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Smart AI-Based Traffic control System

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1. ABSTRACT

The limited ever-increasing facilities and ever-increasing demand for vehicular transportation have led to the development of Automated traffic management systems. Automated traffic management systems are cost-effective and require less human interaction in the management of traffic. Video processing/Image processing captures and processes real-world traffic scenarios such as a traffic signal at the junction. Various object detection algorithms are trained to count the number of vehicles struck in the traffic in each direction and an ML model is designed to output which direction of vehicles must be allowed to move first, based upon the weight of vehicles detected in the traffic in each direction. Most of the energy and time of human beings is spent on roads struck by traffic and thereby increasing air pollution as well. Therefore an efficient Automated transport management system helps in the management of traffic and overcomes the above-said problems.

General Terms

Image Processing, object detection, Machine learning, Artificial Intelligence, Deepstream, Automated Traffic management system, Intelligent transport systems, Traffic Congestion, Identification, Classification, YOLO.

2. INTRODUCTION

Traffic congestion is one of the major concerns at the global level. Ever increasing population and growing demands for vehicular transport has led to the idea of developing smart AI-based traffic controller. According to the intensity of traffic congestion. The ML model performs decision-making on which direction vehicles should be given the green signal earlier. The larger the traffic congestion, the faster will be the clearance rate. Implementation of the above-mentioned can be done using image processing, object detection algorithms, and machine learning models. Thus the model focuses on decreasing traffic congestion at bottleneck points, peak traffic hours, etc. Traffic research has the goal to optimize the traffic flow of people and goods. As the number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future.

However, some limitations to the usage of intelligent traffic control exist. Avoiding traffic jams for example is thought to be beneficial to both the environment and the economy, but improved traffic flow may also lead to an increase in demand. There are several models for traffic simulation.

3. LITERATURE REVIEW

Various papers describe the techniques and methods suggesting the implementation ways as illustrated and discussed here.

An intelligent IoT Enabled Traffic queue handling System Using a Machine Learning Algorithm by Shamitha, et al[1] has proposed a system that reduces traffic congestion and travel time by creating a smoother transition. A machine-learning algorithm called the DBSCAN clustering algorithm used to indicate and identify any unintentional anomalies in the design.

An Intelligent Traffic Surveillance for Detecting Real-Time Objects Using Deep Belief Networks over Convolutional Neural Networks with improved Accuracy by G. Vinod, et al[2] have proposed a technique of object detection by adaptive structural learning of Deep Belief Networks (DBN) implementing the real-time object detection captured in the traffic scene by using DBN in comparison with CNN to get the accuracy improved.

AI Traffic Control System Based on Deepstream and IoT Using NVIDIA Jetson Nano by Md. Imran Uddin, Md. Shahriar Alamgir, et al[3] have proposed a system that detects the number plate of those vehicles which violate traffic rules. NVIDIA's Deepstream algorithm has been used to implement their project.

Image Processing Based Smart Traffic Control System for Smart City by Vedansh Bhardwaj, et al[4] have proposed a system that is designed and verified using Proteus software and offers improvement in response time and overall efficiency of the existing traffic control system.

They described the traffic control system with advanced features like emergency vehicle situations is also incorporated into the proposed image processing-based traffic control system to improve its resilience and reliability.

Coordinated Control of Traffic Lights on the main road with Intelligent Traffic Management by Sergey Lyapin, et al[5] have designed an intelligent transport system (ITS) that comes under the umbrella of automated transport management systems(ATMS). ATMS controls the traffic flow in cities or highways road network. Real-world conditions or implementation conditions must be taken into consideration while designing ATMS along with appropriate and efficient algorithms. Efficient and organized management of traffic is necessary to reduce traveling time and air pollution.

RealTime Traffic Management System Using Object Detection based Signal Logic by Murthy Jonnalagadda, Sashank Taduri, et al[6] developed a model which concludes by providing a case study of the object-detection-based signal logic scheme using real-world data sets in the Kakinada Smart City test bed.

Smart Control of Traffic Light Using Artificial Intelligence by Mihir M. Gandhi, et al.[7], have proposed a Framework for aims to utilize live images from the cameras at traffic junctions for traffic density calculation using image processing and AI.

