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Smart Traffic Signal Control System

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Abstract: *The project is designed to develop a density-based dynamic traffic signal system. At the junction, the traffic density is sensed, and the signal timings will be changed automatically. Across the globe, in many prime & metro cities, traffic congestion is a serious problem, and it has become a nightmare for citizens in these cities. In a traditional traffic signal system fixed timing is allocated to either side of the junction which cannot be varied as per diverse traffic density. Timings allotted to junctions and intersections are fixed. Sometimes longer green light is demanded at one side of excessive traffic density as compared to the standard assigned time. In the smart traffic signal, the object detection is processed and transformed into a proposed system and various features are extracted. The profile has been drawn based on the calculated threshold. The drawn contour calculates the density and number of vehicles present in the area. We will come to know on which side the density is high after calculating the number of vehicles. Based on the collected data it will be concluded that on which green signal and the red signal will be allotted for the specified time on a particular side.*

Keywords: “Deep Learning”; “Feature Extraction”; “Segmentation”; “Convolutional Neural Network CNN”.

I. INTRODUCTION

The traffic congestion problem is increasing day by day everywhere around us and must be solved. As per Ministry Of Road Transport And Highway - every year, approximately 1.5 lakh people dies on India roads, which translate, on an average, into 1130 accidents and 422 deaths every day or 47 accidents and 18 deaths every hour. Major cause of these accidents are distracted drivers, aggressive driving, and other traffic violations with severe injuries leading to permanent disabilities. People are able to use different transportation facilities such as automotive vehicles, subways, and bicycles, However, among all these transportation facilities, automotive vehicles are still the most adopted due to this comfort and practically. In this way, assuming a continuous population growth, the number of vehicles in large cities will increase as well, but much faster than transportation infrastructure; consequently, traffic congestion will become a pressing issue. WHO World Health Organization stated for all age and gender road traffic injuries are one of most common cause of disability-adjusted life years. The same mentioned in World Health Report by WHO. In Saudi Arabia to counter issues of road accidents which leads to 4 million road accidents.

1.1 Contribution

The work proposes CNN based traffic signal control system for metro and populated cities that can avoid traffic and congestion problems and ensure smooth traffic flow less of accidents.
The concept of lane detection is also proposed which will help in reducing accidents caused by illegal and improper lane change due to which other drivers fails to react immediately which results in serious accidents.
Vehicle authentication is done.

II. LITERATURE SURVEY

As per Ministry Of Road Transport And Highway every year, approximately 1.5 lakh people dies on India roads, which translate, on an average, into 1130 accidents and 422 deaths every day or 47 accidents and 18 deaths every hour. Major cause of these accidents are distracted drivers, aggressive driving, and other traffic violations with severe injuries leading to permanent disabilities. WHO has identified distracted driving and excessive speed as the critical risk factor in

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road accidents that has a direct impact on the rate of RTAs Road Traffic Accidents and congestion. Studies show that speed is directly associated with traffic accidents. As per TOI (The Times Of India) traffic signals at some major cities don't function properly and manages the traffic effectively. As a result, chaos ensued at squares. Commuters complaints that with vehicle coming from both sides it is difficult for them to cross the junction and further some leads to accidents. Pedestrians has to face even more problems with congestion at the squares. "With the traffic signals not controlling the traffic, vehicle do not allow down. There should be a system that control the traffic automatically", a pedestrians complained. The congestion leading to accidents data are collected from 49 states of the USA (The United States Of America) from February 2016 to December 2021 using multiple APIs and variety of entities such s law enforcements, traffic sensors with road network, cameras & the US and state departments of transportation states that 2.8 million accidents records in dataset.

Asha C S et.al, [1] Vehicle counting is a process to estimate road traffic density and assess traffic conditions for intelligent transportation systems. This work proposes a video-based vehicle counting method that can detect, track and count vehicles accurately.

Muhammad hanif tunio et.al, [2] This paper presents research on controlling real-time traffic using image processing techniques in Matlab using various image processing techniques to count transport vehicles and allocate lanes based on the number of vehicles counted. LEDs are used to show green and red signals, and seven segments of seven LEDs show the decrementing timer of signal green.

Zulaikha Kadim et.al, [11] A deep-learning-based traffic volume survey is proposed and tested with 48 high-traffic video clips from four selected urban arterials, with an average accuracy of 97.6893.7 and 94.23respectively. The system is also able to run in real-time with an average processing time of 37.27ms per frame.

Boris A.Alpatov et.al, [12] Proposed image processing algorithms for traffic control and safety, implemented and tested on smart cameras.

Dongfang Ma et.al, [8] Deep learning methods are emerging to serve as the benchmark tool for traffic flow forecasting, but most studies are based on simple deep learning methods. This paper proposes a novel deep-learning based method for daily traffic flow forecasting where incorporating contextual factors and traffic flow patterns can be critical. It achieves over 90% prediction accuracy, outperforming existing benchmark methods, and is robust under various scenarios.

