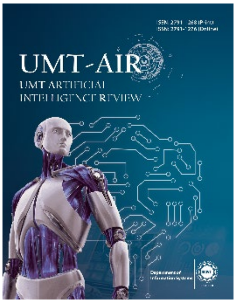


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Article: **A Survey of Algorithms on Traffic Light Scheduling System**

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# A Survey of the Algorithms Used for Traffic Light Scheduling Systems

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**ABSTRACT:** Due to the increasing volume of vehicles in both urban and rural areas all over the world, it is pertinent to investigate the issues surrounding traffic congestion.Hence, it is required to develop improved models and procedures of smart traffic management to meet the transportation needs, particularly in urban areas. The core objective of this paper is to highlight and examine the latest techniques and algorithms used for scheduling traffic lights. Moreover, a comparison based on the accuracy achieved by particular techniques and algorithms was also conducted.

**INDEX TERMS:** algorithms, control, road, traffic light scheduling system, svehicles

## I. INTRODUCTION

Traffic is among the biggest essential things of the city in multiple means such as financial markets, communication, and transportation. Unluckily road traffic has been one of the massive complications due to rapidly augmentation for public transportation [1]. Further traffic light scheduling shows an important part in growing traffic amounts and decreasing intervals [3]. While organizing traffic signals, violation ought to be contemplated because they can provocatively influence the control system. Traffic signal control systems requires a methodology to plan the traffic signals to verify that traffic movement could modify as safely and quickly as possible. These method requirements encompass automobile outputs, pending intervals etc. The purpose of this strategy is to make a sequence of the systems model for traffic passing through a 4-way connection, determined by a traffic light. The optimization of traffic light exchanging can meliorate the vehicular movement and avoid traffic jams [6]. Now a day's traffic light utilizes the adaptive phases rendering of the recent traffic situation of the lane sections. Through the traffic lights clues, an automobile will be capable of discovering an improved following stage of packet distribution.

## II. RELATED WORK

In [1] the author elaborates a model based on rational multi-agent architecture to control traffic lights. Their method presents an organization to accomplish flexible and independent system. They suggest a collection of five units:

traffic simulator, organization element, communication element, choice element, and analyzer element. In [2] the author proposed an optimization approach through a particle swarm optimization (PSO) algorithm which can discover positive cycle programs of traffic. They attempted to restrict vehicular links with actual insufficient traffic lights. In [3] the author proposed a multi-agent architecture by utilizing Traffic Simulation Management API to motivate the execution of a device to examine and to check dissimilar traffic control approaches. In another work [4] illustrates a unique approach for intelligent transportation light convergence on real time facts found by self-motorized schemas. In [5], the writers develop a POVA for identifying traffic warning in extended metropolitan zones. Their most significant opinion is to inspire the strategy of POVA, where a road traffic light causes a significant impression. In [6] the author describes a shortest path approach that is used for coordination of traffic light system. They simulate that all traffic lights with a parallel period of time are coordinated. In [7] the author proposed a novel and well-organized structure for sensing and identifying traffic lights. They recognized the light signals based on pattern identical portion. Their investigation outcomes determine the efficiency of the projected structure. In [8] the author used a Green Light Optimal Speed Advisory (GLOSA) system, where traffic lights are considered individually. In [9] the authors appraise a dispersed algorithm for various connections via WSN which describes the green lights series and period in a multi-intersection intelligent transportation system (ITS). In [10], [11] the authors proposed an optimization method where a particle swarm optimizer (PSO) is capable to discover positive traffic light sequence joined with a simulator of urban mobility (SUMO) . In [12] the authors utilized the dispersed adaptive traffic light control algorithm for several connections which employ a wireless sensor network (WSN). They argue that the presented algorithm is able to accomplish a better waiting and travel time as well as queue length than a scheduled result and robust way outs. In [13] the authors studied the varied uniqueness of smart grid traffic, as well as interactive media and suggest a priority-based traffic preparation methodology for cognitive radio (CR). In [14] the authors suggested a novel plan of attack for the active supervision of traffic lights to decrease wait in line. Whereas In [15] the authors proposed vehicular ad hoc networks (VANETs) that can calculate pace, location at actual time of various vehicles to raise warning signs witch at traffic connections. They first express the vehicular traffic management issue as a function, resolving issues on workstations, with consistent sections of vehicles. In [16] the authors' presents Distributed Coordination of Exploration and Exploitation (DCEE) and Reinforcement Learning methods. They estimate a number of alternative advantage controls in the best execution method. In [17] the author employed morphological edge detection and fuzzy logic techniques to resolve real time traffic control. They discussed the execution of fuzzy logic supervisor for the stream of traffic flow control. In [18] the authors purposed Distributed Traffic Light Control System (DTLCS) to read the road conditions using the method of Principal Component Analysis (PCA). This method is able to recognize a vehicle from an image captured by a video camera that is directed to the highway. In [19] [20] the author proposed a Secure Traffic-light of Vehicle Communication (STVC) mechanism for exchange of information connecting traffic light and automobiles.