Real-time Traffic Management in Emergency using Artificial Intelligence by Mahima Jaiswal, et al[8] have proposed a design to implement lane management for effective traffic flow during a medical emergency.

Muhammad Hanif Tunio, et al[9] have proposed a paper called Automation of Traffic Control System Using Image Morphological Operations which presents research on controlling real-time traffic using various image processing techniques in which the pictures are captured using the webcam of various lanes of roads where traffic takes place. The timer is allocated to a lane based on the number of vehicles counted in the specific picture of the lane for showing the green signal to pass the vehicle.

An Image Processing and Artificial Intelligence based Traffic Signal Control System by Abu Salman Shaikat, Rezwan-Us Saleheen, et al[10] have proposed a system that will support an extremely effective, self-coordinated, and self-organized traffic control appliance. Viola and Jones introduced a system, which is called as Haar Cascade method. It's used for detecting the object, which superimposes a positive image over a set of negative images.

Khaled Zaatouri, et al[11], have proposed An intelligent IoT Enabled Traffic queue handling System Using a Machine Learning Algorithm which describes a real-time traffic light control algorithm based on the traffic flow is proposed in this paper. This is done by a state-ofthe-art, real- time object detection based on a deep Convolutional Neural Network called You Only Look Once (YOLO).

Performance Analysis of Different Spatial Domain Methods for Traffic Control Using Image Processing: A LabVIEW Approach by G. Mallikharjuna Rao, et al[12] present a scheme for performance analysis of spatial domain methods, namely, Laplacian, Arbitrary, Sobel and Prewitt operator methods for traffic control using an image processing with LabVIEW approach, including timing constraints are used to control the signal along the crossroad signal posts.

4. RESEARCH OBJECTIVE

The project "Smart AI Based Traffic control system", aims at designing and developing a model that helps to reduce traffic congestion. This model is basically designed to decongest traffic issues arising around the world. It basically focuses on algorithms that detect objects and classify them. After repeated training of the ML model, It is expected to predict the required solutions to decongest the traffic. Thus, this model helps to solve one of the major issues in the metro Politian cities and make this world a better place to live.

5. PROPOSED SYSTEM

YOLO Algorithm

YOLO is an abbreviation for the term You Only Look Once. This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images. YOLO is a clever convolutional neural network (CNN). It divides the image into many boxes and predicts the probability of finding an object in the bounding boxes. YOLO is used because error occurrence is very minimal in it.

A single CNN can detect multiple bounding boxes. The data set required to train the data model was taken from google. Then the YOLO model was trained by calculating the weights of vehicles. The model was trained for Indian vehicles such as bikes, cars, trucks, etc. the model was trained until we get minimal errors. A threshold value is kept for object detection.

The input is the video file which is divided into set of images/frames given to the model then the model calculates the count of vehicles based on the traffic to find out the optimum green signal time to reduce traffic congestion quickly.

