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Designing a Smart Traffic Light Algorithm (HMS) Based on Modified Round Robin Algorithm

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Abstract: ***Nowadays, traffic light system is very important to avoid car crashes and arrange traffic load. In the Sulaimani City / Iraq, there are many traffic problems such as traffic congestion or traffic jam and the amount of time provided manually to the traffic light system. This is the main difficulty that we try to solve. The traffic lights exist but still do not manage traffic congestion due to the fixed time provided for each lane regardless of their different load. Therefore, we are proposing to change the traditional traffic system to smart traffic system (adaptive system). This paper Focuses on the existing system (fixed system), then propose the adaptive one. The main crucial side effects of the existing system are:***

1. ***Emergency cases: congested traffics might block the way of emergencies for instance ambulance, which transports people to the hospital urgently.***
2. ***Wasting time of people generally and specially drivers.***
3. ***Delays, which lead people to not to be punctual, this means people arrive late to the work places.***
4. ***Wasting more fuels as staying more in the traffics, which affects the environment by increasing pollution.***

Keywords: Smart Traffic Light, HMS Algorithm, Modified Round Robin.

1.INTRODUCTION

Intelligent Traffic Light system is vitally important to control traffic light or traffic jam especially in less developed countries, like Sulaimani City, which is a part of KRG-Iraq, to enhance their services and make traffic lights adaptive. In addition, smart traffic light facilitate traffic police works; reduce their load and people will be convenience due to they will be able to attend their works on time without traffic jam [1]. Moreover, it will be able to facilitate towards the achievement of reducing vehicles crashes, reduce load, in Sulaimani; the initiative has to some extend increase the efficiency of the traffic light in providing better services to its drivers. A Simulation had conducted to test the proposed Algorithm, which is depended on Modified Round Robin algorithm and using Statistical equation [2] [3].

Even though the traffic light does exist in Sulaimani City, the existing system is a fixed system, which is based on specified time to each direction in a junction manually. This is done by providing more time to the lane, that is more crowded. In some cases, all vehicles will be passed with the provided time but the time still remain, the other drivers on the other lanes must wait until the time will be finished which is inconvenience, So the proposed algorithm specifying the time to each of the lane by the number of vehicles in each lane [5][6]. The main aims are to provide a system with the following capability:

- Reduce waiting time: the system has ability to reduce the amount of time consuming by vehicles in a traffic light queue.
- Resource utilization: it aims to be ensure of maximum using roads and resources.

By using the designed HMS Algorithm based on Modified Round robin algorithm, this paper will thus reveal the enhancement of traffic light services in Sulaimani City.

Consequently, in the existing system a lot of amount of time is wasted. Drivers must wait on the other lane. However, all the cars from the other lane passed through the traffic. So, they wait much longer. The given time is divided to the lanes regardless to the number of car in each lane. By the way waiting is another issue. In addition, in the proposed system the problem of wasting and waiting time will be solved due to the amount of time is divided on each lane depending on the number of car in each lane. This is conducted by using HMS Algorithm which is based on Modified Round Robin Algorithm.

2.BACKGROUND

With increasing the number of vehicles on street, crowded will be happened especially in main junctions at rush time, in the morning and after work in the evening. The problem can be solved by creating a system to give longer time to the lane that has high movement than the lane that has low postponement, this is called manual or normal mode [8]. The existing system is not efficient due to vehicles in a junction will hold more time when the traffic light is red; if they pass through red light they have to pay fine. On the other hand, other lane there is no vehicles or few vehicles waiting. This

issue can be solved by developing Round Robin algorithm as explained [4].

