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Vehicle Traffic Control System Using Modified Smart Optimized Round Robin Scheduling Algorithm

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ABSTRACT : *Traffic congestion arises mostly in density populated areas where the number of road users and vehicles are on increase beyond the intended capacity of road at an instance of time. In this area, the congestion is mostly caused by violation rules, poor traffic management, accidents and low response to removal of broken down vehicles. Providing solution to this problem requires urgent attention due to its adverse effect on human daily activities such as waste of valuable time on the road, which possess treats to the economy, loss of life due to accidents and hindrances experienced by emergency vehicles in rendering their adequate services. This paper proposed a solution to control the flow of traffic at road junctions by modifying a round robin scheduling algorithm through assigning priorities to emergency vehicle at their arrivals and consequently use of traffic control barricade to enforce strict compliance of traffic rules to the vehicle road users. The results obtained show that the Modified Smart Optimized Round Robin Algorithm reduced the total and average waiting time of vehicles by 11.61%, though with a drop by 13.52% as emergency vehicle arrival increased.*
KEYWORDS *–Algorithm,Barricade,Traffic, Round Robin Scheduling,, and Vehicle*

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I INTRODUCTION

Traffic is the movement of either vehicles or pedestrians on the road or in an area. The interactions between vehicles, drivers, pedestrians, cyclist, other drivers and infrastructure on the road is being study through traffic flow, this is because it enables in understanding an optimal road network with efficient movement of traffic. Traffic congestions have been problem that people encounter in their daily activities in cities with high density of population. Cities and their transport systems are fully complementary.Cities are location of accumulation and concentration of economic activities, therefore complex spatial structures can only be supported for transportation system[1]. Transportationis an indispensable catalyst foractivating and stimulating the tempo of economic,social, political and strategic development[2]

Nigeria has number of commercial cities such as Lagos, Kano, Ibadan, Portharcout and Federal capital territory (FCT) Abuja. These road can carry 80% of the population and goods[3]. Because of the complex spatial structure of road in the commercial cities there is investable traffic congestion. This paper proposed a solution to control the flow of traffic at road junctions by modifying a round robin scheduling algorithm through assigning priorities to emergency vehicle at their arrivals and consequently use of traffic control barricade to enforce strict compliance of traffic rules to the vehicle road users.

1.1 Background of the study

Scheduling algorithms are the techniques used by the Central Processing Unit (CPU) to decide which process will be allocated to the CPU and for how long. The choice of the algorithm adopted by the operating system designer determines the efficiencies of the CPU[4]. There are lots of scheduling algorithms such as, First Come First Serve, Shortest Job First, Priority Scheduling Algorithm and Round Robin Algorithm (RR). The Round Robin (RR) CPU scheduling algorithm is a fair scheduling algorithm that gives equal timequantum to all processes[5]. With this approach the various processes are giving equal time slice of allocation to the CPU, once a process exhaust its allocated time the CPU is allocated to the next process in the waiting queue for another same time quantum. The major problem with this algorithm is deciding the choice of time quantum that will be allocated to processes. Performance of RR scheduling is sensitive to time quantum selection, because if time

quantum is very large then RR will be the same as the FCFS scheduling. If the time quantum is extremely too small then RR will be the same as Processor Sharing algorithm and number of context switches will be very high [6]

Controlling traffic situation has been in existence for many decades evolving from when police officers are used to control traffic flow. The urban traffic control system has the following technological phases[7]:

1.1.1 Phase1:Origins of Traffic Lights

In the year 1868, the idea of police officer designated in controlling traffic at T junction, eventual implementation of traffic control system has taken its phase

1.1.2 Phase2 – Fixed Time Plans(1920 – 1980)

This was a new beginning of urban Traffic control (UTC) and it was this era that it was realised that constructing more roads cannot absolutely solve congestion problem. This leads to improvement of the original isolated fixed time plan by coordinating traffic signal. It involves using offset times i.e time delay of green time between subsequent traffic signals to create smooth traffic flow between neighbouring junctions and this time may be biased towards a route with heavy traffic. It calculates the timings off line, using historical, measured traffic data to generate optimum plans for the specific time of day, and day of the week

1.1.3 Phase 3: Vehicle Actuated (Isolated) Junctions (1970's – present).

The rate at which vehicles traffic increases, the fixed time plan was unable to solve the alarming rate of traffic and this leads to further research on how to tackle this problem. The development and use of inductive loop was invented and installed throughout the road network so that traffic signals could be triggered by vehicle presence at junctions.

1.1.4 Phase 4 -Vehicle Actuated Junctions (Late 1970s –Present)

Vehicle actuated systems for coordinated junctions use on-line detector measurements to optimise signal timings on a cycle to cycle basis to better meet demand. These systems can be coordinated from a central computer or have distributed intelligence and be coordinated at a local level. An advantage of isolated vehicle actuated junctions compared with a coordinated system is that there is greater flexibility to change the traffic signals because there is no consideration of the subsequent effects on neighbouringjunctions[7].

