

New Sensing Method for Vehicle Mobility at Traffic Light Junction

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ABSTRACT

Around the world, traffic lights are well known as a device in ensuring efficiency and safety of traffic flow in a certain road junction. The traffic light system is believed to be the best practices in ensuring the smoothness of traffic flow operation which is automated now days. But, the conventional traffic light system still has its drawback to effectively control the traffic flow in and out of a certain junction even though it is still the best practices around the world now days. Some of the traffic light system requires human intervention during peak and rush hours especially in urban cities. One of the contributing factors to inefficiency of traffic lights system is it's measurability of vehicles in and out of a road junction. The enhancement of vehicle detection could be visualized with a new sensing technique which has better measurability of vehicles. The proposed new sensing method will increase and improve the smoothness of traffic flow within the available resources by creating intelligence to the conventional controllers. The new traffic control model or algorithm would be intelligence within the controller and respond to every change on sensor detection in ensuring better traffic control without human interventions at all time. Such intelligence would result in less waiting time and travel time with improved safety features for vehicle. This paper highlights a new sensing method for betterments in traffic flow in a certain traffic light junction.

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INTRODUCTION

Traffic lights are widely used as the stop and go signaling lights in multiple road junctions around the world. Traffic lights systems are usually positioned on a certain road intersections, pedestrian crossing and other locations to control competing flows of traffic in order to enhance the smoothness of traffic flow. Fig. 1 shows a set of traffic light system in operation for traffic flow control.



Fig. 1: Conventional traffic light system.

Traffic lights systems have been installed in most cities around the world regardless of different standards and physical appearance. Traffic light is a device which operates in timely assigned sequence to various aspects (display) in multiple junctions with fool proof safety system. The aspects are on in standard colors around the world which is Red, Amber and Green (Federal Highway Administrator, 2009).

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The traffic light system is build with a combination of three individual components which is the aspect unit, controller unit and sensor unit. The sensor unit is used to sense the presence of vehicles approaching to a junction and will commutes a signal to the controller to operate based on the preprogrammed sequence or condition as it will be display on the traffic light aspects on the road. The general traffic light block diagram is as shown in Fig. 2 (Department of Transportation Traffic Engineering Division, n.d., Douglas, E. Betts, 2007, S.K. Subramaniam, 2009, Lalit, S.N., 2006).

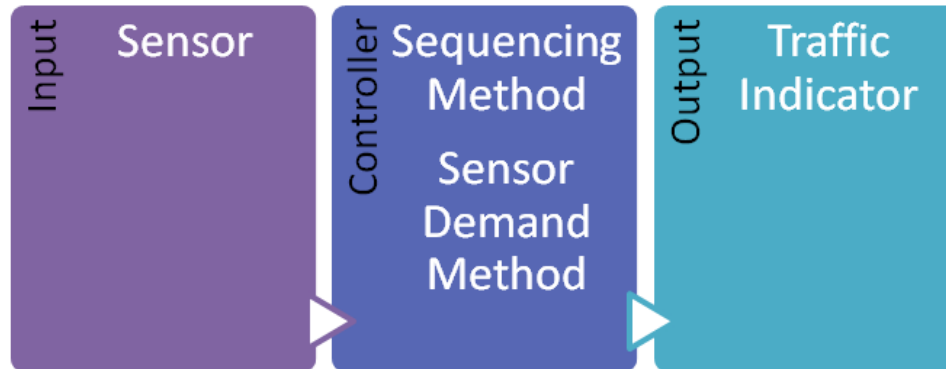


Fig. 2: Block diagram of general traffic light.

The traffic light system plays an important role in ensuring the traffic smoothness in and out of a junction without compromising the safety issues within the users. The traffic light system has gain recognition around the world till today for its crucial needs towards mankind. Even though traffic lights are known as the best device in controlling traffic flow for road users, yet there are certain limitations in the conventional traffic light system especially in safety matters. There are still many accidents reported at the traffic junction and it is very common about users. This is as results of less intelligence in the existing traffic light system as it requires human intervention for better traffic flow especially during peak hours. Such a practice is also common in many cities especially in urban areas.

