An Automated Traffic Surveillance Control system by using STC algorithm

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ABSTRACT

Nowadays people are spending approximately 4.8 billion hours on every 12 months in traffic congestion. The traffic control mechanism was handled by humans dynamically. we have many automated systems which are not giving fruitful results. so, there is a need to improve an advanced automate systems. In this system we can combination different technical aspects of computer vision, prescient, massive records and system gaining knowledge for designing a dependable and scalable machine with the intention to help to resolve these traffic problems. In modern-day lifestyles we observe high volume of vehicles, inadequate infrastructure; irrational distributions are principal reasons for increasing traffic jam. One of the main reasons for traffic congestion is excessive use of wide variety of cars because of huge population and development of financial system. To resolve this problems , the authorities have to encourage people to use public transport or automobiles with small length along with bicycles. This paper presents an insight of ways technologies can be used and give a rational solution for traffic congestion.

Keywords: *Automated Traffic Surveillance, Control system, Machine Learning Techniques, Reinforcement Learning Method, Traffic, Image-processing, GPS tracking.*

1. INTRODUCTION

In recent years of modern Asia, capital cities are rapidly urbanized so there was urban congestion. This problem afflicting city on agglomerations and urban economies. Urban congestion is due to excess demand for journey over its supply. The presence of city congestion prevents free movement of traffic. as an example, in step with the International Association of Public Transport (UITP) in 2016, the average pace of vehicles on Bangkok streets become 18 km/h, even as that in Manila, Jakarta and Singapore become 20 km/h, 21 km/h and 23 km/h, respectively. In developing nations public transportation consisting of bus, subway, trains which are not fulfilling the need of people and also the toll road avenue network is incapable of meeting the requirement of growing number of car. Handling these problems, the authorities are investigation new solutions inside the traffic centres, namely, the public transport further, it is useful to construct overpasses and greater lanes in the streets. References **[1]** utilize cameras that can be set in a roadbed to distinguish vehicles that ignore the circle and associated in a CPU while more modern sensors gauge the speed, length, and weight of vehicles and the distance between them. Here at least one camera are introduced in streets, The optical information from both the unmistakable and infrared range as caught from the camera are considered it has the disadvantage of a high error rate in discovery and transmission of activity data. Different downsides incorporate lumbering establishment of RFID, repetitive support and the impossibility of overseeing movement locally.

2. REASONS FOR TRAFFIC CONGESTION

2.1 Saturation: Reaching more than maximum number of vehicle on a road leads to special type of congestion called saturation, frequently happens while a town's population grows quicker than its infrastructure. In locations like Bangalore, as an instance, which is taken into consideration the quickest-developing city in the country, highway saturation is a crucial difficulty that lawmakers have sought to cope with for years**[2].**

2.3 Car crashes: In many instances, when drivers hit heavy traffic, they immediately marvel if there has been a car accident. Car crashes disrupt visitors go with the flow for several reasons. The smash is probably blocking the interstate in order that no cars can get round it. Drivers would possibly should forestall, slow down or flow over in order that emergency vehicles could make their manner to the scene of the coincidence. Now and again, even if damage has been cleared to the aspect of the street, drivers will "rubberneck," which means they will drive slower with a purpose to get a higher have a look at the crash. **[5].**

2.4 Weather: Horrific weather interrupts the free drift of traffic because it makes drivers extra careful. Even as drivers might experience annoyed by way of drivers who are driving slower than traditional due to rain, snow or ice, they are surely taking protection

precautions. In fact, it is advised to move barely under the speed restriction in unfavourable weather in order to lower danger for crashing **[5].**

2.5 Distracted driving A more recent form of traffic that is affecting cities increasingly every day is clearly the end result of distracted driving. While drivers are distracted by means of their smart phones or different hand-held devices, they will not drive at a steady speed, thus by accident increasing traffic density. In reality, cell phone distraction at traffic lights can negatively impact everyday visitors glide for a mean of 27 seconds once stopped, but also increase the chance for crashing.

2.6 Difficulties for non-motorized transport. Problems for non-motorized delivery. These difficulties are either the final results of intense traffic, where in the mobility of pedestrians, bicycles and vehicles is impaired, however also due to a blatant lack of consideration for pedestrians and bicycles inside the physical design of infrastructures and centres.

