyadhar 	IoT integrated with cameras, clinical sensors	<ul style="list-style-type: none"> Real-time Monitoring Automation 	<ul style="list-style-type: none"> Data Overload Privacy Concerns
2	Real-Time Monitoring System Based on IoT for Cardiac Care (2023)	<ul style="list-style-type: none"> Luqman Qader Abdulrahman Siyamand Hasan Moheidin 	IoT, Cloud Computing, Machine Learning Algorithms	<ul style="list-style-type: none"> Remote Care Predictive insights 	<ul style="list-style-type: none"> Connectivity Dependence Data Privacy Risks
3	IOT-Based Wireless Patient Monitor Using ESP32 Microcontroller (2023)	<ul style="list-style-type: none"> Mujeeb Rahman K K Mohamed Nasor M Rayan Zidan 	Wireless Connectivity, Cloud Integration, IoT	<ul style="list-style-type: none"> Cost-Effective Real time Monitoring 	<ul style="list-style-type: none"> Data privacy Limited range
4	An Edge-AI-Enabled Autonomous Connected Ambulance-Route Resource Recommendation Protocol (ACA-R3) for eHealth in Smart Cities (2023)	<ul style="list-style-type: none"> Syed Thouheed Ahmed R. Manikandan 	Edge AI, Cloud integration	<ul style="list-style-type: none"> Reduced Response Time Improved Patient Care 	<ul style="list-style-type: none"> High Implementation Cost Complexity
5	Smart Healthcare Monitoring System Using IoT Technology (2023)	<ul style="list-style-type: none"> Adapaka Sai Kishore Gopiswara Rao Chinni 	IoT, Cloud Computing, Machine Learning Algorithms	<ul style="list-style-type: none"> Proactive Care Improved Accessibility 	<ul style="list-style-type: none"> Privacy and Security Risks Connectivity challenges



EXISTING METHODOLOGY

The existing system for Ambulance Routing, Patient Monitoring, and Traffic Signal Management has the following characteristics :



- **Ambulance Routing:** Uses static routes with basic GPS, causing delays due to traffic congestion or roadblocks.
- **Patient Monitoring:** Relies on manual or semi-automated systems, with limited real-time monitoring outside healthcare facilities, leading to delayed interventions.
- **Traffic Signal Management:** Operates on fixed timers or simple sensors, inefficiently managing traffic flow and not prioritizing emergency vehicles, causing delays and congestion.

PROPOSED METHODOLOGY

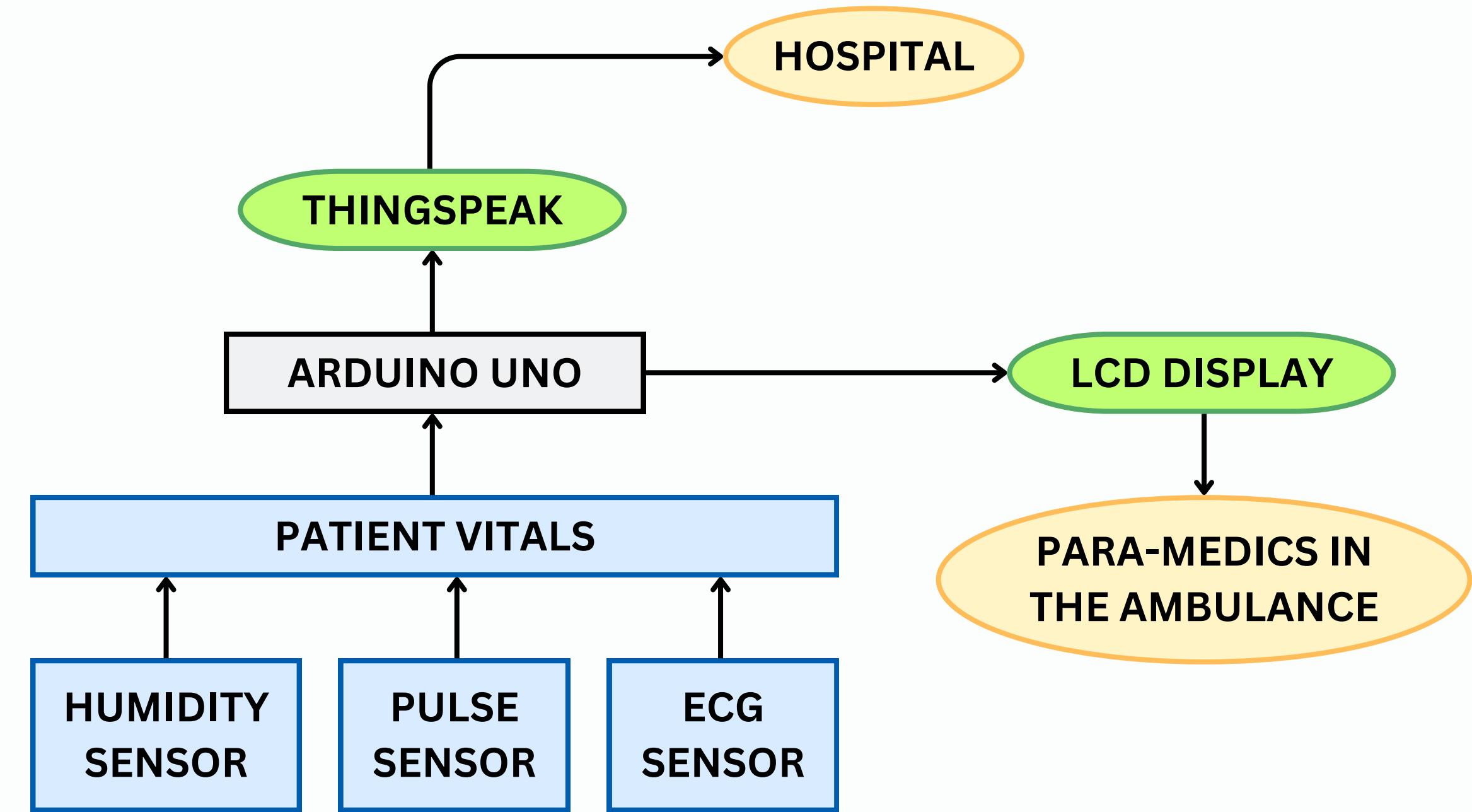
The proposed system for *AI-Driven Ambulance Routing, Patient Monitoring, and Dynamic Traffic Signal Management* aims to enhance emergency response and healthcare efficiency:

- **AI-Driven Ambulance Routing:** Uses real-time traffic data, AI algorithms, and predictive analytics to find the fastest, least congested routes, minimizing response times and optimizing ambulance allocation using *Geoapify*, *Tom-Tom* and *OpenRouteService (ORS) API*.
- **Patient Monitoring:** Employs continuous, real-time monitoring of vital signs using wearable devices, AI-driven analysis to detect abnormalities early, and remote monitoring to reduce hospital visits and ensure timely intervention.
- **Dynamic Traffic Signal Management:** Adjusting traffic signal timings based on real-time traffic flow, reducing congestion and prioritizing emergency vehicles for faster movement through traffic, improving overall road safety.



