Proceedings of the 6th International Conference on Civil Engineering for Sustainable Development (ICCESD 2022), 10~12 February 2022, KUET, Khulna, Bangladesh (ISBN-978-984-35-1972-6)

ELECTRIC AUTONOMOUS VEHICLE ADOPTION IN BANGALDESH: OPPORTUNITIES, BARRIERS and POLICY NEEDS

M. N. Murshed[1], A. I. Zamee*[2]

[1]*Associate Professor, Bangladesh University of Engineering and Technology, Bangladesh, e-mail: neaz_murshed@ce.buet.ac.bd*
[2]*Bangladesh University of Engineering and Technology, Bangladesh, e-mail: ahmedimtiazzamee04054@gmail.com*

*** Corresponding Author**

ABSTRACT

Transportation- undoubtedly being the backbone of modern-day economy is not devoid of negative externalities of which air pollution and global warming are most prominent. Electric autonomous vehicles are the most anticipated futuristic and ecofriendly mode of transportation to curb these downsides as well as have some added benefits like- ease of traffic regulations, improved safety, uninterrupted service, better accessibility for disabled people, better emergency services during pandemic situations etc. Bangladesh, proclaimed as the "New Asian Tiger", is challenged by its inadequate transport infrastructure crippling its expected growth. Integration of electric autonomous vehicles into this incubating transportation system in the future will be challenging unless planned properly considering various aspects like- initial cost, demand and locations of necessary installations, pedestrian behavior, automatic traffic control systems to name a few. This study endeavors to find the opportunities and barriers for the adoption of electric autonomous vehicles in the context of a developing country like Bangladesh, along with probable implementation procedures and policy needs.

Keywords: *Electric autonomous vehicle in developing countries, Safety and security, Pedestrian behaviour, Cost-benefit analysis*

1. INTRODUCTION

Bangladesh is a developing country that is aiming at sustainable and efficient technologies. Electric autonomous vehicles are supposed to be the next generation transport mode. More than 2.5 million people lose their lives every year due to road accidents according to Disease, Control and Prevention. Human errors such as recognition blunders, choice blunders, execution mistakes and also non-performance blunders contribute to 94% of crashes according to US National Highway Traffic Safety Administration (NHTSA). As a result, car manufacturers are moving towards self-driving vehicles which are considered to be more intelligent and user friendly (Contreras-Castillo et al., 2019).

Bangladesh is also facing challenges to control road accidents. People are dying just to cross a road or walk even on the sidewalk and highway crashes are seen in the newspapers almost regularly. Unlicensed drivers are often caught and overtaking tendencies are noticed frequently along with driving errors. Self-driving vehicles can solve this problem and also add some other benefits to the transportation sector of Bangladesh.

Bangladesh has already taken steps for the adoption of EVs by establishing plants. The autonomous vehicles are still in the initial production stages. Tesla being the leading company had introduced "Autopilot" feature in their cars in 2015. Ford, General Motors, Audi and many other companies are working on the features of AVs(Top 30 Autonomous Vehicle Technology and Car Companies - GreyB, n.d.). The sensors play a major role in the structure of the vehicles which is also a matter of concern in the AV implementation. As AVs are in the development stage, the sensors are failing to detect and connect properly to stop accidents. Tesla's autopilot feature failed in some cases and accidents occurred. Automation may increase energy use and result in loss of miles or months of driving than human-driven EVs due to additional weight, sensor loads and computing loads(Mohan et al., 2020). These factors should be considered in further researches of AVs.

Here the word "electric" is highlighted because it adds an extra pressure on the power demand of Bangladesh. The power production is already dealing with shortage leading to continuous load-shedding. EVs also comes with some benefits such as less emission, less dependency on non-renewable sources (fossil fuels).

