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TRAFFIC CONGESTION ANALYSIS USING COMPUTER VISION

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ABSTRACT—

The traffic monitoring system has become an important part of a smart city. With the increase in traffic, conventional systems are not capable of managing traffic in densely populated areas. Also, there is no way of determining speed of vehicles using these conventional systems. Various challenges like increase in transportation cost and number of accidents due to traffic jams are also encountered. This system intends to monitor and manage traffic flow without any human interference. In conventional traffic management system traffic police uses timer-based traffic lights to manage traffic. But in such systems, it becomes hard for traffic authorities to manage traffic congestion in different areas with limited manpower.

Key Words: Computer Vision , You Only Look Once (YOLO), Vehicle Detection, Speed Estimation, Traffic Density Calculation.

INTRODUCTION

Given the growing urbanisation process, traffic congestion, incidents, and violations are significant difficulties for traffic management systems. Although CCTV cameras have been used to monitor traffic in major cities, their only purpose in traffic management is monitoring. Smart traffic management systems are effective solutions for conventional traffic management systems, which depend on human labour to control traffic. It is challenging for one individual to control traffic alone considering the increasing populations in big cities. Numerous ideas have been put out to address this issue, including enforcing current traffic regulations, enlarging roadways, introducing or eliminating bus lanes, increasing the number of parking spaces, etc. Although these methods work, it is not always realistic to put them into practice.

Traffic management must be a part of the smart city initiative, which was started by a government with the intention of promoting sustainable and inclusive cities that offer essential infrastructure, give their residents a respectable standard of living, a clean and sustainable environment, and application of "Smart" solutions. The quality of life of a citizen suffers from traffic jams, violations, and accidents. Thus, we may create a traffic monitoring system that accurately detects and tracks [automobiles using computer vision techniques. Digital images, movies, and other visual inputs can be used to extract usable information by computers and systems using artificial intelligence (AI) computer vision fields. The computer can view and comprehend the environment thanks to computer vision. One of the many applications for computer vision is object detection. The demand for traffic control officers will reduce thanks to computer vision-based systems. These devices collect data in real time and use it to provide efficient traffic congestion reduction strategies. Tolls can be equipped with these clever traffic management technologies to allow automatic number plate identification of every passing vehicle. These technologies can be used on highways to track traffic, identify risky drivers, and do other things.

The goal of this project is to use computer vision to create a better system for managing traffic in large urban areas. Using the You Only Look Once (YOLO) Algorithm, the suggested system detects vehicles in real-time. We use a live feed that is collected from the highway security cameras. The YOLO Algorithm, which is based on convolutional neural networks, is then applied to this video input. Additionally, the car's speed is evaluated. A better traffic management model is created using these data.

LITERATURE SURVEY

We plan to develop a system where we can detect and track vehicles using computer vision algorithms. This system will be able to detect and track vehicles in real time from the video feed which will be obtained from surveillance cameras on the street. In this system first, the video is taken as a input. The frames from the video are extracted and YOLO algorithm is implemented on the frames. The YOLO algorithm separates the image into SxS grid cells. The class, objectness score, and B bounding box predictions are displayed in each grid cell. Four coordinates are assigned to each bounding box (bx, by, bw, bh). Out of these four coordinates, bx and by represent the bounding box's center points, while bw and bh, respectively, denote the bounding box's width and height. The probability that an item is present in the cell is indicated by the objectness score, p0. The objectness score is run via a sigmoid function, and as a result, its value ranges from 0 to 1.Class prediction is probability of number of classes. Since we are using COCO dataset, we have 80 different classes.

There are many applications of computer vision but its application in traffic management has been an interest of study for many researchers. Many researchers have worked on a traffic management system. Literature review of the research papers we referred is as following: The suggested system is divided into two primary components: the Computer Vision module, which addresses real-world traffic issues, and the Traffic Management module, which regulates and manages the performance of a virtual traffic model. In the Computer Vision module, the video is analysed and vehicles are detected, tracked. The data from this model is input for the Traffic model and a more optimized model is developed. This paper presents a solution for Indian toll plazas. This system uses a Convolutional neural network, TensorFlow's Computer vision API to detect vehicles, vehicle model classification, vehicle registration plate detection.