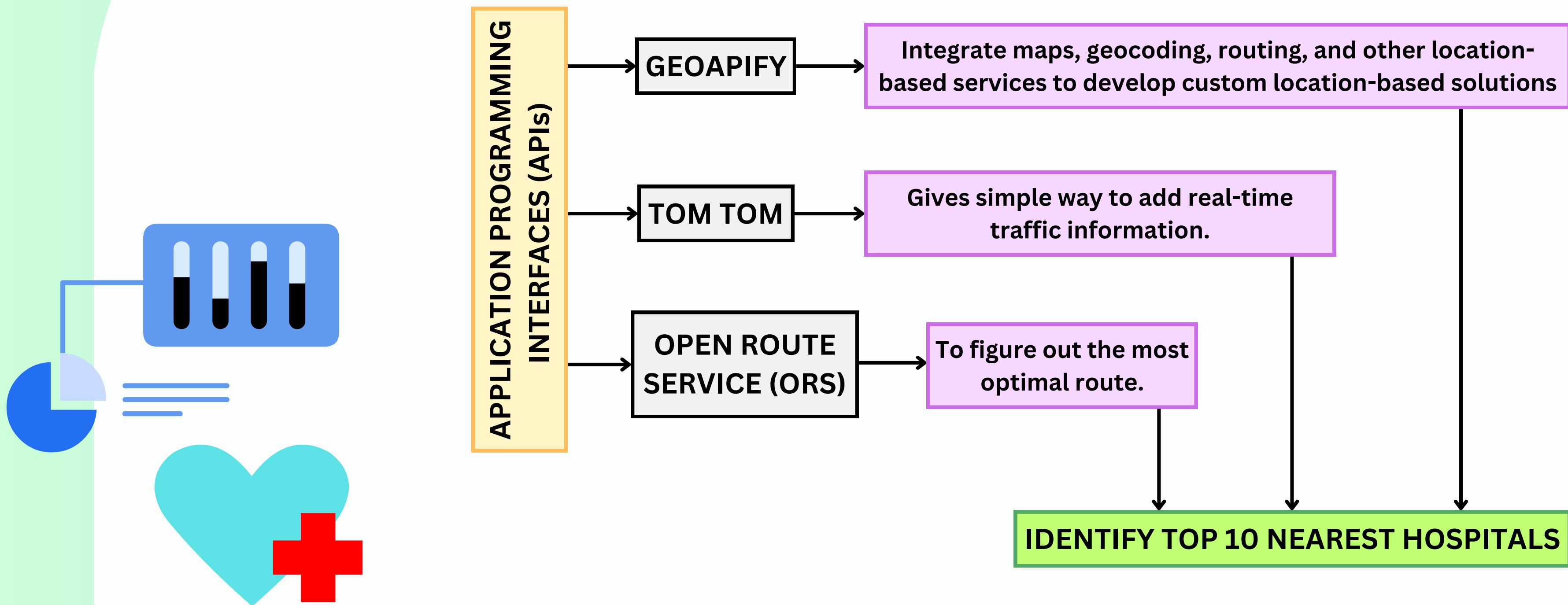
BLOCK DIAGRAM

Real Time Patient Monitoring



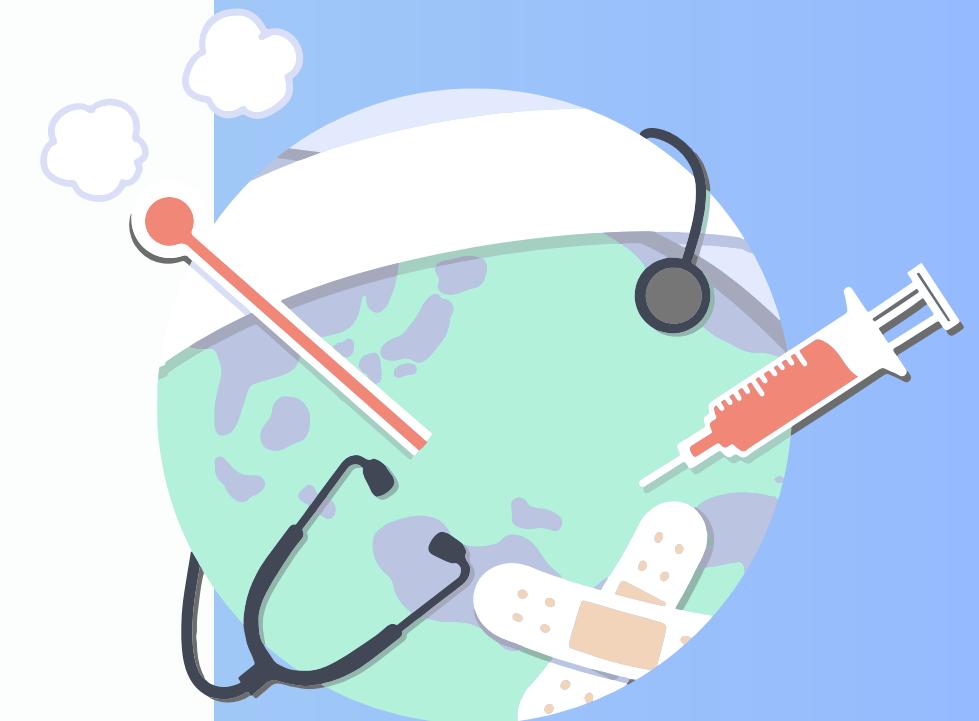
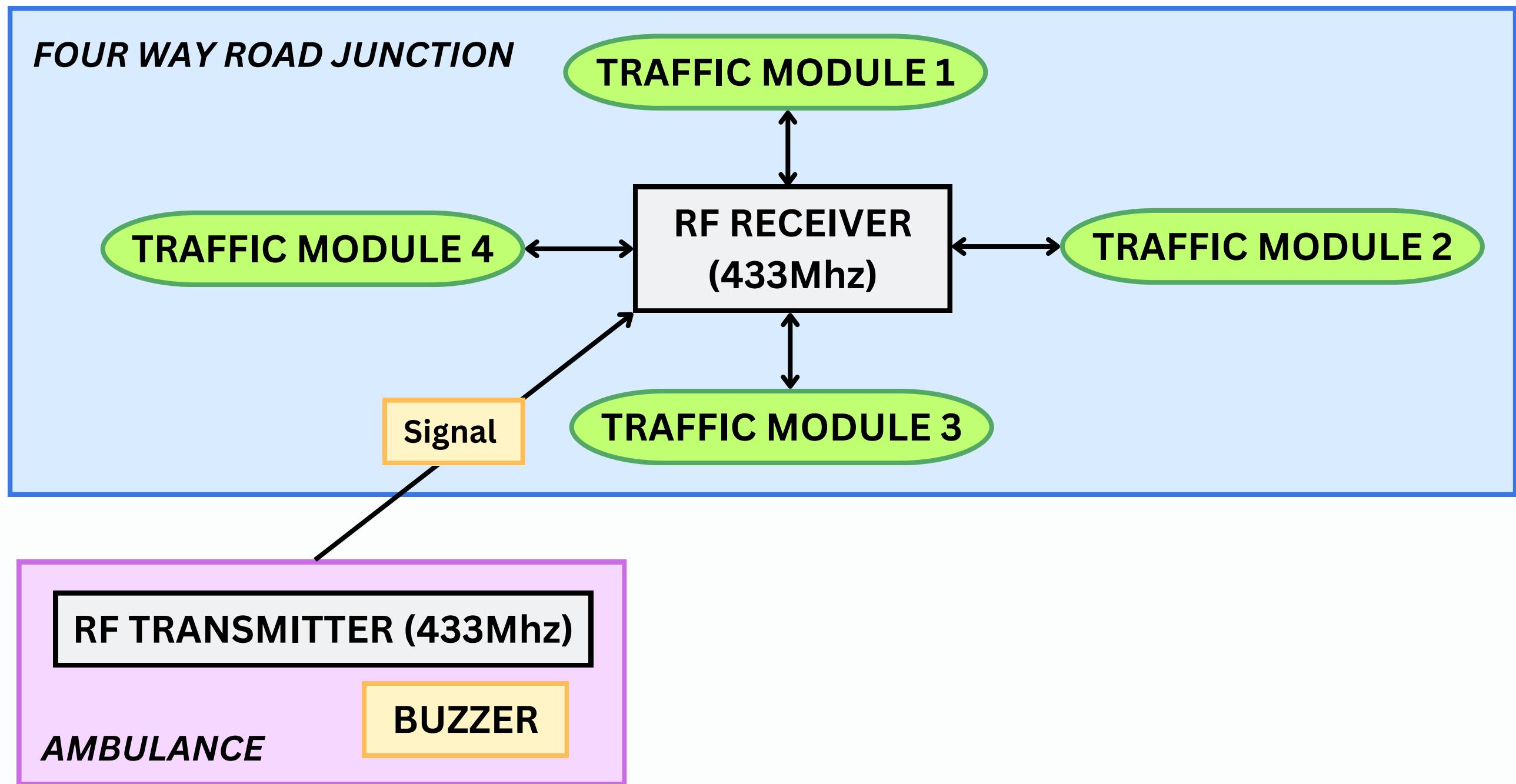
BLOCK DIAGRAM

