AI BASED-TIME TABLE GENERATION AND TIME PREDICTION SYSTEM FOR VEHICLE

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***Abstract*—A transportation system that is healthy, sustainable, and efficient must have public transportation as a component. This helps alleviate traffic jams, enhances air quality, and offers transportation options to those who may not have access to personal vehicles. Precise arrival times are essential.When arrival times are accurately predicted, riders can plan their trips more effectively, transit agencies can improve their service quality, and congestion on the roads can be reduced.There are several factors that can affect the accuracy of arrival times for public vehicles these could include the weather, road construction, and traffic conditions.Transit agencies often use a variety of tools and technologies, such as GPS tracking and real-time data feeds, to help predict and track the arrival times of their vehicles. Overall, GPS tracking in public vehicles can be expensive due to the various costs associated with hardware, maintenance, data, and integration in each vehicle. In this situation, our proposed system became relevant. To estimate the arrival time, deep learning, ocr technology, and machine learning algorithms are applied in our proposed system.The study employs a deep learning algorithm to recognize vehicles in a video, identify license plates, and extract the corresponding numbers using OCR technology. The resultant data, along with the processing time, is stored in a database for subsequent processing. Along with this another model is also trained to detect the vehicle type and filter the processed vehicle data by vehicle type bus which removes redundant data in the obtained data.Vehicle number, vehicle type, source, destination, and historical time are some of the elements in the dataset that are taken into account for prediction.This technique handles the problem of forecasting the vehicle arrival time cost effective and can be implemented using existing hardware and available dataset.Overall , predicting the arrival times of public buses is important for both riders and transit agencies, as it can help to improve the efficiency, reliability, and attractiveness of public transportation.**

Keywords—prediction, vehicles, arrival time, machine learning ,YOLOv5 .

I. INTRODUCTION

A time prediction system for vehicles is a system that uses data and algorithms to evaluate the arrival time of a vehicle at a specific location. These systems can be used in various types of transportation, including public transportation (such as buses, trains, and trams) and private transportation (such as taxis and ride-hailing services). Time prediction systems typically use a combination of data sources to generate estimates, including schedules, real-time tracking data, and traffic data. In an effort to enhance the precision of predictions, some systems make use of machine learning algorithms. Such time prediction systems are valuable to passengers as they allow them to plan their journeys and minimize their wait time. They can also be useful for operators, as they can help them optimize routes and schedules and improve the overall efficiency of the transportation system. Overall, time prediction systems can help improve the reliability and convenience of transportation, making it easier for people to get where they need to go.

It can be difficult to estimate when a bus will arrive because of a variety of uncontrollable circumstances, including changes in travel demand, shifting traffic conditions throughout the day and week, interference from other vehicles, delays at junctions, accidents, and weather. The irregular and random nature of these factors make bus arrival time highly uncertain.

By identifying the number plate on the car from the CCTV video captured on the roadways, the data needed for the forecast of the vehicle's arrival time is produced. You can use computer vision techniques to detect vehicles and number plates, specifically object detection algorithms. These algorithms allow you to identify and locate objects within an image or video by training a model to recognize specific features and patterns in the data. There are many pre-trained object detection models available, such as YOLO (You Only Look Once) and Faster R-CNN, that you can use to detect vehicles and number plates. These models have already been trained on large datasets and can be fine-tuned for your specific use case.

In the end, the precision and efficiency of a vehicle arrival time prediction model will hinge on three crucial elements: the model itself must be complex, the training data must be of high quality, and the predictions must be tailored to a particular use case.

II. REVIEW OF RELATED LITERATURE

1.*Utilizing machine learning, anticipate travel times proposed by Leone Pereira Masiero and Marco Antonio Casanova* [3]

In this paper, the authors describe how they convert raw trajectory data into aggregated data, and then use this data to analyze vehicle behavior. One advantage of their approach is that it can help travelers make better decisions about trip planning and routing. However, a limitation of the study is that the methodology has not been fully validated with real-time data, and it can only predict the arrival times of transit vehicles.

2. Vehicle arrival time forecasting in real-time using historical data proposed by Santa Maiti and Arpan Pal [4]

The authors of this paper have used Connect-Port X5 R devices to gather data from buses. One advantage of this approach is that it provides real-time information about the location of vehicles, which can make predictions more accurate. However, a disadvantage is that the amount of information used as input features is quite limited. Additionally, the methodology is only able to predict the arrival times of transit vehicles, and it may not be feasible to install the required devices in every vehicle.

