TRAFFIC MANAGEMENT SYSTEM

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering/Information Technology

By

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CANDIDATE'S DECLARATION

I hereby declare that the work presented in this report entitled **"Traffic Management System"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering/Information Technology** submitted in the department of Computer Science & Engineering and Information Technology**,** Jaypee University of Information Technology Waknaghat is an authentic record of my own work carried out over a period from July 2022 to May 2023 under the supervision of **Dr. Shubham Goel** (Assistant Professor in Computer Science & Engineering / Information Technology).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

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LIST OF ABBREVIATIONS

CNN- Convolution Neural Network

ANN- Artificial Neural Network

HOG- Histogram of Oriented Gradients

AI- Artificial Intelligence

VSC- Visual Studio Code

GPU- Graphical Processing Unit

IDE- Integrated Development Environment

DBMS- Database Management System

GDS- Graph Data Science Library

API- Application Programming Interface

NER- Named Entity Recognition

SVM- Support Vector Machine

YOLO- You Only Look Once

SQL- Structured Query Language

ML- Machine Learning

TSE- Total Squared Error

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ABSTRACT

A traffic management system is a sophisticated, integrated system that strives to promote safety, improve traffic flow, and boost overall transportation system effectiveness. To gather and analyse real-time data regarding traffic conditions, it depends on cutting-edge technology like sensors, cameras, and communication networks. Using traffic lights, road signs, and other traffic control equipment, this data is utilised to control traffic flow and to give drivers real-time information on accidents, traffic congestion, and other problems.

Reducing traffic jams, boosting safety, and improving the performance of the transportation system as a whole are the main objectives of a traffic management system. The technology can assist in cutting commute times, lowering fuel consumption and emissions, and improving general quality of life for city dwellers by streamlining traffic and easing congestion. The device can also aid in lowering the chance of accidents and other occurrences by giving drivers real-time traffic information, hence improving safety and security on the roadways.

Overall, a traffic management system is an essential part of contemporary transportation infrastructure, and as traffic volumes rise and urban populations rise, so will the significance of this component. To maintain the security, effectiveness, and sustainability of our transportation networks, traffic management system development and deployment must be given top priority by transportation planners and politicians.

CHAPTER 1
INTRODUCTION

1.1) Introduction

A traffic management system (TMS) is a collection of technologies and practices that aid in the monitoring and control of traffic flow on roads, highways, and other transportation networks. The primary purpose of a TMS is to increase safety, reduce congestion, and optimize infrastructure utilisation.Sensors, cameras, traffic signals, communication systems, and data analysis tools are typical hardware and software components of a TMS[1]. These elements collaborate to gather real-time traffic data, assess it, and send feedback to traffic controllers, drivers, and other stakeholders.One of the most important advantages of a TMS is its capacity to allow traffic managers to make real-time choices based on the most recent traffic data. A TMS, for example, can automatically modify traffic lights to improve traffic flow or offer drivers with real-time information on alternate routes, delays, or accidents.Overall, a well-designed and implemented TMS may considerably enhance transportation network safety, efficiency, and dependability, resulting in a better life for individuals and improved economic growth for communities[2].Sure, here are some more specifics on traffic management systems:

A Traffic Management System includes the following components: - Traffic surveillance systems, such as cameras and sensors, to monitor traffic flow and identify incidents and congestion.

- Tools for traffic data analysis and management to handle and understand data acquired by surveillance systems.
- Intelligent transportation technologies, such as variable message signs (VMS), radio broadcasts, or smartphone apps, are utilized to offer real-time information to drivers. - Traffic control systems, such as traffic

lights and lane control signals, are used to govern traffic flow.

- Incident management systems, which allow for the rapid identification and response to accidents, disabled cars, and other situations that may create delays or congestion.

The Advantages of Traffic Management Systems:

- Increased safety: TMS can help minimize the incidence of accidents by swiftly detecting and responding to problems, as well as by eliminating errors.

TMS may assist detect and alleviating congestion hotspots, adjust traffic signals and speed restrictions, and offer alternate routes to minimize traffic volumes by monitoring and assessing traffic patterns.

- Improved efficiency: Using real-time traffic data, traffic managers may make more educated traffic management choices, minimizing delays and improving travel times. TMS can help reduce air pollution and greenhouse gas emissions by decreasing congestion and smoothing traffic movements.

Overall, TMS can enhance transportation network performance by making it safer, more efficient, and more sustainable. The effectiveness of a TMS, on the other hand, is dependent on its design, implementation, and continuous maintenance, as well as collaboration between traffic managers, government agencies, and other parties involved in transportation planning and management.

Yes, here are some additional details on traffic management systems:

Traffic Management System Technologies:

- Vehicle detection sensors that detect the presence and speed of vehicles, such as inductive loops or radar.
- Automatic Licence Plate Recognition cameras, which read licence plates and identify the vehicle.

Closed Circuit Television (CCTV) cameras will be used to monitor traffic and detect incidents and bottlenecks.

- Data transmission technologies, such as Wi-Fi or cellular networks, to transport data between various components
- Data privacy: Collecting and analyzing traffic data might pose privacy concerns, particularly when ANPR cameras or GPS monitoring are used.
- Integration: Integrating multiple components of a TMS can be difficult, especially when the systems are owned by different government bodies or private enterprises. - Human factors: Even with modern technologies, traffic management still need human interaction and decision-making, especially when responding to events or crises.

Despite these challenges, the benefits of TMS can outweigh the costs, especially in densely populated areas where traffic congestion is a major issue.TMS can therefore boost economic growth and improve individuals' quality of life by decreasing congestion, enhancing safety, and increasing efficiency[3]. A Traffic Management System includes the following components: - Traffic surveillance systems, such as cameras and sensors, to monitor traffic flow and identify incidents and congestion.

- Tools for traffic data analysis and management to handle and understand data acquired by surveillance systems.
- Intelligent transportation technologies, like as variable message signs (VMS), radio broadcasts, or smartphone apps, are useful in giving real-time information to drivers. - Traffic control systems, such as traffic lights and lane control signals, are used to govern traffic flow.
- Incident management systems, which allow for the rapid identification and response to accidents, disabled cars, and other situations that may create delays or congestion.- Improved safety: TMS may help reduce the frequency of accidents by immediately recognising and responding to

events, as well as reducing congestion, which can help prevent accidents caused by disgruntled drivers.

TMS may assist in detecting and alleviating congestion hotspots, adjust traffic signals and speed restrictions, and offer alternate routes to minimize traffic volumes by monitoring and assessing traffic patterns.

- Improved efficiency: Using real-time traffic data, traffic managers may make more educated traffic management choices, minimizing delays and improving travel times. TMS can help reduce air pollution and greenhouse gas emissions by decreasing congestion and smoothing traffic movements.

Overall, TMS can enhance transportation network performance by making it safer, more efficient, and more sustainable. The effectiveness of a TMS, on the other hand, is dependent on its design, implementation, and continuous maintenance, as well as collaboration between traffic managers, government agencies, and other parties involved in transportation planning and management[4].

Vehicle detection sensors, such as inductive loops or radar, are used in Traffic Management Systems to detect the presence and speed of vehicles.

- Automatic Number Plate Recognition cameras aid in the reading of number plate numbers and the identification of cars.

Closed Circuit Television (CCTV) cameras will be used to monitor traffic and detect incidents and bottlenecks.

