International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 11 | Nov 2021 www.irjet.net p-ISSN: 2395-0072

DYNAMIC TRAFFIC CONTROL WITH DENSITY ESTIMATION

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Abstract - *With increasing population in the current scenario, it concerns the vehicular traffic that results in enormous congestion, specifically in urban regions. Developed or developing cities, where every second passing counts, are usually prone to the heavy traffic at the junctions. Mobility and time are considered very precious in these locations. The concern of dynamic traffic signal control faces a challenge when it comes to prioritizing not only the lanes with larger traffic but also taking into consideration the emergency vehicles that are present in the lane. The purpose of this paper is to develop a smart traffic control and management system using image processing on Raspberry Pi while prioritizing that lane which has emergency vehicles such as an Ambulance, a Fire engine or a patrolling vehicle as well.*

***Key Words*: traffic, Raspberry Pi, traffic control, density, image processing.**

1. INTRODUCTION

In the current scenario, with rapidly increasing population, traffic control in the metropolitan cities have become a major concern to be dealt with. The existing solutions for the dynamic traffic signal control are designed to dynamically allocate the green signal for the lanes meeting at the junction, but the proposed system also considers the dynamic time allocation for the lanes based on the density of the traffic that is present on each lane [1][2].

Moreover, the existing implementations focused majorly on the highly dense lanes i.e., which are busy all the time. Hence, it becomes difficult for the less busy lanes to get their quota of time to move from the signal. The above scenario is not so ideal and doesn't happen most of the time, yet is a matter of concern even if it happens rarely also [3]. This system enables the green light, freeing all the lanes in one iteration considering the density and loops continuously doing the same giving a chance for each lane in one iteration. The system has several use cases which include emergency vehicle detection and signal jumper detection which improves the safety on the roads as well as humongous congestion that occur on the busy lanes [4]. Hence, the proposed solution here contains a traffic control, which dynamically allocates time to a particular lane based on the density present on the lane using Raspberry Pi 3B model, with an installed Pi Camera alongside. This setup would help in processing the frames captured by the Pi Camera and actuation of signal lights using Pi GPIO pins [5].

2. DEMERITS OF EXISTING SYSTEM

1) Since traffic signals are controlled completely on a fixed time basis, traffic densities never come into picture [6].

2) No difference between the low dense lanes and the lanes with higher density.

3) The system lacks the uniform flow of traffic resulting in traffic congestion a majority of times.

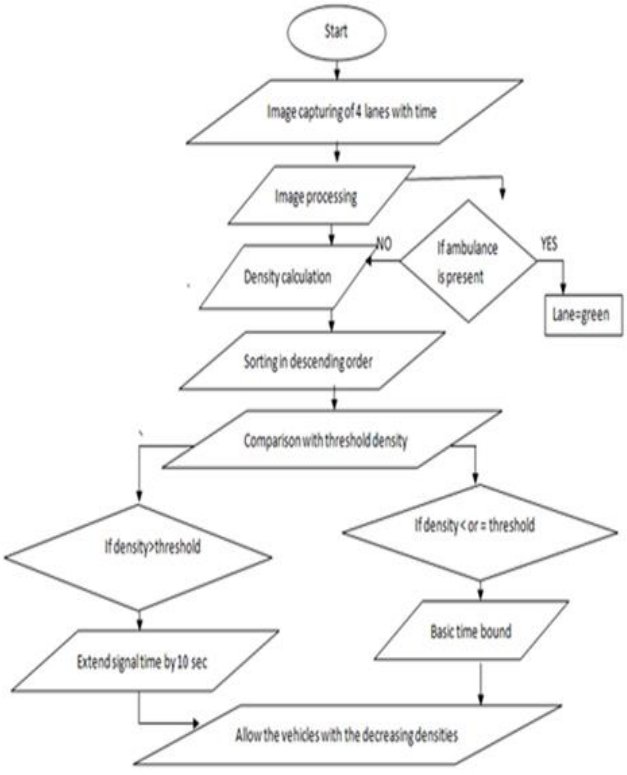
4) Human tolerance decreases in such scenarios and will lead to traffic violations such as signal jumping and over speeding.

5) Though there are resources which already have introduced dynamic traffic signal control, the problem occurs during dynamic time allocation [7][8].

3. PROPOSED TRAFFIC CONTROL SYSTEM

The proposed system constantly focuses on all the four lanes from the junction.

The flowchart of the proposed traffic control system is depicted.



