Grenze International Journal of Engineering and Technology, June Issue

Smart City Traffic Management

B.Meenakshi Sundaram[1], Kantham Thirumal reddy[2], J.Ganesh Chowdary[3], Rahul Gonela[4] and B.Rajalakshmi[5]
[1]Professor, Department of Computer Science and Engineering, New Horizon College of Engineering, Bangalore
Email: bmsundaram@gmail.com
[2-4]CSE department, New Horizon College Of Engineering Bangalore, India Email: chowdaryganesh36@gmail.com, Rahulgonela18@gmail.com, kanthamthirumalreddy7867@gmail.com
[5]Professor, Department of Computer Science and Engineering, New Horizon College of Engineering, Bangalore
Email: dr_rajalakshmi_imprint@yahoo.com

***Abstract*— Nowadays, most people choose to commute in their own private vehicles rather than via public transport, which leads to a high volume of private vehicles on the road. Every road has traffic congestion as a result. In this kind of situation, it is impossible to restrict how much each person uses their private vehicle, but we can control traffic flow so that it doesn't ease traffic congestion. The conventional method of traffic management is only effective when there is less traffic; if there is an increase in the number of cars on one side of the road relative to the other, this method is ineffective. Therefore, our goal is to revamp the traffic signal system to use dynamic signal switching instead of static switching, which can handle and monitor signals in real time. Numerous initiatives are being developed to introduce Intelligent Transport Systems and transform the existing city transport system into a "smart system." A lot of effort is being made to create a traffic signal monitoring system that can monitor traffic signals instantly, meaning that rather than using a preset switching time, the number of vehicles on either side of the road will determine when the traffic light switches on. In regular traffic situations, the vehicle detection will determine the optimal time for the signal to switch on with high accuracy. This procedure has the potential to relieve traffic congestion more quickly and efficiently.**

I. Introduction

In order to centrally manage the freeway system in the Twin Cities metro area, the Traffic Management System was established in 1972. Through the effective management of incidents and special events, the traveler information, the ride-sharing incentives, and the optimization of available road capacity, the Traffic Management System seeks to give drivers a quicker and safer ride on metro area freeways. Since the beginning of time, cities and traffic have coexisted in big human settlements. The same factors that entice people to live in big cities also contribute to occasionally unbearable levels of traffic congestion on city streets. Any nation's economic growth is fueled by its cities. The means of transportation and routes to destinations are provided by the transportation system.

Increasing economic activity and prospects in cities lead to a rapid increase in urban population and the ensuing need for transportation facilities in the majority of developing countries, which are plagued by rising population and extreme poverty. Urban sprawl, traffic jams, unchecked city growth, and environmental deterioration are all results of these countries' authorities' frequent inability to handle the strain of rising urban population and economic activity. Property and transportation play a significant role in the physical and economic growth of towns and cities worldwide. Land and property values typically rise in places with developing transportation networks and fall in

Grenze ID: 01.GIJET.10.2.164

those without such advancements. In cities with transportation, a swift and sustained increase in the cost of housing and land is anticipated.
The transportation route is a vital component of human existence, progress, and civilization. It is a part of a particular development pattern or road network and is mostly characterized by regular street patterns. Route network changes and greater transportation expenditure lead to improved accessibility, as evidenced by cost-benefit analyses, reduced travel times, and other advantages.
Increased catchment regions for services and facilities including stores, banks, offices, schools, and recreational spaces show these benefits. Road networks are evaluated based on factors like connection, accessibility, traffic density, service level, and the density and compactness of individual routes. The phrase "level of service" refers to a holistic metric that takes into account a number of factors to assess the quality of service provided by infrastructure or transportation devices.

A. Sensors

The sensors have been employed to observe traffic on the roads. Radars and loop detectors, for example, are commonplace on many main city roadways, tracking speed and occupancy at a given place with a very high penetration rate. Over the past few years, a lot of work has been done in the field of Langrangian sensors. In many places, real-time traffic status estimation has been achieved by using GPS device observations of point speeds or journey times..