- Communication technologies, such as Wi-Fi or cellular networks, can send data between TMS components and give drivers real-time information. - Data analysis technologies, such as Geographic Information Systems (GIS) or machine learning techniques, to analyze and understand surveillance system data. Traffic Management System Difficulties:
- Cost: Developing and maintaining a TMS may be costly, especially in big,

complicated urban regions with significant traffic volumes.

- Data privacy: Collecting and analyzing traffic data might pose privacy concerns, particularly when ANPR cameras or GPS monitoring are used. Integration: Integrating multiple components of a TMS can be difficult, especially when the systems are owned by different government bodies or private enterprises.

Despite these challenges, the benefits of TMS can outweigh the costs, especially in densely populated areas where traffic congestion is a major issue[4].TMS can therefore boost economic growth and improve individuals' quality of life by decreasing congestion, enhancing safety, and increasing efficiency.

- Improved public transport: By lowering traffic congestion and improving traffic flow, TMS may also improve the operation of public transport systems, such as buses or trains, by reducing delays and enhancing dependability.

TMS can assist in making better use of existing transportation infrastructure, such as roads and highways, by optimizing traffic flow and decreasing congestion, which can help defer the need for costly expansions or new infrastructure.

- Improved accessibility: TMS can increase accessibility for all road users, including pedestrians, cyclists, and drivers with impairments, by giving real-time information regarding traffic conditions and alternative routes.

1.2) Problem statement

The problem of traffic congestion in numerous cities has grown dramatically during the last several years. The advancement of civilization, as well as the widespread use of vehicles, has resulted in an increasing transportation requirement for infrastructure, which is notably connected with network congestion[5]. However, the availability of various transport infrastructure has slowed mobility expansion. Congestion difficulties are connected with increased late issues, vehicle operation costs, including fuel consumption, pollution emissions, and stress caused by cars interfering with traffic flow on the road, particularly when traffic numbers reach a certain level. The majority of people are stuck in traffic in cities, and congestion occurs when demand exceeds road capacity.Several factors have contributed to the traffic congestion. The majority of them were designed to limit road capacity at a certain place or over a specific distance, such as when parking is done on a specific lane of road or when the number of cars is raised[6].Traffic signals have also dominated traffic congestion, and even when there is little or no traffic on the road, the traffic light still displays the same sort of traffic time, forcing traffic in the other lanes to rise and congestion to worsen. As a result, ambulances, police cars, and fire trucks may arrive late at their destinations.

1.3) Objective

The solution we suggested intends to improve the efficacy of the current autonomous traffic signal system and to offer the optimum traffic network with the least amount of delay. The system will utilise an adaptive signal for regular maintenance, as well as sensors for the lane and the maximum number of cars and image processing for all types of emergency vehicles. Following the successful completion of our project on road traffic volume, the time will be automatically computed as the time changes[7]. The method presented in our proposal will be integrated with automated signaling using a typical operational paradigm. The system will have superb artificial vision with the help of digital cameras installed on the motor that will spin our system to face network lanes for checking for emergency cars and perceiving traffic on the road. The method for our project for traffic signals programme is to deliver good services that will meet the objectives of regional partners involved in the management and operation of transportation systems, abbreviated as TSMO, and the ultrasonic sensors we are using in our project are to detect the number of traffic signals[6]. We are using in our project to detect the number of vehicles in a specific lane and then give the best time for vehicles to continue following traffic without much delay, and thus we have given a specific lane a priority in timing of the green light while reducing the time for green light for the other lanes.

1.4) Methodology

The different As previously stated, the various components of this project were completed using the following approaches:
Vehicle Classification Histogram Oriented Gradient-Support Vector Machine

1.Support Vector Machine:

This type of approach is completely based on the supervised machine learning algorithm.This method is entirely based on the supervised machine learning algorithm.This method is mostly used for picture classification as well as pattern recognition.This SVM model may be visualized as a point space with hyperplanes dividing distinct classes. (Support Vector Machines are simply hyperplanes that excel in separating and classifying a wide range of classes. SVM is a well-known object-based classification method.

2. What exactly is a Histogram of Oriented Gradients (HOG)?

The histogram of directed gradients is a useful feature indicator in image processing, notably for detecting things based on their shapes. How does it work?

1. Break the image up into "Cells," or smaller images.

2. Identify the gradients in the cells that require explanation.

3. Fill in the data in each cell's histogram.

4. Arrange the cells in substantial blocks.

5. Make each block normal.

6. Develop a classifier to find things. The HOG SVM-based vehicle categorisation procedure is divided into three stages:

The first is data collecting, the second is feature extraction, and the final is training for our project.

Dataset Collection

The first and most critical step in categorizing automobiles is gathering data. To collect data for the aforementioned application, free datasets that are easily accessible online are employed. The collection contains examples of car images taken at various sizes, locations, and lighting settings[2]. The dataset should support any detection circumstances that must be used for recognition or classification. The accuracy is determined by the example photographs from the dataset that were used to train various automobiles. We initially acquired three distinct sorts of sample footage of automobiles in case of emergency detection, according to the programme. We have gathered front, back, and side view movies for the automobile vehicle type. All other categories follow the same procedures. The used automobile dataset contains the bulk of vehicle pictures taken on Indian roadways.

Extraction of features

Feature extraction techniques are used to tackle the most prevalent types of computer vision issues, such as object identification and recognition. The oriented gradient histogram (HOG) is one of the most prominent feature extraction approaches utilized in the case of object recognition. According to current vehicle classification and application count, HOG is the most often used approach for feature extraction from a tagged training set of photos.

Training

According to the data obtained, training provides the foundation for vehicle categorization. If necessary, some picture sequences are added to the photographs from the Internet utilized for the current application's training. The HOG method is used to train the Support Vector Machine model with the aid of a training set of feature vectors.

Classification of Vehicles

Vehicles are divided into one of three types: passenger cars, HMVs, or two-wheelers. To classify the acquired vehicle, a characteristic of the vehicle HOG is extracted. This vector is used by the SVM model to compute the matching score for the input vector to each label. When using trained vehicle data, the SVM will return the highest confidence score in the case of a best match.

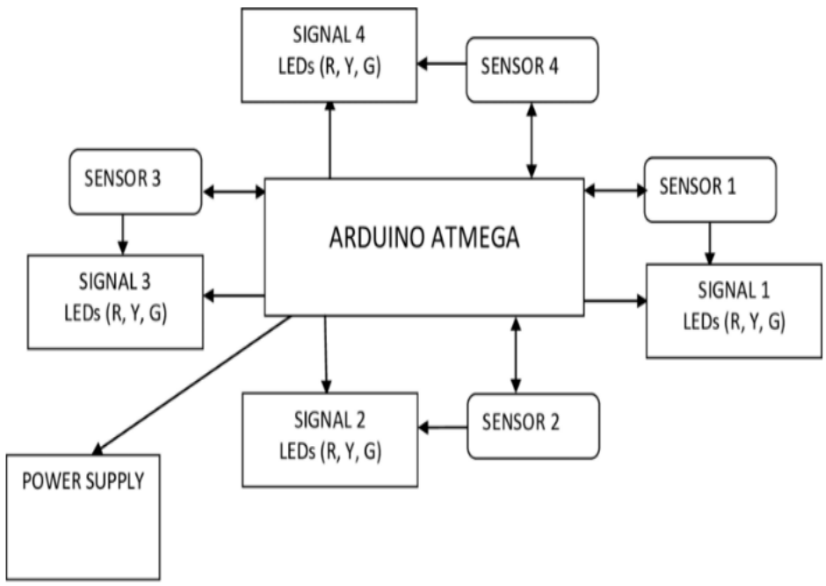


Figure : Flowchart of Traffic Management System

CHAPTER 2
LITERATURE SURVEY

2.1) Introduction

Companies are working to create technology that increases the accuracy of current models as AI is used in more common goods. The suggestion mechanisms seen in virtually every product we use serve as a common illustration. Recommendations are also used by search engines to enhance search results, as well as by e-commerce websites and movie recommendation systems. Additionally, the AI and knowledge graphs used in our voice assistants, like Siri or Alexa, give them an advantage. To learn more about knowledge graphs, we have encountered several research articles, books, journals, and websites.

