International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 9 Issue 2, Mar-Apr 2025 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Smart Transportation

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ABSTRACT

Smart transportation also known as Intelligent Transportation Systems (ITS) is the application of advanced sensor, computer, electronics, and communication technologies, and management strategies in an integrated manner to improve the safety and efficiency of the surface transportation system. In other words, smart transportation leverages on advanced technology, such as the Internet of Things (IoT), artificial intelligence (AI), and data analytics to enhance transportation by improving traffic management, safety, and efficiency, ultimately aiming to create smarter, more sustainable, and user-friendly transportation networks. The paper examines the benefits, challenges, solutions and the future prospects of intelligent transportation systems for the use of humanity.

KEYWORDS: *Smart or intelligent transportation, Internet of Things (IoT), artificial intelligence (AI), data analytics, advanced sensors, communication technologies, robotics, greenhouse gas (GHG) emissions, autonomous vehicles, cloud computing*

How to cite this paper: Paul A. Adekunte | Matthew N. O. Sadiku | Janet O. Sadiku "Smart Transportation" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-9 | Issue-2, April 2025, pp.606-616, URL: www.ijtsrd.com/papers/ijtsrd78432.pdf

IJTSRD78432

1. INTRODUCTION

The astronomical increase in global population as a result of increasing urbanization is a severe multiple global problem that requires pragmatic solution mechanism. As at mid-November 2022 global human population reached 8.0 billion people from an estimated 2.5 billion in 1950, adding 1 billion people since 2010 and 2 billion since 1998. This is expected to increase by nearly 2 billion persons in the next 30 years, from the current 8 billion to 9.7 billion in 2050 and could peak at nearly 10.4 billion in the mid-2080s. This dramatic growth has been largely driven by increasing numbers of people surviving to reproductive age, the gradual increase in human lifespan, increasing urbanization, accelerating migration, and major changes in fertility rate – which portends far-reaching implications for future generations. The current world population is 8,211,369,642 as at Tuesday, March 18, 2025 according to the most recent record [1, 2].

Smart transportation is the integration of modern and advanced technologies, such as information and communication technologies (ICTs), wireless communication, IoT, AI, data analytics, cloud computing, location-based services, computer vision, and other tools to enhance and improve the efficiency, safety, and sustainability of transportation systems [3, 4], as shown in Figures 1 and 2.

HISTORICAL BACKGROUND

Early concepts (1930): The early concept of a fully controlled road system emerged at the General Motors' Futurama exhibit at the 1939 World's Fair, showcasing electronically controlled vehicles moving smoothly along superhighways [5].

Automated Highway System (AHS) (1960s-1970s): The initial focus of ITS programs in the 1960s and 1970s was on the automated highway system (AHS), with emphasis on centrally controlled route guidance [5].

Early beginnings (1960s-1980s): The concept of smart transportation emerged in the 1960s, with the development of the first intelligent transportation systems (ITS) [6], by the use of sensors and cameras to monitor traffic flow and optimize traffic signal timing.

Expansion and development (1990s-2000s): The US Department of Transportation in the 1990s launched the Intelligent Transportation Systems (ITS) program, which was aimed at developing and deploying transportation technologies [7]. The program gave birth to the development of various smart transportation systems, traffic management centers, electronic toll collection systems, and transit management systems. The concept of intelligent transportation systems (ITS) originated in 1991 when transportation professionals recognized the potential for electronic technologies to enhance surface transportation efficiency. Some examples of ITS applications include: navigation, traffic management, public transit, and emergency response. The late 1990s saw the widespread adoption of the GPS-based Automatic Vehicle Location (AVL) systems by transit agencies, enabling the real-time tracking of vehicles and providing information to passengers [8]. Japan in 2003 introduced the world's first Vehicle Information and Communication System (VICS), which has since been widely adopted [9].

Emergence of new technologies (2010s-Present): The 2010s saw the emergence of new technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and Big Data analytics, that have now transformed the smart transportation landscape [10]. These technologies have enabled the development of more advanced smart transportation systems, as well as smart traffic management, intelligent route optimization, and autonomous vehicles.

