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Big Data for Surveillance in Mobility Sector: Application and Opportunities

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Abstract*: *Everyday technologies are evolving with rapid pace. Domain relevant innovations are the driving force in achieving new milestones in different technical sector. This paper resolves issues related to surveillance of Road Transport and Mobility Sector. There are a couple of domains which are marking their concrete existence in almost every field, like Big Data and Internet of Things (IoT). Big Data is an integral part of Data Science which deals with massive amount of data. When we talk about collecting data, there is no big source than internet. Internet of Things (IoT) plays a credible role in information generation from different locations using different devices and collecting the raw data to a centralized location, where the pennies will add up to a dollar, i.e. the small amount of data from different location when collected at one place will add up to the pool of data, which scale up from terabytes to 10s of petabytes, and thus we term it as Big Data. Road Transport and surveillance sector has a wide variety of problems, ranging from illegal breaching of vehicles without paying Toll taxes at Toll Plaza, to Violation of Traffic Signal law. All these problems can be eradicated by making use of hot technologies which uses a centralized system to handle these issues effectively and efficiently, Big Data is one such Technology. Big Data Analytics can help in optimizing operating procedure at such places.

***Index Terms*: Transport, Mobility, Big Data, IoT, Surveillance, Computer Vision.**

I. INTRODUCTION

Nowadays the transportation sector is taking its way towards new technologies by implementing some scaled up technologies like RFID (radio frequency identification) card detection at toll plazas where the electromagnetic waves' signals are been detected by the RFID Readers. Thus, the tag or the RFID card on each vehicle will be linked to the wallet or bank account of the vehicle owner and the receipt of toll taxes will be generated, which is to be paid thereafter. The future scope for management of transportation and mobility sector is image processing which is widely used in current era of surveillance and management. There are numerous institute level projects which are been actively working on Open Sourced Computer Vision (OpenCV) and with IOT as the base technology. The most precise way is to collect the vehicle's and associated owner's data from centralized authority and make it accessible for the payment app specially designed for paying toll taxes, which will ease the task of paying toll taxes and make it convenient, both for the traveller and commuters as well for the toll plaza regulatory body.

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The following research work represents the technology driven toll plaza by using today's hot technologies like Big Data, Internet of Things, Computer Vision, etc. The work aims at providing various types of services like automatic tax payment at toll plazas, automatic fine receipt generation at traffic signals and many more intense data driven services for surveillance.
Herewith, this work will focus on how these two technologies (i.e. Big Data and IoT) will be digging its way in Road Transportation and Mobility sector.

II. APPLICATION OF TECHNOLOGIES

Mobility sector was facing a lot of inefficiency issues due to lack of technological intervention. In a matter of five to ten years, many researchers made their way to integrate high-scaled and booming technologies in transport and mobility sector to circumvent accidents, road traffic detection, etc. Thus, this field is experiencing a constant change and updates with the introduction of complex, yet simplified solutions. When data from multiple devices is collected, it will be a huge pool of structured data collected from hardware devices i.e. Mobile phones over the Internet, which authorized the use of the Internet of Things (IoT). This data will be combines with the data collected from the central vehicle registration department, which has the information of owner of a particular vehicle and the license plate associated with it, this add on data will make the data lake into a Data Warehouse as the data will be structured and well defined, making it suitable for big data analytics. The data will be analyzed for multiple purposes depending on its area of application and the task which is expected to be performed by it.

A. Big Data & IoT in Toll Tax Collections

Considering the toll tax collection as the first example- The application will have a user login, which has a wallet associated with it. The application will give an alert message a few kilometers prior to the arrival of the plaza. Thus, allowing the commuter to pay the tax on a single click from their wallet. Also, they will enjoy easy passage from the 'Paid Lane', benefiting them by saving their time to wait for their turn in the long queues. The commuters, the whose licensed plate is marked as 'Paid' for the specified Toll Plaza in the Data Warehouse, will be allowed through the lane and the others won't be allowed and will be stopped by the flap at the end of the lane. The Computer Vision enabled cameras installed on the plaza will make sure to close the flap at the end of the lane to stop the illegal infiltrations of vehicles without payment. The Computer Vision enabled camera will have lightweight License Plate Detection software installed in it,

which will make sure to detect the characters on a number plate. This image will be the best quality images chosen from the multiple frames of a live-time video. This License Plate Detection Software will detect the characters in the number plate within milliseconds and this data will be checked in the big data analytics layer for authentication. This procedure will take place in a matter of a second, making it the most efficient way for surveillance in Mobility Sector.

