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Intelligent Traffic Signal Automation Based on Computer Vision Techniques using Deep Learning

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***Abstract*— According to the Population Reference Bureau (PRB), traffic accidents are the third highest and the tenth highest in the world. Delays at intersections due to congestion lead to speeding, which increases traffic accidents that require effective traffic management. Traffic management is an important issue in densely populated cities. Currently, there is a fixed amount of green time in all directions, regardless of traffic volume, which leads to unnecessary waiting. Automated object detection and calculation techniques can be useful in the development of next-generation real-time traffic management systems equipped with artificial intelligence. Traffic congestion in densely populated urban areas is a major problem today. Many researchers have proposed many systems to monitor traffic flow and deal with congestion using various techniques. However, current systems are not reliable enough to detect traffic lights in real time. Therefore, our goal is to create a system that can effectively run real-time environments to solve the problem of traffic congestion through signal automation. Since vehicle detection and counting is critical to any transportation system, we use modern deep learning techniques to detect and count vehicles in real time.**

Keywords— PRB (Population Reference Bureau, Signal Automation, Deep learning, Na Traffic Management.

I. INTRODUCTION

In recent years, traffic congestion in densely populated urban areas has become a major problem. Many researchers have proposed many systems for traffic flow monitoring and congestion management using various techniques. However, current systems are not reliable enough to recognize traffic signals in real time. Therefore, we aim to build a system that can efficiently operate a real-time environment to solve the traffic congestion problem caused by traffic signal automation. Vehicle detection and counting is critical in any traffic system, so we use state-of-the-art deep learning technology to detect and count vehicles in real time. Next, automate traffic light control by comparing traffic on both sides of the intersection [1]. Traffic congestion is a serious urban problem that we all face in our daily lives. It's about endless patience and hope that the roads are clear before you're late for work or your destination. This makes us feel helpless and wastes time and related resources such as fuel, energy, and effort. Since signal timing is critical in the node, we proposed signal automation to solve this problem. Traffic lights automatically update the number of vehicles at the intersection. The proposed system receives images from cameras installed at traffic junction**.**

II. RELATED WORK

A. Deep Learning Approaches

The current deep learning techniques for detecting and tracking vehicles are supervised, unsupervised, or reinforcement learning.[2] Reinforcement learning has been in use since the 1990s for traffic control. Zhang et al.used deep reinforcement learning (DRL) in a partially observable environment for DSRC-based intelligent traffic signals. The proposed system has a low waiting time for vehicles detected at an intersection, even when low detection rate [3]. Deep learning methods became widely helpful in traffic Automation [4]. Deep learning has made significant progress in many fields including computer vision and natural language processing by allowing models to learn complex patterns in data and perform advanced tasks in present system vehicle recognition & classification is done using smart cameras, interception & video enabled computer-based system [5]. Present system also used video as input & using detectors, sensors which has drawbacks

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like high cost, slow response & more communication overhead for chaotic traffic. To reduce the death rate & accident rate, an automatic traffic surveillance system is necessary [6]. Hence the proposed work classifies the vehicles as two/four-wheeler based on edge/shape features. The images are classified using YOLO. The traffic surveillance/bottleneck is determined based on object count and threshold value. Future work can be carried by combining video/still images with acoustic/sound signal.

B. Language Models: YOLOv5/ FUZZY LOGIC

In object detection, there are several state-of-the-art architectures that can be used on real datasets to detect objects with reasonable accuracy [7]. For example, the distribution of a dataset is very different from where the dataset detector was trained. In such a scenario, we often use the concept of transfer learning, where we use a pre-trained detector and tune it with a newer dataset.[8] Trained YOLOv5 object recognizer on custom dataset without writing much code. The term vague refers to things that are unclear or unclear. In the real world we often encounter a situation where we cannot determine whether a state is true or false, their fuzzy logic provides a very valuable flexibility for reasoning. This way we can consider the errors and uncertainties of each specific situation. In the Boolean system, a Boolean value of 1.0 represents an absolute true value and 0.0 represents an absolute false value. But in a fuzzy system, there is no logic of absolute truth and absolute falsehood. But fuzzy logic also has an intermediate value that is partly true and partly false[9]. It is a technique for incorporating human thinking into a management system. It may not be designed to provide accurate reasoning, but it is designed to provide reasonable reasoning. It can mimic human deductive reasoning, the process by which people draw conclusions based on information. All uncertainties can be easily handled by fuzzy logic.

