Driverless Commute in Smart Cities

Vasu Madduru[1], Suresh Kolli[2]
M.S Student, Deportment of Civil Engineering, University of Bologna, Bologna, Italy {1}
M.S Student, Deportment of Civil Engineering, University of Bologna, Bologna, Italy {2}

Abstract:- This study presents a detailed evaluation of various factors involving the use of driverless commutes in smart cities. The study presents a detailed evaluation of early developments of these autonomous systems and the effectiveness of these systems in smart cities. A detailed research has been conducted based on the views of managers of various organisations in smart cities worldwide. A survey has been conducted in order to evaluate their views and ensure proper accomplishment of goals relating to gaining knowledge regarding the effectiveness and efficiencies of these autonomous systems. The study also discusses various factors that influence governing bodies to incorporate driverless commutes as a potential alternative transportation system.

Keywords:- Autonomous Vehicles, Ultrasonic Sensor, Urban Planning, Infrastructural Developments, Economic Growth, Social Sustainability.

I. INTRODUCTION AND BACKGROUND

In the modern contemporary world, facilities related to public transportation have become an inevitable property of government and organizational resolutions to maximize its efficiency. Since the revolution of technology, several innovations in transportation aspects have facilitated to incorporate flexibility and affectivity into account. However, the introduction of fuel vehicles has significantly affected sustainable components of environment. Implementation of autonomous vehicle can be a driving force to conquer against pollution and on road accidental incidents. An autonomous vehicle is designed to provide services without drivers and can be an effective alternative to amplify the efficiency of smart cities. Autonomous cars are designed to move without human inputs while responding various sensors installed within the vehicle. Self-driving cars confine a systematic framework of sensors that anticipates its surroundings including radar, leader, sonar, GPS and other measurements units to identify its navigation path while avoiding obstacles and malfunctions. This study intends to describe the necessity of autonomous vehicle and its efficiency within modern Cities. The study also provides a complete guidance and factors that influences governing bodies to incorporate as a potential alternative transportation system.

Autonomous vehicle has a rich historical background that consists of various experimental and testing experiences to evaluate as a potential reference since the early decades of the twentieth century. In 1977, a Japanese company namely, Tsukuba Mechanical Engineering Laboratory was developed a semi automated car which confined two cameras and analog computer [1]. The car requires a specifically marked road which reached top speed of 30 kmh. The first fully developed autonomous vehicle has been created by Mercedes Benz in 1984 EUREKA project in USA. The government allocated budgets to facilitate the research team to produce national automated highway and networking system that allows monitoring the vehicles. In 2015, a combined project of Audi and Delphi technology tested autonomous vehicle in public road successfully while driving the car in an automated system. An effective success was achieved in 1995 with CMU's Navlab 5 as they were able e to completing first autonomous coast to coast drive with an average speed of 63.8 km per hour [2]. Furthermore, this success drives the various associated organizations such as DARPA, the US army and Navy to allocate higher budget to improve its functionality to incorporate control, sensor system and more complex conditions.

In addition, implementation of various newly developed technological gadgets such as laser scanner and ultrasonic sensor while replacing old accommodation facilities such as cameras has significantly improved its efficiency as a driver less vehicles. In November, 2018, US based company Waymo has developed a driver less car which is capable of traveling without drivers and announced that the company successfully tested driverless vehicle and covered 16,000,000 km [3]. In December 2018, Waymo has successful implemented autonomous vehicle as a commercial vehicle within public transportation system in the USA. Upgraded technological involvement within transportation system allows transforming the concept of smart city with driverless cars in its streets.

II. LITERATURE

Due to rapid growth of cities in world context, the demands of mobility and transportation have become more reluctant. In order to cope with the attendant pressure of growing cities in economic, social stability and environment, implementation of autonomous vehicle has become obvious. To ensure utmost facilities in various sectoral phases, several applications of autonomous vehicle have been deployed to understand the empirical framework.

➤ *Self Driving Rides*

In order to cope with the increasing demands of public transportation, deployment of self driving car can be an effective alternative to emphasize its efficiency. Various popular ride healing service providers such as Uber and Lyft has successfully incorporated autonomous vehicle within its service manifesto in various smart cities like Boston and Pittsburgh [2]. Several vehicle makers such as Volvo and Waymo have been engaged with Uber and Lyft to deliver utmost quality of autonomous vehicles with self driving technology. The increasing popularity of advanced car facilities will be the next big project that will incorporate a significant amount of investment.