Round Robin is a basic and simple scheduling algorithms used to serve multiple queues. In this case, lanes on red light based on round robin fashion. The scheduler give a similar chance (green light time) for each queues regardless of car size and lane load [7]. However modified round robin MRR gives a weight for each queue, the weight then determine the amount of resource. In this case, it is the green light time given to each queue, in this work, the equation of the weight is been studied thoroughly and designed to be adaptive based on the lane load, and named HMS algorithm [11]. As explained

• The total amount of time is fixed which is 120 seconds for one round, for the first cycle the time will be divided similarly for each lane

• The time of the next round will be divided based on load of the previous round of each lane

• Then it repeats the cycles based on the number of cars of each lane.

3.METHODOLOGY

This section provides the method by which the algorithms designed and works. By looking at Table 1.0, it shows that how the system collects the data and provide times for each lanes.

Steps	
1	Counting the number of vehicles in each lane for a round by using the sensor network.
2	Process the collected data into the useful information to be the input for the algorithm
3	Calculating the given time for each lane for next round based on proposed (**HMS algorithm)**
4	Outcome of the algorithm which are the amount of red and green time for each lanes

Table 1.0 illustrate the steps of the system

3.1 HMS ALGORITHM

The first step is about collecting the number of vehicles in each line by using the sensor network or camera, which uses image processing to determine the vehicles passed through, and then pass the number of vehicles to the main control board, which can be an Arduino board

Then the number of vehicles will be sent to the control system to calculate the amount of time providing for each lane. In this step, the first term algorithm will be used. After that, HMS algorithm is used which is based on modified Round Robin and the equation one is designed for it is weight.

Yn (next state) = (((Round Time)/F (previous state))*Ln (previous state)) ……1

Yn: the amount of green time given for a lane, n is the lane number Yn: given time for each lane, n is lane number L1, L2 …

F: Total number of vehicles on the all lanes

Ln : number of vehicles on a lane , n is lane number

After that, each lane will get their green and red seconds to backlog the cars of the lanes by Round Robin fashion.

The following figure reveals the processes of the simulation.

Figure1.0 the process of the simulation

The following figure shows the flowchart step by step processes of the simulation.

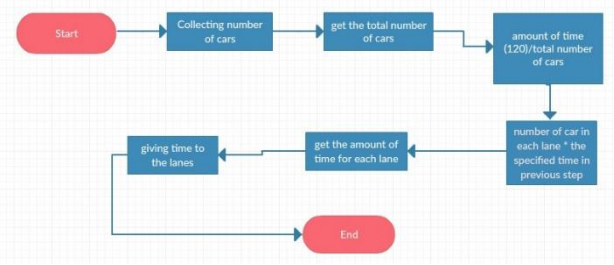

Figure2.0 the flowchart of the processes

3.2 APPLYING HMS ALGORITHM IN THE SIMULATION

To simulate the outcome and comparing the existing and

proposed system, a program written in C#. For the first round, the given time for all lanes, which is 120 second, divided equally. Then Random method in C# is used to generate number of cars randomly for each lane, after that, the total time is divided by the total number of cars on the lanes, and multiplied by number of cars for each lane differently, the results will be the amount of provided time for each lane. The simulation interface is shown in Figure 3.0

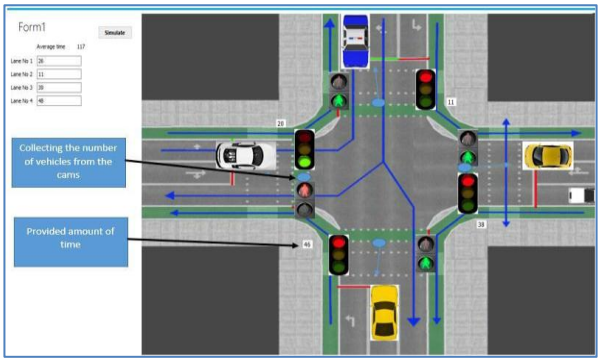

Figure 3.0 Sample of the Simulation Interface

3.3 RESULT OF THE SIMULATION

Assuming that total number of cars for the all lanes equal to 80 for each rounds and the given green time for one round is 120 seconds, after the simulator was run for several times, the results are shown on the below graphs. Looking at the Figure 4.0, clearly can be seen that, the existing system wastes several seconds, especially when there are no cars on the lane, while the proposed system gives adapted time based on the number of cars, when the number of cars increases, the given time will increase as well.

