A novel Smart Transportation based framework interlinking the advancements in Technology and System Engineering

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Abstract

Everything and everyone is growing smarter day-by-day, from a small kid to an entire nation. The current research incorporates a thorough study on intelligent transportation, keeping the former view in mind. It briefly highlights the need for an efficient transport system in India and analyses what factors lead to the need for more efficient transport systems in the making of a smart city. With the current tech-savvy society, it has become necessary to propose such a system that can not only benefit society but also the environment, as the current emission of harmful gases has been outnumbered by excessive traffic more than any other source. Next, the research proposes a novel framework that links three different subsystems, each with its own functionality, for a new and efficient method of transport. While describing the proposed approach, the paper discusses the need for society and the government to be a pivotal factor in supporting and maintaining such frameworks to increase the safety, security, and wellbeing of every vehicle driver.

Keywords

Smart Transport, Smart City, Artificial Intelligence, IoT, Technology, Data Science CEUR-WS

1. Introduction

A 'Smart City', as the name suggests, uses technology to provide intelligent and quickly responsive support to the needs of the city, further contributing to the growth of a nation and the development of the country as a whole [1]. In complex social ecosystems of metropolitan areas, preserving sustainable growth and standard of living are major problems. Currently, cities have become more familiar with the idea of "smart city" or better, the "city of the future" and many are even exploring ways of becoming "competent" and effectively managing local services whilst solving growth as well as diversity concerns. In a developing country like India, such a concept would not have been possible a decade ago. With a rapid increase in advancements of technology and quality engineering, it has become possible to suggest and incorporate the technologies for future betterment. Figure 1 illustrates the various things that make up a smart city. It includes variable factors such as vehicles and drivers, and fixed factors

International Conference on Smart Systems and Advanced Computing (Syscom-2021), December 25–26, 2021
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like roads, area, and infrastructure. According to an initial study that the authors performed,

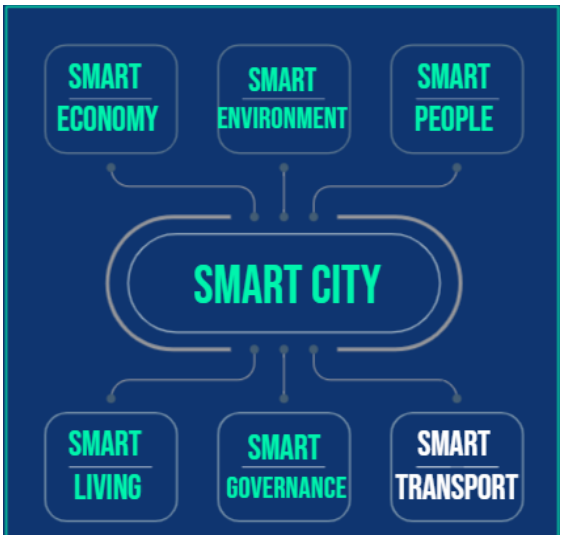

Figure 1: Components of a Smart City

smart transportation can further be divided into four different aspects that include:

1. Area
2. Population
3. Society
4. Technology

In the above-enumerated points, "area" refers to the area of the city/state/country where the work will take place. This area is a fixed parameter that needs to be utilised smartly and in a more compact manner. Secondly, in a country like ours, where the growth rate is high with a constant area, the role of smart transport, however formidable, is in high demand due to an increasing population.

The remaining article is as follows: Section 2 provides insights into current works existing in developing smart transportation systems. Section 3 briefly discusses the role of transportation in smart cities. The proposed framework with subsystems is discussed in Section 4. Next, Section 5 discusses the opportunities and challenges in the implementation of intelligent transportation while Section 6 concludes the paper.

2. Literary Work

Several papers [2], [3], [4], [5][6] have been published in order to foster an investigation into frameworks to break down and improve the Smart Vehicular Traffic Management Framework [7]. The study in [8] ponders an advanced traffic signal framework using a genetic algorithm utilising stochastic information post-processing to show up as a sophisticated vehicle framework. Once all the information is processed and each traffic signal is programmed, the total for each

course is determined to track down the ideal state. It assists to observe the ideal state, where the most extreme vehicles are able to manoeuvre with the proposed traffic signals, depending on the course length and normal speed of the vehicle. The authors in [9] give a model of a vehicle equipped for collaborating with other side of the road vehicles and with inward electronic gadgets, which also shows how the relevance of digital media [10] has increased so far. The model additionally indicates the different parts taken on in the proposed onboard unit. This additionally gives different applications that could apply this strategy for efficient tasks.