2.2 Related Work

[1] Applications for video-based traffic surveillance analysis, which is a hot research field, are abundant in intelligent transport systems. Urban landscapes are more difficult to photograph than highways, in part because of camera placement, background clutter, and changes in vehicle attitude or orientation. The most contemporary video processing techniques for vehicle recognition, identification, and tracking are thoroughly examined in this paper[1]. In this study, we categorize vehicle recognition techniques into groups based on motion and appearance. These techniques vary from simple probabilistic to adaptive median filtering and frame differencing.

[2] Applications for video-based traffic surveillance analysis, which is a hot research field, are abundant in intelligent transport systems. Urban landscapes are more difficult to photograph than highways, in part because of camera placement, background clutter, and changes in vehicle attitude or orientation. The most contemporary video processing techniques for vehicle recognition, identification, and tracking are thoroughly examined in this paper[2]. In this study, we categorize vehicle recognition techniques into groups based on motion and appearance. These techniques vary from simple probabilistic to adaptive median filtering and frame differencing.

[3] The properties of moving objects, such as their high speed degradation and uncharted pathways, make it difficult to identify and track them. Detecting moving targets may be done in a variety of ways, however the noise of detection greatly affects the accuracy of detection[3]. The three-frame method is used in this work to extract the target, and the extracted image is then processed using the mathematical morphology methodology. While successfully detecting moving targets, this method significantly reduces noise. According to the testing results, this method operates better in real-time, is appropriate for outdoor use, and is more accurate at recognising moving things.

[4] Tracking vehicles is an integral part of intelligent transportation monitoring. However, there are currently problems with vehicle tracking, such as scale change, interference from too similar colors, low resolution video data, and others. The optical flow MCMC (OF-MCMC) tracking method for tracking moving objects is suggested in this paper as an improved Markov chain Monte Carlo (MCMC) tracking method[4]. We first estimate the vehicle's traveling direction in initial frames using the optical flow approach, and then address the scale change problem and replace the second-order autoregressive motion model with the ability to calculate the vehicle's speed.

[5] Parking on the street can cause major traffic problems, like accidents and congestion in urban areas. A trustworthy and practical method for locating parking violations is given. The method is predicated on frame difference detection of abrupt changes in vehicle motion. In addition to the temporal information, vehicle traits from a static image are employed to reduce the false alarm and missing rate[5]. The proposed method generates a detection accuracy of 94.7% and can precisely estimate parking duration, according to testing results on 24-hour streets. Comparing our method to previous solutions based on EPI image processing, it is evident that ours employs a video camera in a fixed place without operating the measurement vehicle.

[6] Recognition and counting of intelligent vehicles are becoming more and more important in the field of highway management. It might be challenging to see automobiles due to their wide range in size, which affects how precisely counts of vehicles are performed[6]. An identifying and counting system for vehicles based on vision is suggested by this research to solve this issue. In total, there are 57,290 annotated occurrences in 11,129 images from a brand-new high definition highway vehicle dataset presented in this work. As contrast to the currently available datasets, the recommended dataset includes annotated microscopic elements in the image and provides the whole data foundation for vehicle detection based on deep learning. For counting and detecting automobiles, the proposed system.

[7] The description of a brand-new technique for categorizing autos from videos. Two novel concepts are presented: first, probes composed of local 3D curve groups which, when projected onto video frames, serve as characteristics for distinguishing distinct vehicle classes in video clips[7]. The second method uses class probability densities to identify groupings of 3D distances between pairs of 3D probes. The picture curves connected to the 3D ridges on the surface of the vehicle appear to be the most trustworthy image features for categorising cars. The bulk of these ridges are located at metal/glass interfaces, two-surface intersections, such as the back and sides, and self-occluding forms, such as wheel wells or apparent curves of the vehicle body, or silhouettes.

2.3 Summary of Literature Review

The literature study for these systems covers in detail the design, implementation, and application of traffic management systems. One of the primary implications is that:

Real-time data collection and analysis: To effectively regulate traffic flow, real-time data must be acquired and analyzed from a variety of sources, such as traffic sensors, cameras, and GPS devices. Complex algorithms and software tools are required to analyze this data and provide real-time traffic forecasts and reports.

Intelligent transportation systems (ITS): ITS use state-of-the-art tools and methods to improve the efficiency, security, and general functionality of transportation networks. In addition to other technological advancements that enhance traffic management, these systems may incorporate connected and driverless cars.

Communication networks are crucial components of traffic management systems because they provide reliable and efficient data transfer between the system's many components, such as traffic management centres, traffic control devices, and drivers.

Safety and security: Traffic management systems employ strategies including the use of traffic signals, street signs, and other traffic control devices to alert drivers to possible risks and regulate traffic flow in regions with a high accident rate. These methods are meant to increase road security and safety.

Engagement of stakeholders: The design and execution of traffic management systems depend heavily on the success of stakeholders. It may be necessary for this to involve cooperation between governmental agencies, transportation departments, technology businesses, law enforcement groups, and other parties.

CHAPTER 3
SYSTEM DEVELOPMENT

1) A data set

There are street surveillance cameras all over the world, but traffic photographs are rarely made public owing to copyright and security issues. Looking at the traffic photo dataset from the standpoint of image capture, we may divide it into three groups: automobile camera photographs, surveillance camera images, and non-surveillance camera images. The dataset utilized in our work comprises photographs of roads and typical streetscapes, which can be used to automatically recognise and count automobiles and will aid in the solution of issues such as 3D object identification and tracking. Here are some of the most widely used dataset lists around the world:

1) The dataset utilized in Tsinghua-Tencent Traffic-Sign contains around 100,000 photos obtained from automobile cameras and covers diverse lighting and weather situations, however no cars are indicated in that case.

2). Stanford Cars dataset is essentially a vehicle dataset obtained from non-monitoring cameras using a bright car appearance. This dataset will comprise a total of 19,000 estimated car categories encompassing the brands, models, and manufacturing years of the various vehicles.

2) Hardware and Software Requirements

The Following are the software requirements for this project:

1. 4.2 GB RAM

2. MS Window 7 and above Software Requirements

3. Visual Studio Code

Microsoft has successfully developed Visual Studio Code, also known as VS Code, which is essentially a free open-source text editor. VS Code works with Windows, Linux, and macOS. VS Code has effectively become one of the most popular programming tools in recent years, despite the fact that the editor is quite tiny and provides some complex capabilities. VS Code supports a wide range of programming languages, from Java, C++, and Python to CSS. Furthermore, VS Code allows users to add and create new extensions such as code linters, debuggers, and cloud and web development support. In comparison to other text editors, VS Code's user interface allows for a great deal of interaction.