B. Big Data & IoT for Automatic Challan Generation:

The view copy of previously used structured Data for Toll Tax Collection can be taken into account for fine receipt (challan) generation also. It will ease the working of both the systems with minimal maintenance by sharing the resources. Additionally, it will keep raw data safe by creating the view copies of the data and to store the manipulated data on to a different location, thereafter. The vehicles which will be violating the parking rules or any traffic rules will get a fine receipt on their application login with a copy of it on email. Thus, failing to pay the challan within 24 hours will lead to blacklisting of the vehicle from the database and the vehicle will be ceased in the next few hours. Projects like these already existed in the market and can be easily integrated with the Big Data Pool. The License Plate Recognition (LPR) software enabled cameras will act the same way as they were used in the Toll Tax collection scenario. The application will work the same and thus defining the use of the Internet of Things (IoT), yet again.

The same application and the same database can be used for multiple purposes, making the surveillance easier with less human intervention and more technological involvement. Thus, making it the most efficient and effective way to tackle these problems, or rather be called as needs.

III. WORK FLOW

This dataflow of the overall system of Toll Tax Collections System or Automatic Challan Generation System will direct its way from Data Server at the base to Application layer or end-user interface as the final standalone phase.

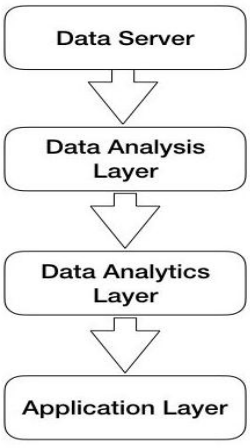
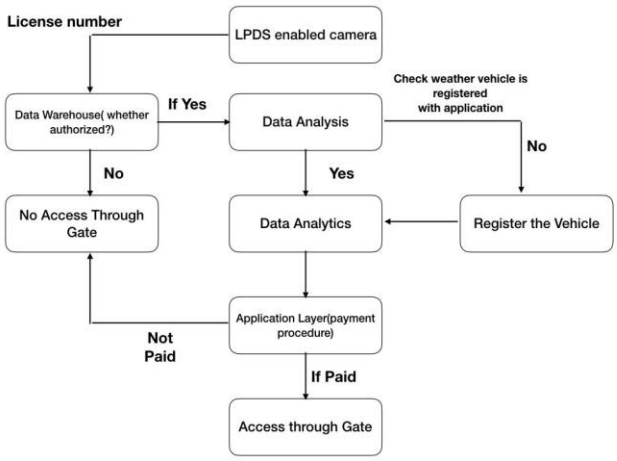


Fig. 1: Data Flow in the Surveillance System

In betwixt, the data received from IoT devices will undergo a numerous manipulation and modifications to provide you with the desired functionality. These modifications are namely done in Data Analysis Layer and Data Analytics Layer. Analysis will do the authorization part, while the analytics will decide the action to be taken depending on the analysis and availability of data. Reverse engineering works with the same blocks in opposite manner, where application layer will feed the data in data servers, and thus the analysis and analytics will then be performed over the newly generated data, or information to be precise.

IV. SYSTEM ARCHITECTURE

The architecture of Toll Tax Collection System will have the Data Warehouse as the main block and it will remain to be of foremost importance throughout the working of the system. The Procedure tends to start with input data given by the IoT devices at the Toll Plazas, such as the License Plate Detection System (LDPS) enabled camera, which will send the license plate number detected by it. The number will make its way to the Data Warehouse and thus the analytics and analysis process is performed, where the authorization of vehicle is checked, and whether it is registered or not, and to provide option to do the needful in the middle of process flow. Henceforth, depending on the live circumstances, the Access through the gate is either approved or denied, updating the newly generated information on the Data Warehouse.



