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A Hybrid Method for Automatic Traffic Control Mechanism

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Abstract—Traffic control method is an interconnection of sign devices positioned at road intersections, pedestrian crossings and different locations to manage competing flows of traffic. This work provides a novel idea and application procedures of priority and round robin scheduling algorithms. These algorithms methodologies are combined and a new hybrid automatic traffic control mechanism is proposed for efficient traffic and transportation management systems. This mechanism is necessary and it may be applied to modern cities wherever particular paths have more traffic jam compared to other paths of signal and wherever equal or normal traffic. This proposed hybrid approach applies priority scheduling concept to specific paths which has more traffic, on the other hand, this hybrid approach uses round robin scheduling concept for normal traffic signals. This mechanism is well suited for controlling the traffic of modern and old cities,both preplanned and not preplanned before construction. Some general conclusions and promising future research topics are also provided.

Keywords—Priority Scheduling, Round Robin Scheduling, Traffic signals, Paths, Interconnection.

I. INTRODUCTION

Traffic signals are used to assign transport and pedestrian right-of-way [1]. They are providing orderly movement of transport and pedestrian traffic. To prevent excessive delay to traffic moving and increasing capability for every intersection approach [17]. A traffic engineering study should be conducted to see whether the traffic signal should be installed or not. The normal function of traffic lights needs sophisticated management and coordination to confirm that traffic moves as smoothly and safely as potential and also pedestrians are protected when they cross the roads [2]. Manual operations on traffic [3] controller assemblies begin with a section describing common ministry intersections, traffic movements and signal displays. An Advance Warning System may be a feature that warns drivers to organize to prevent at an approaching intersection. The light is either red, or getting ready to flip red.Advance Warning System has set of flashing lights fixed on a special forewarning sign and this signal is installed at a prearranged distance and the warning lights are controlled by electronics within the traffic controller assembly [12].The main advantages of traffic signals that are properly located and operated are likely to provide for orderly movement of traffic andincreased traffic capacity of the intersection. It reduces the frequency of certain types of crashes (e.g. right-angle crashes).Provision for continuous movement of traffic along a given route and interrupt heavy traffic to permit other traffic vehicular or pedestrian to cross [12]. Disadvantages of signals are justified by; traffic and roadway conditions traffic control signals can be ill-designed, ineffectively placed, improperly operated or badly maintained [12]. Baseless or improper traffic control signals can result one or more of the following disadvantages: Excessive delay; extreme disobedience of the signal indications; Increased use of less sufficient routes, road users attempt to avoid the traffic control signals; and significant increase in the frequency of crashes. In this work, a hybrid method of automatic traffic control mechanism for cities is developed.The remaining section of the paper is organized as follows. Section 2 discusses related works, Section 3 describes hybrid method based automatic traffic control mechanism and results are discussed in Section 4. Conclusion is given in Section 5.

II. REVIEW OF LITERATURE

Some popular algorithms provides this traffic control techniques are i) CoSIGN a Parallel Algorithm for Coordinated Traffic Signal Control developed by Shih-Fen Cheng, Marina A. Epelman, and Robert L. Smith in 2006[4]. ii) Evolutionary Algorithms can be used in Adaptive Traffic Control [5]. The scope of this is to develop a fully distributed responsive traffic control system. iii) Traffic Control with Standard Genetic Algorithm[6].Simulated optimization control of a Traffic Intersection conducted by GustafJansson in 2010. iv) A New Genetic Algorithm Based Lane-By-Pass [7] Approach is applied for Smooth Traffic Flow on Road Networks. In this paper a new lane bypass algorithm has been developed for route diversion resulting in smooth traffic flow on the urban road networks.Various Traffic control based works have been reported for the past decades,[8] related concepts and approaches for traffic signal design , solar traffic signal [9] and Passenger–Bus–Traffic Interactions [10].Janakiram .M, Porkodi.R have analyzed [11] about Interconnection of Automatic Traffic Control Mechanism which is used to control the vehicles at intersection. This mechanism is used commonly in all places. But this mechanism is efficient at cities where the distances between the signals are equal.

