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Smart Control of Traffic Light Using Artificial Intelligence

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ABSTRACT:

Traffic congestion is becoming one of the critical issues with increasing population and automobiles in cities. Traffic jams not only cause extra delay and stress for the drivers, but also increase fuel consumption and air pollution. Although it seems to pervade everywhere, megacities are the ones most affected by it. And its ever-increasing nature makes it necessary to calculate the road traffic density in real-time for better signal control and effective traffic management. The traffic controller is one of the critical factors affecting traffic flow. Therefore, the need for optimizing traffic control to better accommodate this increasing demand arises. Our proposed system aims to utilize live images from the cameras at traffic junctions for traffic density calculation using image processing and AI. It also focuses on the algorithm for switching the traffic lights based on the vehicle density to reduce congestion, thereby providing faster transit to people and reducing pollution

1.INTRODUCTION :

With the increasing number of vehicles in urban areas, many road networks are facing problems with the capacity drop of roads and the corresponding Level of Service. Many traffic-related issues occur because of traffic control systems on intersections that use fixed signal timers. They repeat the same phase sequence and its duration with no changes. Increased demand for road capacity also increases the need for new solutions for traffic control that can be found in the field of Intelligent Transport Systems. Let us take the case study of Mumbai and Bangalore. Traffic flow in Bangalore is the worst in the world while Mumbai is close behind in fourth position, according to a report detailing the traffic situation in 416 cities across 57 countries. In Bangalore, a journey during rush-hour takes 71% longer. In Mumbai, it is 65% longer

1.1* CLASSIFICATION

Classification is a technique where we categorize data into a given number of classes.The maingoal of a classification problem is to identify the category/class to which a new datawill fall under. Image Classificationis the task of assigning an input image one labelfrom afixed set of categories. This is one of the core problems in ComputerVision that, despite itssimplicity,hasalargevarietyofpracticalapplications.ManyotherseeminglydistinctComputer Vision tasks (such as object detection, segmentation) can be reduced to imageclassification.

1.2ClassificationAlgorithms:

Object Recognition is a technology that lies under the broader domain of Computer Vision. This technology is capable of identifying objects that exist in images and videos and tracking them. Object

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Recognition also known as Object Detection, has various applications like face recognition, vehicle recognition, pedestrian counting, self-driving vehicles, security systems, and a lot more. The two significant objectives of object recognition involve: Identification of all objects that exist in an image Filtration of the object that seeks attention In the following tutorial, we will understand how to perform Object Recognition in the Python programming language using the ImageAI library. We will create a basic object recognition model using the ImageAI library in Python by the end of this tutorial.

1.3 Machine Learning:

Machine learning is a growing technology which enables computers to learn automatically from past data. Machine learning uses various algorithms for **building mathematical models and making predictions using historical data or information.** Currently, it is being used for various tasks such as **image recognition, speech recognition, email filtering, Facebook auto-tagging, recommender system**, and many more.Machine Learning is said as a subset of artificial intelligence that is mainly concerned with the development of algorithms which allow a computer to learn from the data and past experiences on their own

AdvantagesofMachineLearning:

Machine learning is a field of computer science and artificial intelligence that deals with the task of teaching computers to learn from data without being explicitly programmed. It is a type of data mining that allows computers to "learn" on their own by analyzing data sets and using pattern recognition. Machine learning has many benefits, including improved accuracy, efficiency, and decision-making.

Handling large amounts of data: With the ever-growing volume of data generated every day, it is increasingly difficult for humans to process and make sense of all this information. Machine learning can help businesses handle large amounts of data more efficiently and effectively and even use decision trees to take action on the information.

Reducing bias: Machine learning algorithms are not biased toward certain data sets, unlike human beings, who may have personal biases that can distort their judgment. As a result, machine learning can help reduce bias in business decisions.

Improving accuracy: Machine learning algorithms can achieve much higher accuracy than humans when making predictions or

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classifying labeled data. This improved accuracy can lead to better business outcomes and increased profits.

Discovering patterns and correlations: Machine learning can help businesses uncover patterns and correlations in data that they may not have been able to detect otherwise. These learning systems can lead to better decision-making and a deeper understanding of the data.

Making predictions about future events: Machine learning algorithms can predict future events, such as consumer behavior, stock prices, and election outcomes.

