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A New Way to Resolve Real Time Traffic Control System by Using Machine Learning Approach

Rabia Khan, Rashid Hussain, Shivani Sharma, Dr. Rajesh Kumar Tyagi

Abstract— Real-time traffic is now a days biggest challenging factor. Due to bottleneck of traffic, environmental challenges are increasing. Hence, AI based Real time traffic managed to control with efficiency and it is also an important part of the urban traffic control system. It is an extremely challenging task to resolve this problem at the peak time. In this paper, an "Artificial Intelligent System Model" was developed for managing traffic systems. The developed Intelligent model makes "real time" decisions to control the traffic Signals. The model is developed using Linear Regression. A traffic managing simulator is developed by using Python 3.5 for controlling congestion point by using dynamic traffic control AI techniques. A comparison was made between the static time and artificial intelligence based dynamic traffic systems. Many tests have been carried out to check the validity of the model. It has been found that proposed model is giving good results as compared to contemporary models.

Index Terms— Modeling, Linear Regression, Cost Estimation, Intelligent system, Linear Regression (LR).

I. INTRODUCTION

The exponential indefinite quantity of vehicles on the road occurs traffic congestion at any time. This problem can arise at any time but hugely impacted at the official time. Hence, it is an urgent need to manage the vehicles with optimum efficiency (Shuji et.al, 2017). As vehicles production continues to increase exponentially, the roads become witness to encounter the congestion which badly impacts the time and environment. To avoid congestion at Red light, it is an urgent need to control this menace(Dipti et. al, 2006).

To control the traffic at peak time, it is necessary that this process must be dynamically controlled. It is time consuming if traffic is controlled by static way(Dusan et.al,2006) . Static management can lead to traffic delays, substantial reduction in energy savings, and, as a result, a drastic enhancement in traveling time and increased un-safety for the public. Control of traffic signals is a ambitious part for cost-effective movement of traffic on urbanized roads(Zhijun et. al, 2017)

Traffic signal control change in complexions, from unsophisticated scheme that use real data to find out determinate timing strategy, to adjustive signal activity, which allows regulating schemes to network signals in real-time according to traffic conditions (Ramanujan et. al, 2013).

Figure 1: Heavy Traffic at red light in new Delhi(TOI, 2019)

In figure above 1, it distinctly displays that the behavior of the traffic flow in the city depends on time as well as input. It must be controlled analytically if we have some data-set. This data-set can be helped to learn the machine learning model (Yujie Dai et.al, 2011).

The sketch of this paper is organized as stick with:

Module I: Introduction of the Problem Definition.
Module II: Describes the modeling of the traffic simulator.
Module III Modeling of The Traffic Control System.
Module IV: Demonstration of the simulation outcome
Module V: Conclusion and Future Scope.

II. REPRESENTATION OF THE SIMULATOR

The aggregation of the vehicles at anytime, anywhere is tremendous problem. This machine learning projection is modeled to utilize a fully synchronous simulator of vehicles and traffic-signal lights fundamental physical phenomenon at an intersection. The purpose is to take use of the Python language, which includes multi-threading primitives as part of the language itself and as part of package python(Mohiuddin et al. 2015).

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Rabia Khan, *MCA, Punjab Technical University, India*[1]
Rashid Hussain*, Department of Mathematics and Computer Science, Sule Lamido University, Kafin Hausa, Jigawa State, Nigeria*[2]
Shivani Sharma*, Research Scholar, Department of Computer Science, Starex University, Gurugram, India*
Dr. Rajesh Kumar Tyagi, *Dept. Of CSE, ASET, Amity University, Haryana, Gurugram, India*

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Meanwhile, the simulator would also need to take care of the properties of the real traffic control situation, such as safety (without vehicles collision), liveliness (without long-time jam at the intersection), random concurrency (cars are come from different entrance with different destination) and free left turn over the four legs.

Traffic simulator exist of a four straight-legged disjuncture crossing with same 4 traffic lights for dominant continuous and straight turn traffic, while the left bend is independent. The vehicles propagation speed and car velocity can be varied as per in demand.

