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ANALYSIS ON APPLICATIONS OF BIG DATA ON INTELLIGENT TRANSPORTATION SYSTEM

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ABSTRACT

Research in intelligent transportation systems (ITS) is becoming increasingly focused on big data, which can be seen in numerous projects around the world. Data-driven approaches are needed because of the volume and availability of data in the Intelligent Transportation System (ITS). Big Data algorithms are being used to improve transportation applications' intelligence. There has been a rise in the use of Big Data algorithms in both academic and industrial contexts in ITS. There are many uses for ITS big data algorithms, including but not limited to signal recognition, object detection and traffic flow prediction as well as travel time and route planning and vehicle and road safety. There will be a bibliography, an in-depth look at the application of ITS, and an examination on some well-known Big Data models in the context of ITS. This research sheds light on how Big Data algorithms are being used in ITS, revealing new areas of application and bringing together models and applications in new ways.

1. INTRODUCTION

Big Data has recently become a hot topic in academia and industry. Large and complex data sets from a variety of sources are represented here. Data mining, machine learning, artificial intelligence, data fusion, social networks, and so on are just a few of the many popular Big Data techniques [1]. Big Data analytics has been used by a wide range of people, and they have had great success [2]. It is not uncommon for businesses to use Big Data to better understand their customers' buying habits and make more informed decisions about their products and services [3]. Using Big Data analytics of online social networking, microblog and sharing space, some social network companies, such as Facebook and Linkedin, are able to better understand their users' current behaviour and social connections and rules of social behaviour in the social network field [3]. It is possible for doctors in the medical field to examine the pathogenic characteristics and physical assessment of patients to develop more humane treatment plans and suggestions and reduce the incidence of patients by processing and querying health care data. Grid operators can use smart grid data to identify which parts of the electricity load and power frequency are excessive, and even which lines are in a failing state. As a result of these data analyses, the electrical grid can be upgraded, renovated and maintained [5]. Because Big Data analytics has been so successful in so many fields, intelligent transportation systems are now taking a close look at Big Data.

Since the beginning of the 1970s, ITS (intelligent transportation systems) have been developed. It's the future of the transportation system, and it's already here. ITS integrates advanced technologies into transportation systems, such as electronic sensors, data transmission, and intelligent control [6]. The goal of ITS is to improve transportation services for both drivers and riders [7–9].

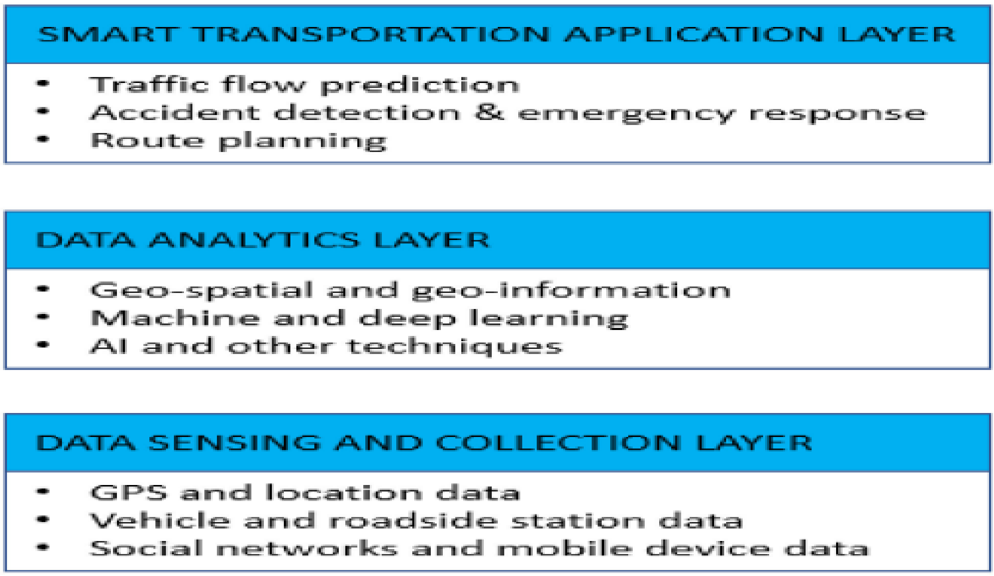

Figure 1. Generic architecture for big data analytics in smart transportation

Smart transportation, control systems, and communities have been designed and planned using big data analytics in recent years. There are a variety of data sources in smart transportation, including GPS data, transportation logistics data, video data, social media data, and sensors and systems data, such as VSD, vehicular mobile service data, advanced driver assistance data, connected cars data, and other types of data. Figure 1 depicts a generic architecture for using and deploying big data analytics in smart transportation systems. The data collection and analysis, as well as the smart transportation application, are all separated into three distinct layers in the architecture.

