International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Traffic Monitoring System: A Review

Amogh Sanjeev Sinai Karapurkar[1], Sonia Kuwelkar[2]

[1]Department of Electronics and Communications, Goa College of Engineering, Farmagudi, Goa, India
amogh293[at]gmail.com

[2]Department of Electronics and Communications, Goa College of Engineering, Farmagudi, Goa, India
soniakuwelkar[at]gec. ac. in

Abstract: ***The wastage of fuel and time in unwanted traffic jams has created a problem in the life of all ordinary Indian citizens. The traffic jams not only waste fuel and time but also create pollution problems due to running engines in the jam. An individual who is digitally independent and wants to experience a better way of living with minimal compromises does not want to spend long periods being stuck in traffic jams. An automated traffic monitoring system will most definitely reduce this unnecessary wastage of time getting stuck in traffic significantly while guiding the country towards its goal of a "Digital India". A neural model in practice is a great choice of image detecting body. A neural model with required/customizable image detection capabilities will help to bring out the best use of image processing for traffic monitoring at the junction and near accurate detection with the count of the vehicles can help to achieve a dynamic allocation of timing for vehicles for smooth and congestion - free traffic movement.***

Keywords: Traffic Monitoring System (s), Traffic Signal (s), Traffic, Image Processing, vehicle (s), congestion - free, Neural model

1. Introduction

In India, typical Traffic signal lights work with a predefined number of seconds allotted. The issue with this type of system sometimes has to wait at the other junction even if there are no vehicles at other junction due tothe "RED" signal or if there are very few vehicles that require less time to move than allotted. A dynamic timing system based on vehicles when allotted will improve traffic congestion and reduce inefficiencies in traffic and reduce time wastage.

There are numerous ways in which an image processing technique is applied to detect vehicles at different traffic points. A general traffic system has a fixed number of seconds allotted for “GO” and “STOP” corresponding to the lane. The number of seconds allotted is static and is allotted based on the priority of the road lane or the number of static seconds is based on how busy is the road lane compared to the other. But sometimes so is the case that even if there are fewer or no vehicles on the lane for many seconds one at the other lane has to wait for the "GREEN" signal on his lane. This not only wastes time but sometimes fuel too if one’s vehicle’s engine is still running.

In this paper, we present an overview of different research studies carried out in the domain of Traffic Systems using image processing. With the review, we try to bring the most efficient system out of those and also propose a methodology that is most appropriate for use.

The following paper is organized with more other sections with section II describing the need and guidelines for incorporation of Traffic Monitoring System. It also describes the various enhanced addition to the system. It also classifies the systems based on the hardware and software tools used and also the methodology followed. Section III compares the various researches reviewed and section IV concludes the paper.

2. Literature Overview

Different techniques are used to determine the traffic density at different levels. Some systems use the mathematical operation to control the traffic density [1], based on the mathematical operations data corresponding lane is allotted with a "GREEN/GO" signal.

Some use sensor data and communicates to traffic signals helping to check for traffic congestions over the next levels [2]. The sensor provides data of traffic congestion and via communication devices data is being sent to the user.

A system wherein the conditions surrounding traffic area are related to check densities and determine different aspects to give lane priority is known to be an adaptive traffic control system [3]. Priorities like the priority for public transport, emergency vehicles, in and around conditions that affect traffic like ongoing construction work, or the check towards how busy is the lane at what hour, this data is being mined and accordingly set the signals [3].

In reference [4] authors propose a system purely with just image processing wherein an empty street image is matched to that of a busy street and obtained result is then put across some image processing filters that determine the densities at the lane. An algorithm to determine the number of targets using background subtraction which uses pixel matching and applying edge detection to the system to enhance the detection is seen.

The idea proposed in [5] proposes three different techniques that deal with obtaining a centroid from imaging techniques which are now seen as equated to the number of vehicles present, using Kalman filter for imaging and based on pixel values.

1) Software and Hardware tools

a) Software Tools

The use of MATLAB as a programming language for mathematical imaging is seen widely, precisely used in [1]

as the base language, use of language for rescaling and operations like RGB to Greyscale, segmentation, Morphological operations is seen. It uses MATLAB's seamless ability of matrix calculation for Contrast Limited Adaptive Histogram Equalization (CLAHE) algorithm is used.

