Traffic Management System Using IOT, Data Analytics And Machine Learning

OBJECTIVES:

The objective of the project is to provide real-time traffic data to users, assisting them in selecting the most efficient route to their destination. Additionally, the project aims to utilize machine learning to predict congestion, offering suggestions that incorporate parking availability when it is needed.

COMPONENTS DESCRIPITION:

A traffic management system circuit typically involves the use of electronic components to control and monitor traffic flow.

POWER SUPPLY :

- The bridge rectifier is used to convert alternating current (AC) from the electrical grid or another source into direct current (DC), which is often used to power various components of the system.
- The converted current is pulsated, Using capacitors as a filter to stabilise the DC

SENSORS :

- In traffic management projects, sensors are vital for data collection and monitoring. Common sensor types include inductive loops, magnetic sensors, video cameras, infrared sensors, and radar sensors.
- In this project Camera sensors are used to Identify vehicle congestion and change traffic lights accordingly.

BOARDS :

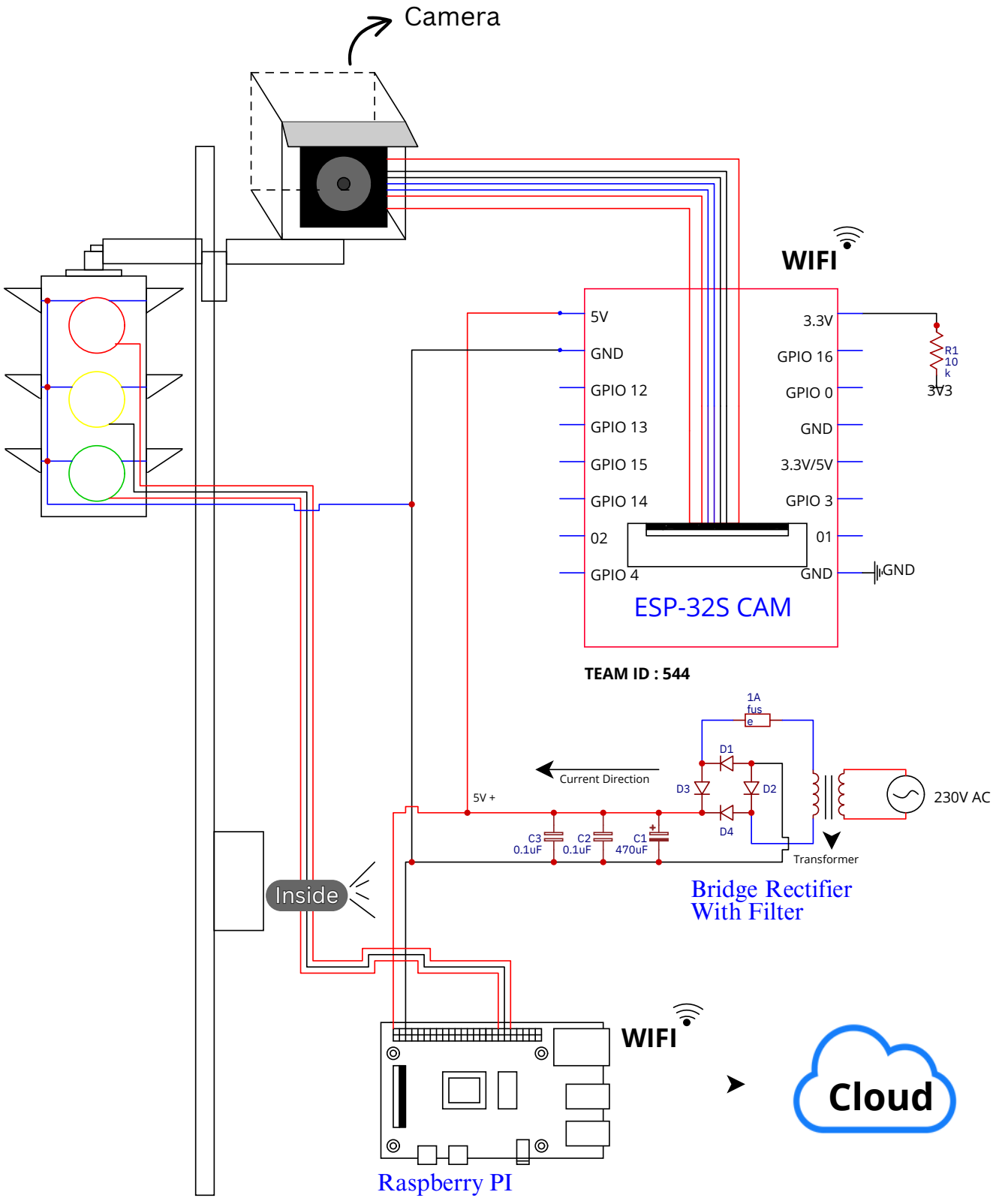
- The **ESP32 CAM** is programmed to capture images and videos and It can process the captured data locally by sending the live stream to the local server.
- The Live footage is received from the camera by **Raspberry PI** using the local IP of the network to deduct the vehicles and perform traffic clearance by changing the traffic light according to the vehicle data.
- And finally the vehicle data is shared to the cloud (firebase).