2.7 Public transport inadequacy. Many public transit structures, or parts of them, are both over and beneath used. At some stage in peak hours, crowdedness creates discomfort for users because the system copes with a temporary surge in call for. Low ridership makes many offerings financially unsustainable, particularly in suburban regions. Notwithstanding substantial subsidies and cross-financing (e.g. tolls) almost every public transit device can't generate sufficient profits to cowl its running and capital prices**[4].**

2.8 Parking difficulties: In primary areas of massive towns cruising may additionally account for more than 10% of the neighbourhood movement as drivers can spend 20 minutes searching out a parking spot. This exercise is regularly judged greater economically effective than using a paying off-street parking facility because the time spent looking for a loose (or low value) parking area as compensated by way of the economic savings**[3].**

3. TECHNICAL SOLUTIONS FOR TRAFFIC CONGESTION

3.1 Handling Big Data

As traffic data maintains to grow, the average month-to-month data has now reached 10 terabytes. Since statistics such as autio and video are stored in one-of-a-kind records centres in special divisions, it has come to be difficult to use. Furthermore, some traffic management centres, equipment, and application structures run in silos, which want to be incorporated. The city stored twelve months of traffic data. However the ancient data confirmed that traffic statistics has grown 60 percent in keeping with 12 months, forcing the duration of saved information to grow to be shorter and shorter. The metropolis needed to make bigger the storage period of traffic facts to support public safety group of workers, criminal research groups, monetary investigations, and frontline police. Vehicle traffic facts are regularly key proof that helps identify individuals concerned in criminal instances. Because the city keeps broadening, the scale of visitors tracking operations has also grown. The information amassed through monitoring equipment wishes reliable storage. Additionally, with the development of latest technology and the increase in the electronic police checkpoint device to high-definition video pictures, image size is bigger than earlier than, worrying better storage overall performance. Some other trouble the city confronted turned into that traffic information could not be completely utilized. The guide information question and statistical analysis had ended up less efficient with the developing amount of records. because those data also have capacity cost for the town's traffic control, the metropolis hopes to transform the video tracking packages, the usage of the information as preventive visitors statistics that could increase public safety and transportation management**[6]**.

3.1.1 Traffic management system used big data technology can handle vast amounts of complex and diverse data: Big data has resolved 3 questions: data storage, data analysis and data management. A huge task is divided into small obligations, and be finished in map Reduce model. At the identical time, its stability and fault tolerance is critical. Hive as a records warehouse can shop big information in HDFS, its HQL sentence is translated into Map Reduce task, and be performed on one of a kind node, HBase as a database can keep and functions, the records in column mode. Sqoop can translate information among RDMS and Hadoop. Flume is incredibly available, fantastically dependable systems; it could collect disbursed large logs, and combine, shipping them.

3.1.2 Big data can improve the efficiency of transportation industry: Transportation industry, concerning many components of labour, need to address massive amounts of records, has more manage model of software, has a extremely good deal of system, if a bit accident happened, the whole device will run into inefficient nation, after using big statistics technology, the information machine can process the

information and discover the accident in true time, mechanically manage it, or suggested to the management team of workers and ask them to make choices. Big data has a very good predictive capability; it is able to lessen the chance of fake alarm and underreporting of traffic incidents. Site visitors steerage is a vital a part of wise transportation systems. By way of publishing steering statistics for travellers, it can imply visitors conditions of downstream street, allow travellers to pick the right journey direction, and improve the site visitors situation inside the metropolis. Inside the element of enhancing transport performance, enhancing the capacity of the street community, adjusting traffic demand, big data generation has obvious advantages**[7].**

3.13 Big data can improve the safety level of traffic: The real-time processing abilities of large statistics can as it should be probe site visitors accidents, its predictive capability can efficiently predict the incidence of traffic incident, the use of microwave detection structures,

video surveillance structures, cell detection machine, which could construct a powerful safety version to improve the safety of cars. While protection incidents happened, and emergency rescue wanted, because of its complete processing and choice-making functionality, speedy reaction functionality, massive facts can greatly improve the capability of emergency rescue, and reduce casualties and assets losses [**7].**