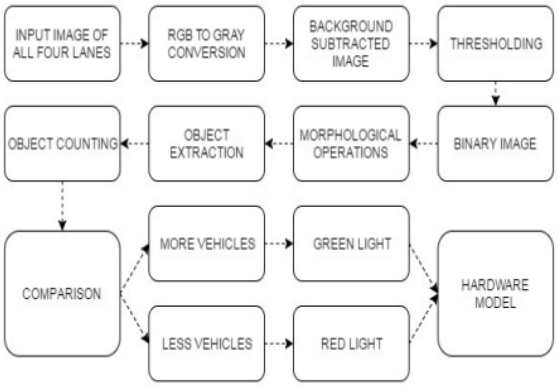

Figure 1: Implementation Development of Closed Loop Traffic Control System Using Image Processing [1].

Fig.1 shows the software implications in [1] It suggests based on density data obtained and comparison based on obtained densities, let decide which lane to be allotted "GREEN/GO". [1] is more of a software - oriented proposal than [2] which is more hardware - oriented.

The idea proposed in [2] relies on more sensor data. It uses Keil software uvision 3 program in C language. Here the software is just a directing body, the project is more hardware - oriented.

The proposed system in [3] authors suggest the use of data that is mined or sourced via the internet from connected traffic systems that are next to or previous for comparison with data mined around the system for adaptive traffic management. The connected systems at different levels allow the sole main controller to allocate adaptive guidelines at different traffic signal points. The fact that traffic data is mined matched and compared every time helps determine priorities and movement of vehicles to be specific.

MATLAB is also used as the base language in [4] and [5]. After the acquisition and conversion of an image into grey scale, an image is applied with the GAMMA function for enhancement [4]. The basic plot of image background subtraction is applied wherein an image of an empty road is compared or rather subtracted from the busy lane image. The application of the GAMMA function enhances image quality to a certain extent. The GAMMA function applied image is then processed through the Prewitt filter for enhanced edge detection.

The proposed idea in [5] has a first technique that uses a projective Kalman filter to determine mean - shift blob tracking. It tracks the vehicle using the integration of the projection equation of the vehicle onto the image plane of a camera.

b) Hardware Tools

The most common hardware material is a camera sensor for capturing the images/ recording the frames [1], [3], [4], and [5]. A camera sensor is a part of image acquisition [1]. For the MATLAB to be used a designated system is available with MATLAB installed [1], [4], and [5].

A camera sensor used for capturing images of lanes needs to have a motor attached in the case of [1] a stepper motor is used where a camera sensor is mounted on it which rotates to capture images of all lanes at a traffic signal junction. To control the traffic light at junction [1] uses PIC controller which also has a bridge circuit of L239D for motor control on which camera module is mounted.

The proposed idea in [2], uses hardware materials like IR sensors for data collection and other corresponding sensors for communication. A GSM module is incorporated in the proposed system which provides traffic updates for emergency services to divert their routes to avoid traffic congestion. A microcontroller AT89C52 which is a low - power, high - performance CMOS 8 - bit microcontroller with 8K bytes of in - system programmable Flash memory is used for sensor controls.

Majorly a hardware use is focused on processing and evaluating the data. The use of an embedded system for communicating over channels and controlling traffic signals is seen widely at use [1], [2], and [3].

2) Methodology

Though the ideas proposed in [1], [4], and [5] uses MATLAB as a basic platform to build the codes, the methodologies applied are sourced differently. In the proposed idea in [1], a major function used is Contrast Limited Adaptive Histogram Equalization (CLAHE) used for matrix calculation. Different image processing levels are implemented.

The [2] and [3] are many sorts of data acquired - based techniques. Based on the data that got available from sensors after proper evaluation the traffic signals are allotted with signals and alerts.