Janakiram.M, Vijayarani.S have analyzed [12] about Priority Based Automatic Traffic Control Mechanism, which is necessary and it may be applied to modern cities wherever particular paths have more traffic jam compared to other paths of signal. This mechanism is well suited for controlling the traffic of old cities which are not preplanned before construction.B.G. Heydecker (2004) conducted a study [13] on“ObjectivesStimulus and Feedback in Signal Control of Road Traffic”.Author discussed the importance of different kinds of variability in traffic flows and reviews the state of knowledge in respect of control in the presence of different combinations. In light of this formulation and review,

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authorhasidentified a range of important possibilities for contributions to traffic management and control through various kinds of automated learning. Bart De Schutter, JeroenPloeg, Lakshmi DheviBaskar, GerritNaus& Prof. Dr. HenkNijmeijer conducted a study on "Hierarchical, Intelligent and Automatic Controls". Authors presented a survey on traffic management and control frameworks for Intelligent Vehicle Highway Systems (IVHS)[14]. They outlined the presently used traffic control methods, various traffic management architectures for IVHS such as PATH, Dolphin, Auto21 CDS, etc., are briefly discussed and the comparisons of various frameworks are presented. CarstenDalaff, Ralf Reulke, Axel Kroen, Martin Ruhe& Thomas Kahl have found a new Optical Information System for road traffic observation and management [15]. Under the requirements of an intelligent transportation system, the complete architecture of system from the sensor for automatic traffic detection up to the traffic light management for a wide area is designed. The developed real-time algorithms used to extract traffic data even at night and bad weather condition and this concept opens the opportunity to identify and specify each traffic object, traffic location, traffic speed and it contains other important object information. In addition, the algorithms are able to spotaccidentsand traffic like pedestrians and bicyclists. Further a lot of traffic control based works have been reported for the past decades namely urban planning and traffic congestion, [16] Automatic traffic accident detection and notification with smart phones andAutomatic Control Methods in Traffic and Transportation.

III. HYBRID METHOD FOR AUTOMATIC TRAFFIC CONRTOL MECHANISM METHODOLOGY

A. Objectives

In most of the cities there are three possible signals are available. They are three path signals, four path signals and five path signals. Most of the signals have equal traffic in all paths. In some signals, a path can have more priority compared to another one. Here priority means that particular path should have more green signals time and less red signal time because of (more vehicles passing on the road) the following constrains happen. i) More vehicles may pass on that particular road. ii) If there is a possibility to have any hospitals, educational institutions, play grounds, more shopping malls or a place which have to be covered by crowd. iii) Normally we can give first priority to the vehicles of paths coming inside to the cities compared to the vehicles of paths going out from the cities. Hence, the main objective of this work is to reduce the traffic in the city, prevent the crashes with this user friendly Hybrid method based Automatic Traffic Control Mechanism.

B. Priority Scheduling

Scheduling [17] is the process of deciding how to commit resources between varieties of possible tasks. Time can be specified or floating as part of a sequence of events. In this work a priority is associated with each path, and the green signal time is allocated to the path with the highest priority. Equal-priority paths are scheduled in First Come First Serve order. Three path signals are having a maximum of three priorities, four path signals are having maximum of four priorities and so on.

C. Round Robin Scheduling

Basically Round Robin [17, 18] concept was implemented in all areas. The scheduler assigns a fixed time unit per process, and cycles through them. Round Robin scheduling involves extensive overhead, especially with a small time unit. A small unit of time, called a time quantum or time slice, is defined.Particular time slice goes to each signal. For exampleifthe time slice allotted to each signal is 30 seconds, every 30 seconds the process of green moves to other path in the signal.There are S numbers of total signals, S2 number of priority signals and P numbers of total paths, PP number of priority paths are considered and it is represented in the flowchart. Priority checking and the result are illustrated separately for clear view in figure 2. Figure 3 illustrates all types of signals and its execution belongs to round robin.Thesophisticated control flow of figure 2 belongs to three path signals. There should be a separate control flow for four and five path signals to check its priority and result.Their execution flows are similar to figure 2.

