# PROJECT PROPOSAL

# PATIENT MONITORING IN AMBULANCE AND OTHER VEHICLES

## EC6020:EMBEDDED SYSTEMS DESIGN


**GROUP NO - 31**

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# Introduction

In emergency situations, timely medical intervention is crucial to saving lives. However, during patient transportation, whether in ambulances or other vehicles, continuous health monitoring remains a significant challenge. Delays in detecting critical conditions can worsen health outcomes, and the lack of real-time communication between vehicles and hospitals further complicates emergency response efforts. Our project aims to develop an advanced patient monitoring system that ensures real-time tracking of vital signs during transportation, enhancing pre-hospital care and improving patient outcomes.

# Problem Statement

Currently, there is no comprehensive system to monitor patients' real-time health parameters while they are being transported to hospitals. Some critical challenges include:

- Delayed Medical Response: Lack of real-time data sharing leads to delays in preparing hospital facilities for incoming patients.
- Inconsistent Data Transmission: Manual reporting by paramedics can introduce errors and delays.
- Limited Vehicle Integration: Existing systems are mostly restricted to ambulances, leaving other emergency vehicles without adequate monitoring solutions.
- Lack of Predictive Analytics: Current solutions lack the ability to predict potential health deteriorations during transport.

These issues lead to suboptimal emergency care, increased hospital burden, and in some cases, loss of life due to delayed treatment.

# Proposed Solution

To address these challenges, our system will provide a real-time, cloud-based patient monitoring solution that can be deployed in ambulances and other emergency vehicles. Key features include:

1. Real-time Health Monitoring:
    - Sensors to continuously measure vital signs such as heart rate, oxygen saturation, temperature, and GPS location.
    - Integration with wearable devices for seamless patient data acquisition.
2. Cloud-Based Data Transmission:
    - Secure transmission of patient health data to hospital systems via cloud infrastructure.
    - Mobile and web applications for paramedics and hospital staff to track patient status.
3. Alerts:
    - Instant alerts to medical staff in case of abnormalities.
4. Multi-Vehicle Compatibility:
    - Designed for ambulances, police vehicles, rescue teams, and other emergency transport modes.
5. User-Friendly Interface:

    - Interactive dashboards for monitoring via mobile and desktop applications.
    - Two-way communication between paramedics and hospital teams.

## Novelty of the Project

Our proposed system offers several

novel features that differentiate it from existing solutions:

- Multi-Vehicle Integration: Unlike conventional ambulance-only solutions, our system supports deployment in various emergency vehicles, broadening its application.
- provide proactive alerts, improving patient safety during transport.
- Low-Cost IoT Solution: Utilizing affordable microcontrollers and cloud services to ensure cost-effective implementation.
- Seamless Communication: Integrated mobile and desktop applications will enable real-time interaction between hospital and transport teams.
- Scalability and Flexibility: The system can be scaled to accommodate multiple vehicles and hospital networks, ensuring adaptability across healthcare infrastructures.

## HIGH-LEVEL ARCHITECTURE

1. ESP32 Development Board

- The dual-core processor on the ESP32, together with Wi-Fi and Bluetooth, can comfortably support a load of several sensors that can send updates in real time to cloud platforms.
  Low power consumption, and thus ideal for mobile use in ambulances.
  Robust SDKs and libraries for integrating different types of communication protocols and peripherals.
- It will serve as the main controller to process and forward the sensor data to cloud servers for real-time access.

2. MAX30102 Pulse Oximeter and Heart Rate Sensor

- Accurate heart rate and $SpO_2$ measurement, essential for patients suffering from respiratory or cardiac disorders.

  Compact size, low power consumption; hence, suitable for portable devices.

- Keeps monitoring the vital signs and transmits the data to ESP32 for further processing and radio transmission.

3. DS18B20 Digital Temperature Sensor

- A high-accuracy, easy-to-use digital temperature sensor.

  Suitable for applications that need consistent monitoring of temperature.

- Measures the body temperature of the patient and feeds it to the system in real time.

4. NEO-6M GPS Module

- Reliable GPS module for accurate tracking of the ambulance.

  Compact size, and compatible with ESP32.

- Tracks the location of the ambulance to estimate the time of arrival by the hospital staff and to prepare accordingly.