VISUAL STUDIO CODE

Figure : Visual Studio Code

4. TensorFlow:

TensorFlow was launched in November 2015 and has since grown to become one of the most popular machine learning libraries. It has a big active developer community, including users who have contributed to its development, who may share their expertise and resources and give help to one another.TensorFlow is compatible with a wide range of platforms, including Windows, Linux, and Android, and it can be used with a variety of programming languages, including Python, C++, and Java.TensorFlow is useful for a number of machine learning applications, including supervised and unsupervised learning, reinforcement learning, and generative models, in addition to deep neural network training and inference.TensorFlow is supported by a large ecosystem of tools and frameworks, including Keras, TensorFlow Lite, and TensorFlow.js.TensorFlow is also very flexible, allowing you to create and train bespoke models by combining different types of layers, activation functions, loss functions, and optimizers.Overall, TensorFlow is a robust and adaptable machine learning and artificial intelligence technology, and its open-source nature makes it accessible to a diverse set of users and applications.

Figure : Tensorflow

5. OpenCV:

OpenCV is a sophisticated tool that performs a wide range of computer vision and image processing tasks. It has a large number of algorithms and functions that are organized into modules according to their functionality, such as core, imgproc, video, calib3d, features2d, and machine learning. The core module contains fundamental data structures and operations that are utilized by other modules, whereas the imgproc module contains image processing functions such as filtering, thresholding, and edge detection. One of the most notable advantages of OpenCV is its ability to process video streams in real time.This is especially beneficial in applications like surveillance, traffic monitoring, and autonomous cars, where speed and accuracy are critical. OpenCV also includes a comprehensive set of features for object identification and recognition, such as face detection, object tracking, and feature detection. OpenCV has several applications in fields such as robotics, medical imaging, and augmented reality. It may be used to detect and track items in the environment of a robot, to execute image-guided activities, and to overlay virtual objects on real-world scenes in augmented reality applications. OpenCV may also be used with other libraries and frameworks, such as TensorFlow, to develop more complicated applications.Because OpenCV is an open-source library, it has a thriving developer community that can assist with development and maintenance.This has resulted in the creation of a variety of useful tools and resources, such as tutorials, documentation, and forums, to assist users in learning and utilising the library. Because of its ease of use, large range of features, and active community, OpenCV has become a go-to tool for computer vision and image

Figure : OpenCV

HARDWARE REQUIREMENTS:

The Following mentioned above are hardware requirements for this project:

1. Arduino Nano [A000005]

The Arduino Nano is a compact, breadboard-friendly board that is entirely based on the ATmega328. It offers nearly the same capabilities as the Arduino Duemilanove, but in a different packaging. It just lacks a DC power connector and can function using a Mini-B USB cable rather than a conventional one.

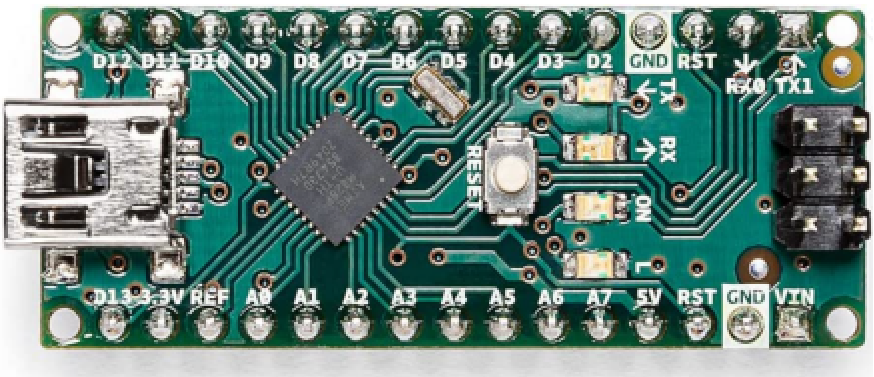


Figure : Arduino Nano

2. ArduinoMega2560

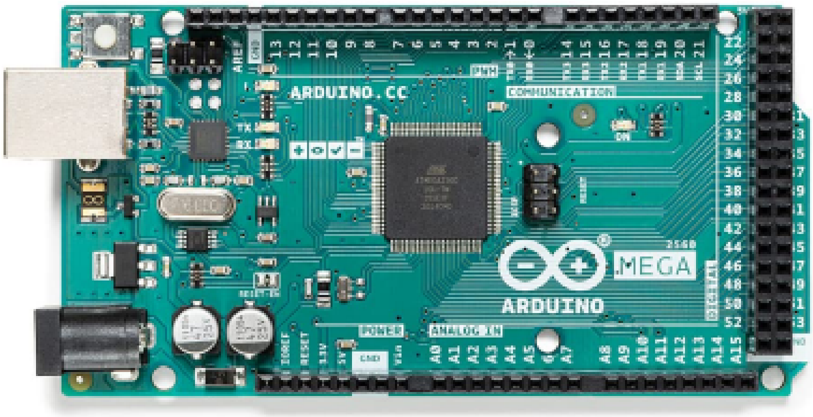


Figure : ArduinoMega2560

It's simply a small microcontroller board that's totally based on the ATmega2560. It features 54 digital I/O pins in total, including 16 analogue inputs, 4 UARTs for the hardware serial ports, and a 16 MHz crystal oscillator, as well as a USB connection, a tiny power connector, an ICSP header, and a small reset button. It has everything needed to support the microcontroller, and it is usually used for connecting to a computer through a USB cable, or we may power it using an AC-to-DC converter.The Mega 2560 board is compatible with the vast majority of shields designed specifically for it and previous boards.

3. IR Sensor:

Figure : IR Sensor

An infrared, abbreviated as IR, is a type of sensor circuit that is one of the most fundamental and widely used sensors in products on the market.Although this device is very similar to the human visionary senses, which are primarily used for obstacle detection, it is also one of the most common applications in the real world. The transmitter component is primarily an infrared sensor that can send continuous IR rays that are utilized by the IR reception module. The output terminal of an infrared receiver alters continually depending on how the IR photons are received. Although this type of variation is not beneficial,

4. 10k Resistor:

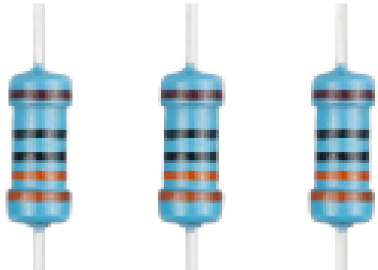


Figure : 10k Resistor

5. 330-ohm resistor

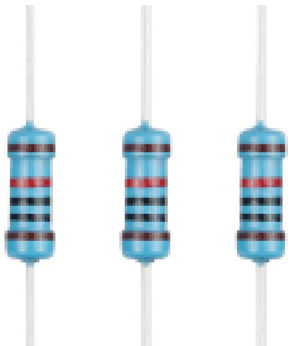


Figure : 330-ohm resistor

The RC522 RFID module is entirely based on the NXP MFRC522 IC and is one of the best RFID alternatives available at a reasonable cost. It essentially comes with the RFID card tag and the key fob tag, and the greatest part is that it can be written as a tag, which means we can store any type of message in it.

7. HC SR04 Ultrasonic sensor 4 Nos

Figure : HC SR04 Ultrasonic sensor

The HC-SR04 offers the finest value for money, is simple to use, and is ideal for measuring distance sensors ranging from 2cm to 400cm.The sensor is mostly made up of transducers. One end is the transmitter, which emits ultrasonic sound pulses, while the other end is the receiver, which listens to the reflected waves. It is essentially a sound navigation and ranging system, or SONAR, that is used in submarines to identify underwater objects.