Ambulance Routing



BLOCK DIAGRAM

Traffic Management System



HARDWARE REQUIREMENT



The hardware requirement for the proposed project can be broadly divided into three aspects:

- *Real time patient vitals monitoring system.*
- *Optimal Path Ambulance routing.*
- *Dynamic Traffic Management system with priority to Emergency vehicles.*

Real Time Patient Monitoring Mechanism

- *Arduino UNO*
- *Pulse Sensor*
- *16*2 LCD Display with I2C module*
- *Resistor 470 ohms*
- *Humidity Sensor*
- *ECG Sensor*
- *Breadboard and Jumper Wires*



Dynamic Traffic Management System



- *RF Transmitter Module*
- *RF Receiver Module*
- *Traffic Light Modules*
- *Arduino UNO*
- *Buzzer*
- *Adapter*
- *Breadboard and Jumper Wires*

SOFTWARE REQUIREMENT

- *Geoapify API*

Integrate maps, geocoding, routing, and other location-based services to develop custom location-based solutions

- *Tom Tom API*

Gives simple way to add real-time traffic information.

- *Open Route Service (ORS) API*

To figure out the most optimal route.

- *ThingSpeak Platform*

For Updating Patient Vitals in Real Time Patient Monitoring

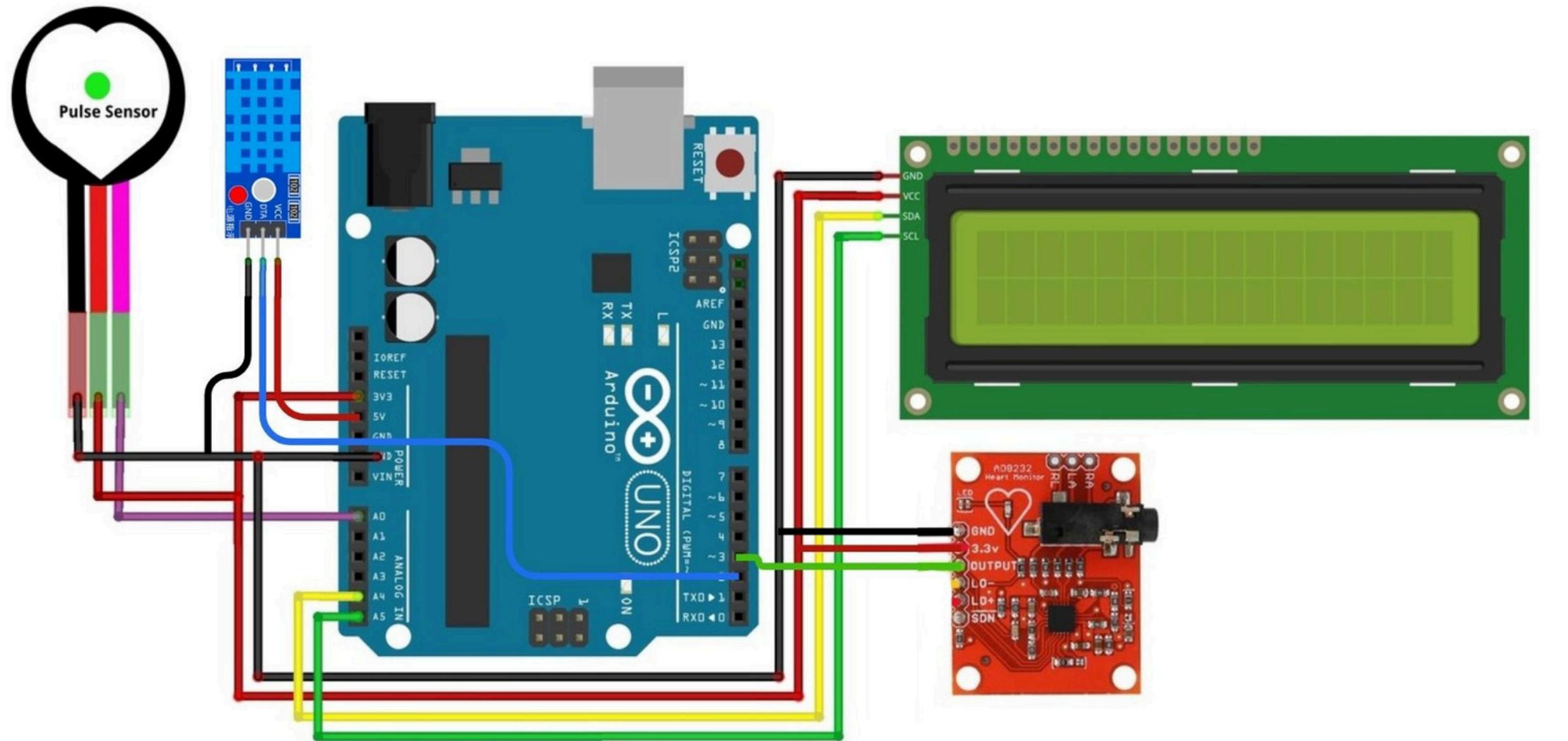
- *Arduino IDE*

Programming modules in Real Time Patient Monitoring and Dynamic Traffic Management.



CIRCUIT DIAGRAM

Real Time Patient Monitoring Mechanism



1. Arduino Uno:

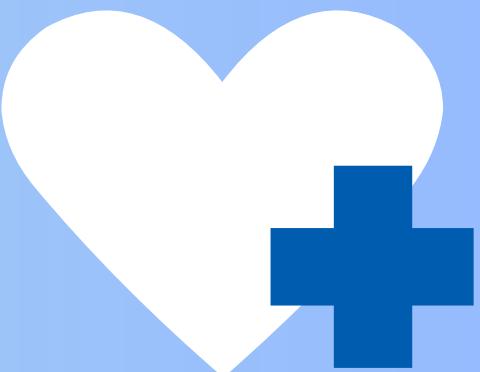
The microcontroller board is the heart of the system, interfacing with the sensors, display, and other components.