1.4Applications of Machine Learning

Image Recognition

Image recognition is one of the most common applications of machine learning. It is used to identify objects, persons, places, digital images, etc. The popular use case of image recognition and face detection is, Automatic friend tagging suggestion: Facebook provides us a feature of auto friend tagging suggestion. Whenever we upload a photo with our Facebook friends, then we automatically get a tagging suggestion with name, and the technology behind this is machine learning's face detection and recognition algorithm. It is based on the Facebook project named "Deep Face," which is responsible for face recognition and person identification in the picture.

Speechrecognition:

While using Google, we get an option of "Search by voice," it comes under speech recognition, and it's a popular application of machine learning. Speech recognition is a process of converting voice instructions into text, and it is also known as "Speech to text", or "Computer speech recognition." At present, machine learning algorithms are widely used by various applications of speech recognition. Google assistant, Siri, Cortana, and Alexa are using speech recognition technology to follow the voice instructions.

Traffic Prediction:

If we want to visit a new place, we take help of Google Maps, which shows us the correct path with the shortest route and predicts the traffic conditions. It predicts the traffic conditions such as whether traffic is cleared, slow-moving, or heavily congested with the help of two ways:

1.Real Time location of the vehicle form Google Map app and sensors

2.Average time has taken on past days at the same time.

Product Recommendations

Machine learning is widely used by various e-commerce and entertainment companies such as Amazon, Netflix, etc., for product recommendation to the user.

Whenever we search for some product on Amazon, then we started getting an advertisement for the same product while internet surfing on the same browser and this is because of machine learning.

1.5 DEEPLEARNING

Deep learning technology is based on artificial neural networks (ANNs). These ANNsconstantlyreceivelearningalgorithmsandcontinuouslygrowingamountsofdatatoincrease the efficiency of training processes. The larger data volumes are, the more efficientthis process is. The training process is called deep, because, with the time passing, a neural network covers agrowingnumberoflevels.Thedeeperthisnetworkpenetrates,thehigherit

Productivity is. DL algorithms can create new tasks to solve current ones.

Advantages of Deep Learning

CreatingNewFeaturesOneofthemainbenefitsofdeeplearningovervariousmachine learning algorithms is its ability to generate new features from a limited series offeatures located in the training dataset. Therefore, deeplearning algorithms can createnewtasks to solve current ones. What does it mean for data scientists working in technologicalstartups? Since deep learning can create features without a human intervention, data scientistscansavemuchtimeonworkingwithbigdataandrelyingonthistechnology.Itallowsthemtousemorecomplexsetsoffeaturesincomparisonwithtraditionalmachinelearningsoftware.

AdvancedAnalysis

Duetoitsimproveddataprocessingmodels,deeplearninggeneratesactionableresults when solving data science tasks. While machine learning works only with labeled data, deep learning supportsunsupervisedlearningtechniquesthatallowthesystemtobecome smarter on its own. The capacity to determine the most important features allows deep learning to efficiently provide data scientists with concise and reliable analys is results.

- APPLICATIONSOFDEEPLEARNING

Automatic speech recognition

Large-scale automatic speech recognition is the first and most convincing successfulcase of deep learning. LSTM RNNs can learn "Very Deep Learning" tasks that involve multi-second intervalscontainingspeech eventsseparated by thousands of discrete time steps,where one- time step corresponds to about 10 milliseconds. LSTM with forget gates iscompetitive with traditional speech recognizers on certain tasks. The initial success in speechrecognition was based on small-scale recognition tasks base on TIMIT. The data set contains630 speakers from eight major dialects of

American English, where each speaker reads 10sentences. Its small size lets many configurations be tried. More importantly, the TIMIT taskconcerns phone-sequence recognition, which, unlike word-sequence recognition, allows weakphone bigram language models. This lets the strength of the acoustic modelling aspects ofspeechrecognition be moreeasilyanalysed.

Imagerecognition

A common evaluation set for image classification is the MNIST database data set.MNIST is composed of handwritten digits and includes 60,000 training examples and 10,000testexamples.AswithTIMIT,itssmallsizeletsuserstestmultipleconfigurations.Acomprehensive list of results on this set is available. Deep learning- basedimage recognitionhasbecome"superhuman",producingmoreaccurateresultsthanhumancontestants.Thisfirstoccurredin 2011.

Military

The United States Department of Defence applied deep learning to train robots in new tasks through observation.

Bioinformatics

AnautoencoderANNwasusedinbioinformatics,topredictgeneontologyannotations and gene-function relationships. Inmedical informatics, deep learning was usedto predict sleep quality based on data from wearables and predictions of health complicationsfrom electronic health record data.