Real-time traffic data is gathered, processed, and stored for various scenarios using an IoT-based system. In order to give real-time traffic updates on traffic congestion and odd traffic occurrences to increase mobility, this data is then analysed using ML Algorithm. Detecting the vehicle and calculation of physical length estimation, traffic congestion and warning message display are some of the features of the system.As is well known, one of the main issues in contemporary cities is traffic management. This research work focuses on using machine learning techniques to estimate when green signals at a single intersection will minimise, Here, the timeframe for light signals is set using neural networks and Qlearning, aiming to minimise overall delays. The assumption is that an intersection acts like an intelligent agent that is taught how to determine the green times for each cycle based on traffic data. In this article, a comparison of Q-learning and neural networks is given.

1. PROPOSED SYSTEM

In the proposed system we have developed a model using YOLO v3 algorithm. The proposed system consists of yolo algorithm to determine the traffic congestion of vehicles. This algorithm is used to detect count and track the vehicles which are provided in the video feed. It only requires single neural network to the entire image. The possibility of an object appearing in the bounding box is estimated as part of the vehicle detection process, which involves applying the s*s grid to the entire image. Using the confidence score, the probability that the object will appear in the bounding box is displayed. Further if object is appearing in two or more boxes its intersection over union is calculated. After applying YOLO algorithm, the output image will have many bounding boxes detecting the same object. To get rid on unnecessary Bounding boxes we use a technology called Non Maximum Suppression (NMS).

1.1. METHODOLOGY

We plan to develop a system where we can detect and track vehicles using computer vision algorithms. This system will be able to detect and track vehicles in real time from the video feed which will be obtained from surveillance cameras on the street. In this system first, the video is taken as a input. The frames from the video are extracted and YOLO algorithm is implemented on the frames. The YOLO algorithm separates the image into SxS grid cells. The class, objectness score, and B bounding box predictions are displayed in each grid cell. Four coordinates are assigned to each bounding box (bx, by, bw, bh). Out of these four coordinates, bx and by represent the bounding box's center points, while bw and bh, respectively, denote the bounding box's width and height. The probability that an item is present in the cell is indicated by the objectness score, p0. The objectness score is run via a sigmoid function, and as a result, its value ranges from 0 to 1.Class prediction is probability of number of classes. Since we are using COCO dataset.

1.2. ALGORITHMS

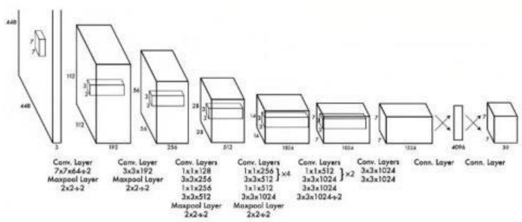

Fig3.2.:YOLO Architecture

1) **YOLO v1:**
YOLO v1 was the 1st YOLO algorithm, It was a 1- stage detector which had batch normalization (BN) and Leaky ReLU activation function which was relatively new at the time. The first version of YOLO had 24 convolutional layers with 2 fully connected layers. An average pooling layer and a fully connected layer, both of which were trained on the ImageNet dataset, followed the first 20 convolutional layers. The layers consist of 3x3 convolutional layers and 1x1 reduction layers. All the other layers use leaky ReLU activation function but only the last layer uses a linear activation function.

2) **YOLO v2 :**
YOLO v2 had 22 convolutional layers and 5 maxpool layers. Apart from other things authors of YOLO v2 removed fully connected layers at the end. Due to this the YOLO v2 became truly resolution-independent. During this the authors also introduced various flavors of YOLO like Tiny YOLO v2.

3) **YOLO v3**
YOLO v3 has implemented different techniques like residual block , skip connections, up sampling. YOLO v3 took ideas from various algorithms like ResNet and FPN(Feature-Pyramid Network).Just like FPN YOLO v3 has 3 prediction heads. Instead of pooling layers,

YOLO v3 uses additional convolutional layers with stride 2.

The input image has dimension of 416x416x3 where 416x416 is height and width of input image and 3 represents that the image is RGB. YOLO v3 has 53 convolutional layers called Darknet-53 stacked with 53 more layers producing 106 layers in total. Each Convolutional layer in YOLO v3 is followed by Batch Normalization and Leaky ReLU. As said before YOLO v3 has 3 prediction heads. YOLO v3 makes detection at 3 different scales and three separate places.