D. Signals

A signal is an indicator, such as [19] a gesture or colored light, that serves as a means of communication.This work is implemented for three types of signals namely three path signal, four path signal and five path signal. There are S number of signals are considered from which S2 and S3 are the number of signals belongs to priority based and round robin based respectively. It may be any one of the above type which is specified by N[I]. The flowchart of three types of signal with its time delay(a, b, c, aa, bb, cc) of all paths (up to n1, n2, ..n6) and entire control flow is shown in figure 1.

E. Paths

Path [20] is the directions for reaching a particular place in a city. This work consists of P number of total paths, PP number of priority based paths.

P=P+N (I) where I=1,2……S
PP= PP + N (I) where I=1, 2,… S2
N specifies the type of signal.

F. Interconnection

Interconnection specifies a connection [21] between two or more carriers. This mechanism is interconnected between signals of its. Thus provides an efficient priority based traffic control. The algorithm for hybrid automatic traffic control mechanism is given below.

Algorithm: Hybrid Automatic Traffic Control Mechanism
Inputs: No of signals (*S1*), No of priority based signals (*S2*), Type of signals (*N[I],I=1,2,..S1*), Paths (*P, P=P+N[I]* where *I=1,2…S1*), Priority based paths (*PP, PP= PP + N[I],* where *I=1,2…S2*), Time delays for priority ((*A[I], I=1,2,….N1*), (*B[J],J=1,2,..N2*), (*C[K], K=1,2..N*)), Time delays for round robin((*AA[II], II=1,2,….N4*), (*BB[JJ], JJ=1,2,..N5*), (*CC[KK], KK=1,2..N6*))

Outputs: Light Signals and its delay time

International Journal of Computing Algorithm
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ISSN: 2278-2397