Limitation Of Conventional Traffic Light System:

During peak hours, plenty amount of vehicles at certain junction cause traffic congestion. When a volume of traffic greater than the available road capacity is considered traffic congestion occur. During traffic congestion, there are time wasting of road users. Delays issue will happen which may result in late arrival for meeting, education and employment, resulting in lost business, disciplinary action or other personal losses. Great time wasted by the drivers or road users. Delays issues to enter and exit a certain traffic light junction is the result during late arrival for most meeting, education and employment and this will result in business lost, disciplinary action or other personal losses.

The increasing air pollution of carbon dioxide due to the vehicles emissions during the heavy traffic crawl. During traffic congestion, the vehicles engine is still running and the fuel keep burning for the use of air conditioning in the car only. Since the fuel price is always on the hike, drivers have their concern on this matter but the solution is nowhere near to enhance the traffic management system especially in big cities. For safety issue, a traffic police is needed when the junction is heavily congested. Sometimes, the instructions of traffic police are hardly to be seen by drivers or road users at a faraway distance from the junction. This is one of the causes of road accidents. This is some of the most crucial problems in regards to the conventional traffic light system (Andrew, D., 2008, Wiering, M., 2004, Jochen, W., 2004, Hashin, W., n.d., Sheu, 2006). The limitation of the conventional traffic light system can be summarizing as shown in Fig. 3 below.



Fig. 3: Downfall of conventional traffic light system.

Factors Of Traffic Congestion:

Nowadays, traffic congested is an unsolved issue in many cities around the world. Some of the factors of traffic congested are the poor traffic management of the cities, increasing of the number of vehicles on the road, insufficient of public transport, bad weather and the inefficiency of traffic light system.

Poor Traffic Management:

Some of the cities are facing problem on the unplanned road. For example, some of the cities roads are tend to be narrow and poorly built as shown in Fig. 4. For those, the cities grow in an ad-hoc manner; no provision is made towards scaling road capacities, eventually resulting into several bottleneck roads, which remain congested for extended period of time (Vipin, J., 2012). Besides that, some cities are facing problem on the discipline. The drivers are not trained sufficiently to follow the rule on the road. Whichever cities getting tighter budgets to set up a traffic light system will face problem on the traffic management infrastructure which can scale with the increasing traffic (Vipin, J., 2012).



Fig. 4: Poor road built on the middle of the road.

Increasing of Number of Vehicles on The Road:

Most of the cities, with rapidly increasing on number of vehicles will cause the heavy traffic congested especially during peak hours as shown in Fig. 5. The peak hours period can be declare as the morning period which is before office hours and evening period which is after office hours where everyone is going back from office. During that time, the traffic flow on the road will become heavy (S.K. Subramaniam, 2012).



Fig. 5: Traffic congestion due to the heavy volume of vehicles on certain road.

The country which is fast growing on economies has witnessed a surge in the volume of vehicles across major cities. Most of the people are forced to operate private vehicles because the cities seldom have efficient mass transit systems. This problem will make the driver assume the public transport is being used by the lower echelons of society (Vipin, J., 2012).

Inefficiency of Traffic Light System:

Delay of road user will be created if the traffic light system is inefficient. For example, even the lane is empty but road users in the other lane still need to wait for their turn. Such a situation is quite common in most of the traffic light junctions because most of the traffic light systems are using time-based and sequencing methods which are the traffic light turn by fixed timing. The road users need to remain waiting until the flow turns back to them. In the worst case, some of the road users are trying to jump the queue such as jumping the red light, but after jumping they have to face the consequences in paying a fine or ending up with a road accident (S.K. Subramaniam, 2012). Some researchers try to solve the problem by using something to detect the traffic flow on each lane and set the timing according to the conditions in that traffic light junction (Wen, 2006). However, they still cannot solve the problem for emergency situations such as the vehicles being an ambulance, fire brigade, and police car. Those vehicles still get stuck on the road especially during heavy traffic (S.K. Subramaniam, 2012).

