Big Traffic Data Analytics For Smart Urban Intelligent Traffic System Using Machine Learning Techniques

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Abstract—Due to huge number of private and public vehicles in last two decades, the traffic load and congestion have increased significantly, which is major problem in transportation system. An intelligent traffic management system becomes an important part of the transportation system to manage the traffic properly in smart cities. In this paper, we have proposed intelligent traffic management system to build smart platform in Mandalay, Myanmar. The main aim of the paper is to reduce traffic congestion, road crash accidents, fuel consumption and save travel time. To provide safe, comfortable, and less frustrating travel, this paper uses big data technology and machine learning technique for analysis of the volume of traffic data and predicts optimal road traffic using machine learning.

Keywords—Smart city, machine learning, Big data analytics, intelligent Traffic, Mandalay

I. INTRODUCTION

Myanmar is one of the developing countries and the number vehicle ownerships has increased considerably in 2011 due to new transport policies of the Government of Myanmar. Thus, the traffic volume has been increasing since 2011 and number of accidents is also increasing. As the traffic volume rate increases, the traffic congestion becomes as major problem in big cities of the country, Yangon and Mandalay. Although the rate of Traffic volume has increased, there is no enough road infrastructure to manage and support that. This has become main reason for increased number of accidents and deaths also. The increased rate of traffic volume also damages the environmental conservation. The reduction of CO_2 gas emission from vehicles is important issue in Myanmar and planning of smart city and smart transport system can be of great help.
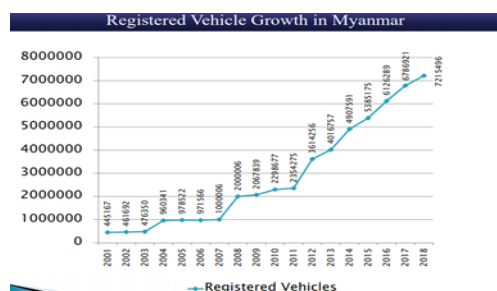

Fig. 1.   Growth of Registered Vehicle in Myanmar

In Fig 1, we have shown the increasing number of vehicles registered in Myanmar. Traffic congestion and long waiting time are major challenges and act as main reason for road accidents. The pollution is also attributed due to congestion since the vehicles do not move and traffic jam condition increases smoke and emissions from the vehicle. Thus, the need of smart traffic management system using technology is essential so that automatic road transport system can effectively manage the traffic, congestion, parking etc. The traffic management and smart monitoring system will help to manage the congestion and address the issues thereof. The automatic traffic signaling system will reduce the volume of traffic and avoid the number of accidents and also help proper route and paths to the commuters so that the congestion is avoided. The smart transport system is already in use in several developing and developed nations and country like India where huge traffic load is there, is also in implementation stage [6].
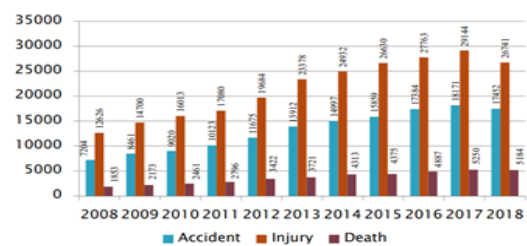

Fig. 2.   Road Traffic Crashes in Myanmar

Fig 2 shows the number of crashes or accidents that led to injuries and death in Myanmar from 2008 to 2018. We can see from this figure that the number is increasing every year.

II. METHOD

In this section, we discuss the methodology used and suggested in this paper for smart management of traffic on roads of Myanmar. This mainly include big data, machine learning and traffic management system.