## III. EXISTING METHODS FOR SCHEDULING TRAFFIC LIGHTS

In this section we will discuss some of these methods and algorithms which are proposed by the authors.

### *A. Agent Based System*

In [1] the authors introduced an intelligent agent which allows dynamic execution of tasks using certain algorithms of control within a manufacturing system. The authors represent different model and evaluate traffic situations in interconnected transport networks. Figure. 1 describes the general strategy of the proposed methodology, which consist of five modules:

i. Traffic simulator module, which uses a novel traffic simulator to simulate the traffic system and embeds two modules created for the simulator vehicle generator and intersection configurator, respectively

ii. Infrastructure module, which contains all the operators envisioned in the interconnected intersections

iii. Communication module, which serves as a protocol of communication to inform other operators and to make commitments among them

iv. Decision module, which endows operators with reasoning skills in order to find some alternatives to deal with any particular situation in a determined lane of an intersection and

v. Analyzer module, which performs both mobility and environmental analyses based on the time at which the vehicle arrives and departs within some lane of any intersection.

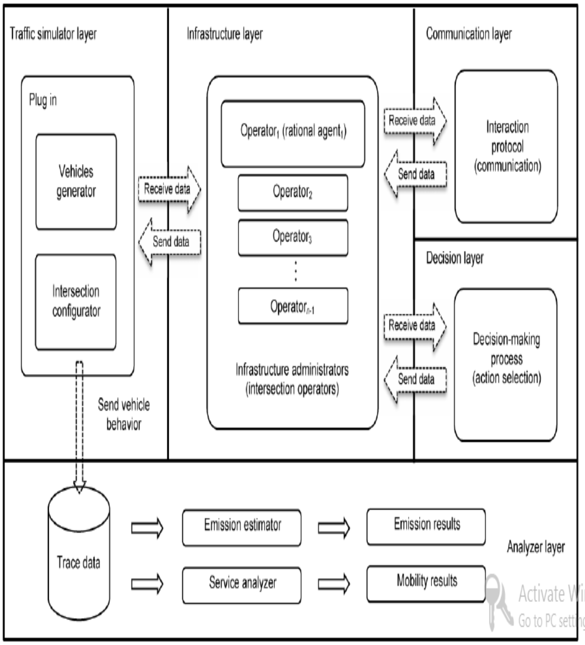


Fig. 1. General Scheme of the Proposed Architecture

### B. *Particle Swarm Optimization (PSO)*

In [2] the authors describe their optimization methodology for traffic lights. The optimization is approved through the PSO algorithms that have particularly modified to improve a set of programs for traffic signals. Their most important aim is to discover optimized cycle programs (OCP). They used fitness function that turns over the information is as follows:

$$\text{Fitness} = \frac{TT + SW + (NV * ST)}{V^2 + P} \qquad (1)$$

The central aim of this equation is to exploit the amount of automobiles that accomplish their terminuses (V) and decrease the total trip time of the entire set of automobiles (TT), throughout the simulation time (ST). The automobiles quantity, which reach to their destination is squared ($V^2$) for highlighting it than other additional conditions with characteristics. Apparently, the means of transportations which fail to arrive at their stations (NV) have derogated.

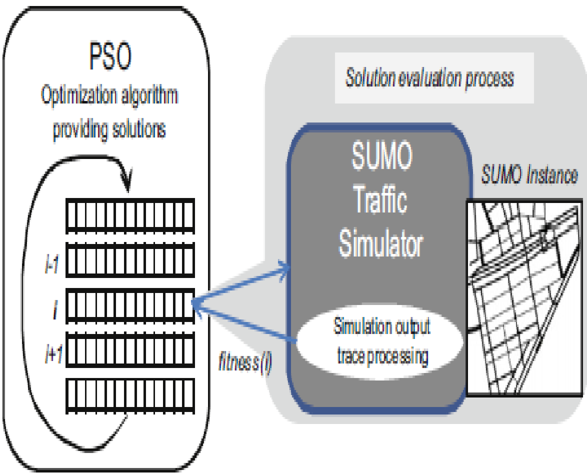


Fig.2. Optimization Scheme for the Cycle Program Conformation of Traffic Lights

### *C. Multi-Agent Architecture using TraSMAPI*

In [3] the authors proposed a multi-agent architecture by means of TraSMAPI to examine, check along dissimilar traffic management approaches.

