Smart Traffic Control System At Toll Booths

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Abstract

This paper proposes to revamp the current toll collection system used in India. This basic aim of the proposed model is to eliminate waiting at toll booths and make the entire process automated and free of human errors. Radio Frequency Identification (RFID) tags are installed onto the vehicles by the car manufacturers during production in order to accurately identify vehicles and provide a seamless toll collection experience. Since the reading time of the RFID tag is negligible, it essentially provides for a continuous flow of traffic. The lane-diversion system uses image processing in order to detect the traffic density in the lanes ahead of the toll booth. This processing data is relayed to the Programmable Logic Controller (PLC) technology which processes the data and sends the vehicles to the appropriate lanes in order to attain minimum congestion of the roads. The SCADA software has been used to provide a working simulation of the proposed method. The results have been shown using Flowcharts, tables and relevant statistics. This paper has a basic aim to eliminate waiting at toll booths and make the entire process automated and free of human errors.

Keywords: Toll Booth, Radio Frequency Identification, SCADA, Image Processing, Programmable Logic Controller

I. INTRODUCTION

The unprecedented increase in population has played a vital role in increasing the number of vehicles on road. The sharp incline in number of vehicles has led to heavy traffic on roads, ultimately contributing to wastage of time. Moreover, congestion on
roads also leads to a large number of accidents. The manual method of toll collection by toll booths also contributes to traffic jam on roads.

Automatic method of toll collection would be instrumental in reducing traffic on road. In order to reduce traffic jam on roads, it is essential that we divert the vehicles on different lanes depending on the density of vehicles on various lanes. Automatic method of toll collection by toll booths would play a vital role in reducing the waiting time of vehicles thus reducing traffic jam on roads and will also contribute to cashless society.

Reducing traffic jam on roads through vehicle diversion and automatic toll collection is the major aim of this project. The vehicles will be diverted to various lanes depending on the traffic density of each lane. This will reduce traffic congestion on roads.

Our proposed method of smart traffic control system uses RFID tags for number plate recognition, image processing for traffic diversion and programmable logic for data handling. Through this implementation waiting time of vehicle will be reduced drastically. This will be effective reducing traffic jam on roads.

The rest of the paper is organized as follows iterature survey IN (II) which gives about the prerequisite knowledge for proposed methodology. (III) covers the proposed methodology of this paper. (IV) gives the results and statistics which prove the necessity of this paper. (V) gives the conclusion obtained from this paper. References are cited in (VI).

II . LITERATURE SURVEY

In the current world, where traffic vehicles are increasing rapidly, we require a traffic control system to manage it effectively. The foremost constraint of all is time. Security and authenticity of the vehicle is also important. These act against each other in general. For example, it takes least waiting time for all the vehicles to be passed immediately after collecting the toll. On the other extreme it increases the waiting many fold if each vehicle is vetted thoroughly. On average, a vehicle waits for 10 minutes at a toll booth [1]. We propose a solution to optimize the issue and to ease the traffic at toll booth.

With the current technology, we can use weight sensor to decongest the traffic to different lanes based on the three – way classification i.e, Light, Medium, Heavy vehicles. The vehicles of heavy weight are generally much slower than cars and other
light vehicles like bikes for safety reasons. To increase the overall speed of the vehicles, we divert all the heavy vehicles to one lane and the others to another lane. This method allows faster transit time and reduces the travel time in the number of trips made. [2]

In the process of digitizing the toll booth collection, we have image processing and auto recognition of number plates [3]. This enables the computer to understand the text letters and numbers of the car plate which it can use to fetch the details of the car from the central server. To get the image of the car plate, we need to use high quality cameras angled at towards the plate. An embedded system can be used, with this setup only to extract the letters and number on a car plate to a recognizable and understandable format to the computer. This process is not as authentic as expected because the car plate can be easily replaceable. This leads to misinformation.