Research in [11] proposes another framework that coordinates the Internet of Things with the proposed advanced transportation framework in order to provide better transportation, but excellent wireless connectivity [12] is required for the same. The framework in [13], [14] utilises the sensors to screen the climate, which is then utilised by the observing framework to illuminate the drivers in regards to the situating of the gadget and subtleties relating to it.

Accordingly, this data can be productively used to control vehicle traffic but requires high performance computing [15], [16]. All signs from advanced camcorders are sent to focal frameworks that break down traffic streams. As of now, the measurable in-line information is gathered in the genuine working items where camcorders with programming support are linked so they can perceive vehicles and their permit figures. At the point when this data is gathered, it is feasible to assess the effectiveness of the data gathering subsystem exhaustively [17]. Overall, every research [17], [18], [19] [20], [21], [22], [23][24] in one way or the other suggests that the development in technology aids in demonstrating frameworks with high adaptability.

3. Role of Transport in Smart City

In India, the Smart Cities Mission represents a pioneering initiative that will spur economic development and improve people's quality of life by stimulating local development and leveraging technology as a means to create smart outcomes for citizens, including better public transport services, one of the key infrastructure elements of smart cities. Smart transport is a pivotal factor in establishing the concept of a smart city. To further improve the well-being of the people and the environment, society can act as an impactful factor in present-day transport systems by proactively maintaining legislation. Lastly, the word "smart" itself shows the significance of technology, the role it plays, and its relationship to smart transportation.

4. Proposed Intelligent Transport Framework

The proposed framework is a part of existing subsystems, making use of different concepts, technologies, and subsystems as discussed in the following subsections:

4.1. Subsystem 1

Figure 2 depicts Subsystem 1.The actor is an individual who wishes to drive the vehicle and has all the necessary information in the form of a card or other means. Now these details will be passed onto an authenticator, who checks whether the details of the actor are valid for travel or not. The Details DB will carry all the information about the trip with input from the

authenticated actor of the destination. The Authenticator will be an IoT device [25, 26] that can fetch and match the details provided by the actor with the true details in the Transport Department.

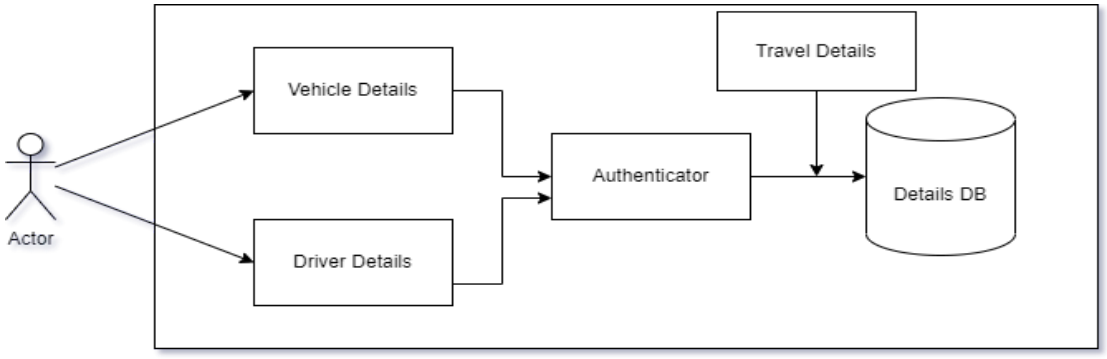

Figure 2: Subsystem 1 of the proposed Intelligent Transport System

4.2. Subsystem 2

Subsystem 2 depicted in Figure 3 is a regulation and monitoring subsystem. First, it will focus on the regulatory measures depending on the vehicle details, primarily the type of vehicle, being input from the Details DB. These regulatory measures are those which are set by the respective Transport Department of the city, and will include things such as the speed limit of 45kmph for two-wheelers and 60kmph for four-wheelers in Chandigarh, India. Based on the actor's response to these regulatory details during the trip, it will send the response as after ride details to the monitoring system. The monitoring system will now check for the defaulters of regulatory measures, attaching a tag of defaulter or non-defaulter to it with the after-ride details and, in return, sending it as a report to the Details DB.

4.3. Subsystem 3

The subsystem 3 depicted in Figure 4 is responsible for end-user benefit and conveyance. It fetches the report from the Details DB, which is passed on to the actor as a response to having the details of the last travel with every fault and warning. On the other hand, the report is also provided to the data-analysis mechanism, which will be required to access the defaulters and non-defaulters. Based on the data analysis performed by this subsystem, potential candidates for incentives can be found, which can be awarded through the incentive mechanism by the respective transport department after a travel of a certain number of kilometres or so.