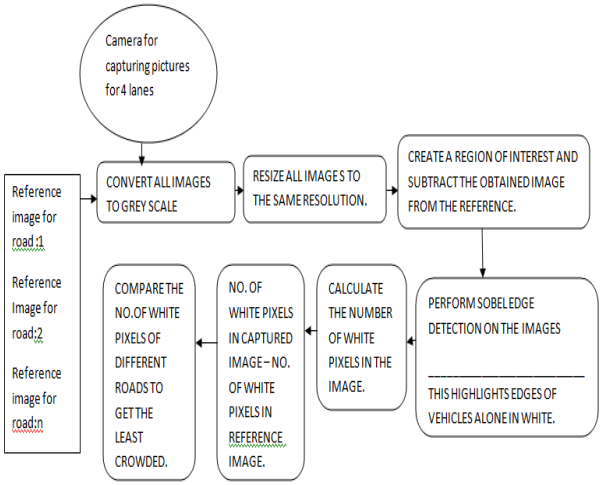
The installed raspberry pi alongside Raspberry Pi 3B module, takes the picture of a reference, which ideally doesn't have any vehicles on the lane and stores the image in the system folder. In a similar way we collect the images of all the four lanes from the junction. Later on, we go on with taking the images of the lanes with vehicles present. Now that we have both the images i.e., reference image and the image of the lane with vehicles i.e., actual image, we now need to perform a few image computations in order to extract the density from the images collected.

The acquired images both reference and actual, are converted into grayscale images [9]. Now, further moving into image processing we subtract both the grayscale converted images one from another respective reference and actual images. This will result in the extraction of the image with only vehicles present. Later, we trace the edges of the image acquired [10]. This will help us avoid large chunks of unwanted information, and also results in quick computation in the further stages. In the edged images which have been acquired, we now need to calculate the length of the pixels that are present in the image. This will give us the pixel density of each lane, indirectly giving us the vehicular density of each lane.

Further in this system, we can store the length of the pixel in a list, and proceed with the logical computation that results in setting free the lanes based on the density present in each lane. This system enables the green light, freeing all the lanes in one iteration considering the density and loops continuously doing the same giving a chance for each lane in one iteration. Also, a threshold for density is set. If the density of a more than or equal to the threshold density, then the time assigned to that particular lane is extended by 10 seconds.

The concern of dynamic traffic signal control faces a challenge when it comes to prioritizing not only the lanes with larger traffic but also taking into consideration the emergency vehicles that are present in the lane. Here comes the enhanced solution, where the effort goes into prioritizing that lane which has emergency vehicles such as an Ambulance, a Fire engine or a patrolling vehicle as well.[6]

We can enhance the existing solution using two methods. One of the methods is to use image processing and recognize an emergency vehicle by processing one such attribute like a siren/beacon that's present over the vehicle. Another, yet effective solution would be deep learning. This could be possible by making your machine learn the attributes of the emergency vehicles by passing a large set of acquired test images and get desired outputs while in the real time. The process of density calculation is depicted below.



4. IMPLEMENTATION

1. Start the program
2. Capture the images of empty lanes which will be used as reference images
3. Image acquisition of lanes with vehicles using Pi Camera
4. Convert the images captured to grayscale
5. Calculate the density of four lanes based on the pixels data
6. If the emergency vehicle is detected, allow that particular lane
7. Else, sort the density values in descending order and prioritize the lanes accordingly
8. If any lane has density less than the threshold, allow that lane for a minimum bound time.
9. Next set of images are captured at the last 10 seconds of the allowance duration of the last lane
10. Every lane is given chance in one cycle