The main delay while driving through the toll booth occurs when the user has to stop to pay the toll amount. This is the most time consuming task in the entire drive through. In the process of automation, this process must also be automatic and should only stop the vehicle in the case of an exception. This is one other method which reduces the overall wait time of the drive. A centralized system is required where all the details of the vehicle and the details of the owner are stored in a central database. So when a car is registered, the computer immediately searches for the owner’s details with the input details. Using these details the toll fees is automatically deducted from the bank account mentioned in the details. Should there an error, the vehicle is stopped in a few yards from the main toll, by a watch guard.

Generally, the roads on which the tolls are levied have varying amount of traffic, based on the month, time, occasion, etc. This leads to an inefficient solution for the heavy and the light weight vehicles to a particular lane in the road. If in the case of a skew, the solution worsens the situation. For example – if there are only heavy trucks and little to none cars that day, this forces all the vehicles to one lane keeping the others free. To avoid such a problem, a new methodology is required.
III. PROPOSED METHODOLOGY FOR REDUCTION OF WAITING TIME AT TOLL BOOTH AND PROPER LANE DIVERSION

When the vehicle reaches the toll booth, it need not stop at the booth rather it can pass the booth with a good speed which would result in control of congestion at the booth. The RFID reader at the toll booth reads the RFID tag in the car with every car having a unique RFID number. The RFID number gives the information of the vehicle number and aadhar card number of the owner. The toll amount is automatically deducted from the bank account which is linked to the aadhar card already. If there is no balance in the accounts the money can be paid at the toll station ahead where toll police awaits the defaulters with the car number being displayed at a device with the police.
For diversion of traffic, each lane ahead had a camera with an image processing technique which senses the traffic density at the lanes. The data is processed in a central system which calculates the lane number with least traffic density and displays the lane number on the eight segment display at the toll booth. The cars have to pass through the lane which is shown on the display so that they pass through a lane with the least traffic density and the congestion is controlled.
Thus basically the cars will not have to stop at the toll booth and move to a lane with the least traffic which results in a great save of time. The data is sent to the display after every 10 seconds which makes the system more efficient. Thus if a car enters a wrong lane by mistake, this will not cause any trouble to the system but instead cause a very little delay to the vehicle itself.

IV. RESULTS AND STATISTICS

The present day statistics on the toll booths are as follows:

**Table 1**: Present day Waiting time (in seconds) at different tolls [4]

<table>
<thead>
<tr>
<th>TOLL PLAZA</th>
<th>WAITING TIME (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHAI</td>
<td>13.5</td>
</tr>
<tr>
<td>Nice</td>
<td>26.6</td>
</tr>
<tr>
<td>BEHL</td>
<td>17.3</td>
</tr>
</tbody>
</table>
If the proposed methodology is applied,

In a recently conducted experiment, it was found that 39 of the 40 tags were read in 12 seconds [5]

Therefore, reading time = 12/39 = 0.3 seconds

Let the processing time of the RFID reader and the collection of toll at the toll booth be 5 seconds

Then the total waiting time for toll collection would be 5 + 0.3 = 5.3 seconds

However as the vehicles move freely, the waiting time is not for vehicles but for the process of toll collection.

Table 2: Proposed Waiting time (in seconds) at different tolls

<table>
<thead>
<tr>
<th>TOLL PLAZA</th>
<th>WAITING TIME OLD (Seconds)</th>
<th>WAITING TIME NEW (Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NHAI</td>
<td>13.5</td>
<td>5.3</td>
</tr>
<tr>
<td>Nice</td>
<td>26.6</td>
<td>5.3</td>
</tr>
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<td>5.3</td>
</tr>
</tbody>
</table>
Figure 5: Graph for old waiting time vs proposed waiting time at different toll booths

V. CONCLUSION

This method helps to reduce the waiting time of vehicles at the toll booths and ensures proper diversion of vehicles in different lanes which results in proper diversion of traffic. The proposed method makes the toll payment digital and hassle free. This methodology completely eliminates the stopping of vehicles at booths and instead make the vehicles travel continuously through it. Using the RFID tags has the added advantage of uniquely identifying the owner of the vehicle passing through the booth. This helps in avoiding identity theft and getting back stolen vehicles. This system has never before been implemented and has a high chance of success. In this age of advanced technology, our toll booths are in desperate need of an upgrade and this method hopes to do the same

VI. REFERENCES


