

Revolutionizing Urban traffic control with Artificial Intelligence: A Review

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Abstract: Artificial intelligence (AI) has the potential to revolutionize traffic flow management and road safety. In this piece of examination, we present a traffic signal framework that uses computer-based intelligence to upgrade the progression of vehicles in metropolitan regions. A machine learning algorithm is used in our system to analyze real-time traffic conditions data and make predictions about the best routes for vehicles and how to control intersections. We exhibit the viability of our framework through reproductions and contrast its presentation with conventional traffic signal techniques. In light of our discoveries, the computer-based intelligence based traffic signal framework is prepared to do essentially shortening travel times and expanding wellbeing, bringing about a more useful and pleasurable driving experience for drivers.

Keywords: Traffic control system, machine learning algorithms, sensors and camera, safety improvement

1. Introduction

Urban areas all over the world face significant challenges, including controlling traffic flow and ensuring road safety. With the rising number of vehicles out and about, conventional strategies for traffic signal have become less viable in overseeing blockage and further developing in general transportation effectiveness. To resolve these issues, there is a developing interest in utilizing computerized reasoning (man-made intelligence) to upset traffic the board frameworks. In this review, we present an original traffic light framework that uses man-made reasoning (simulated intelligence) capacities to upgrade vehicle stream in metropolitan conditions. Our framework integrates the most recent advances, including sensors and cameras, to gather constant information on traffic conditions. By utilizing this information, we can pursue informed choices that add to successful traffic the executives. Through the utilization of AI calculations, we examine the gathered information, empowering us to make exact expectations and further develop vehicle directing and convergence control.

The essential target of our review is to exhibit the adequacy of man-made intelligence based traffic light frameworks in further developing travel times and upgrading street wellbeing. Through broad reenactments and execution assessments, we contrast the exhibition of our framework and customary traffic signal techniques, featuring the advantages and benefits it offers. Our exploration discoveries show that simulated intelligence-based traffic light frameworks can possibly altogether diminish travel times for drivers and upgrade by and large street wellbeing. Our system is capable of dynamically adapting to shifting traffic patterns, maximizing signal timings, and making real-time route recommendations by utilizing predictive analytics and real-time data. This outcomes in smoother traffic stream, less clog, and a more useful and lovely driving experience for drivers.

The structure of this paper is as follows: We will discuss the data collection, machine learning algorithms, and system architecture of our AI-based traffic control system in the following sections. We will then introduce the consequences of our recreations and execution assessments, contrasting the exhibition of our framework and traditional techniques. At long last, we will examine the ramifications of our discoveries, feature the capability of simulated intelligence in changing rush hour gridlock the executives and propose roads for additional exploration and execution.

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Generally speaking, our exploration adds to the developing group of information on simulated intelligence based traffic signal frameworks, giving significant bits of knowledge into their viability and potential to change metropolitan transportation.

2. Literature Review

To take care of this issue, a potential arrangement proposed in [1] includes the utilization of video handling. The video transfer goes through handling prior to being communicated to the servers. The outcomes are produced there with the assistance of a C++-based calculation. At the point when hard code and dynamic coding were looked at, the unique calculation beat hard code by 35%.

For of decreasing traffic and stand by times, a framework in view of the Arduino-UNO is recommended in reference [2]. This framework takes pictures with its camera. From that point forward, the photos are handled in MATLAB to dispose of varieties and immersion and transform into an edge picture that is utilized to gauge the traffic thickness. Preconfigured proliferation packs are used, and MATLAB and Arduino are related through USB. The Arduino calculates the time each path has a green light in light of traffic volume and thickness. However, there are a few drawbacks to this strategy. It is difficult to definitively count the number of vehicles because they frequently cross over. Plus, since different things were moreover gone to exceptionally differentiating, it was hard to perceive vehicles and ordinary articles like releases, shafts, and trees. As per a review led by reference [3], a modified traffic signal arrangement is proposed to adjust to the ongoing traffic circumstance. Two fuzzy controllers, each with three inputs and one output, are used in the system to control the primary and secondary ramps. VISSIM and MATLAB were utilized to further develop the mimicked light traffic conditions.

