

Analysis of Artificial Intelligence in Traffic Congestion and Management System

Asifullah Samim

Student of MSc (Computer Science), Department of Computer Science, University of Mysore, India.

URL <https://uni-mysore.ac.in/english-version/computer-science-0>

Email: [asifullahsamim.ai\[at\]gmail.com](mailto:asifullahsamim.ai[at]gmail.com)

Abstract: *The management of road traffic has undergone a radical change as a result of the quick development of artificial intelligence (AI). The movement of people, things, cars, and cargo at various points on the transportation network may now be predicted and controlled by AI with remarkable accuracy. AI is making it feasible to prevent accidents by optimising flows at crossings and enhancing safety during times when roads are closed due to construction or other activities, in addition to offering citizens better service than ever before. Furthermore, efficient mass transit, like ride-sharing services, has been made possible by AI's capacity to process and analyse enormous volumes of data. Then how is road traffic management being revolutionised by AI? The study uses secondary data for analysis of the present study. This study is limited to automated vehicles including Taxis, Buses, Delivery vans or drones Trains, Commercial aircraft etc. .*

Keywords: artificial intelligence, Traffic Congestion, Traffic Congestion and Management

1. Introduction

Real-time data from many forms of transportation, such as vehicles, buses, and trains, is analysed with the use of AI in road traffic management. The AI examines this data in search of trends that might point to potential safety concerns. (N 2019) Then, using this knowledge, suggestions are made for methods to lessen these risks and the likelihood of accidents happening. (Ren et al.2022) A new traffic management system is being used in Phoenix that employs AI to synchronise lights. (Lüthi et al.2020) Through the use of this technique, Phoenix saw a 40% reduction in vehicle delays. An essential component of the transportation

system are traffic lights. They aid in maintaining order and flow in the traffic. (Cucchiara et al.2000)

In the past, people controlled traffic signals. To keep things organised, they employed timers and other tools. That is no longer the case, though. Nowadays, computers control the traffic lights. This modification was made to improve productivity. (Kaplan & Haenlein 2019) It makes it possible to better regulate the timing of traffic signals. There has been a drive to upgrade traffic signals in recent years. (Ren et al.2022) The purpose of this is to improve driver efficiency. This initiative is being led by a business by the name of traffic. The new initiative to make traffic signals smart is motivated by it. ("Difference Between Machine Learning and Artificial Intelligence" 2018) (See Figure-I)