B. Cellular Network

Data from cameras and sensors along the side of the road can be effectively sent to cloud-based servers or central control centers over cellular networks for analysis. The system can produce insights on incidents, traffic patterns, and congestion levels thanks to this real-time data flow. Furthermore, bidirectional connectivity made possible by cellular networks enables the control center to communicate commands back to the field units. For example, traffic signals can be remotely changed to optimize traffic flow based on current traffic circumstances, energy sources, less often to mechanical ones, and infrequently to other individuals.

C.GPS-Equipped Devices

Traffic management systems can provide useful information about traffic conditions, improve route planning, and recommend different routes to ease congestion by utilizing GPS data. These devices also make it easier to gather important data for predictive analysis, which enables the system to foresee traffic patterns and make proactive adjustments to traffic signals or route guidance. Using GPS-equipped devices in a computer science project requires building interfaces that reliably collect, analyze, and interpret GPS data. For efficient traffic management, this integration requires algorithms for real-time data processing, map rendering, and decision-making. An essential component of such initiatives is also developing user interfaces or APIs to convey this processed data to traffic control centers or drivers.

D. Automatic Vehicle Identification

Because it makes vehicle monitoring and identification easy, Automatic Vehicle Identification, or AVI, is essential to contemporary traffic management systems. When a vehicle passes through a designated area on the road network, AVI systems use technologies like GPS, RFID (Radio-Frequency Identification), and license plate recognition to automatically identify the vehicle. By offering real-time data on vehicle movements, these systems play a major role in traffic management by facilitating effective toll collection, traffic flow analysis, and enforcement of traffic laws.

E. Traffic State and Estimation

Traffic state estimation and prediction play pivotal roles in Advanced Traffic Management Systems By offering vital insights into both the present and future traffic circumstances, traffic state estimate and prediction play critical roles in Advanced Traveler Information Systems (ATIS) and Advanced Traffic Management Systems (ATMS). These systems analyze real-time data from multiple sources, including as sensors, cameras, and GPS devices, to estimate the current traffic status using complex algorithms and data processing techniques. This estimate provides a thorough picture of the traffic situation at the moment by calculating characteristics including vehicle speeds, density, and flow rates.

II. WORKING METHODOLOGY

Our goal is to create and implement a machine learning model that can manage traffic light switching by displaying the quantity of vehicles on a route and identifying the various kinds of vehicles that are there. The suggested

method aids in the creation of a solution that addresses traffic congestion and analyzes the presence of vehicles on the road, leading to a more coordinated, more intelligent, and better controlled usage of traffic networks. This can be accomplished by applying a trained machine learning model known as YOLO to analyze vehicle count data collected from sources such as CCTV cameras installed in traffic signals or on roads. YOLO is a machine learning model built with OpenCV that performs object detection and counts the quantity of tackles heavy traffic at the point where cars eventually rely on the Corridor Impact sensor.
Thus, the proposed intelligent traffic management system may provide hassle-free traffic control and round-the-clock safety. When our concept is put into action, traffic officers won't be required to control traffic at different intersections. As a result, using this technology to analyze and enhance road traffic performance is beneficial. Priority to emergency vehicles has also been the subject of previous study, which can be made possible with additional machine learning training for our model

Fig 1. Block diagram of the system

III. LITERATURE SURVEY

Vehicle Detection and Tracking using Gaussian Mixture Model and Kalman Filter

Recent years have seen a tremendous increase in technology advancement across several industries, most notably transportation and the Intelligent Transport System (ITS). ITS was a technique utilized in developed nations to arrange traffic in order to create an effective road-based transportation system. A prime example of an ITS application is the surveillance camera system. Data on vehicle speed and quantity, which are useful in traffic engineering, are readily available to decision-makers and the transportation authority. The first step in using CCTV to get information on vehicle count and speed is to identify vehicle objects. Vehicle detection can be accomplished using a variety of techniques, including Viola Jones and the Histogram of Oriented Gradient (HOG).Two detection techniques that use an existing database to aid in the process of detection are HOG and Viola Jones. There are two types of data in this database: positive and negative data. Negative databases are collections of data that do not contain the object to be discovered, whereas positive databases are collections of data that do. Typically, this data distinction scenario is used to identify objects in an image. The GMM method is a detection technique that contrasts moving objects in the foreground with stationary objects in the background. This method is typically used to find objects in videos. The object tracking in traffic surveillance using CCTV is the second thing, after vehicle detection.

