Priority Based Automatic Traffic Control Mechanism

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ABSTRACT
Traffic control system is an interconnection of signaling devices positioned at road intersections, pedestrian crossings and other locations to control competing flows of traffic. This paper presents basic notions and application procedures of Priority Based Automatic Traffic Control Mechanism, and outlines current and potential applications of these methodologies for efficient traffic and transportation control systems. This mechanism is necessary and it may be applied to modern cities wherever particular paths have more traffic jam compared to other paths signals. This mechanism is well suited for controlling the traffic of old cities which are not preplanned before construction. But if we are going to construct a preplanned city we may choose appropriate traffic control mechanism to control the traffic. This paper discusses general concepts of traffic control mechanism and proposes priority based scheduling algorithm for automatic traffic control mechanism.

Keyword: Priority Scheduling, Traffic signals, Paths, Interconnection.

INTRODUCTION
The normal function of traffic lights [7] needs complicated control and coordination to ensure that traffic moves as smoothly and safely as possible and also pedestrians are protected when they cross the roads. A variety of different control systems are used to accomplish this, ranging from simple clockwork mechanisms to complicated computerized control and coordination systems that are self-adjusted to minimize delay when people using the road.

Manual operations on traffic controller assemblies [3] begin with a section describing common ministry intersections, traffic movements and signal displays. An Advance Warning System is a safety feature that warns drivers to prepare to stop at an approaching intersection. The light is either red, or about to turn red.

An Advance Warning System consists of a set of flashing lights, mounted on a special warning sign. This sign is installed at a prescribed distance on an approach to an intersection. The warning lights are controlled by electronics within the traffic controller assembly.

Traffic signals [10] are used to assign vehicular and pedestrian right-of-way. They are used to promote the orderly movement of vehicular and pedestrian traffic and to prevent excessive delay to traffic, moving traffic in an orderly fashion, minimizing delay to vehicles and pedestrians, reducing crash-producing conflicts and maximizing capacity for each intersection approach. A traffic engineering study must be conducted to determine whether the traffic signal should be installed. The installation of a traffic signal requires sound engineering judgment.

Advantages of traffic signals that are properly located and operated are likely to: Provide for orderly movement of traffic; Increase traffic capacity of the intersection; Reduce the frequency of certain types of crashes (e.g. right-angle crashes); Provide for continuous movement of traffic along a given route; and Interrupt heavy traffic to permit other traffic, vehicular or pedestrian, to cross. Disadvantages of Signals are justified by traffic and roadway conditions, traffic control signals can be ill-designed, ineffectively placed, improperly operated, or poorly maintained. Unjustified or improper traffic control signals can result in one or more of the following disadvantages: Excessive delay; Excessive disobedience of the signal indications; Increased use of less adequate routes as road users attempt to avoid the traffic control signals; and significant increases in the frequency of crashes. In this work, the priority based automatic traffic control mechanism for cities is developed [1, 15, 17].

bypass algorithm has been developed for route diversion resulting in smooth traffic flow on the urban road networks.

The remaining section of the paper is organized as follows. Section 2 discusses related works, Section 3 describes priority based automatic control mechanism and results are discussed in Section 4. Conclusion is given in Section 5.

Wang Weizhi & Liu Bingham conducted a study on [22] “Automatic Recognition Algorithm of Traffic Signs in Road Tunnel”. In this article authors conducted feature extraction and feature selection of the pattern of traffic signs based on environmental characteristics of the road tunnel, and the color and shape information of traffic signs, then further accomplished multi-level classification of traffic signs using decision tree method. The method proposed in this article is based on decision tree classification algorithm which converts a complex multi-class problem into several simple classifications. Experimental results show that the algorithm has good recognition results.

Bart De Schutter, Jeroen Ploeg, Lakshmi Dhevi Baskar, Gerrit Naus & Prof. Dr. Henk Nijmeijer conducted a study on [2] “Hierarchical, Intelligent and Automatic Controls”. Authors present a survey on traffic management and control frameworks for Intelligent Vehicle Highway Systems (IVHS). First, authors give a short overview of the currently used traffic control methods that can be applied in IVHS. Next, various traffic management architectures for IVHS such as PATH, Dolphin, Auto21 CDS, etc., are briefly discussed and a comparison of the various frameworks is presented. Subsequently, authors focus on control of vehicles inside a platoon, and consider higher-level control of platoons of vehicles. Finally, authors presented an outlook on open problems and topics for future research.

John F. Gilmore & Naohiko Abe conducted a study on [13] “Neural Network Models for Traffic Control and Congestion Prediction”. Advance Traffic Management Systems (ATMS) must be able to respond to existing and predicted traffic conditions if they are to address the demands or the 1990's. Artificial intelligence and neural network are promising technologies that provide intelligent, adaptive performance in a variety of application domains. This paper described two separate neural network systems that have been developed for integration into ATMS blackboard architecture. The first system is an adaptive traffic signal light controller based upon the Hopfield neural network model, while the second system is a back propagation model trained to predict urban traffic congestion. Each of these models are presented in detail with results attained utilizing a discrete traffic simulation shown to illustrate their performance.