3. An Intelligent Transportation System with an Edge Traffic Flow Detection Method Based on Deep Learning proposed by Chen Chen and Bin Liu [1]

The primary objective of this article is to put forward a novel traffic flow detection approach for an intelligent transportation system (ITS) that deals with the issues presented by conventional cloud computing-based systems. The proposed scheme aims to provide efficient and accurate traffic flow detection using deep learning on the edge node.The merits of this paper is it eliminates the need for extensive storage, communication, and processing capabilities required by traditional cloud computing-based systems. The demerits of this paper is it require a large amount of training data and computational resources

4. A Model for Predicting Bus Arrival Times Based on Past Traffic Patterns proposed by Haitao Yu and Randong Xiao [5]

This study employs GPS data to create a travel-time forecast model. The availability of real-time vehicle locations enhances the accuracy of the prediction. However, the system only forecasts the arrival and departure times of transit vehicles.

5. Weighted historical and real-time GPS data is used in a hybrid dynamic prediction model for bus arrival time proposed by Jun Gong and Mingyue Liu [6]

The present study describes the application of a hybrid moving average and dynamic adjustment technique to enhance the precision of predictions. The resulting improvement in the quality of real-time transit information leads to an overall increase in the quality of public transport service. However, the prediction method is only capable of estimating the arrival and departure times of transit vehicles, and installing the required device in every vehicle may not be a feasible solution.

6. A Comparative Study of Travel Time Prediction and Explanation Using Spatial and Temporal Features proposed by Irfan Ahmed and Indika Kumara [7]

The current study investigates and assesses the performance of Ensemble learning, Neural Networks, and Support Vector Machine Regression models for the purpose of travel time prediction. The models can be applied to predict and explain travel time in the logistics sector and freeway travel. However, the limited hardware capability renders the training of an SVR model infeasible.

7. Integrating RFID, ALPR, and WSN into a smart parking management system proposed by Hans Chandra and Michael [8]

This paper introduces a Smart Parking Management System (SPMS) that utilizes a combination of Radio Frequency Identification (RFID), Automatic License Plate Recognition (ALPR), and Wireless Sensor Network (WSN) technologies. The SPMS is paired with a customized Android application that displays real-time updates on parking space availability and facilitates parking space reservation. It is worth noting that the RFID technology is only functional within a limited range of the reader's radio coverage area.

8. A Versatile Method for Recognizing License Plates Automatically in Unrestricted Situations proposed by Sergio M. Silva and Cláudio Rosito Jung [9]

The current study puts forth an Improved Warped Planar Object Detection Network (IWPOD-NET) capable of detecting the four corners of a license plate under diverse conditions. The research outlines a comprehensive Automatic License Plate Recognition (ALPR) system that prioritizes unconstrained capture scenarios. Notably, the image processing phase consumes a substantial amount of time to complete.

III. METHODOLOGY

NUMBER PLATE DETECTION

To detect a vehicle's license plate using computer vision techniques, several steps are typically involved. These may include acquiring images or video frames containing the license plate using a camera or other image capture device, pre-processing the images to improve their quality and make the license plate more visible, extracting features from the image that can be used to locate the license plate, and recognizing and extracting the license plate information using pattern recognition algorithms or by training a neural network on a large dataset of labeled images. The specific methodology used for vehicle number plate detection may depend on the characteristics of the images being processed and the requirements of the application.

VEHICLE TYPE DETECTION

To detect the vehicles from the video we use YOLOv5 (You Only Look Once version 5).YOLOv5 is a state-of-the-art object detection algorithm for real-time object detection. In the context of vehicle detection, YOLOv5 uses a deep neural network to detect and locate vehicles in an image or video. The algorithm takes an input image, divides it into a grid of cells, and for each cell, it predicts the presence and location of multiple objects,including vehicles. The output of the network is a set of bounding boxes around each detected object, along with a confidence score indicating the likelihood of the detection being correct. YOLOv5 is highly accurate and efficient, making it well-suited for real time applications such as self-driving cars and video surveillance systems. YOLOv5 is a single-shot object detection algorithm, meaning it performs object detection in one forward pass through the network. The algorithm can be divided into several key steps such as image pre-processing, grid cell assignment,feature extraction , bounding box prediction, non-maximal suppression and the output.