3.2 Machine Learning Techniques to Reduce Traffic:

Traffic is an intricate issue to comprehend, and traffic control engineers have since quite a while ago chipped away at enhancing productivity. The trouble emerges in light of the fact that there are two unmistakable and testing errands included the initial step is to make a helpful model of traffic stream, and the following is to by one means or another figure out how to improve it. traffic stream utilizing an improved simulation of an eight-path crossing point, with just red and green lights (no yellows) and vehicles just permitted to go straight through (no right, left, or U-turns were allowed).

Deep reinforcement learning algorithm is that automatically extracts all useful features (machine-crafted features) from raw real-time traffic data and learns the optimal policy for adaptive traffic signal control. Utilizing this simplified situation, a reinforcement learning algorithms with a specific end goal to decide signalling activities that were most valuable to the system. This was assessed by measuring the lining length of traffic in the two headings. By mimicking diverse signalling circumstances, the algorithm expected to limit the length of traffic lines and in this way diminish driver hold up time. Be that as it may, reinforcement learning is lacking without anyone else, because of the huge unpredictability of reasonable traffic conditions. Deep learning makes utilization of neural systems to discover concealed examples in datasets. Joining the two sorts of algorithms is called deep reinforcement learning, and it incredibly lessens the calculation time expected to discover upgraded solutions.

3.3 Problems with Existing Systems

As traffic information keeps on increasing, the normal month to month information has now achieved 10 terabytes. Since information, for example, pictures and video are put away in various server farms in various divisions, it has turned out to be hard to utilize. Also, some traffic administration offices, gear, and application frameworks keep running in storehouses, which should be coordinated. The city kept a year of traffic information. Be that as it may, the recorded information demonstrated that traffic information has grown 60 percent for every year, compelling the term of put away information to end up plainly shorter and shorter. The city expected to broaden the capacity time of traffic information to help open security staff, criminal examination groups, financial examinations, and cutting edge police. Vehicle traffic information is frequently key confirmation that distinguishes people associated with legitimate cases. As the city keeps on building up, the size of traffic checking operations has likewise developed. The information gathered through observing gear needs solid stockpiling. Likewise, with the improvement of new advancements and the overhaul in the electronic police checkpoint framework to superior quality video pictures, picture measure is bigger than some time recently, requesting better stockpiling execution. Another issue the city confronted was that traffic information couldn't be completely used. The manual information inquiry and factual investigation had turned out to be less proficient with the developing measure of information. Since this information likewise have potential incentive for the city's traffic administration, the city would like to change the video checking applications, utilizing the information as preventive traffic data.

4. Existing Models to Control Traffic Congestion

4.1 Traffic source – alternative path/ reroute

Recent research has proved that real-time traffic flow data and road travel time can be determined based on data reported by vehicles or road-side sensors. The question is how to utilize this knowledge in an

intelligent fashion to avoid congestion and reduce the drivers' travel times. This section presents our three re-routing strategies; all of them use the estimated travel time in the computation of the (k-)shortest path(s) for each of the vehicles selected as described in the previous section. Dynamic Shortest Path (DSP) is a classical re-routing strategy that assigns the selected vehicles to the path with lowest travel time. The advantage of this strategy lays in its simplicity and consequently reasonable computational cost O(E + V log(V)), where E is the number of road segments and V is the number of intersections. This strategy to provide good results when the number of re-routed vehicles is low. In this case, the risk of switching congestion from one spot to another is low. (Shanmuk Srinivas Amiripalli, inpress)

4.1.1 Random k Shortest Paths: Random k Shortest Paths (RkSP) computes for each vehicle to be re-routed its k-shortest paths. Then, it assigns each selected vehicle to one of the k paths randomly. The goal is to avoid switching congestion from one spot to another by balancing the re-routed traffic among several paths. The price to pay is a higher computational complexity, O(kV (E + V log(V))), which increases linearly with k. Although a larger k will allow better traffic balancing, it also increases the difference in the travel time among the k paths. Therefore, to prevent an excessive increase of the travel time for some drivers, RkSP limits the maximum allowed relative difference between the fastest and the slowest path to 20%. In section V, experimentally vary k to measure its impact. A model implementation have been conducted in major highways of Bengaluru, GPS traffic data gathered in the month of Nov, 2017was used as training data sets to predict the result.