### *D. Bluetooth Network Architecture*

In [4] the author proposed Bluetooth network architecture that can examine automobile traffic streams close to a traffic light. Their offered architecture is considered an original technique to find out green signals with stage structures of travelling signals, depends upon precise standards of traffic movements.

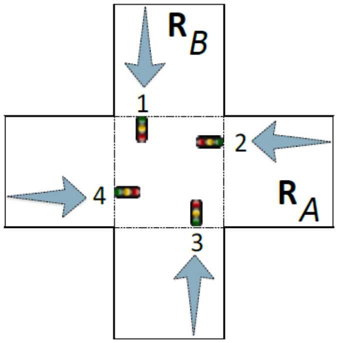


Fig.3. Road Intersection

The traffic symbolling intersection is indicated in Fig. 3. The traffic symbol 1 and 3 needs to be considered as single traffic light as both conveys the similar red and green times. The similar liveliness for traffic symbols 2 and 4. To achieve that stated purpose, they designate along $R_A$ the road comprising traffic symbols 1 and 3 and $R_B$ the road comprising traffic symbols 2 and 4.

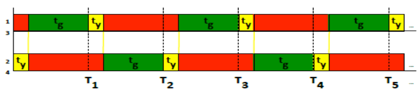

Fig. 4. Periodic Traffic Light Task Scheduling

Go on the same path and the lowest time between two succeeding vehicles that right of entry to the battle region at variance movements.

## VI. COMPARATIVE STUDY

In this section enough similarities and differences of techniques used for traffic light scheduling are compared in a meaningful way such as experiments performed on different datasets. Further results obtained frm them and distribution of results after testing are discussed. These results are obtained after the implementation of different algorithms and then then their accuracy is mentioned as per their performance which is shown in Table 1.

In [1] the author used Agent Based technique for schedule the traffic signals. Their experiment on different dataset have been implemented which shows 90 % accurate results. The data used by their experiments have been gained in real traffic studies dating from October 2011 to March 2012.

In [2] the author used particle swarm optimization technique and experimental results are tested by employing different t-test for distributions of the results. There experiment shows 87 % accurate result.

In [3] the multi agent architecture was used by the author. In the experimental result they compare the ITSUMO and SUMO. ITSUMO performs three time better then SUMO. Their Experiment shows 92%.

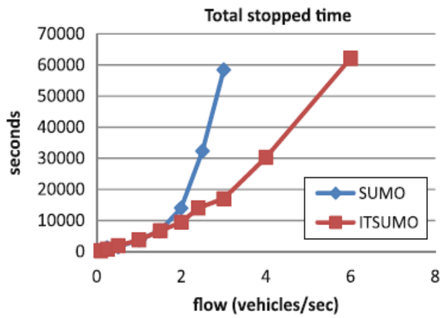


Fig.4. Evaluation of Total Stopped Time

In [4] the author used Bluetooth network architecture for monitoring the traffic flow. Their experiments were tested on LTC3588 which shows 85% accurate results. In [5] the author used POVA algorithm for sensing traffic lights. Their experiments are carried out by use a dataset generated by probe vehicles. Their experiment shows 95% correct results.

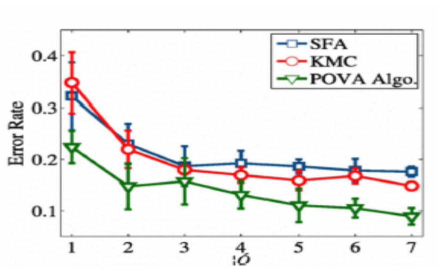


Fig.5. Estimation Error Rate by using Different Algorithm

TABLE 1

ACCURACY OF DIFFERENT PAPERS

| Paper | Author Name | Accuracy % |
|---|---|---|
| 1 | Salvador Ibarra | 90.5 |
| 2 | J. Garci a Nito | 87.8 |
| 3 | Ivo J. P M Timoteo | 92.78 |
| 4 | Mario Collotta | 85 |
| 5 | Xuemei Liul | 95.5 |

## VII. Conclusion

Smartly governed traffic signals can create efficient and effective vehicular netwroks, improving the overall flow of traffic. Traffic signal optimization techniques and methodologies were utilized to resolve the issue of public transport. This paper evaluated and compared the results in terms of their accuracy. Therefore, an intelligent traffic signals manager is required.

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