Bad Weather:

Traffic congestion is not only caused by accidents, road maintenance, but it can also be caused by bad weather (Boris, S.K., 2007). It is known as inclement weather conditions and it will decrease the traffic demand and the freeway capacity. Traffic congestion occurs when the rate of the freeway capacity decreases faster than the decrease of the traffic demand (Lalit, S.N., 2006). During bad weather conditions, the road users need to drive slowly and it will slow down the traffic flow. Those road users concentrate on driving because it is very difficult to see the road conditions especially in raining days as shown in Fig. 6.



Fig. 6: Traffic congestion during a raining day.

New Sensor Placement:

New sensing methods will be a practical solution for a cross traffic light junction. By using this method, self-routing programs can be incorporated. This proposed new sensing method is able to measure the total volume of vehicles entering or exiting at a certain junction. According to this proposed system, a better sensor or detection approach should be used. A new sensing method should focus on detecting vehicles present in and out of a certain traffic light junction. Furthermore, the new sensing method is very easy for the further implementation of a traffic light system in ensuring the efficiency of traffic flow during bad weather conditions.

The basic idea of this proposed system is just adding two additional sensors on each lane compare to the conventional sensor demand method as shown in Fig. 7. By using this new traffic controller model called 'Self Routing Traffic Light (SRTL)', it should create an intelligent within the controller and sensors. It work based on the real time changes as being detected by the sensors placed on the strategic location in each lane. Based on the input signal from the sensor, the controller able to make decision and give the right priority and sufficient timing for the vehicles pass through. Once the input signal is accurate, the changer of vehicles on that lane also can be measure in very accurate.

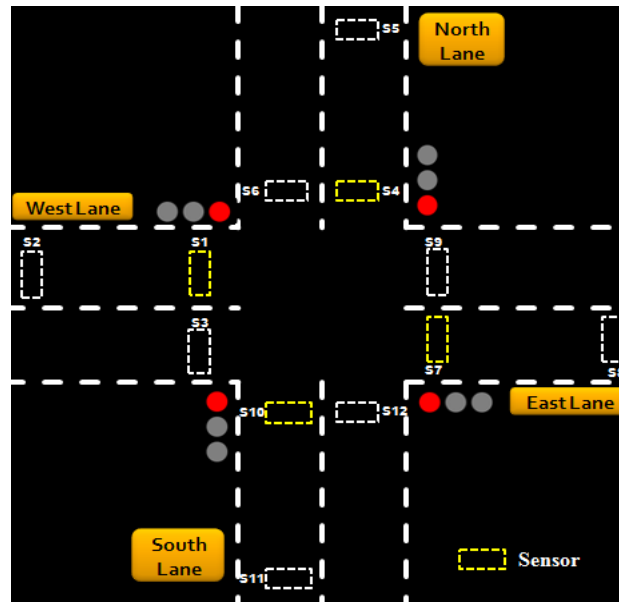


Fig. 7: New sensor placement.

Basically, the Sensor 1 and Sensor 2 in one of the lane are used to sense the volume on the entering lane on certain junction. Then, Sensor 3 is used to counting the vehicle exit from the junction. Fig. 8 shows the block diagram of the new sensing method traffic light controller work (S.K. Subramaniam, 2012).