A. Big Data

Big data is the technology that allows handling of high volume of data irrespective of structures of data as structured, unstructured or semistructured. The different types of data in large volume pose a big challenge in implementation of any smart system where data is involved and traditional methods

are used. Big data is viable solution to this problem which is actually combination of various datasets of high volume. The difficulties in data processing as complexity, rate of growth of data, variability are analyzed with the help of appropriate tools of visualization packages so that the load of data is eased and it becomes useful in simplified ways. Big data has its own limitations [2] while implementing, and few major limitations are: uutilization and interpretation of data; privacy, regulatory and security challenges and issues; the viable cloud based solution is needed; and archiving of big data for signal and data processing applications

B. Machine learning techniques

Machine learning facilitates the automatic system to get trained over the data. The knowledgebase and designed rule-set is used by the appropriate machine learning to train the data and interpret accordingly. The artificial intelligence (AI) based systems are used in automation and smart monitoring systems which perform successfully because of AI and machine learning methods. There are different types of machine learning methods in literature broadly categorized into: **Supervised learning:** In this scheme, the system learns and trains itself automatically with the help of experience, labeled dataset, and provides classification and data interpretation of input data to the system. The feature extraction is used to get suitable number of features from the data and used in handling unlabeled data as well. **Unsupervised learning**: In this type of machine learning, no labels are subjected for training and the method itself finds some structure of input in certain ways. The hidden patterns of data are explored using this type of machine learning technique. **Reinforcement learning**: Here, AI plays an important role in obtaining optimal ways of finding features and classification results. An AI enabled agent is used to attempt solving a specific task and predict the next step so that the classification converges into some final step.

C. Traffic Management System

An intelligent traffic system (ITS) is a combination of services and tools which are connected to various transportation modes and traffic management software. The most common use of such systems is in providing citizens with detailed transportation information, shortening the duration of commutation (travel time), and reduction of traffic congestion. Subsequently, the accident rate will also decrease. Intelligent traffic management system can target at achieving specific goals of comfortability of commuters and also reduction of crashes and traffic jam.

III. PROPOSED ITMS PLATFORM

In this section, we discuss the proposed ITMS (Intelligent Transport Management System). Mandalay is the second largest city in Myanmar and large number of motorbikes are most commonly used in daily transportation. Moreover, the number of vehicles which includes cars, and other vehicles also are increasing. Thus, traffic problem is main goal of the to transform smart city. In this paper, we propose to build smart intelligent traffic management system for Mandalay city of Myanmar. As shown in Fig 3, the proposed system has three stages for processing. In first stage, the frame work collects information of massive amount of data from heterogeneous resources which may be IoT

devices, sensors and CCTV data. Then, this raw data (unstructured, semi-structured and structural) is subjected to transform and analysis of massive amount of traffic data using big data technology through Map Reduce framework. The second stage employs machine learning method which helps to detect and classify the traffic data of different lanes of road and types of vehicles. Among different machine learning techniques, we propose Random forest theory and Neutral network methods to simulate complex and nonlinear processes, characteristics that combine optimum route management, traffic flow in real time and avoidance of road traffic accident in future using time series based on historical traffics data. Moreover, comparison is made in terms of various statistical parameters such as mean absolute error (MAE), root mean square error (RMSE), mean absolute percentage error (MAPE). The comparison substantiates the claim made in our hypothesis that machine learning based methods have capability of providing a smart transport system despite traffic flow, unstructured routes, different categories vehicles, accident occurrence and the road conditions.
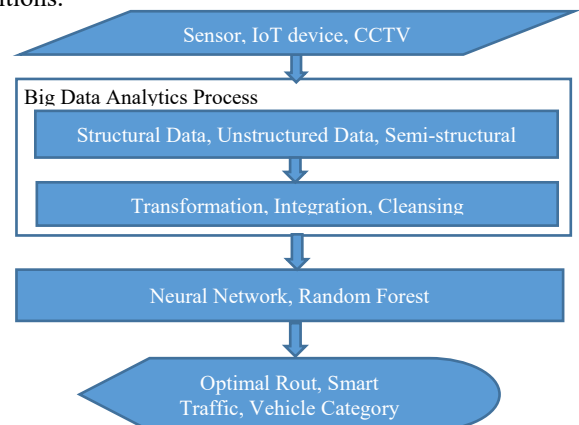

Fig. 3. Intelligent Traffic Management System Design

IV. CONCLUSION

This paper proposes an Intelligent Traffic Management System for developing a smart transportation system to make the second largest city of Myanmar, Mandalay as smart city. The main aim is to reduce traffic congestion, road crash accidents, fuel consumption and save travel time, and to provide safety, comfortability and enjoyable travel experience for all.

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