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BUILDING STRONGER BONDS: THE DIGITAL ALUMNI INITIATIVE

Prabal Bhatnagar, Aditya Saraswat, Abhilash Sharma Paras,
Abhay Chauhan, Aryan Khanna, Divjot Singh Sahi
Department of Computer Science & Engineering, MIT Moradabad, India
prabal.bhatnagar22@gmail.com[1], adityasaraswat2@gmail.com[2], abhilashsharma425@gmail.com[3]
Chahuhanabhay89212@gmail.com[4], khannavansh2002@gmail.com[5],
divjotsahi08@gmail.com[6]

ABSTRACT

In order to provide efficient mobility and minimize congestion, effective traffic management is essential in metropolitan settings. The real-time traffic simulation project presented in this paper aims to precisely calculate the number of vehicles in each of a roadway's four lanes and prioritize the lane with the most vehicles. In order to guarantee prompt response to urgent circumstances, the simulation also recognizes and prioritizes lanes for emergency vehicles, such as ambulances. The suggested simulation has a number of advantages, such as more effective traffic control, less traffic, and better emergency response times. Authorities are empowered by the simulation to make well-informed decisions that improve traffic flow and guarantee the safety and well-being of all road users by prioritizing lanes based on vehicle count and recognizing emergency vehicles. All things considered, this research shows how real-time traffic simulations may be used to effectively count vehicles, prioritize lanes, and detect emergency vehicles. This helps to make traffic management systems in cities more effective and responsive.

KEYWORDS: *YOLO, Pre-Processing, Traffic Light Control, Machine Learning, Vehicle Detection, Intelligent Traffic Management Systems (ITMS)*

1. Introduction

Efficient traffic management is essential in contemporary urban settings to guarantee seamless transit and minimize traffic jams on roads. Innovative solutions utilizing cutting-edge technology are becoming more and more necessary to do this. In this regard, employing simulations based on video input offers a viable method for precisely identifying and tracking moving vehicles in real time. The goal of this simulation is to identify how many cars are on four lanes of a road at once by using video data from security cameras. Vehicle counts may be computed in real-time by the system by the identification and tracking of cars in each lane through the analysis of the video stream. Additionally,

the simulation gives priority to the lane with the most vehicles, allowing traffic management authorities to efficiently distribute resources and enhance traffic flow. In addition, heavy traffic causes delays, gasoline exhaustion, and even financial waste. One recurring link between traffic congestion and other traffic-related problems is the obstruction of emergency vehicles. To avoid significant loss, it is imperative that rescue vehicles arrive on time. As such, it is crucial to assist an emergency vehicle in escaping traffic jams. to address the issues raised above. The "Smart Ambulance and traffic controlling system" is what we have devised. The major objective of this apparatus is to enable the ambulance to arrive at a designated

2. Literary evaluation

For traffic control, video monitoring and surveillance can be employed. An intelligent transportation system may be built with the assistance of surveillance cameras, which give valuable information such as vehicle information and traffic density. Traffic monitoring and analysis done by hand is a laborious task. For efficient traffic control and traffic signal management, it is important to monitor traffic density on roadways, particularly in large cities. This is untrue: automated analysis of traffic surveillance footage removes the requirement for human involvement. Systems for detecting vehicles now in use include radar, infrared, loop, and microwave sensors. The current approaches are costly and challenging to set up and use. In the transportation sector, video processing techniques for vehicle recognition are becoming more and more important.[1] Technologies for computer vision have been used to a number of public domains, including transportation networks and other public highways. One of the primary uses of computer vision is the process of examining traffic footage to extract insightful information. It may be applied to traffic management systems to make the right judgments and efficiently handle peak traffic.[2] The density of vehicles or traffic is computed. This information is useful for managing automobile traffic and can be important in various surveys. One of the greatest contemporary approaches being tried by the nation to improve the transportation network is this one.[3] We'll talk about precisely accurate vehicle tracking and unique identification in a chosen region of interest. Vehicle detection and counting is a key component of many technologies that assist in controlling traffic in urban areas. The primary objective is to be able to identify and count automobiles as accurately as possible on roads, highways, narrow lanes, etc. Our approach counts the number of automobiles that are visible on a given input picture or video by processing the input as a video or image and using foreground objects, such as hair cascades, to detect cars. [4] Traffic congestion is one of the numerous issues we deal with in contemporary life, and they are becoming worse every day. Numerous issues, including traffic accidents and bottlenecks, have emerged because of the increase in vehicle traffic. A automobile may be tracked and identified in a variety of ways while it's on the road. Some of the methods include applying particular ID tags, employing image processing, detecting movement, and more.