1.1.5 Phase 5- Integrated UTC & Intelligent Transport Systems(1997–Present)

The most advanced urban traffic control systems are now becoming more centrally integrated with other traffic management systems to reduce the workload of network operators and to improve the efficiency of the network. They are designed in such a way that they integrate some other functionality like; parking management, environmental monitoring control, public transport system, etc. As there is serious advancement in technology, this ultimately will make better invention in development of intelligent traffic system.

II LITERATURE REVIEW

Lots of works has been done in the area of vehicle traffic control, researchers has either used different round robin scheduling algorithm or other methods to control the flow of traffic.

A real time traffic signal control system that assigns proper traffic light signal duration to traffic junction by using round robin scheduling algorithm through variation of time quantum was proposed [8]. The proposed work does not take care on giving priority to emergency vehicles at road junction. Fixed time traffic control system does not provide the flexibility to readjust the traffic signal computation according to changing traffic situation. A modified round robin algorithm to schedule flow of traffic was proposed for traffic control, Round robin algorithm, and some other scheduling algorithm like shortest job first, priority scheduling algorithm and the modified round robin was applied to scheduled traffic[9]. Results show that the proposed modified round robin outperformed the other algorithm. The major drawback of the proposed work is that it does not cater for the arrival of emergency vehicle prompt passage. An intelligent traffic control system based on round robin scheduling algorithm mainly to reduce the waiting time of vehicles at road junction was proposed [10], the proposed method does not provide a way to make emergency vehicles get to their destinations at shortest time possible by assigning them priority at the road junctions. Traffic light pre-emption control system for emergency vehicles in reducing the delay experienced by emergency vehicles especially at the road junction [11]. The researchers proposed an automatic voice sensor which is attached to the traffic light that recognizes the siren of an emergency vehicle and shifts the red signal to green by them priority ahead of other vehicles but has a limitation on the control of other non-emergency vehicles arrival. A traffic control system using Programmable Logic Control(PLC), that measures the traffic density by counting the number of

vehicles in each lane and their weight, and automatically diverge them accordingly through application of weight sensing was proposed[12]. In all the related work, vehicles still encounters different degree of delay at road traffic junction which is still a major limitation in traffic control.

III METHODS

Round robin scheduling algorithm is specifically designed for a time sharing system such as the scheduling of traffic light signal at road junction for the passage of vehicles. The algorithm incorporates assignment of priority for emergency vehicle arrival.

3.1 Case Assumption

Considering a real multiprocessing time sharing environment such as the vehicle traffic scheduling, some assumptions are considered to implement the design which are :

1. Road junctions are made up of three to four roads
2. Each road is allowed for only one way movement
3. Road status is considered to be motor-able and in good state and any damaged vehicle on the road are not considered.
4. vehicle arrival time and service (burst) time are taken considering real situation
5. Only emergency vehicles use sirens and their rate of arrival at road junctions are considered based on real life situation.

Algorithm 1: Modified Smart Optimized Round Robin Algorithm(Msorra)
Step 1: Start
Step 2: Input: Indicator1 = Traffic_Light_Red,
Indgencicator2 = Traffic_Light_Green,
Service time for each lane, No of Lanes, lanes = L
Step 3: Set default service time for each number of lanes
for each lane as L
if traffic indicator(L) == indicator1 and arrival of emergency vehicle with siren sound
then
Call Emergency sub-Algorithm
Call **T**raffic barricade sub algorithm
else
Call Schedule service time
Step 4: End

Algorithm 2: Scheduled Service time Sub Algorithm
Step 1: Start
Let R_servicetime = Remaining Service time
Let n be the no of lanes
Let STQ= Smart Time Quantum
Let $R_1 \ldots R_N$ be the corresponding service time for each lane 1-n
Step 2: Set default service time $R_1 \ldots R_N$ for each lane 1-n
Step 3: Arrange service time in ascending order
Step 4: Get the highest service time
Step 5: Compute mean = $(R_1 + R_2 \ldots R_N)/ n$
Step 6: STQ = (mean+ highest service time)
Step 7: for each lane as L
if L is idle
then
Pass vehicle on the non_idlelane based on the service time
else
Schedule the road based on their ascending order of service time
Step 8: while STQ < service time of each lane
do
Schedule the road based on STQ
letR_servicetime of current lane = STQ - service_Time
if (R_servicetime of the current lane ≤ STQ)
then

Reschedule the current lane for the R_servicetime
else
Pick the next lane.
Step 9: Return

