



ISSN: 2350-0328

**International Journal of Advanced Research in Science,
Engineering and Technology**

Vol. 9, Issue 11 , November 2022

Artificial Intelligence in Transportation Systems – An Overview

Papiya Bala, Amarpreet Kaur, Ruchira Shinde

Lecturer, ME. Environmental Engineering, Department of Civil Engineering, Agnel Polytechnic, Vashi, Navi Mumbai, India

Lecturer, M Tech Construction Management, Department of Civil Engineering, Agnel Polytechnic, Vashi, Navi Mumbai, India

Lecturer, BE Civil, Department of Civil Engineering, Agnel Polytechnic, Vashi, Navi Mumbai, India

ABSTRACT: One of the most important factor that affects the growth and development of the country is its transportation system. Increase in population has led to more number of vehicles on the road, traffic congestion, risk of accidents, rise in CO₂ emission which causes environmental degradation. Hence, these days Artificial Intelligence and Machine Learning are proving as useful tools to provide safe, efficient and reliable transportation systems. A good understanding between Artificial Intelligence and data on one side and characteristics of transportation system and variables on the other side is required for the impactful application of Artificial Intelligence and Machine Learning. These techniques seem to be very promising to collect, manage and analyse the enormous amount of data generated in transportation. This paper emphasizes on application of Artificial Intelligence and Machine Learning for developing a systematic and structured Traffic management system in terms of smart parking, smart street lights, reducing human error involved in traffic accidents, accident spot detection, and to locate parking spaces. It re-views scheduling and routing of public transport, autonomous driving, and traffic patterns, foresee paths for cyclists and pedestrians. It also summarizes cycle length for traffic signals, prediction of traffic demands, future state of traffic management to minimize congestion and fast decision making during emergency situations. Artificial intelligence is a specialized sentient machine that makes the daily decision making done by humans easier and more efficient. It mimics the intelligent behaviour that humans portray and extemporizes it logically and efficiently. Artificial Intelligence (AI) is a broad concept that spans over many fields and is also an integral part in our day to day lives. As a result, AI is a discipline of science that is concerned with the study, design, and implementation of time saving technologies via machines that carry out tasks.

KEY WORDS: Traffic, Artificial Intelligence, congestion, traffic signals, Parking, Street lights

I.INTRODUCTION

Transportation is a vital factor that attributes to the quality of life. The development of a transportation is an essential accessory for development of any nation. It connects rural to urban areas, serves the remotest location, enables mobility, allows communication and also helps in revenue generation. Modes of transportation are Roadways, Railways, Waterways and Airways. Artificial Intelligence (AI) is developing at a fast rate and provides a good opportunity to enhance its implementation in various fields on transportation. It overcomes the challenges faced by the traditional system of transportation in terms of travel, demand, safety pollution, accidents, parking etc. AI is a wide range branch of Computer science that makes machine function like a human brain. Nowadays, it's a leading research area in transportation engineering, especially in prediction of traffic congestion complementary solutions. Complementary solutions are designed to work as a component of a larger filtering system, offering support to the primary filter (whether it be ML or non-ML based). Complete solutions aim to construct a comprehensive knowledge base that allows them to classify all incoming messages independently.



ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 9, Issue 11, November 2022

II. LITERATURE REVIEW

“APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN TRANSPORTATION” - Dr. Raed Nayif Alahmadi
Civil Engineering Department, Albaha University, Saudi Arabia: Artificial Intelligence (AI) has developed at a rapid pace and this provides a good chance to enhance the execution of different fields like business, industries, and the transportation sector. In the transportation field, the AI had applied to overcome the challenges of pollution, environmental deterioration, increasing travel demand, and safety concerns. The good understanding of the relationship between the AI and input data on one hand and characteristics of the transportation system leads to a perfect and successful application of AI. This paper provides an overview of the AI methods with a concentration in two methods of AI, Knowledge Base System method (KBS) and Artificial Neural network systems (ANNs). The paper tried to explain in detail the two methods and their application in transportation with advice and points of strength, weakness, and guidelines for application. The second part of the paper deal with AI application areas in Transportation. The overview concludes by a summary of the two methods with a brief of their important application in transportation

“APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN TRANSPORT: AN OVERVIEW” - Rusul Abduljabbar, Hussein Dia, Sohani Liyanage and Saeed Asadi Bagloee: The rapid pace of developments in Artificial Intelligence (AI) is providing unprecedented opportunities to enhance the performance of different industries and businesses, including the transport sector. The innovations introduced by AI include highly advanced computational methods that mimic the way the human brain works. The application of AI in the transport field is aimed at overcoming the challenges of an increasing travel demand, CO₂ emissions, safety concerns, and environmental degradation. In light of the availability of a huge amount of quantitative and qualitative data and AI in this digital age, addressing these concerns in a more efficient and effective fashion has become more plausible. Examples of AI methods that are finding their way to the transport field include Artificial Neural Networks (ANN), Genetic algorithms (GA), Simulated Annealing (SA), Artificial Immune system (AIS), Ant Colony Optimiser (ACO) and Bee Colony Optimization (BCO) and Fuzzy Logic Model (FLM) The successful application of AI requires a good understanding of the relationships between AI and data on one hand, and transportation system characteristics and variables on the other hand. Moreover, it is promising for transport authorities to determine the way to use these technologies to create a rapid improvement in relieving congestion, making travel time more reliable to their customers and improve the economics and productivity of their vital assets. This paper provides an overview of the AI techniques applied worldwide to address transportation problems mainly in traffic management, traffic safety, public transportation, and urban mobility. The overview concludes by addressing the challenges and limitations of AI applications in transport

“APPLICATIONS OF MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE IN INTELLIGENT TRANSPORTATION SYSTEM: A REVIEW” - Divya Gangwani and Pranav Gangwani: Due to the tremendous population growth in the country, the use of vehicles and other transportation means has increased which has led to traffic congestion and road accidents. Hence, there is a demand for intelligent transportation systems in the country that can provide safe and reliable transportation while maintaining environmental conditions such as pollution, CO₂ emission, and energy consumption. This paper focuses on providing an overview and applications of how Artificial intelligence (AI) and Machine Learning (ML) can be applied to develop an Intelligent Transportation system that can address the issues of traffic congestion and road safety to prevent accidents. We will then re-view various ML approaches to detect road anomalies for avoiding obstacles, predict real-time traffic flow to achieve smart and efficient transportation, detect and prevent road accidents to ensure safety, using smart city lights to save energy, and smart infrastructure to achieve efficient transportation. Next, we review various AI approaches such as safety and emergency management system to provide safety to the public, autonomous vehicles to provide economical and reliable transportation. We then propose smart parking management and how it can be used to find parking spaces or spots conveniently, incident detection which detects the traffic incidents or accidents in real-time provides a report. Finally, we conclude with predictive models and how the algorithms utilize sensor data to develop an Intelligent Transportation System.

HOW IS THE ARTIFICIAL INTELLIGENCE USED IN APPLICATIONS FOR TRAFFIC MANAGEMENT- RNDr. Šusteková D. PhD., RNDr. Knutelská M. PhD: There are described in the article current applications with the artificial intelligence and value of using it for the road transport efficiency. This paper deals with concept of artificial intelligence, main reasons for successful growing of AI at present and main areas of AI using in transportation. One

part of the article aims to define the artificial neural networks and basic elements of them. The article describes the reason of use them in transportation problems solving, the possibility of using neural networks in the road transport, examples of tasks solvable by neural nets, the advantages and disadvantages of using neural networks

A REVIEW OF TRAFFIC CONGESTION PREDICTION USING ARTIFICIAL INTELLIGENCE-Mahmuda Akhtar and Sara Moridpour: In recent years, traffic congestion prediction has led to a growing research area, especially of machine learning of artificial intelligence (AI). With the introduction of big data by stationary sensors or probe vehicle data and the development of new AI models in the last few decades, this research area has expanded extensively. Traffic congestion prediction, especially short-term traffic congestion prediction is made by evaluating different traffic parameters. Most of the researches focus on historical data in forecasting traffic congestion. However, a few articles made real-time traffic congestion prediction. This paper systematically summarises the existing research conducted by applying the various methodologies of AI, notably different machine learning models. The paper accumulates the models under respective branches of AI, and the strength and weaknesses of the models are summarised.

SMART TRANSPORTATION: A PRIMER-Matthew N.O. Sadik u, Adebowale E. Shadare, Sarhan M. Musa: Smart transportation is an important component of the smart city. It refers to the application of information and communication technologies to road transport, infrastructure, vehicles, and users. It improves safety, increases productivity, and ensures greener environment. This paper provides the basics of smart transportation, including its enabling technologies, applications, and challenges.

III. APPLICATIONS OF AI IN VAIROUS FIELDS OF TRANSPORTATION

A. Reducing Traffic Congestion:

Traffic congestion causes financial losses and increases the emission of carbon around the world. Use of AI will reduce the congestion and carbon emission and less fuel utilisation. Researchers are using AI to design a Computer Vision System which allow the movement of traffic safely through intersection.

