Real Time Traffic Control Detection System

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Abstract-With the rapid advancement of deep learning techniques, there has been a significant improvement in the field of computer vision, especially in the area of object detection and recognition. One crucial application of this progress is in the domain of traffic control systems. Traditional traffic control methods often rely on manual monitoring and intervention, leading to inefficiencies and potential safety risks. In this study, we propose a novel approach for traffic control detection using deep learning algorithms. Our results indicate that deep learning-based traffic control detection systems have the potential to revolutionize the way traffic is managed, making it more intelligent, responsive, and efficient. By harnessing the capabilities of deep learning, we can pave the way for the development of smarter cities with optimized transportation networks, ultimately leading to enhanced quality of life for urban residents.

Keywords: *Traffic control, deep learning, object detection, compu vision, convolutional neural networks*

I. INTRODUCTION

Automation and intelligent control technologies are a way to ameliorate flow of traffic and safety in contemporary transportation systems which leads to the suggested system, microcontroller and cameras will be used to track the number of vehicles, allowing for time-based monitoring of the system. With the growing number of road users and limited infrastructure resources today, smart traffic regulation will be a crucial topic in the coming days. Traffic jams may occur due to heavy traffic jams at intersections. There are various traffic management strategies that are inherently self-changing to avoid congestion. To adapt to ever-changing real-time traffic scenarios, a system implemented using Image processing based on adaptive signal control and computer vision technology is proposed. Timing is calculated automatically according to the traffic volume.

Furthermore, the high cost of living in industrial districts causes employees to live away from their places of work/education, forcing them to commute back and forth between their homes and places of work. Over a one-day period, more automobiles must be accommodated. When dealing with increased traffic, a common solution is to enlarging lanes or elevating road levels is a frequent option. Cities, on the other hand, should concentrate on improving the efficiency of their streets rather than just extending them or adding additional roads.The High-speed and mass transportation systems are the nerves of economic development in all countries. Mismanagement and congestion can lead to protracted times, wasting fuel and money. So, a quick, efficient and an economical traffic control system is of utmost importance for the development of the country.

We will discuss about smart traffic control by using image processing to count vehicles. Vehicle detection and counting are important in calculating traffic congestion on highways. The main objective of detecting cars and counting in a video or image traffic paper is to develop a methodology for automatic detection of vehicles and count them on highways. Our method does not use background, it uses a filter that we detect and count the cars, takes a video or an image and makes some processing to finally give the number of cars.

II. LITERATURE REVIEW

Traffic congestion is a pervasive problem in urban areas, necessitating innovative solutions to optimize traffic flow and alleviate congestion. Traditional traffic management systems often face challenges in adapting to dynamic traffic conditions in real time. With the rise of artificial intelligence, particularly Convolutional Neural Networks (CNN) and YOLO, there has been a paradigm shift in traffic management strategies, enabling the development of Real-Time Adaptive Traffic Management Systems (ATMS).

1] EMIN GUNEY , C ¨ UNEYT BAYILMIS , AND BATUHAN C¸ AKAN , Thanks to the rapid development of computer vision and deep learning technologies, advanced driver assistance systems (ADAS) have recently become widespread. These systems aim to increase driving safety and reduce the number of traffic accidents. Modern cars usually have ADAS systems integrated into their electronics, but other vehicles do not have such an integrated system. This paper presents a portable and image-based ADAS system for real-time detection of traffic signs, vehicles, and pedestrians. To realize real-time detection, the developed system uses the YOLO v5 algorithm. This single-stage detector is very popular as it has high detection speed and accuracy. The model was trained on the Tesla P100 graphics processing unit (GPU) with nearly 2500 images and 8 hours using GTSRB and study-specific dataset to analyze the developed system. Then, the implementation metrics (F1 score, P, R, PR curves) were calculated to evaluate the training and testing performances of the model. In addition, the model was compared in low-power, high-performance embedded platforms and in a computer to measure the real-time performance.

