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Intelligent Traffic Management using RFID Technology

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Abstract: ***Vehicular traffic can hardly escape the list of critical problems in the world that demand to be resolved at the earliest. Attempting to eradicate the factors that led to this menace is a process too long for the current critical situation to wait for and stay unattended. Considering the serious consequences that ensue as a result of traffic jams, some solution that can bring an expeditious remedy needs to be found in order to handle the current situation. And this paper is aimed at proposing one such solution which can considerably ameliorate the degree of the mayhem that is prevailing, using Radio Frequency IDentification (RFID) technology.***

Keywords: Vehicular Traffic,RFID, Vehicular wear and tear.

I. INTRODUCTION

With the exploding population, the surging number of vehicles getting registered every day, the increasing severity of gridlocks incurring greater and greater losses in various aspects, the number of accidents that occur due to such congestions, and with the failing strategies that get adopted, it is high time we all, everybody who is victimized by this menace every day, volunteer to find a solution because we know what would content the
common people and turn out to be a successful strategy which will work satisfactorily in the long run. This paper is all about introducing an entire system that can help us overcome traffic jams with the least difficulty i.e. a system which can alleviate the severity of the consequences of traffic congestion. This system is thought up with modules which work in a way that facilitates the task of successive modules and the same continues as a cycle, thus making the system independent of human input or intervention. In addition to this, the system's overall outputs are those which have other utilities that are not strictly required for traffic management, thus helping us get a lot more achieved apart from the primary goal of guiding one to make one's way through choke points in the roads with lesser difficulty.

II. PROBLEMS FACED DUE TO TRAFFIC

As previously mentioned, the motive of this proposal is to reduce the loss incurred due to traffic jams.

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And to do this, the negative impacts of traffic which fall under the category of which require immediate attention and deserve priority should be determined.
The following are the most commonly reported troubles imposed by traffic jams:
Loss of time: Traffic jams are known to cause delays, and many times, while desiring to reach a place on time to attend an important event or a meeting. Congestions often detain people who hold important positions in office,

those whose jobs demand their presence in the workplace to the best possible extent, et cetera.
Impedance to emergency services: Traffic jams are the most nightmarish to vehicles that operate to salvage people from situations of emergency. Each second lost by these vehicles during their commute is a life lost.

- **Uncertainty:** Because of unforeseen congestions in the road, travel times are no longer predictable. This poses problems to drivers and reduces productivity.
- **Vehicle wear and tear:** Traffic jams cause idling and frequent acceleration and application of brakes which lead to more repairs.
- **Fuel wastage**: Idling of vehicles due to traffic congestions lead to fuel emission and waste a huge amount of fuel.
- **Pollution:** The emission of fuel due to vehicle idling in traffic releases greenhouse gases with harmful chemicals into the atmosphere, accelerating global warming rates.

Considering about time loss and delays, though it may seem a bit far-fetched to try to eradicate the problem, it would be a huge relief if people are at least aware about the amount of time they will be required to wait under a traffic signal. For example, commuters who are stuck in a gridlock cannot predict how long it will take to cross the specific intersection because they have no idea about the vehicle density and the rate of vehicle flow in the other roads crossing the junction because of the endless queue of vehicles that are already waiting before and after them. The attempt to remedy such situations is where our solution comes in.

III. DESCRIPTION

1. RFID:

RFID (Radio Frequency IDentification), as its name implies, uses radio waves to identify targets. This technology is one among the various methods under the AIDC (Automatic Identification and Data Capture) umbrella, which can recognize targets, fetch desired data from them, and store the collected data in a database. An RFID module's 3 necessary components are:

- RFID tag/label
- RFID reader
- Antenna

***2. Basic working*:** The RFID tag/label affixed to the target item consists of an Integrated Chip (IC) which stores all the information about the particular target. Once the tag receives radio waves from the RFID reader/antenna, the energy received reaches the integrated chip which in turn transmits the desired details about the target to the reader module and saves it in a database for future use [1]. The details about how RFID could be implemented to serve our purpose will be explained later.

