Survey On Adaptive Smart Signal

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Abstract- *Computer vision is a field of artificial intelligence that trains computers to interpret and understand the visual world. Using digital images from cameras and videos and DRL models, machines can accurately identify and classify objects. Digital image processing is the use of a digital computer to process digital images through an algorithm. Traffic light control systems are extensively used to control and efficiently manage the flow of automobiles .Other possible solutions are using ultrasonic sensors for detecting vehicles, or using PIC microcontroller that would evaluate the traffic density using IR sensors. The major disadvantages with these systems are it would be very expensive to implement and maintain and are completely dependent on Sensors and Input Factors. Using a dynamic & efficient approach to meet the requirements of the traffic control system. The continuous changes of state in traffic and the requirement to respond quickly are the specific characteristics of the environment in a traffic control system. In this approach, image recognition algorithms and machine learning are used to identify the automobile. Reinforcement learning to create a dynamic traffic control model which quickly responds to the actual conditions found in the environment while simultaneously learning about it. In this system another feature is added which is regarding the priority to special/emergency vehicles. Using Google maps as a reference for the city roads.*

Keywords- Smart Signal, Digital Image Processing, Reinforcement Learning, Threshold, IR Sensor, Traffic Control System, Vehicle Priority

I. INTRODUCTION

Traffic lights have become an important part of our life. With increasing traffic and road accidents, it has become necessary to create a safer and more efficient traffic control system. The conventional traffic management systems cannot deal with the variable flow of traffic approaching the junctions. So traffic light control systems are used to manage and control the flow of vehicles through the junction of various roads. The input of a traffic light control system is generally an image, video or readings from a sensor such as an ultrasonic sensor. The output is the timing of the signals according to the vehicle density on each lane. The vehicle count is generally calculated from the given input using detection algorithms . Then based on this count the various techniques are used to control the signal lights such as reinforcement learning or fuzzy-logic.

II. LITERATURE SURVEY

A. Reinforcement learning Agent: Authors in [1] proposed a network structure contains a straightforward Softmax classification branch and Q-value network branch, specifically Mixed Q-network (MQN), which is trained by Q-learning with a memory palace that maintains completely different replay buffers for various classifications. The comparative deep Q-network (DQN) is trained using Q-learning with experience replay. The simulation of traffic is performed by using an open source traffic simulator software SUMO (Simulation of Urban MObility) which can be used for discrete time simulation. The entire reinforcement learning framework is implemented by using the tensorflow framework. It is a data-efficient method to learn and reuse the lower layer of neural networks under various traffic flow configuration. Also in this paper [8], authors projected a deep reinforcement learning model designed to deal with the traffic signal control problem. Their DRL framework utilized readily available real-world information sensor streams to be told the optimal policy for the agent in VISSIM. They tested their DRL agent's performance on real traffic information throughout high traffic demand periods. They conjointly mentioned thoroughly about the performance of their DRL agent with a linear increase in traffic demand. They will extend their DRL framework towards intersections with left and right turns and arterial corridors. They're going to explore creating intelligent control systems additional robust from adversarial perturbations towards traffic sensors.

B. Neuro – Fuzzy Based Adaptive Traffic Light Management system: In this paper [2], the authors have proposed a neuro-fuzzy based system which considers traffic on the current lane likewise as on its adjacent lane. Lanes are chosen using the round robin scheduling algorithm. So every lane gets a green signal in a fixed periodic manner. Fixed green light signal of 15 seconds is appointed to every lane. And if there are no vehicles present on a given lane then the green light signal is not given to that particular lane and passed onto the next lane. In case of emergency vehicles at an intersection, round robin algorithm is not used to select the lane, instead green signal is given to the lane on which these vehicles are present.

C. Using YOLO Object detection Algorithm: Authors in [3] aim to create a model to produce an answer for current traffic problems by managing traffic signals on the idea of real time scenarios. Here a pretrained model YOLO is employed to perform the task of object detection, and correspondingly the count of the vehicles are stored in order to process further requests of signal processing. Additionally the model is compatible with nearly any type of camera, even the cheaper ones as well as the conventional surveillance camera and can be used to capture images at initial levels. These images are then passed to the model for vehicle detection followed by vehicle counting. And this entire process is replicated on all four sides of the road using a camera. When the object is detected then a rectangular box is created around the object. The count obtained from all the sides of the road is then passed as input to a raspberry board. The raspberry board calculates the result by comparing all the counts obtained from four different images. The model has some fixed threshold value and if the result from the four images is under the threshold value then simple static switching will be applied and every signal will be allotted with the same switching time. Paper [4] proposes an IOT system containing ultrasonic sensors for controlling the traffic. The timing of signals is dynamically monitored and adjusted according to the traffic density in a given area. The inputs from the ultrasonic sensor which rotates at 180 degrees with a digital camera are taken and then passed onto a Raspberry Pi microcontroller for processing. A program is then created in python and used to process the input data and make certain decisions to control the signal timer on the basis of the vehicle density. This algorithm is created and stored in the raspberry pi board. The Raspberry Pi board makes its interface to the signal through IR technique so as to manage and modify dynamically. The signal timer is going to be adjusted as per instructions by the controller. And this decision is given on the basis of an algorithm designed to control the timer. The algorithm consists of checking for density of traffic for a specific lane under the threshold timing. If the traffic density of any lane reaches above this threshold value, then the green light signal is provided for that particular lane..

