Various Technologies used in Smart Transportation System in the Direction of a Smart City: A Systematic Review

S. Aysha Asra[1]

[1]*Demonstrator, Department of Information Technology, South Eastern University of Sri Lanka.*

[1]*ashrasahabdeen005@seu.ac.lk*

ABSTRACT

Citizens in smart cities benefit from smart and innovative services that improve their quality of life. Nevertheless, it has been noted that the storage, gathering, processing, and evaluation of diverse data carried by citizens would face certain challenges. By definition, smart transportation is a method of incorporating today's technology into transportation networks. Wireless connectivity, Computer vision, Cloud computing, location-based services, and other mobility-enhancing techniques are all examples. In this context this study used to develop using systematic review and gathered the data from previously published reputed publications as well. According to the previous papers there are various technologies used in the Smart Transportation System for various purposes. Moreover, the study will provide the overview of Smart Transportation technologies.

Keywords*: location-based services, Smart City, Smart Transportation, technology*

1. Introduction

The rapid rate of urbanization has exacerbated the major issues facing future cities. These issues include meeting rising energy demand, lowering greenhouse gas emissions, promoting societal welfare, and reducing reliance on fossil fuel supplies. Current networks are being upgraded from centrally operated separate systems to more decentralized, intelligent, interdependently operated, as well as autonomous systems using emerging technology (Hadi Amini, Mohammadi, & Kar, 2019). As cities become such a main energy consumer in human civilization, intelligent transportation (Zacepins, Kviesis, Komasilovs, & Bumanis, 2019) systems that play a crucial role in smart cities (Mohamed Nafrees & Shibly, 2021) raise important concerns about energy efficiency and time. Latest events in autonomous vehicles (AVs) have the potential to drastically alter our everyday lives in the future. When merging AVs into intelligent mobility in smart cities (Kariapper, Suhail Razeeth, Pirapuraj, & Nafrees, 2020), nevertheless, the application scenarios, needed AI supporting technologies, and difficulties related with practical engineering implementation stay available (Cui et al., 2019).

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Because the digital transport ecosystem involves various participants, it's critical to define their responsibilities, interests, as well as business models in a thorough way so that the ecosystem's governance may be effectively controlled. To that goal, value networks will be employed to build the ecosystem's relationships. Because the ecosystem's values are formed via interactions between the numerous parties involved, representation in the form of a value network is appropriate for this ecosystem (Mukti & Prambudia, 2018).

In this paper the various technologies are identified in Smart Transportation (A. Gohar & Nencioni, 2021) Method in the concept of Smart City (Nafrees, Sujah, & Mansoor, 2021). Also the technologies are used for various purposes. So the uses of those technologies, accuracy of the technology and finally the limitations are provided in this study. The concept of this paper provides overall view of the Smart Transportation as well.

The remainder of the paper is laid out as follows. This related work is presented as Literature Review in Section 2. The methodology that used to develop in this study is displays in Section 3. Also that includes the research question and article selection criteria. The results and discussions are reported in section 4. Section 5 contains our conclusion. Chapter 5 contains a list of references.

2. Literature Review

Smart cities as well as their positive effects have already received a lot of attention. On reality, the smart urban, which is the field of gathering and processing data from a variety of sources while making appropriate judgments and providing data to all sections of the system, will become the cities of the future. So put it another way, smart communities is a complicated big data challenge that requires combining several disciplines of study to create a cohesive ecosystem. This short survey will cover every facet of smart communities (Azgomi & Jamshidi, 2018). The Iterated Local Search (ILS) and (2) Genetic Algorithm (GA) algorithms can determine the best bus allocation but also build bus timetables in moments (Thiranjaya, Rushan, Udayanga, Kaushalya, & Rankothge, 2018).