5. OLED Display

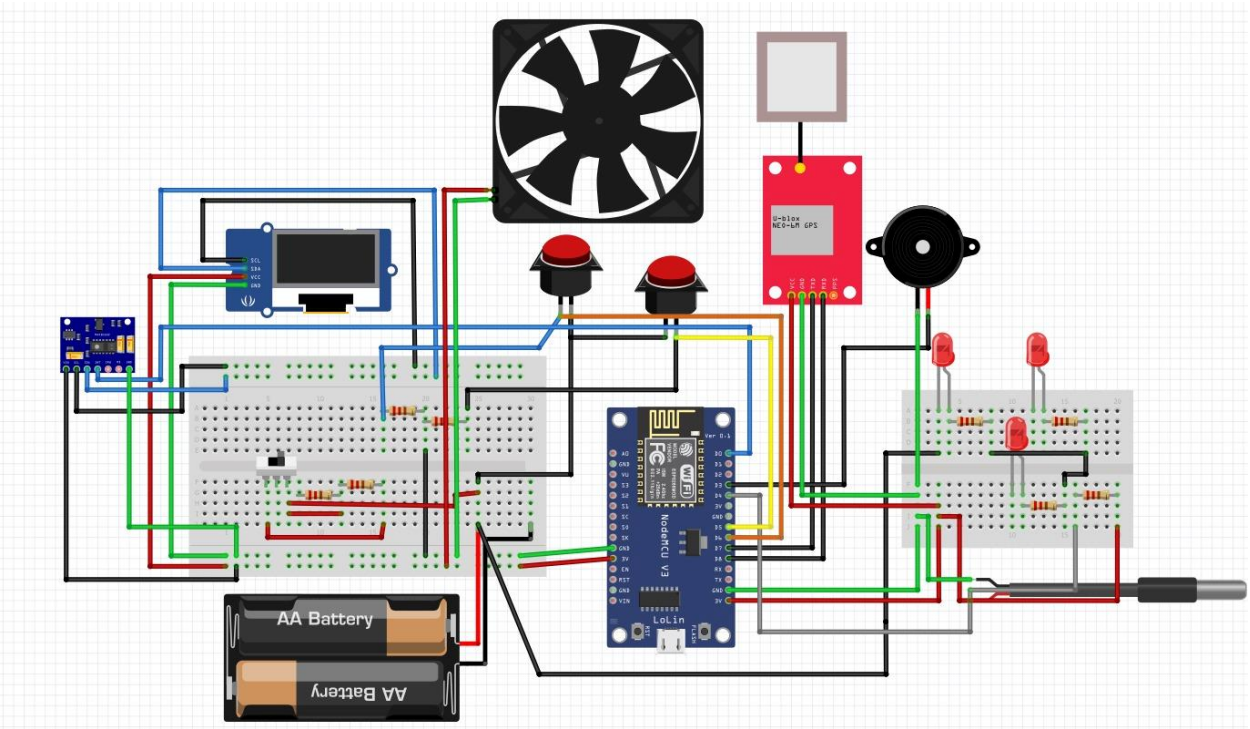
- Provides real-time feedback to the ambulance staff regarding the health status of the patient and functionality of the device, Lightweight and energy efficiency.
- Displays vital parameters such as heart rate, oxygen saturation, temperature, and connection status directly in the ambulance.

8. Mobile and Web Applications: Flutter Framework

- Cross-platform development assures consistent user experience across mobile and desktop devices. Intuitive UI for real-time monitoring by hospital staff.
- Displays the patient's health data and ambulance location to hospital staff for better preparation.

9. Power Supply and Battery Backup Reason for Selection: Ensures that the system operates without interruption, even when there is power fluctuation inside the ambulance. Role: Supplies constant power to sensors, ESP32, and display unit

## CIRCUIT DESIGN




# Communication Protocols

### MQTT (Message Queuing Telemetry Transport)

MQTT is a lightweight, publish-subscribe messaging protocol ideal for IoT-based systems that require low bandwidth and high reliability.

### HTTP/HTTPS (HyperText Transfer Protocol / Secure)

HTTP/HTTPS is used for secure communication between the web-based hospital dashboard and the cloud database to retrieve and display patient data.

### Bluetooth Low Energy (BLE)

BLE is used for short-range wireless communication between wearable health monitoring devices and the onboard monitoring system in the vehicle.

# Github repo link. With updated ReadMe file.

https://github.com/Nidhushan13NDS/PATIENT-MONITORING-IN-AMBULANCE-AND-OTHER-VEHICLES

## TimeLine

| Activity | Weeks | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| Find and purchase components | | | | | | | | | | |
| Design the system and do initial testing | | | | | | | | | | |
| Assemble the hardware and write the firmware | | | | | | | | | | |
| Integrate the sensors and display | | | | | | | | | | |
| Build the web application and set up the database | | | | | | | | | | |
| Test the system and improve the user interface | | | | | | | | | | |
| Fix any issues and do final integration | | | | | | | | | | |
| Write the documentation and prepare for the presentation | | | | | | | | | | |
| Final review and project submission | | | | | | | | | | |

## Budget

| **components** | **price** |
|---|---|
| ESP32 | 1300 |
| DS18B20 temperature sensor | 300 |
| MAX30100 heart rate sensor | 500 |
| NEO6MV2 gps module | 1500 |
| OLED mini display 0.96 inch | 950 |
| Copper board (5cm*7cm) | 150 |
| Jumper wires(40pcs) | 300 |
| Push button, Switch | 80 |
| CPU fan | 1500 |
| Outer cover & Other | 4000 |
| Total | 10580 |