5. Opportunities and Challenges

The subsystems shown in the previous system are an abstract representation of what the complete system will look like. For different phases of evaluation, these subsystems will arouse

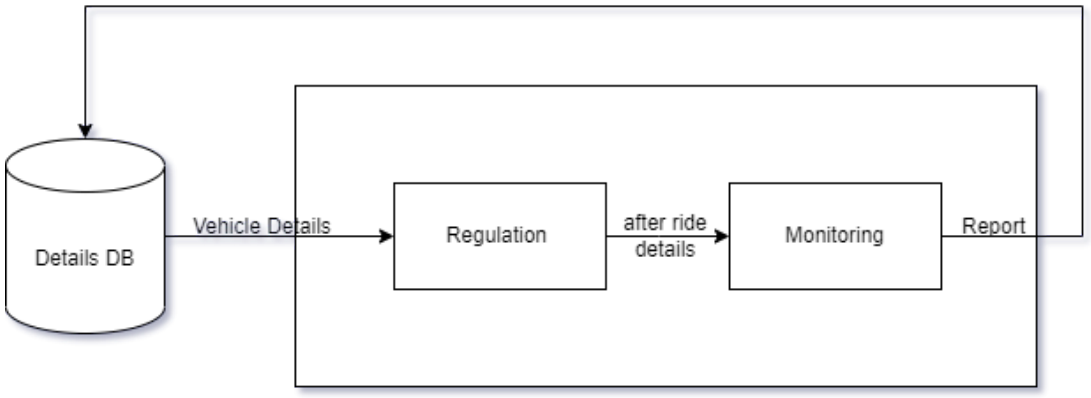

Figure 3: Subsystem 2 of the proposed Intelligent Transport System

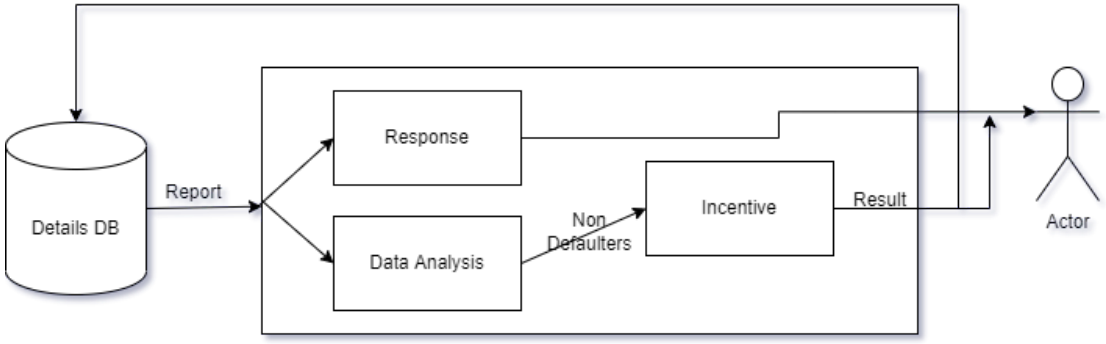

Figure 4: Subsystem 3 of the proposed Intelligent Transport System

further opportunities in the domains of artificial intelligence, data engineering, IoT, etc. It is true that efficient traffic and transport systems have been the need of the hour for smart cities for a long time now. This implies that if a proposed system like the one suggested in the paper, with a non-abstract design, is implemented, it could lead to the world's finest transport system. Indeed, the obstacles are high – whether it is the infrastructure, the number of vehicles, or the growing population – but it is in our hands to propose such changes to the existing system and in the hands of the government to implement them, so that there is a reduction in not only traffic but also other environmental effects with a regular check on the vehicles via smart cards with IoT features.The same, if utilised to the benefit of the general public, can help improvise the concept of a smart city and thereby build a smart nation afterward.

6. Conclusion

The market for transportation systems is profoundly encouraging for society [27]. As the transportation frameworks for brilliant urban communities are being used all throughout the planet, people can start to procure the numerous security, effectiveness, and money-saving advantages that accompany the present-day public vehicle. It is energising to ponder how society may associate their urban communities with the most recent innovations that are opening up today. The future work of this research will focus on the details and less abstraction of the proposed subsystems of the stated framework and is in continuation of the stated work. Truly, a high-performance computing back-end infrastructure is required to implement the proposed autonomous system with an end-to-end flow of development for millions of vehicles, but it is perfectly possible to be implemented with available and in-hand resources.

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