Literature Review on Traffic Control Systems Used Worldwide

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Abstract— Road infrastructure has seen consistent improvement in the last few years. Connectivity has improved and road transportation has become a focus of rapid development. Roads are providing better access to services, ease of transportation and freedom of movement to people. But in metropolitan cities traffic congestion is increasing rapidly, it results in chronic situation in dense downtown areas. Traffic signals play a significant role in the urban transportation system. They control the movement of traffic on urban streets by determining the appropriate signal timing settings. Adaptive traffic signal controllers as the principle part of intelligent transportation systems has a primary role to effectively reduce traffic congestion by making a real time adaptation in response to the changing traffic network dynamics. Many methods used for traffic signal timing optimization under different criteria's. In this paper different methods are proposed by reviewing different research papers for traffic signal control, which gives best adaptability & optimization ideas in traffic signal control.

Index Terms— Traffic control system, Adaptive traffic signal controllers, optimization.

I. INTRODUCTION

Signalized traffic control has significant effect on reducing vehicle delays at intersections, balancing traffic flow, and improving operational efficiency of an urban street network [15]. The intersection signal control systems can be largely classified into fixed-time or real-time adaptive signal control systems, such as SCAT and SCOOT [14] The modeling of the intersection signal control system is usually based on the changes of traffic volumes [1]. In past days the use of fixed time traffic signal and vehicle actuated traffic signal is more. Now a days many other techniques are used to optimize delay and to control traffic flow, adaptive traffic signal controllers are one of them to optimize traffic signal, different types of algorithms are used to make best adaptive traffic signal controllers, different types of algorithms are highlights of this paper.

II. LITERATURE REVIEW

Rongrong Tian, Xu Zhang [13] suggested to use the TRANSYT traffic modeling software to find the optimal fixed-time signal plan and VISSIM micro-simulation software to affirm and evaluate the TRANSYT model and to help assess the optimal signal plan; build an adaptive frame signal plan and refined and evaluated the plan using VISSIM with VS-PLUS emulator. Through micro-simulation, it was shown that delay in the adaptive signal control was shortened noticeably than that in the fixed time control.

Jianhua Guo et al [7] introduced a new method for area-wide traffic signal timing optimization under user equilibrium traffic. The optimization model was formulated as a multi-dimensional search problem aimed to achieve minimized product of the total travel time associated with urban street network and the variance of travel time for unit distance of travel. A genetic algorithm was developed to derive the model solution. A simulation control protocol embedded in PARAMICS software tool capable of conducting area-wide micro simulation is adopted to design the logic frame and function module of the area-wide traffic signal control system. His results shown that mobility improvements are achieved after applying the proposed model along with the genetic algorithm for area-wide signal timing optimization, assessed by extended capacity ratio, and reductions in through and turning movement delays, as well as average and variance of travel time for unit distance of travel.

Gustav Nilsson _ Giacomo Como [4] focused on a class of dynamic feedback traffic signal control policies that are based on a generalized proportional allocation rule. There results in a differential inclusion for which there prove existence and, in the special case of orthogonal phases, uniqueness of continuous solutions via a generalization of the reflection principle. Stability is then proved by interpreting the generalized proportional allocation controllers as minimizes of a certain entropy-like function that is then used as a Lyapunov function for the closed-loop system.

Junchen Jin and Xiaoliang Ma [8] proposed a group-based signal control approach capable of making decisions based on its understanding of traffic conditions at the intersection level. The control problem is formulated using a framework of stochastic optimal control for multi-agent system in which each signal group is modeled as an intelligent agent. The proposed system is designated to be compatible with the prevailing signal system. The parameters were off-line optimized using a genetic algorithm. Simulation results shown that the proposed adaptive group-based control system outperforms the optimized GBVA control system mainly because of that's real-time adaptive learning capacity in response to the changes in traffic demand.

Nasser R. Sabar et al [11] controlled the movement of traffic on urban streets by determined the appropriate signal timing settings. Proposed algorithm was based on the so-called memetic algorithm that combines the strengths of the genetic algorithm and local search in an adaptive manner. In that used two important techniques for improving the performance of traditional memetic algorithms. First, a systematic neighborhood based simple descent algorithm was employed as a local search to effectively exploit the search space. Second, an indicator scheme was proposed to control the local search application based on the quality and diversity of the search process. The proposed algorithm was coded in the commercial microscopic traffic simulator, AIMSUN, and tested on two difference real world case studies in Brisbane, Australia, and Plock, Poland. The results demonstrated that the proposed algorithm was better than genetic algorithms and fixed-time settings, indicated that the proposed algorithm was an effective solution method for traffic signal optimization problems.