The accident condition is enforced by the thought of fixing lock. A fixed lock is a area that can be engaged by a vehicle. A vehicle can dwell a lock next to it alone if its continuous and the signal is green and it is the first vehicle in the path. Likewise, while turn, a vehicle must confine all secured objects overly before automotive, otherwise, it will be closed.

The aggregation of vehicles imitates apply determinate series dimension and constant phase succession to check that all the paths gets their turn and no path is ignored for a very long time. The simulator investigates the channel and sends the data to the control algorithmic program for valuation. The outcome from the algorithmic program are exploited to render input constants.

III. Modeling Of The Traffic Control System

The point of intersection is considered comparatively engaged and is intensified with momentous need variations across all the approaches. For each approach the intersection with a phase is considered a four-phase, and that the phase series does not change from each time interval. The cycle time is fixed.

In the actual time-period, the traffic reaching design, which can be acquire from sensor placed upstream, are known. All vehicles are acknowledged as constant velocity. The outcome is to evolve a traffic adjustive control scheme that see the actual time traffic scene in small steps (surveillance amount), and yield appropriate green time extensions to optimizes the cost-effective function exist of linear combination of performance scale of measurement of all the four lanes[6].

The cost function can be calculated as:

$$J(\theta) = \frac{1}{2} \sum_{i=1}^{m} (h_{\theta}(x^{(i)}) - y^{(i)})^2 .$$

where h belongs to learning parameter and it is depend on the dependent(y) and independent parameter(x).

Performance Index (P.I.$_1$)= W_1*S_1/GT_1

Where:

W_1 is weight allotted to road 1.

S_1 is number of stopped vehicles at road 1.

GT_1 is basically addition of green light and green expansion time (g1).

IV. Projected Method To The Difficulty Using Linear Regression (LR).

A Linear Regression Analytical model in short LR is a technique to analyzed e problem with some dataset to find out the co-relation between different attributes for predicting the congestion problems at crossings. Regression is an analytical method acting on some attributes/features. This statistical based analytical method is generally used for prediction and determine the real-time origin and analyzed relation between various features. The LR techniques is basically rely on the number of independent features of the data-set and the variety of relationship between the in-dependent and dependent features.
The LR equation can be written as:

$y = mx + c$

where m and c are the constants

x is called the independent variables

y is called the dependent varaiables

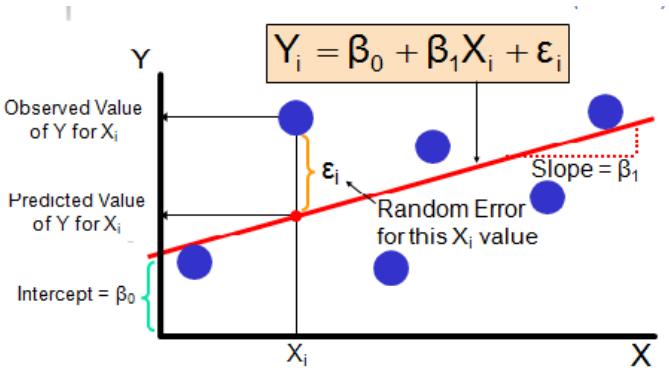

Figure 2: Description of Linear Regression [13]

As per shown in the figure [2], the Linear Regression model shows the description about the linear equation, random error, slope and intercept notifications.

The methodology of this work has been carried out in following manner:
1) Collection of Real-time data-sets of traffic.
2) Refining of this data-set by removing noise, handling missing data and outliers.
3) Apply linear regression by using Python modules.
4) Processed this data-set with Proposed Learning Algorithms.
5) Compare the Accuracy of the Algorithms after comparing the test results.

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V. SIMULATION RESULT

In this section, we are analyzing the effect receive by the proposed analytical analyzed above with the conventional and static fixed-timed scheme. Both the scheme is time-tested on the setting of fixed green signal time of 30 seconds with a green extension of up to 10 seconds in case of actual time-based system. The examination of different variables is considered as the total number of out-going vehicles at a set vehicles velocity on a fixed interval of times. The results of this model are as follows:

A sample run:
For car generation speed of 200milli/sec: -

Table 1: Comparison between fixed time and Real time-based system

Time-zone (Minutes)	Out Traffic (Fixed time system)	Out Traffic (Real time-based system)
1	60	67
2	110	116
3	170	186
4	232	248
5	273	296
	Total: 845	Total: 913

This sample result yields the exit of 845 vehicles and 913 vehicles in the scenario of set-time based and real-time based system respectively thus these results exhibited a momentous performance which increases of more than 63 vehicles in just fraction of minutes. Other sample runs also support the result.

