# Simulation of Traffic Optimization to Reduce Congestion

**Abhishek Goyal, Mradula Singh, Anurag Aeron**

***Abstract:*** ***There has been an alarming increase in the number of vehicles on the Indian roads in the recent times, almost triple as that in 2005[10]. which obviously leads to traffic congestion on road and enhanced pollution, although there has been many reasons for the same but major one is unmanaged traffic light system as the current traffic light system is either manual or static timings of traffic lights regardless of the flow of traffic. There is a need for smart solution to the traffic light in Indian cities or to have ITS (Intelligent traffic system). Paper provides a solution based on camera feed at crossings for each lane, process the data through and allocates the "Green" time according to its traffic flow density using YOLO v3 and also takes care of starvation issue that might arise of the solution. As a result the flow of traffic on each lane is automatically optimized and the congestion that used to happen unnecessarily earlier is eliminated and results shows significant benefits in reducing traffic waiting time.***

***Keywords: Traffic optimization, YOLO, Traffic Congestion, ITS (Intelligent Traffic System)***

## I. INTRODUCTION:

In the recent years there has been a growing problem of traffic congestion. In the urban cities, the most prominent areas where the traffic jams starts are the traffic lights. Modern city administrations around the world is struggling to control traffic in junctions. As mostly traffic signals operate on fixed time intervals therefore vehicles need to wait even in case no traffic from any one of the direction.As per AAA [11] the average American As per AAA [11] Americans spent nearly 58.6 hours in a year at red light by driving 17,600 minutes ad wait time is 3,520 and Indian cities are no way better in the same calculations.One of the solution to resolve this by optimizing the flow of traffic at the crossing hence reducing the congestion. With the new rise of Smart Cities in India this is a great opportunity for us to build system that can tackle these everyday problems efficiently. The Intelligent traffic control system will assist the smoother flow of traffic in Smart Cities thus providing a great deal of relief to people on the road.Vehicles count in some traffic management system is done through single camera and Bayesian network for traffic monitoring. There exists systems in countries works only for one vehicle and when that vehicle arrives at signal it turns on the traffic signal light green. In other system the traffic light is optimized on the basis of average speed attained by vehicles in each direction and transmitting the data at central server . These servers with predefined algorithms calculate the shortest path to all modes while solution provide in this paper monitors traffic on each lane of the traffic signal and counts the number of vehicles on each lane and then calculates the time each lane vehicles would require to cross and in this way the traffic signal gets optimized. The objective is to employ Machine learning and Deep learning algorithms on traffic cams to measure the traffic flow and accordingly adjust the timings of the traffic lights. By employing this system one can increase the speed of traffic flow on crossings. System requires footage from traffic cams and output timings for each light.

## II. LITERATURE SURVEY

Vehicle tracking & detection, Traffic monitoring, route optimization and reduction in traffic congestion has gained enormous attention with the increase of express and high ways. Many authors has provided or discusses the solution to traffic optimization . Like Uke and Thool demonstrates counting system & detection of vehicle through image development kit in OpenCV. Computer vision based system is followed for counting and detection of vehicles running on roads by analysing pictures through camera. Traffic monitoring by object classification using Bayesian network which is capable of modelling internal dependencies of the measured image features of the targets and hence classification results are more robust and reliable for different vehicle types and pedestrians another novelty motion parameters are obtained by tracking the object in the 2D image space for classifying the object type as different object have different characteristic motion parameters like pedestrian will usually be slow than a motor bike also motion is good indicator of objects position in perspective projects and objects position determines the size of the object imaged in perspective projection. [2].Javier et. al. did traffic simulation of traffic light cycles in a real city area using supplied maps, statistics and the present-day traffic behaviour based on hypothetical congestion situations, Many predefined parameters yields good results in optimizing traffic signal time [3]. Solution of Traffic optimization will surely lead to the ITS (Intelligent traffic management system) shown in fig 3.1 which further reduces the congestion. Many authors discusses the implementation of ITS through various ways like Manikonda et.al. suggested the same by using RFID technology to reduce travel time Besides using the stated system for reducing the travel time can also be used to trace vehicles jumping signals, cars being stolen, for toll collection etc. Several Electronics devices are integrated with database to collect data and On basis of average speed and using Dijkstra's algorithm fastest route is computed and a map of whole city is created with shortest path