Teams of researchers used three smart stop light cameras for collection Real-World data from images of vehicles as they passed through intersections. AI was applied to teach the cameras to identify the type of vehicle and gas mileage estimated from vehicle and then send the data to the next intersections of traffic light. Prediction of traffic congestion gives required time to the authorities to plan the allocation of resources for smooth journey of people travelling on the intersection.



Fig1. Traffic Congestion (Pic courtesy: Hindustan Times)

B. Detection of Accidents:

These days the news of death of people because of road accidents is seen everywhere on the television, in the newspaper, social media etc...Rate of fatal accidents have increased especially on the highways during the night due to insufficient lights on the road or strong glare. Human lives can be saved by creating a system for preventing accidents. This can alert the driver of any critical situation so that he can take proper action to avoid the accident. Also, instant accident detection on the road helps the driver to divert his path and take another road along with time delay expected

for reaching a particular location. According to the studies, by placement of sensors in the vehicles, detection of the location of the vehicle will take place and compare with other vehicles moving on the road. A beep sound will be generated by sensors in the car when two vehicles come very close to each other. Also, in the vehicles, an automatic alarm device helps in sending information to police station, medical rescue team and family members of the person within fraction of seconds of an accident, which will help in saving the life of the people.



Fig2. At grade Intersection (Detection of Accidents)

C. Parking Management:

Nowadays, a biggest stress for a driver is to find a good parking space because of immense rise in vehicle purchasing. More cars lead to less space on the roads, both on main roads as well as space allotted for parking. Many colleges, residential buildings, commercial buildings, universities intend to organize a well-planned parking system so that time is not wasted in locating a parking space. Smart parking systems are using sensors and cameras for gathering real time data in order to measure occupancy of parking. Artificial intelligence based parking system helps in navigation drivers to vacant spots of parking. Data such as vehicle type, vehicular traffic, peak hour flow can be analysed to provide effortless parking experience. Smart parking system helps in saving fuel as the vehicles can be guided straight to the empty parking slot. Many multi-storeyed buildings are provided with parking lot monitoring sensors to guide drivers in order to locate available parking. Drivers get online notification about the empty parking floor so that they can directly head towards that particular floor for parking. This helps to save energy, time and decrease carbon emissions.

D. Street lighting:

Street lighting nowadays has become more essential since the night use of public roads has readily increased. There is a need street lighting during night time to have safe, comfortable, efficient and convenient movement of vehicles and pedestrians. Street lighting is a community service which consumes a majority portion of energy resources. Research study shows that nearly 18%-38% of power resource goes towards fulfilling this need. Due to rise in demand for power and significant gap between demand and supply issues, un-optimized usage like bright street light lead to wastage. There is urgent need to optimize the consumption using smart light without compromising the safety of citizens. The Internet of Things (IoT) enables the concept of using AI to deliver automated services like when the object comes closer to the light pole, the light gets brighter and when the object moves away from the pole, light gets dip.



Fig 3. Street lights (Pic courtesy: Mumbai Live)

Various components required for working of AI automated street light system are LDR (Light dependent resistors,). IR (Infrared) Sensors, LED (Light emitting diode). In this system, street lights are automatically turned ON and OFF by detecting the movement of objects on the street. IR sensors are used to detect the objects. LDR and IR sensors used to sense the light intensity and objects of particular area. It then transmits the data to the base station where energy gets stored using wireless technology. The merits of this system includes automatic ON and OFF switching of street lights, cost effective, power saving and reduction in light pollution. The demerits include, high implementation cost, prone to environmental conditions and troubleshooting may be complex in case of defect.

E. Self-Driven Vehicles:

Automated cars are the ones which can drive themselves are not only in fiction anymore, they are seen on roads in real life too these days. This have become possible only because of the AI related technologies, mainly deep learning and computer vision technologies. Self-driven cars provide smart driver's assistants which monitors the surrounding of the vehicle and support the driver or them in case of any emergency or an accident risk. Such systems allow driver to benefit as:

- a) Emergency braking: can use full breaking power to stop the car and avoid the accident.
- b) Night visions: These systems use thermographic cameras and Lidar to increase the sight distance in darkness or poor weather conditions.
- c) Enhanced communications systems and alerts: voice commands and weather alerts
- d) Lane control: The vehicle alerts you when you drive off your lane.