Self-Drivingcars

DeepLearning isthe force that isbringing autonomousdrivingto life.A millionsets of dataare fed to a system to build a model, to train the machines to learn, and then testthe results ina safe environment. Data from cameras, sensors, geo-mapping is helping createsuccinctandsophisticatedmodelstonavigatethroughtraffic,identifypaths,signage,pedestrian-onlyroutes,andreal-time elementsliketrafficvolumeandroadblockages.

Fraud-Detection

Another domain benefitting from Deep Learning is the banking and financial sectorthat is plagued with the task of fraud detection with money transactions going digital. Autoencoders in Keras and TensorFlow are being developed to detect credit card frauds savingbillionsofdollarsofcostinrecoveryandinsuranceforfinancialinstitutions.Fraud prevention and detection are done based on identifying patterns in customer transactions andcreditscores, identifyinganomalousbehaviour and outliers.

CNNARCHITECTURES

Convolutional Neural Network (CNN, or ConvNet) are a special kind of multi-layerneuralnetworks,designedtorecognizevisualpatternsdirectlyfrompixelimageswithminimalpre-processing.

VGG Net

VGGNet consists of 16 convolutional layers and is very appealing because of its veryuniform architecture. Similar to AlexNet, only3x3 convolutions, but lots of filters. Trainedon 4 GPUs for 2–3 weeks. It is currently the most preferred choice in the community forextractingfeatures fromimages.Theweightconfiguration oftheVGGNetispubliclyavailable and has been used in many other applications and challenges as a baseline featureextractor standsfor VisualGeometry Group. VGGNetisa neuralnetwork that performedvery well in the Image Net Large Scale Visual Recognition Challenge (ILSVRC) in 2014. Itscored first place on the image localization task and second place on the image classificationtask.

VGG-19:

VGG-19 is a convolutional neural network (CNN) architecture developed by the Visual Geometry Group (VGG) at the University of Oxford. It is a deep neural network with 19 layers and was introduced as part of the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) in 2014.One of the key innovations in VGG-19 is its deep architecture, which allows for a more expressive representation of image features.VGG-19 is trained on the ImageNet dataset, which consists of millions of labeled images from thousands of categories

Inception v3 algorithm:

Inception-v3 is a convolutional neural network (CNN) architecture developed by Google for image recognition and classification tasks. It is an improvement over the original Inception model. The Inception-v3 architecture is designed to be deeper and more powerful than previous CNNs. It consists of 48 layers, including convolutional layers, pooling layers, and fully connected layers. It also includes several unique features such as the Inception module. This technique reduces the number of parameters in the model, which helps to reduce overfitting and improve performance

ADVANTAGESOFCNN

- Oncetrained,thepredictionsareprettyfast.
- Withanynumberofinputsandlayers,CNNcantrain.
- Neuralnetworksworkbestwithmoredatapoints.

- Oneofthepowerfulmodelsinclassification.

DISADVANTAGESOFCNN

- HighComputationalcost.
- TheyusetoneedalotofTrainingdata.

APPLICATIONSOFCNN

ImageRecognition

CNNs are often used in image recognition systems. In 2012 an error rate of 0.23percent ontheMNISTdatabasewasreported.Anotherpaperonusing CNNforimageclassification reported that the learning process was "surprisingly fast"; in the same paper, thebest published results as of 2011 were achieved in the MNIST database and the NORBdatabase. Subsequently, a similar CNN calledAlexNet won the Image Net Large ScaleVisual Recognition Challenge 2012. Image recognition, in the context of machine vision, istheabilityofsoftwaretoidentifyobjects,places,people,writingandactionsinimages. Computers can use machine vision technologies in combination with a camera and artificialintelligencesoftwaretoachieveimagerecognition.

Video Analysis

Compared to image data domains, there is relatively little work on applying CNNs tovideo classification. Video is more complex than images since it has another (temporal)dimension. However, some extensions of CNNsintothe video domain have been explored.One approach is to treat space and time as equivalent dimensions of the input and performconvolutions in both time and space. Another way is to fuse the features of two convolutionalneuralnetworks,onefor thespatialandonefor thetemporalstream.Longshort-termmemory (LSTM) recurrent units are typically incorporated after the CNN to account forinter-frame or inter-clip dependencies. Unsupervised learning schemes for training spatial-temporal features have been introduced, based on Convolutional Gated Restricted Boltzmann.

Historic and Environmental Collections

CNNs are also used for more complex purposes such as natural history collections.Thesecollectionsactaskeyplayersindocumentingmajorpartsofhistorysuchasbiodiversity,evolution,habitatloss,biologicalinvasion,andclimatechange.

