SMART INDIA HACKATHON 2024

A Smart AI Based Solution for Traffic Management.

- **Problem Statement ID – SIH1775**
- **Problem Statement Title- A smart AI based solution for traffic management.**
- **Theme- Blockchain & Cybersecurity**
- **PS Category- Software**
- **Team ID- 1958**
- **Team Name- 6-Bit Battalion**

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A Smart AI Based Solution for Traffic Management.

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❖ Identified Chanllenges

Challenges faced with the current pre-timed/fixed-timed traffic management system:

- ❑ The inability to dynamically adjust traffic signals based on real-time traffic density leads to inefficiencies and increased congestion.
- ❑ Prolonged high traffic flow in one direction without effective management causes delays for other directions and disrupts overall traffic balance.
- ❑ Failure to detect and prioritize emergency vehicles at intersections results in delayed response times and potential safety risks.

❖ Proposed Solution

An AI-based traffic management system is designed to integrate with and enhance the existing pre-timed or fixed-time traffic control systems at road junctions by:

- ✓ Analyzing ***traffic density*** in all directions approaching the junction.
- ✓ ***Prioritizing the direction*** with the highest density, allowing traffic to pass while halting others. Traffic continues in that direction until it reduces to a moderate or lower level.
- ✓ If the traffic does not reduce within a fixed interval, the system stops that side and ***shifts priority*** to other directions.
- ✓ Siren vehicles/***Emergency vehicles*** are detected and prioritized, enabling an immediate green signal for their direction.

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TECHNICAL APPROACH

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❖ Required Components

Hardware Components:

- Raspberry Pi
- Cameras (IP)
- Traffic Signal Lights
- Sensors(LiDAR)
- Power Supply, Networking etc.

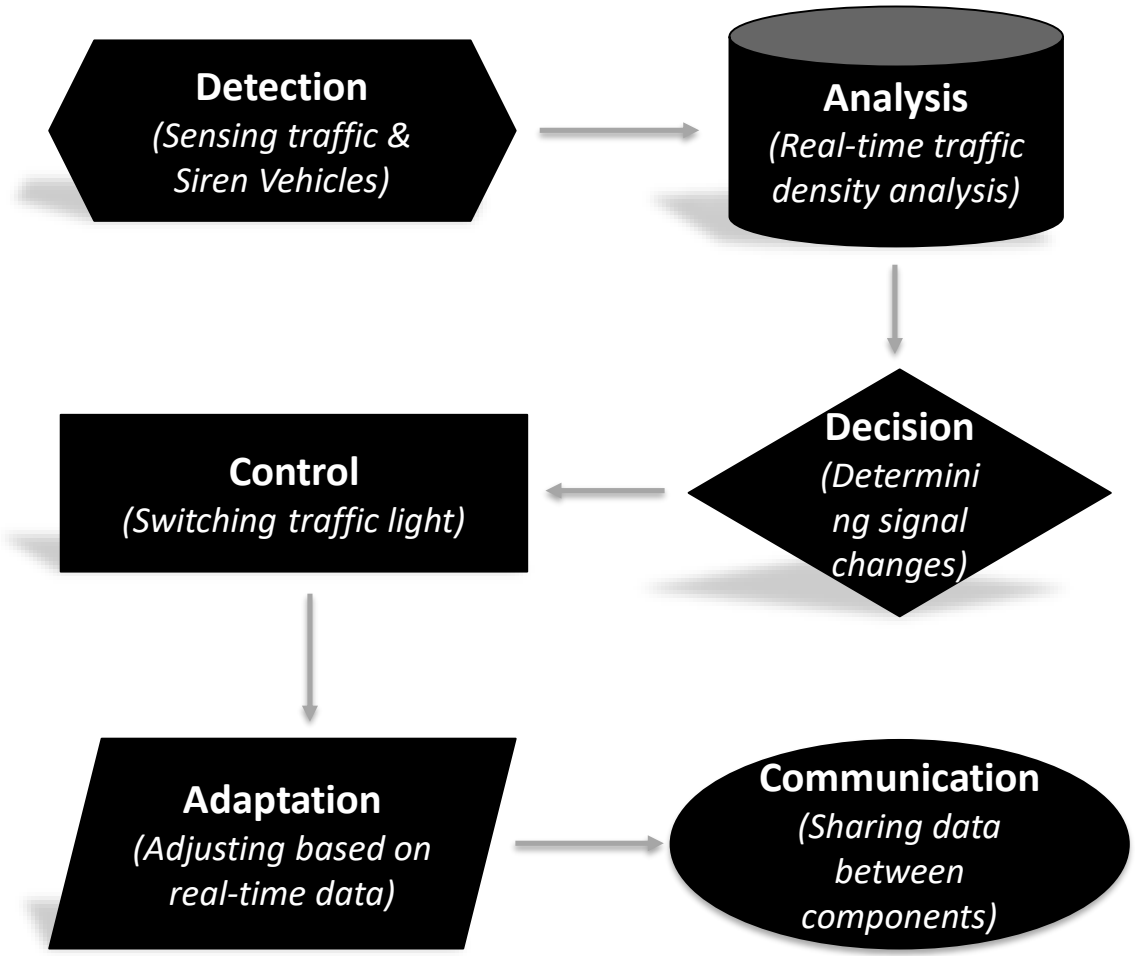
Libraries:

- OpenCV, Numpy for AI image processing.
- RPi.GPIO, picamera for controlling the Pi and cameras.
- Socket, MQTT for communication.

Programming Languages:

- Python: Main language for AI, image processing, and defining traffic control logic.
- Bash: For automation and system scripts.

❖ Process Flow



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FEASIBILITY AND VIABILITY

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❖ Feasibility

- ❑ Readily available hardware like cameras, Raspberry Pi, and AI algorithms make the system implementation possible.
- ❑ Using Python and machine learning libraries allows for dynamic adaptation to traffic conditions.
- ❑ The system can be deployed at individual intersections or scaled across a city.
- ❑ Integrating the system with existing traffic signal setups is achievable with minor modifications.

❖ Viability in Implementation

- ❑ After the initial investment, reduced traffic congestion and emergency prioritization can improve urban mobility.
- ❑ Reducing congestion cuts down on fuel consumption and emissions, contributing to environmental goals.
- ❑ The system provides valuable data on traffic patterns, which can be used for future urban planning and optimizing public transportation routes, making the system highly viable for long-term urban development strategies.

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IMPACT AND BENEFITS

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❖ Impact of this system in real word.

- The system dynamically adjusts signal timings, allowing traffic to flow smoothly, especially during peak hours. This reduction in wait times improves overall travel efficiency and reduces driver frustration.
- Emergency vehicles are prioritized with green lights, enabling them to pass through intersections faster. This reduces delays in critical situations, potentially saving lives.
- By minimizing traffic jams, the system helps reduce fuel wastage from idling vehicles. This leads to lower CO2 emissions, contributing to cleaner urban air quality.

❖ Benefits

- With better-controlled traffic flow, there are fewer chances for accidents at intersections. Safer roads also mean less strain on emergency and healthcare services.
- The system collects valuable traffic data, which urban planners can use to make informed decisions on road expansions, public transport routes, and future smart city initiatives.
- Once implemented, the system reduces operational costs through more efficient traffic management. The long-term savings, both in fuel and emergency response, outweigh the initial setup expenses.

Your Team Name

RESEARCH AND REFERENCES

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Several systems similar to AI-based traffic management have been proposed and implemented. For example, a system using IoT and AI for real-time traffic density detection and emergency vehicle prioritization was developed, improving flow in smart cities. A notable project involved a smart traffic signal system that used machine learning algorithms to adapt signals based on real-time traffic flow, significantly reducing congestion and delays. Another example includes integrating emergency vehicle detection using image processing to prioritize green lights, optimizing safety and response time.

Below listed are few research papers that discuss AI-based and IoT-driven traffic management systems:

1. **Smart Traffic Management System for Metropolitan Cities** – This paper focuses on using cutting-edge technologies to create adaptive traffic systems in smart cities. It details how real-time data can improve traffic flow efficiency. >>https://link.springer.com/article/10.1007/s13177-024-00400-9
2. **IoT-based Intelligent Traffic Signal System for Emergency Vehicles** – This research discusses integrating IoT for prioritizing emergency vehicles in traffic systems. >>https://link.springer.com/article/10.1007/s13177-024-00400-9
3. **Adaptive Traffic Lights Based on Traffic Flow Prediction** – This paper uses machine learning models to adapt traffic lights dynamically based on predicted traffic conditions. >>https://link.springer.com/article/10.1007/s13177-024-00400-9