2. LITERATURE REVIEW

ITS, or intelligent vehicle highway systems, was first conceived in the 1980s by a small group of transportation professionals who saw the potential of computer and communication technology in transportation. In the last decade, ITS has played an important role in the global world, and its applications go beyond highway traffic. To provide navigation, railway, water and air transport systems ITS generates a large amount of data. This data is used to provide services to ITS. An article by Cox and Ellsworth in October 1997, entitled "Application-controlled demand paging for out-of-core visualisation," was the first to introduce the term "Big Data." The term "Big Data" originally refers to the volume of data that cannot be collected, processed, or analysed using traditional database models and tools. Techniques for obtaining structured and semi-structured information as well as mixed data have been developed over time (Zhu et al., 2018). Data analytics is the collection, management, processing, analysis and visualisation of constantly evolving data (Marjani et al., 2017).

Data-driven models are required to operate, control, and manage this enormous volume of data. In order to improve the ITS operation efficiency, provide information for traffic management decisions, plan better public transportation service, track trucks and planes or ships using real-time data, and help users reach their destination in the most suitable route and with the shortest possible time, Big Data algorithms are developed. (Zhu et al (2018). One of the most significant changes to come from this is the creation of more sophisticated models for dealing with Big Data in ITS.

According to Yang and Pun-Cheng (2018), vehicle detection under varying environments has been studied extensively. Short-term traffic forecasting is examined in Vlahogianni (2014). It takes Neilson et al. (2019) no more than 28 articles to cover the years 2012–2017 of Big Data research and applications in the transportation industry. According to Zhu et al. (2018), ITS Big Data sources and collection methods are discussed, and data analytics methods and platforms are summarised.

The final set of dataset includes 586 documents that were vetted by hand. Only six papers in the dataset cover other modes of transportation, including railways (Said et al., 2017), subways (Ding et al., 2017), and sea transport (Fumeo et al., 2015; Li et al., 2019), which are the only other modes of transportation in the dataset (Chen et al., 2019). A lack of interest in the topic of "intelligent transportation systems" in rail, sea, and air modes of transportation suggests that these modes of transportation use fewer Big Data algorithms. It was not included in the search methodology for Ghofrani and colleagues (2018), who reviewed 115 papers involving Big Data analytics in railway transportation, to include the term "intelligent transportation system." There is a strong case to be made that intelligent transportation is not yet widespread in modes of transportation other than roads.

3. METHODOLOGY

Electronic sensors, data transmission, and intelligent control systems are all part of an intelligent transportation system that incorporates advanced technology. The goal of ITS is to improve transportation services for drivers and riders. Transportation management systems, traveller information systems, vehicle controls and business vehicle management are just some examples of ITS's six fundamental components. Advanced public transportation systems, and advanced urban transport systems are also included.

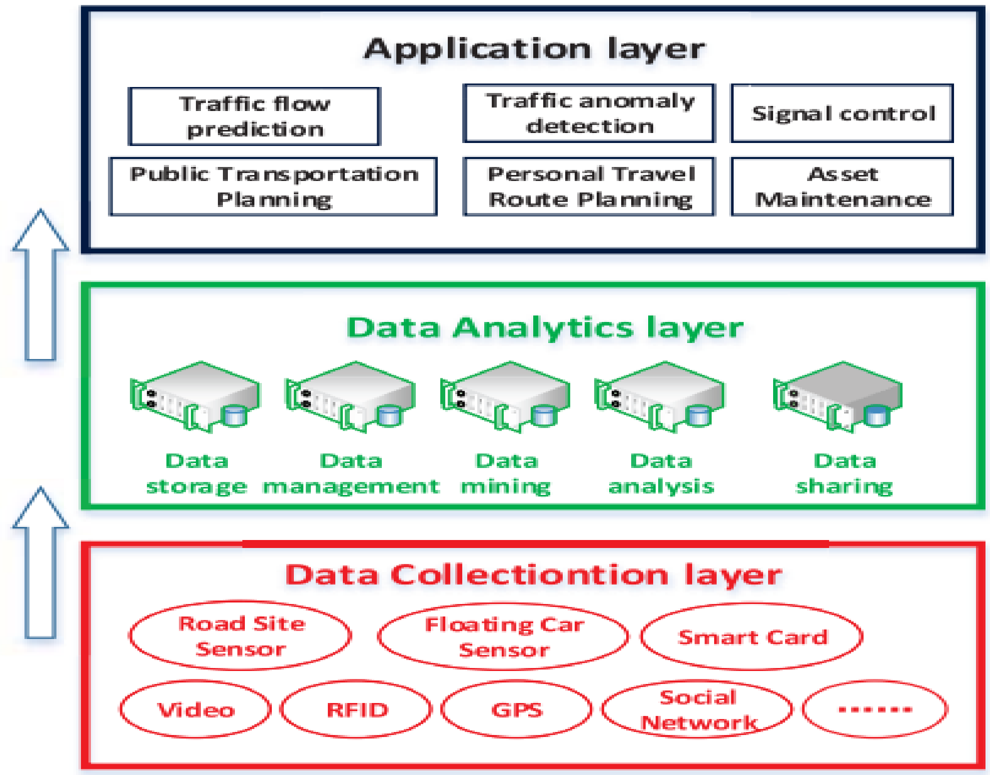

Fig. 2. Architecture of conducting Big Data analytics in ITS.