3. Objectives

For traffic control, video monitoring and surveillance can be employed. An intelligent transportation system may be built with the assistance of surveillance cameras, which give valuable information such as vehicle information and traffic density. Traffic monitoring and analysis done by hand is a laborious task. For efficient traffic control and traffic signal management, it is important to monitor traffic density on roadways, particularly in large cities. This is untrue: automated analysis of traffic surveillance footage removes the requirement for human involvement. Systems for detecting vehicles now in use include radar, infrared, loop, and microwave sensors. The current approaches are costly and challenging to set up and use. In the transportation sector, video processing techniques for vehicle recognition are becoming more and more important.[1] Technologies for computer vision have been used to a number of public domains, including transportation networks and other public highways. One of the primary uses of computer vision is the process of examining traffic footage to extract insightful information. It may be applied to traffic management systems to make the right judgments and efficiently handle peak traffic.[2] The density of vehicles or traffic is computed. This information is useful for managing automobile traffic and can be important in various surveys. One of the greatest contemporary approaches being tried by the nation to improve the transportation network is this one.[3] We'll talk about precisely accurate vehicle tracking and unique identification in a chosen region of interest. Vehicle detection and counting is a key component of many technologies that assist in controlling traffic in urban areas. The primary objective is to be able to identify and count automobiles as accurately as possible on roads, highways, narrow lanes, etc. Our approach counts the number of automobiles that are visible on a given input picture or video by processing the input as a video or image and using foreground objects, such as hair cascades, to detect cars. [4] Traffic congestion is one of the numerous issues we deal with in contemporary life, and they are becoming worse every day. Numerous issues, including traffic accidents and bottlenecks, have emerged because of the increase in vehicle traffic. An automobile may be tracked and identified in a variety of ways while it's on the road. Some of the methods include applying particular ID tags, employing image processing, detecting movement, and more.

4. Proposed System

The proposed system is an intelligent traffic management system that prioritizes emergency vehicles and optimizes traffic flow using machine learning techniques. The system's functionality includes processing live video data, classifying and detecting cars, and adjusting traffic signals as necessary.

4. 1 Module 1: Video Processing Module

Class Creation:

To include all video processing functions, the Video Processing Module is implemented as a distinct class. The purpose of this class's distinct thread operation is to enable concurrent operation with other system components.

Input Handling:

A video filename is accepted as input by the Video Processing Class upon instantiation. The class reads the video file and retrieves frames for processing using the OpenCV

Frame Extraction:

To extract frames from the input video file, the class makes use of OpenCV.To guarantee effective processing, frames are extracted at a set frame rate.

Vehicle Detection:

Every frame, computer vision methods like deep learning-based models or Haar cascades are used to detect vehicles. The class recognizes cars in the video frames by using the selected detection technique.

Emergency Vehicle Detection:

To identify emergency vehicles (such as ambulances, fire engines, and police cars) within the video frames, specialized algorithms are put into place. To reliably identify emergency vehicles, these algorithms may make use of machine learning, shape analysis, or color-based identification methods.

This modification can entail stopping traffic on other lanes with red lights and prolonging the green signal for the lane that the ambulance is in.

Numerous issues, including traffic accidents and bottlenecks, have emerged as a result of the increase in vehicle traffic.

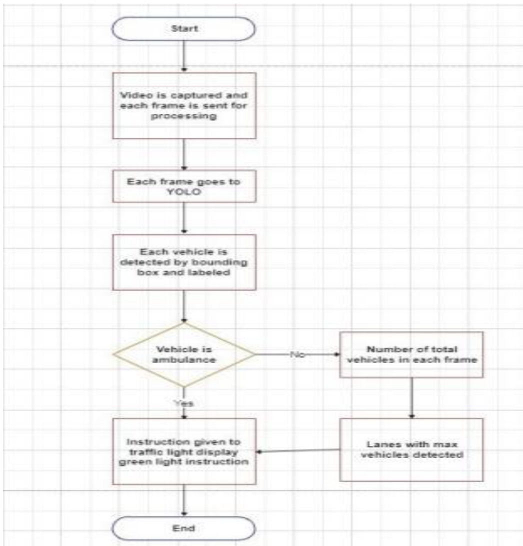

Fig 1. Flowchart

4. 2 Module2: Traffic Light Control Module

Class Creation:

The traffic signal management function is accounted for in the architecture of the Traffic Light Control Module, a distinct class. All functionality pertaining to the administration and control of traffic signals is contained in this class.

Signal Timing:

All lanes' signal intervals are set by the Traffic Light Class using preset configurations. To efficiently control traffic flow, it sets up a sequential succession of signal phases (1->2->3->4).

Traffic Signal Operation:

The Traffic Light Class replicates traffic lights for all four lanes at predetermined intervals. It follows the preset signal time sequence, switching between red, green, and yellow signals.

Vehicle Counting:

In order to find out how many cars are in a certain lane while the red light is on, the Traffic Light Class communicates with the Video Processing Module. Based on traffic density, this data is utilized to dynamically modify signal timings.