Some key milestones:

1. **1969:** The first ITS system was developed in the United States, through the use of sensors and camera to monitor traffic flow [6].
2. **1991:** the US Department of Transportation launched the ITS program, aimed at developing and deploying advanced transportation technologies [7, 11].
3. **2004**: The first electronic toll collection system was deployed in the US, using RFID technology to collect tolls [12].
4. **2010**: The first smart traffic management system was deployed in Singapore, using real-time data analytics to optimize traffic signal timing [13].
5. **2015**: The first autonomous vehicle was tested on public roads in the US, marking a major milestone in the development of autonomous transportation [14].

GOALS OF SMART TRANSPORTATION

The primary goals of smart transportation are to:

1. **Improve/optimize traffic flow**: This is by enhancing overall traffic efficiency, thereby reducing congestion as well as decrease travel times/costs by dynamically adjusting traffic signals and routes [15].
2. **Enhance safety**: Detect potential safety hazards, prevent accidents, and respond quickly to emergencies [16]. This can be achieved via advanced driver-assistance systems (ADAS), smart traffic lights, and real-time tracking/improved communication channels [17].
3. **Increase efficiency**: This can be achieved by reducing traffic congestion, maximization of infrastructure capacity, and the reduction of travel time, leading to optimizing the routes, reducing fuel consumption, and lowering emissions [18, 19].
4. **Improve passenger experience**: By providing real-time information, enabling seamless payments, and offering of convenient services [20].
5. **Accessibility to all**: It should be designed to be accessible for people with disabilities, the elderly, and other vulnerable populations, such that everyone can benefit from a well-functioning transportation system. Real-time information should also be provided so that people can easily plan their journeys and access transportation options [21].

KEY COMPONENTS OF TRANSPORTATION SYSTEMS IN INFRASTRUCTURE DEVELOPMENT

The followings are the primary components of Intelligent Transportation Systems (ITS) in infrastructure development that are to ensure the collective and effective movement of goods and people [22]:

1. **Modes of transportation**: These are the various conveyances used to transport passengers and freight. These modes are classified into:
   - Passenger transport: These are vehicles designed specifically for carrying people, e. g. buses, trains, and airplanes.
   - Freight transport: These are vehicles designed for transporting goods, e. g. trucks, cargo ships, cargo planes, and freight trains.
   - Combined modes: These are vehicles that can carry both the passengers and freight, enhancing flexibility in transportation.

2. **Infrastructure**: This has to do with the physical structures and facilities that support transportation systems. They include:
   - Roads and highways, as shown in Figure 3.
   - Railways, as shown in Figure 4.
   - Airports
   - Ports
3. **Transportation planning and modeling**: This is the strategic planning of transportation systems to meet current and future demands. Effective planning includes:
   - Traffic modeling
   - Sustainability considerations
4. **Public transportation systems**: Efficient public transport is vital for urban development, mostly especially in densely populated areas. Some of the key aspects would include:
   - Bus Rapid Transit (BRT), as shown in Figure 5.
   - Subway systems, as shown in Figure 6.
   - Accessibility
5. **Maintenance and safety**: The timely maintenance of transportation infrastructure is critical for longevity and safety, which must involve regular inspections, repairs, and upgrades to meet safety standards.
6. **Service integration**: Modern transportation systems increasingly focus on integrating various modes and services to enhance user experience. This includes:
   - Mobility-as-a-service (MaaS): This combines various transportation services into a single accessible platform, allowing users to plan and pay for their journeys seamlessly, as shown in Figure 7.
7. **Environmental sustainability**: This involves the consideration of environmental impacts that will promote practices which will reduce carbon emissions and enhance energy efficiency.
8. **Funding mechanism**: There is also the need for adequate funding which is important and critical for the development and maintenance of transportation infrastructure. This can come from government budgets, public-private partnerships, or foreign direct investment, as shown in Figure 8.

Each and all of these components play a vital role in creating an efficient and effective transportation network that will enhance economic growth and social development.