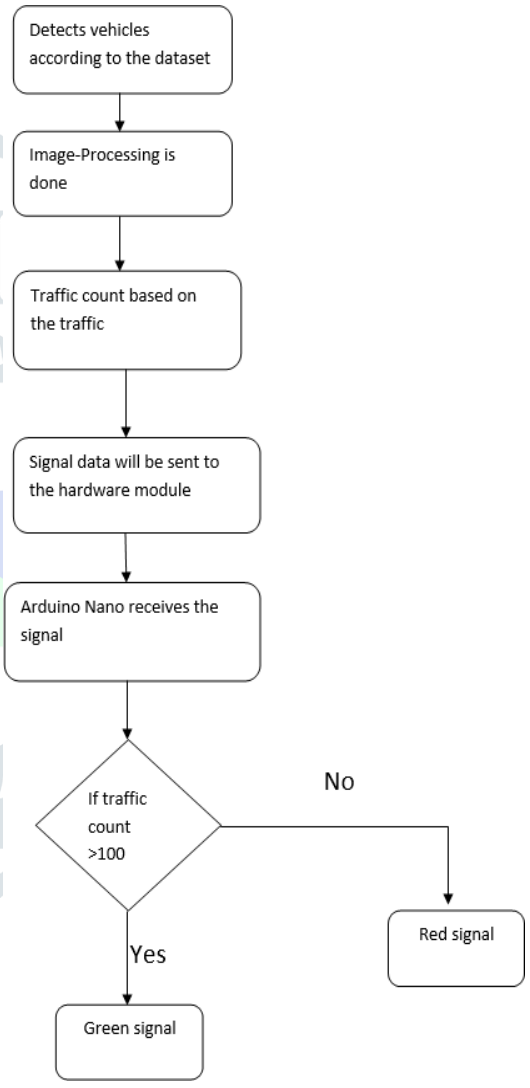

Figure 1: Flow chart Of AI based Traffic Signal

6. DESIGN AND ANALYSIS

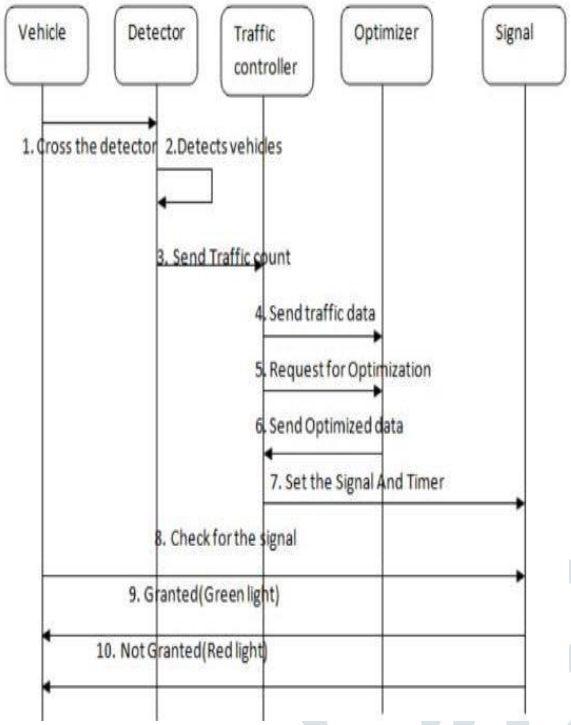

Figure 2: Analysis and Design

• Detectors are placed across the road to detect vehicles.

• The number of vehicles crossing the detector sends the count to traffic control.

• Based on the number of vehicles the model predicts which direction preference should be given

• When the number of vehicles doesn't match the threshold, the default signal timer is followed.

• If the number of vehicles crosses the threshold the ML model predicts the signal prediction.

7. IMPLEMENTATION

A real-time video is captured and given as input to the ML model. The video is analyzed as frames. From each frame, an area of interest is considered for image processing and the rest is neglected. Using an object detection algorithm objects are detected.

When the centroid of the vehicles crosses the imaginary line it is considered to be detected.

When the number of vehicles is below the threshold value, the default signal timing on each lane is set (2 secs). When a scenario occurs where a particular lane crosses the threshold value the traffic clearance priority is given to that particular lane by providing a green signal for a longer time.

The priority signal timing is calculated using the formula:

Green signal value for up direction =(Total vehicles in up direction *30) /(Total number of vehicles in both direction)

Green signal value for down direction =(Total vehicles in down direction *30) /(Total number of vehicles in both direction)

The priority signal timing is sent to the Arduino nano IC. The Arduino code present within the IC glows priority lane led to green

The system will contain two files namely 'vehicles.py' and 'main.py'.

Save the below code in the file named 'vehicles.py'.

8. RESULTS AND CONCLUSION

This model is basically designed to decongest traffic issues arising around the world. It basically focuses on algorithms that detect objects and classify them. After repeated training of the ML model, It is expected to predict the required solutions to decongest the traffic.

The overall outcome of the project is as follows:

• To manage traffic in an efficient and effective manner to make this world a better place to live.

• This model is basically designed to decongest traffic issues arising around the world

• The smart AI-Based traffic control system is a low-cost and efficient management system.

• proper traffic management system helps people in society, reduce their stress levels during traveling.

• An efficient management traffic system helps society. If any emergency services like ambulance, fire extinguishers, etc. arise proper traffic management helps these emergency services will get first priority to move in the traffic.

• An efficient Automated transport management system to minimize air pollution.

Thus, this model helps to solve one of the major issues in the metro Politian cities and make this world a better place to live.

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