Reference [4] offers an extraordinary way to deal with tending to literary theft worries inside scholarly exploration. In this review, a fluffy regulator and a smart traffic signal framework utilizing Counterfeit Brain Organization (ANN) are presented. The camera-captured images from various traffic areas are used in the proposed system. To handle the pictures, a grayscale change is at first applied, trailed by additional standardization. To precisely include the vehicles in the picture, we utilize a Counterfeit Brain Organization (ANN) in the wake of portioning the picture. This guarantees precise counting of strategies, no matter what their size. The subsequent result is then utilized by a fluffy regulator to progressively change the red and green result spans of the traffic signals. The typical mistake pace of the outcomes was 2% and the execution time was 1.5 seconds.

The methodology introduced in reference [5] coordinates a picture handling calculation with a help vector machine (SVM) calculation. Pictures in little edges are removed from live video and afterward the calculation is utilized. OpenCV is utilized to deal with the pictures, and grayscale is changed over completely to the pictures before SVM is utilized. As well as estimating traffic volume, this device can identify red light infringement. Reference [6] talks about utilizing traffic thickness and picture handling procedures to manage versatile light clocks. This system includes transmission based on UART principles, microcontroller-controlled traffic light timing, high-resolution image sensors, and MATLAB. Coincidentally, this technique has an issue in that neither embraced emergency vehicles nor disasters at the intersection point are given need.

In Reference [7], numerous strategies for traffic light management systems are discussed. This study observes that each procedure has a relative plan, which integrates picking input data, eliminating traffic limits from it, dealing with it, figuring out thickness, and invigorating limits. One methodology includes the utilization of VANETs (Vehicle Specially appointed Organizations) to gather area information of individual vehicles. Then, this information is Sent by GPS to the closest astute traffic signal. framework incorporated at the separate traffic signal. These ITLs will likewise send refreshed data to vehicles that are close to them. In the event of an accident, drivers would be informed, allowing them to choose a different route to avoid traffic. This strategy is illogical because of the significant expense of execution.

The subsequent method makes use of transmitters and beneficiaries to collect each vehicle's unique identification number using microcontrollers based on infrared sensors. Vehicles can be distinguished in a crisis utilizing radio

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recurrence labels, permitting other portability vehicles. Infringement of the red light standard are distinguished with this method. However, the absence of customization in this approach originates from the need to make the infrared sensor noticeable.

The third approach makes use of two soft justification adjusters and employs a soft justification strategy. The main agent is answerable for drawing out the span of the green stage at the crossing point, while the subsequent agent features the meaning of the sign. Input information procurement sensors are cameras connected to the info and result lines. The controller then makes decisions to reduce the target function based on the information it receives from these sensors. A fourth methodology utilizing fluffy rationale includes input boundaries like the all out quantities of vehicles and the typical speed of traffic in the two bearings. Estimating the volume of cars and the average speed of traffic is made possible by using sensors. The fifth strategy gathers data from far off photoelectric sensors and communicates it to the traffic regulator. The traffic controller then evaluates each route independently and adjusts the traffic lights as necessary. In any case, it ought to be noticed that upkeep costs for this framework are moderately high.

In the 6th technique, the information are caught utilizing video imaging. Dynamic foundation deduction and various morphological cycles are used to get a perfect picture of the car. Each time a vehicle enters the designated zone, a new square is formed, and the number of vehicles increases. Albeit the strategy is not difficult to use, there is compelling reason need to cover shadows or obstructions. Partaken in the worldwide gathering on AI and computer science in 2005, the review "Canny Participation Control of Metropolitan Traffic Organizations" [8] was introduced. The review expects to foster a clever framework that have some control over and oversee traffic networks in urban communities. To improve efficiency and simplify traffic flow, the authors propose a cooperative control strategy that makes use of cutting-edge machine learning techniques. The framework endeavors to work on the coordination and cooperation of traffic signals, bringing about a more wise and responsive metropolitan traffic the executives framework. This is achieved by blending wise calculations with constant traffic information and sensor data.