2. METHODOLOGY

This study is based on previously published research works and their findings. This paper also considers the overall scenario of Bangladesh. The focus of this study to answer these questions:

1. Why autonomous vehicles are needed?
2. What are challenges associated with the adoption of self-driving vehicles?
3. What policies should be recommended for the adoption procedures?
4. Which additional research works are needed in this field?

3. RESULTS AND DISCUSSION

3.1 Benefits of AV Adoption

3.1.1 Help for elderly and disabled people

The elderly and disabled people are often ignored in Bangladesh. Most of the transport modes do not have enough facilities for them. Self-driving vehicles will overcome this problem and they will not require any help from others to go from one place to other. Voice-initiated interfaces could give the opportunity to blind people to claim a vehicle and visual and contact interfaces could be utilized by people who cannot speak(Contreras-Castillo et al., 2019).

3.1.2 Reporting Disease

Every year so many people die for not going to the hospital in time. AVs could be designed to have a special feature named body area network. Diseases could be detected if a passenger shows any sign of sickness and reported in the closest hospital with the assistance of this feature(Contreras-Castillo et al., 2019). Many lives will be saved by this. With the advancement of technologies, primary medication features could be introduced in these smart vehicles.

3.1.3 Reduction of accidents in a significant level

Though it is not certain yet, it can be said that AVs are better than human-driven vehicles in decision making, judgement, weather action response etc. The AI performance is still controversial and more researches are needed to make a conclusion. AVs are could reduce some of the problems made by less skilled drivers and unlicensed drivers. The cost of road accidents is very high. A study on cost estimation of road accidents finds that in 2020 the total cost of crashes is about 4118 million USD which denotes 1.3% of the GDP of Bangladesh(Ahsan et al., 2021). This loss could be mitigated in a significant percentage by AV adoption.

3.1.4 Smart Traffic System

Smart Traffic system can be adopted easily with the implementation of self-driving vehicles. Smooth and safe movement will be ensured. Total green movement from one signal to another with the help of a specific speed limit can be achieved. Pedestrian crossings can be considered in a regular manner and their safety will be maximized.

3.1.5 Reduction in Congestion

Human driving generates stop-and-go type of congestion which can be eliminated by a small number of automated vehicles as 5%. Traffic accidents reduction by self-driving vehicles will reduce the 25% congestion created by accidents.(10 Advantages of Autonomous Vehicles | ITSdigest, n.d.) Dhaka is a city where traffic jams are becoming a big headache. Valuable time can be saved by self-driving vehicles.

3.1.6 Reduction in emission of gases

Specially programmed software can be developed to reduce the emission in a significant level. New-age cars can be designed to make a contribution in 60% emission.(10 Advantages of Autonomous Vehicles | ITSdigest, n.d.) A study on the vehicle exhaust emission level assessment data finds that Dhaka city is experiencing high concentration of harmful gases such as CO, NOX and SOx etc. Decreasing PM10 concentration in Dhaka city by 20% would bring about keeping away from 1200 deaths, 80 million instances of sickness and a health cost savings of US$169.00 million. Assuming PM10 concentration could be additionally diminished by another 80%, then, at that point, that would bring about keeping away from of 3500 deaths, 235 million instances of sickness and bringing about a health cost savings of US$492.00 Million. (Hasan et al., 2013) This study clearly shows that emission of gases which brings a significant amount of health hazards reduction is badly needed for Bangladesh.

3.1.7 Increased Lane Capacity

Lane Capacity can be increased by 100% and expressway travel speed by 20% by AVs found in research by SSTI (State Smart Transportation Initiative). Monitoring surrounding traffic condition and responding with finely tuned braking and acceleration could lead to safe driving at higher speeds.(10 Advantages of Autonomous Vehicles | ITSdigest, n.d.)

3.1.8 Travel Time and Transportation Cost Reduction

40% reduction in travel time which will recover 80 billion hours lost in traffic jams and 40% fuel cost reduction will save US$1.3 trillion. Manpower cost such as drivers and traffic police will also be saved. (10 Advantages of Autonomous Vehicles | ITSdigest, n.d.)