D. Density Based Smart Traffic Control System using IOT as the main engine: Authors in [5] propose that the workflow of traffic control systems is mainly based on Density of the lane and the priority. The density is calculated using an IR sensor on each lane; the count of the vehicle on each lane is sent to Raspberry pi which is the main unit of the traffic system. This Raspberry pi will send the data to the cloud server and to send the data to the cloud it uses Message Queuing Telemetry Transport (MQTT) which is mainly based on messaging protocol. The send by the Raspberry pi will be stored in the cloud database which will be used for further process.This smart traffic control system uses web applications using which Admin can add the subscribers to the system; then subscribers are able to login to the system and get the information about the traffic. As the count of the vehicles in lane reaches the threshold, traffic light for that lane will be activated. If the vehicles in one lane do not reach the threshold but the opposite lane is conjunct then the subscriber will get the information about the alternativeroute. During this survey paper [9], an effort made to travel through the concept of smart city and smart community. It's different aspects were reviewed and a few of their challenges presented. additionally , it indicated that among all categories including Environment, Healthcare, Energy and smart transportation, the latter one has received more attention in recent years. Some Recent work on smart control and autonomous vehicles were presented and eventually a posh path planning framework was discussed as our future challenge for smart cities. At the top , we tried to introduce a number of the longer term challenges during this concept.

E. Vehicle Detection, Tracking and Counting: In literature [6], The paper principally focuses on the essential plan of designing a system that uses a camera and functions according to a camera-based algorithmic program so as to manage the traffic flow on the road. The process of vehicle detection was done by subtracting the background and foreground images. The following of the vehicles was done by using Kalman. The system maintained its accuracy in day as well as evening time from the videos. The detection of vehicles, calculation and following was done using computer vision application. BLOB analysis was used to separate the vehicles from the background. The model has enlarged its scope in detection and is a lot of flexible in terms of cluster variance.

2.1 SUMMARY OF RELATED WORK

The summary of methods used in literature is given in Table 1.
Table 1 Summary of literature survey

Title	Technique Used	Advantage	Disadvantage
Training Reinforcement Learning Agent for Traffic Signal Control[1]	Reinforcement Learning	It is a data-efficient method to learn and reuse the lower layer of neural networks under different traffic flow configuration	Stagnate traffic can cause haywire
Neuro – Fuzzy Based Adaptive Traffic Light Management system [2]	Neuro - Fuzzy Based System	System provides negligible waiting time for the priority vehicles.	Doesn't work on a bigger intersection.
Real Time Traffic Management Using Machine Learning [3]	YOLO	The model is compatible with almost every type of camera, including the normal surveillance camera can be used to capture image at an initial level	It is completely dependent on the input sensor
Proposed Algorithm for Smart Traffic Control Using Ultrasonic Sensors [4]	YOLO	Usage of sensors help in determining the pollution caused by vehicles.	It is expensive to implement and maintain

Density Based Smart Traffic Control System for Congregating Traffic Information [5]	IOT	Accuracy is very high as sensors provide precise information.	Cost of implementation is high.
Vehicle Detection, Tracking and Counting [6]	Kalman Filter	Compatible even with low resolution camera	Doesn't work in harsh weather conditions
A Brief survey on smart signal controlled Transportation [7]	Efficient, Road network management	Controlled by centralised system	Completely dependant on sensors
Deep Reinforcement Learning For Adaptive Traffic Signal Control [8]	DRL, VISSIM	DRL framework utilized readily available real-world data sensor stream.	Doesn't work for intersections with left and right turns

After carrying out a detailed survey on related technical papers we found out that using IOT and ultrasonic sensors as input devices for the system can easily cause haywire as equipment can be easily hampered. Using a camera as an input for the system can be much more reliable and resourceful for differentiating between vehicles. Conclusively the program can control and manage a traffic signal faster and more accurately. Saving resources wasted on a traffic signal due to congestion.

III. CONCLUSION

After considering paper [1] and adapting the data efficient method to learn and reuse to train the neural network in order to make the network smaller and more efficient. The network then can easily handle different loads of traffic data supplied to it. [2] paper provides a neuro-fuzzy driven algorithm which can reduce computational time irrespective of hardware installed. [3] source provides an approach which works efficiently with a huge range of resolutions provided by cameras but cannot be considered as it relies on other sensors more, hence defeating the motive/purpose of the project. Paper [4] concentrates on using ultrasonic sensors as main input to the program which can not be considered as ultrasonic sensors are vulnerable to multiple hindrance on Indian streets.

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