Understanding Climate

Thereasonswhyweseesuchdrasticchangesandhowwecouldexperiment incurbing the effect. It is said that the data in such natural history collections can also providegreater

social and scientific insights, but this would require skilled human resources such asresearcherswho can physically visit thesetypes ofrepositories.

DecodingFacialRecognition

Facialrecognitionisbrokendo wnbyaconvolutionalneuralnetworkin tothefollowing majorcomponents–

- Identifyingeveryfaceinthepictur e.
- Focusingoneachfacedespiteexte rnalfactors,suchaslight,angle,po se,etc.
- Identifyinguniquefeatures.
    - Comparingallthe collecteddatawit halreadyexisting datainthedataba setomatchaface withaname. Asimilarprocessis followedforscen elabellingaswell.

AnalysingDocuments

Convolutional neural networks can alsobe used for document analysis. This is notjust useful for handwriting analysis, but also has a major stake in recognizers. For a machineto be able to scan an individual's writing, and then compare that to the wide database it has, itmust execute almost a million commands a minute. It is said with the use of CNNs and newermodels and algorithms, the error rate has been broughtdown toa minimum of 0.4% at acharacter level,thoughitscompletetesting isyettobewidelyseen.

2.LITERATURE SURVEY:

TITILE :
Smart Control of Traffic Light System using Image Processin
AUTHORS:
Khushi,
ABSTRCT:
The congestion of the urban traffic is becoming one of critical issues with increasing population and automobiles in cities. Traffic jams not only cause extra delay and stress for the drivers, but also increase fuel consumption, add transportation cost, and increase carbon dioxide air pollution. The traffic controller is one of critical factors affecting the traffic flow. The conventional traffic patterns are nonlinear and complex and time dependent rather than traffic dependent. This paper proposes a traffic control system based on image processing using MATLAB code which changes the time of green, amber and red light with respect to the traffic density and traffic count. Two Arduino UNO is used, one for controlling green and amber lights and other for controlling red light. This is a continuous process

3.EXISTING SYSTEM :

In the first method, VANETS are used to get information and location of every vehicle, which in turn is passed on to the nearest Intelligent Traffic light with the help of installed GPS Further, these ITLs will

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update the statistics and sent it to nearby vehicles. In case of accidents, the information would be sent to drivers to choose an alternate route to avoid congestion. However, this technique is not feasible as its deployment is quite expensive. • In the second method, infrared sensor-based microcontrollers are used, which capture the unique ID of every car using transmitter and receiver. In case of an emergency situation, vehicle's radio frequency tags can be used to identify them and let other vehicles move. This method detects red light violations. However, this technique is not flexible due to the fact that infrared sensors need to be in sight

3.2 LimitationsofExistingMethods:

In the third method, fuzzy logic technique is used in which two fuzzy logic controllers are used – one is to optimize the signal and the other controller is used to extend the green phase of a road in an intersection. The sensors used to collect input data are video cameras that are placed at incoming and outgoing lines. The controller then utilizes the information collected through these sensors to make optimal decisions and minimize the goal function. • In the fourth method, fuzzy logic is used, and the system takes in the number of vehicles and the average speed of traffic flow in each direction as the input parameters. The number of vehicles and the average speed of traffic flow can be determined using sensors placed on the road.

4:PROPOSEDMETHOD

4.1PROPOSED SYSTEM :

Now-a-days due to increasing number of vehicles it's becoming difficult to manage traffic efficiently which leads to longer duration journey and maximum petrol consumption and to avoid this problem standard techniques was introduce such as manual traffic control which require more number of traffic person, static time traffic control which is not effective as it will use same timer for all lanes with heavy and light traffic and sensor based traffic management but this require heavy budget of sensor deployment to sense and manage traffic based on density.

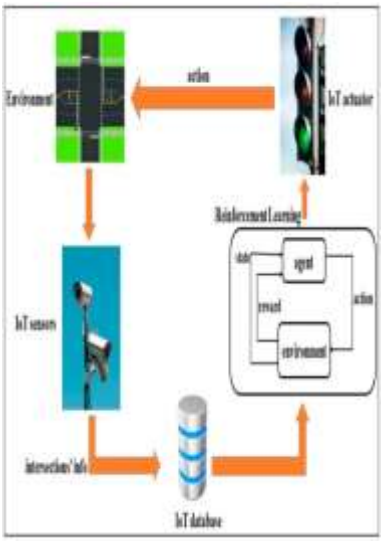
To overcome from above issues author of this paper is utilizing traffic cameras and YOLO object detection algorithms to estimate traffic density at all lanes and then adjust red and green signal time. Cameras will take snapshot of all lanes every five seconds and then estimate traffic at lanes and based on density green and red signal time will be adjusted.