Analyzing large amounts of data is illustrated in ITS in Fig. 2. The data collection layer, the data analytics layer, and the application layer are all subdivided into these three categories.

Data collection layer: In order for the upper layers to function, they must have the necessary information from the lower layer. Induction loop detectors, microwave radars, video surveillance, remote sensing, radio frequency identification data, and GPS are just some of the many sources of data that can be accessed. In the following sections, we'll go into more detail about how Big Data is collected.

• Data analytics layer: The foundation of any architecture is its data analytics layer. In this layer, the primary function is to receive data from the data collection layer, and then apply various Big Data analytics approaches and the corresponding platform to complete data storage and management as well as data mining, analysis, and sharing.. Big Data analytics methods and platforms are to be discussed in the following sections.

• Application layer: This architecture's top layer is the application layer. Traffic flow prediction, guidance, signal control, and emergency rescue are all examples of how the data analytics layer's results are used in various transportation scenarios.

3.1 Traffic Monitoring and Management

A few studies on traffic management and monitoring for SCs are discussed in this section. The goal of traffic management is to make sure that intersections, roads, and motorways are efficient. For example, real-time data and forecasts of traffic density are two examples of the kinds of information these systems provide to drivers (e.g., road accidents, traffic congestion). Connecting traffic control systems with smart lighting and signals can provide useful data on traffic patterns. In an effort to reduce vehicle wait times, an intelligent traffic system was proposed. In order to determine the best time for traffic signals, their adaptive system uses detectors to gather information about the condition of the road.

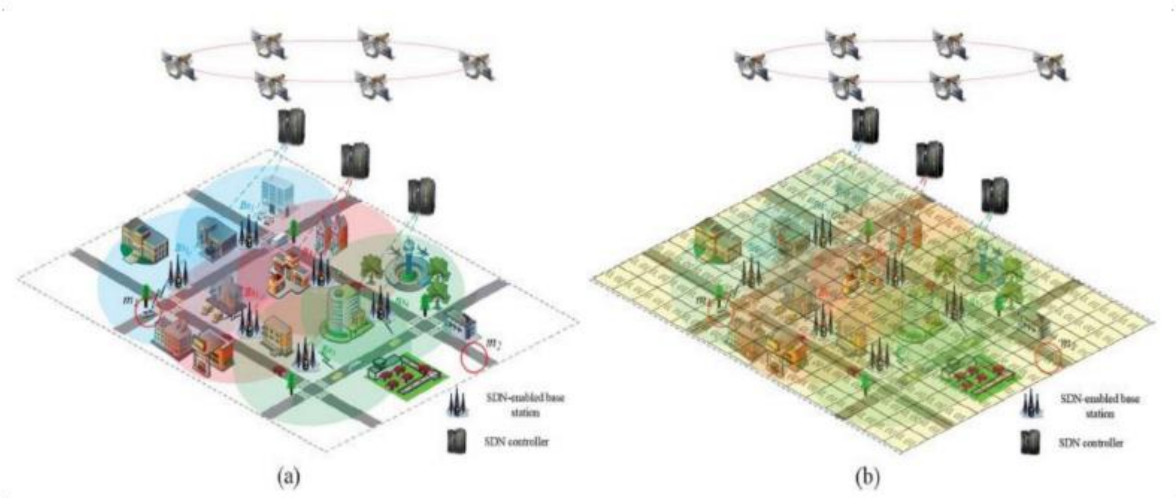

Figure 3. SDN-enabled smart city and the grid-square embedded model [26]: (a) SDN-enabled SC with distributed path planning management; (b) Grid-based network model.

SDN-enabled SC and grid-square embedded model are shown in Figure 3. In a given area, the likelihood of traffic congestion is inversely proportional to the average daily traffic flow in each square kilometre.

4. RESULTS AND DISCUSSION

Figure 4: Illustrative visualization of IoV data processing results

Using a single dashboard, Figure 4 shows the raw data and the resulting visualisation in two separate sketches. Those who have a deep understanding of intelligent system operations and functionality are rewarded. To be compatible with new technologies and data management processes, big data must be kept in the system indefinitely. Systematic handling and analysis of IoV data using big data guarantees users get what they need and enjoy an easy discovery process.