Algorithm 3: Emergency vehicle sub-Algorithm
// emergency vehicle sound sensor pre-install and attached
Step 1: Start
Step 2: if emergency vehicle arrival with the siren sound
Compare and synchronize the sound with pre-installed sound
else
Return( )
Step 3: if traffic light signal is green
maintain green light till emergency vehicle passes or traffic time exceed 1 minute
else
Preempt the traffic signal for emergency vehicle
Step 5: Return

Algorithm 4: Traffic barricade sub algorithm
Step 1: Start
Step 2: If arrival of emergency vehicle and traffic light signal is red
then
Traffic barricades shut down all the lane access that emergency vehicles is not coming from
else
Traffic barricade allow traffic flow
Step 3: Return

The existing algorithm before the modification was purely designed for scheduling of processes to the central processing unit (CPU), majorly meant to reduce the waiting time that occurs when processes are competing for resource allocation which a round robin algorithm does effectively based on some chosen criteria by the algorithm designer[6].

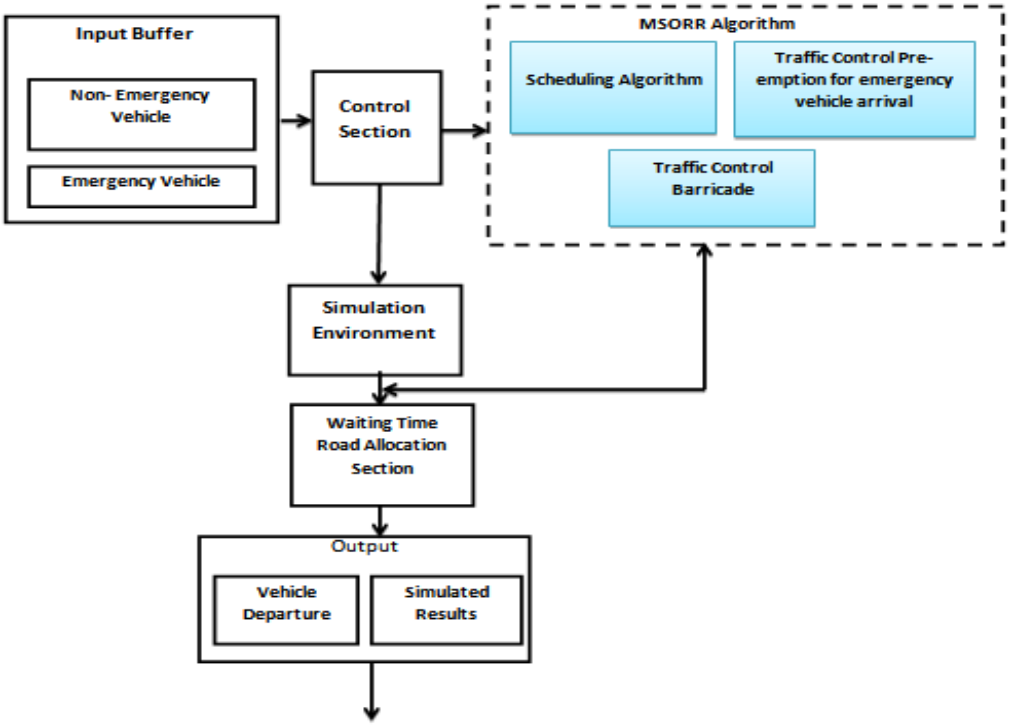

Figure 1: proposed model architecture

IV RESULTS AND DISCUSSION

Java programming language with AnyLogic Java based simulator was used in implementation; the design of the vehicle under the scheduling of the round robin algorithm in the control of the vehicle traffic, the traffic control barricade and the priority assignment for emergency vehicles arrival at the road junction. When non-emergency vehicles are on the traffic, the traffic control system schedule each road based on the traffic density on each lane but whenever there is arrival of emergency vehicle, priority is giving to the road where the emergency vehicle is approaching from and the traffic control barricade shuts down all other alternate roads. Sensors are used to sense the siren sound of the emergency vehicle which confirms their arrival at traffic junction. Fig2 show the implementation interface.

