GREENVOY: IMPLEMENTATION OF A SMART AMBULANCE ROUTING AND PATIENT HEALTH MONITORING SYSTEM USING GREEN AI AND IOT

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Introduction:

1. Emergency Medical Services (EMS) play a crucial role in saving lives during critical situations such as accidents, cardiac arrests, and medical emergencies. However, traditional ambulance systems face significant challenges including traffic congestion, inefficient route planning, and lack of real-time patient monitoring. These issues often lead to delays in providing timely medical assistance, which can be life-threatening.
2. To address these challenges, this project proposes “Greenvoy”, a smart ambulance system that integrates Internet of Things (IoT) and Green Artificial Intelligence (AI). The system enables real-time monitoring of patient vitals using sensors such as MAX30102 (heart rate and SpO2) and DHT11 (temperature). A patient-side application allows users to request emergency services instantly, while a hospital dashboard enables medical staff to monitor incoming patients. The system also incorporates an AI-based routing model that optimizes ambulance paths based on traffic conditions, distance, and energy efficiency. This approach not only reduces response time but also promotes sustainability through reduced fuel consumption and carbon emissions.

Figure 1: System Architecture

Objectives:

1. To design and develop a smart ambulance system using IoT and AI technologies.
2. To enable real-time monitoring of patient vitals during transit.

3. To optimize ambulance routing using Green AI for reduced response time.
4. To improve hospital preparedness through real-time data sharing.

Methodology:

1. The system begins with data acquisition, where the patient or a nearby user triggers an emergency request using a mobile application. The request includes location and medical details, which are transmitted to the backend server. The backend processes the request and identifies available ambulances based on proximity and availability.
2. The ambulance is equipped with IoT hardware consisting of a Raspberry Pi connected to sensors such as MAX30102 and DHT11. These sensors collect real-time patient vitals including heart rate, SpO2, temperature, and humidity. The collected data is processed locally and transmitted to the backend using communication protocols such as MQTT and WebSockets. A Green AI-based routing model is implemented to optimize ambulance selection by considering energy consumption along with travel time.
3. The system selects the most suitable ambulance and continuously updates the route based on real-time traffic conditions. The processed data and patient vitals are transmitted to the hospital dashboard, enabling medical staff to monitor the patient and prepare in advance. This integrated methodology ensures efficient communication, reduced response time, and improved emergency healthcare services.

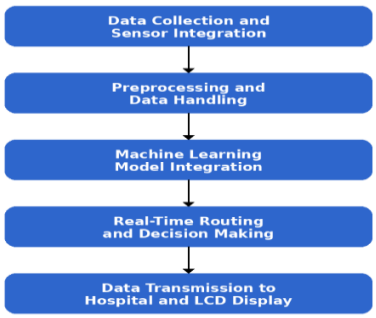

Figure 2: Methodology for Smart Ambulance System with Machine Learning-Based Routing and Sensor Data Transmission

Result and Conclusion:

The Greenvoy Smart Ambulance System was successfully implemented and tested using both software and hardware components. The system integrates a patient application, hospital dashboard, and IoT-based ambulance monitoring unit to provide real-time emergency response.

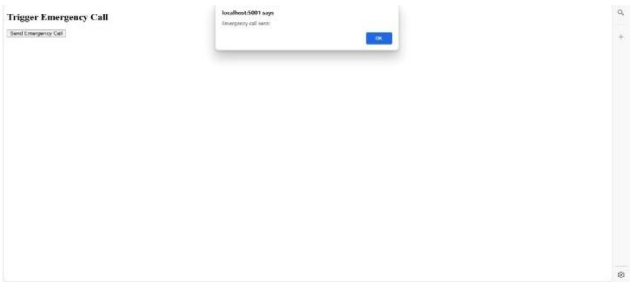

Figure 3: Trigger Emergency Call and Acknowledgement

As shown in Figure 3, when an accident occurs, the patient or a nearby user can immediately trigger an emergency request using the mobile application. The emergency button is prominently placed for quick access, ensuring that help can be requested with a single click. This reduces delay in initiating emergency services. Once the emergency request is triggered, the backend server acknowledges the request within milliseconds.

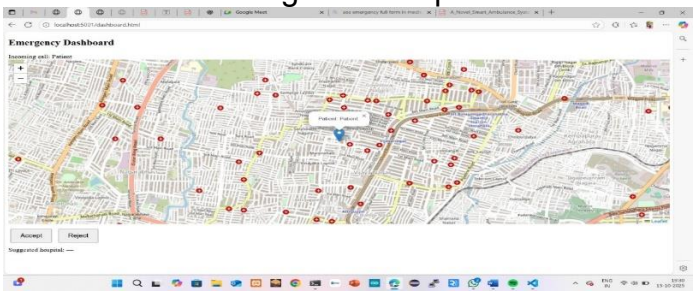

Figure 4: Hospital Dashboard

As shown in Figure 5, the hospital dashboard is a real-time interface that displays emergency requests received from patients. It shows patient locations on a map using multiple markers, making it easy to identify and track emergencies. The system provides important patient details such as medical history and current condition. This helps hospital staff prioritize cases based on severity and distance. As a result, doctors can make quick decisions and prepare in advance before the patient arrives.

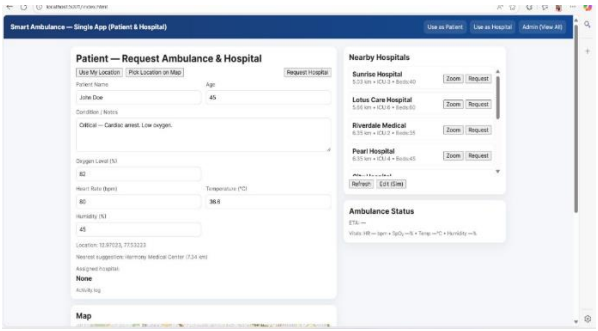

Figure 5: Patient Request and Hospital Selection Interface

As shown in Figure 7, the system uses GPS technology to track the patient's location in real-time. The map displays the exact position of the patient using a marker, enabling ambulance services to navigate accurately. This helps in selecting the shortest and fastest route to reach the patient. Real-time tracking ensures continuous monitoring during emergencies

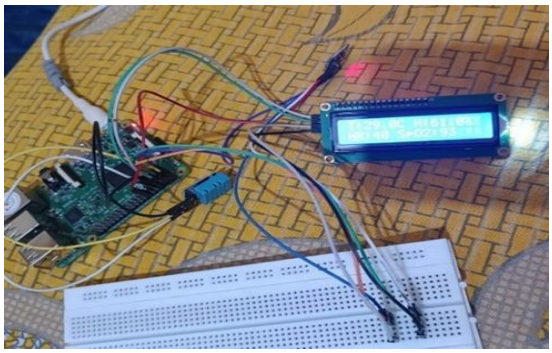

Figure 6 : IoT Hardware Setup for Patient Monitoring

As shown in Figure 8, the IoT hardware setup consists of a Raspberry Pi connected with sensors such as MAX30102 and DHT11. These sensors are used to measure vital parameters including heart rate, SpO2, temperature, and humidity. The collected data is processed by the Raspberry Pi and displayed on an LCD screen in real-time.

References:

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Future Scope:

The future scope of this project includes:

1. Integration of 5G technology for faster data transmission.
2. Implementation of advanced AI models for predictive healthcare analysis.
3. Use of blockchain technology for secure medical data sharing.