. **2]** MOHAMMED ALONAZI1 , ASIFA MEHMOOD QURESHI, Autonomous vehicle detection and tracking are crucial for intelligent transportation management and control systems. Although many techniques are used to develop smart traffic systems, this article discusses vehicle detection and tracking using pixel-labeling and real-time tracking. We propose a novel smart traffic control system that segments the image using an Extreme Gradient Boost (XGBoost) classifier to extract the foreground objects. The proposed model is divided into the following steps: 1) at first, all the images are preprocessed to remove noise; 2) pixel-labeling is performed by using the XGBoost classifier to separate the background from the foreground; 3) all the pixels classified as a vehicle was extracted and converted into a binary image, then blob extraction technique is used to localize each vehicle; 4) to verify the detected vehicles Intersection over Union (IoU) score using the ground truth is calculated; 5) all verified vehicles were subjected to Visual Geometry Group (VGG) feature extraction and based on which a unique identifier was assigned to each of them to enable multi-object tracking across the image frames; 6) vehicles are counted and categorized into stationary and moving cars by detecting motion in each of them using Farneback optical flow algorithm; and 7) finally, the Simple Online and Real-time Tracker (SORT) is used for tracking. The proposed model outperforms existing state-of-the-art traffic monitoring techniques in terms of precision, achieving 0.86 for detection and 0.92 for tracking with the Karlsruher Institut for Technology Aerial Image Sequences (KIT-AIS) dataset, 0.83 for detection, and 0.87 for tracking with the Vision Meets Drone Single Object-Tracking (VisDrone) dataset

3] Sai Charan Kanigolla, Chaitanya kumar Avala , In the modern era, with the rise in vehicles and population, many urban cities have faced traffic problems like traffic congestion, which causes travel delays. The main reason for the delay is that current traffic systems use fixed signal timers at the traffic signal intersection. These unnecessary delays at the traffic signals lead to excessive fuel consumption and increased pollution. This paper uses vehicle detection methods through surveillance cameras and machine learning to predict traffic based on historical data in a region. Finally, optimizing traffic by utilizing the predicted data and proposed methodology reduces the average wait time of travelers.

4] Saba Kheirinejad, Noushin Riaihi, Reza Azmi, Recently, traffic panel detection has attracted both academic and industrial attention. However, there are a few works that studied text based traffic panels. This is because there are many challenges in this kind of traffic panels. To obtain an appropriate accuracy in text recognition in the text based traffic panels, we need to detect the panel. Since there is no public text based traffic panels dataset, we collected a new dataset included the Persian text based traffic panels in the streets of Tehran-Iran for the first time. Our dataset contains two sets of figures. The first set has 9294 pictures and the second set has 3305 pictures. The second dataset is more uniform than the first dataset. Therefore, we exploit the first set as an additional dataset and use the second one as the main dataset. Accordingly, we pretrain the network by the additional dataset and train it by the main dataset. We use the tiny YOLOv3 (You Only Look Once version three) algorithm to pretrain, train, and test the dataset. The algorithm is fast and has low complexity

5] C.Heltin Genitha, A.S. Hepsi Ajibah, This study presents a novel system that utilizes computer vision and machine learning approaches to address the problem of traffic congestion in urban areas. The proposed system leverages the advanced object detection algorithm, You Only Look Once (YOLO), to detect and track vehicles in live camera footage from traffic junctions. The system then calculates the traffic density in real-time by analyzing the number and speed of vehicles passing through the intersection. The proposed system utilizes an intelligent algorithm that optimizes traffic flow by switching traffic lights based on the calculated traffic density. This approach reduces congestion and minimizes delays, resulting in faster transit times and reduced fuel consumption and air pollution. To assess the performance of the proposed system, experiments are carried on real- world traffic data. The results demonstrate that the system can accurately detect and track vehicles with high precision and recall rates.

III. PROBLEM STATEMENT

To traffic management, law enforcement, safety enhancement, and efficient resource allocation. The primary goal is to utilize advanced technologies and data-driven approaches to address these challenges effectively . to develop a deep learning-based system that can accurately detect and analyze traffic flow in real-time, enabling dynamic traffic control adjustments to improve efficiency, reduce congestion, and enhance overall traffic management. This includes counting vehicles, identifying their types (cars, trucks, motorcycles), and estimating their speed. The system can track the movement of vehicles and understand the overall traffic dynamics. Based on the analyzed data, the system can adjust traffic light timings to optimize traffic flow and reduce congestion.

IV. METHODOLOGY

A. System Architecture

System Architecture for Real Time Adaptive Traffic Management System :

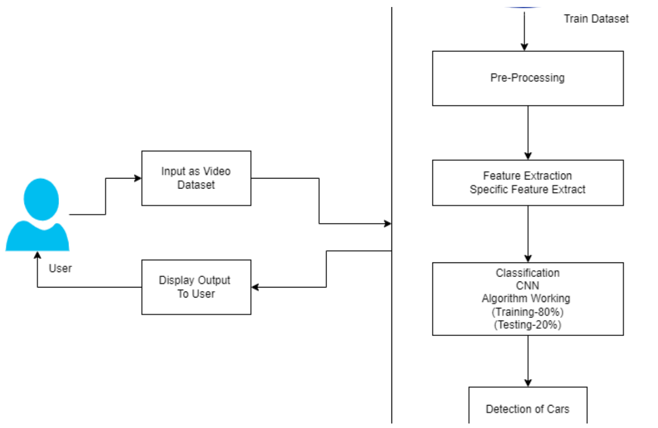


Figure 1:SYSTEM ARCHITECTURE DIAGRAM

- **Input** :- Input as Video Dataset
- **Preprocessing** : - Preprocess dataset, data mining, transforming raw data into understandable format, remove the noise and blur part of the dataset.
- **Feature extraction** :- Extract the features for classifications.
- **Classification** :- Classify the objects in video through Yolo v5 algorithm.
- **Output** :- Detect the Traffic control in video and send alert pop-up message.