IV. PROPOSED SYSTEM

Our aim is to design and develop a machine learning model to handle the traffic signal switching by depicting the number of vehicles present in a road along with detection of different types of vehicles present in the road. The proposed system helps to develop a solution that analyses the presence of vehicles on the road and handles the traffic congestion issues, resulting in a better managed, more coordinated and smarter use of traffic networks. This can be done using the analysis of vehicle count data obtained from source like CCTV Cameras present in highways or in traffic signals, using a trained machine learning model called YOLO. YOLO is an OpenCV based machine learning model which does the Object Detection and counts the number of vehicles in a lane. The recorded data is then sent into the predefined python program where the machine learning model is already written and based on the obtained vehicle count data – we can dynamically switch the signal among the lanes. Thereby, round the clock safety and hassle-free traffic management can be obtained using Proposed Intelligent Traffic Management System. Implementation of our project will eliminate the need for traffic personnel at various junctions for regulating traffic. Thus, the use of this technology is valuable for the analysis and performance improvement of road traffic.

Also, priority to emergency vehicles has been the topic of some research in the past which can be enabled with further training of our machine learning of our model.

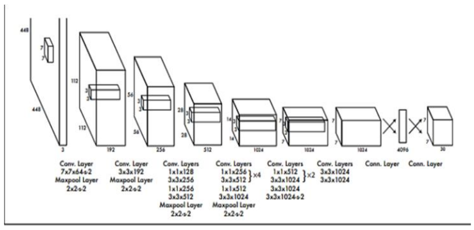

Fig 2.

A. Vehicle Detection, Tracking and Counting

One important area of computer vision research that aids in addressing an increasingly complex issue in traffic monitoring and security is the detection of automobiles in a series of frames. The automatic extraction, comprehension, and analysis of meaningful information from a single image or from a series of images is a major area of focus for computer vision. It involves the processes that are algorithmically based and theoretical in order to automatically obtain visual understanding. This article proposes a computer vision-based approach for vehicle detection, counting, and tracking. The approach uses a Gaussian mixture model for background subtraction, resulting in a binary mask that represents the foreground. After obtaining the foreground mask in this way, noise is removed from it using morphological operators including dilation, erosion, opening, and closing. Next, using the BLOB (Binary Large Object) analysis method A binary classifier then assists in distinguishing between a car and a pedestrian. This classifier utilizes the fact that the ratio of a vehicle's width to height is always more than one, whereas that of a pedestrian is always less than one. The next update interval's vehicle locations are then predicted with the use of the Kalman filter. The monitored cars are subsequently labeled by utilizing the Hungarian algorithm. All of this processing is carried out inside a region of interest (ROI), which is defined in our video frames so that only those cars are recognized who enter the ROI. is increased only when a vehicle enters the ROI in order to speed up calculation.

B. Automated Traffic Monitoring using Image Vision

The most popular method for keeping an automated traffic monitoring system in working order is to use 15 fps CCTV cameras strategically positioned. Since the invention of Internet of Things-based cameras, modern cities have begun utilizing this facility. In order to make the procedure better, some particular algorithms must be used to make it less difficult. In order to get results as soon as possible, this is really crucial. Currently, a variety of devices, including inductive loop detectors, infrared detectors, radar detectors, and video-based systems, provide real-time access to traffic information. These days, intelligent traffic monitoring systems are essential. The approach used in our nation is to utilize. The inability to logically calculate the number of cars on a given road and prioritize the ones with the highest volume of traffic to lessen traffic congestion is another issue. Pressure plates and the RFID idea applied to vehicle number plates can be used to automatically count the number of vehicles. Video surveillance of traffic is the other method. Traffic cops frequently monitor various traffic cameras while seated in a control room and conducting semi-manual traffic monitoring. The fact that manpower is required for the procedure makes this approach less effective as well. Therefore, we are presenting a technique in this research that uses the principles of Digital Image Processing (DIP) to determine the quantity of the image.