Mohammad Aslani et al [9] utilized RL (Reinforcement learning) algorithms to design adaptive traffic signal controllers called actor-critic adaptive traffic signal controllers (A-CATs controllers). Worked done rested on the integration of three threads: (a) shows performance compared of both discrete and continuous A-CATs controllers in a traffic network with recurred congestion (24-h traffic demand) in the upper downtown core of Tehran city, (b) analysed the effects of different traffic disruptions included opportunistic pedestrians crossing, parking lane, non-recurring congestion, and different levels of sensor noise on the performance of A-CATS controllers, and (c) compared the performance of different function approximators (tile coding and radial basis function) on the learning of A-CATs controllers. First an agent-based traffic simulation of the study area was carried out. Then six different scenarios are conducted to find the best A-CATs controller that was robust enough against different traffic disruptions. They observed that the A-CATs controller based on radial basis function networks (RBF (5)) outperforms others. They said that RBF (5) was benchmarked against controllers of discrete state Qlearning, Bayesian Q-learning, fixed time and actuated controllers; and the results revealed that (RBF (5)) consistently outperforms others.

Huajun Chai et al [5] captured the interaction between travellers' route choice and traffic signal control in a coherent framework. They tested their algorithm and control strategy by simulation in OmNet++ (A network communication simulator) and SUMO (Simulation of Urban Mobility) under several scenarios. The simulation results shown that with the proposed dynamic routing, the overall travel cost significantly decreases. It was also shown that the proposed adaptive signal control reduced the average delay effectively, as well as reduced the fluctuation of the average speed within the whole network.

Ekinhan Eriskin et al [3] suggested a new method for designing traffic signal timing at oversaturated intersections was expressed "the elimination pairing system". An object function with vehicle delay and stop-start numbers has been generated. Total cost value has been calculated according to the object function. Obtained results were compared with Webster as a traditional traffic signal timing design method and Transyt 14 signal timing software. While Webster gives exaggerated results, Transyt 14 and Elimination Pairing Systems provided better results. As a result of that study, the elimination pairing system could be used for optimizing the traffic signal timings.

The author Shailendra Tahilyani et.at. [16] developed a new lane bypass algorithm for route diversion given a result in smooth traffic flow on the urban road network. Genetic algorithms are utilized for the parameter optimization.

Ishant Sharma and Dr. Pardeep K. Gupta [6] proposed to replace existed traffic signals with a system that are monitored the traffic flow automatically in traffic signal and sensors are fixed in which so the time feed are made dynamic and automatic by processed the live detection.

Chandrasekhar.M et.al. [2] suggested a system that implement image processing algorithm in real time traffic light control which will control the traffic light efficiently.

Ramteke Mahesh K. et.al. [12] proposed FPGA (Field Programmable Gate Array) controller based on Neuro-Fuzzy system thought provided effective solution for Traffic Control. It can used to minimize drawbacks of the conventional traffic controllers with the accuracy of provided variation in green cycle intervals based on the heavy traffic loads that changed at every lane in a four leg intersection.

Naren Athmaraman and Srivathsan Soundararajan [10] introduced an adaptive predictive signal control system that performed real time queue length estimation and employed an efficient signal coordination algorithm with APTTCA-based system.

Pavan Kumar and Dr. M. Kamala kumara [17] studied adaptive traffic control systems with VANET, Focused on reliable traffic prediction approaches and various types of adaptive traffic control algorithms also proposed a mobile crowd sensing technology to support dynamic route choices for drivers to avoid congestion. Suggested crowd sourcing can be one of the best options for Adaptive traffic control system for India.

Prof. Jayesh Juremalani and Dr. Krupesh A. Chauhan [18] author described various soft computing techniques to tackle traffic control system. Which are fuzzy approaches, neural network and genetic algorithms, ant colony algorithm, particle swarm optimization, simulation model.

III. SUGGESTION

From the above study it can be concluded that Traffic signal optimization is depends on several criteria's like real time traffic condition, volume, congestion, and delay time, user equilibrium traffic, oversaturation, travellers' route choice. To optimize traffic signal of urban roads all these variables are considered and formulate best fitted methods to solve our problem. In this, paper for every different conditions a different methods is used , here are some methods which are commonly used in current years are TRANSYT software, genetic algorithm, the generalized proportional allocation controllers, a group-based signal control, memetic algorithm, RL (Reinforcement learning) algorithms to design adaptive traffic signal controllers, dynamic routing in a network with adaptive signal control, elimination pairing system, fuzzy approaches, neural network, colony algorithm, particle swarm optimization, simulation model.

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