COMPONENTS REQUIRED :

- ESP 32 CAM
- Raspberry PI 3 / 4
- Router
- AC Power Supply
- Step Down Transformer
- Diode
- Resistor
- Capacitor
- LED : Red , Green , Yellow
- Required amount of wire

CIRCUIT

The program written in ESP32 board for streaming video through IP is shared in the Github repository.



SIMULATION :

- The Simulation for this project is made by using Python. From this simulation we will understand the actual working of this project under the single area.
- Pygame Library is used to make the simulation.

THE PROGRAM AND ASSETS FOR THIS SIMULATION IS ATTACHED ON THE PHASE 3 REPOSITORY. (SIMULATION.PY / IMAGES)

OUTPUT :

VEHICLE DEDUCTION :

- Image processing is used to deduct the vehicle on the road to assign the timing of red and green lights and also for the App's congestion data.
- **Open Cv**: The "Open Source Computer Vision Library," is a crucial tool designed specifically for computer vision applications tailored to traffic management.
- In **Python**, with a comprehensive set of functions and algorithms for visual data processing, OpenCV facilitates real-time monitoring of traffic conditions, offering valuable insights for data analysis and decision-making.
- Firstly the original frame is taken from the **IP** of the **ESP 32 CAM** and processed by **Raspberry Pi.**
- The code starts by importing the necessary libraries for Image Processing and its dependencies.
- Pillow, opencv-python, requests.
- **Pillow** is a well-known which is used in image processing, Image creation, Image enhancement, Image analysis and image conversion.
- The **requests** library helps Raspberry PI to interact with the cloud and receive frame shared in a localhost by the camera.

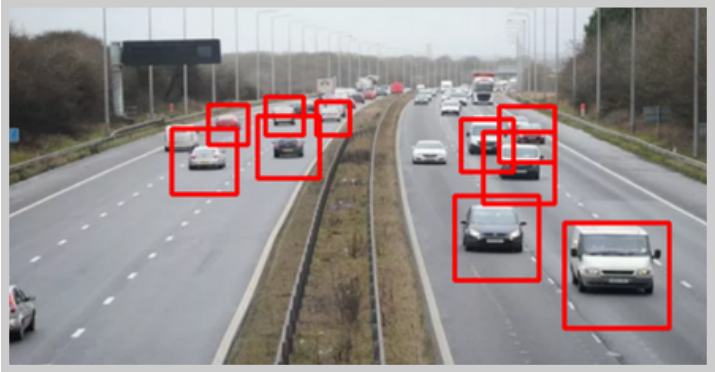
THE PROGRAM AND DOCUMENT FOR THIS VEHICLE DEDUCTION ARE ATTACHED ON THE PHASE 3 REPOSITORY. (VEHICLE_DEDUCTION.IPYNB / VEHICLE_DEDUCTION.PDF)

INPUT:

- Link of the Image or video frame callback with the vehicles. It works in both Local and internet streams.

OUTPUT:

- After Deductiong the Vehicles.



USES AND ADVANTAGES:

- **License Plate Recognition (LPR):** It can capture license plate images for automated license plate recognition.
- **Incident Detection:** Detect and capture images of accidents, road obstructions, or traffic violations.
- **Remote Accessibility:** It allows authorized users to access traffic data from anywhere, enabling real-time monitoring, analysis, and decision-making.
- Data can be accessed by traffic management authorities, **law enforcement**, and **urban police officers**, enabling informed decision-making.

- **Scalability and Redundancy:** Cloud storage can scale to accommodate changing data volumes and provide redundancy, ensuring data reliability even in the event of hardware failures.
- It provides enhancement in **road safety** and traffic efficiency by reducing the waiting time to **save fuel**

MAIN OBJECTIVES:

- Using automated technology, the traffic light adjusts automatically to prioritize the passage of the **emergency vehicle**, swiftly clearing the traffic and ensuring a seamless route. This system effectively optimizes the flow of traffic, allowing the emergency vehicle to **proceed rapidly** without any obstructions to save lives.
- In addition, the system aims to offer users a seamless experience through an app that **predicts congestion**. This is achieved by leveraging recorded data and employing a **machine-learning** algorithm. Furthermore, the system provides a low-latency live stream of the traffic in the area, enhancing the user experience with an excellent interface.

SUMMARY:

The Emergency Vehicle Priority system clears the path for emergency vehicles and optimizes traffic flow. It integrates advanced technologies for swift passage and employs a user-friendly app to predict congestion, ensuring a seamless experience for all road users.