1. YOLOv5s

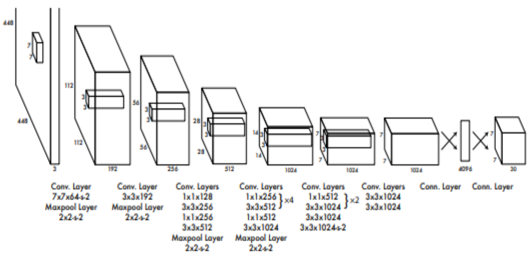


Fig. 1. YOLOv5 Architecture

YOLO algorithm is an object detection method that partitions images into a grid to identify objects. YOLO is recognized for its accuracy and speed, and the latest version, YOLOv5, will be released by Ultralytics in 2020. YOLOv5s has a compact parameter size of only 27M, which is 1/9 the size of YOLOv4 and requires minimal memory and energy. YOLOv5s has three components: the head network, neck network, and backbone network. The input image is first processed by the backbone network, followed by feature fusion through PANet (Path Aggregation) and SPP (Space Pyramid Pooling). The head network then predicts the bounding box, category, and confidence using output feature maps from three different scales.

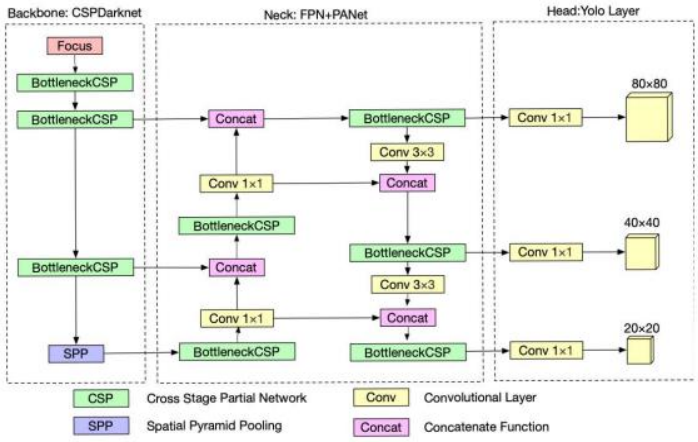


Fig. 2. YOLOv5s Network structure.

PREDICTION

In order to predict the arrival time of vehicles using historical data, we implemented a linear regression model in Python using the scikit-learn library. Linear regression is a simple and popular method for predicting a continuous target variable based on one or more predictor variables. We began by loading the historical data into a Pandas dataframe. The data contained the following columns: 'vehicle_number', 'date', and 'time'. We used the 'vehicle_number' and 'date' columns as the predictor variables, and the 'time' column as the target variable. Subsequently, we divided the data into training and testing sets using the train_test_split function from the scikit-learn library. This step is crucial as it enables us to assess the model's performance on data that it has not seen before. We then created a linear regression model using the LinearRegression class from scikit-learn. We trained the model using the training data by calling the fit method, which fits the model to the data using an optimization algorithm.Once the model was trained, we used it to make predictions on the test data by calling the predict method. We evaluated the model's performance through the use of the mean squared error (MSE) metric, which calculates the average of the squared differences between the predicted and actual values. To make predictions with the model on new data, it's simply a matter of utilizing the predict method with the new data as input. This linear regression model presents a straightforward and effective solution for forecasting the arrival time of vehicles utilizing historical data.

BACKEND

The backend of the proposed system is a software component that is written in the Python programming language and is responsible for handling data processing and machine learning tasks. It provides a set of application programming interfaces (APIs) that can be used to send and receive data from a database for further processing. The backend uses machine learning algorithms to perform predictions of arrival times based on stored data. It also includes functionality for authenticating and authorizing incoming data sources to ensure the integrity of the data, as well as for validating and sanitizing received data to ensure it is in a suitable format for processing. The backend serves as a bridge between the frontend (web application) and the database, allowing the frontend to store and retrieve data and perform predictions using the machine learning algorithms provided by the backend. The backend plays a crucial role in the suggested system and is responsible for managing data processing, carrying out machine learning operations, and establishing a link between the frontend and the database.

IV. RESULT

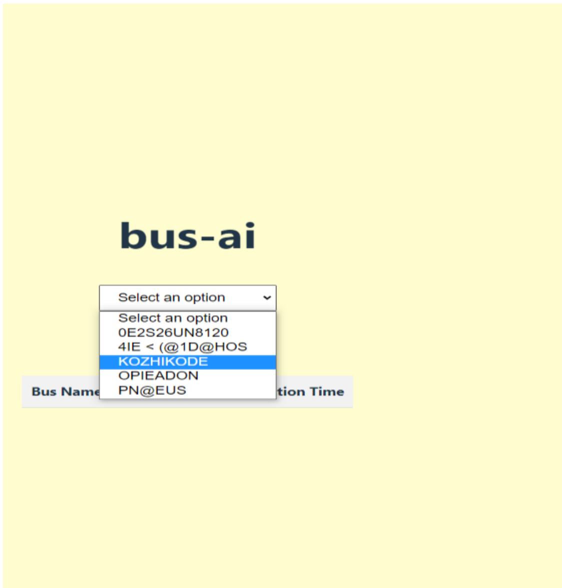
This model is used to identify the arrival time of a transit vehicle(bus) by detecting the number plate and the placeboard with the help of different algorithms such as YOLOv5.