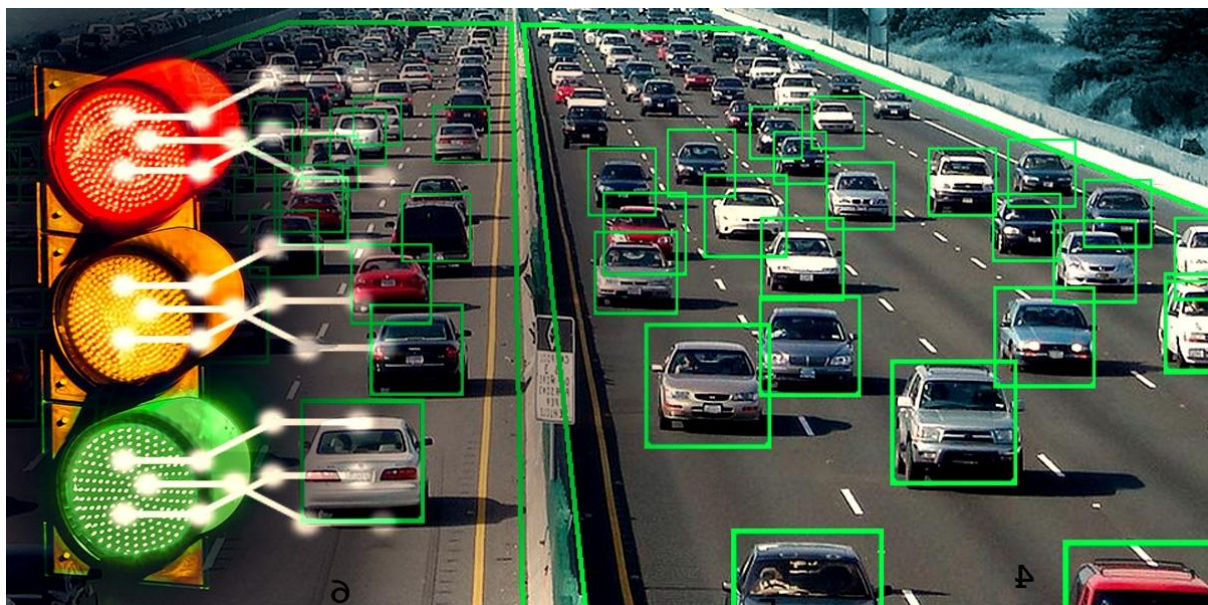


Figure I

AI can aid in parking scenario prediction. For instance, AI can assist in identifying the locations that are most likely to be congested and recommend parking spots ahead of time if

a concert or other significant event is taking place in the neighbourhood. (Gonzalez et al.2016) Drivers might do this to save time and avoid bottlenecks. (Assbeihat & Rafi

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2021) AI is used in traffic management to enforce the law. ITMS provides a tool to automatically challan offenders as per law of the land, with supporting evidence data in terms of snapshots & videos. (Wu 2022)

AI is also used for speed violation detection which alerts the user when there are multiple people riding on a bicycle or motorcycle with no helmet, this helps prevent accidents involving those two modes of transportation and other motorized means of transport. The system can also be integrated with CCTV and Traffic Control systems, which results in a holistic solution towards preventing the current traffic menace. (Lüthi et al.2020) There are numerous benefits of using artificial intelligence to keep traffic moving in response to the present situation: (“Artificial Intelligence (AI) vs. Machine Learning” n. d.)

- Traffic moving smoothly thanks to AI
- It's better for the environment when traffic moves freely and there are no backups. Additionally, this necessitates the continued development of software rather than the utilisation of hardware, adding another important environmental factor.
- Many corporate procedures, including deliveries, can be optimised thanks to it, which is quite advantageous for the economy. (Arel et al.2010)
- By carefully controlling the flow of traffic, human error, by far the most frequent cause of accidents, may be virtually minimised. Accident rates may be significantly lowered if the human aspect were eliminated.

- The phrase "Truck Platooning" refers to the idea of connecting many trucks electronically so they can drive in a convoy on the highway. This creates appealing potential in the transportation industry. Only the leading vehicle in this situation has a human driver. (Fadlullah et al.2017)

All of these elements help to optimise the transportation system as a whole. This benefits every road user, including individuals who could only engage in traffic to a limited degree before the invention of digital instruments. Event flow helps transportation managers better plan their routes by locating forthcoming events and showing them on an intuitive visual map. This may result in more users and better service, as well as fewer manual searches. (“What is Artificial Intelligence (AI) ? Definition, Benefits and Use Cases” n. d.)

It is clear that there will be many setbacks for AI in traffic, especially at this level in its development. Numerous incidents using subpar software have been in the news. However, these specific occurrences only partially support a reasonable argument against autonomous driving as a whole. (Ramos et al.2008)

A trustworthy comparison that compares two figures in relation to one another is required for a concluding declaration on the impact of autonomous driving to traffic safety and the decline in accident statistics. (Allen 2018)