2. Humidity Sensor:

- *VCC: Connected to the 5V pin on the Arduino.*
- *GND: Connected to the GND pin on the Arduino.*
- *DATA: Connected to a digital pin on the Arduino (as per the diagram, it looks like pin D2).*

3. Pulse Sensor:

- *VCC: Connected to the 5V pin on the Arduino.*
- *GND: Connected to the GND pin on the Arduino.*
- *Signal Pin: Connected to an analog input pin on the Arduino (likely A2).*



4. I2C Module for LCD Display:

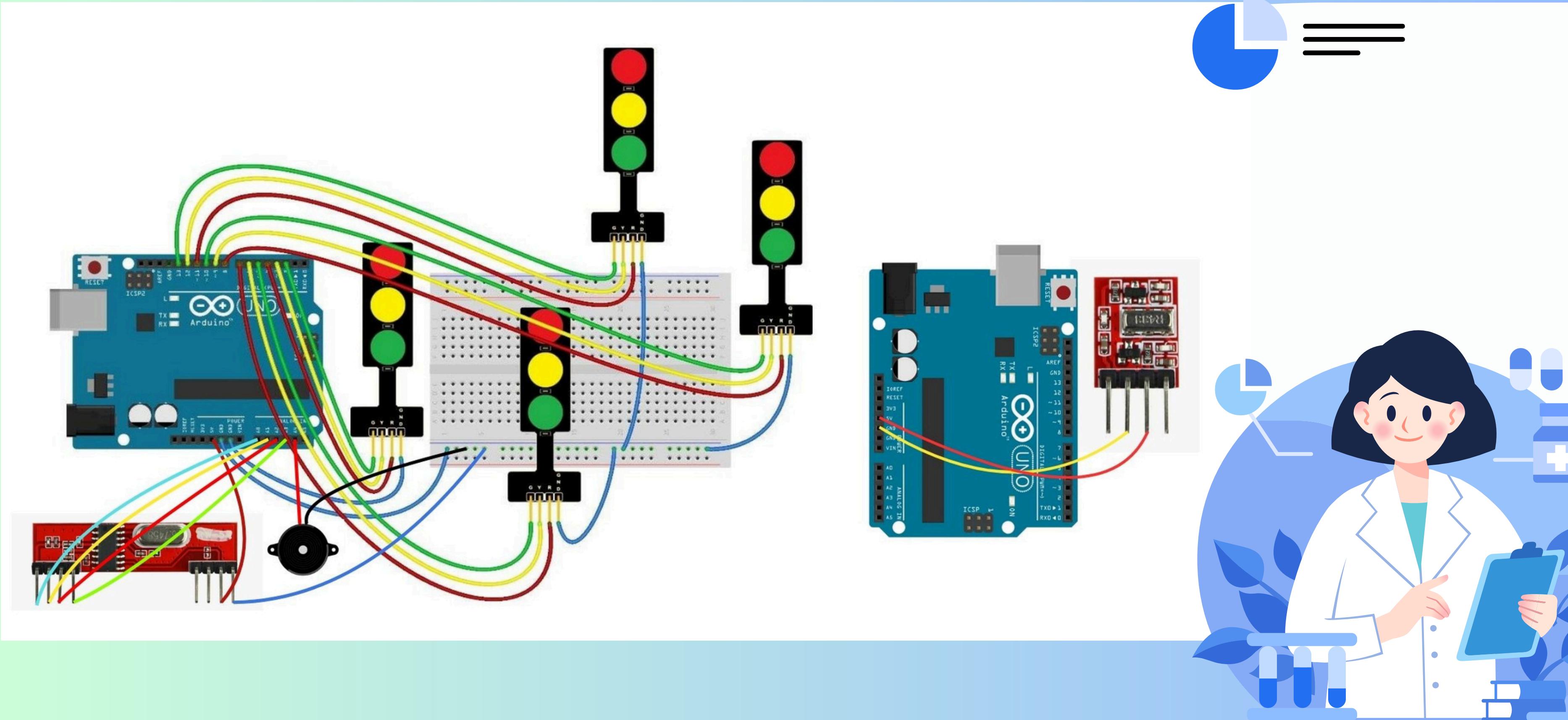
- *VCC*: Connected to the *5V* pin on the *Arduino*.
- *GND*: Connected to the *GND* pin on the *Arduino*.
- *SDA (Data Line)*: Connected to the *SDA* pin on the *Arduino* (*A4* pin on *Arduino Uno*).
- *SCL (Clock Line)*: Connected to the *SCL* pin on the *Arduino* (*A5* pin on *Arduino Uno*).

5. ECG Module :

- *3.3v* : Connected to the *3.3v* pin on the *Arduino*.
- *GND*: Connected to the *GND* pin on the *Arduino*.
- *OUTPUT*: Connected to *A1* pin on the *Arduino*



Dynamic Traffic Management System





ARDUINO 1

1. RF TRANSMITTER (433 Mhz)

- *5v: Connected to the 5V pin on the Arduino.*
- *GND: Connected to the GND pin on the Arduino.*

ARDUINO 2

1. RF RECEIVER (433 Mhz)

- *5v: Connected to the 5V pin on the Arduino.*
- *GND: Connected to the GND pin on the Arduino.*
- *D0: D2 pin on the Arduino*
- *D1: D3 pin on the Arduino*
- *D2: D4 pin on the Arduino*
- *D3: D5 pin on the Arduino*