C. Intelligent Traffic Light System using the Computer Vision with Android Monitoring and Control

One of the main unresolved issues that the people and business sectors of the Philippines have been dealing with for decades is traffic congestion, which becomes worse every year. As the number of automobiles rises, this is starting to become a global phenomenon. The productivity and economy of a nation are negatively impacted by this traffic problem. In actuality, the corporate sector lost approximately $70 million annually as a result of traffic congestion in the United States alone, where nearly $300 billion was spent on gas and time. Furthermore, the Boston Consulting Group predicts that by 2022, traffic in Manila, Philippines, would reach "standstill levels," meaning that during peak hours, average vehicle speeds will be 5 mph or less. Japan International Cooperation Agency (JICA) study. The nation has undertaken a number of measures to control the traffic issue, such as expanding the nation's highways and roads and implementing various traffic plans. A research focus is on finding a way to overcome the drawbacks of conventional traffic signal systems. The main objective of the intelligent transportation system (ITS), which is being proposed as an alternative to the traditional traffic signal system, is to increase traffic efficiency. The traffic lights, also known as traffic signals, are used to control traffic flow at intersections, pedestrian crossings, and other locations in order to further maximize traffic efficiency. Traditional traffic light systems, sometimes referred to as conventional traffic light systems, typically have fixed-timed cycles, meaning that the signaling lights alternate between one another through.

V. Results And Discussion

A. Implementing Traffic Lights

The circuit sheets for the traffic lights are printed on PCBs. The traffic lights display a start timer to show how much time is left before the red and green lights go out.All of them are connected to the Arduino and have programming loaded into them; the duration is specified as six secondtraffic lights are carried out on PCB printed circuit sheets.

B. Estimating TRAFFIC Thickness

Arduino is the core controlling module of the entire system. The system makes use of servomotors, traffic signals, an Arduino microcontroller, and a Lobby Impact sensor in addition to a common door. The traffic thickness is measured using the Corridor Impact sensor. Corridor Impact sensor recognizes the constant attractive field when there is a lot of traffic and sends a message to the Arduino and after that, the signs' planning is altered to 12 seconds.

Fig 3. Measuring traffic density

C. Controlling Person on Foot Crossing based on Traffic

Density The pedestrian crossing signals are controlled by the Arduino when it receives the signal from the impact sensor in the corridor. The timing of the green light would be multiplied when there is a lot of traffic. The sign time would remain consistent at the location where regular traffic is present. The entryway and sign for bystanders will be managed as needed.

D. Observing TRAFFIC Lights ON Versatile Telephone Utilizing BLYNK Application

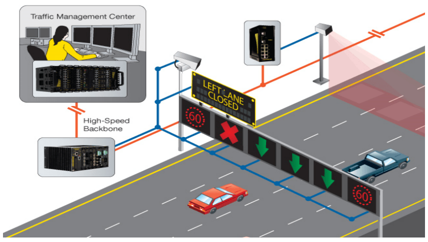

Fig 4. Monitoring traffic signals on mobile phone

Here, we're using the Blynk app on our phone to view our traffic signals. If someone logs in with that username and secret key, they should see the traffic lights. Residents would find it very helpful to be aware of the traffic ahead of time and plan their route accordingly. The frequency at which the cars pass the signal each second is 10 at first; after 10 seconds, this frequency drops to 5, at which point the RFID controller automatically instructs the signal to turnred.

VI. Conclusion

With the aid of this project, whose primary goal is to reduce vehicle congestion, the Intelligent Traffic Management System aims to address the traffic issue that the majority of cities in both urban and rural areas face. In order to ensure effective traffic flow without causing significant disruption to the road, our machine learning model requires traffic data as input. Although the model may require a longer training period, the response time will be shorter. The model is set up in a way that allows it to determine when to switch signals on both sides of the road intelligently, saving everyone from having to wait longer than necessary.

