

# A Framework for Smart Transportation using Big Data

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**Abstract**— In the current era of information technology, data driven decision is widely recognized. It leads to involvement of the term “Big Data”. The use of IOT and ICT deployment is a key player of the smart city project in India. It leads to smart transportation systems with huge amounts of real time data that needs to be communicated, aggregated, interpreted, analyzed and maintained. These technologies enhance the effective usage of smart transportation systems, which is economical and has a high social impact. Social applications like transportation can be benefited by using IOT, ICT and big data analytics to give better prediction. In this paper, we present how big data analytics can be used to build a smart transportation system. Increasing traffic and frequent jams in today’s scenario are becoming a routine, citizens are facing various health issues due to the bad transportation systems such as high blood pressure, stress, asthma due to air and noise pollution. In smart transportation mobility can be easily implemented as most of the citizens use smartphones. It can be easily linked to smart traffic signals to achieve the objective of smart transportation. Smart transportation is a key component to attract companies as it leads to better services, business planning, support beneficial environment and social behavior.

**Keywords:** *Smart City, Big Data, Smart Transportation, Internet of Things (IoT), Information and Communication Technology (ICT)*

## I. INTRODUCTION

Smart cities have gained momentum with the smart city initiative of the Government of India. A smart city can be described as urban infrastructure [1] evolving with the help of integrating multiple information and communication technology (ICT) and Internet of Things (IoT) solutions in a fashion which is secure and with the end goal being to manage a city's assets. Big Data analysis [2] techniques could play a significant role in smart city planning and facilitation of infrastructures and services or be it related to sustainability (eg. water, gas, electricity). The society needs real time information [9] (weather, public transportation, and parking). With the help of big data, real time monitoring, management, prediction and optimization, may be made possible.

In urban environments, various data sources exists such as, mobile data sources, like wearable devices, smartphones, smart cards, GPS enabled vehicles. These devices continuously send data to the cloud, this Big Data collected over cloud can help citizens and urban development authorities to plan infrastructure and services.

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This prevailing data collected from various resources connected to the internet has not been utilized to the maximum. The huge amount of data is collected with very little information is a very common challenge these days. Big data can play a major role in planning & management of smart cities [3] by applying knowledge discovery techniques on the data collected from various sensors deployed at different locations.

## II. MOTIVATION

Smart cities are a great initiative taken by the Government of India. For effective urban planning and smart city development, big data plays an important role which includes facilities such as health and safety, traffic management, pollution control, disaster management and so forth. Various sensor services [4] are deployed for the project such as vehicle monitoring, public parking etc. The surveillance system for disaster management facilities of city should be remarkable; the transport system facilities should also be citizen friendly for the rapid growth of the city.

In a tier-2 city like Indore, which comes under the smart city project of Government of India, it is observed that because of lack of smart public transportation [11] service, various issues have come to light such as air & noise pollution, man hours being wasted in traffic jams. One solution to this problem is to have a smart transportation facility. Terabytes of vehicular network [5] data is generated by billions of connected devices. This big data can be used to analyze different aspects of transportation [7] [8] to achieve a smart city.

## III. SMART CITIES

Although a smart city is a buzz word in the present time, no unanimously accepted definition exists. It could be treated as an urban development vision to integrate diverse information for better decision making for the benefit of the citizens. IOT and ICT [6] could be used to secure various city assets such as hospitals, schools, local departments, libraries, water supply networks, waste management, law enforcement and various other community services.

The basic objective of the smart city project should be to improve the standard of living by using big data collected from various sources of technology to increase the efficiency of services to meet the citizen’s needs.

ICT helps the authorities in urban planning by providing real time data for continuous monitoring and to interact directly with the community. For data collection, sensors are required

with real time reporting to collect data from citizens' devices and individual devices deployed at different locations. After the data is collected, it is processed and analyzed. With this technology, urban planners can improve the quality, performance and interaction of city services. Reductions in cost based on resource consumption and to facilitate face to face interaction between citizens and the government. The smart city concept has garnered attention due to wide technological, environmental and economic changes.

Aadhaar cards in India (smart cards) are another step that could be used as source towards building smart cities. This single card allows governments to aggregate data about citizens. It can be extended to various services such as to log the user preferences based on past intervention and receiving feedback to improve services, to find out common interest groups or to allow card owners to login to various e-services provided by the government.

People, Process and Technology (PPT) [7] should go hand in hand to build a successful smart city. The basic objective of any smart city development is to study the community, processes and policies to meet the citizens' needs, then introduce technology to implement the plan and improve the quality of life.

#### IV. SMART TRANSPORTATION SYSTEM ARCHITECTURE

Fig. 1 shows proposed framework for smart transportation system. It is divided into layers for information collection, processing and decision making. The first layer is the input layer which is considered as a data collection layer from various sources such as surveillance camera, smart traffic signals, GPS, RFID and Internet.