2. BUZZER

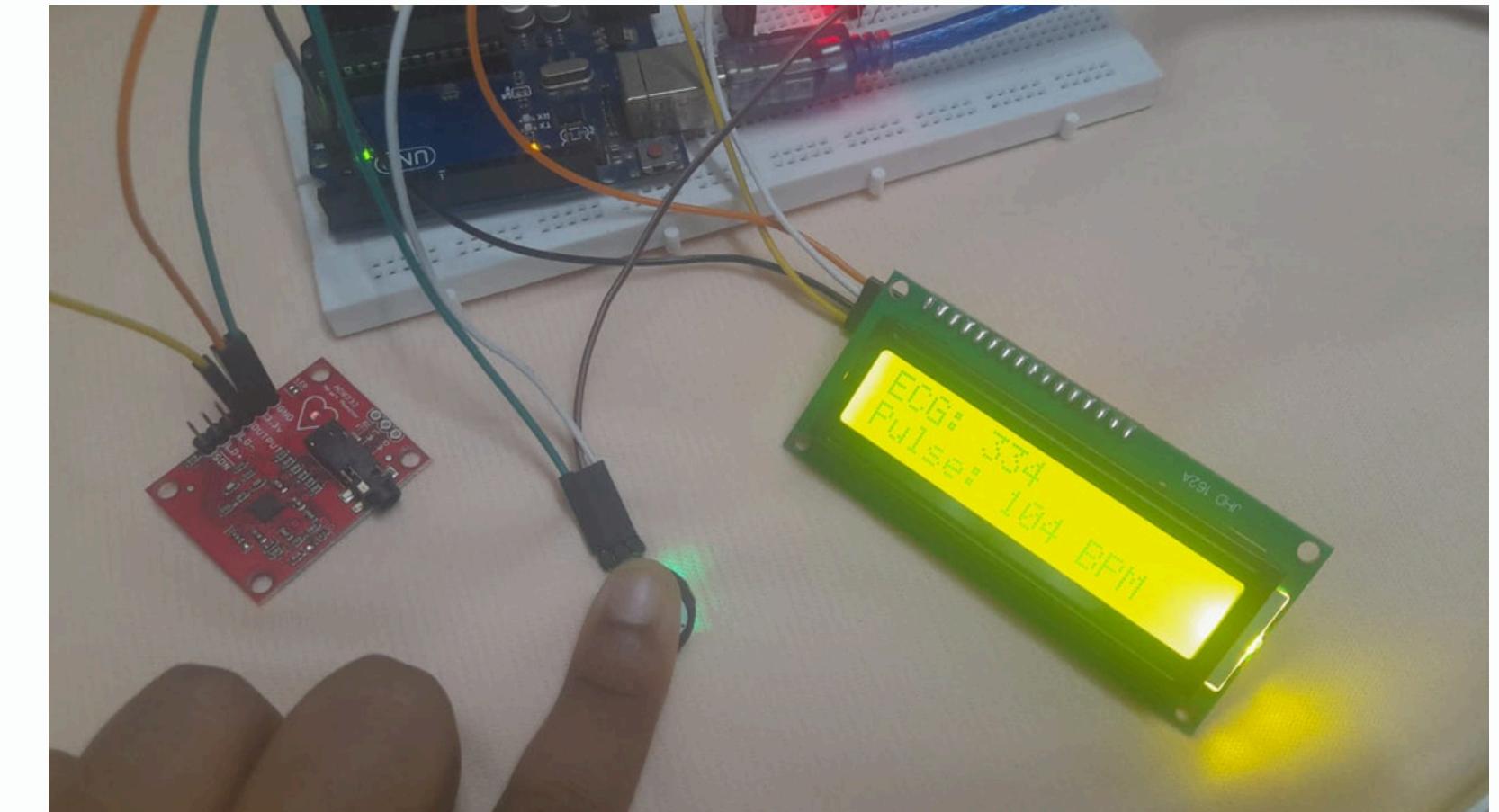
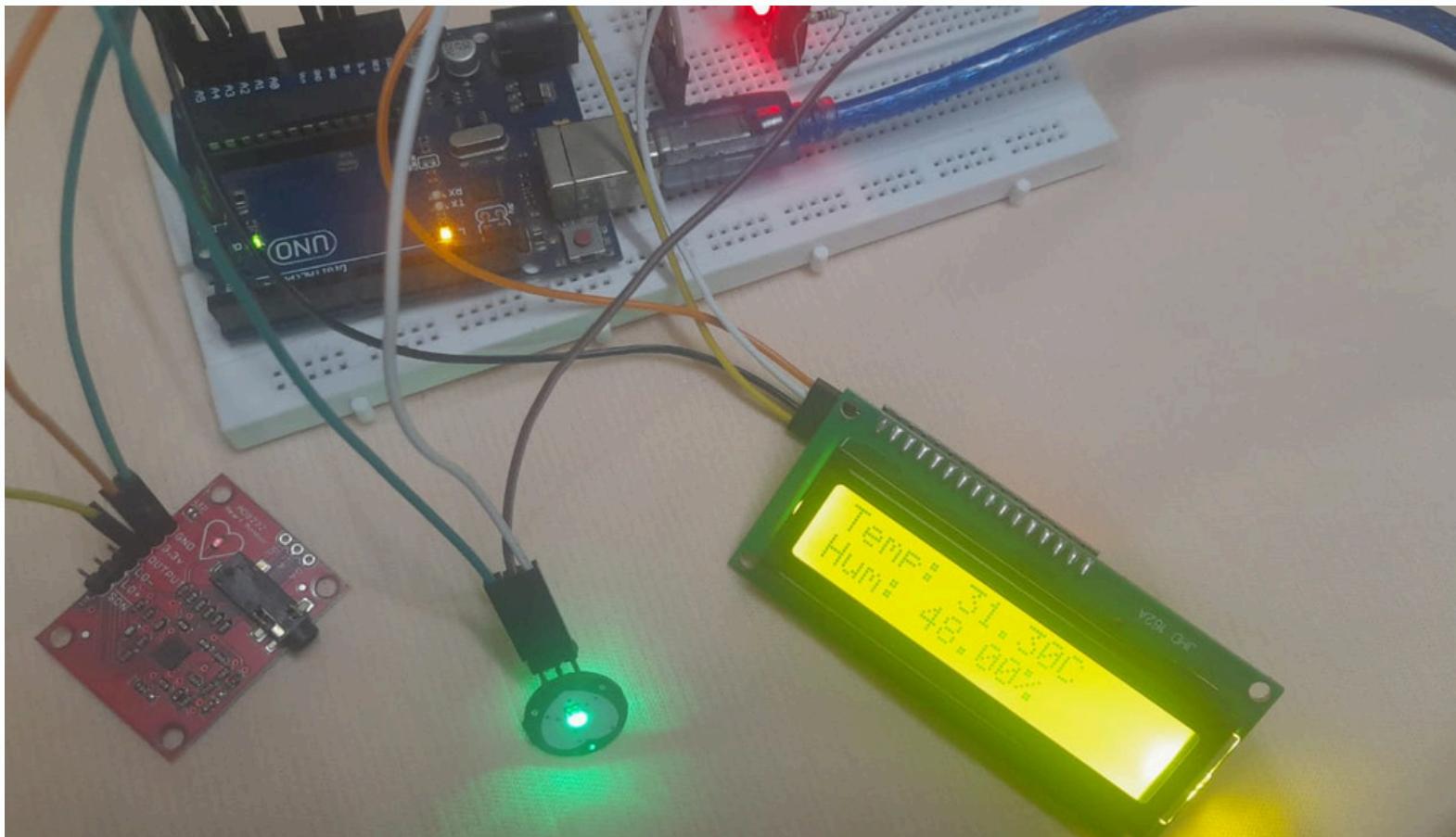
- *GND: Connected to the GND pin on the Arduino.*
- *+ve: A4 pin on the Arduino*

3. TRAFFIC MODULES

- ***Module 1***
 - *Red: D6 pin on the Arduino*
 - *Yellow: D7 pin on the Arduino*
 - *Green: D8 pin on the Arduino*
- ***Module 2***
 - *Red: D9 pin on the Arduino*
 - *Yellow: D10 pin on the Arduino*
 - *Green: D11 pin on the Arduino*
- ***Module 3***
 - *Red: D12 pin on the Arduino*
 - *Yellow: D13 pin on the Arduino*
 - *Green: A0 pin on the Arduino*
- ***Module 4***
 - *Red: A1 pin on the Arduino*
 - *Yellow: A2 pin on the Arduino*
 - *Green: A3 pin on the Arduino*

OUTPUT

Real Time Patient Monitoring Mechanism



Ambulance Routing

The image shows two windows from the Arduino IDE. The left window is titled "Real_Time_Patient_Monitoring_Maps_api | Arduino 1.8.19 (Windows Store 1.8.57.0)" and displays the C++ code for the project. The right window is titled "Command Prompt" and shows the output of the uploaded sketch, which includes a list of hospitals and their details, and a series of vital sign updates.