4.1.1 Proposed Methodology:

The number of vehicles of each class, such as car, bike, bus, and truck, is detected, which is to calculate the density of traffic. The signal switching algorithm uses this density, among some other factors, to set the green signal timer for each lane. The red signal times are updated accordingly. The green signal time is restricted to a maximum and minimum value in order to avoid starvation of a particular lane. A simulation is also developed to demonstrate the system's effectiveness and compare it with the existing static system

5:SYSTEMDESIGN

5.1 SYSTEM ARCHITECTURE :



5.2 DataFlowDiagram

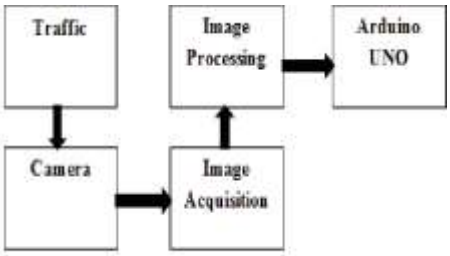
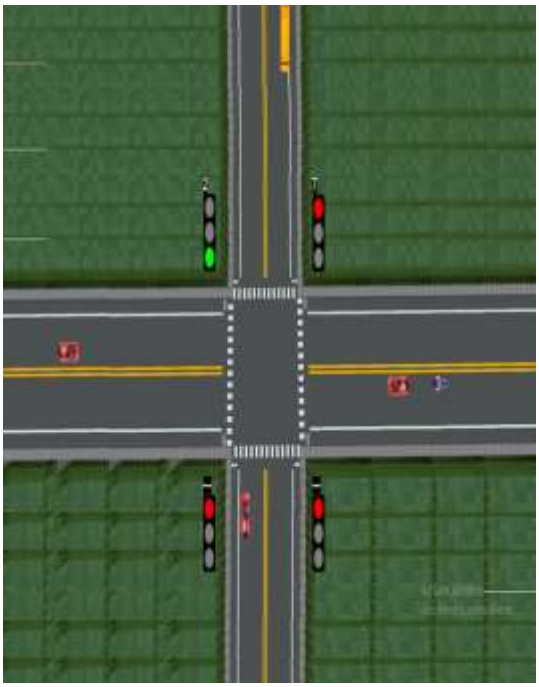


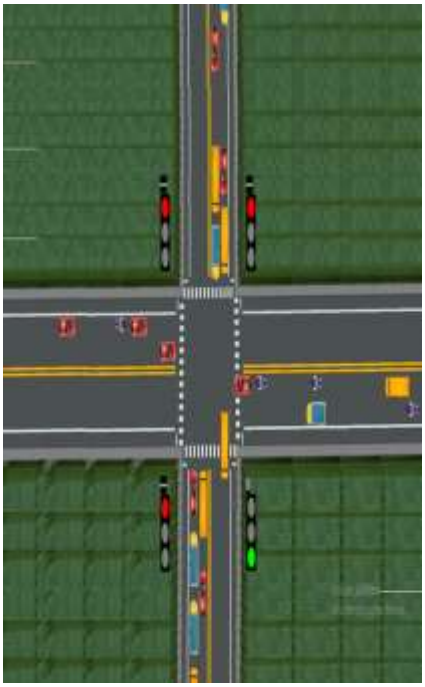
Fig. 1. Block diagram of the Proposed System

6.RESULTS

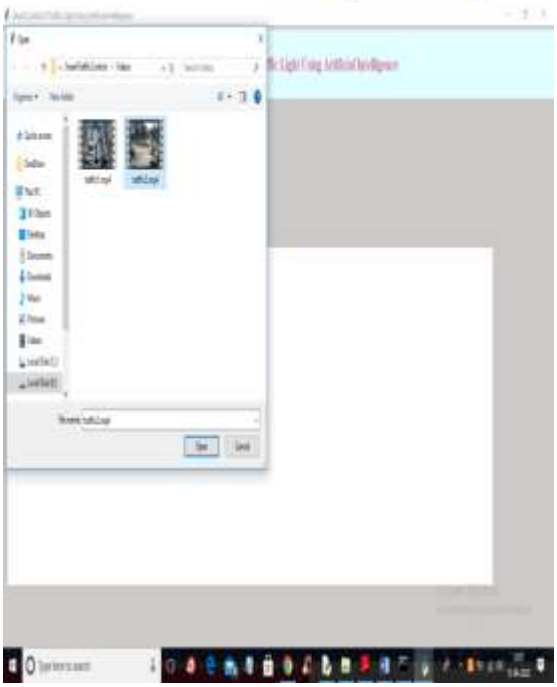
To run project double click on ‘run.bat’ file to get below output