➤ *Streamlined Public Transit*

Streamlined public transportation system can be an asset to conquer against the growing problems with current public transportation. Implementation of autonomous buses and trains that confines automated sensor technology and remote sensor could be an innovative and effective approach to implicate moderately safer and efficient operational movements. Autonomous public transportation system can be an effective asset to cut off personal vehicles from the road which can contribute significantly to reduce pollution, carbon emissions and traffic accidents [4]. Use of automated services also provides necessary facilities to reduce economic loss and enhance sustainable development components to cope with various environmental issues such as air pollution, climate change and global warming.

➤ *Expanded Options*

Installation of automated public transportation can be an effective alternative to promote shared and automated shuttles that offer the same facilities. In addition, it may also contribute a convenient, eco-friendly, efficient and cost effective transportation system to transport people in a more significant way [5]. Resolving this vexing first and last mile challenges can provide necessary guidelines to develop public transport usage. Increasing rate of shared vehicles can also be an effective initiative to reduce traffic congestion, carbon emissions and travel costs.

➤ *Transportation Access for Senior Citizens*

Several reports that have been provided by the Insurance Institute for Highway Safety stated that nearly 16 million citizen of ages more than 65 years lives in communities faces difficulties to travel due to lack of proper transportation facilities and effective communications [2]. Implication of innovative automated transportation system can be a potential opportunity for elderly people to travel while using taxi services cost effectively. It has been proven that autonomous vehicles are most convenient, economical and reliable mobility system for aged population.

➤ *Transportation for Disabled Individuals*

Self driving car facilities have become an irreplaceable portion of transportation for individuals with physical disabilities. A study conducted by Ruderman Family Foundation and Securing America's Future Energy (SAFE) stated that the use of autonomous vehicles could save up to $19 Billion annually at healthcare expenses [1]. Improvisation of innovative automated vehicle can be a driving force behind transporting disabled individuals.

➤ *Movements of Goods*

Installation of autonomous vehicles in supply chain management is an inevitable property to increase efficiency and productivity. Innovative technological aspects of vehicles can be an asset to emphasize cost effective supply chain system. Various well recognized organizations such as Tesla and DHL has implemented automated vehicles to deliver products and services. A collaborative effort of government, public transportation authority and regulatory bodies is necessary to uphold the validity of the deployment of autonomous vehicles in transportation management.

III. PROPOSED METHODOLOGY AND DISCUSSION

This study has been conducted based on experimentation processes involving the use of various methodologies. The study utilizes a positivism philosophy that deals with the use of natural sciences and logicality in order to achieve a certain goal [6]. The use of logicality is effective in ensuring proper use of critical thinking in order to evaluate various issues. Other philosophies such as the interpretivism and constructionism lack in the use of these critical thinking processes and thus have not been used. Additionally, a deductive approach has been used in order to deduce results based on the use of logical thinking [7]. There is no requirement for the development of new ideas and thus the inductive approach has not been utilized within this study.

The study also uses an explanatory design for providing a detailed explanation of the information learned from various respondents. This information can be effective in ensuring significant improvements in regards to the development and implementation of driverless commutes in smart cities. Other designs such as the descriptive and correlation process lack in a detailed in-depth analysis and thus has not been utilized in this study. The data has been collected using a quantitative method. The use of quantitative

methods can be used in order to collect survey data and present them in graphical and statistical forms [8]. The evaluation of these graphical and statistical processes can lead to improved effectiveness of retrieving the necessary data.

The survey was conducted by collecting data from 45 respondents. These respondents are managers within various organizations involved in the development of automated cars and driverless commutes. A small time-frame was selected for the study and only a few questions were asked to the respondents. These views were reviewed in order to evaluate biases based on the views of various authors regarding these factors.

IV. EXPERIMENTAL RESULTS

A few demographic questions were asked to the respondents in order to know about them and to build proper rapport with them. These questions and their answers were not presented in order to prevent problems with vulenerabilies of the respondents and a breach of ethical conduct due to the sharing of personalised information. The remaining questions and their responses have been presented and analysed.

Q1. What are the factors that influence organizations to pursue Driverless commute developments?

Responses	No. of Respondents	Total No. of Respondents	Percentage (%)
Improved Safety of the Vehicles	14	45	31.11
Economic and Social sustainability	16	45	35.56
Economic growth	15	45	33.33

Table 1

Based on the information collected it can be stated that all the responses have almost equal frequencies and the responses are not spreaded. It can be stated that the mentioned factors are based on the perceptions of respondents and thus may not contain biased views. The differences between responses gained are significantly low and thus all variables need to be evaluated using data collected based on the views of authors from various books, journals, articles and websites.

Fig 1

Installation of automated vehicles is an integral part of current transportation system as it allows reducing human errors that has been responsible for countless road accidents. Over 35000 fatalities occur only within the United States of America each year [9]. Adaptation of autonomous vehicles can potentially reduce if not eliminate most of the scope of motor vehicle accidents worldwide due to human errors.