B. Algorithm

- **YOLOv5** (You Only Look Once version 5) is a state-of-the-art object detection algorithm that can be adapted for video classification tasks. It is an advanced object detection model that uses a combination of convolutional layers and other neural network components to achieve high performance. The architecture of YOLOv5 can be divided into several key parts: Backbone, Neck, and Head. Here's a breakdown of the layers and components typically found in the YOLOv5 model:

1. Backbone

The Backbone is responsible for extracting essential features from the input images. YOLOv5 uses CSP (Cross Stage Partial) Darknet as its backbone, which is an improvement over the original Darknet used in YOLOv4.

- Convolutional Layers: These layers apply filters to the input image to detect various features.
- Batch Normalization: Normalizes the output of the convolutional layers to stabilize and accelerate training.
- Leaky ReLU Activation: Introduces non-linearity into the model to help it learn complex patterns.
- CSP Bottleneck: This component splits the feature map, processes it through a series of layers, and then merges it back together to enhance gradient flow and reduce computational complexity.

2. Neck

The Neck in YOLOv5 is designed to generate feature pyramids, which help in detecting objects at different scales. This part often includes PANet (Path Aggregation Network) layers.

- FPN (Feature Pyramid Network): Combines features at different scales, making the model more robust to objects of varying sizes.
- PANet Layers: Enhances the propagation of strong features through the network and improves the localization and classification tasks.

3. Head

The Head is where the final predictions are made. YOLOv5 uses anchor boxes and predicts the bounding boxes, objectness scores, and class probabilities.

- YOLO Layers: These layers are responsible for making the final predictions. They use anchor boxes to predict the bounding boxes and apply sigmoid activation functions to output probabilities

C. Stages Involved

i). Setting Up the Environment:

First, ensure you have the necessary libraries and environment set up.

ii). Load YOLOv5 Model:

Load the pre-trained YOLOv5 model.

iii). Process Video Frames:

Read the video file frame by frame and apply the YOLOv5 model to each frame

iv). Extract and Process Detection Results:

Extract detection results from the YOLOv5 model and process them for video classification.

v). Classification Logic

Implement logic to classify the video based on the detected objects in the frames.

vi). Optional: Save Processed Video

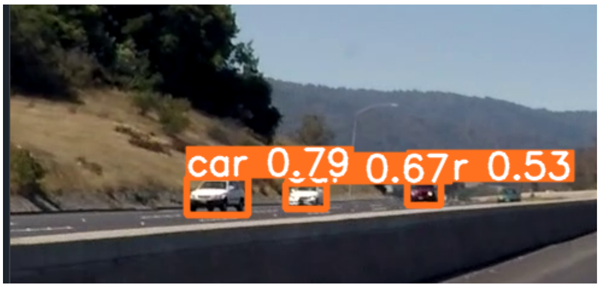
Save the processed video with annotations and classifications.

vii) Display the result:

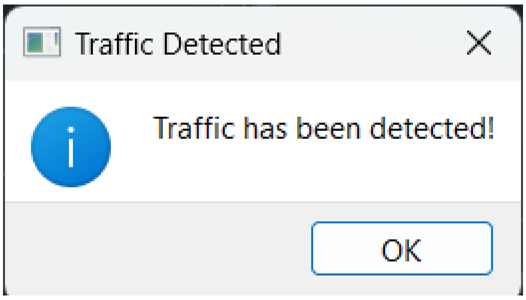
The result or the output is displayed.

V. RESULTS

Car detection.



Pop up alert.



Accident detection (Another module integrated with original module) It is implemented using CNN.

VI. CONCLUSION

In conclusion, traffic control detection plays a pivotal role in modern transportation systems, with its significance stemming from the pressing need for safer, more efficient, and sustainable roadways. This technology-driven approach to traffic management and safety has evolved to address a myriad of challenges associated with urbanization and increased vehicular traffic. It leverages technology, data analysis, and automation to create safer, more efficient, and sustainable transportation systems that benefit both individuals and society as a whole. By continually advancing and integrating these detection systems, we can look forward to a future with improved road safety, reduced congestion, and enhanced urban mobility..

VII. REFERENCES

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