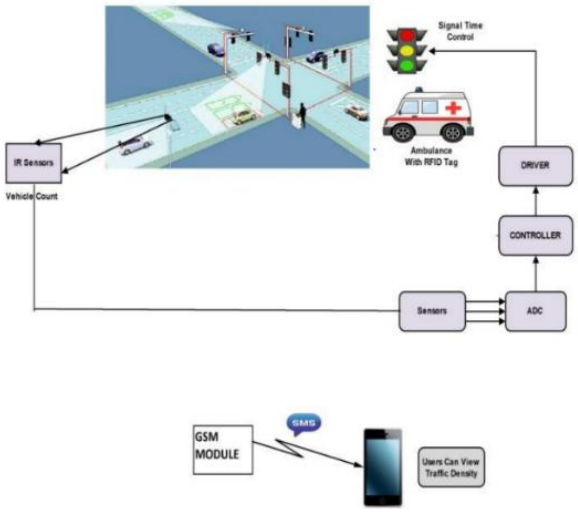

Figure 2: Intelligent Traffic Control System Using GSM Technology [2]

The idea proposed in [2] is more data provider to a traffic signal system. Fig.2 suggests workflow where data obtained and evaluated from these IR sensors is used for traffic tracking it also provides scope for traffic redirection if traffic at some point is too congested for an emergency vehicle that is diverted via other routes with signal transferred through RFID tag.
The proposed methodology in [3] suggests a connected network of adjoining traffic systems to monitor its congestion - free movement. Using Arduino boards, Internet/ network services, data mined is compared and adaptively is then suggested to handle the traffic signals. It more focusses on surrounding conditions that create a database that is compared with another before providing a "GREEN/GO" signal.

A classic technique of object detection is with background subtraction or with obtaining results from the subtraction of subsequent frames which is seen to be proposed in [4] and [5] respectively.

The proposed methodology in [4], uses background subtraction for the detection of vehicles and uses filters like the GAMMA function and Prewitt filter for edge detection that enhances detection quality. The proposed idea in [4] reference paper is divided in three phases, where the first phase is importantly marked with the capture of a reference image which is capturing the blank road. The second phase is capturing the actual image and the third and last phase is a comparison of images and based on returned match value the timing for the same to be given. The use of the GAMMA function enhances images quality. The GAMMA function is an image - improving technique that uses power - law transformation. The application of power - law transformation to image results in great grey levels in an image which further improves pixel sorting whether in the darker or lighter regions. The use of the Prewitt filter in edge detection improves the edge detection by looking for the maximum and the minimum in the first derivative of the image. The sign of the second derivative determines whether an edge pixel lies on the dark or light side of an edge.

The idea in the reference [5] on the other hand proposes two more techniques where the use of projective Kalman filter for mean - shift blob tracking and based on pixels wherein at certain points in traffic values of these pixels will shrink or surge as when the vehicle passes through these points which are then directly related with vehicle movement. Though it does not provide a certain number the density of vehicular movement provides with the overall idea. Fig.3 discusses the flow chart [5] which also proposes the background subtraction or more precisely comparing the two subsequent frames to project vehicular movement with application of image processing techniques in the likes of morphological operations and edge detections then allotting a centroid to the detected movement which is now associated as centroid, these centroids are correlated with the number of vehicles which is also proposed in [5].

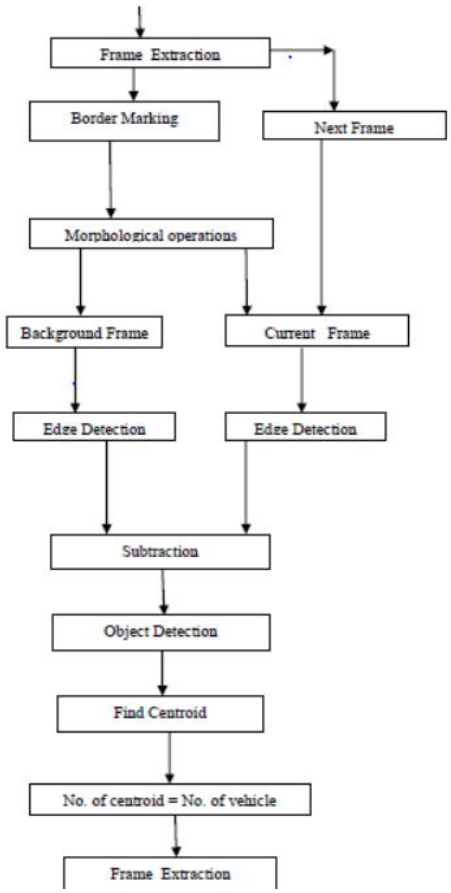

Figure 3: Flow chart for detection using centroids [5]