Various studies suggested that a significant number of car crashes can be avoided as a result of autonomous braking. Autonomous vehicles are also designed to compile traffic rules and significantly capable of avoiding certain crashes.

Current social and economic aspects plays fundamental role to incorporate the systematic empirical framework of autonomous vehicle as it allows demonstrating road capacity, improving traffic flow and reducing traffic congestion. Heavy usage of personal transportation and poor accommodation sets potential limitations to amplify operational performance of transportation system. Meanwhile implementation of automated transportation system allows getting higher benefits. Traffic congestion and road accidents are responsible for causing financial loss and human loss which has significant impact of the GDP growth of the country. Various studies have mentioned that only traffic congestions causes loss of $120 billion in the USA and £30 billion in the UK within a year [5].

Automated vehicles are designed to increase its performative actions regarding economic benefits as it allows eliminating various negative elements of current transportation system and limited facilities in transportation. Implementation of autonomous vehicles can be an asset to boost collective economic growth of various associated organizations [3]. Furthermore, implementation of autonomous vehicles for facilitating elderly and physically challenged people can enhance their performative activities and allows incorporating further financial fluidity within personal and sectoral development as it allows eliminating limitations. In addition, shared autonomous facilities provide enormous importance of accessibility to ensure cost effective mobility services.

Q2. How can driverless commutes be implemented in Smart Cities?

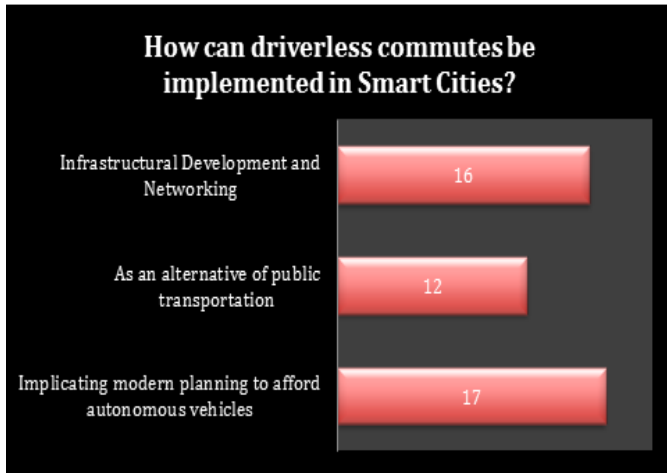| Responses	No. of Respondents	Total No. of Respondents	Percentage (%)
Implicating modern planning to afford autonomous vehicles	17	45	37.78
As an alternative of public transportation	12	45	26.67
Infrastructural Development and Networking	16	45	35.56

Table 2

Fig 2

Based on the views provided by respondents most of the respondents believe that implicating modern planning processes can lead to effective development and implementation of driverless commutes. However, the development of infrastructures and networking has also gained significant popularity in regards to the development processes. The use of autonomous vehicles as an alternate form of transport received lower responses than the others but still holds a value of around 26.67% of the total responses.

Implementation of autonomous vehicles and driverless commutes in smart cities has become an integral part of sustainable development and has helped in establishing a systematic framework of development. As per a report provided by the United Nations stated that currently half of the world's population live in Cities and within 2050, it will increase up to two-thirds of the entire population [5]. Introduction of autonomous vehicles in a smart city context can be a beneficiary vision to incorporate economic development, social stability and environmental sustainability. In order to implement automated system within smart cities, it is necessary to develop certain aspects of the transportation system.

In order to make a potential change within the transportation system, it is essential to implicate moderate planning to afford autonomous vehicles as a potential reference. The authorities need to develop certain planning regarding road location and accommodation of associated responsibilities [4]. As autonomous vehicles enhance the value of time, it is obvious to deliver a handful of resources to use such derivatives. A systematic empirical framework is required to establish as it well demonstrate how to develop certain planning to manage traffic flow and everyday mobility of passengers.

Implementation of autonomous vehicles as an effective alternative of public transportation system required a potential management process to conduct the exploitations of traffic flow and parking conditions. As the process reduces the usages of conventional cars, it is necessary to provide utmost guidance about the availability of autonomous vehicles [10]. The authorities need to engage with innovative strategies and ideas to ensure utmost quality services while providing qualitative and quantitative database of empirical framework of newly developed transportation system.

Infrastructure, networking and designing are cornerstones of the foundation of transportation system within any demographic characteristics of smart city. Implementation of newly developed transportation required a standard design of infrastructure to facilitate the passengers as per requirements [11]. The authority needs to develop a potential networking system with upgraded navigation system and needs to ensure safety within its operational movements. The authorities need to engage a potential application to provide complete information about the position and availability of shared autonomous vehicles. In addition, the development of potential network system will help to demonstrate about parking area, road map and vehicle locations.