The exploration paper named "Continuous metropolitan traffic light framework " depicts the state of the art CRONOS framework for Ongoing city traffic signal. Estimations and Tests" [9] Boillot, Florence, Sophie Medent and Jean-Claude Pierre Lee, which was dispersed in Transportation Investigation Part C: 2006's Arising Innovations. The paper provides an overview of the CRONOS algorithm and in-depth descriptions of the tests carried out to ascertain its usefulness. CRONOS proposes to streamline traffic light timings in metropolitan regions by melding complex traffic stream models, dynamic control calculations, and continuous information handling, eventually improving traffic productivity and facilitating clog. The review's discoveries advance information on traffic signal frameworks and shed light on the potential benefits of executing them in metropolitan settings.

The review "An investigation of remote sensor networks for metropolitan traffic observing:" looks at the utilization of WSNs for traffic checking in urban communities. applications and designs" by Kafi, Mohamed Amine, and others [10] The paper takes a gander at different WSN advancements and applications that could be utilized to gather continuous traffic information in urban communities. It causes to notice the benefits of embracing WSNs for traffic checking, including better traffic light, less clog, and expanded street security. The paper offers a careful examination of the applications and structures included and offers supportive bits of knowledge into this present reality organization of WSNs in metropolitan rush hour gridlock observing frameworks.

The review "Movement for SITRAFFIC: A Cutting edge Way to deal with Metropolitan Traffic Control"[11] acquaints a spic and span approach with overseeing traffic in urban communities. The idea of SITRAFFIC, a framework that utilizes smart transportation frameworks to further develop traffic the board in metropolitan regions, is introduced by creators Busch and Kruse. To further develop proficiency and decrease blockage on city streets, the paper, A paper introduced examines the utilization of cutting edge calculations and innovations for traffic signal.

The main point of the article "Advancement of an IoT-based Constant Traffic Checking Framework for City Administration" [12] by Zarrab, Polyaramid, and Awadalla is the sending of a traffic observing framework based on the Internet of Things (IoT). An ongoing traffic checking innovation for viable city administration is depicted in the paper. what's more, it was distributed in the diary Worldwide Changes in 2020. The creators put areas of strength for an on the utilization of IoT gadgets and information examination to accumulate and dissect traffic information, permitting specialists to improve decisions about how to oversee metropolitan traffic.

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In their study, "Intelligent Ecofriendly Transport Management System Based on IoT in Urban Areas," Ajay and colleagues [13] propose a smart transportation management system for urban areas. The examination, which will be distributed in 2022 in the diary *Climate, Improvement and Supportability*, centers around utilizing Web of Things (IoT) innovation to make a harmless to the ecosystem transportation framework. To further develop transportation tasks, cut outflows, and advance manageable metropolitan turn of events, the creators stress the combination of shrewd sensors, information examination, and continuous checking.

A savvy traffic the executives framework explicitly made for metropolitan urban communities is introduced in Praveen and Raj's work, "Shrewd Traffic The board Framework in Metropolitan Cities," [14] which was distributed in 2021 in the *Diary of Encompassing Knowledge and Refined Processing*. The creators discuss the utilization of the most recent innovations like man-made brainpower, information investigation, and others to further develop traffic stream and diminish blockage. also, canny sensors. to have the option to achieve viable and reasonable traffic the board, the review stresses the benefits of consolidating shrewd framework and wise dynamic calculations in metropolitan districts.

A brilliant city's wise programmed traffic light framework, utilizing remote sensor organizations, is portrayed in the paper named "Mechanized Continuous Canny Traffic Signal Framework for Shrewd Urban communities Utilizing Remote Sensor Networks" [15] by Hilman, Mazzite, and Hassouni. to have the option to accumulate ongoing traffic information and apply cunning calculations for viable traffic signal, the creators recommend utilizing remote sensor organizations. The review centers around the advantages of robotized navigation and constant checking in creating traffic light procedures for savvy urban communities.