8. Solderless Breadboard

Figure : Solderless Breadboard

3) Concepts Requirements

1. Machine Learning Algorithms

Machine learning algorithms, or ML algorithms, are the methods that turn a data set into a model. The right method is determined by the type of issue you are attempting to answer, the processing power available, and the type of data you have (supervised, unsupervised, etc.).

2.Data Pre-processing Functions and tools

The process of preparing raw data for the machine learning model is known as data preparation. This is the initial and most essential stage of the machine learning model's development.We don't always come across clear, well-formatted data when working on a machine learning project. Data must be cleansed and formatted before it can be processed. As a consequence, we employ the data pre-processing task.

3.Knowledge of Image Pre-processing

Data preprocessing or cleaning is a common step in machine learning research. As a machine learning engineer, you will spend a significant amount of time cleaning and preparing the data before building your learning model.

4.Knowledge of Artificial Neural Network

The artificial neural network, which is a network of interconnected nodes, is built on a simplification of the brain's neurons. In this picture, the link between the output of one artificial neuron and the input of another neuron is represented by an arrow with circular nodes for each artificial neuron.

5.Knowledge of Convolution Neural Network

Deep learning neural networks are used to process organized data series, such as Deep learning neural networks, commonly known as convolutional neural networks (CNN), are used to analyze ordered data sets such as images. Convolutional neural networks are widely employed in computer vision and have successfully become state-of-the-art in many visual applications, including the most typical example, picture categorization. They have also proved beneficial in text categorization via natural language processing.

6.matplotlib

Matplotlib is one of the most well-known and established Python plot libraries and is used in machine learning. Through various visualizations, machine learning facilitates the understanding of enormous amounts of data. 7.64bit processors are required.

4. Libraries and Conversion Required in Project

4.1 Importing the required libraries:

```
from PIL import Image

import cv2

import numpy as np

import requests
```

4.2 Reading image from the url:

```
image =
Image.open(requests.get('https://a57.foxnews.com/media.foxbusines
s.com/BrightCove/854081161001/201805/2879/931/524/854081161001_57
82482890001_5782477388001-vs.jpg', stream=True).raw)
```

image = image.resize((450,250))

image_arr = np.array(image)

image

Output:

Figure : Output

We conducted several changes on an image from our video collection to achieve the best possible outcome. The picture has been converted to grayscale in this example.

4.3 Grayscale

grey = cv2.cvtColor(image_arr,cv2.COLOR_BGR2GRAY)

Image.fromarray(grey)

Output:

Figure : Output

4.4) Gaussian Blur:

In the following stage, we used the GaussianBlur to blur out the image's noise. One of the most used image processing methods is Gaussian blur. In addition to image processing, it is often used in graphics design to remove noise from pictures and smooth them out so that subsequent preprocessing can offer better results. We utilized the GaussianBlur function () after using this pre-processing approach.

4.5) Application of dilation:

dilated = cv2.dilate(blur,np.ones((3,3)))

Image.fromarray(dilated)

Output:

Figure : Output

After completion of dilation, the nucleus underwent morphological transformation. Here The nucleus underwent morphological alteration when dilatation was completed. The morphology ex-approach is used here, which instructs the function on which operations to do during image processing. The second argument is about the methods that must be followed, and you may demand kernels with an elliptical or circular form. To build the morphology ex technique, we shall utilize OpenCV's obtained structural element function.

Morphology-Ex, structuring element

kernel = cv2.getStructuringElement(cv2.MORPH_ELLIPSE, (2, 2)) closing = cv2.morphologyEx(dilated, cv2.MORPH_CLOSE, kernel)

Image.fromarray(closing)

Output:

Detection of the cars with the help of car cascade

We need to detect multiple objects.

car_cascade_src = 'cars.xml'

car_cascade = cv2.CascadeClassifier(car_cascade_src) cars = car_cascade.detectMultiScale(closing, 1.1, 1) cars

Output: Using the contours returned above, we will create a rectangle around the observed automobiles. We can see here that it will draw a rectangle with a red border around every automobile it detects.

cnt = 0

for (x,y,w,h) in cars:

cv2.rectangle(image_arr,(x,y),(x+w,y+h),(255,0,0),2) cnt+= 1

print(cnt, " cars found")

Image.fromarray(image_arr)

3.1) Code for the Vehicle Detection in our Project:

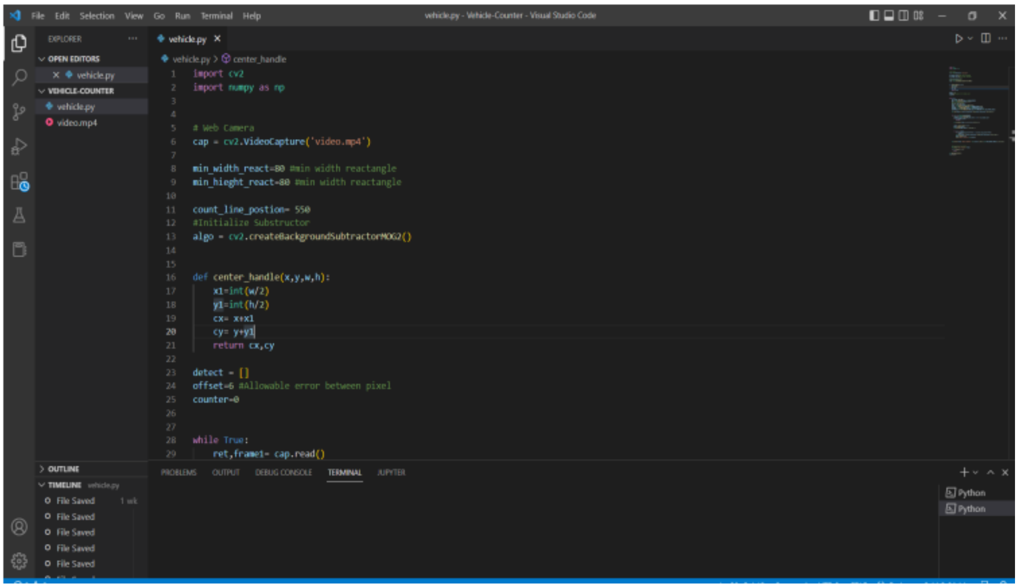


Figure : Code for vehicle detection

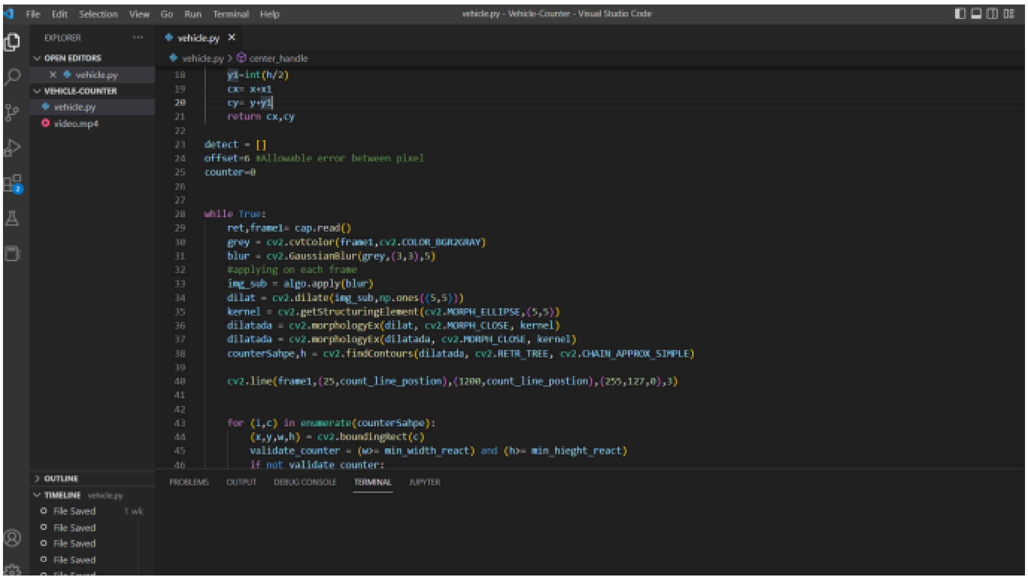


Figure : Code for vehicle detection

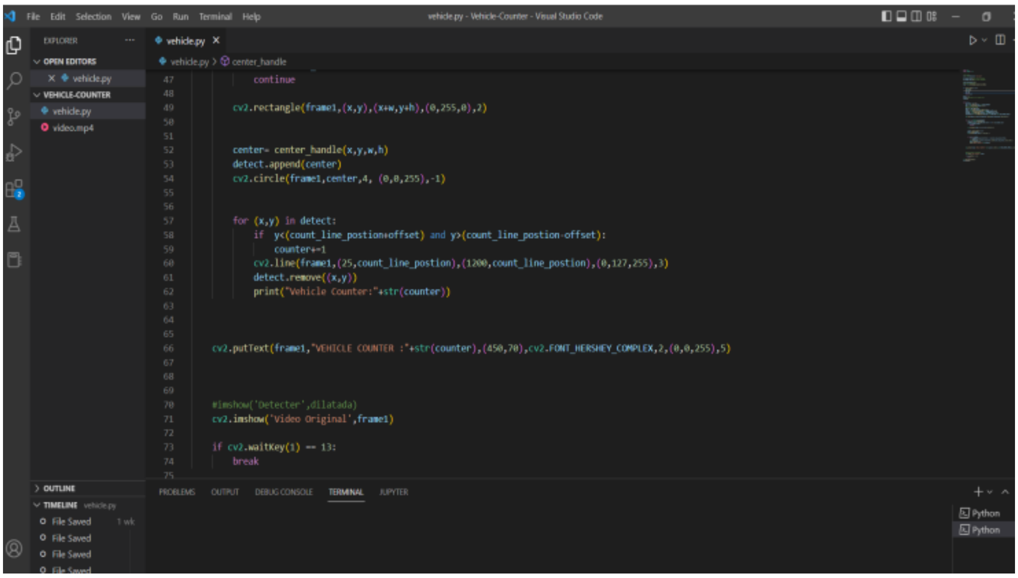


Figure : Code for vehicle detection

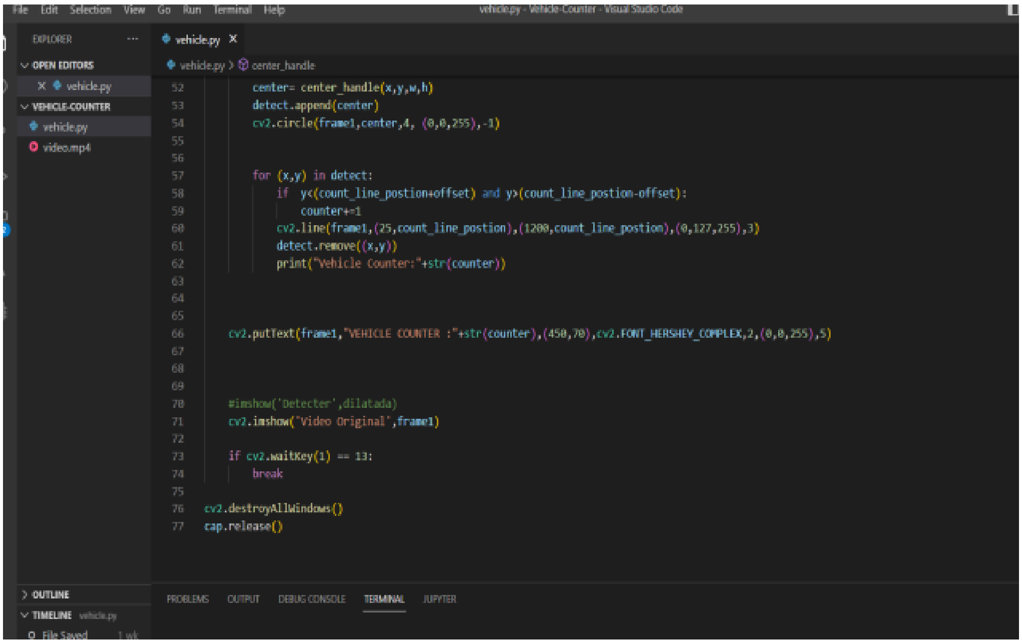


Figure : Code for vehicle detection

3.2)Code for arduino sensor

```
#include<TimerOne.h>

int signal1[] = {27, 29, 31};    // connect signal lights
int signal2[] = {37, 39, 41};   // connect signal lights
int signal3[] = {47, 49, 51};   // connect signal lights
int signal4[] = {4, 5, 6};      // connect signal lights

int redDelay = 5000;
int yellowDelay = 2000;

volatile int triggerpin1 = 23;      // ultrasonic signal out pin
volatile int echopin1 = 25;         // ultrasonic signal receiving pin
volatile int triggerpin2 = 33;
volatile int echopin2 = 35;
volatile int triggerpin3 = 43;
volatile int echopin3 = 45;
volatile int triggerpin4 = 2;
```

Figure : Code for vehicle detection

```
MFRC522::MIFARE_Key key;
                            //  for rfid

void setup(){
  Serial.begin(115200);
    SPI.begin();
    rfid.PCD_Init();
    pinMode(LED_PIN, OUTPUT);

  Timer1.initialize(100000);  //Begin using the timer. This function must be called first. "microseconds" is the period c
  Timer1.attachInterrupt(softInterr); //Run a function each time the timer period finishes.


  for(int i=0; i<3; i++)
  {
    pinMode(signal1[i], OUTPUT);        // Declaring LED pins as output
    pinMode(signal2[i], OUTPUT);
```