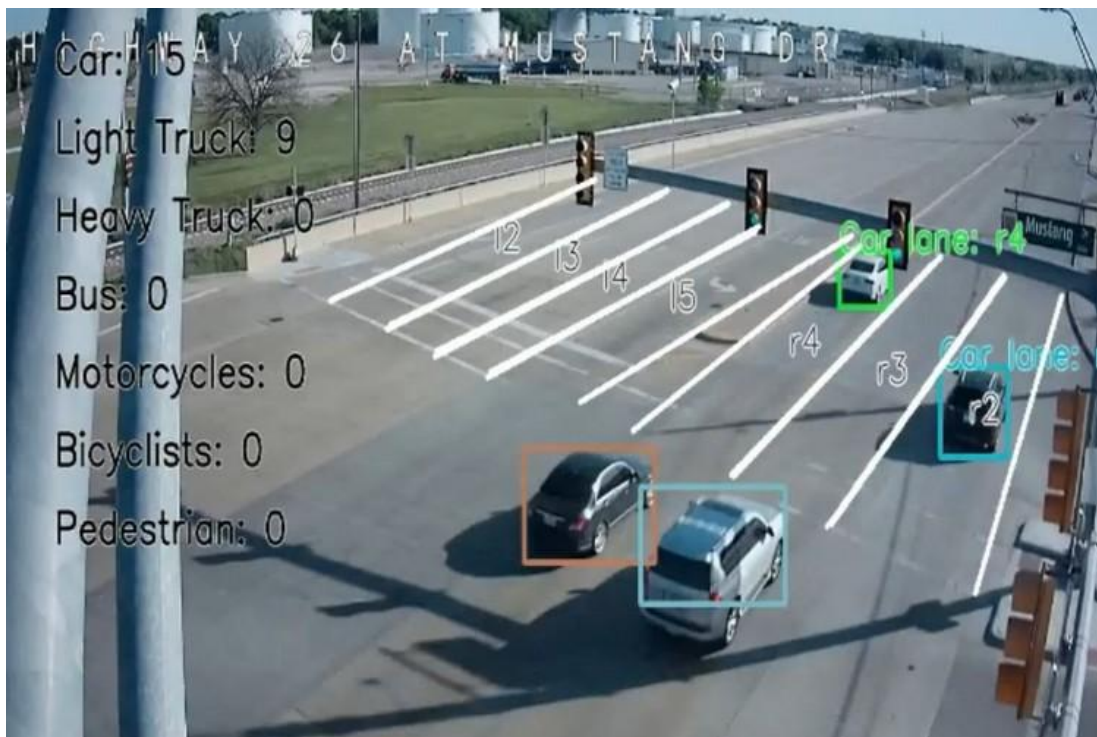


Figure II

The question can be pondered that

- 1) How many mishaps are brought on by bad programming?
- 2) How many accidents are caused by human mistake in the same circumstances?
- 3) Is the system capable of handling an increase in load as cities grow?

The application of artificial intelligence (AI) to traffic management is debatable. A common complaint about city living is traffic congestion. In addition to increasing pollutants and the risk of traffic deaths, it can irritate drivers. How big of an impact AI will have in lowering these factors is unclear, though. AI can be applied to traffic management

in a variety of ways. (“Artificial Intelligence News & Articles-IEEE Spectrum” n. d.)

When responding to an emergency, for instance, emergency vehicle preemption enables vehicles like ambulances and fire engines to go around red lights or other obstructions. Buses are given precedence at junctions thanks to transit signal priority, which reduces congestion and shortens commute times for passengers. (SITNFlash 2017)

Additionally, pedestrian safety systems use embedded sensors in the pavement to detect pedestrian crossings so that the crossing signal can be changed more rapidly. *Employing AI for traffic control presents several hitches.*

- gathering data and comprehending the underlying problem
- analysing data and extracting features for predictive modelling.
- deployment, monitoring, and updating of the model.
- Analyzing feedback and improving after errors.
- dealing with data ambiguity and noise.
- integrating several data types (e. g., video, image, GPS)
- ScalabilityConcerns about privacy-how will personal information be used or shared?
- Cost-effectiveness: Can AI be deployed without large additional infrastructure investments?
- Will there be a single platform used by all municipalities to manage traffic?

Modern technology's data and operations are impacted by the critical issue of cyber security. These systems, which are specifically designed to manage road traffic, are vulnerable to possible attacks from hackers who might do significant harm, which is why cyber security is so crucial. If these systems aren't safe and there's a potential that the data could be changed, they can't work properly. (SITNFlash 2017)

Artificial Intelligence Traffic Systems in Cities

What does the phrase "smart city" actually mean? It has been in use for a while. A smart city is one that effectively uses technology to offer services and advantages to its residents. The most well-known instance would be Dubai, which was created using cutting-edge technology and can offer the government and its residents services like trash management, traffic monitoring, and public transportation. (Atske 2018) Let's examine a few traits and attributes of a developing countries like Afghanistan, Burundi (6.5% of the population), Malawi (9.8% of the population), Liberia (9.8% of the population), Central African Republic (10.8% of the population), Burkina Faso (13.1% of the population), Sierra Leone (14.2% of the population), Niger (14.4% of the population), Tanzania (15.3% of the population) etc. where experiencing the lowest electricity access. So it would be incompatible with the AI system. let's go ahead to touch upon another area where people do not have computer-based knowledge of what would be the future of AI and traffic systems. (“What is Artificial Intelligence (AI) & Why is it Important?” n. d.) see the figure