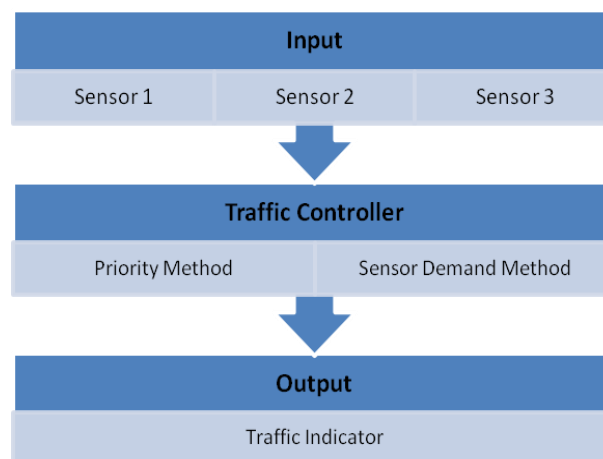


Fig. 8: Block diagram of new sensing method.

Apart from that, SRTL able to load the pre-program in the traffic light controller which is based on the response from the sensor. The timing provided for each lane is depends on the Sensor 1 and Sensor 2 on each lane. If only a Sensor is triggered, the timing provided for that lane is shorter compare to the lane which is triggered by Sensor 1 and Sensor 2 at the same time. The flowchart in Fig. 9 shows the overall functionality of the SRTL.

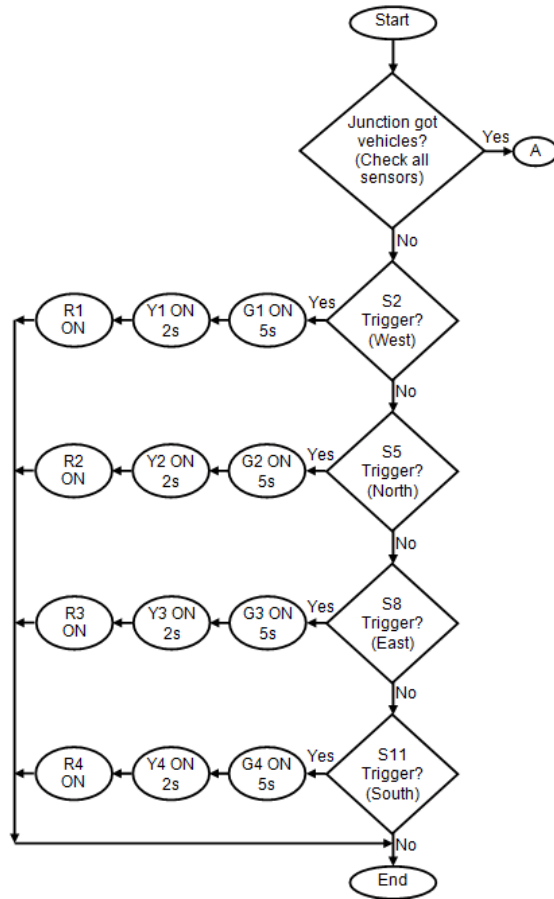


Fig. 9a: Flowchart part A.

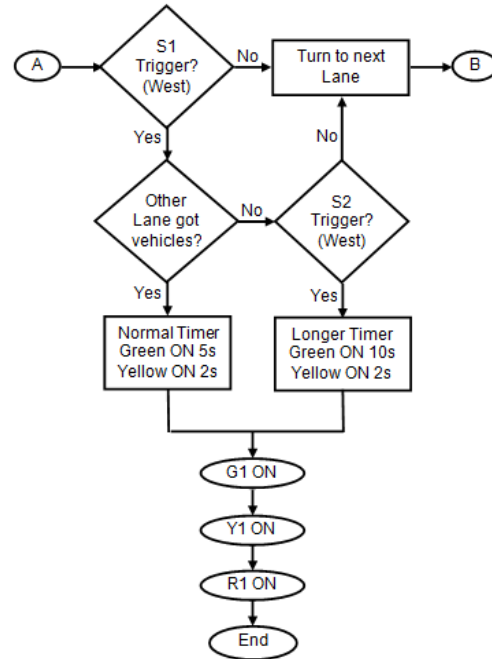


Fig. 9b: Flowchart part B.