***3.Selecting the appropriate RFID type*:**

RFID systems can be primarily broken down into two types, viz. **active** and **passive**, the former's tag having its own energy source and the latter's relying on energy from the reader module of the RFID system [2]. RFIDs can also be classified into different types based on the frequency range they can operate on:

IV. FREQUENCY BASED CLASSIFICATION [3]:

4.1 Low Frequency RFID:

- Frequency range: 30 Kilo Hertz - 300 Kilo Hertz
- Read range: Upto 10 centimeters
- Application: access control

4.2 High Frequency RFID:

- Frequency range: 30 Mega Hertz - 300 Mega Hertz
- Read range: 10 centimeters to 1 meter
- Application: payment/data transfer

4.3 Ultra High Frequency RFID:

- Frequency range: 300 Mega Hertz – 3 Giga Hertz
  - Read range: Upto 12 meters
  - Application: vehicle tracking

Based on the aforementioned information, the type of RFID to be chosen for tracking vehicles is an active, Ultra High Frequency range operating RFID because it can operate in a wide frequency range and also provides the largest read range, which are very desirable characteristics for a vehicle tracking system.

4.4 Placing the RFID tag/label:

RFID tags can be placed/fixed in vehicles in the following areas. The read range that can be achieved by tags placed in each of these locations is also mentioned below:

5 In the windshield:

Read range: 20 feet in ideal conditions.

6 In the rearview mirror/ hang mirror:

Read range: 20 feet in ideal conditions.

7 In the license plate:

Read range: 50 feet in ideal conditions.

Comparing the read range facilitated by tags fixed in each of the above areas, it is obvious that the RFID tags placed in license plates would work the best for purposes such as vehicle tracking**.**

V. SOLUTION

This solution consists of introducing and setting up an RFID system in our traffic management system first. The RFID reader modules have to be mounted on to traffic signals which control the movement of vehicles in our roads. The RFID tags/labels need to be affixed/stuck to the vehicles. And, as previously discussed, the tags/labels will be fixed to the license plates of the vehicles aiming for the best reachable probability of the label getting read by the reader. Now, the entire plan is broken down into 3 modules based on the different ways in which the RFID technology can be utilized.

Module 1:

First, the RFID reader mounted on the required traffic signals is used to record the important details like the license number, vehicle type, et cetera of each vehicle that passes the particular signal from the RFID tag fixed in the vehicles' license plates and store them in a database. So that, after having done this for a sufficient period of time, the data about:

- The approximate number of vehicles that pass through the signal every day
- The different traffic densities observed in the road for each day of the week

can be obtained. The plan of this module is to utilize this data in order to automate the traffic signals such that the signal timings suit the traffic density and flow we have in our roads.

The existing traffic signals are programmed such that the red, green and yellow lights alternately glow for some fixed interval of time. But, the traffic jams we face every day are telltale signs that the traffic signal program is not formulated apposite to the situation in our roads. Therefore, this module aims to reprogram the traffic signals by inputting them with the real time data about the number of vehicles commuting in each road at specific hours of every day, so that the signal timings are germane to the actual situation.

With a little tweaking on days with anticipated traffic density anomalies, like on festive days when the traffic is unusually high, or on those days when some strike is going on and the traffic is significantly low, the traffic signal can reliably work with a little to no human intervention.

The conceptual framework of the solution proposed is presented below to gain a better understanding of the setup:

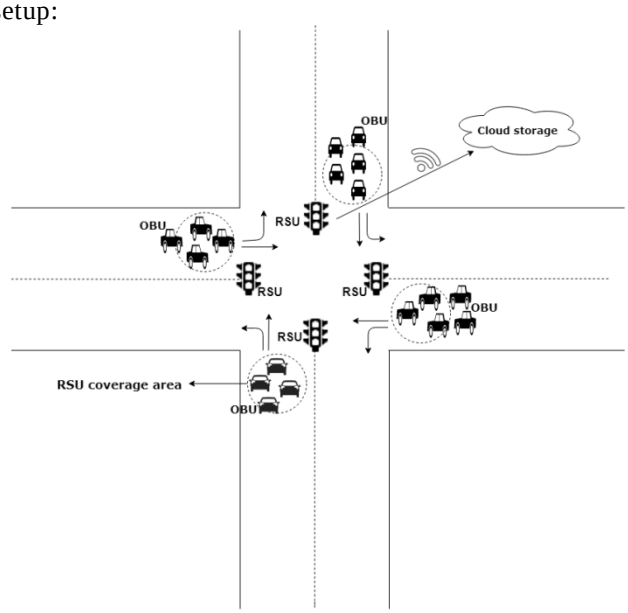

Figure 1: Conceptual framework

The above figure (Figure 1) shows a visual representation of the setup of the system we propose.

RSU (Road Side Unit) represents the traffic signals in which the RF reader module is positioned. This reader collects data from the vehicles that enter the RSU coverage area through the OBU (On Board Unit) which is the RFID tag/label that is affixed to each vehicle. The RSU then stores the collected information in a cloud through internet (WiFi network) which is used whenever there is a future need for the data recorded.

Module 2:

In addition to reprogramming the traffic signals to suit our traffic density and flow, we plan to help people select the most efficient route for their commute.

Since there is no reliable source which can inform people about the traffic density experienced by each available road, deciding the best route to take while in a situation of urgency is a nightmare.

Therefore the goal is to help people choose the most efficient route to get to their destination by presenting a system that actively records the traffic density without relying on fixed data from the past which becomes irrelevant in a few days' time due to the rapidly increasing number of commuters on the road every day. The advantage with this system is that this is extremely reliable because it is predicated on real-time traffic statistic and the system moreover gets tweaked every now and then according to the reality.

This model is sure to work and it would be the most effective if applied to introduce a new 'route guidance boards' system in roads (at least, those that are busiest among all in the city). These boards which we envision are those which could show the best route one could take depending on their priority (i.e. the route with the shortest distance or the one with the least traffic, et cetera.) based on reliable traffic data that gets updated quite frequently to maintain dependability. From traffic patterns observed until the very recent times in the particular roads, these guidance boards would almost accurately be able to predict the time it would take for one to reach the desired destination. This could become a panacea that can help eliminate getting stuck in gridlocks etc. because of one's inability to foresee the status of the road ahead.

Module 3:

This final module is all about effectively utilizing RFID for vehicle tracking purpose. Tracking vehicles is something ineluctable and therefore more efficient methods to do the task are always in demand.

As mentioned in Module 1 of our solution, the RFID system mounted on the traffic light pole collects necessary data about every vehicle passing through the particular signal, like, the type of vehicle (two/ three/ four wheeler), the license number of the vehicle, the color of the vehicle, et cetera.

Therefore, whenever a particular vehicle is to be traced, all that needs to be done is to check the records of the nearest or otherwise suspected traffic signals. The RFID fixed at each signal, as previously mentioned, records the license number, color and vehicle type of each vehicle that passed the signal. These records which inform us about the signals the particular vehicle being tracked has passed will help in determining the route taken and also the current location of the vehicle.

GPS (Global Positioning System) is commonly used for vehicle tracking purposes. But RFID has many advantages over GPS and therefore, can replace it for the better.

The main disadvantage of the GPS is the huge amount of power it consumes, when compared to the RFID system. Since the GPS needs to constantly communicate with the satellites, it uses more data and consumes a lot more power.

Another drawback of the GPS is that its service gets cut off when the equipment is not in line of sight communication with the satellites. GPS is also sometimes prone to poor tracking efficiency, whereas the RFID is always accurate [5].

Therefore, RFID seems like the best option to choose for vehicle tracking purpose, and other applications which required a large range of operation, because of the aforementioned merits it possesses.

VI. CONCLUSION

Thus the paper has accomplished its aim of introducing a smart method to navigate through and overcome the traffic jam conundrum. Further the solution proposed has been broken down into modules which throw light on the clear benefits this method could bring about. Also, the advantages of choosing the proposed system (RFID) over others have also been underscored. Thus, this paper is believed to help people get confidently assured that the above proposed solution is something promising and would definitely bode well for a better future.

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