KEY COMPONENTS OF SMART TRANSPORTATION

The key components of smart transportation are:

1. **Sensors and IoT devices**: These are for the collection of data on traffic conditions, vehicle locations, weather (environmental factors), which are then used to make informed decisions that impact transportation [23, 24], as shown in Figure 9.
2. **Data analytics**: Analyze data to optimize traffic flow, detect safety hazards, and improve passenger experience [25].
3. **Cloud computing**: This helps to store, process, and manage large amounts of data generated by transportation systems [26].
4. **Artificial intelligence**: This is the use of AI to optimize traffic signal timing, detect anomalies, and predict traffic patterns [27].
5. **Intelligent transportation systems (ITS):** This involves the use of technology to improve transportation efficiency, safety, and sustainability, which can be achieved via advanced traffic management systems, automatic vehicle location and fleet management, advanced traveler information systems, traffic signal control systems, electronic fare payment systems, and central control systems [28], as shown in Figure 10.

BENEFITS OF SMART TRANSPORTATION

Some of the benefits of smart transportation include:

1. **Reduced congestion**: Smart transportation systems help to optimize traffic signal timing, reduce congestion, and improve travel times [29].
2. **Improved safety**: ITS can detect potential safety hazards, prevent accidents, and save lives [30].
3. **Increased efficiency**: ITS can optimize routes, reduce fuel consumption and lowering of greenhouse gas (GHG) emissions [31].
4. **Enhanced passenger experience**: ITS helps to provide real-time information, enable seamless payments, and also offer convenient services [32].

Smart cities may not be feasible without due consideration and application of smart transportation. The way citizens move within a city – both on public transportation and or with their own vehicles – are very crucial to the way that city functions. The US Department of Transportation, "Intelligent Transportation Systems (ITS) apply a variety of technologies to monitor, evaluate, and manage transportation systems to enhance efficiency and safety." Essentially, the goal of smart transportation is

to make movement within a city "more convenient, more cost effective (for both the city and the individual), and safer" [33], as shown in Figures 11 and 12.

The benefits are in the areas of: more efficiency by way of cutting-edge technology, management of traffic, budgets, less energy for more money freed up for more pressing issues like healthcare and education, lesser or fewer accidents (ensuring safety), and also the public can save money for other pressing family needs when public transportation becomes more efficient. A few cities around the globe that are benefiting from ITS include: Oslo, Barcelona, San Francisco, Portland in Oregon, Wyoming, Paris, London's Oyster card, and Atlanta [33].

ESSENTIALS OF A GOOD TRANSPORT SYSTEM

High quality public transport services must have the features of been reliable, frequent, fast, comfortable, accessible, convenient, affordable and safe. A good transport system should be aidless, must be one that should serve the purpose of transportation and satisfy at least the following seven requirements [34]:

1. **Available**: The transport service should be available regularly as and when required, and also must ensure the safety of the goods.
2. **Insured**: It should provide for insuring the risks of loss or damage to goods in transit, and also assure payment of due compensation in case of delay causing loss to the owner of the goods.
3. **Delivery**: As much as possible, the delivery of goods should be made at locations convenient to the receiver of the goods.
4. **Loading and unloading**: Proper arrangements for loading and unloading of goods promptly must be made and at minimum cost.
5. **Economical**: Transportation cost should be low enough to enable the users to carry their goods at the lowest possible charge so that the ultimate (or final) consumer gets the products at a reasonable price.
6. **Speedy**: The transport system should be capable of carrying goods as speedily as possible, i. e. no delay in reaching the destination except for natural calamities or unavoidable causes.
7. **Skilled operators/workers**: The transport system should be operated by properly trained/skilled and efficient persons who are capable of handling problems in emergency situations.

It is been argued that the process of achieving more sustainable transportation is hinged on the following four pillars: 1. The effective governance of land use and transportation; 2. Fair, efficient, and stable funding; 3. Strategic infrastructure investments and; 4. Attention to neighbor-hood design [35].