3. Comparative Study and Discussion

Table I

Sr. No.:	Author	Proposed Method	Tools Used	Hardware
1.	S. Halladamani and R. C. Radha	Finding Traffic density using MATLAB as base language for image processing [1].	MATLAB for image processing	A system with MATLAB, PIC controller with board, Camera sensor, stepper motor and bridge circuit of L239D and LCD
2.	Ramaprasad S S and Sunil Kumar K N	Uses IR sensor data to check for traffic congestions and GSM module to communicate for transfer of said data [2].	Keil software uvision3 program in C language.	IR sensors, GSM module, AT89C52 (Atmel microcontroller based on 8051) A system with Keil.
3.	G. R. Andrei, T. R. Serban, S. V. Alexandru and B. L. Dorin	Use of Arduino boards for adaptive checking of data mined and received over internet to reduce congestion [3].	Uses Arduino boards to compare data.	Arduino board, camera sensor, data storing device
4.	P. Choudekar, S. Banerjee and M. K. Muju	Primarily uses MATLAB for detection of vehicles uses GAMMA function and Prewitt filter for more accurate edge detection [4].	MATLAB for image processing	A system with MATLAB, camera sensor for image capture
5.	Susmita A. Meshram and Rani S. Lande	Proposes three types of system with projective Kalman filter, based on pixel and based on allocation of centroids equated to number of vehicles [5].	MATLAB for image processing	A system with MATLAB, camera sensor for image capture, advanced system for motion detection.

Figure 4: Comparison Table

Table I. displays all the five reviewed papers and their respective proposed method. It also displays the tools which were used and the hardware platforms used during experimentation/proposal. All the review papers have their different style of detecting the vehicle. The most general phenomenon among them is based on density evaluated at traffic signals, highest among to let a "GREEN/GO". Different styles of density detection and comparison show different levels of accuracy.

Among these references, none of these papers have considered the usage of a neural model as a strong source of detection. A neural model can be an advanced image detecting mechanism to detect cars at the junction. A neural model that is as efficient, will help to explore the near exact count of the vehicles that can improve accuracy to provide dynamic timing to the system. The comparison with a near accurate count will also help to allow us to use dynamic timings for the "GO" or "STOP" signal rather than keeping it static.

4. Conclusion

In this paper, we have reviewed five different research papers all discussing the need for automated traffic signals for congestion - free movement of vehicles. After reviewing all the above research, it can be concluded that not only finding the density of vehicles at the junction will reduce the congestion but also providing a dynamic timing for the signal based on the number of vehicles counted will empower time - saving, with the small town having less number of vehicles at the junction will highly improve the time saving due to dynamic time allocation but will also reduce the fuel consumption at the junction due fewer seconds of a wait when engine kept on. Also, explore the potential towards being digital India to maximum level.

References

[1] S. Halladamani and R. C. Radha, “Development of closed - loop traffic control system using image processing, " 2017 InternationalConference on Energy, Communication, Data Analytics and Soft Computing (ICECDS), Chennai, pp.3036 - 3040, 2017.
[2] Ramaprasad S S and Sunil Kumar K N, “Intelligent Traffic Control System using GSM Technology, ” 2017 IEEE International Conference on Power, Control, Signals and Instrumentation Engineering (ICPCSI - 2017)
[3] G. R. Andrei, T. R. Serban, S. V. Alexandru, and B. L. Dorin, “Simulation of traffic management systems using Arduino boards, " 2016 8th International Conference on Electronics, Computers and Artificial Intelligence (ECAI), Ploiesti, 2016, pp.1 - 6.
[4] P. Choudekar, S. Banerjee and M. K. Muju, “Real time traffic light control using image processing, " 2011 Indian Journal of Computer Science and Engineering (IJCSE).
[5] Susmita A. Meshram and Rani S. Lande, “Traffic surveillance by using image processing, ” 2018 (RICE) 978 - 1 - 5386 - 2599 - 6/18©2018 IEEE.