In above screen click on ‘Run Traffic Simulation’ button to start PYGAME simulation and get below output

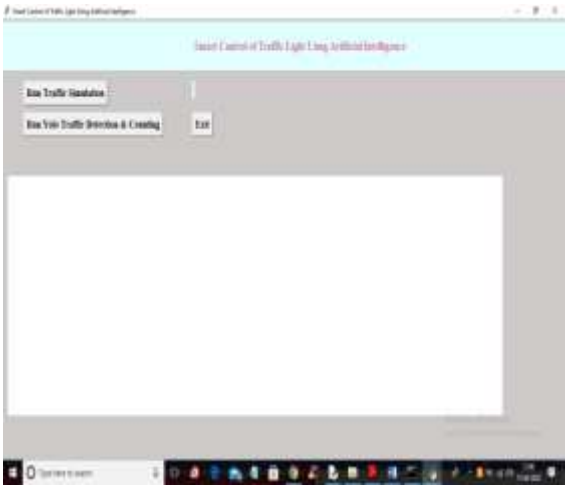




In above screen you can see PYGAME simulation output and at each lane traffic density is calculated and then adjust green and red line. This simulation run in INFINITE loop so you press 'windows' key from keyboard and then close application and then restart and run second YOLO module



In above screen selecting and uploading 'traffic2.mp4' video and then click on 'Open' button to get below output



Now in above screen click on 'Run Yolo Traffic Detection & Counting' button to upload traffic video and then estimate traffic density

In above screen detecting traffic and then estimating its count and based on that traffic time will be adjusted. YOLO runs very slowly in normal laptop so let it finish all frame processing then u will get output.mp4 file which you can play as normal video with traffic density.

CHAPTER-7:

7. CONCLUSION:

In conclusion, the proposed system sets the green signal time adaptively according to the traffic density at the signal and ensures that the direction with more traffic is allotted a green signal for a longer duration of time as compared to the direction with lesser traffic. This will lower the unwanted delays and reduce congestion and waiting time, which in turn will reduce fuel consumption and pollution. According to simulation results, the system shows about 23% improvement over the current system in terms of the number of vehicles crossing the intersection, which is a significant improvement. With further calibration using real- life CCTV data for training the model, this system can be improved to perform even better.

8.REFERENCES :

[1] TomTom.com, 'Tom Tom World Traffic Index', 2019. [Online]. Available: https://www.tomtom.com/en_gb/traffic-index/ranking/

[2] Khushi, "Smart Control of Traffic Light System using Image Processing," 2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC), Mysore, 2017, pp. 99-103, doi: 10.1109/CTCEEC.2017.8454966.

[3] A. Vogel, I. Oremović, R. Šimić and E. Ivanjko, "Improving Traffic Light Control by Means of Fuzzy Logic," 2018 International Symposium ELMAR, Zadar, 2018, pp. 51-56, doi: 10.23919/ELMAR.2018.8534692.

[4] A. A. Zaid, Y. Suhweil and M. A. Yaman, "Smart controlling for traffic light time," 2017 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), Aqaba, 2017, pp. 1-5, doi: 10.1109/AEECT.2017.8257768.

[5] Renjith Soman "Traffic Light Control and Violation Detection Using Image Processing”.” IOSR Journal of Engineering (IOSRJEN), vol. 08, no. 4, 2018, pp. 23-27

[6] A. Kanungo, A. Sharma and C. Singla, "Smart traffic lights switching and traffic density calculation using video processing," 2014 Recent Advances in Engineering and Computational Sciences (RAECS), Chandigarh, 2014, pp. 1-6, doi: 10.1109/RAECS.2014.6799542.

[7] Siddharth Srivastava, Subhadeep Chakraborty, Raj Kamal, Rahil, Minocha, “Adaptive traffic light timer controller” , IIT KANPUR, NERD MAGAZINE

[8] Ms. Saili Shinde, Prof. Sheetal Jagtap, Vishwakarma Institute Of Technology, Intelligent traffic management system:a Review, IJIRST 2016