Yu-Chiu Chiou & Yen-Fei Huang conducted a study on [23] “Genetic fuzzy logic traffic signal control with cell transmission modeling”. This study presented an adaptive traffic signal control model based on an iterative genetic fuzzy logic controller (GFLC). The proposed model considers traffic flow and queue length as state variables and extension of green time as control variable, toward the minimization of total vehicle delays. Cell transmission model is used to replicate the traffic condition. Results show that the proposed GFLC model performs best. As traffic flows vary more noticeably, the GFLC traffic signal control model performs even better than any timing plans. In the case of sequential intersections with four coordinated signal systems: simultaneous, progressive, alternate, and independent, the experimental example study also show that the proposed GFLC model can perform better than current and pre-timed timing plans. Further a lot of traffic control based works have been reported for the past decades [17].

**Priority Based Automatic Traffic Control Mechanism Methodology**

**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. In any signal, a path can have more priority compare 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 compare 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 Priority Based Automatic Traffic Control Mechanism.

**Priority Scheduling**

Scheduling [6, 21] 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.

**Signals**

A signal is an indicator, such as [4] a gesture or colored light, that serves as a means of communication. This work implemented three types of signals namely three path signal, four path signal and five path signal. There are 5 number of signals are considered. 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) of all paths (up to n1, n2, n3) and entire control flow is shown in figure 1.

Fig 1: Entire Control Flow of Signals
There are $S$ numbers of signals and $k$ numbers of paths are considered in the flowchart. Priority checking and the result are illustrated separately for clear view in figure 2.

**Fig 2:** Priority checking and result for three path signal

The above flow chart belongs to three path signals. There is a separate control flow for four and five path signals to check its priority and result.

**Paths**

Path [8] is the directions for reaching a particular place in a city. This work consists of $K$ number of paths.

$$K = K + N (I) \text{ where } I = 1, 2, \ldots, S$$

$N$ specifies the type of signal.

**Interconnection**

Interconnection specifies a connection [5] between two or more carriers. This mechanism is interconnected between signals of its. Thus provides an efficient priority based traffic control. The algorithm for priority based automatic traffic control mechanism is given below.

**Algorithm:** Priority based Automatic Traffic Control Mechanism

**Inputs:** No. of signals, Type of signals (n[I]), K, L, S, Total no. of paths (p, p=0), priority processing (P[I]), Time delay of (q[I]), L=1, 2, …, n, K[I], S[I], P[I], Q[I], N, K, S, P

**Outputs:** Light Signals and its delay time.

**Algorithm:**

1. **Step 1: Initialization**
   - Initialize all the inputs and assign priority to every path.

2. **Step 2: Control process**
   - If time delay of green signal paths ($a[I]=0$) & ($b[I]=0$) & ($c[I]=0$) // Decrease one from time delay of all paths.

3. **Step 3: Priority Checking (for 3 path)**
   - If the current path has the highest priority, print the time delay from $a[I]$ then Go to Step 6
   - If the current path has the second highest priority, print the time delay from $b[I]$ then Go to Step 6
   - If the current path has the third priority, print the time delay from $c[I]$ then Go to Step 6
   - If the current path has the lowest priority, current path = current path + 1

4. **Repeat Step 3 if (t=3)**

5. **Step 4: Priority Checking (for 4 path)**
   - If the four-path signal is less than zero, print the time delay of the red signal path and provide a predefined green signal time delay for the upcoming green signal path.

6. **Step 5: Control Signals**
   - If the green signal path is equal to the current priority
   - Print “G” with the time delay
   - Otherwise, print “R” with the time delay

7. **Step 6: Repeat step 3**

8. **Step 7:**
   - Terminate the process

**EXPERIMENTAL RESULTS**

This work consists of two classes namely priority and traffic control. Priority class gets some inputs as number of signals ($S$), type of signals ($N[I]$), priorities ($P[I]$) and so on. Then the control moves to the upper class traffic control. Here the traffic control class has five methods namely control, type1, type2, type3 and green. All the methods have some parameters. At the beginning of control method we made some initialization and there is a separate time limit for three types of 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 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 path 1 of 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 will be happen within that method as in type 1. All these three methods are recursive methods. Type1 method call itself three times, if once generated, because it belongs to three path signal. Type2 method belongs to four paths and calls itself four times if once generated. Type 5 also calls itself five times. This process 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 signal is less than zero, then 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 3.

**Fig 3:** Screen shot of Traffic signal inputs

Figure 3 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. 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 paths 1, 2 and 3 respectively. As like this, 2nd type 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 3rd type signal is a five path signal and its burning time for five paths is shown in figure 4.

Figure 4 shows the output at runtime which gives clear picture of all signals, paths and about delay status of particular signal in a path at particular time which is based on priority.

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Fig 4: Screen shot of Traffic signal output
CONCLUSION
Priority Based Automatic Traffic Control Mechanism could be used to the cities like coimbatore, chennai and any cities in the world where particular paths have more traffic compare 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.

REFERENCES

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