LDPS – License Plate Detection System

Fig 2.1: Toll Tax Payment working Architecture

Now, casting some light on the Architecture of Automatic Challan Generation System, which will make the use of same Data Warehouse and decide whether the vehicle has violated any traffic rule? Even in this architecture, the Data Warehouse block is of prime importance. The first input will definitely be from the LPDS enabled camera with the use of Internet of Things. The Analysis and Analytics layers then decide whether the vehicle is authorized? Depending on the circumstances, the necessary action will be taken, whether to generate a challan (fine receipt) on the application layer and wait for the user to pay it within specified time duration, or to take direct action, which is termed as 'Instant Action' in the figure below. Instant action will constitute of several options, like the vehicles to be seized, the person or driver to be arrested, etc. Criminal records will get updated on real time if such system is implemented in real life,

which will definitely reduce the humanly task for surveillance over different places. The primary source of information i.e. the camera will be the only thing to keep physical maintenance of, during the life span.

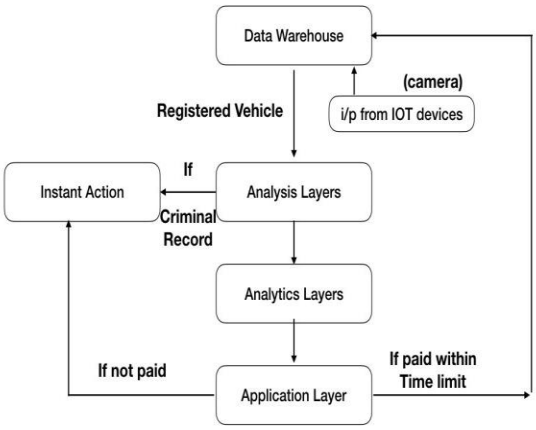


Fig. 2.2: Automatic Challan Generation Architecture

V. OPPORTUNITIES

Of the numerous problems in this field, major ones are solved by using the Big Data Methodology and Internet of Things (IoT), but as technologies are ever evolving, there is vast scope of improvement. Also, while considering the challan generation example, it is been observed from the data that there are considerably high numbers of accidents every year, alone in India. The over speeding, lane indiscipline, jumping red light are among the few, which constitutes **78.06%** and **72.76%** of total accidents in the year 2017 and 2018, respectively in India.

Table- I: Category wise number of accidents in year 2017 and 2018

Traffic Rules Violation	*Number of accidents in 2017*	*Number of accidents in 2018*
Over-speeding	3,27,448	3,10,612
Lane-indiscipline	29,148	24,781
Jumping Red Light	6,324	4,441
Sub-Total	3,62,920	3,39,834
Others accidents	1,01,990	1,27,210
TOTAL	4,64,910	4,67,044

With increasing number of cases, there comes the need of improvising the current procedure. Thus there will be utmost scope for IT companies to showcase their onboard skills to make the procedure more sophisticated, leveraging the horizon of IT industry.

VI. CONCLUSION

Big Data and IoT are among those technologies which solves more than 50% of the problems in any field, when blended together properly. Thus we conclude that Big Data and Internet of Things (IoT) can be used in Transport and Mobility sector in number of ways to solve the multiple problems cited above. The model has tremendous scope independently as well as at times when contrived with other technologies in the technical world. From hereafter with this model we can make the crime free environment and an automated system for surveillance. Introducing new solutions using latest technologies will revamp the archetype. The Compound Annual Growth Rate (CAGR) of country will also be getting a boost. Thus, this paper figured out that making use of Big Data will ease the surveillance procedure by making double use of same data. It also inferred that IoT and Big Data can be the best blend to eradicate problems in surveillance sector, as up till now.

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