"City Traffic Surveillance," a book by Butyl, Eugen Valentin, and Răzvan Gabriel Boboc. furthermore, *Investigation Utilizing Automated Airborne Vehicles (UAVs): A Deliberate Writing Survey* [16], was delivered in Remote Detecting in 2022. This report offers an exhaustive assessment of the earlier examination on the utilization of automated elevated vehicles or UAVs to screen and break down traffic in urban communities. To decide the ebb and flow status of examination around here, the creators basically assess various investigations. The objective of the review is to introduce an exhaustive handle of the capability of UAVs in checking and dissecting metropolitan traffic while featuring their advantages, challenges, and expected future purposes.

In the article named "A Complete Survey on Traffic Signal Displaying for Accomplishing Manageability Goals in Road Traffic Conditions" by Sheik, Mohammad Samir, and Yinqiao Peng, the writers give a careful audit of different traffic light demonstrating strategies utilized in turnpikes. do Traffic conditions [17]. The reason for this paper is to feature the techniques used to accomplish maintainable targets in rush hour gridlock the executives. "A Clever Traffic Light Framework Utilizing Neutrosophic Sets, Unpleasant Sets, Diagram Hypothesis, Fluffy Sets and Its Augmentations: A Writing Survey" by Syed, Broomey, et al. [18] spotlights on a wise traffic signal framework that integrates numerical ideas, for example, neutrosophic sets, harsh sets, diagram hypothesis and fluffy sets to upgrade traffic light.

A concentrate by Kotsialos, Apostolos, and Polyxeni Vassilakopoulou [19] named "Armada The executives Undertaking Frameworks and Traffic Light Coordination: A Writing Survey and Exploration Plan" presents a writing audit and examination plan that investigates armada the executives endeavor frameworks. Assesses similarity among framework and traffic. with the intention of enhancing transportation control, effectiveness, and sustainability.

In an exploration paper named "Profound Implementation Picking up Utilizing Keen Traffic Signal Framework" by Anirudh, R., Mithankrishnan, and Akshay Kikoda [20], a canny traffic light framework is proposed, which enhances the traffic stream. uses techniques of deep reinforcement learning to build and reduce. the group. Jatoi, Muhammad Uzair directed an efficient survey named "A Precise Survey of Picture Handling Methods Utilizing Insightful Savvy Traffic Signal Frameworks (ITCs)" [21]. The audit centers around the utilization of picture handling strategies to enhance traffic the executives inside keen shrewd traffic light frameworks.

Kamio, Nahoku, in a survey paper [22], audit the book "Dead Retribution: Aviation authority, Framework Impacts, and Hazard" and deal bits of knowledge into its substance and commitments. Lee, Romain, et al. [23] in their paper titled "A traffic control optimization strategy based on license plate recognition data" suggest a traffic control

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optimization strategy to effectively manage congestion and improve traffic flow. It utilizes tag ID information. Jain, Naman, Richit Parwanda, and Anamika Chauhan in their paper "Constant Brilliant Traffic Signal and Recreation: A Methodology for Metropolitan Clog The board" [24] have introduced a methodology for constant shrewd traffic signal and reproduction, which The point is to actually make due. metropolitan group.

3. Proposed System

A. Outline of the proposed framework

Our suggested game plan uses pictures dealing with and article revelation to learn persistent traffic thickness from pictures got by CCTV cameras put at convergences. Pygame is an adaptable Python module used for creating computer games and interactive media applications. It gains by PC designs and sound libraries that consistently coordinate with the Python programming language. The number of cars, bicycles, buses, and trucks in each class is counted to determine traffic volume. The sign exchanging calculation execute thickness estimations and different factors to synchronize the planning of the green sign for every path, which thus changes the planning of the red sign. The green signal time is limited to certain maximum and minimum values to ensure that no lane is left empty. Moreover, a recreation is created to exhibit the viability of the framework and contrast it and the current static framework, subsequently featuring the distinctions.