3.1.9 Real-time Route Optimization

"Autonomous vehicles may be able to read the condition of the roads in real-time and redirect the routes accordingly. Using V2V(Vehicle to vehicle) and V2I(Vehicle to infrastructure) to determine optimal routes can reduce the number of miles driven, saving time and fuel use."(4 Benefits of Autonomous Vehicles You May Not Have Considered - Fleetio, n.d.)

3.1.10More Productivity

Multi-tasking, requirement of less or no concentration on driving, longer travel periods could increase the productivity of the traveler. (4 Benefits of Autonomous Vehicles You May Not Have Considered - Fleetio, n.d.)

3.2 Challenges Associated with AV Adoption in Bangladesh

The problems associated with the adoption of autonomous vehicles are described below:

3.2.1 Pedestrian behaviour

The pedestrian behaviour of Bangladeshi people is alarming and very risky. 72% accidents happen to pedestrians of this country and one-third of the deaths are occurring to children under 15 years(Ahasan, 2018). People have a tendency to cross roads without using proper overbridges or signals. Additionally, most of the signals in Bangladesh do not consider pedestrians. As a result, they have a tendency to cross the road midway with just raising their hands and indicating the vehicle to stop which is very risky. Sometimes the drivers couldn't notice these pedestrians and accidents happen. This is not a common behaviour for foreign people. So, the car making companies which are mostly foreign are not familiar with this behaviour. Therefore, the sensors are not tested and developed considering this factor. This could be a big barrier in adopting autonomous vehicles.

3.2.2 Security issue

Automation is a subject of cyber-attacks. Data can be lost and sometimes hacking can be done to take people's lives. Security is needed to provide safety for the vehicle. Car Manufacturing companies could use robust security protocols and cloud-oriented communication programs to ensure data security for customers(Contreras-Castillo et al., 2019).

3.2.3 Cost

In the primary stages, the cost of autonomous vehicles could be so high. After a massive demand and production by different companies, the cost will be minimized. Mass production and mass encouragement are needed in the industry(Contreras-Castillo et al., 2019).

3.2.4 Reluctance to give control to machine

Various surveys show that people don't find themselves comfortable in giving full control to machine. Semi-automated cars are encouraged but fully automated ones are seen as a threat by many people. Gradual automation of vehicles are needed to be applied by the manufacturers to give reliability to customers(Contreras-Castillo et al., 2019).

3.2.5 Unavailability in Market

Level 4 (High Driving Automation) or 5 (Full Driving Automation) are not commercially available. The testing and collecting data are on progress. (Esch, 1996)

3.2.6 Accidents by AVs

The number of accidents caused by AVs are very small. Still some fatal accidents took place and development procedures are adopted. In March 2016, Tesla failed to identify a truck and the driver lost his life. Uber Volvo fatally crushed a woman on the street of Arizona in March 2018. Due to the

ignorance of constant warning provided by the "Auto-pilot" feature, another accident happened in California by Tesla Cars. (Esch, 1996)

3.2.7 Unemployment of Drivers

With the development of fully automated vehicles, more drivers are going to lose their jobs and a crisis will start. (What Are the Main Disadvantages of Self-Driving Cars? - Global Auto Transportation, n.d.) With development of apps, the number of drivers is increasing rapidly in Bangladesh. Taking such a huge population towards unemployment could lead to riots and crimes.

3.2.8 Weather Effects

Heavy rainfall or snowfall will affect the efficiency of cameras or leases-sensors. Road signs reading will become challenging for the AVs under such conditions. (What Are the Main Disadvantages of Self-Driving Cars? - Global Auto Transportation, n.d.)

3.2.9 Terrorism threats

Terrorists could use AVs to attack villages and self-driving drones and bombs will be thrown. (What Are the Main Disadvantages of Self-Driving Cars? - Global Auto Transportation, n.d.)

