GSN 90

RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

Team ID	**90**			
Semester	**6th**			
Course:	**INTERDISCIPLINARY PROJECT**			
Team Details		**Program**	**USN**	**Name**
	1.	**CSE**	**1RV22CS086**	**KIRAN V**
	2.	**CSE**	**1RV22CS087**	**KISHAN KUMAR S D**
	3.	**ECE**	**1RV22EC175**	**UMESHA K N**
	4.	**ECE**	**1RV23EC416**	**VIVITHA SEQUEIRA**
	5.	**ME**	**1RV22ME103**	**SHASHANK J**
Project Title	**VEHICLE CONGESTION CONTROL AND MANAGEMENT SYSTEM**			
Centre of Excellence (CoE)	**CCTV Research**			
Internal Guide				
Name **Designation &** **Department**	**Dr. Nagaraja G S** **Professor** **Computer Science and Engineering**			

INTRODUCTION:

Traffic congestion remains a significant challenge in urban areas, particularly at busy intersections where fixed-timing signals often cause long delays and disrupt efficient vehicle flow. To tackle this issue, our project introduces an intelligent traffic management system powered by IoT and machine learning technologies. Ultrasonic sensors are deployed to continuously measure the distance to vehicles, providing real-time estimates of traffic density. Additionally, cameras at intersections capture live video, which is processed using computer vision techniques to detect and count vehicles. This information is fed into a machine learning model trained to analyse traffic patterns and recommend optimized signal timings, enabling smarter and more responsive traffic control.

Based on real-time traffic density, the system dynamically adjusts traffic light durations to ensure smoother vehicle flow and reduced congestion. Unlike traditional systems that operate on fixed timers, our solution offers adaptive control, greater accuracy, and scalability. By integrating IoT and machine learning, the system can intelligently respond to changing traffic conditions, enhancing road safety, minimizing delays, and providing a cost-effective upgrade to existing traffic infrastructure.

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OBJECTIVES:

1. **To Design a Smart Traffic Control System** using ultrasonic sensors, IR sensors and image processing to detect vehicle density and dynamically manage signal timings.
2. **To Implement Machine Learning Algorithms** that prioritize emergency vehicles like ambulances and adapt traffic signals based on real-time traffic patterns.
3. **To Develop a Web-Based Platform** that provides real-time traffic updates, helping users identify congested routes and make informed travel decisions.

METHODOLOGY:

1. **Deploy Ultrasonic and IR sensors** are strategically placed on key traffic lanes to capture real-time data on vehicle presence, proximity, and lane occupancy for accurate traffic density estimation. In the absence of vehicle detection, the system defaults to a round-robin signal rotation to maintain continuous traffic flow.
2. **Capture live video streams using high-resolution cameras**, and apply image processing algorithms (e.g., OpenCV with YOLOv5 or SSD) to perform object detection, vehicle classification, and emergency vehicle identification.
3. **Train and integrate a supervised machine learning model** (e.g., decision tree or random forest) on historical and real-time sensor and image data to dynamically predict traffic flow patterns.
4. **Implement a microcontroller-**based control unit using the ATmega2560 and ESP8266, designed to adjust traffic signal durations dynamically based on real-time traffic analysis.
5. **Integrate priority logic for emergency vehicle detection** using camera-based object tracking or RF modules, enabling immediate green signal override through GPIO-controlled signal relays.
6. **Develop a web-based dashboard** using technologies like Flask/Django for the backend and HTML/CSS/JavaScript for the frontend to display live traffic data and congestion levels from each direction.
7. **Simulate and test the system** using traffic scenario emulators or custom simulation environments to evaluate responsiveness, accuracy, and prioritization efficiency.
8. **Calibrate and optimize system parameters** through iterative testing and performance analysis to ensure low latency, accurate detection, and robust signal control under varying traffic conditions

SOFTWARE REQUIREMENTS:

- Python
- OpenCV
- TensorFlow / Scikit-learn
- Arduino IDE
- ESP8266
- VS Code
- Flask / Django
- HTML, CSS, JavaScript
- MQTT / HTTP Protocols

HARDWARE REQUIREMENTS:

- Ultrasonic Sensor (HC-SR04)
- IR Sensor
- High-Resolution Camera
- ATmega2560
- LED Traffic Signal Modules
- Power Supply Unit / Battery Pack
- Wi-Fi Module (ESP8266)
- Breadboards, Jumpers, and Connectors

INTERDISCIPLINARY RELEVANCE:

- **Electronics Engineering**: Involves sensor integration (ultrasonic, IR, cameras), circuit design, microcontroller programming (e.g., Arduino, Raspberry Pi), signal processing, and communication module handling (Wi-Fi, IoT protocols).
- **Computer Science Engineering**: Focuses on machine learning algorithms for traffic prediction, image processing for vehicle detection, data analytics, backend development for real-time traffic updates, and IoT-based system integration for data transmission.
- **Mechanical Engineering**: Deals with the design, installation, and optimization of traffic infrastructure, including sensor placements, traffic signal systems, motor control for actuating signals, and ensuring system durability in various environmental conditions.

INNOVATION / CONTRIBUTION TO THE FIELD:

- **Real-time Dynamic Traffic Management**: The system utilizes **Ultrasonic sensors, IR sensors** and **image processing** to dynamically adjust traffic signal timings based on real-time vehicle detection, optimizing traffic flow and reducing congestion.
- **Machine Learning Integration**: By incorporating **machine learning** models, the system predicts traffic patterns and adjusts signal timings intelligently, enhancing traffic management efficiency.
- **Prioritization of Emergency Vehicles**: The system prioritizes **emergency vehicles**, such as ambulances and fire trucks, ensuring faster and safer passage through intersections.

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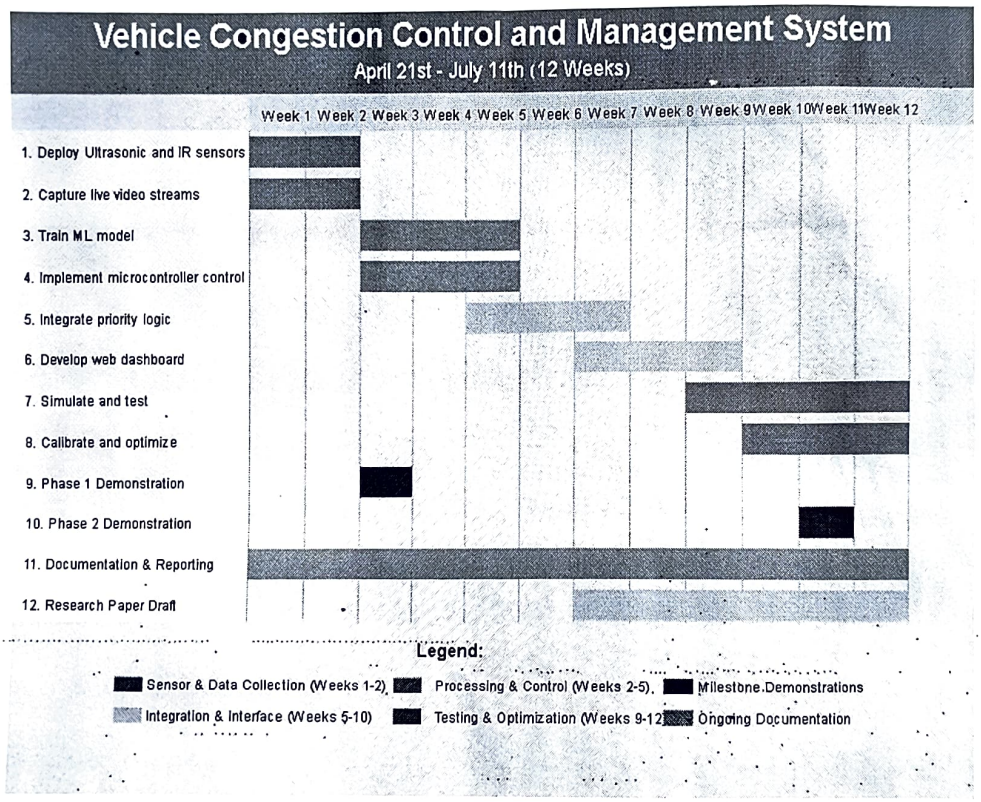
TIMELINE (GANTT CHART):



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Name : Dr. Nagaraja G S
Designation : Professor
Department : Computer Science and Engineering

15/5/25

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