SYSTEM ANALYSIS

Our goal is to create and implement a machine learning model that can manage traffic light switching by displaying the quantity of vehicles on a route and identifying the various kinds of vehicles that are there. The suggested method aids in the creation of a solution that addresses traffic congestion and analyzes the presence of vehicles on the road, leading to a more coordinated, more intelligent, and better controlled usage of traffic networks. This can be accomplished by applying a trained machine learning model known as YOLO to analyze vehicle count data collected from sources such as CCTV cameras installed in traffic signals or on roads. YOLO is a machine learning model built with OpenCV that performs object detection and counts the quantity of The recorded data is then fed into a pre-built Python application, where a machine learning model has already been written. This allows us to dynamically switch the signal between lanes based on the car count data that has been gathered. Thus, the proposed intelligent traffic management system may provide hassle-free traffic control and round-the-clock safety. When our concept is put into action, traffic officers won't be required to control traffic at different intersections. As a result, using this technology to analyze and enhance road traffic performance is beneficial. Priority to emergency vehicles has also been the subject of previous study, which can be made possible with additional machine learning training for our model.

Thus, the proposed intelligent traffic management system may provide hassle-free traffic control and round-the-clock safety. When our concept is put into action, traffic officers won't be required to control traffic at different intersections. As a result, using this technology to analyze and enhance road traffic performance is beneficial. Priority to emergency vehicles has also been the subject of previous study, which can be made possible with additional machine learning training for our model.

FUTURE SCOPE

When the model fails to detect at critical moments, such as inclement weather and limited visibility at first, the timer-approach can be made to function. Future updates to the system could include cloud computing capabilities, allowing it to record traffic in the designated lanes along with the time and date. This would be very useful for analysing traffic statistics and making improvements to the roadways. With continued application of our model, this scenario can be significantly reduced because machine learning models are able to continuously learn and adapt to new situations. Additional specific functions, such as a closure signal for pedestrians crossing the road, priority for lanes with ambulances and vehicle monitoring, can be added to the programme by our model.

REFERENCES

[1] Hu, S., Su, L., Liu, H., Wang, H., & Abdelzaher, T. F. (2013, April). Smartroad: a crowd-sourced traffic regulator detection and identification system. In 2013 ACM/IEEE International Conference on Information Processing in Sensor Networks (IPSN) (pp. 331-332). IEEE.

[2] Hu, S., Su, L., Liu, H., Wang, H., & Abdelzaher, T. F. (2015). Smartroad: Smartphone-based crowd sensing for traffic regulator detection and identification. ACM Transactions on Sensor Networks (TOSN), 11(4), 1-27.

[3] Williamson, A., & Lennon, A. (2015). Pedestrian self- reported exposure to distraction by smart phones while walking and crossing the road. In Proceedings of the 2015 Australasian Road Safety Conference (ARSC2015) (pp. 1- 11). Australasian College of Road Safety (ACRS).

[4] Viani, F., Polo, A., Giarola, E., Robol, F., Benedetti, G., & Zanetti, S. (2016, September). Performance assessment of a smart road management system for the wireless detection of wildlife road-crossing. In 2016 IEEE International Smart Cities Conference (ISC2) (pp. 1-6). IEEE.

[5] Pau, G., Campisi, T., Canale, A., Severino, A., Collotta, M., & Tesoriere, G. (2018). Smart pedestrian crossing management at traffic light junctions through a fuzzy-based approach. Future Internet, 10(2), 15.

[6] Saad, W. K., Hashim, Y., & Jabbar, W. A. (2020). Design and implementation of portable smart wireless pedestrian crossing control system. IEEE Access, 8, 106109-106120.

[7] El Hamdani, S., Benamar, N., & Younis, M. (2020). A protocol for pedestrian crossing and increased vehicular flow in smart cities. Journal of Intelligent Transportation Systems, 24(5), 514-533.