5. RESULTS

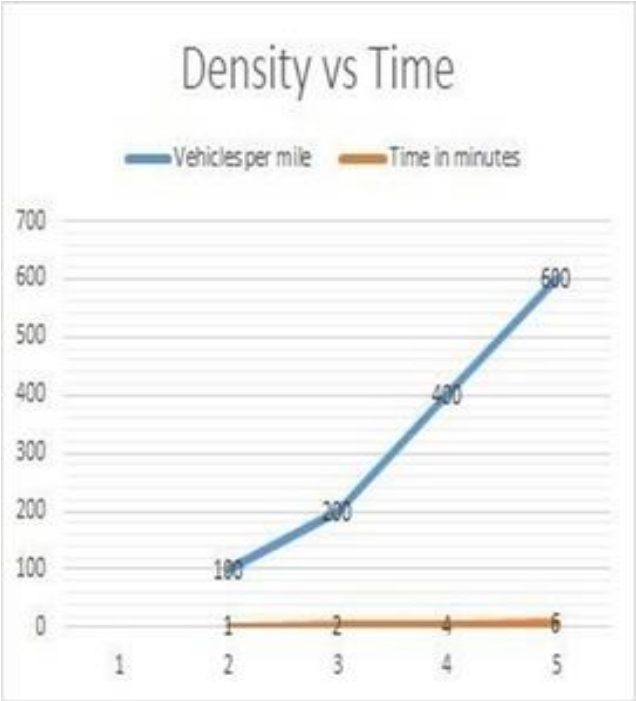


Chart -1: Relationship between density of vehicles and the time

The above graph depicts the relationship between density of vehicles and the time allotted to each lane. If the density of vehicles in a lane is 100 then the time allotted to that particular lane is 1 minute. Similarly, if the density of vehicles in each lane is 200, 400 and 600 then the time allotted to each lane will be 2 minutes, 4 minutes and 6 minutes respectively.

If the time allotted to a lane is very less, then the vehicles would have very less time to be freed. Similarly, if the time allotted to a lane is more, then the vehicles in the other lanes would have to wait for a long time to be freed. In order to overcome this problem, a minimum and maximum threshold for the time allotted to each lane is set. If the time allotted to a lane is less than the minimum value or more than the maximum value, then that lane would be assigned the minimum or maximum value respectively.

6. CONCLUSIONS

Traffic congestion control plays a vital role in a country like ours, which has irregular traffic behaviour and also where huge transportation network developments happen on a regular basis. The Dynamic traffic control with density estimation as a whole, comes out with providing some revolutionary solutions that need to happen and are very much possible in the near future.

The proposed system can also be extended in solving problems in various verticals in road network development, such as signal jumping detection and many more traffic violation activities.

REFERENCES

[1]Vidya Bhilawade, L.K.Ragha, "Intelligent Traffic Control System", International Journal of Scientific and Research Publications, Volume 8, Issue 2, February 2018, ISSN 2250-3153

[2]Pezhman Niksaz, Science &Research Branch, Azad University of Yazd, Iran, "Automatic Traffic Estimation Using Image Processing", 2012 International Conference on Image, Vision and Computing.

[3]Muhammad Hanif Tunio, Imran Memon,Ghulam Ali Mallah, Noor Ahmed Shaikh, Riaz Ahmed Shaikh, Yumna Magsi, "Automated of Traffic Control System Using Image Morphological Operations", 2020 International Conference on Information Science and Communication Technology.

[4]Shibin Balu, Dr..Priyadarshini.C, "Smart Traffic Congestion Control System", Proceedings of the Third International Conference on Computing Methodologies and Communication (ICCMC 2019) IEEE Xplore Part Number: CFP19K25-ART; ISBN: 978-1-5386-7808-4

[5]Arjun Dutta, Abhisikta Chakraborty, Amit Kumar, Anirup Roy, Swarnabha Roy, Debarpita Chakraborty, Prof. Himadri Nath Saha, Aadriza Sen Sharma, Meghma Mullick, Swarnali Santra, Sudeepta Saha, "Intelligent Traffic Control System: Towards Smart City", 978-1-7281-2530-5/19/$31.00 ©2019 IEEE

[6]Vahedha, B. Naga Jyothi, Smart Traffic Control System Using ATMEGA328 Micro Controller And Arduino Software : International conference on Signal Processing, Communication, Power and EmbeddedSystem(SCOPES)-2016, 978-1-5090-4620-1/16/$31.00 ©2016 IEEE

[7]Aman Dubey, Akshdeep, Sagar Rane, "Implementation of an Intelligent Traffic Control System and Real Time Traffic Statistics Broadcasting", International Conference on Electronics, Communication and Aerospace Technology ICECA 2017

[8]Vikramaditya Dangi, Amol Parab, Kshitij Pawar & S.S Rathod, "Image Processing Based Intelligent Traffic Controller", Undergraduate Academic Research Journal (UARJ), Vol.1, Issue 1, 2012.

[9]Naga Harsha.J, Sheena Mariam Jacob, Nikhil Nair, J. John Paul, "Density Based Smart Traffic System with Real Time Data Analysis Using IoT", IEEE ICCTCT 2018 –Volume 2, 6145

[10]Sk Riyazhussain, Riyazhussain, C.R.S. Lokesh, P.Vamsikrishna, Goli Rohan, "Raspberry Pi Controlled Traffic Density Monitoring System", IEEE WiSPNET 2016 conference.