3.3 Policy Needs

3.3.1 Pedestrian behaviour control

The people crossing roads should be brought under control. Strict laws should be implemented to control crossings. Signals should be maintained. Pedestrian crossing facilities should be provided in signals. Awareness should be spread about this matter and seminars should be arranged by proper authority.

3.3.2 Smart Traffic System Implementation

Smart traffic system can reduce a lot of problems in adopting AVs. Roadway signals with automated design could give a smooth driving experience for AVs.

3.3.3 Funding for Research

Central funding is mandatory to expand the research of AVs. Different transportation agencies should come forward to expand the research works to find better sensors and computation factors to overcome the problems associated with road crossing and detection of pedestrians or other vehicles.

3.3.4 Determining suitable standards for data security

The standards and guidelines should be arranged in a proper way so that the AV penetration could be done in the fastest possible time. As the crying need of automation of vehicles are increasing day by day, the AV-enabling legislation should address the privacy information and data to ensure the safety of the passengers (Contreras-Castillo et al., 2019).

3.3.5 Creating and Shifting Alternative Employment Opportunities for Drivers

New and alternative jobs should be created or new skills should be taught to the drivers so that the crisis of unemployment could be handled.

4. CONCLUSIONS

The globe is changing at an intense speed. Bangladesh needs to adopt new technologies in a planned way. A safe and better transportation system can be ensured by the adoption of self-driving vehicles. Additional researches are needed in this field as the data available are limited. AVs could easily solve

some of the burning problems of Bangladesh such as accidents by human error, traffic congestions, cost management issues etc. AVs could grow some problems such as unemployment, security threats, terrorisms, privacy issue etc. which can be solved by further development research and adopting suitable policies. In fine, for the safe and comfortable movement of Bangladeshi people, AVs sould be adopted in a planned way.

REFERENCES

10 Advantages of Autonomous Vehicles | ITSdigest. (n.d.). Retrieved December 29, 2021, from https://www.itsdigest.com/10-advantages-autonomous-vehicles

4 Benefits of Autonomous Vehicles You May Not Have Considered - Fleetio. (n.d.). Retrieved December 30, 2021, from https://www.fleetio.com/blog/4-benefits-of-autonomous-vehicles

Ahasan, R. (2018). *Pedestrian Insecurity : Proposals To Improve the Situation in Dhaka , Bangladesh*. *Icrice*, 12–13.

Ahsan, J., Roy, S., & Huq, A. S. (2021). *an in-Depth Estimation of Road Traffic Accident Cost in Bangladesh*. *2021*(2012), 12–13.

Contreras-Castillo, J., Zeadally, S., & Guerrero-Ibáñez, J. (2019). Autonomous Cars: Challenges and Opportunities. *IT Professional*, *21*(6), 6–13. https://doi.org/10.1109/MITP.2018.2876930

Esch, J. (1996). Autonomous Vehicles. *Proceedings of the IEEE*, *84*(8), 1145. https://doi.org/10.1109/JPROC.1996.533959

Hasan, M., Rahman, S., Paul, N., Halder, P. K., Alam, M., Raquib, M. A., Islam, M. A., & Khan, P. A. (2013). Analysis of Exhaust Emission of Vehicles in Dhaka city of Bangladesh. *Global Journal of Science Frontier Research: Environment & Earth Science*, *13*(2), 51–55.

Mohan, A., Sripad, S., Vaishnav, P., & Viswanathan, V. (2020). Trade-offs between automation and light vehicle electrification. *Nature Energy*, *5*(7), 543–549. https://doi.org/10.1038/s41560-020-0644-3

Top 30 Autonomous Vehicle Technology and Car Companies - GreyB. (n.d.). Retrieved November 29, 2021, from https://www.greyb.com/autonomous-vehicle-companies/

What are the main disadvantages of Self-driving cars? - Global Auto Transportation. (n.d.). Retrieved December 30, 2021, from https://www.globalautotransportation.com/main-disadvantages-self-driving-cars/