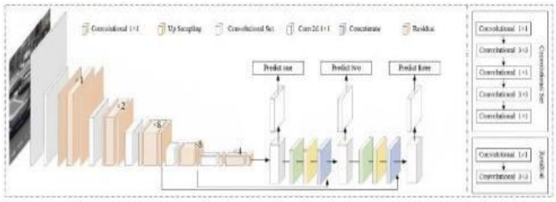

Fig3.2.1:YOLO Architecture(V3)

The 3 separate places where the object detection is done in network are layer 82, layer 94 and layer 106. Along with detection at these 3 levels the network also down samples the input image by factor 32,16 and 8 at those separate layers accordingly. These 3 factors are called strides in the network. As we know the input image is of size 416x416 the output image at stride 32 will be 13x13. Similarly, the output size of image at stride 16 and stride 8 is 26x26 and 52x52 respectively. The stride 32 is responsible for detecting small object, stride 16 is responsible for medium objects and stride 8 is responsible for detecting large objects. To generate results a t these three different locations throughout the network, YOLO V3 uses 1x1 convolutional layers. To down sample the images, 1*1 convolutional layer are used. As a result, the feature maps that are produced will have the same spatial dimensions. The depths of the shape detecting kernels are determined by $I \times (5 + I)$ Where, b = number of bounding boxes. (since each grid cell has 3 bounding boxes b is 3) c = Number of classes (since we are using coco dataset c is 80) Therefore, the output feature maps will have depth of 255. The size of output feature maps is 13x13x255 , 26x26x255, 52x52x255

RESULT&DISSCUSSIONS

Fig4.1:Object Detection on image

At first stage, we achieved basic objective of vehicle detection using image. In the above image vehicle detection is performed on an image**.**

Fig 4.2:Vehicle count and classification

At second stage, we achieved objective of vehicle count and Classification. In the above figure, vehicle classification and count is being performed. When a vehicle crosses the line, the count is updated according to the direction of vehicle i.e. up or down.

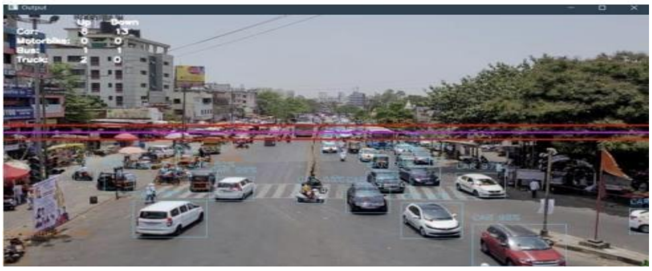

Fig4.3:Vehicle_Tracking

In the above figure we track the number of vehicles present on the road and set timer based on the number of vehicles.

CONCLUSION

In this paper we presented Intelligent traffic management systems. In this system we use computer vision techniques to detect, track, count vehicles. With help of already installed CCTV surveillance cameras we will obtain the live feed and this feed will be passed through algorithm to detect and count vehicles. In this work, we presented a method to accurately count vehicles, detect vehicle speed, and identify vehicles that violate the posted speed limit. This approach is based on shifting pixel values and many reference lines. For the realtime video feed inputs tested, the suggested system had the highest accuracy for both vehicles counting and speed violation detection. We see that the accuracy of this system increases when the video camera is positioned to capture a perfect top view of the lane. Additionally, it was mentioned that using surveillance video with a greater frame rate and better quality could improve the result's accuracy. These requirements might be easily accomplished in practical applications, and our method could produce accurate results. This system will help in designing a new traffic model. Law enforcement officers will be able to use this system to catch illegal cars. In big urban cities, we will be able to implement this system to better manage traffic congestion. Since, the YOLO algorithm is trained using the COCO dataset, it is not very effective on Indian traffic. So, we can perform transfer learning to further improve accuracy of the model. In future, using high-resolution cameras we can apply Number Plate Recognition to the store number plates of traffic violators. Such a system will help authorities in catching traffic violators and will also help them in tracking particular vehicle. We can also implement systems like helmet detection and mask detection to catch people who are not following traffic rules.

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