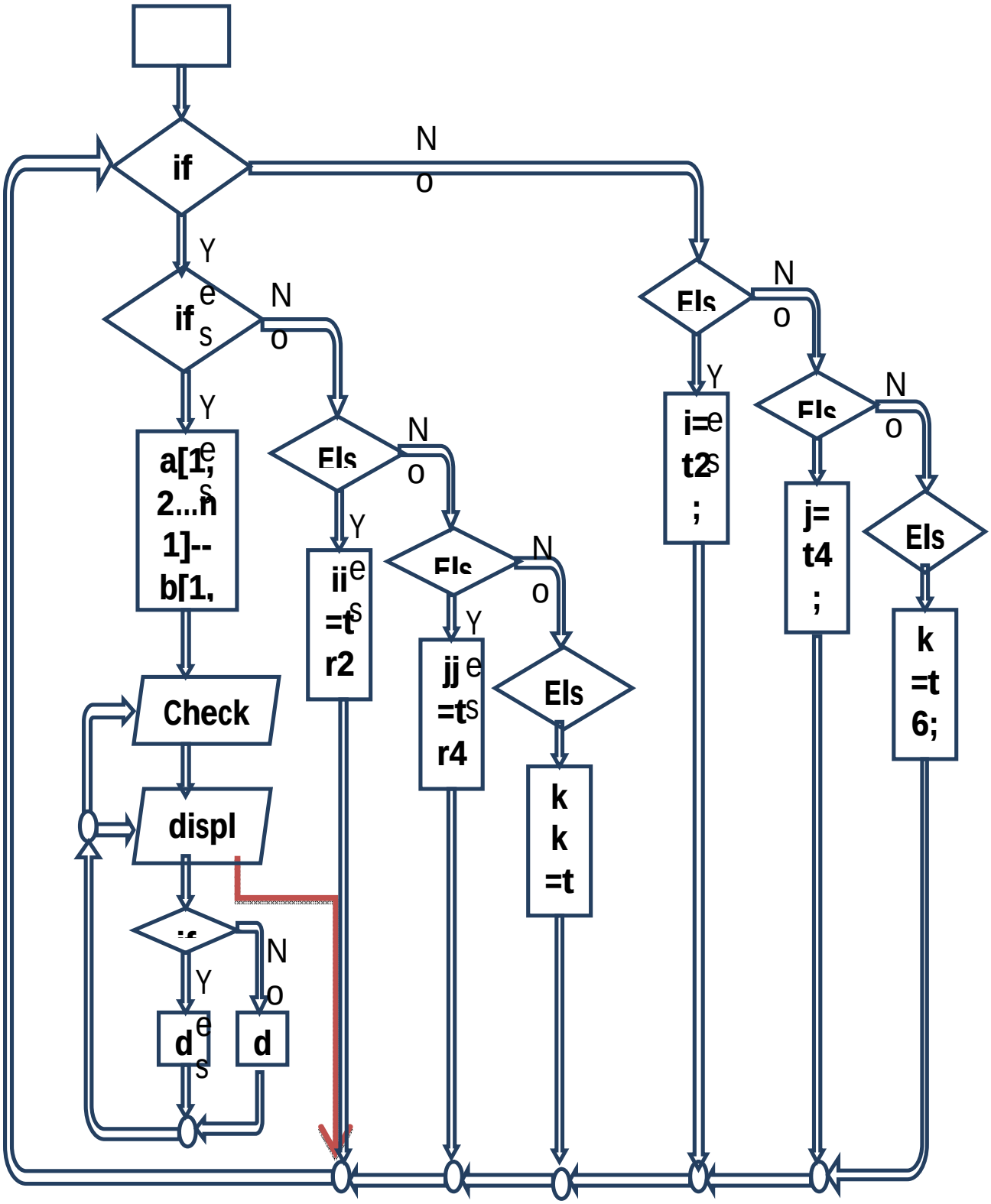

Fig.1. Entire Control Flow of Signals

International Journal of Computing Algorithm
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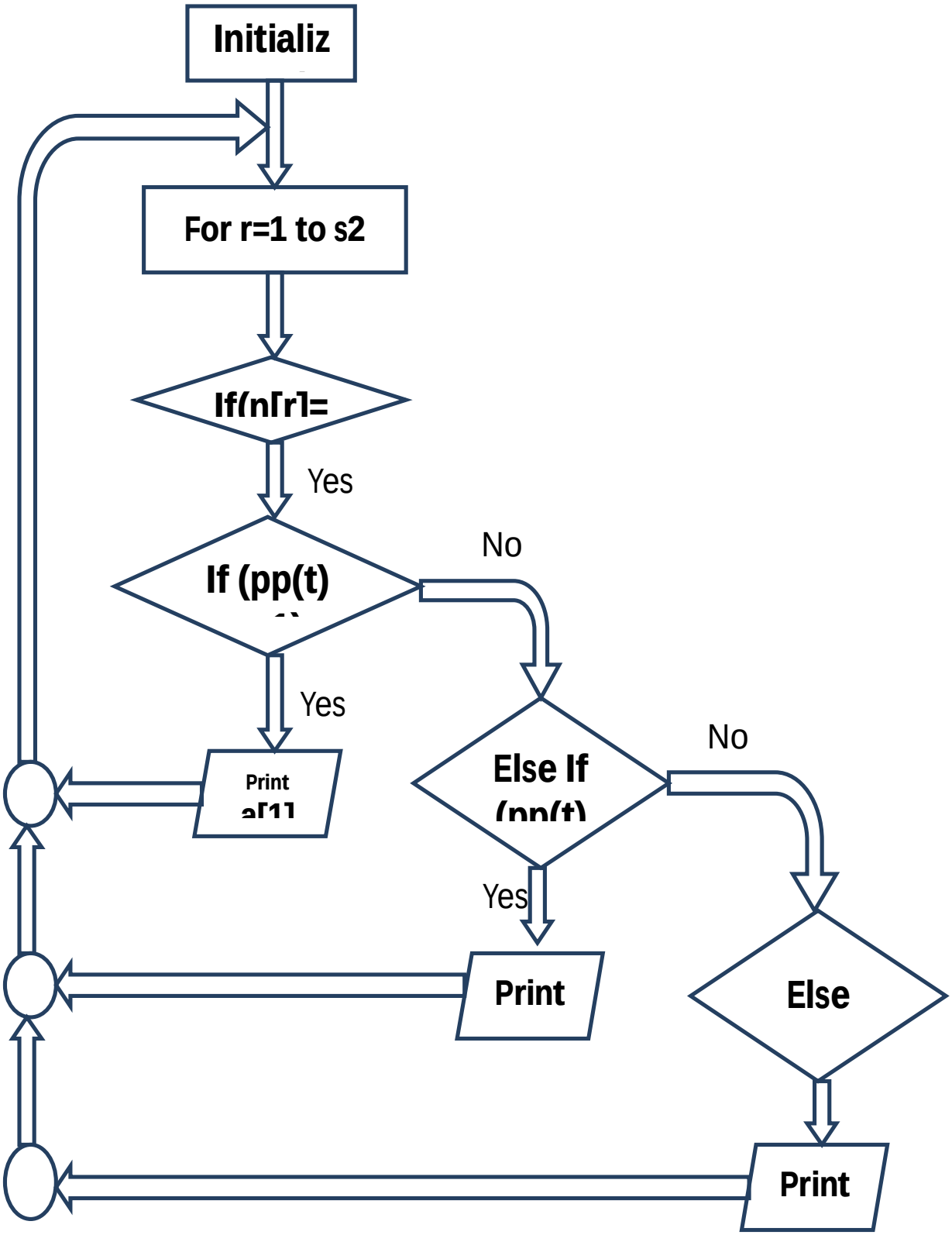