In addition, the high loaded lane graph in Figure 5.0 shows that, the existing system causes lots of traffic jam as it does not give the necessary amount of time to backlog all cars on the lane, while the proposed system increase the time based on the number of cars. On the other hand, when the load of each lanes are equal, the proposed system gives equal amount of time.

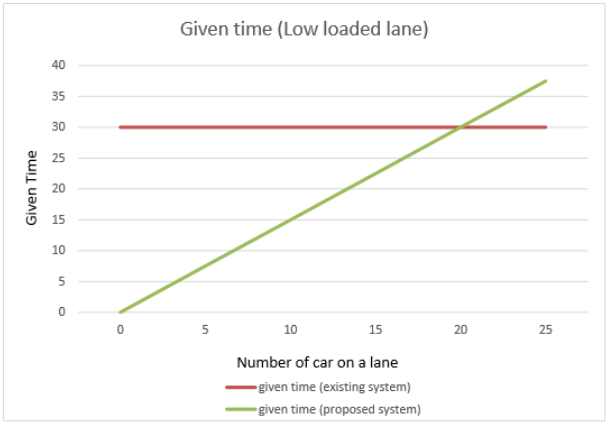

Figure 4.0 Given Time for Low Loaded Lane

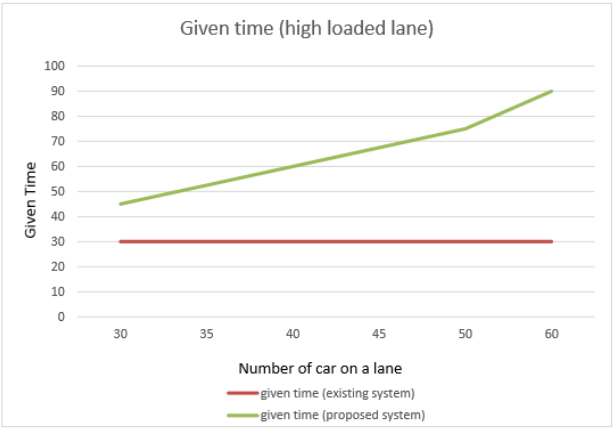

Figure 5.0 Given Time for High Loaded Lane

4. DISCUSSION

To sum up, according to the figure 4.0 low loaded lane; in the existing system the time is divided on each lane with ignoring the number of car in each lane. However, the number of cars in each lane are different but the amount of given time is the same which is shown in red lines. On the other hand, the proposed system divides time according to the number of car. This means that by increasing the number of car the amount of given time will be increased. Consequently, there will be no wasted time. In addition, according to figure 5.0 high-loaded lane; when there is more crowded or the number of car increased in each lane. Based on the existing system; However, the number of car is increased but the amount of given time is the same. So, a lot of amount of time will be wasted. Based on the proposed system the number of car is taken into considerable due to the time is divided depending on the number of cars in each lane as it is shown in green lines. As a result, a lot of amount of wasted time in the existing system will be used in the new one.

Over all, in the existing system increasing or decreasing the number of car, low-loaded or high-loaded lanes, does not affect the amount of given time. The amount of given time will be the same. On the other hand, in the

proposed system, the amount of given time depends on the number of car in each lane. Consequently, there will be much less wasted time.

5.CONCLUSION

In this paper, the weight of Modified Round Robin algorithm has designed to be used for adaptive traffic light system. The system then modelled and simulated using a C# program. After the simulation was run for several times, the data then has been collected and Compared with the existing traffic light system, which is fixed time. The result shows that the designed system facilitates the cars on the traffic light to wait less by providing more time for the high loaded lane. In addition, the amount of time for each lane provided by using HMS Algorithm adaptively gives different times based on load of each lanes.

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