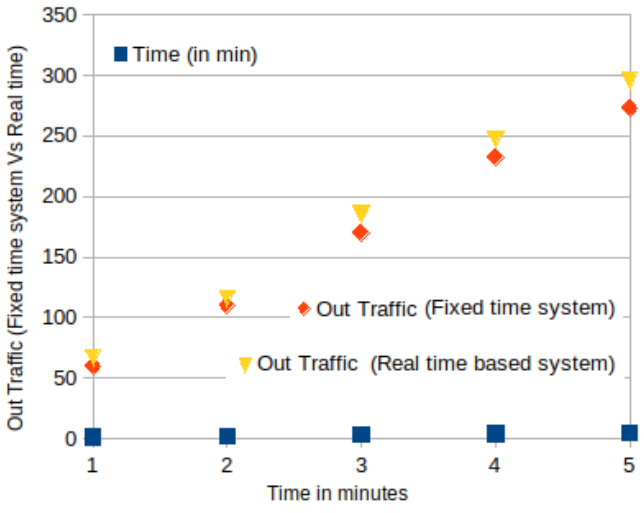

Figure 3: Comparison between fixed time and Real time-based system.

It has been clearly shown in the figure 3, if we use new technique such as Linear Regression Algorithm to resolve traffic congestion significantly then this technique will improve the system and manage the traffic dynamically.

VI. CONCLUSION

In this paper, an "intelligent" intersection control system was developed using linear regression model. The developed "intelligent" system makes "real time" decisions without any human interference after predicting the actual time of the red-light on the basis of given data-set. This linear regression learning model updated the self-learning as the time-progress and Hence, it provided the desire prediction by which the more traffic at the same interval of time. This presented Linear Regression model appeared to be more promising as compared to contemporary systems. Simulating results showed significant performance improvement compared to fixed time-based system within experimental limits (computation power, random path selection, simulator settings) under the given assumptions.

This presented model will be further extended and improved with deep learning model. Interested researcher may implement deep learning model with the help of python library for further improving.

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AUTHORS PROFILE

Rabia Khan received a B.Sc. degree from CCS University and Master of Computer Application (MCA) from PTU University. She is pursuing Ph.D. in Computer Science. She has published more than 6 scientific and conference papers. Her research interests include Cloud Computing, Machine Learning and Image Processing.

Dr. Rashid Husain is currently working as Associate Professor in the Department of Mathematics and Computer Science at SLU University, Kaffin Hausa, Jigawa. He received a B.Sc. degree in 2004 and Master of Computer Application in 2009. He received his Ph.D. degree in Computer Science in 2013. He is author of more than 30 scientific and conference papers. He has supervised more than 13 Master Students. His research interests include Cloud Computing, Machine Learning, Data mining, and Software Engineering.

Shivani Sharma is currently pursuing Ph.D in the Department of Computer Science, Starex University, Gurugram. She received her MCA Degree from MDU, Rohtak. She also did MBA in HR from Symbiosis University, Pune. Her Publications, Research papers, International and National Conferences included are 1. Intrusion detection by automated Honey-pot Machine learning technology in an unstructured Big-data 2.Modern approaches of Big data analysis 3.Changing scenario of air: An analogous approach on health. Her current research interests include Machine Learning, Web Data Mining, Big data Analytics and E-Commerce.

Dr. Rajesh Kumar Tyagi, received Ph.D. degree from University School of Engineering and Technology, Guru Gobind Singh Indraprastha University, New Delhi, India. Dr. Tyagi has vast teaching and research experience and published more than 60 research papers in various reputed International/National Journals/Conferences. He has guided several B.Tech(CSE/IT), M.Tech(CSE/IT) and Ph.D. students. His research area of interests include Ad hoc Networks, Machine Learning, Cloud computing, Cryptography, Network Security and Modeling & Simulation of Nano-Devices.

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