Q3. What are the impacts of implementing autonomous vehicles on smart cities and urban planning processes?

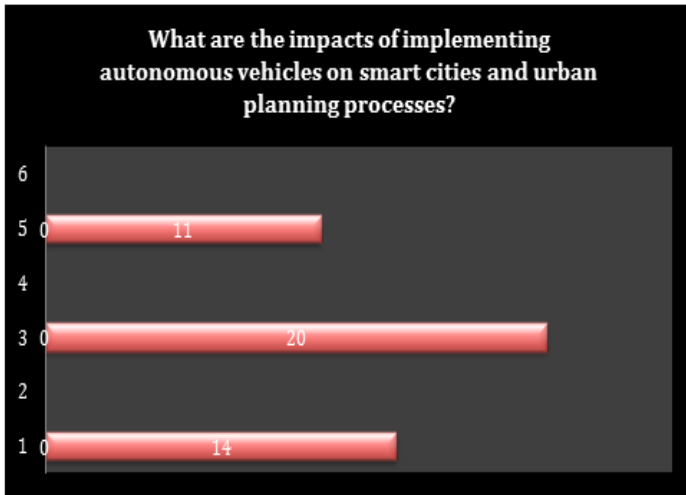| Responses	No. of Respondents	Total No. of Respondents	Percentage (%)
Accessibility and Value of Time	14	45	31.11
Improvement of Transportation	20	45	44.44
Development in Communication	11	45	24.44

Table 3

Fig 3

Based on the information collected, it can be stated that most of the respondents feel that the development of autonomous vehicles can lead to efficient transportation procedures. The use of these autonomous vehicles is helpful in ensuring better urban planning in smart cities. Additionally, a large number of people also stated that it contributes to better accessibility to time and value. A smaller number of people stated that these processes lead to better communication.

Autonomous road vehicles are designed to provide sufficient availability and utmost quality transport services along with developing affordable price structure. These innovative strategies can be an effective initiative to increase the availability of road transport services while providing mobility to the group of passengers together in shared vehicles [12]. It helps to incorporate less accidents and crashes due to human errors and provide necessary services following moderate speed and braking within all modes of urban transportation. Involvement of driverless vehicle allows reducing traffic congestions and increases values of time during rush hours.

Autonomous public and personal vehicles can be an effective add in urban transportation as it follows nationwide transportation policies while leading normalize traffic flow, moderate speed profile, less accidents due to human error and organized traffic behaviors while increasing accessibility and influencing light mobilities such as bicycle and e-scooters within dense urban transportation [13]. Furthermore, it also has significant impact on the capacity of road infrastructure and road conditions with systematic mobility movements of autonomous vehicles. It also has significant impact on increasing parking plots and safety issues for the passengers.

Wide scale implementation of autonomous vehicles has effective attributes in developing efficient communication within the development program of smart cities [14]. It

allows developing potential networking system to navigate specific vehicles within no time and helps to follow schedule planning processes. Implementation of effective automated system allows incorporating innovative designs to enhance urban transportation along with telecommunication process [15].

V.   RECOMMENDATIONS

Addition of autonomous vehicles in smart cities transportation is inevitable property that incorporates sustainability and cost effective transportation within socio environmental development program. Various recommended options are required to implicate to ensure productivity and profitability transportation context.

- The authorities need to set preliminary enquiries to evaluate the effectiveness of autonomous vehicles in modern transportation.
- It is also necessary to provide utmost facilities to increase the availability of automated transportation for public and personal usage.
- The organization also needs to engage with comprehensive practice to investigate Issues related to database and requires taking initiatives to prevent deceptive involvements.
- The government needs to engage with productive initiatives with various effective organization of marketplace to enhance the functionalities of ongoing autonomous vehicles implementation as a sustainable transportation system.
- The authorities need to implicate innovative cyber-security strategies and policies to uphold stability within all modes of transportation.

VI.   CONCLUSION

Autonomous road vehicles are an integral part of newly developed urbanization. It has potential impacts of the effective mobility of public and personal transportation system. Since the technology has significantly created a new chapter of transportation system and expected to be ready for hitting roads within a decade to make changes in current traditional and conventional procedures of transportation within developed urban areas. It has efficient property to change the prime courses of urban development. Furthermore, implementation of autonomous vehicles will affect the value of location choices and will help to assess various reformative situations of roads. A wide range of its motion network will influence transportation system to incorporate systemic operational movements. This study discussed the beneficiary portions of automated transportation along with its inspiring involvement in sustainable development of modern society. This research framework also consists of various sectoral impacts and factors that influence authorities to engage with innovative

ideas of autonomous vehicles within the transportation system of smart cities.

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