**Revised Manuscript Received on September 05, 2019.**
**Abhishek Goyal,** ABES EC, Ghaziabad
**Dr. Mradula Singh ,** COER, Roorkee
**Dr. Anurag Aeron ,** ICFAI, Dehradun

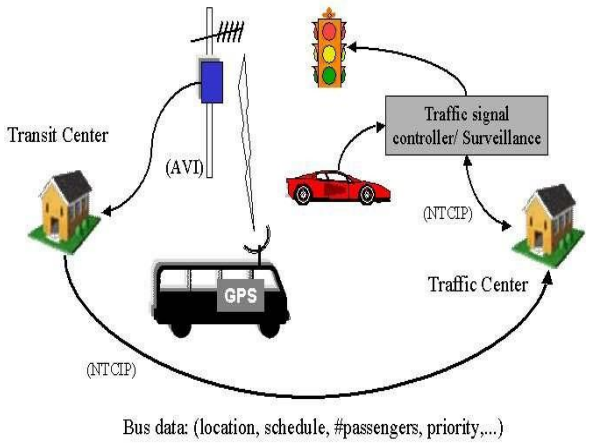


**Figure 3.1 Working of Intelligent Traffic Systems**

In the same way Bali el al. discusses a system comprises of a traffic control centre, a GPS Tracer , Information centre and a the traffic light all connected through a Wireless network. and same conventional traffic signal lights would be provided with a "smart-box" to perform real time smart switching ON/OFF (which reduces the cost of installation due to the utilization of same existing traffic lights facility)[8].

In multilane network, this system identifies the traffic density in each lane which will get clearance priority signal from the real time system as per the needed traffic density clearance requirement guided by the priority algorithm criterion of clearing the densest lane first and so on. Therefore, allotted clearance time will be proportional to the density of the traffic of each lane in this multilane network traffic clearance system

In order to enhance the efficiency of an ITS there should be precise communication between its components: Automated vehicles , ,Drivers , Traffic signals , Private and public transportation and optimized route planning etc.

There is a need to have a self-adaptive system that can react rapidly as per changes in modified traffic signals and conditions of road and further reroute path to avert the congestion. Research matter should contain driver models, distributed architecture, control inter-agent communication and optimization. [9].

Zhao et.al. provides designed solution based on DSP and Nios II to ITS and can create over 160 category of phases. Also, the system can intelligently accomplish kinds of human-computer interactions [14].

## III. IMPLEMENTATION

### System Design and Methodology

The system architecture shown below in fig 4.1 describes the data flow and control flow between various modules of traffic management system.

Firstly input through camera passes live streams to YOLO model then the traffic management module calls up yolo model requests the vehicle count thereafter yolo model performs various operations and passes vehicle count to traffic management model further serial communication is done through micro controller and finally traffic lights are pre-set accordingly

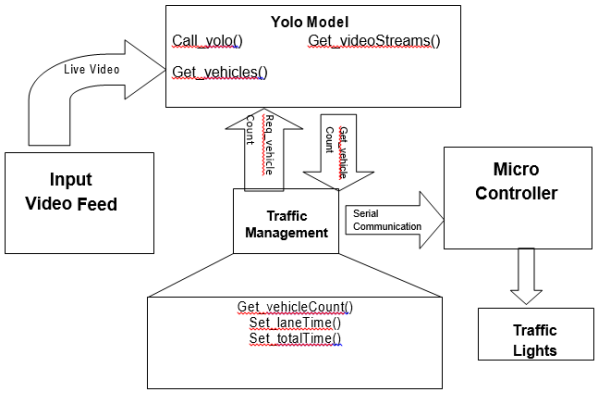


**Fig 4.1: System architecture**

The system architecture provides the broad view of how components are connected, fig 4.2 (Traffic flow diagram) elaborates more on how red and green light works on traffic movement , It describes various steps that are included in the Project.