Figure : Code for vehicle detection

Figure : Code for vehicle detection

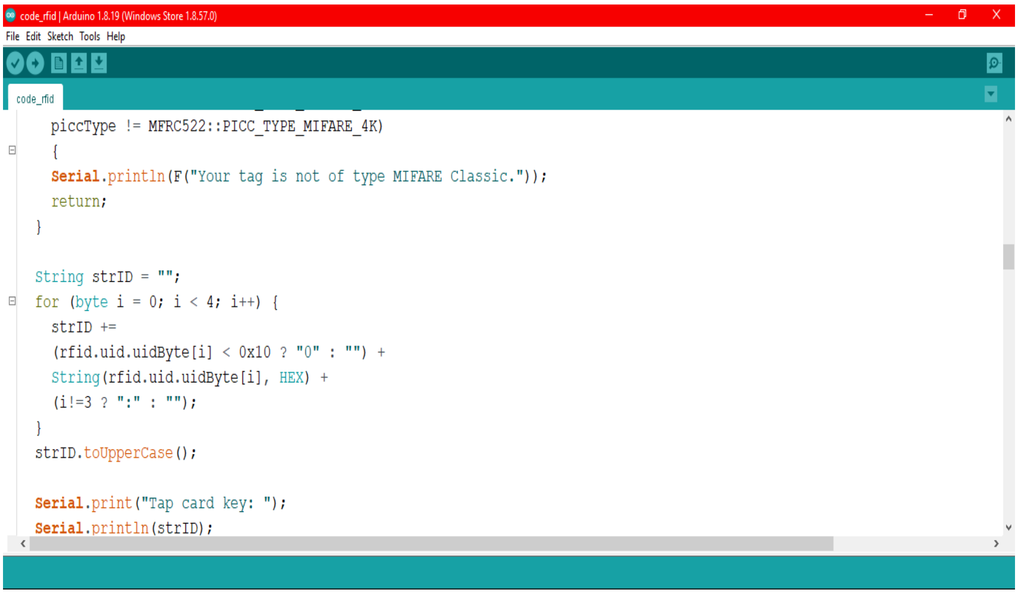
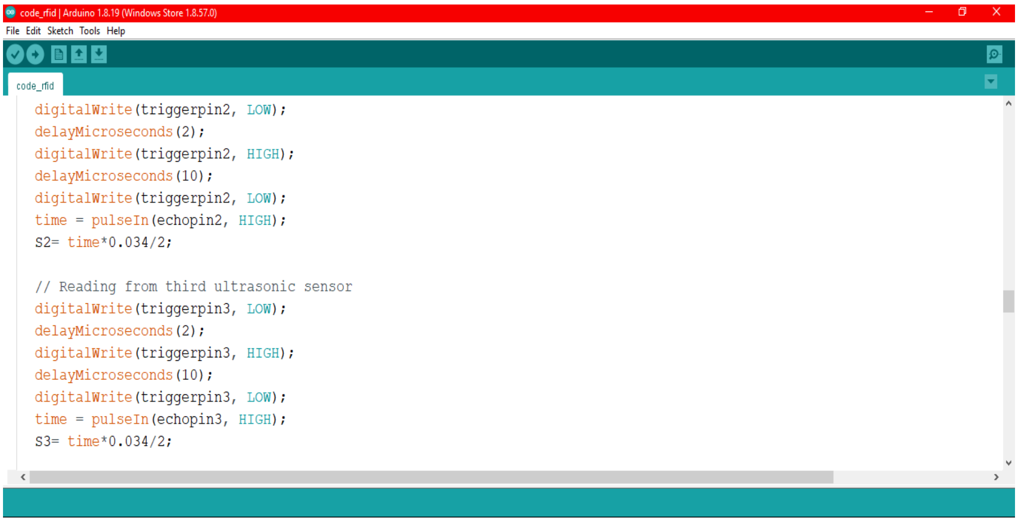


Figure : Code for vehicle detection




```
digitalWrite(triggerpin2, LOW);
delayMicroseconds(2);
digitalWrite(triggerpin2, HIGH);
delayMicroseconds(10);
digitalWrite(triggerpin2, LOW);
time = pulseIn(echopin2, HIGH);
S2= time*0.034/2;

// Reading from third ultrasonic sensor
digitalWrite(triggerpin3, LOW);
delayMicroseconds(2);
digitalWrite(triggerpin3, HIGH);
delayMicroseconds(10);
digitalWrite(triggerpin3, LOW);
time = pulseIn(echopin3, HIGH);
S3= time*0.034/2;
```

Figure : Code for vehicle detection

3.3) Circuit Diagram for Traffic Light Control:

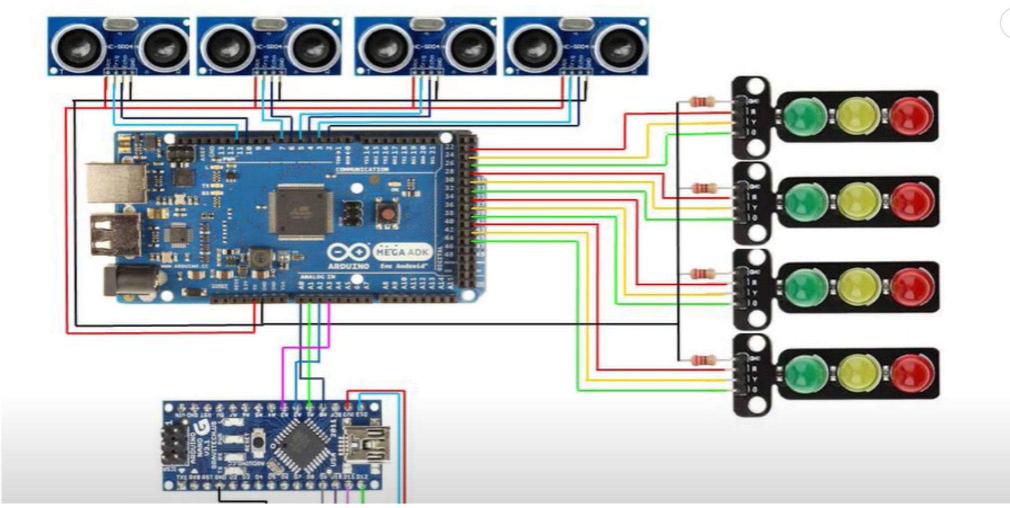


Figure : Circuit diagram

3.4) Algorithms Used for Emergency vehicle detection:

Vehicle detection is carried out using TensorFlow. A vehicle's corner points are discovered as soon as it is found. The identified corner points help in identifying whether the found object is a vehicle or not. Following vehicle detection, the relevant points from the vehicle zone are provided to the CNN algorithm to help with tracking.

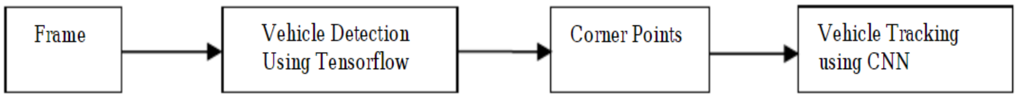


Figure : Vehicle tracking using CNN

CHAPTER 4
PERFORMANCE ANALYSIS

1) Accuracy of Different Machine Learning Models:

1.1) Random Forest

Random forests, also known as random decision forests, are a collaborative learning method that works by training a collection of different decision trees and outputting the class that is the mode of the classes classification or the mean prediction regression of the different trees. It explains why decision trees frequently outperform their training set.

1.2) Artificial neural network

Artificial neural networks are basically the computational systems that are inaccurately triggered by the biological neural networks that make up the brains of animals:

$$y_t = \alpha_0 + \sum_{j=1}^{q} \alpha_j g\left(\beta_{0j} + \sum_{i=1}^{p} \beta_{ij} y_{t-i}\right).$$

The integers p and q represent the number of input and hidden nodes.

The connection weights are j() j = 0, 1, ", q and I p j q) ij = 0, 1, ", ; = 0, 1, ", and the bias terms are 0 j. The logistic sigmoid function () x e g x + = 1 1 is commonly used as a nonlinear activation function. Other activation functions can also be used, e.g., linear, hyperbolic tangent, Gaussian, etc.