Arduino IDE Window Content:

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>

// DHT Sensor Setup
#define DHTPIN 2
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

// ECG & Pulse Sensor Pins
#define ECG_PIN A1
#define PULSE_PIN A2

// LCD Display (I2C Address: 0x27)
LiquidCrystal_I2C lcd(0x27, 16, 2);

unsigned long previousMillis = 0;
int displayState = 0; // 0 = Temp & Hum, 1 = ECG & Pulse

void setup() {
    Serial.begin(115200); // For Serial Monitor
    dht.begin();
    lcd.init();
    lcd.backlight();

    Serial.println("System Initialized...");
}

void loop() {
    if (millis() - previousMillis > 1000) {
        previousMillis = millis();
        float temperature = dht.readTemperature();
        float humidity = dht.readHumidity();
        int ecgValue = analogRead(ECG_PIN);
        int pulseValue = analogRead(PULSE_PIN);

        if (displayState == 0) {
            lcd.setCursor(0, 0);
            lcd.print("Temperature: ");
            lcd.print(temperature);
            lcd.print("C");
            lcd.setCursor(0, 1);
            lcd.print("Humidity: ");
            lcd.print(humidity);
            lcd.print("%");
        } else {
            lcd.setCursor(0, 0);
            lcd.print("ECG Value: ");
            lcd.print(ecgValue);
            lcd.setCursor(0, 1);
            lcd.print("Pulse Value: ");
            lcd.print(pulseValue);
        }
    }
}
```

Command Prompt Output:

```
Location Identified!
City: Chennai, Country: India
Coordinates: 13.0895, 80.2739

Naz Unani Hospital - 2.08 km, 3.05 min, Traffic: Moderate
Amrit Hospital - 0.77 km, 2.19 min, Traffic: Moderate
Sugumar Hospital - 2.11 km, 2.95 min, Traffic: Moderate
The Arya Vysya Meternity Home and Child Welfare Centre - 1.91 km, 2.64 min, Traffic: Moderate
Apollo Hospital - 2.14 km, 2.99 min, Traffic: Moderate
Meta Hospital - 2.53 km, 3.33 min, Traffic: Moderate
Corporation Baby Hospital - 0.9 km, 0.86 min, Traffic: Moderate
An-Noor Eye Hospital - 2.34 km, 3.15 min, Traffic: Moderate
Rajiv Gandhi Government General Hospital - 1.64 km, 1.89 min, Traffic: Moderate
Goverment dental hospital & collage - 1.79 km, 2.04 min, Traffic: Moderate
★ Best Hospital: Corporation Baby Hospital - 0.86 min
Map saved as ambulance_route.html

Patient Vitals 1/15: 31.80°C | 48.00% | 338 | 40 BPM
ThingSpeak Update Success! ✓
Patient Vitals 2/15: 31.80°C | 48.00% | 340 | 115 BPM
ThingSpeak Update Success! ✓
Patient Vitals 3/15: 31.80°C | 48.00% | 338 | 105 BPM
ThingSpeak Update Success! ✓
Patient Vitals 4/15: 31.80°C | 48.00% | 343 | 106 BPM
ThingSpeak Update Success! ✓
Patient Vitals 5/15: 31.80°C | 48.00% | 345 | 66 BPM
ThingSpeak Update Success! ✓
Patient Vitals 6/15: 31.80°C | 48.00% | 332 | 110 BPM
ThingSpeak Update Success! ✓
Patient Vitals 7/15: 31.80°C | 48.00% | 343 | 109 BPM
ThingSpeak Update Success! ✓
Patient Vitals 8/15: 31.80°C | 48.00% | 341 | 109 BPM
ThingSpeak Update Success! ✓
Patient Vitals 9/15: 31.80°C | 48.00% | 344 | 66 BPM
ThingSpeak Update Success! ✓
Patient Vitals 10/15: 31.80°C | 48.00% | 338 | 118 BPM
ThingSpeak Update Success! ✓
Patient Vitals 11/15: 31.80°C | 48.00% | 344 | 109 BPM
ThingSpeak Update Success! ✓
Patient Vitals 12/15: 31.80°C | 48.00% | 343 | 108 BPM
ThingSpeak Update Success! ✓
Patient Vitals 13/15: 31.80°C | 48.00% | 342 | 69 BPM
ThingSpeak Update Success! ✓
Patient Vitals 14/15: 31.80°C | 48.00% | 339 | 118 BPM
ThingSpeak Update Success! ✓
Patient Vitals 15/15: 31.80°C | 48.00% | 338 | 108 BPM
ThingSpeak Update Success! ✓
Data upload completed! Exiting program.
```

```
C:\Users\madhu\AppData\X + v - 0 X

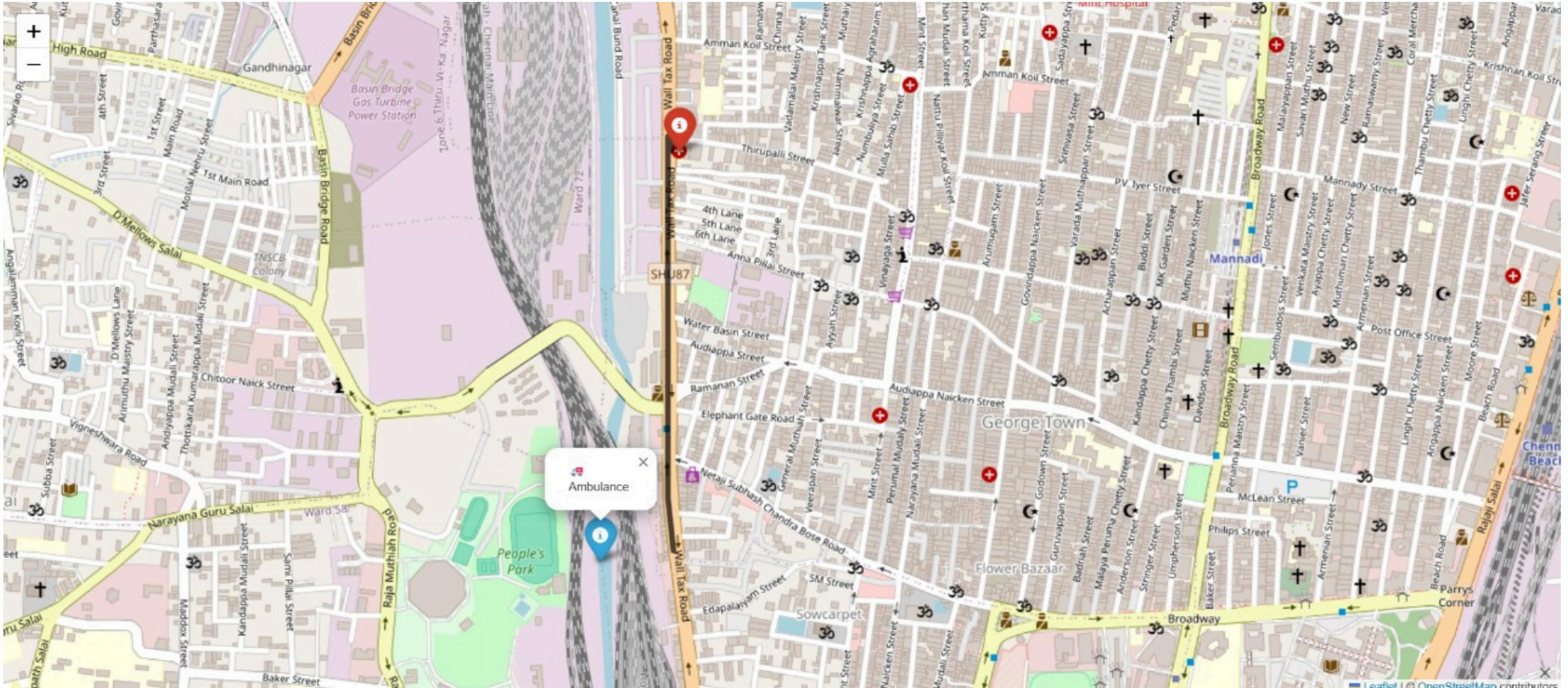
📍 Location Identified!
📍 City: Chennai, 🌎 Country: India
📍 Coordinates: 13.0895, 80.2739