Fig.2. Priority checking and result for three path signal

International Journal of Computing Algorithm
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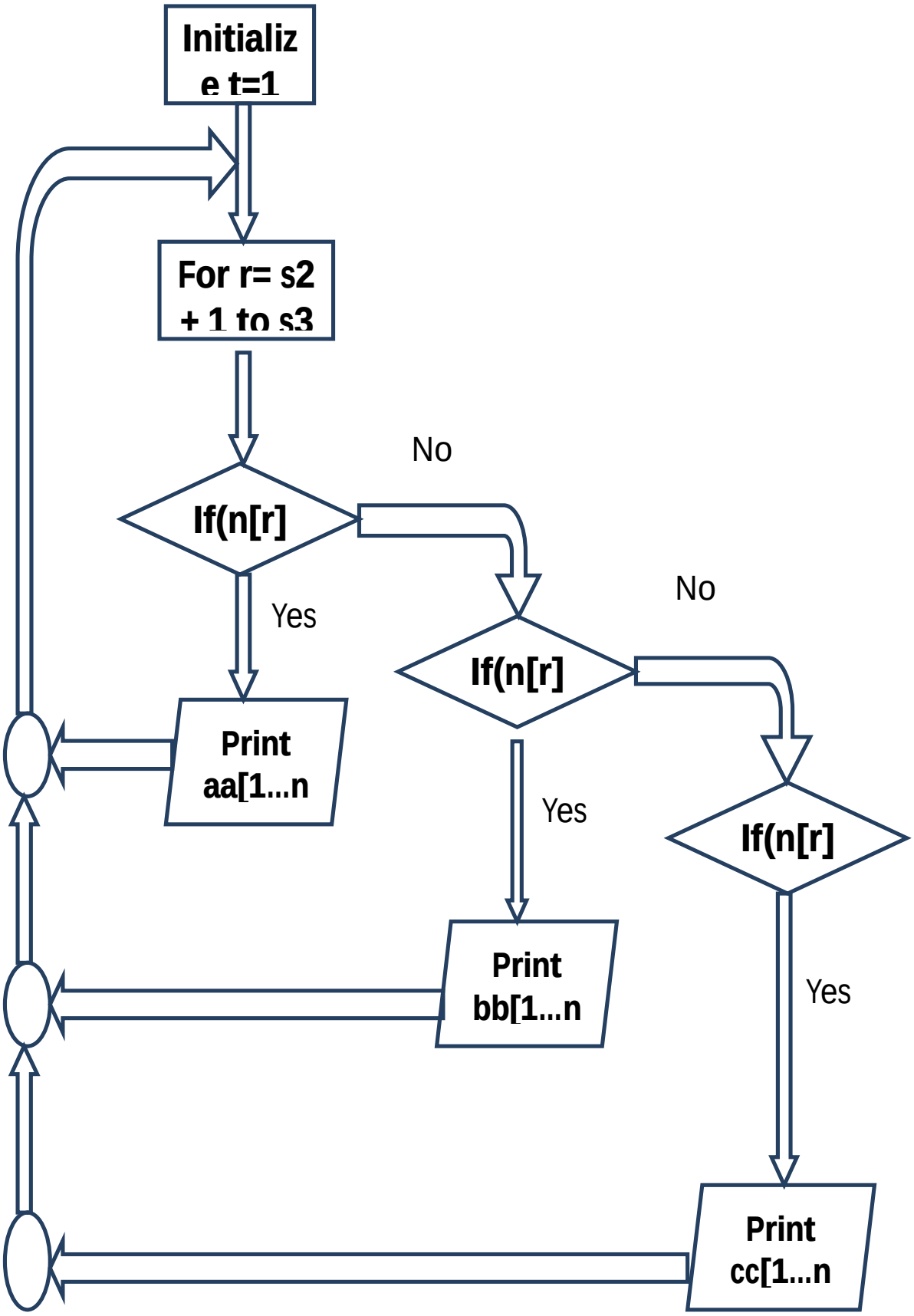