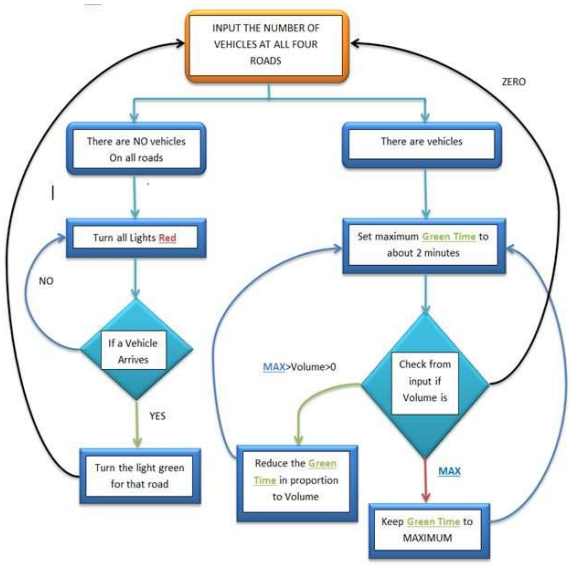


**Fig 4.2: Flow diagram of traffic movement**

The algorithm used for object detection is YOLO v3. YOLO v3 uses a mutant of Darknet, having 53 layer network trained on Imagenet further 53 more layers are piled on it to detect the task, that provides entire 106 layer convolutional underlying architecture for YOLO v3.

YOLO v3 performs multilabel classification for objects detected in images. YOLO v3 performs at par with other state of art detectors like RetinaNet, while being considerably faster, at COCO map 50 benchmark. It's better than SSD and its variants. The entire system works as an integrated approach of in which modules communicate to provide a feasible and better solution over existing ones. In our approach Camera captures the video streams from all the specific paths & by using video processing video is broken into 30 FPS, these processed images are converted into blobs which further fed into the Deep Learning object detection model – YOLO which provides high accuracy with speed. Apt green time can be decided by system mapping the average time taken by n no. of vehicles to pass the crossings various kinds of vehicles are categorized as per their types like heavy trucks, motor cycles and cars etc. that can be shown by various coloured squares and by counting the no. of vehicles that pass through roads on each side of junction in prescribed Green light time. Once the volume on a lane increases that leads to congestion therefore more time to this lane, doing this may lead to starvation problem by giving the best optimum time to the same lane. To solve this max time limit of approximately 2 minutes is given to each road Also the System checks if there is no vehicle on a particular lane then no green signal is provided that makes the solution more effective. Figures below (fig. 4.1, 4.2 and 4.3) shows the different lanes of a road that has been considered as camera fed moving images.

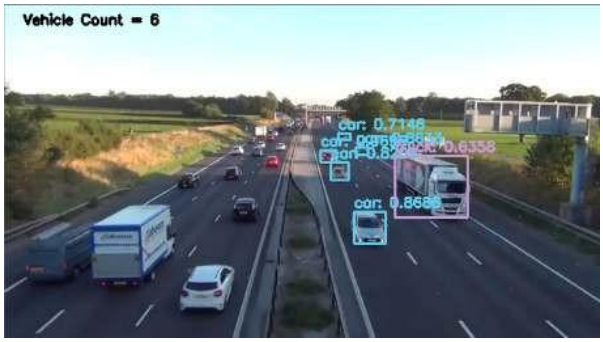


**Figure 4.3 Vehicle Detection Lane 1**

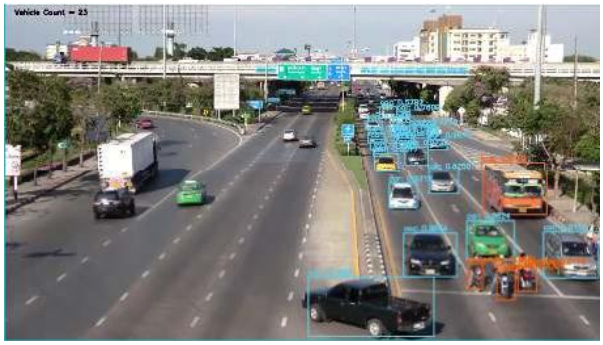

**Figure 4.4 Vehicle Detection Lane 2**

**Figure 4.5 Vehicle Detection Lane 3**

## IV. RESULTS AND CONCLUSION:

The analysis is done by two ways, one is static (manual) way of operating the traffic lights and other is by using our system.