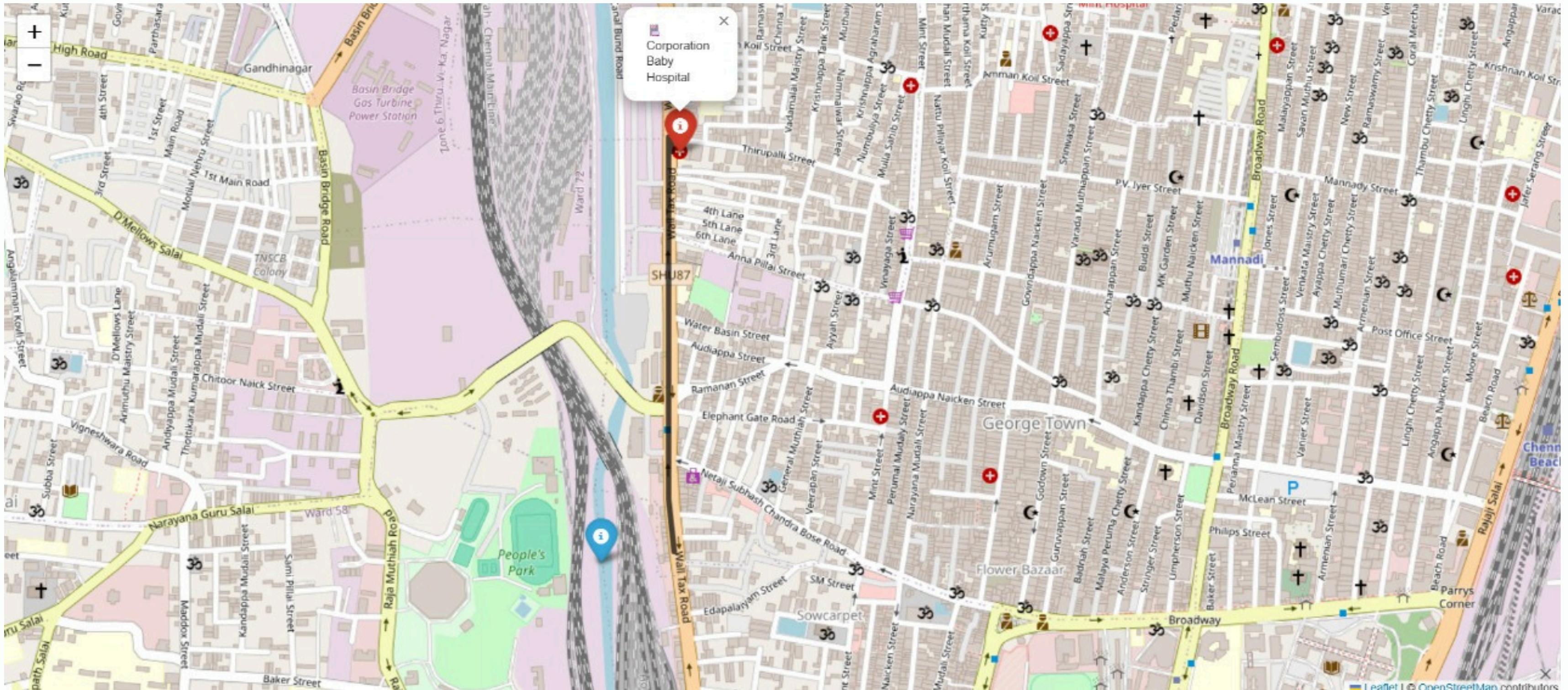
Top 10 Nearest Hospitals

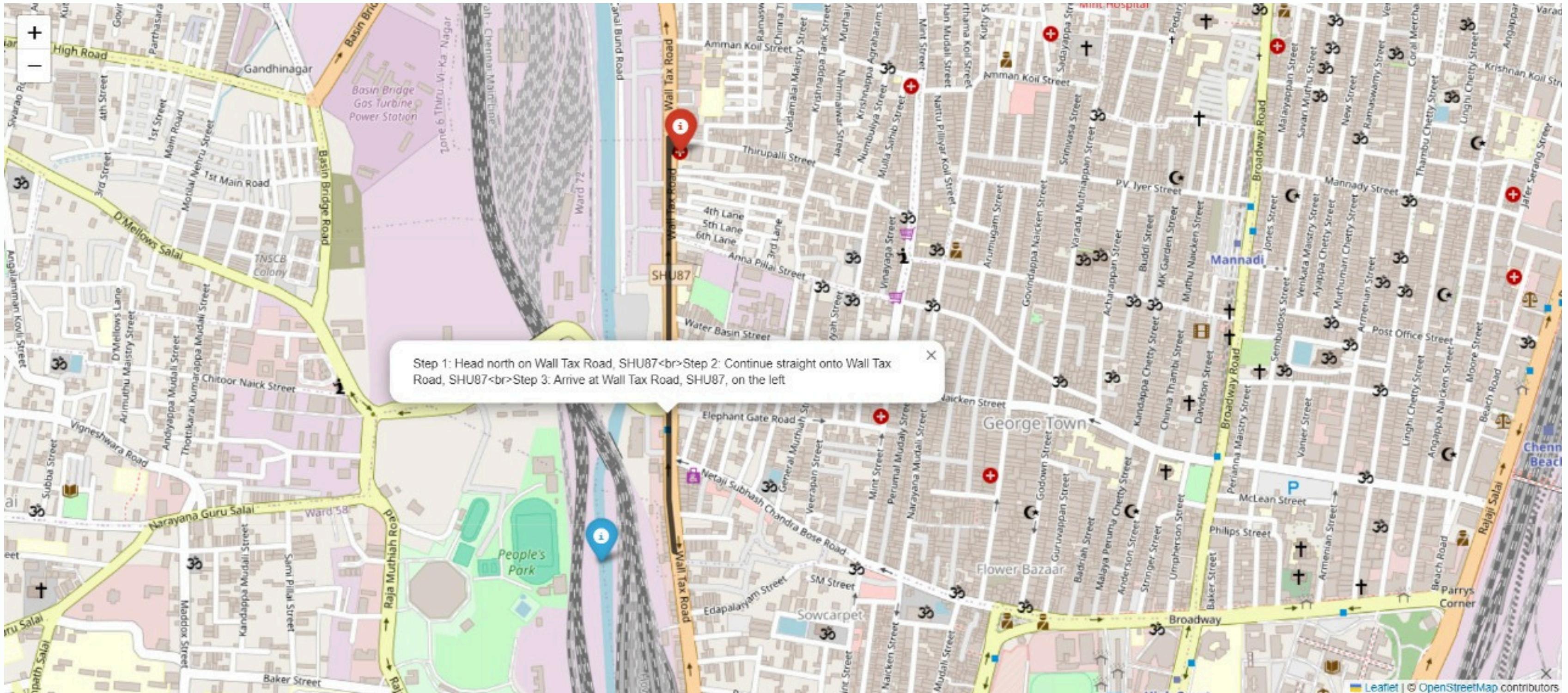
Naz Unani Hospital - 2.08 km, 🕒 3.05 min, ⚡ Traffic: High
Amrit Hospital - 0.77 km, 🕒 2.19 min, ⚡ Traffic: Moderate
Sugumar Hospital - 2.11 km, 🕒 2.95 min, ⚡ Traffic: Moderate
The Arya Vysya Maternity Home and Child Welfare Centre - 1.91 km, 🕒 2.64 min, ⚡ Traffic: Moderate
Apollo Hospital - 2.14 km, 🕒 2.99 min, ⚡ Traffic: Moderate
Meta Hospital - 2.53 km, 🕒 3.33 min, ⚡ Traffic: High
Corporation Baby Hospital - 0.9 km, 🕒 0.86 min, ⚡ Traffic: Moderate
An-Noor Eye Hospital - 2.34 km, 🕒 3.15 min, ⚡ Traffic: Moderate
Rajiv Gandhi Government General Hospital - 1.64 km, 🕒 1.89 min, ⚡ Traffic: Moderate
Government dental hospital & collage - 1.79 km, 🕒 2.04 min, ⚡ Traffic: Moderate
★ Best Hospital: Corporation Baby Hospital - 0.86 min
Is this hospital acceptable? (yes/no): no
★ Best Hospital: Rajiv Gandhi Government General Hospital - 1.89 min
Is this hospital acceptable? (yes/no): yes
➤ Map saved as ambulance_route.html