On a transportation level, the “Park-and-Ride” facility is engaged in the implementation of arterial access roads administration and affects traffic flow redistribution to crowded locations inside the metropolis. As a result, by intercepting portion of the automobile flow on "Park-and-Ride", it is allowed to facilitate intermodal transfers and the overall traffic condition. In this circumstance, the automobile owner must take public transportation. As a result, population movement on passenger transportation will be expanded, and the issue of traffic congestion

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will be addressed (Danilina & Slepnev, 2018). Intelligent Transportation Systems (ITS) play a critical part in the transformation of a metro region into a smart city (Gorev, Popova, & Solodkij, 2020). the most ITS applications have been deployed in smart cities over the last twenty years, including city-wide traffic management and monitoring (Mohamed Nafrees, Salees Raseez, Ubeshanan, Achutharaj, & Hanees, 2021; Nizzad et al., 2021), smart parking, public transportation information services (bus, train, taxi, plane, etc.), logistics (Mohamed Nafrees, Majeed, Rifai Kariapper, Suhail Razith, & Pirapuraj, 2021), real-time traffic, road speed limit monitoring and management, and so on. The sensors or mobile objects in ITS are continually generating mobility data, as well as the size at which this data is created is growing exponentially. New systems, specifically intended for coping with big data, are required to store as well as interpret the huge amounts of data gathered from sensors (M. Gohar, Muzammal, & Ur Rahman, 2018).

All concepts, notably in the domain of ACP (system constructed, computers developed), based on parallel management and control system, from the creation of intelligent transportation to a community that wants to establish and turn into a smart city (PTMS). PTMS is being expanded to a modern trend of intelligent transport systems (Lee & Chiu, 2020), as well as its key architectural components are being developed into software and hardware to enable a new architecture in a growing city's transition to a smart city (Putra, Warnars, Gaol, Soewito, & Abdurachman, 2019). Demand-responsive transit (DRT) systems respond to a passenger's request for transportation. Requirements are received using advanced telecommunications technologies (via websites, SMS, mobile apps, less often phone calls). These systems fall between route systems as well as taxi cabs, although they don't vary much from those in extreme implementations. DRT systems use a variety of technology and organizational concepts to enable adaptability in transportation services based on the market (Gorev et al., 2020).

A flexible platform is given by Sii-Mobility, a nationwide smart city initiative on mobility but also transport. It enables the creation of diverse and complicated scenarios including sensors/actuators as IoT/IoE in a Big Data, Machine Learning, as well as Data Analytics context. A thorough and difficult case study was provided to verify the approach in the context of a system that continuously reverses the traveling orientation of a road segment while maintaining all safety requirements (Badii, Bellini, Difino, & Nesi, 2019). Microservice-Oriented Big Data Architecture (MOBDA) incorporates data analytics techniques such as prediction in order to achieve smart mobility and analytics microservices essential for future

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smart cities. To achieve this goal, provide important transportation measures that may be applied to diverse sources of transportation data. A new hybrid architecture is presented that blends streaming and batch processing of big data for smart calculation of microservice-oriented transportation metrics that may meet the demands of many users (Asaithambi, Venkatraman, & Venkatraman, 2020).

3. Methodology

The importance of the specific research direction can be seen by assessing the current state of research in the area of the smart city but also smart transportation as a part of the smart city initiative in the transportation field, as this research sees the transportation domain as part of the smart city effort. To examine relevant papers, this paper used Preferred Reporting Items for Systematic Reviews. The analysis was based on scholarly articles from 2018 to the present, which were found using the terms "Smart City Transportation" AND ("IoT" OR "Big Data Analytics "OR" Machine Learning") in Google Scholar, IEEE Xplore and Scopus

1. Research Question and Research Objectives

Table 1. Research Question and Research Objectives.

S.No	Research Question	Research Objectives
1	What is meant by Smart Transportation?	Identifying the Smart Transportation in the concept of Smart City.
2	What are the technologies used in Smart Transportation system?	Examine the relevant technologies used in Smart Transportation sytem.
3	In which way the technologies that used in Smart Transportation used for?	Identify and analyze the uses of existing or previously used technology in the Smart Transportation system in various aspects of transportation.