Fig 4. Self- driven car (Pic Courtesy: The Guardian)

The AI system software in the vehicle is connected in the vehicle is connected to all the sensors and it collects the input from the Google street view and the video cameras installed inside the vehicles. The AI simulates the human brain and decision-making processes using deep learning ad controls the steering and braking actions. The computer vision on the other hand uses high resolution cameras that can detect what happens in the immediate surroundings of the car. Thus the vehicle system can react to the possible obstacles and avoid any chances of accidents. Self-driving cars are a real smart option and can be operated even in very congested places. It can reduce road deaths, congestion, fuel consumption, improve the mobility of senior citizens and disabled people and also reduce the time of commuting.

IV. CHALLENGES IN APPLICATION OF AI IN TRANSPORTATION ENGINEERING:

AI solves many main traffic related issues such as traffic congestion, parking management, accident prevention etc... but at the same time it also gives rise to certain challenges. It helps to reduce and channelize traffic and improves air quality by reducing CO2 emission. Also, automatic vehicles help people to travel conveniently. However, this can lead to more people opting for automatic vehicles instead of public vehicles for transport, which will in-turn lead to more



ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 9, Issue 11 , November 2022

traffic congestion and pollution. Use of AI put up many ethical, economical, legitimate and societal/communal issues. AI means the data stored in computer systems that mimic human intelligence. The main concern that arises here is cyber security and hacking. This contains a numerous data, and more the data, highest is the possibility of leakage. This data is critical and should be protected.

If by any mishap this data is hacked or accessed by any illegal third party, the safety is endangered, especially in the case of automatic vehicles, where the data of the passengers is involved. It also poses threat for the people as the data can be used for tracking purpose, endangering their privacy. In case of semi-autonomous vehicle, the drivers may pay less attention or get distracted to the road which may cause accident. Even in fully automated vehicles, if any mishap happens, accountability is a question. It also raises employment issue. Although AI can contribute to the creation of jobs, it can lead to elimination of others, example, because of use of automatic vehicles, buses, rickshaws, trucks might not be required in the future. AI requires high skilled labour. Hiring and training people with the required skills and expertise takes time and money, hence it becomes costly. Due to this, adopting AI technologies in transportation may sometimes become difficult.

V. CONCLUSION

This paper focuses on overview of application of Artificial intelligence in various fields of transportation. Our review explains how AI makes transportation easy, efficient and convenient by addressing the issues such as traffic congestion, detection of accidents, parking management, street lighting, and self-driven vehicles. This paper mainly streamlines the merits, demerits and challenges of AI in the field of transportation from civil engineering point of view. Artificial Intelligence holds the key to unlocking a magnificent future for us, where, driven by data and computers that perceive and analyse our world better than us, and help us make more informed decisions. Artificial Intelligence in Transportation Engineering, for example, has advanced to the point where efficiencies are fed directly into algorithmic processes to produce direct results effortlessly. In today's date. It is critical to understand that construction organizations who have already begun to apply AI processes in their fieldwork are already 50% more profitable than most census.

REFERENCES

1. "APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN TRANSPORTATION" - Dr. Raed Nayif Alahmadi Civil Engineering Department, Albaha University, Saudi Arabia:
2. "APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN TRANSPORT: AN OVERVIEW" - Rusul Abduljabbar, Hussein Dia , Sohani Liyanage and Saeed Asadi Bagloee
3. "APPLICATIONS OF MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE IN INTELLIGENT TRANSPORTATION SYSTEM: A REVIEW" - Divya Gangwani and Pranav Gangwani
4. HOW IS THE ARTIFICIAL INTELLIGENCE USED IN APPLICATIONS FOR TRAFFIC MANAGEMENT-RN Dr. Šusteková D. PhD., RNDr. Knutelská M. PhD:
5. A REVIEW OF TRAFFIC CONGESTION PREDICTION USING ARTIFICIAL INTELLIGENCE-Mahmuda Akhtar and Sara Moridpour:
6. SMART TRANSPORTATION: A PRIMER-Matthew N.O. Sadiku, Adebowale E. Shadare, Sarhan M. Musa:
7. <https://www.online-sciences.com/robotics/artificial-intelligence-in-transportation-advantages-disadvantages-applications/>
8. <https://www.mumbailive.com/en>
9. ARTIFICIAL INTELLIGENCE IN TRANSPORTATION- Sadek, A. *Transp. Res. Circ.* 2007, E-C113, 72-79
10. AN ARTIFICIAL INTELLIGENT APPROACH TO TRAFFIC ACCIDENT ESTIMATION: MODEL DEVELOPMENT AND APPLICATION. Akgüingör, A.P.; Doğan, E. *Transport* 2009, 24, 135–142.