B. The Vehicle Detection Module

The framework being proposed consolidates the Consequences be damned calculation for vehicle recognition, which is known for its quick handling pace and high exactness in vehicle identification. The vehicle acknowledgment growing experience utilizes a custom Just go for it model that can perceive bicycles, vehicles, enormous vehicles (like transports and trucks), and carts.

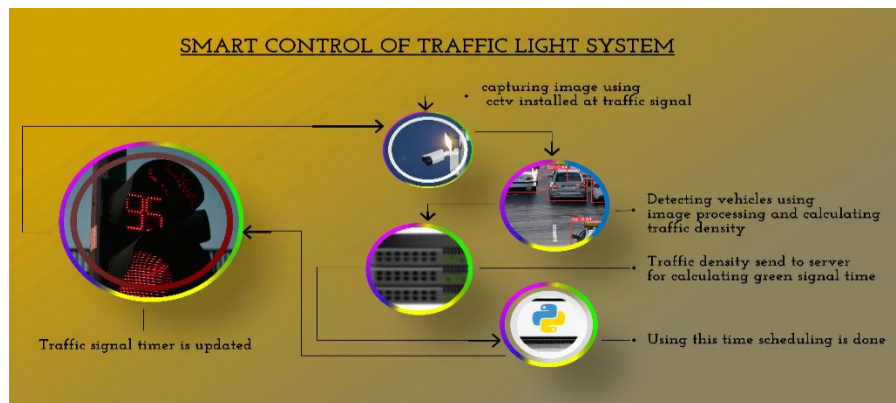


Figure 1. System Model

The "You Only Look Once" (YOLO) algorithm is a cutting-edge Convolutional Neural Network (CNN) for real-time object detection. This approach contrasts from others by utilizing a solitary NN to deal with the whole picture and afterward section it into locales. YOLO thus generates potential predictions and bounding boxes for each region. Since it can run consistently and accomplish unprecedented accuracy, Who cares about anything else is famous. As in it simply needs to perform one forward causing go through the mind association to make assumptions, the estimation "looks immediately" at the image. It yields perceived things close by the bouncing boxes following nontax disguise (which ensures the article acknowledgment computation simply separates every thing once). A solitary CNN can at the same time foresee numerous bouncing boxes and class probabilities utilizing Just go for it. The CNN Consequences

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be damned spine can be additionally advanced to accelerate handling. An open-source mind network system called Darknet was inherent C and CUDA. It maintains focal processor and GPU calculation, hurries to game plan, and is fast. In ImageNet, Only put it all on the line gets 72.9% top 1 accuracy with Darknet and 91.2% top 5 precision. Darknet by and large uses 3 3 channels for incorporate extraction and 1 1 channels for yield channel decline. Worldwide normal pooling is also used to set expectations.

The dataset utilized for model preparation was produced by gathering pictures from Google and in this manner explaining them physically with the help of LabelMe, a graphical picture comment device. By changing the class variable, The last layer of the brain network was altered to change the quantity of result neurons to the absolute number of classifications that the model expected to separate. In our system there were 4 of them: bicycle, transport, truck, cart and vehicle. In our model, 45 channels are expected by changing the $5 \times (5 + \text{number of classes})$ equation. The model was ready until the hardship was a ton of lower and as of now not had every one of the reserves of being decreasing following making these arrangement changes. The exercise was now over, and the loads had been adjusted to deal with our problems. The loads that were placed into the program were then used to distinguish vehicles utilizing the Open the resume library. The limit is Fruitful distinguishing proof of items requires a base degree of certainty. In the wake of applying the model to the picture, it returns the outcomes in JSON design or as key-esteem matches. The names are represented by the keys, and the properties and directions of the identified objects are shown by the values. To reproduce jumping boxes on pictures utilizing given marks and organizes, OpenCV can be utilized.

Our vehicle detection model was tested using the test images in the figure. On the right half of the image, diagrams and marks were added utilizing a vehicle location calculation. On the left, you can see the original picture.