2. Article Selection

At the conclusion of the initial search of the relevant databases, 165 publications were discovered. Duplicates were removed from the list, the remaining abstracts were evaluated, and publications that did not fit the inclusion and exclusion criteria were eliminated. At the end of the procedure, 25 publications were found to be eligible for inclusion. The searching diagram and the quantity of articles reviewed at each stage of the review are shown in Fig. 1.

- Open access research papers
- Merely full-length articles deliberated.
- Issued in English
- Technologies used in Smart Transportation

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- Articles having a high index in citation databases.

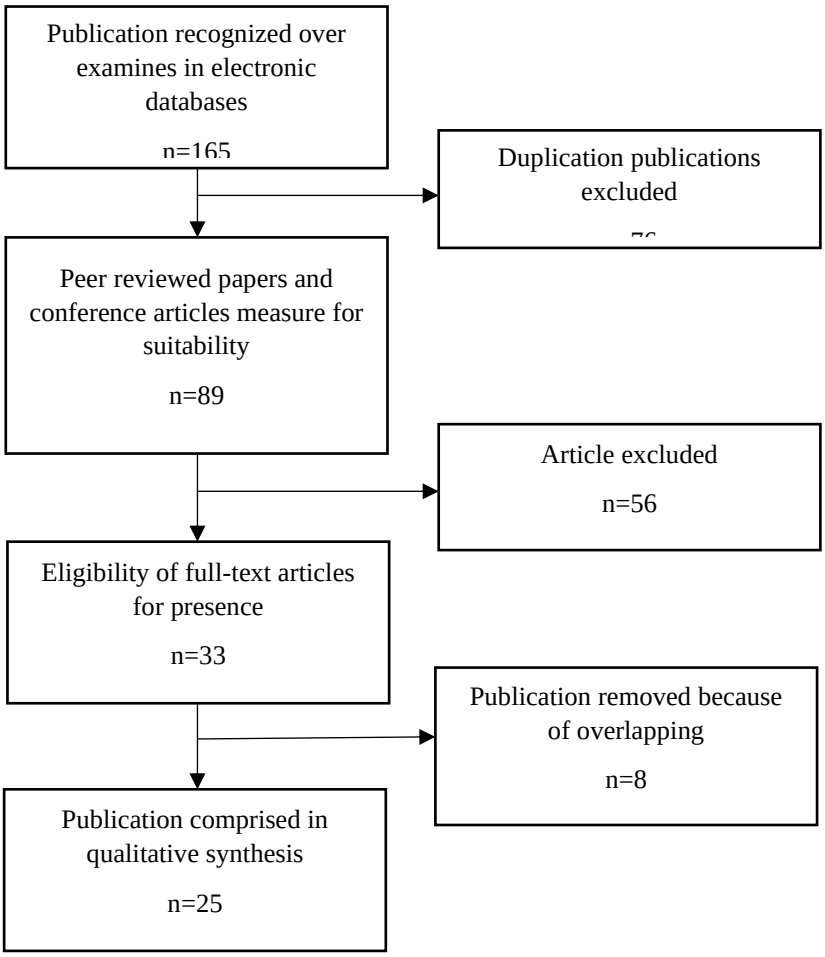

Fig. 1: The Research selection criteria

4. Results and Discussion

Table 2. Technologies used in previous articles.

Reference	Main technology	Purpose	Accuracy	Limitations
(Lai, Boi, Buschettu, & Caboni, 2019)	SmartMobility	Assisting to the reduction of traffic created by private vehicles in the city, as well as assisting drivers approaching congested regions, by displaying real-time mobility data from various resources	-	Lacking service about car sharing and bike sharing
(Kaptan, Kantarci, Soyata, &	Support Vector Machine (SVM)	By overlaying the position information with other types of	90% accuracy	-