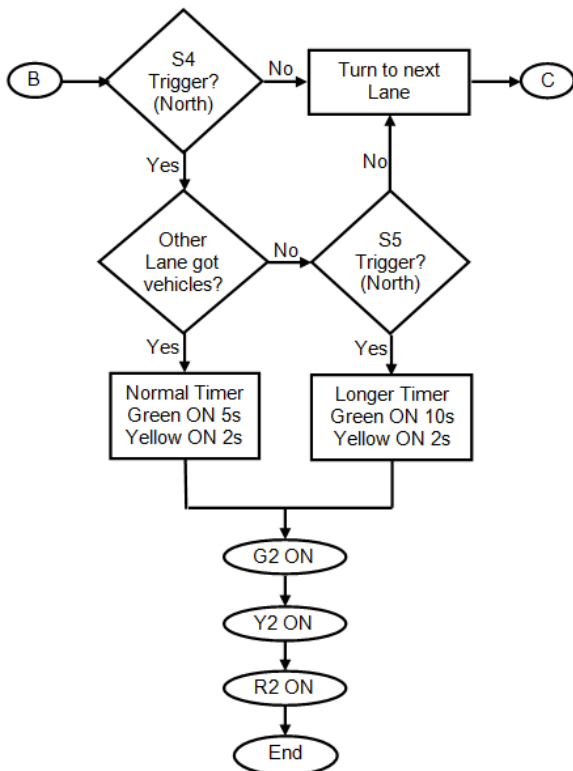


Fig. 9c: Flowchart part C.

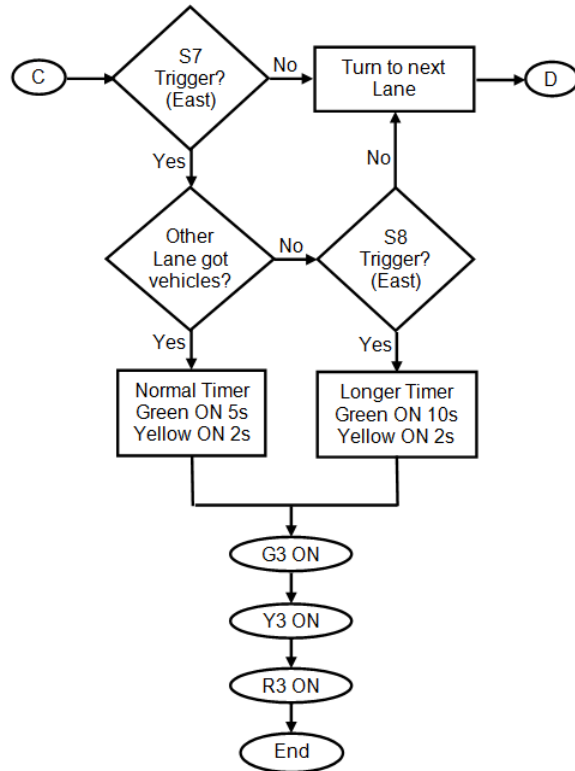


Fig. 9d: Flowchart part D.