Table 1: Alternative path/ reroute

Date	Time bracke	Total Speed (Km/h)	No. of Updates	Speed of Traffic (Km/h)	Set's Speed of Traffic (Km/h
10-10-2017	09:00 – 10:00	36	3	12	7
11-10-2017	09:00 – 10:00	61	6	10	
12-10-2017	09:00 – 10:00	15	3	5	
13-10-2017	19:00 - 21:00	15	18	0.83	

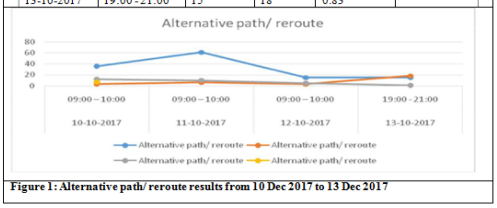

Figure 1: Alternative path/ reroute results from 10 Dec 2017 to 13 Dec 2017

4.2 Modified release: In traffic signals the sustained or modified release can be used to control or avoid the traffic congestion. Commonly traffic signals are working in a systematic way and it may not modify according to the situation. If sustained release or modified release method used in signals it will bring down the probability of high traffic congestion. A model implementation has been conducted in major highways of Bangalore and analyses the speed of traffic for the selected road segment. GPS traffic data gathered in the month of Nov, 2017was used as training data sets to predict the result.

Table 2: Modified Release

Date	Time bracke	Total Speed (Km/h)	No. of Updates	Speed of Traffic (Km/h)	Set's Speed of Traffic (Km/h
10-10-2017	09:00 – 10:00	7	2	3.5	16.66
11-10-2017	09:00 – 10:00	24	2	12	
12-10-2017	09:00 – 10:00	58	5	8.29	
13-10-2017	19:00 - 21:00	66	7	33	

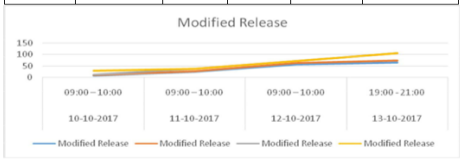

Figure 2: Modified Release results from 10 Dec 2017 to 13 Dec 2017

4.3 Peak hour non-peak area: Since distributed traffic is a boundless framework and a wide range of sorts of vehicles are in the road. When contrasting and the measurement of these vehicles morning have peak time and peak region. For instance Morning 8 to 9 and evening 6 to 8 are the peak deals time in the city and summer have less traffic inroads. At the point when bore into this idea the servers may require high handling velocity and memory in peak seasons. Or maybe killing the peak time and non-peak time, the

peak and non-crest range can be killed. At the end of the day utilize the servers which are sit or have less jobs in the sit out of gear area in the peak time. In like manner utilize non-peak time accessible servers in the peak area.

Peak based calculations are exceptionally touch to the accuracy of the from the earlier peak discovery. A peak might be characterized as the time-settled flag power hint of a diagnostic particle's comparing mass coordinating predefined criteria, for example, the decency of-fit to a predefined top model shape, together with a flag to-clamour proportion. On the off chance that a peak is labelled to be missing amid pre-processing, it can't be adjusted by a peak based calculation. With a specific end goal to deal with missing tops in information networks for factual examination, then filled the crevices by utilizing gauges in light of earlier gathering of the information. Such a gathering for the most part comprises of no less than two gatherings (control and treated gathering). At that point, for a peak missing inside a gathering, where most different peaks are available, the missing worth can be accessed from the present individuals from the gathering. Be that as it may, such peak attribution might be wrong in the event that it is just in light of the last peak tables and does not get to the first information to guarantee that a peak is truly present. Model implementations have been conducted in major highways of Bangalore and .analyses the speed of traffic for the selected road segment. GPS traffic data gathered in the month of Nov, 2017was used as training data sets to predict the result as shown in Fig-3.