Boukerche, 2018)		sensors that are already accessible in a non-dedicated way in a smart infrastructure, it is possible to localize public transportation vehicles while lowering the need of GPS sensors.		
(Jan, Farman, Khan, Talha, & Din, 2019)	Hadoop	handle real-time transportation data, The data can be disseminated in real time for citizens to check the status of road traffic in order to save time and reach their destinations on time.	high accurate	-
(Brincat, Pacifici, Martinaglia, & Mazzola, 2019)	IoT	In order to increase data transmission, establish diverse connection, and low latency applications in high capacity settings, linked and automated cars, collaborative transport systems, and smart roads will be used.	-	-
(Iqbal, Khan, Abbas, Hasan, & Fatima, 2018)	Mamdani Fuzzy Inference System verified by MATLAB Simulation	resolving a variety of traffic as well as transportation issues		
(Howard, Lee, Mahar, Intrevado, & Woodbridge, 2019)	Logistic Regression, Random Forrest Regressors and Classifiers, Principal Component Analysis, and Gradient Boosted Regression and Classification Tree machine learning Techniques and distributed systems	To develop a smart transportation data pipeline.	95.2%	-

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(Kariapper, Pirapuraj, Suhail Razeeth, Nafrees, & Rameez, 2019)	GPA and Shotest path algorithm were used.	Find the quickest route to travel towards a specific point in the road.	N/ A	-

According to the table the references, technology used, purpose for the technology, accuracy level of the technology and imitations as shown. There are variety of technologies used in previous paper such as SmartMobility, Support Vector Machine (SVM), Hadoop, IoT, Mamdani Fuzzy Inference System verified by MATLAB Simulation, Logistic Regression, Random Forrest Regressors and Classifiers, Principal Component Analysis, and Gradient Boosted Regression and Classification Tree machine learning Techniques and distributed systems. The SmartMobility used to assisting to the reduction of traffic created by private vehicles in the city, as well as assisting drivers approaching congested regions, by displaying real-time mobility data from various resources. But there is a limitation while using this technology. That is lacking service about car sharing and bike sharing. When we consider about SVM, the main objective of the technology in Smart transportation is by overlaying the position information with other types of sensors that are already accessible in a non-dedicated way in a smart infrastructure, it is possible to localize public transportation vehicles while lowering the need of GPS sensors. And the accuracy level of the system is 90%. The reference (Jan et al., 2019) indicating the Hadoop technology for handle real-time transportation data, The data can be disseminated in real time for citizen to check the status of road traffic in order to save time and reach their destinations on time. The paper indicates that the system will have the higher accuracy level. IoT used in reference (Brincat et al., 2019) to increase data transmission, establish diverse connection, and low latency applications in high capacity settings, linked and automated cars, collaborative transport systems, and smart roads will be used in the concept of Smart Transportation. Mamdani Fuzzy Inference System verified by MATLAB Simulation technologies are used in (Iqbal et al., 2018) reference. In order to that it used for resolving a variety of traffic as well as transportation issues. The reference (Howard et al., 2019) usedLogistic Regression, Random Forrest Regressors and Classifiers, Principal Component Analysis, and Gradient Boosted Regression and Classification Tree machine learning Techniques and distributed systems technologies and algorithms for To develop a smart transportation data pipeline. The accuracy level of the system is 95.2%.

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5. Conclusion

By trying to implement terms such as governance as well as government, smart cities intend to be at the cutting edge of technology with the goal of assisting in the evaluation and selection of different criteria that allow optimizing the continuous flow of these and facilitating urban development, considerably enhance the quality of life of citizens (Gonzalez, Ferro, & Liberona, 2020).

In this sense, the technologies SmartMobility, Support Vector Machine (SVM), Hadoop, IoT, Mamdani Fuzzy Inference System verified by MATLAB Simulation, Logistic Regression, Random Forrest Regressors and Classifiers, Principal Component Analysis, and Gradient Boosted Regression and Classification Tree machine learning Techniques and distributed systems are used for various apsects of Smart Transportation. Assisting to the reduction of traffic created by private vehicles in the city, as well as assisting drivers approaching congested regions, by displaying real-time mobility data from various resources, By overlaying the position information with other types of sensors that are already accessible in a non-dedicated way in a smart infrastructure, it is possible to localize public transportation vehicles while lowering the need of GPS sensors, handle real-time transportation data, The data can be disseminated in real time for citizens to check the status of road traffic in order to save time and reach their destinations on time are some of the uses of these systems.

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