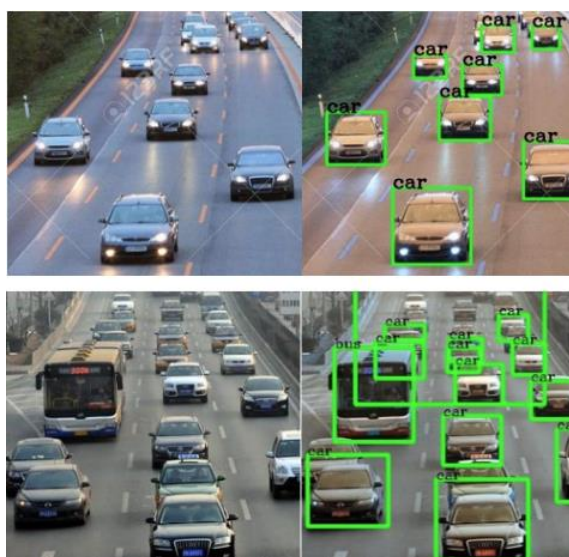


Figure 2. Results of Vehicle detection

C. Module for exchanging signals

The vehicle acknowledgment module's traffic thickness data is used by the Sign Changing Computation to set the green sign clock and update other lights' red sign clocks. Additionally, it traverses the signals in sync with the timers. The area module's data on the perceived vehicles, as depicted in the principal fragment, is used as a commitment by the computation. This information is introduced in JSON design, with the article's name as the key and the certainty and directions as the qualities. The going with parts were considered while making the computation:

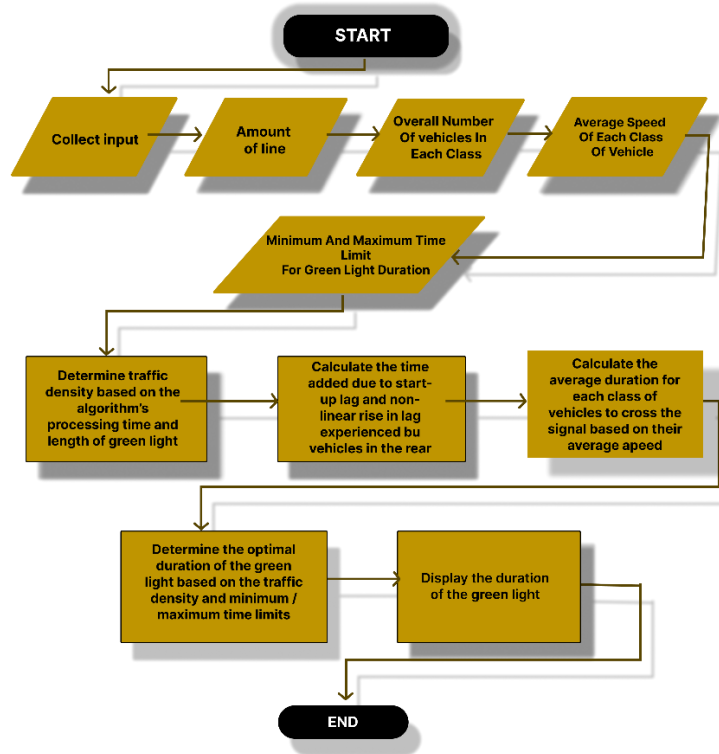


Figure 3. Working Flow

At the point when the estimation is initially begun, it sets the default time for the primary circle start sign and all resulting circle signs, and the times for the leftover principal circle signs. The live sign clock is overseen by the principal string and a subsequent string is begun to deal with vehicle identification toward every path. When the current green light clock (or the next green light clock) reaches 5 seconds, each channel will show the next route. After breaking down the outcome, a clock is set for the following green sign. Since the base string abbreviates the term of the ongoing green tick on the clock, this is totally finished covertly. Consequently, there is no free time during the clock movement. At the point when the ongoing sign's green clock arrives at nothing, the calculation decides the term for which the following sign will be green. The photograph is taken when the sign, which in this way becomes green, is five seconds separated. This permits the framework to handle the picture, distinguish and count the vehicles having a place with For each class that is noticeable in the picture, decide the span of the green sign as well as the particular lengths for each class for both the green and red signs as follows: It takes a sum of ten seconds to change. Signal in a legitimate way. Considering the typical speed and speed increase seasons of the vehicles leaving from the crossing point, the ideal time for the green sign is resolved considering the no. Of vehicles of each class at the sign. In view of the gave information, a guess is determined for the typical term it expects for every classification of vehicle to go through the convergence. Eventually, the length of the green not entirely settled by using condition (1).