Patient Vitals 1/15: 🌡32.30°C | 💧 50.00% | ❤️ 513 | ❤️41 BPM
➤ ThingSpeak Update Success! ✓
Patient Vitals 2/15: 🌡32.30°C | 💧 50.00% | ❤️ 315 | ❤️115 BPM
➤ ThingSpeak Update Success! ✓
Patient Vitals 3/15: 🌡32.30°C | 💧 50.00% | ❤️ 350 | ❤️106 BPM
➤ ThingSpeak Update Success! ✓
Patient Vitals 4/15: 🌡32.30°C | 💧 50.00% | ❤️ 331 | ❤️106 BPM
➤ ThingSpeak Update Success! ✓
Patient Vitals 5/15: 🌡32.30°C | 💧 50.00% | ❤️ 377 | ❤️77 BPM
➤ ThingSpeak Update Success! ✓
```

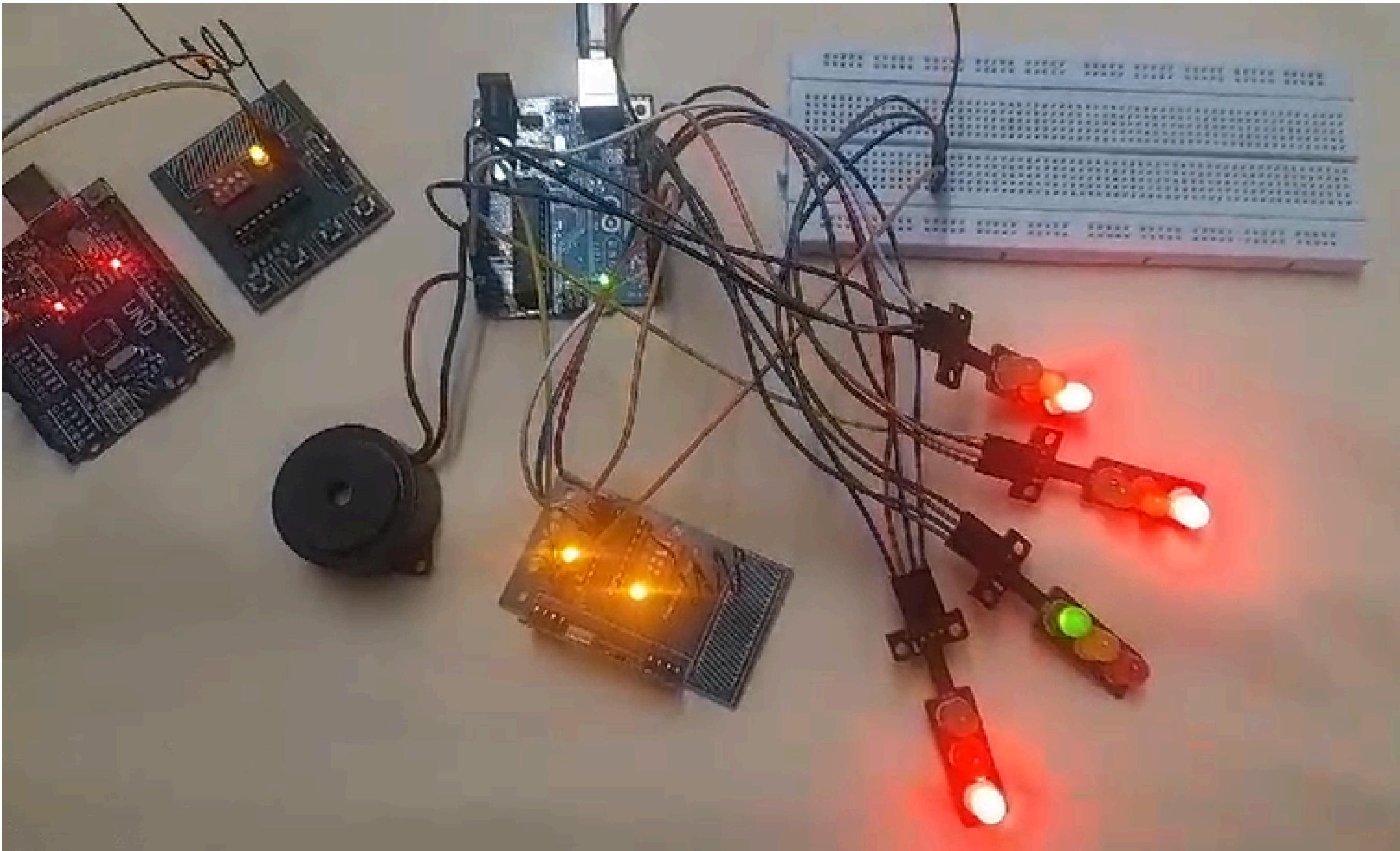
Ambulance Route (HTML file)







Dynamic Traffic Management System



ADVANTAGES

- ***Real-Time Patient Monitoring***

Provides continuous monitoring of patient vitals (e.g., heart rate, oxygen levels) via IoT sensors, enabling quicker response to critical health conditions.

- ***Dynamic Traffic Signal Management***

Adjusts traffic signal timings dynamically to prioritize ambulances, reducing delays in emergency situations.

- ***AI-Driven Multi-Factor Decision-Making***

Uses API like Geoapify, Tom-Tom and OpenRouteService (ORS) for accurate traffic density estimation, improving routing decisions.

- ***Seamless Integration***

Provides real-time notifications to hospitals, enabling them to prepare for incoming patients.



APPLICATIONS



- *Real-time patient monitoring.*
- *AI driven diagnosis.*
- *Smart ambulance systems.*
- *Automated emergency dispatch.*
- *Personalized emergency care.*
- *Mental health emergency support.*
- *Emergency care for elderly and children.*

REFERENCES

1. *Adapaka Sai Kishore, Gopiswara Rao Chinni, "Smart Healthcare Monitoring System Using IoT Technology," IEEE Xplore, 2023*
2. *Luqman Qader Abdulrahman, Siyamand Hasan Moheidin, "Real-Time Monitoring System Based on IoT for Cardiac Care," IEEE Xplore, 2023*
3. *Mujeeb Rahman K K, Mohamed Nasor M, Rayan Zidan, "IOT-Based Wireless Patient Monitor Using ESP32 Microcontroller," IEEE Xplore, 2023*
4. *Pola Anirudh, G.A.E Satish Kumar, R Phani Vidyadhar, "Automatic Patient Monitoring and Alerting System based on IoT," IEEE Xplore, 2023*
5. *Syed Thouheed Ahmed, R. Manikandan, "An Edge-AI-Enabled Autonomous Connected Ambulance-Route Resource Recommendation Protocol (ACA-R3) for eHealth in Smart Cities," IEEE Xplore, 2023*



Thank You