Fig.3. Three path signal (Round Robin)

International Journal of Computing Algorithm
Volume: 04 Issue: 01 June 2015 Pages:6-14
ISSN: 2278-2397

a) .Algorithm
Step 1: Initialization
1.1 Initialize all the inputs

Step 2: Control process
2.1 If time delay of green signal paths *(A[I]>0) && (B[J]>0) && (C[K]>0)*

2.1.1 If time delay of green signal paths *(AA[II]>0) && (BB[JJ]>0) && (CC[KK]>0)*
// Decrease one from time delay of all paths.
For R=1 TO S1
If (R<=S2) then T=1;
If (N[R]==3) then Go to Step 3*Else if (N[R] ==4)*Go to step 4
*Else*Go to step 5
Else // which means *IF (R > S2 <= S3)*
If (N[R]==3) then Go to Step 6
Else if (N[R] ==4) then Go to step 7*Else*Go to step 8

2.1.2 Assign red and green signal time of round robin to last green signal path & upcoming green signal path respectively.
2.2 Assign red and green signal time of priority based to last green signal path & upcoming green signal path respectively.
Repeat step 2.

Step 3: Priority Checking (for 3 paths)
3.1 If current path has Ist priority print time delay from*A[1]*
3.1.1 If current path has IInd Priority print time delay of*A[2]*
3.1.2 If current path has IIIrd priority print time delay of*A[3]*
3.2 Go to step 9
3.3 If the *current path<=PP* then, *current path= current path + 1*
Repeat Step 3 if *T<=3*

Step 4: Priority Checking (for 4& 5 paths as like as step 3)

Step 5: Delay time
5.1 Print delay time from *AA[1], AA[2], AA[3]* then Go to Step 9

Step 6: Print delay time (for 4& 5 paths as like as step 5)

Step 7: Control Signals
7.1 If the green signal path is equal to the current path
Print "*G*" with the time delay
Otherwise
Print "*R*" with the time delay

Step 8: Terminate the process
Algorithm: Hybrid method for Automatic Traffic Control Mechanism

IV. EXPERIMENTAL RESULTS

This work consists of two classes namely hybrid and traffic control. Hybrid class gets some inputs as total number of signals(S), number of priority based signals(S2), round robin based signals(S3), type of signals (N[I]), priorities(PR[I]) and so on. Then the control moves to the upper class traffic control. Here the traffic control class has eight methods namely control, type1, type2, type3, type4, type5, type6 and green and all methods have some parameters. Methods type1, type2, type3 belongs to priority signals. Methods type4, type5, type6 belongs to round robin signals. At the beginning of control method we made some initialization and there is a separate time limit for three types of signals for both priority signals and round robin signals. If all the three types of signal has time seconds which is greater than zero, decreasing the seconds of red and green signals for all the K number of paths in S signals.