Green Time Calculation:

Depending on the quantity and kind of cars in each lane, the Traffic Light Class determines how long the green light. Ambulance Presence:

The Traffic Light Class keeps a close eye out for ambulances in the stream of traffic. It modifies signal priorities to give priority to the emergency vehicle's passage when it detects an ambulance. This modification can entail stopping traffic on other lanes with red lights and prolonging the green signal for the lane that the ambulance is in. The suggested system accomplishes a holistic approach to traffic control by merging these elements. In order to enhance traffic flow and safety, the Video Processing Module makes sure that vehicles are detected accurately, and the Traffic Light Control Module dynamically modifies signal timings based on traffic circumstances and the presence of emergency vehicles.

5. Advantages

- Effective Traffic Management: The system may optimize traffic flow and lessen congestion by precisely estimating vehicle counts in real-time and giving priority to lanes with the highest vehicle counts.
- Resource Optimization: By using real-time traffic data, the system helps traffic management authorities to distribute resources more efficiently.
- Emergency Response: The system's capacity to identify and assign emergency vehicles priority lanes guarantees a prompt reaction to dire circumstances, possibly saving lives.
- Fuel Efficiency: The system can help with fuel efficiency and lower carbon emissions by assuring smoother traffic flow and minimizing traffic congestion.
- Cost Savings: For all users of the road, reduced traffic congestion and improved traffic flow can result in considerable fuel and time savings.
- Scalability: The system's capacity to detect and track vehicles using video input from surveillance cameras raises the possibility that it may be expanded to encompass greater distances or more cities. Innovation: Using cutting-edge image processing techniques to monitor and detect vehicles is an example of how innovatively technology may be applied to tackle practical issues.
- Safety: The system improves everyone's safety and well-being on the road by guaranteeing the efficient passage of emergency vehicles and easing traffic congestion.

6. Conclusion

In conclusion, the Traffic Management System project has proven to have a great deal of promise for improving urban traffic control. The system is capable of properly detecting and monitoring vehicle traffic in several lanes in real-time by utilizing simulations based on visual input. This feature makes it possible for traffic management authorities to prioritize lanes based on vehicle density and calculate car counts in real-time, which helps them manage resources and improve traffic flow. All road users' safety and well-being are dependent on the system's capacity to identify and prioritize lanes for emergency vehicles, which guarantees a prompt response to dire circumstances. These goals have been successfully attained by putting sophisticated image processing techniques and a prioritizing algorithm into practice. The project's accomplishments in lowering traffic, strengthening emergency response capabilities, and increasing traffic management efficiency highlight the need of incorporating cutting-edge technology into traffic management systems. The project is evidence of how well vehicle counting, lane prioritizing, and emergency vehicle identification work when real-time traffic simulations are used.

All things considered, this initiative makes a substantial contribution to the creation of more effective and responsive traffic control systems in metropolitan regions. It opens the door for more study and advancement in this area, which might lead to even better traffic control plans and systems. The project's results also demonstrate how crucial technical innovation is to solving today's urban problems.

7 Future Scope

- Integration of Additional Emergency Services: Extend the system to prioritize other emergency services such as ambulances, fire trucks, and police vehicles. Each type of emergency vehicle may have different priority levels and requirements.
- Real-Time Route Optimization: Implement real-time route optimization for emergency vehicles based on traffic conditions, road closures, and accidents. This can involve dynamic rerouting to minimize response times.
- Predictive Analysis: Integrate predictive analytics to anticipate traffic patterns and potential emergencies. By analysing historical data and current trends, the system can proactively adjust traffic signals and routes to prevent congestion and respond more effectively to emergencies.
- Multi-Modal Traffic Management: Expand the system to manage not only cars but also other modes of transportation such as bicycles, pedestrians, and public transportation. This can enhance overall traffic efficiency and safety for all road users.
- Enhanced Video Analytics: Improve the accuracy and efficiency of video data processing through advancements in computer vision techniques. This may involve incorporating deep learning models for object detection, tracking, and behaviour analysis.

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Authors

Mr. Prabal Bhatnagar has received his M.Tech degree in Computer Science and Engineering in 2012 from Teerthankar Mahaveer University, Moradabad and currently pursuing Ph.D. from Uttrakhand Technical University, Dehradun. He is working as Assistant Professor in Computer Science & Engineering department with 14 years of professional experience. he has participated in many FDP's and STC'c in various fields

Aryan Khanna is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr. A.P.J Abdul Kalam Technical University his research interest including Machine Learning, Artificial Intelligence and Natural Processing Language, Python and SQL.

Abhilash Sharma Paras is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including HTML, CSS, JavaScript, and React and SQL.

Aditya Saraswat is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including HTML, CSS, JavaScript, and React and Python, Machine Learning, Artificial Intelligence.

Abhay Chauhan is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr. A.P.J Abdul Kalam Technical University his research interest including Machine Learning, Artificial Intelligence and Natural Processing Language, Python and SQL.

Divjot Singh Sahi is a B.Tech 4th year student in computer science and engineering department at Moradabad Institute of Technology affiliated with Dr APJ Abdul Kalam Technical University her research interest including HTML, CSS, JavaScript, and React and SQL.