It can be easily formulated in case of static 80 second time for 2 iterations or 40 sec per iteration is provided to each lane means 320 seconds in total and at least 240 seconds for each lane.

Using the solution provided and implemented by camera feed, traffic lights are dynamically adjusted to optimize the traffic flow and the solution does took only 157 in total time in full two iteration being implemented on both static one and dynamic being provided as solution .

Fig 5.1 and 5.2 are the two iterations done using YOLO solution.

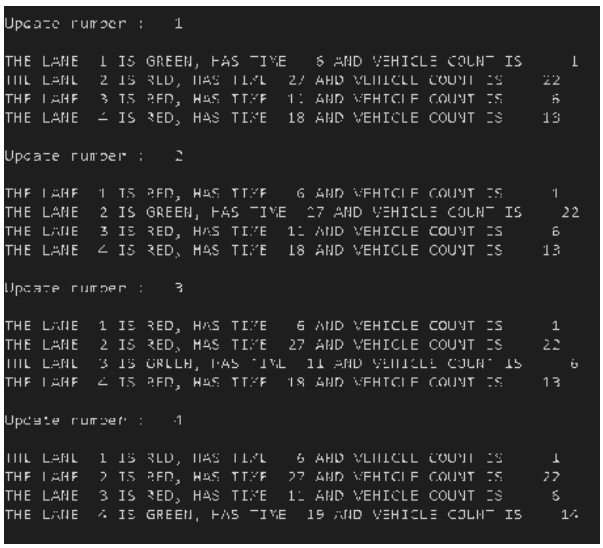


**Figure 5.1 Iteration 1 of traffic movement using dynamic sol.**

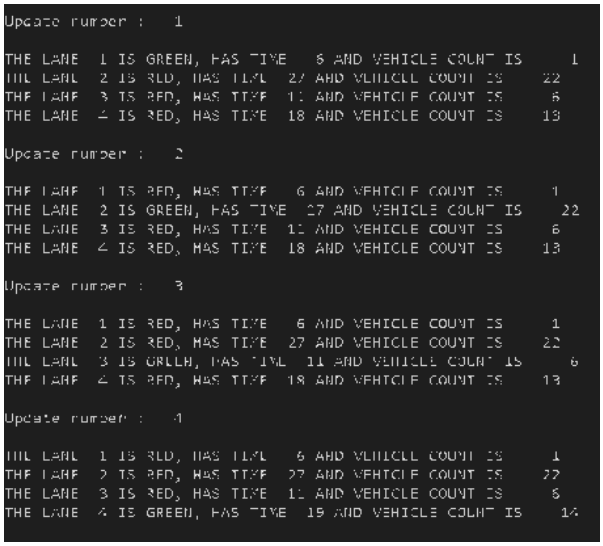


**Figure 5.1 Iteration 2 of traffic movement using dynamic sol.**

Clearly its 162 seconds shorter than the static one hence a boost of 203% as depicted in fig 5.3

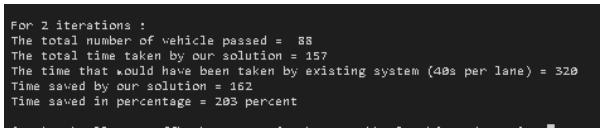


**Fig 5.3 Results of Approach followed**

The solution provided here is quite better as compared to the algorithms used earlier as mentioned in literature review. This is a huge time saving, efforts, reduce pollution and better driver social behaviour.Also due to the time saving methodologies used in the solution provided will eliminate t h e domino effect at traffic crossings which is the core reason of unnecessary congestion. The results can be compared with Kanungo et.al. who compared hardcoded and dynamic coded based camera feed and predefined algorithms the accuracy is 32% [12]. Tripathi and Arora presented a solution with notable performance rise of 21.9% in real time system based on the genetic algorithm, based on 573 vehicles in real time system and 662 in fixed time system. The solution optimizes traffic signal timings in real time.