$$GST = \frac{\sum_{vehicleClass} (NoOfVehicles_{vehicleClass} * AverageTime_{vehicleClass})}{(NoOfLanes + 1)} \text{-----(1)}$$

In this unique situation, GST alludes to the green sign time. The no Of Vehicles Of Class, average Time Of Class, and no Of Lanes factors address the quantity of paths at the crossing point. Additionally, the number of vehicles detected by the vehicle detection module for each vehicle class on the signal is shown by no Of Vehicles Of Class. To

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further develop traffic the board, it is feasible to determine the typical measure of time it takes for each class of vehicle to get through an intersection in view of the area, i.e., the district, the city, the region, or even the crossing point itself. For this, information from the important vehicle specialists can be inspected.

Traffic lights in our framework are not steered in view of the course with the most elevated traffic thickness at some random time. All things being equal, they follow a foreordained cycle like current traffic signal frameworks. This consecutive example guarantees that signs become green in an anticipated way, staying away from disarray or expecting people to change their way of behaving. Also, we've added yellow signs to the framework, and the sign arrangement continues as before as the ongoing arrangement: red, green, yellow, and red.

D. Simulation Module

A Pygame-based reproduction module was made to imitate certifiable traffic situations and consider the proposed framework in contrast to the ongoing static framework. The reenactment envelops a 4-way crossing point with traffic lights this way and that. In addition to displaying the number of vehicles passing through the intersection, each signal has a timer that displays the remaining time for signal transmission. The simulation includes cars, bikes, buses, trucks, rickshaws, and other types of vehicles. Arbitrary direction decides if vehicles turn at a crossing point or go on straight. Figure 4 shows an example of the simulation output and shows how much time has passed since the simulation started thanks to a timer.

Pygame is an adaptable Python module used for creating computer games and mixed media applications. It gains by PC illustrations and sound libraries that consistently incorporate with the Python programming language. Pygame engages clients to foster component rich games and sight and sound projects, and is viable with different stages and working frameworks.



Figure 4. Simulation output

4. Conclusion

Momentarily, The proposed framework executes a unique way to deal with change the green sign span at a traffic light gadget in view of the ongoing traffic volume. In this methodology, the span of green signs is powerfully changed in view of traffic volume toward every path. By focusing on headings with weighty traffic, the framework expects to further develop traffic stream and decrease blockage. The methodology depicted in this exploration means to lessen pointless deferrals, blockage and holding up times, subsequently diminishing fuel utilization and contamination levels. Traffic light equipment is supposed to facilitate the vehicles. Turmoil would result at convergences and in unambiguous regions on the off chance that traffic signal was missing. The need is given to somewhere safe and secure and effective by controlling how a vehicle moves. According to our findings, the AI-based traffic control system has

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the potential to significantly cut travel times while also improving safety and making driving more pleasurable and productive.

Proposed framework offers a few benefits over other insightful movement control frameworks, including pressure mats and infrared sensors. It is practical by utilizing existing CCTV film from traffic signal cameras, killing the need to introduce extra gear at occupied crossing points. Just negligible arrangement changes might be required. Moreover, support costs are lower than elective traffic checking frameworks, for example, pressure mats, which are inclined to burst when presented to weighty burdens on interstates. For simple administration, the proposed framework can possibly be effortlessly coordinated with shut circuit TV (CCTV) cameras conveyed in wide metropolitan regions. By consolidating this imaginative methodology with CCTV cameras in such regions, better traffic signal usefulness can be accomplished.

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