III. METHODOLOGY

We build up a decentralized architecture that can be implemented on aspect computing gadgets at the traffic signal intersections. The high-stage evaluation of the proposed model at traffic signal junction is shown in Figure

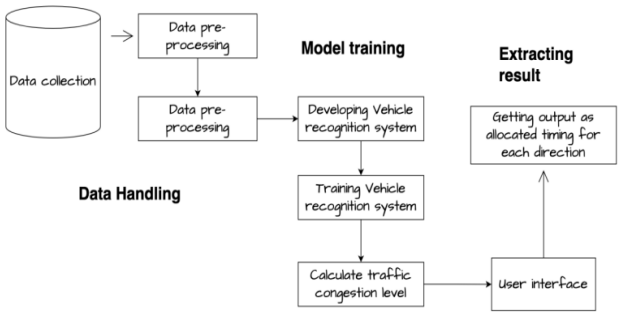

Figure 1: Image Extraction Architecture

The problem is to automate the traffic signals placed at the junction using deep learning techniques. The proposed system improves the traffic infrastructure at intersections on the road. For this, we estimated the density and count of the vehicle from every side of the junction. The green and red-light time is updated based on the count of the vehicle on every side of the junction. Vehicle detection is quite complicated and challenging, especially from different camera views and angles. For vehicle detection vehicles, notable designs, i.e., hand-crafted features and occlusion modelling, are used.

B. Object Detection

YOLO (You Only Look Once) is a method/way to do object detection. It is the algorithm strategy behind how the code is going to detect objects in the image. Earlier detection frameworks looked at different parts of the image multiple times at different scales and repurposed image classification technique to detect objects. This approach is slow and inefficient. YOLO takes entirely different approach. It looks at the entire image only once and goes through the network once and detects objects. Hence the name. It is very fast. That's the reason it has got so popular. There are other popular object detection frameworks like Faster R-CNN and SSD that are also widely used.

C. IMAGE PROCESSING

The system receives the signal from these CCTV cameras. The algorithm is designed to control the traffic flow of an intersection. A traditional traffic sign has a fixed intersection time and updates the red light to other sides. The main function of the system is to automate the green light and update the red light on both sides of each cycle. At first it started giving a green light to all sides of the intersection at the same time. The red-light time is also constant throughout the initial run. As a traffic light system, one side is always open to traffic flow. A few seconds before the green light on a certain side, this model took a frame of an image from the CCTV cameras. The photos are taken from all three other sides of the intersection. Based on these images, the vehicles are classified and counted. Vehicle detection was done in real time, such as vehicle detection and calculation before green time update.

IV. EVALUATION DATASETS AND RESULTS

Data plays a central role in deep learning models. The problem with deep learning algorithms is that they consume data. The data set must be relevant to the problem to get the correct result. A custom dataset has been created for the system. The data was collected from different traffic intersections in the city. We have almost all categories of vehicles viz. buses, private cars in these vehicles. In this model, input is taken from CCTV camera frames which are extracted from images. It is also ensured that the user frame

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is not unclear or unclear. For example, the time reserved for a car and two wheels is two seconds.

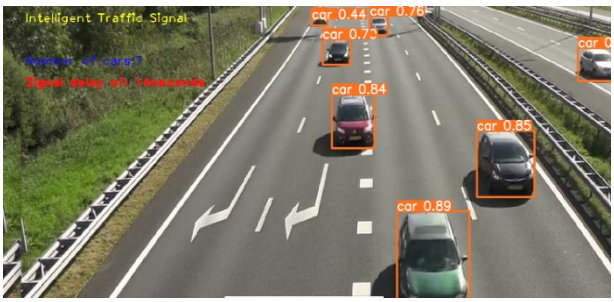

Figure 2: A Sample Image of Time Delay Generation Using YOLO Model

V. CONCLUSION

Our paper proposes an automatic signal automation system based on traffic images. The results show that with the fine-tuned faster accuracy of material detection is very high even in difficult situations. In addition, our automation algorithm effectively changes the signals according to the traffic intensity on different sides of the intersection. The working speed of our system is quite high, so it is suitable for real-time situations. In the future, we plan to collect data for different scenarios and train them according to our model. We also plan to detect and count pedestrians and other large vehicles on roads and install our system in other cities and environments.

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