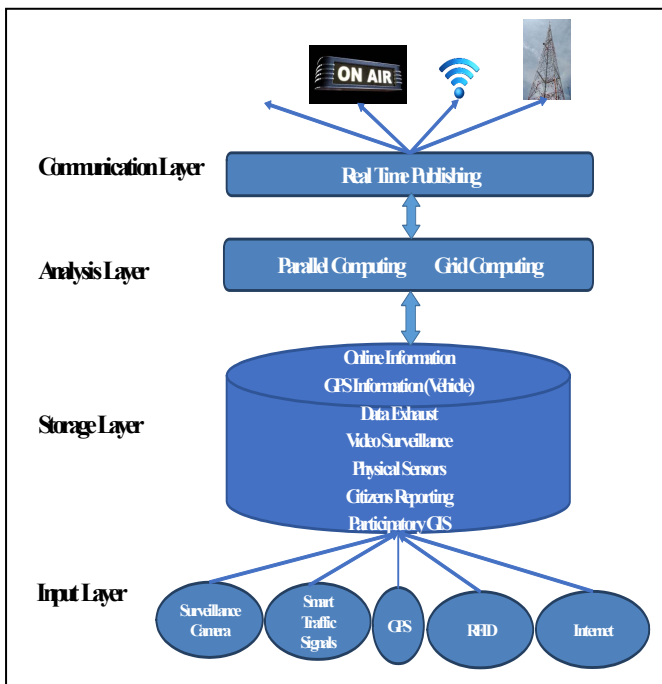


Fig. 1 Smart City Transportation Framework

In the storage layer data is collected from diverse sources and stored for analysis. At the Analysis layer data will be fetched from the storage layer and analysed using different data analytic tools on parallel or grid computing environment. Once the analysis is completed inference based on the data are forwarded to communication layer for real time publishing using different communication mediums like mobile, radio, television or internet.

#### V. CHALLENGES IN BIG DATA TECHNIQUES

The challenging task in a smart city using big data is to analyze the huge amounts of data and make the appropriate decision intellectually. The challenges of big data driven decision making is broadly recognized. It leads to involvement of the term "Big". Huge amounts of data are reported by different sensors deployed at various locations of the cities. To get meaningful information from this huge collection needs precise data mining techniques. Data quality, data access & connectivity and speed of processing are the basic challenges faced while dealing with big data.

##### A. Data Quality

Big data for smart city transportation [3] is basically real time data collection from various sensors deployed at different locations of the city. This data may contain noise which may lead to wrong predictions and in the smart city systems it may cause unnecessary chaos. Even if we analyze data quickly with various hardware mechanism but if the information utilized for decision making is not accurate, all the efforts invested may not be effective.

##### B. Data Access & Connectivity

As data for smart city and urban planning projects are taken from sensors deployed at various locations, we need to have continuous connectivity with high bandwidth so prediction can be precise and timely.

##### C. Speed Requirement

In recent year's hyper-computing environment companies not only need to find relevant data, they also want it on time. Data visualization helps organizations to analyze and take faster decisions but the main challenge is the volume of data. A solution to this, is to use parallel processing mechanism or grid computing approach. It helps the organization to work in a near real time environment but it is a costly solution.

##### D. Interpreting Data

Getting the data into the specific format needs a lot of understanding. Data from social media is in an unstructured form which needs preprocessing to make it meaningful for customers and big data analytics tools.

##### E. Lack of Talent

Organizations are facing a dearth in data analyst talent. There is a need of a team of data scientists, developers and analysts with domain expertise which is lacking and hard to find.

## F. Security

Security is one of the biggest challenges in every computer science application. In Big Data [2] this gets even more complex and complicated to provide security. It requires authentication for individuals accessing data. Need based restricted access is required to maintain data integrity and confidentiality. Use of proper encryption techniques for data in-transit and stationary data. Various smart city components are shown in *Table 1*.

TABLE 1 SMART CITY COMPONENTS AND THEIR USAGE

Smart city Components	Usage
Smart Healthcare	Healthcare information to be utilized by healthcare providers to analyze diseases. It can also be utilized by insurance and government agencies. Increase real time monitoring of patient data gathered through smart devices.
Smart Transportation	Traffic analysis and communication based on real time data. Use of big data to plan traffic regulation to avoid congestion and deviate traffic for better traffic management.
Smart Safety	Temporal and geographical information to provide safety to citizens. To be able to predict natural disasters like floods, earthquakes etc. and future environmental changes.
Smart Governance	In this various government offices can collaborate and share data for better decision making and streamline processing.

## VI. CONCLUSION

Smart city projects are getting a lot of momentum these days. Big data is the key enabler for smart city projects. These two concepts merger can provide better services such as healthcare, transportation [10], effective governance etc. that helps to enhance the quality of life. In this paper we have proposed how big data as a technology can be used to build a smart transportation system for tier-2 cities. What are the challenges faced by the citizens? How can they be resolved using the concept of big data analytics to provide citizens with better services? In future these Big Data techniques can be utilized for individual and organization for appropriate decision making based on traffic pattern analysis and urban planner can use it to provide better public transportation. Various opportunities exists for smart city transport for tier-2 cities like Indore using big data techniques.

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