Figure III

Additionally, let's fly a kid over the discourse that what would be the scenario for a landlocked state like Afghanistan and where the traffic system is diverted by the

mountain. So these are all debatable issues. Furthermore, due to earthquakes or storms or bad programming or hacking data or environmental failure or national security

threat, what would be the future of traffic systems? (*Blackman 1986*)

Compared to conventional, human vehicles, automated vehicles can benefit from a variety of factors. For instance, they can assist in lowering engine emissions and energy consumption caused by idling automobiles. They can automate parking procedures, giving drivers more time to work efficiently. (*"Artificial intelligence" 2017*)

The ability of automated systems to distinguish between different road users is improving, which can increase safety. However, using autonomous cars has certain drawbacks as well:

Long-term planning choices must still be made by humans, although many jobs can be automated for urgent problems like accidents and traffic rerouting. For instance, the Vivacity Smart City uses a combination of human and machine labour to lessen the load of congested city centre traffic. (*SITNFlash 2017*)

Consider yourself entering the city by car to attend a meeting. You allow extra time to find parking because you are aware that there is a lot of work going on. As you near your location, you become more and more aware of how difficult it will be to locate parking. (Allen 2018)

What if, however, there existed a parking situation forecasting software that could provide up to a 5-hour head start? In this situation, Eventflow is useful. They are a business that specialises in event forecasting and predictive analytics. (*Benjdira et al.2022*) Their software forecasts everything from traffic jams and roadblocks to parking availability and truck driver rest breaks. Then, this data is made accessible using a simple HTML5 visualisation tool that can be accessed via an open API. (*"Artificial Intelligence-an overview | ScienceDirect Topics" n. d.*)

By planning deliveries more efficiently, avoiding congested locations, and minimising the need for new building, artificial intelligence helps ease traffic congestion. Smart cameras at intersections can automatically recognise several types of road users, including automobiles, bicycles, and pedestrians. Systems for traffic management should be modified to account for road users' needs, such as traffic at schools or the state of the air. For instance, the system would need to divert traffic if there was an accident on a particular road. (*Atske 2018*)

Everyone is particularly concerned about emergency circumstances. It is crucial in these situations that the government is able to respond swiftly and effectively to safeguard the safety of all citizens. Agencies will implement an Integrated Traffic Management System to achieve this (ITMS). The ITMS will automatically control the traffic light and alert drivers to detours. In order to facilitate speedy access to emergency vehicles like ambulances and fire tenders, the new system will be crucial. Additionally, the ITMS will advise drivers on detours to take if there is any congestion up ahead. (*Sukhadia et al.2020*)

AI-assisted transit planning can improve the efficiency of buses, trains, and ferries while reducing travel times and

traffic congestion. (Hou 2021) AI assists planners in determining the most effective mode of transportation and route for a given area. Artificial intelligence can be employed to more efficiently route buses and trains in order to enhance public transportation. For the staff members of the transportation authority who are in charge of planning the routes, AI also makes better schedules. (*Hou 2021*)

A wide range of technologies and fields are being advanced thanks to artificial intelligence (AI), which is at the core of many innovative services. Among these is the field of transportation. AI can be used to make transportation quicker, more dependable, efficient, and safe. It allows engineers and drivers to automate processes and can aid in decision-making at all levels, from the individual to the global.

Since the adoption of AI technology in the transportation industry, a lot of things have gradually changed as a result of the various advancements AI has brought. Many businesses utilise artificial intelligence (AI) to forecast collisions based on environmental and other parameters. AI is being used to anticipate accidents.

The merging of artificial intelligence with electric vehicles is another fantastic advancement (AI). As they emit fewer emissions, electric cars significantly reduce environmental pollution. Connect Transit, which uses electric buses with AI integration, is a fantastic example of this.