Control method is interconnected with all other methods and it calls one another continuously. Type1 method is executed when the particular signal is a three path signal. This method checks priority of every path in the signal. For example if path1of this signal has the third priority, display the time delay which belongs to third priority and type of signal which is red or green by calling the green() method.Type2 method is generated by a four path signal. Type3 method is generated by a five path signal. The same priority checking process is used in that method as in type1. Type4, type5, type6 methods have no priority checking process, it just executes the delay time and type of signal which is red or green. Type4 method is executed when the particular signal is a three path signal and display the delay time of three paths. Type5 and type 6 methods are generated by a four path and five path signals respectively. The same kind of process is done in type4. All these six methods are recursive methods.Type1 and type4 methods call itself three times, if once generated, because itbelongs to three path signal. Type2 and type5 methods belong to four paths and call it four times if once generated. Type3 and type6 also calls itself five times.Thisprocess happens continuously to all the signals and then the control method call itself for the next sequence. If any one of the time delay of three types of signals in both priority and round robin signals is less than zero, there we should provide a predefined time delay of red signal for the last green signal path/current path and provide a predefined green signal time delay for the upcoming green signal path/next execution path, and then call the control method to the sequence result. The screen shot of the proposed traffic control system is given in figure 4.

Figure 4 shows the input screen in which users gets inputs related to number of signals, type of signals, time delays of all paths in signals and priorities for first five signals. The input to the 1st signal as three path signal and its execution seconds as green 30 seconds, red 30 and red 50 for the paths1, 2 and 3 respectively. As like this, 2nd signal is a four path signal and its running time for 4 paths are green 40 seconds, red 40, red 70 and red 90 for the four paths respectively. The 4th signal is a five path signal and its burning time for five paths is shown in figure 4. After that, the last five signals belong to round robin. The input to the 6th signal as three path signal and its execution seconds as green 30 seconds, red 30 and red 60 for paths 1, 2 and 3 respectively. As like that, 8th signal is a five path signal and its execution time for green path 30 seconds and all other four paths have red 30, 60, 90 and 120respectively.The 9th signal is a four path signal its delay time as green 30 and all others are red 30, 60, 90. The Fig 5 shows the output at runtime which gives clear picture of all 10 signals, paths and about delay status of particular signal in a path at particular time.

International Journal of Computing Algorithm
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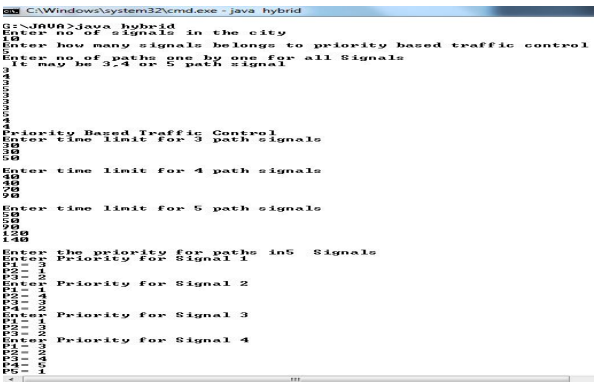

Fig. 4. Sample screen shot of Traffic signal inputs

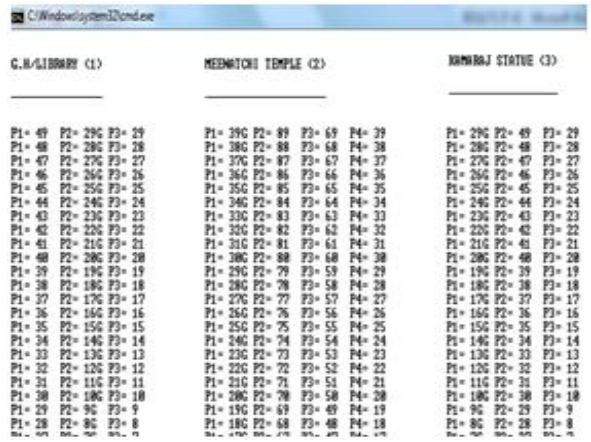

Fig. 5 Sample screen shot of Traffic signal output

V. CONCLUSION

Hybrid method for Automatic Traffic Control Mechanism can be used to the cities like coimbatore, chennai and any other cities in the world where both normal traffic and particular paths which have more traffic compared to other paths in the signals. The main feature of this mechanism is applicable to K number of paths in S number of signals. This mechanism consists of some important concepts such as control process, seconds implementation, priority checking, control signals, and so on. All the above concepts are directly applied and this mechanism gives all possible results.In future we can further modify this mechanism by applying some other technologies and algorithms. Such as RFID, Sensors networks and other vehicle detectors such as Infrared, Ultra wave, Microwave and Video detectors.

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