Yaohang Sun et.al, [10] This paper proposes a new method for vehicle counting using surveillance video, which can count the flow with higher accuracy and lower computational cost.

Markus Lucking et.al, [6] We designed and evaluated a real-time vehicle counting system using deep neural networks to achieve recall and precision values of 99% within a video processing time of 10 frames per second.

Shuang Li et.al, [7] Machine vision based vehicle counting and traffic flow estimation are challenging for dense traffic scenarios, and an LOI counting framework is proposed to address this problem. Three main contributions are a novel spatio-temporal counting feature (STCF), a counting network, and an estimation model. Experiments on the UADETRAC dataset and captured videos show that the proposed vehicle counting method outperforms the tested representative LOI counting methods in accuracy and speed, and can efficiently estimate traffic flow parameters in real time.

Sr.no	Author	Paper	Results/Findings
1.	Asha C S et.al,2018	Vehicle Counting for Traffic Management System using YOLO and Correlation Filter	This work proposes a video-based vehicle counting method that can detect, track and count vehicles accurately.
2.	Muhammad hanif tunio et.al,2020	Automation of Traffic Control System Using Image Morphological Operations.	This paper presents research on controlling real-time traffic using image processing techniques in Matlab.
3.	Zulaikha Kadim et.al, 2020	Real-Time Deep-Learning Based Traffic Volume Count for High Traffic Urban Arterial Roads	The system is also able to run in real-time with an average processing time of 37.27ms per frame.
4.	Boris	Vehicle Detection and Counting System	Proposed image processing algorithms for

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	A.Alpatov et.al, 2018	for Real-Time Traffic Surveillance	traffic control and safety, implemented and tested on smart cameras.
5.	Dongfang Ma et.al,2020	Neural Network Modeling Inter-and Intra-Day Traffic Patterns	It achieves over 90% prediction accuracy, outperforming existing benchmark methods, and is robust under various scenarios.
6.	Yaohang Sun et.al, 2019	Intersection Traffic Flow Counting Based on Hybrid Regression Model.	This paper proposes a new method for vehicle counting using surveillance video, which can count the flow with higher accuracy and lower computational cost.
7.	Markus Lucking et.al,2020	A Video-Based Vehicle Counting System Using an Embedded Device in Realistic Traffic Conditions	Designed and evaluated a real-time vehicle counting system using deep neural networks to achieve recall and precision values of 99% within a video processing time of 10 frames per second.
8.	Shuang Li et.al,2020	Bi-Directional Dense Traffic Counting Based on Spatio-Temporal Counting Feature and Counting-LSTM Network	Show that the proposed vehicle counting method outperforms the tested representative LOI counting methods in accuracy and speed, and can efficiently estimate traffic flow parameters in real time.

III. RELATED WORK

After surveying the literature, comprehensive surveys in traffic monitoring were found.

[1] is related to automatic controlled traffic signals. Automatic controllers includes multiple sensors which are very expensive as electrical sensors, they also includes timers which are of fixed time which don't helps effectively to control traffic of all 4 sides of congestion.

[2] is related to electronic sensor controlled traffic which has accuracy and coverage conflict. It also possesses detection issue and includes expensive technologies.

[3] CNN based signal controller is available which uses image dataset which don't help effectively to detect traffic density as in video dataset.

[4] is related to usage of UAV's to control traffic. In Saudi Arabia to counter issues of road accidents which leads to 4 million road accidents Modern surveillance technologies are adapted . As drones are used in every sector in today's digital world – in both military and civilian domains. Unmanned Aerial Vehicle are used today for various purposes especially for surveillance, weather forecast, mapping, in agriculture for crop assessment. Because of its high mobility, greater visibility, ease of usability and unmanned capabilities countries are deciding to deploy it and using for solving the problems of traffic congestion and accidents. But, as per name states "Unmanned Aerial Vehicle" it works without human interaction and hence it is built with various sensors and actuators such as electronic wing controllers, motors, radio, landing gears for safely landing the drones, propellers to create air pressure, battery, speed controllers and most importantly the radars to detect and track objects & high end cameras. The inclusion of these much hardware and features costs the UAV much more than the proposed system. The average drones are priced at $3000 and above which is more than 2 Lakhs in Indian rupees.

[5] is traffic light controller using microcontroller, similar to automatic controlled traffic signal this includes use of LED lights for indication purpose and for auto changing of signal at specified range of time interval microcontroller is used. LED lights gets automatically turns on and off by making corresponding port pin of the microcontroller "HIGH". An 8051 Microcontroller is the brain of this system.