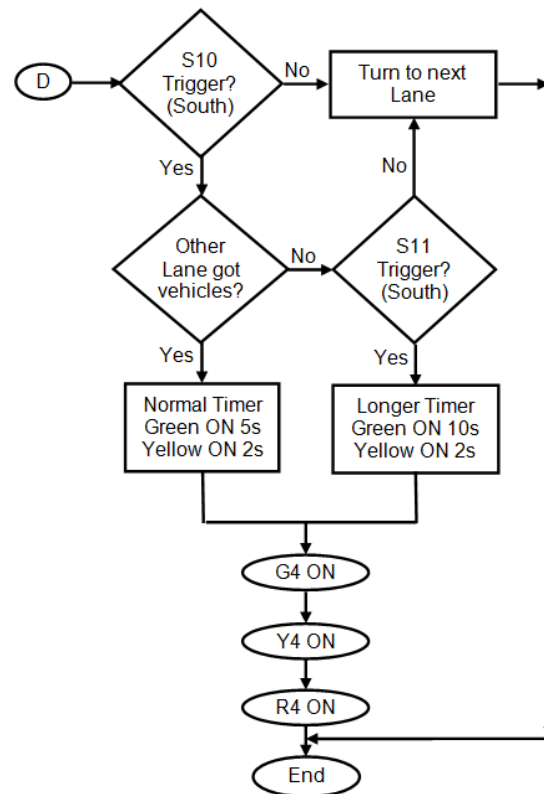


Fig. 9e: Flowchart part E.

Conclusion:

The important of traffic light system is to manage the traffic flow especially at urban cities. Without traffic light system, the traffic flow will become unplanned and traffic congestion happened. This is because there is no regulation on road and driver will behave on their own way when they enter to an intersection point. Their attitudes will affect the cities become chaos and traffic congestion happened. Even the conventional traffic light system is installed in most of the cities, traffic congestion still happening. This is because of the conventional traffic light system unable to manage a large volume of vehicle at urban junction.

Apart from that, the efficiency of traffic light system is depends on the traffic controller. An intelligent traffic light system will perform better compare to normal traffic light system. In proposed system (SRTL), by just adding more sensors at urban junction, SRTL system will reduce the waiting time and travel time of road users. At the same time, the probability of traffic congestion will be reduced also. So, the proposed method is a practice solution to overcome the problems faced on the conventional system.

REFERENCES

- Boris, S.K., 2007. Features of Traffic Congestion caused by Bad Weather Conditions of Accidents. Department of Transportation Traffic Engineering Division, 2007. Traffic Signals, Traffic Signal Brochure of City of Pasadena. Douglas E. Betts, Chris Cavette, Traffic Signal, 2.
- Hashin, W. and N.A. Ramli, A Case Study of Mitigating Air Pollution Emissions at Traffic Light Junctions. Human Settlement Development, 2: 35-43.
- Jochen, W., B. Yuriy, G. Alessandra and R. Jonathan, 2004. Traffic Routing for Evaluating Self-Adaptation. University of Washington Technical Report.
- Lalit, S.N., 2006. Weather Impact on Traffic Conditions and Travel Time prediction. M.Sc. Thesis, University of Minnesota Duluth.
- Public Works Department Malaysia, 2009. Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), Federal Highway Administrator.
- Sheu, 2006. A Composite Traffic Flow Modeling Approach for Incident-responsive Network Traffic Assignment, *Physica A*, 367: 461-478.
- Subramaniam, S.K., S.T. Tan, Ranjit S.S.S., V.R. Gannapathy and A.T.I. Fayeez, 2012. Routing Solutions with Vehicle Sensing System for Heavily Congested Urban Route. *Prosiding Seminar Hasil Penyelidikan Kementerian Pengajian Tinggi*, Jilid III, pp: 322-328.

Subramaniam, S.K., V.R. Gannapathy, S.A. Anas, A.B.M. Diah, M.K. Suaidi and A.H. Hamidon, 2008. "Intellectual and Remotely Self Monitored Flood Observatory System for High Frequency Flood Prone Locations", Universiti Teknikal Malaysia Melaka. Andrew Downie (2008-04-21), "The World's Worst Traffic Jams", Time Worlds.

Vipin, J., S. Ashlesh and S. Lakshminarayanan, 2012. Road Traffic Congestion in The Developing World.

Wen and Yang, 2006. A Dynamic and Automatic Traffic Light Control System for Solving The Road Congestion Problem, WIT Transactions on the Built Environment (Urban Transport). 86: 307-316.

Wiering, M., & J. Veenen, 2004. Intelligent traffic light control. Institute of Information and Computing Sciences, Utrecht University Technical Report UU-CS-2004-029.