Figure 2: implementation interface

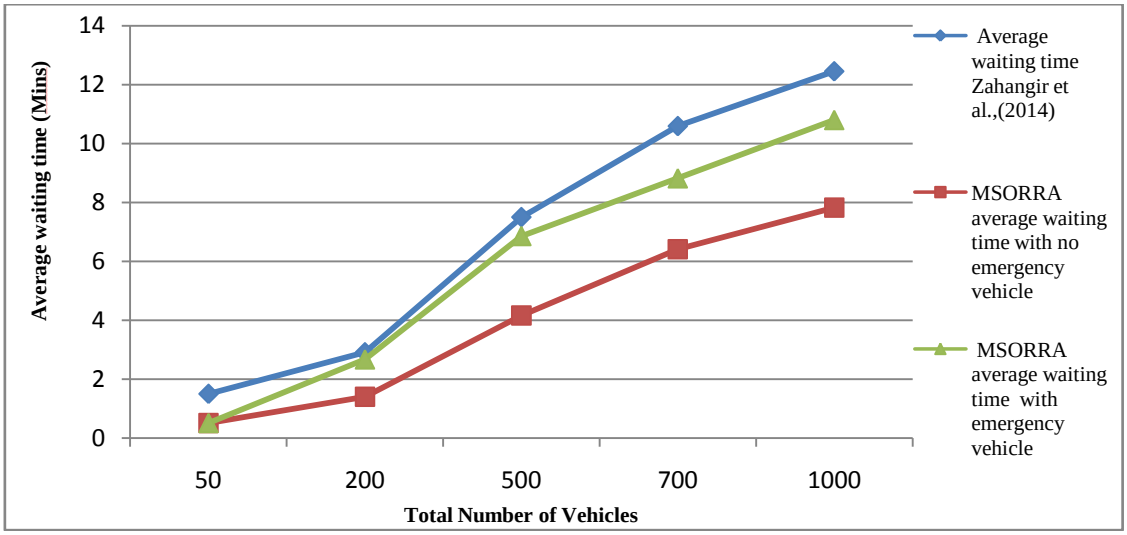

Figure 3: average vehicle waiting time

Due to the priority given to arrival of emergency vehicles, the vehicles waiting time occurrence when there is arrival of emergency vehicle at junction differs from when there are non-emergency vehicle. The waiting time increases once there is arrival of emergency vehicle and this is due to the red traffic light signal(stopping the movement of traffic) of the alternate roads that the non-emergency vehicles are approaching from till the incoming emergency vehicle have passed through the road junction. Fig. 3 shows the graphical relationship of the proposed result compared to [9]

Likewise as the emergency vehicle arrival rate increases, the average waiting time increases against Zahangir*et al.*,(2014) shown in Fig 4.

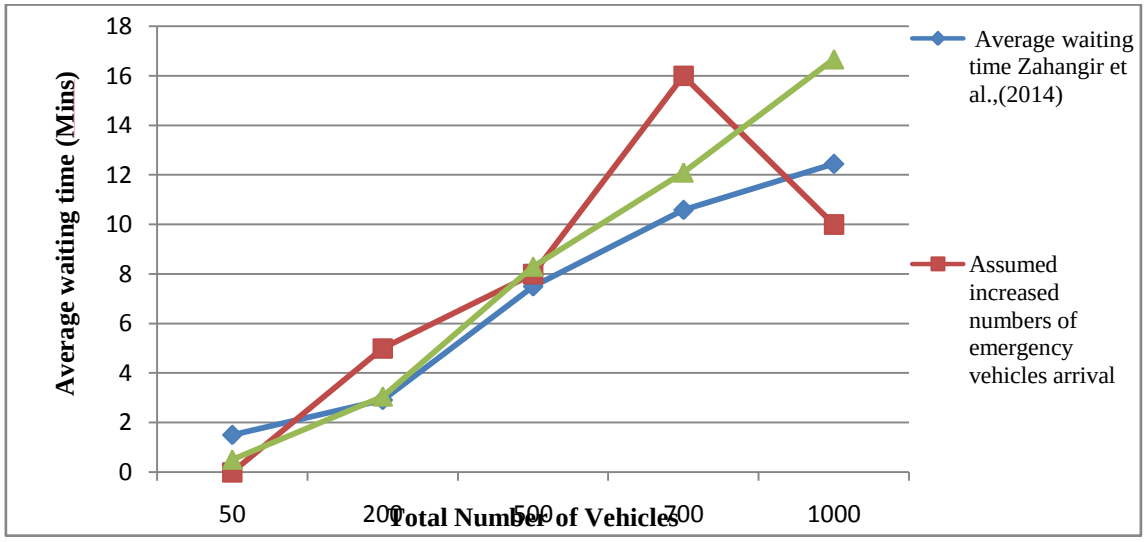

Figure 4. average vehicle waiting time with increased emergency vehicle arrival

V CONLUSION

This paper proposed a solution to control the flow of traffic at road junctions by modifying a round robin scheduling algorithm through assigning priorities to emergency vehicle at their arrival and consequently use of traffic control barricade to enforce strict compliance of traffic rules to the vehicle road users especially in developing countries. The results obtained show that the Modified Smart Optimized Round Robin Algorithm reduced the total and average waiting time of vehicles by 11.61%, though with a drop by 13.52% as emergency vehicle arrival increased. This work will reduces the traffic delay experienced by emergency vehicles when they approached a traffic junction.

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