Additionally, the development of self-driving automobiles with traffic detection capabilities is thanks to artificial intelligence (AI).

The role of AI in transportation

Artificial intelligence (AI) is easing people's lives and improving various forms of transportation by assisting them to operate autonomously and enhancing their safety, cleanliness, intelligence, and efficiency. The value of the worldwide AI transportation market was 4 billion dollars in 2017 and is expected to increase by 3.5 billion by 2023, according to research. These regulations cover electronic freight transport information and standardised digital reporting for ships, both of which are intended to streamline information exchange processes between ships and ports. There appears to be no end in sight to the fast urbanisation that is pushing city populations up across the largest continent in the globe as cities all over Asia are expanding enormously. Large influxes of people moving from rural areas to metropolitan areas put a constant strain on road and traffic systems, and traffic management is a particularly difficult task.

Since AI technology was introduced in the transportation industry, many things have slowly changed as a result of the various advancements AI has brought. Many businesses utilise artificial intelligence (AI) to forecast collisions based on environmental and other factors, and AI is also used to predict accidents. The combination of electric vehicles and artificial intelligence is another fantastic advance (AI). Connect Transit, which employs electric buses with AI integration, is an excellent example of how electric vehicles

significantly help in the reduction of environmental pollution because they have a lower rate of emission.

Additionally, the development of self-driving automobiles with traffic detection capabilities is thanks to artificial intelligence (AI). Because self-driving cars can recognise the pathways of pedestrians and bicycles thanks to artificial intelligence (AI), fewer traffic incidents will occur. This significantly improves road safety.

Artificial intelligence (AI) can be used to alleviate traffic congestion on roadways, resulting in smooth traffic flow. Many smart cities across the world utilise AI traffic management systems to monitor traffic flow, and with the use of AI, drivers can be alerted about hazardous areas on a given road or route. AI is also capable of foreseeing traffic jams and potential security issues.

Although it is still in its infancy, artificial intelligence (AI) in transportation has the potential to completely transform the industry. The rate of adoption of AI in this field has been impacted by trust. The lack of effective regulation, certification, and standardisation of AI tools in the transportation industry exacerbates the lack of trust. However, acceptance of AI in transportation will come after public policy on AI has fully developed since safety will be guaranteed and as a result, confidence will be rebuilt.

Drivers in the huge metropolis of Delhi, the capital of India, spend up to 58% more time trapped in traffic than drivers in any other city in the world. The issue is only getting worse, therefore city officials are motivated to identify a practical remedy. They discovered a new intelligent traffic control system powered by artificial intelligence as a result of their quest (AI).

In order to gather and analyse traffic data, come up with ideas, and implement those solutions on the traffic infrastructure, intelligent traffic management systems use AI, machine learning, computer vision, sensors, and data analysis tools.

2. Conclusion

In conclusion, the transportation industry is one of the most significant economic sectors, and as artificial intelligence (AI) develops, everyone will profit from decreased accidents, decreased pollution, and increased efficiency. Usually, when people think of artificial intelligence, they think of smart devices, speech recognition technology, search engines, and even healthcare. But what about traffic management? If the story's headline perplexes you, we have some exciting news on how AI is about to transform India's terrible traffic in places like Delhi, Bangalore, or Mumbai. By removing bottlenecks and signalling mistakes that regularly congest our urban highways, AI-based traffic management is poised to completely transform urban transportation.

The two-pronged AI gear will aid in dealing with bottlenecks, shorten decision times, anticipate traffic patterns, and of course, enforce traffic laws. For drivers, pedestrians, and commuters alike, it will make our roads

safer. The AI-driven solution is anticipated to lower pollution levels and minimise carbon emissions by cutting down on time spent in traffic. The AI systems should be a blessing for us as private car traffic grows in all Asian cities, with Indian metros in particular.

In reaction to shifting traffic circumstances, ATCS will adjust traffic signal cycles in real-time using the data from ITMS cameras. This is only in place in part. When ATCS is completely operational, traffic signal wait times will be practically cut in half! Additionally, it will assist city traffic authorities in understanding local traffic conditions and trends throughout the city, assisting them with a variety of services from planning flyovers to sending more staff at problem areas.

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