## V. FUTURE WORK

This system can further be used to predict the flow of traffic and congestion at a particular time.
Discussed approach will be a solution for the new age when the number of cars will be many times the current number and the management will be an extremely tedious task. Solution provided can easily be implemented in upcoming new Smart Cities that the Government of India is looking for. This can be implemented on a large scale in such cities. On a large scale this will not only provide a solution to get rid of unnecessary congestion but will also prove useful in surveillance and information gathering , which further can be analysed using machine learning.

## REFERENCES


1. Nilesh J. Uke, Ravindra C.Thool, “Moving Vehicle Detection for Measuring Traffic Count using OpenCV” Journal of Automation and Control Engineering Vol. 1, No. 4, December 2013
2. Pankaj Kumar, Surendra Ranganath, Huang Weimin “Bayesian Network based Computer Vision Algorithm for Traffic Monitoring using Video”
3. Javier J. Sánchez-Medina, Manuel J. Galán-Moreno, and Enrique Rubio-Royo “Traffic Signal Optimization in “La Almozara” District in Saragossa Under Congestion Conditions, Using Genetic Algorithms, Traffic Microsimulation, and Cluster Computing” IEEE Transactions On Intelligent Transportation Systems, Vol. 11, No. 1, March 2010.
4. Nathan H. Gartner, C. Stamatiadis, P. J. Tarnoff, "Advanced traffic control strategies for intelligent vehicle highway systems", Proc. SPIE 2344, Intelligent Vehicle Highway System , 6 January 1995
5. Pankaj Kumar, Surendra Ranganath, Huang Weimin, and Kuntal Sengupta,” Framework for Real-Time Behavior Interpretation From Traffic Video”, IEEE Transactions On Intelligent Transportation Systems, Vol. 6, No. 1, March 2005
6. Qi, Y., Ishak, S., “A Hidden Markov Model for short term prediction of traffic conditions on freeways”, Transport. Res. Part C (2014)
7. P. Manikonda, A. K. Yerrapragada and S. S. Annasamudram, "Intelligent traffic management system," 2011 IEEE Conference on Sustainable Utilization and Development in Engineering and Technology (STUDENT), Semenyih, 2011, pp. 119-122
8. Bali, Pavleen & Parjapati, Gautam & Aswal, Rishabh & Raghav, A & Gupta, Neeraj & Gautam Parjapati, Mr. (2015). Intelligent Traffic Monitoring System (ITMS).
9. Intelligent Traffic System , retrived from http://www.cs.cmu.edu/~ef2s/traffic.html
10. https://www.statista.com/statistics/664729/total-number-of-vehicles-india/ on 6th july 2019
11. https://www.msn.com/en-n/lifestyle/smart-living/you-E2-80-99ll-spend-this-much-of-your-life-waiting-at-red-lights/ar-BBNGZ1Pb on 6th july 2019
12. Anurag Kanungo ; Ayush Sharma ; Chetan Singla “smart traffic lights switching and traffic density calculation using video processing” RAECS , March 2014
13. Sudhanshu Tripathi, Himakshi AroraTime Optimization for Traffic Signal Control Using Genetic Algorithm, IJRTE,December 2009
14. Haimeng Zhao; Xifeng Zheng; Weiya Liu, "Intelligent Traffic Control System Based on DSP and Nios II," Informatics in Control, Automation and Robotics, 2009. CAR '09. International Asia Conference on , vol., no., pp.90,94, 1-2 Feb. 2009


## AUTHORS PROFILE

Abhishek Goyal, Ph.D* from UTU, M.Tech,
Published many papers in various journals and
Conferences Area of interest includes Machine Learning, IoT in Transportation domain. Subjects expertise is in web technologies, Programming , database etc. Having experience of 16 years in Industry and Academia.

Dr. Mridula Singh Ph.D., IIT Roorkee,published numerours papers in various journals of repute and in many conferences . Area of interest is image processing and pattern recongnition.

**Dr. Anurag Aeron , Ph.D from IITR,** published numerours papers in various journals of repute and in many conferences .Arear of interest is Fuzzy, Web semantics etc.