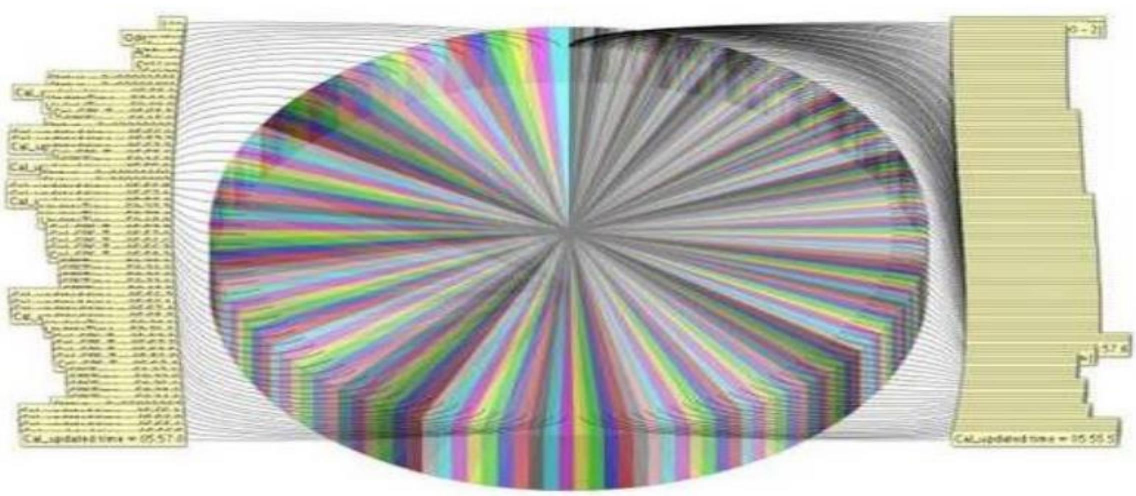

Figure 5: Multidimensional and nonlinear IoV sample data analytics models

Figure 5 depicts the outcome, which provides information to help users make the most appropriate decisions at various time intervals in a sequential process of data from all sensor devices and applications in a given environment.

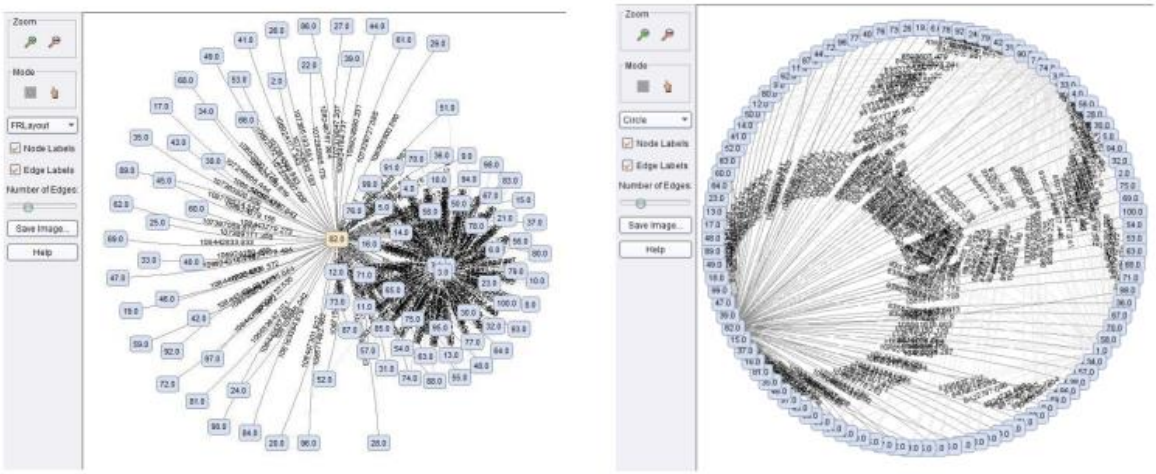

Figure 6: Clustered agent-based vehicular data massive pivot visualization

An important role of sensor nodes is to describe the attributes of the data in the context of the overall system. The roadside equipment performs a variety of functions, such as sound detection, image capture, and spatial data recording. According to its contents, extracting sound sets and recognising objects through the data patterns depicted in figure 6, the image classifies itself.

CONCLUSIONS

The increasing volume, variety, speed, and accuracy of ITS data, as well as the ongoing development of ITS and its many parts, lead to more researches that try to fix the problems with existing Big Data algorithms and look into new areas of the field. Most of the review papers that are already out there go into detail about mathematical modelling or only look at one specific way that Big Data algorithms are used in ITS. But this paper not only looks at the most important ITS applications where Big Data algorithms play a key role, but it also shows how these applications relate to the models that are used. So, one of the results of this paper is that it clearly groups applications and algorithms for scholars in other fields who want to learn more about how Big Data algorithms are used in ITS.

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