Table 3: Peak hour non-peak area

Date	Time bracke	Total Speed (Km/h)	No. of Updates	Speed of Traffic (Km/h)	Set's Speed of Traffic (Km/h
10-10-2017	09:00 – 10:00	127	5	25.4	28.91
11-10-2017	09:00 – 10:00	53	4	13.25	
12-10-2017	09:00 – 10:00	71	2	35.5	
13-10-2017	19:00 - 21:00	83	5	41.5	

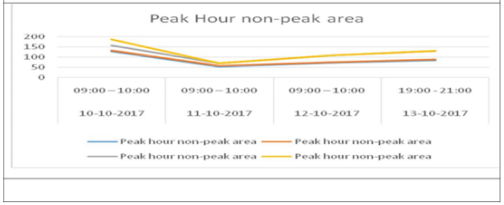

Figure 3: Peak hour non-peak area results from 10 Dec 2017 to 13 Dec 2017

5. Proposed Smart Traffic Control (STC) Algorithm.

5.1 STC Algorithm Architecture

An intelligent framework Automated Traffic Surveillance and Control system has been developed to monitor and measure the road traffic congestions and provide an easy platform to analyse the traffic movement and congestion pattern. Traffic Monitor is a rapidly deployable, cost-effective and easily maintainable traffic congestion monitoring and measurement system that combines Traffic source, GSM technologies, peak hour non-peak area and Complete with the necessary hardware, firmware and software components with the use of smart traffic control algorithm, the system's strength lies in its portability and reliable wireless data communication.

Smart Traffic Control algorithm is the combination of Traffic source – alternative path, sustained release, carpooling monitor peak hour non-peak area image-processing algorithms to extract vehicle trajectories, unscheduled entry monitoring and GPS tracking. This STC algorithm finds the smart way of controlling the traffic deriving best results from above methods. STC compares all the results derived from the above methods and gives the suitable solution for the time. These methods are individually discussed below. Smart Traffic Control algorithm is the combination of Traffic source – alternative path, sustained release, carpooling monitor peak hour non-peak area image-processing algorithms to extract vehicle trajectories, unscheduled entry monitoring and GPS tracking.STC gets all the information from these methods and provide a right mobility solution to the traffic management in a timely manner. Below architecture shows how STC gets all the information and validate those information and provides the best result.

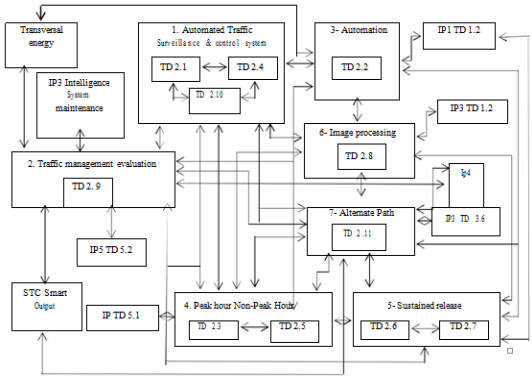

Figure 4: Architecture of Smart Traffic Control System

5.1.1 Entropy Balanced k Shortest Paths: While RkSP addresses the main potential shortcoming of DSP (i.e., moving congestion to another spot), it has its own deficiencies. First, it increases the computational time, which matters because the alternative paths must be computed and pushed to vehicles before they pass the re-routing intersection. Second, it assigns paths randomly to vehicles, which is far from optimal both from a driver point of view and the global traffic point of view. Therefore, to propose an Entropy Balanced k Shortest Paths (EBkSP) strategy to improve on RkSP at the cost of slightly increased complexity. The idea is to perform a more intelligent path selection by considering the impact that each selection has on the future density ofthe affected road segments. To expect this optimization to improve the traffic from a global point of view. In addition, EBkSP ranks the cars to be re-routed based on an urgency function that quantifies the degree to which the congested road affects the driver travel time. Thus, the more affected vehicles will have priority and be re-routed first. To avoid creating new congestions through re-routing, associate a "popularity" measure to road segments in EBkSP. Future congestion occurs if many drivers take the same road segment within the same future time window. 1 Assume that the drivers share their route information, it is possible to estimate the future footprint of each driver in the road network.

