

Automaton:

(A Smart Automated Traffic Enforcement system using real-time data analytics)

Introduction

Bangalore, the silicon valley of India is currently at its peak of traffic congestion. The rapid growth in human population coupled with vehicle population growth is strangling the very infrastructure of the city. The choice of non-transport vehicles for commute, over the public transport is a pattern growing as a huge concern. Single-occupancy travel is also considered as the major cause of traffic in the city. The preferable long-term solution for the traffic issue is considered as the usage of public transport as the primary mode of transport thereby reducing the number of on-road vehicles. As a part of Impact KA Grand Challenge – 5, “Automaton” is a solution proposed in this paper that aims to resolve these traffic congestion issues in Bangalore through a Smart Automated Traffic Enforcement system using real-time data analytics.

Automaton: An Overview

“Automaton” will use improved traffic control algorithms and real-time traffic data to automate traffic enforcements and thereby reduce the number of private vehicles on the road and promote public transport usage. This process will involve tracking of vehicular location on real-time basis and transmit the same to a centralized data server. The transmitted real-time traffic data will enable the Adaptive Control Decision Support System (ACDSS) to optimize the traffic signal patterns in response to changing traffic volumes, and will thus improve the traffic flow.

The real-time traffic data will be collected through pre-existing sources such as induction loops, RFID readers, Surveillance cameras, traffic scan through GPS and mobile density. Also, implementation of additional data sources such as Smart vehicle tags, Smart field sensors will help generate required volumes of data.

The data collected will be interpreted through machine learning algorithms to analyze traffic congestion criteria such as road density during peak hours and lean hours, average speed, on-road vehicle type, commuting time, logjams, route patterns, time stuck in traffic.etc. The data analysis will feed into the Automated Traffic Signaling system and adapt the time cycles associated with the traffic lights and improve signal progression by minimizing the wait time at the signals. Also, the collected data will be used to track the adherence to traffic regulations and initiate automated enforcements.

The novelty of “Automaton” lies in convergence of real-time traffic data with the Smart Automated Traffic Enforcement system.

Objectives:

“Automaton” will act as a holistic solution to resolve the road transport issues of Bangalore. The main objectives of this model are:

- 1) Encourage usage of public transport
- 2) Reduce the number of private vehicles on road
- 3) Real-time Traffic Monitoring system
- 4) Real-time tracking of traffic adherence/violations
- 5) Improved Automated Enforcement System and automated incident management system
- 6) Inculcate greater discipline among the road users
- 7) Synchronization of signal lights and systematic movement of traffic
- 8) Improving signal progression and implementation of uniform speed limits
- 9) Minimize commute time and improve commuter experience
- 10) Real-time Variable Messaging Systems - Digital signage for Traffic recommendations

Working Model:

The systematic implementation of “Automaton” will comprise of three sustainable components:

1) Smart vehicle tags:

Installation of Smart vehicle tags is required for vehicles (both public and non-public) in the city, as these vehicles will act as the data source for “Automaton”. The Smart vehicle tags once installed will track the vehicle location on real-time basis inside the city and transmit the location data to the centralized server. The Smart vehicle tags can be installed at the designated centers of Bangalore traffic Police stations/RTO at a nominal fee (as prescribed by the government). This tag will map the owner’s driving license, vehicle’s certificate of registration, certificates of taxation, certificate of insurance and fitness certificate (if applicable), with the centralized database of “Automaton”.

Vehicles installed with Smart vehicle tags will enjoy privileged transport rights within the city roads. The nominal fee paid at the time of installation of Smart vehicle tag will be liable to deduction when the vehicle registered violates traffic regulations inside the city; as monitored by the “Automaton” system. Once, a vehicle has exhausted the nominal fee due to traffic violations, the vehicle will no longer enjoy privileged transport rights within the city and will once again be eligible for the privileged transport rights upon payment of the nominal fees for renewal after 6 months (from the last payment date).

(Note: Vehicles bearing registrations from states other than Karnataka will be required to pay double the charges for installation of Smart vehicle tags. This is a measure required to minimize the number of other state vehicles running in the city causing congestion)

2) Smart Automated Enforcement System:

“Automaton” system will map the designated parking spaces, no-parking spaces, no-entry roads, one-way roads. etc, in the city geographically in the transportation database. Induction loops, RFID readers and Surveillance cameras in the traffic junctions integrated with the Smart vehicle tags; will track traffic adherence and compliance on a real-time basis. Any traffic violation (such as parking a Smart vehicle tag installed vehicle in a no parking space) will be tracked and the violation will be penalized resulting in auto deduction of the fine amount from the nominal fee paid against the vehicle (for Smart Vehicle tag installation), by the “Automaton” system.

The Smart automated enforcement system can be used extensively for the following traffic offenses (already used in the B-TRAC project):

- a) Dangerous Drive - Non-Transport Vehicle (White Board)
- b) Dangerous Drive - Transport Vehicle (Yellow Board)
- c) No Parking
- d) Jumping Traffic Signal
- e) Wrong Parking
- f) Cutting Yellow Lane/Lane Discipline
- g) No Entry

This Smart automated enforcement system will help in identifying the repeated offenders and habitual offenders of the traffic regulations; and this in turn will help increase the number of registration of cases and increase in the collection of traffic fines through automated incident management system enabled by “Automaton”.

3) Signal Priority:

Public transport vehicles (such as designated BMTC buses) will be given signal priority on channelized roads (privileged lanes), as a privileged transport right. This will reduce the wait time of the public vehicles in the signals and will ensure increase in the usage of public transport facility. This in turn will also bring down the use of private vehicles on road. Availability of real-time public transport information can be made available to the general public through the “Automaton” system. The system can also perform predictive analytics and suggest newer routes or extension of existing routes of public transport, to resolve the last-mile connectivity problem.

In addition, private vehicles will also be eligible for signal priority through the Smart vehicle tag system. However, the privileged transport right of the private vehicles will be subject to compliance of Traffic laws and rules. Also, the signal priority for private

vehicles will be limited as one vehicle per driving license; which will bring down the number of private vehicles on the road and thereby the single occupancy model.

Business Model:

Implementation of “Automaton” system will require initial funding through the grants proposed in the Impact KA Grand Challenge – 5. However, the funding generated through the nominal fees collected for Smart Vehicle tag can be utilized to fund the maintenance and advancement of the system in the longer run. Also, the fine amount generated through the Smart automated enforcement system and the automated incident management system will act as revenue for the Bangalore Traffic Police department/government agencies involved.

Project Plan:

- 1) Pilot phase of this project will be deployed in a high-density traffic junction with a channelized road (privileged lane) simulation during non-peak hours, using Smart vehicle tag enabled vehicles for a period of time in order to track traffic adherence/violations and testing the real-time traffic data feed synchronization with the Smart automated enforcement system of “Automaton”

The per user cost for testing a Smart vehicle tag enabled vehicle will be around Rs.10000 per vehicle and the remaining amount of the grant can be utilized for developing the “Automaton” system.

- 2) The long-term plan is to implement “Automaton” throughout the city in a year’s time, using the grant in phase 2, and thereby using this feasible solution to create a sustainable on-road traffic environment across the city. This will require collaboration with government agencies (such as BMTC, Bangalore Traffic Police department, RTO. etc) and private organizations (such as Google. Inc).

The end-user can access the solution just by installing the Smart Vehicle tag in his/her vehicle.

Conclusion:

The potential impact of the technologically viable solution - “Automaton” is to enhance the quality of traffic experience and enforcement; to promote public transport usage and ultimately achieve systematic and sustainable traffic atmosphere in Bangalore.