CHALLENGES FACING SMART TRANSPORTATION

Some of the challenges facing smart transportation include:

1. **High costs of initial investment and infrastructure**: The implementation of intelligent transportation systems (ITS) require significant upfront investment in infrastructure, technology, and training, as well as robust communication networks and charging stations for electric vehicles [36, 38]. Adequate funding should be made available for both transit capital and operating needs. Fiscal pressures at the state and local have led to the declining support for public transportation in some areas, while the flexible funding provisions of the Intermodal Surface Transportation Efficiency Act (ISTEA) in the US provide opportunities for new sources of funding for transit projects. In other words, transit agencies will need to continue to explore a wide range of funding sources to survive in this environment [37].
2. **Technical and data challenges**: These are in the areas of technical complexity, data integration and management, data security and privacy, data quality and uniformity, and cybersecurity [36, 38].
3. **Regulatory and societal challenges**: These borders on evolving regulations, user adoption, safety concerns, coordination with stakeholders [38].
4. **Road traffic safety and accidents**: This forms a major challenge for the future of smart cities and transportation networks [39]. Accidents and fatalities especially in developing countries are as a result of the growth in intensity of circulation in urban areas. The distractions caused by the use of portable devices are linked as well to the rise in accidents for drivers and pedestrians alike [42].
5. **Inadequate roads**: This is due to growing number of more vehicles on the roads driving more kilometers, leading to more traffic jams, higher fuel bills, and increased CO2 emissions [40].
6. **Changing demographics and travel markets**: The changes in demographics, socioeconomic characteristics, and travel behavior that have occurred over the last 30 years are well known.

Travel behavior is influenced by three major trends which are the worker boom, the suburban commuting boom, the automobile commuting boom, and in addition to the low income and transit dependent groups [38, 41].

7. **Congestion and parking**: Congestion and parking are interrelated since street parking consumes transport capacity, removing one or two lanes for circulation along urban roads. Also looking for a parking space (called "cruising") causes additional delays and impairs local circulation [42].
8. **Public transport inadequacy**: Many public transit systems or segments of them, are either over or underused since the demand for public transit is subject to periods of peaks and troughs. During peak hours, crowdedness causes discomfort for users as the system copes with a temporary surge in demand, creating the challenge of the provision of an adequate level of transit infrastructure and service levels, as shown in Figures 13 and 14. Planning for peak capacity leaves the system under-used during off-peak hours, while planning for an average capacity will lead to congestion during peak hours. However, low ridership makes many services financially unsustainable, particularly in suburban areas due to density not high enough to justify such services, as shown in Figure 15 [42].
9. **Environmental impacts and energy consumption**: Pollution and noise generated by circulation are now impediments to the quality of life and health of urban populations. Coupled with this is energy consumption by urban transportation which is dependent on petroleum. There are pressures to decarbonize urban transport systems, particularly with the diffusion of alternative energy sources like the electric vehicles using robotics, as shown in Figures 16 and 17 [42, 43].
10. **Scalability and performance**: Ensuring the scalability and performance of cloud-based smart transportation is a major challenge [44].

CONCLUSION

Smart transportation systems with its benefits offer significant potential for improving urban mobility, reducing congestion, enhancing safety, better passenger experience, and in promoting increased sustainability, despite the challenges. However, the successful implementation will require careful planning, robust technology, public education/awareness, the development of smart transportation policies, massive investment in smart transportation infrastructure, and strong collaboration and public-private partnerships. Furthermore, there should be greater focus in the areas of: integration of emerging technologies, cybersecurity and data privacy, equity and access, as well as sustainability and environmental impacts in order to enhance public acceptance.

More information about smart transportation can be found in [45-50].