5.2 Proposed STC Algorithm

Algorithm 1: *EBkSP re-routing pseudo-code*

Procedure *main*

UpdateEdgeWeights ()

Congested Roads=detect Congestion (edge Weights)

if #congested Roads>0 then

selectedVehicles=selectVehicles(congestedRoads)

sortedVehicles=sortByUrgency(selected Vehicles)

odPairs=updateODPairs(selectedVehicles)

allPaths=compuate all kShortestPaths(odPairs)

doReroute (allPaths, sortedVehicles)

end if

end procedure

procedure*doReroute(allPaths, sortedVehicles)*

for all *vehicle in sortedVehicles do*

{origin, dest}=getVehicleOD(vehicle)

kPaths=getkPaths(allPaths, origin, dest)

newpath = getLeastPopularPath(kPaths)

setRoute(vehicle, newpath) updateFootprint(vehicle, newpath)

end for

end procedure

5.3 Results of STC Algorithm.

A model implementation have been conducted in major highways of Bengaluru analyses the speed of traffic for the selected road segment. GPS traffic data gathered in the month of Nov, 2017was used as training data sets to predict the result.

Table 4: Smart Traffic Control

Date	Time bracke	Total Speed (Km/h)	No. of Updates	Speed of Traffic (Km/h)	Set's Speed of Traffic (Km/h
10-10-2017	09:00 – 10:00	15	7	22.1	34.5
11-10-2017	09:00 – 10:00	25	5	11.33	
12-10-2017	09:00 – 10:00	40	3	29.6	
13-10-2017	19:00 -21:00	46	5	30.4	

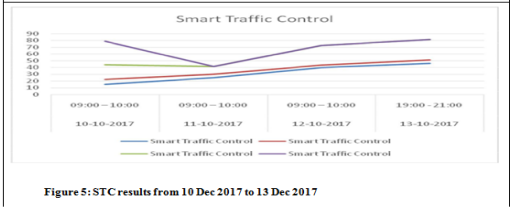

Figure 5: STC results from 10 Dec 2017 to 13 Dec 2017

When looking into the below results we could conclude that STC gives best result as it has high set traffic speed. Especially in peak times STC works efficiently and produce the best result. From the above graphs STC has the top Set's Speed of Traffic (Km/h) and deep reinforcement method comes next

to STC. Moreover the graphs also show even in the high number of vehicles entries STC observes and performs with high speed and accuracy. Moreover STC allows traffic administrators to separate and produce reports for traffic streams like number of entries, speeds of traffic, etc.

Table 5: Comparison of all the methods

Set's Speed of Traffic (Km/h)	
Alternative path/ reroute	7
Modified Release	16.6
Peak hour non-peak area	28.91
Smart Traffic Control	34.5

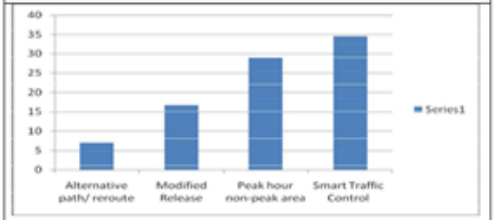

Figure 6: Comparison of existing methods with STC Algorithms

6. CONCLUSION

The application Automated Traffic Surveillance and Control System is proving to being the best solution contrasted with other existing traffic administration techniques like security cameras, human assessment, speed governors. Mapping of situational street traffic speed at any given time draws out the coveted geographic examples and connections which are basic decision making tools for traffic administration. The current confused traffic systems, traffic speed and the tremendous number of the traffic members, requires advanced and programmed techniques for information as the main best answers for traffic control. The application Automated Traffic Surveillance and Control System in traffic information gathering gives a definite investigation of traffic conditions with an additional solution of better recorded storehouse for street traffic information for other future examination. This is a noteworthy commitment towards robotization of traffic administration and examination for any given nation. Furthermore Smart Traffic control algorithms have been created over the span of the investigation which key towards the examination of traffic conditions on any is given street section and area. Programmed email cautions on speeding drivers likewise give better and clearer confirmation to any Traffic Police Department instead of the speed governors.

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