Fig. 3. Labeled image

Fig. 4.Detected image

_id: ObjectId('6461fc0113107bef9bad10e6')
filename: "0019.jpg"
data: Object
placeboard: "4IE < (@1D@HOS"
busname: "KSRTC"
number_plate: "KL159596"
detection_day: 15
detection_date: "2023-05-15"
detection_month: "May"
detection_year: 2023
detection_time: "14:57:41"

Fig. 5. Extracted data from database



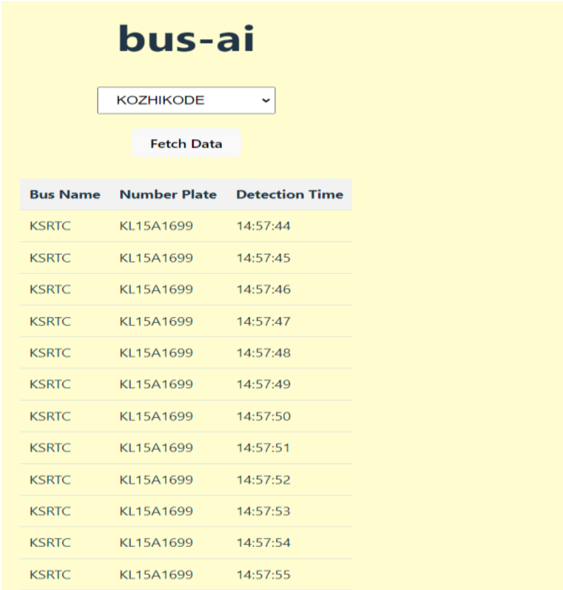


Fig. 6. UI for arrival time listing

RESULT ANALYSIS

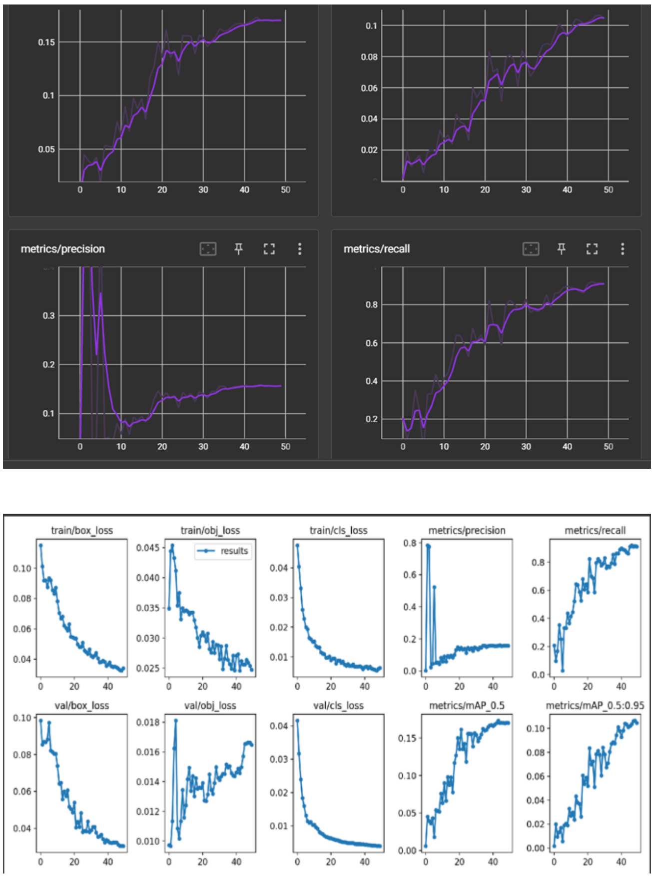


Fig. 7.Graph for accuracy and performance of labeled images

V. CONCLUSION

Predicting the arrival time of vehicles such as buses or cars is a prevalent use case for machine learning. There are multiple factors that can impact a vehicle's arrival time, such as traffic, weather, and the vehicle's schedule and path. To employ machine learning in predicting the arrival time of a vehicle, data on the vehicle's previous arrival times and the factors that could have influenced them must be collected. This data can then be used to train a machine learning model to make predictions about the vehicle's future arrival times.Overall, the use of machine learning for arrival time prediction can help to improve the efficiency and reliability of transportation systems by providing more accurate arrival time estimates to passengers and other stakeholders.

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