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Figure 1. Intelligent Transportation System
Source:https://en.wikipedia.org/wiki/Intelligent_transportation_system

Figure 2. Smart bus
Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=qQOoBGVd44WG3M&vssid=mosaic

Figure 3. Transport
Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=DFFOs_ZrZvbTfM&vssid=mosaic

Figure 4. Sonoma-Marin Area Rail Transit

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Figure 5. Bus Rapid Transit (BRT)

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=Jis9nIPlElqLCM&vssid=mosaic

Figure 6. Smart-tunnel.jpg

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=OaD8z5hu2U2FTM&vssid=mosaic

Figure 7. Public transport

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=GX3XVKCu-RWWkM&vssid=mosaic

Figure 8. Smartway Transport Partnership

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=liAd72_DVl6zUM&vssid=mosaic

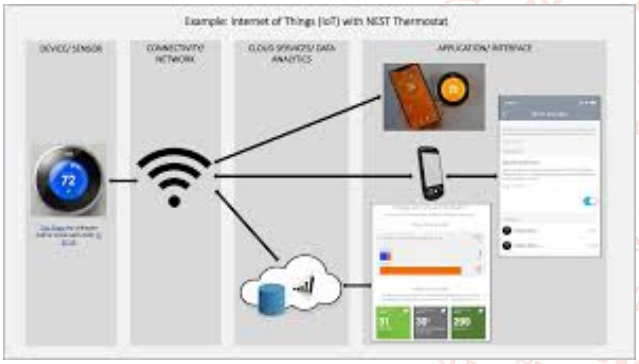

Figure 9. Internet of Things (IoT)

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=S8HLx2NmXEy-LM&vssid=mosaic

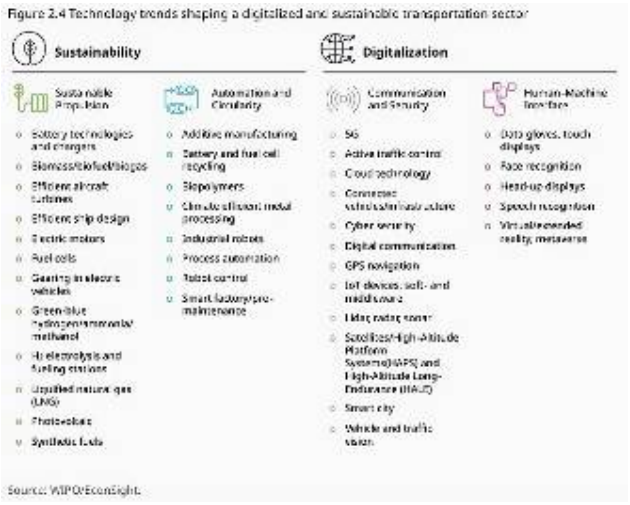

Figure 10. Technology trends in the transportation sector

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV

Figure 11. Smart city

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=mwH7Qpuu9XMPnM&vssid=mosaic

Figure 12. SmartBike DC rental station located in downtown Washington, D. C., near Metro Center station.

Source:https://en.wikipedia.org/wiki/SmartBike_DC

Figure 13. NEX-Minibus EV Bus 147Ljpg

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=PhOXKyINVzHdBM&vssid=mosaic

Figure 14. Transport

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=_L_G-7eRcy3_-M&vssid=mosaic

Figure 15. Suburban mobility authority for regional transportation

Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=d39avbusc8bkqM&vssid=mosaic

Figure 16. Neighborhood Electric Vehicle (EV)
Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=BDrOqHTQhig5aM&vssid=mosaic

Figure 17. London Bus route 452.jpg
Source:https://www.google.com/search?sca_esv=51d03556f21677b2&sxsrf=AHTn8zp68OfQ7e644CBK1R9OmwVjWmxWA:1742671284781&q=images+on+smart+transportation+by+wikipedia&udm=2&fbs=ABzOT_CWdhQLP1FcmU5B0fn3xuWpA-dk4wpBWOGsoR7DG5zJBkzPWUS0OtApxR2914vrjk7XZXfnfKsaRZouQANLhmphfsaRlDNPoWc6rCumaYm3VojqsiuBofLuYVqeJuzeVFrArtYn8anrtQg9oucHCeTR27yMHxAF31k9lv_a8NXq9Jk1mNfGFUy8ZFut1MXrV1vBhNe7WnE43Sd7e7305krgzHUJQw&sa=X&ved=2ahUKEwjIt463tJ6MAxW1VEEAHaRjAekQtKgLegQIEhAB&biw=1036&bih=539&dpr=1#vhid=cwHWpqJtr_GpOM&vssid=mosaic