1.3) Support Vector Machine

Support Vector Machines are supervised learning models that are linked to learning algorithms that are used in machine learning for data analysis in classification and regression analysis. SVM is a strong machine learning technique that relies primarily on mapping learning instances from the input space to a new high-dimensional, possibly enormous feature space with linearly separable cases.

$$\frac{1}{2}w'w + c\sum_{i=1}^{n}\xi_i,$$

The method then finds the best hyperplane where w is a coefficient matrix, φ(x) is a mapping function, and b here defined as a constant. The approach then determines the optimum hyperplane, where w is a coefficient matrix, (x) is a mapping function, and b is a constant. This type of hypersurface divides the learning instances by the greatest possible margin. Support vectors are essentially a limited number of crucial boundary instances from each class that are best separated by this hyperplane. An iterative approach is utilized to produce the ideal hyperplane by decreasing the function's error estimation.

2.) Analysis:

We would "test" our machine learning model in the "training phase" by utilizing different libraries in the system to check for analysis and obtain a sense of how our machine learning model may be generalized to independent data (test dataset).

3.) Other Approach:

This recognition system can also be done using YOLOv3. YOLO is an acronym and here stands for You Only Look Once. This identification method is also possible with YOLOv3. You Only Look Once is an acronym that stands for You Only Look Once. It is essentially a real-time object recognition method. Multiple objects in a single image can be classified and localized. YOLO is a highly quick and accurate algorithm due to its simplified network structure.

YOLO's key strategies are as follows:

1. Residual blocks - Use this function to divide pictures into NxN grids.

2. Bounding Box Regression -In this step, each grid cell is fed into the model. YOLO is then used to determine the chance that the cell belongs to a specific class, and the class with the highest probability is picked.

3.Intersection Over Union (IOU) - Intersection Over Union is a measure that examines the intersection of the expected and actual bounding boxes. By executing the intersection over union with the class and largest probability, the no maximum suppression approach is utilized to reduce very tight bounding boxes.

4.) Comparisons and Results

In this particular section, we will be performing the performance tests of methods presented here above. We experimented with a video dataset containing 4 streets without cars. In this section, we will do the performance tests on the approaches described previously. We tested using a video dataset that had four streets devoid of automobiles. Our experiment used CNN and OpenCV for image detection for checking any emergency vehicle and thus making the lane free of use by removing the green light, as well as making the lane free when there is a large amount of traffic present in any particular site and adjusting the time of the other lanes' green lights accordingly.

Before the detection from our dataset the following input is taken:

Figure : Input video

After the detection of the cars from our video dataset the following output is produced:

Figure : Output

Figure : Output

Here are the result from Traffic Signal Management and Control System based on density of vehicles:

Figure : Circuit diagram

After the detection of the cars from our video dataset the following output is produced

Following are the findings from the traffic signal management and control system based on vehicle density:

In theWithin one minute, the yellow light at signal 1 will illuminate to indicate that the red light at signal 1 is approaching, as well as to indicate to vehicles at signal 2 that the green light is about to blink.

After a specific period of time, ultrasonic sensor (US) pins were attached to the Arduino board for the installation of dynamic light control as shown below: According to the table above, ultrasonic sensors (US) are in charge of providing information about the crowd to controllers so that they may decide whether or not to run the traffic lights on the various sides.

Traffic Modes	US1	US2	Timing Green light
No Car	Low	Low	10 Sec
Normal Mode	High	Low	60 Sec
Traffic Jam Mode	High	High	90 Sec

The number and location of sensors totally depends on the length of the street mentioned in the project and increasing the sensors in the project also gives more accuracy in determining the amount of crowd, but the cost will be also increasing due to this.

CHAPTER 5
CONCLUSION

Expanding on the importance of careful planning, investment, and collaboration for the successful implementation of a traffic management system, Before designing and deploying such a system, it is critical to have a thorough understanding of the local traffic conditions, needs, and challenges. Population density, road infrastructure, traffic volume and patterns, as well as the availability of data sources and communication networks, must all be considered.Furthermore, a traffic management system should be designed to be adaptable and flexible in response to changing traffic conditions and evolving technologies. This necessitates continual performance monitoring and assessment of the system, as well as continuing research and development to increase its capabilities and efficacy.Involving the public in the development sector and, in the case of the deployment of a traffic management system, may also assist boost awareness and support for the programme. By offering real-time.Finally, while a traffic management system can provide significant benefits, it is not a panacea for all traffic problems. It should be viewed as part of a wider strategy to sustainable urban mobility that includes encouraging public transit, active forms of transportation, and land use design that prioritizes walkability and accessibility.Finally, a well-designed and executed traffic management system has the potential to improve urban mobility, safety, and sustainability.

However, in order to realize its full potential and contribute to the creation of more livable and sustainable cities, it requires careful planning, investment, collaboration, and continuous monitoring and improvement.A well-designed traffic management system may also be beneficial to the economy. It can boost production and efficiency by decreasing congestion and improving travel times. It can also bring more visitors and tourists to a city, which can help the local economy.One of the most difficult aspects of designing a traffic management system is making it accessible and helpful to all parts of society. Pedestrians, bikers, public transportation users, and drivers of various sorts of vehicles are all included. It is critical to ensure that the system is constructed with equality and inclusion in mind, so that all people of the community benefit.In addition, the introduction of a traffic management system can also provide opportunities for innovation and job creation. As technology continues to evolve, there is a need for skilled professionals to develop, implement, and maintain these systems.This has the potential to offer new job possibilities as well as encourage an environment of creativity and technical growth in the transportation industry.

To summarize, a well-designed traffic management system may provide various advantages to society, including enhanced safety, decreased congestion and travel time, lower emissions, and an overall improvement in the quality of life for individuals living in metropolitan areas. While developing and implementing these systems presents challenges, it is critical to invest in their development and implementation in order to create a sustainable and liveable urban environment for all.

FUTURE WORK

Some potential areas of future work for traffic management systems include:

1. Integration with self-driving cars: As self-driving cars become more common, traffic management systems will need to be able to communicate with them in order to optimize traffic flow and maintain road safety.

2. Application of machine learning and artificial intelligence (AI): Machine learning algorithms may assist traffic management systems in predicting traffic patterns, identifying possible concerns, and adjusting traffic flow accordingly. Individual drivers can also benefit from more customized and effective route planning thanks to AI.

3. Expansion to non-road modes of transportation: Traffic management systems may be expanded to control forms of transportation other than roads, such as public transportation, bike lanes, and pedestrian walkways. This can aid in the development of a more connected and efficient transportation network.

4. Incorporation of environmental factors: To improve traffic flow and minimize emissions, traffic management systems may be developed to include real-time data on air quality and meteorological conditions.

5. Increased public engagement: By engaging with the public and receiving feedback on their needs and preferences, traffic management systems may be made more successful. This can aid in the development of confidence in the system and guarantee that it meets the demands of all users. 6. Integration with smart city efforts: To create a more efficient and sustainable urban environment, traffic management systems may be combined with other smart city projects such as energy management, trash management, and public safety.

7. Emergency response management: Traffic management systems may be utilized to help with emergency response management, allowing emergency personnel to respond more quickly.

8. Smart parking: Smart parking solutions might be connected with traffic management systems to reduce traffic congestion caused by cars looking for

parking spots. This could include directing drivers to available parking spaces and providing them with information about parking rates and availability using real-time data.

9. Public participation: Involving the general public in traffic management can aid in the development of more effective solutions that suit the demands of all stakeholders. Crowdsourcing and citizen science might be used to collect data and insights on traffic conditions, as well as involving the public in decision-making processes.

10. Cybersecurity: As traffic management systems become more linked and data-driven, cybersecurity will become more crucial. Traffic control systems

CHAPTER 6

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