IV. PROPOSED SYSTEM

The main objective of this project is to design a traffic light controller based on Computer Vision that can adapt to the current traffic situation. Our proposed system aims to use live video feed from the cameras at traffic junctions for real time traffic density calculation by detecting the vehicles at the signal and set the green signal accordingly. The vehicles

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will be classified as car, bike, bus/truck or rickshaw to obtain more accurate estimate of the green signal time. This system accepts input in the form of video dataset. We know that we're doing data processing and trained dataset on the system, therefore we're employing modules: Pre-processing, Feature extraction, and classification, all of which use our CNN algorithm. So First Input as a video dataset, then pre-processed the dataset (preprocessing step is clean the video and remove blur part) After that, then the system extracts the parameters or features of the in the extraction section. Then, in classification, where we utilize our CNN algorithm to detect critical activity these are the steps used to train the CNN.

(1) Fetch the trained model from Layer.

(2)Loading the image of the same size as the one used in the training images.

(3) Convert the image into an array. Transform the numbers in the array to be between 0 and 1 by dividing by 255

we are normalising value between 0 & 1 because machine learning will get over influenced by the higher value and we are dividing it by 255 because pixel ranges from 0 to 256

So apart from 0 the range is 255.

V. FIGURES

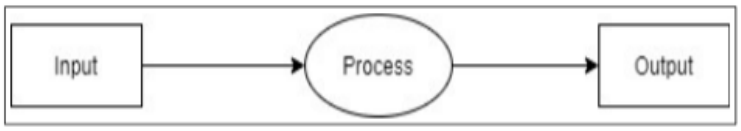

Figure 5.1: Data Flow (1) diagram

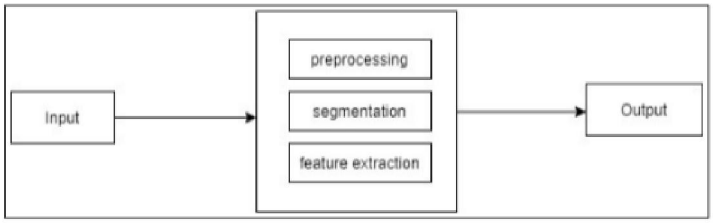

Figure 5.2: Data Flow (2)

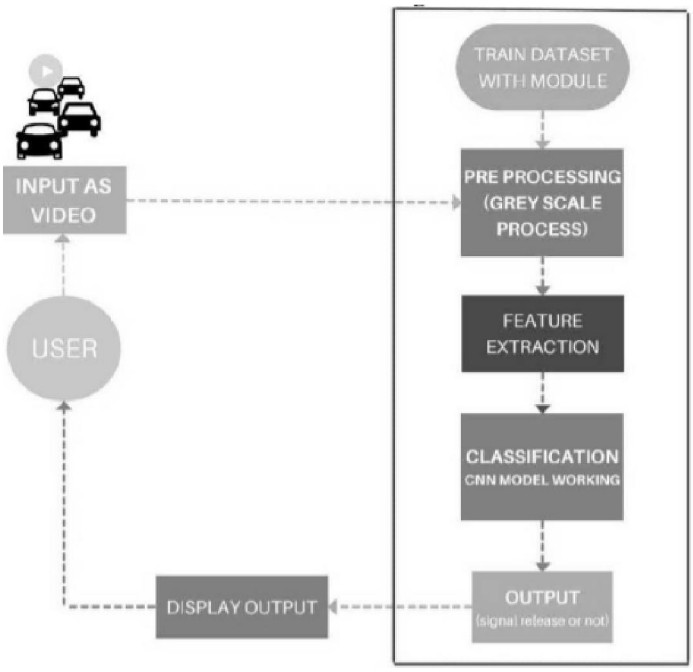

Figure 5.3: Architecture Diagram

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First the module is trained with the input dataset the input is in video format after that pre processing comes into the picture in which grey scale processing is done which converts the video into black and white format and multiple levels of grey colour which helps to improve quality and features of the video after that in the feature extraction phase many features such as size detection, edge detection, corner detection are extracted and the raw data is converted into many more manageable groups which helps CNN model i.e. convolutional neutral network model to help identify images and also help on pixel processing (Greyscale processing is used on every individual frame of the video. It is **an image conversion technique in digital photography**. It eliminates every form of colour information and convert image into black and white format and multiple levels of grey colour which improves image quality and features.
This processing also reduces the image size.)after calculating the density of vehicle the green signal will be released on the side where the density is maximum.

VI. CONCLUSION

The increasing transportation in major cities. Fast transportation systems and rapid transit systems are vital for economic developments for any state. More population means more vehicles on the streets day-by-day. Traditional traffic management systems are not built with the consideration of increasing traffic at this high pace and The Unmanned Aerial Vehicle costs much more which is difficult to state government to manage the expenses.
We propose the system that can solve the congestion and accidents issue which will calculate the density of vehicles and accordingly will allow the deployment of green light on that side where the density is higher. It will eliminate the expensive use of sensors and help authorities manage traffic more efficiently. It will result in smooth and safe journey for the citizens. Further it will give in vehicle authentication and to detect abrupt lane switching which will help to avoid serious accidents and also help pedestrians

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