

ARTIFICIAL INTELLIGENCE IS PAVING THE WAY FOR THE DEVELOPMENT OF INTELLIGENT TRANSPORT SYSTEM IN INDIA - AN EMPIRICAL STUDY

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Abstract:

With the rapid urbanization, smart city concept is becoming popular day by day. One of the major elements of the smart city is its transportation system. To make the traffic management system better different technologies have been used in different developed countries. However, the scenario is different in many developing countries. They have to face several challenges when it is about to implement an Intelligent Transportation System. The aim of this is to shed light on those challenges faced by developing nations. The study will also explore how emerging technologies in Artificial Intelligence and Deep Learning can help the developing countries to overcome all of their challenges as well as current problems in the transportation sector to make their life better, safer and easier. The Indian cities largely lacks of Intelligent Transport System in India and there are various problems such as inefficient public transport system, severe congestion, increasing incidence of road accidents, inadequate parking spaces and a rapidly increasing energy cost etc. Therefore, development of Intelligent Transportation System is essential for smart cities due to concerns regarding the environmental, economic, and social equity. Artificial Intelligence is a key technology to resolve these issues. Therefore, there is an urgent need to adopt Artificial Intelligence system for development of Intelligent Transport System to better understand and control its operations in smart cities. Hence, the main objective of this study is to present some basic concepts of Artificial Intelligence and its applications for development of Intelligent Transport System in smart cities in India.

Keywords: Artificial intelligence, smart city, intelligent transport system

Introduction:

The transportation industry has evolved a lot in the past decade. The integration of the web and software applications has revolutionized the way it functions. However, it still is far from perfect. There still are instances of accidents, air-crashes and miscalculation of journeys such as timing of signals, as well as navigation routes. These may be caused by factors that cannot be predicted such as weather conditions, sudden public gatherings on the road and perhaps even

human errors. However, these unpredictable instances can be handled accurately with the adoption of Artificial Intelligence.

Implementing AI in the transportation industry can be used to collect traffic data and reduce road congestion as well as improve the process of scheduling public transport. This technology will also enable traffic light algorithms to operate based on the amount of traffic. For example, the red light can be turned on for longer durations of time if there is a high amount of traffic and the green light can be turned-on if there are just a few vehicles on the road. AI can also be applied to public transport for appropriate scheduling and routing of the fleet. The United Nations estimates that the urban population of emerging economies across the world, the stride of migration from rural to urban areas is increasing. Artificial intelligence has emerged as the go-to technology when it comes to solving the many complex challenges that the transportation sector faces.

In 2050, about 70 per cent of the population will be living in urban areas, and India is no exception. Intelligent transportation system plays an essential role in today's world and is a vital extension for development of cities due to concerns regarding the environmental, economic, and social equity. Intelligent transport system move people and freight by emphasizing accessible, environmentally friendly, comfortable, affordable and accessible with integrated various transport modes which is safe and operates at suitable speeds without compromising the future needs.

However, at present there are various problems involved in Indian cities such as severe congestion, deteriorating air quality, increasing incidence of road accidents and a rapidly increasing energy cost due to present traffic management, the city largely lacks of Intelligent Transport System in India. As the number of vehicles increased everyday on Indian roads, the average motorists spend hours in traffic jam due to due to lack of urban planning, traffic mismanagement, and parking control which leads to billions of rupees wasted every year in major cities of India. Most of the major cities in India, due to lack of Intelligent Transport System faces various problems like accidents, environmental degradation, congestion; overcrowding and parking space etc. Today India leads the world in traffic accidents and also has the highest fatality rate of traffic accidents in the world.

Hence there is urgent need to develop intelligent transport systems in smart cities proposed to be developed in India for traffic control management and to tackle the rising menace of road accidents and fatalities. Artificial Intelligence is a key technology for development of Intelligent Transport System in smart cities to better understand and control its operations and optimize the use of limited resources in smart cities.

Hence, the main objective of this study is to present some basic concepts of Artificial Intelligence and its applications for development of Intelligent Transport System in smart cities in India.

Artificial Intelligent system is a key technology for improvement of traffic management & control, traveller information system i.e. real-time traffic information provision route navigation systems, parking information etc. It maximizes the capacity of transport system applying real time traffic data. Traffic signal lights can improve traffic flow significantly,

reducing the need to build additional highway capacity, reducing stops by as much as 40%, reducing travel time by 25%, decreasing fuel consumption by 10% and thereby reducing the carbon emission. This study will be useful for engineers and planners to develop efficient transport system in smart cities in India.

Literature Review

Ganeshkumar and Ramesh (2010) designed Emergency Response Management and Information System (ERMIS) for Madurai city, Tamil Nadu. In this study a detailed GIS database of transportation network, accident locations, hospitals, ambulance locations, police and fire stations was prepared and spatial analysis was also carried out for accident records of years 2004–2008. Route finder was designed to find shortest, time saving routes and service areas.

Purushothaman et al. (2011) proposed a similar GIS based Emergency Response Management System for Mysore City, India. The developed system provides the network based spatial analysis such as connectivity, finding paths, allocation, finding the neighbouring facility, defining service areas, dynamic segmentation.

Kumar et al. (2005) developed a GIS based advanced traveller information system for the Hyderabad city, India under Arc View GIS environment. GIS-enabled modules for the shortest path, closest facility, and city bus routes were incorporated in the system. The developed system provides information about fundamental facilities in Hyderabad City.

Logi and Ritchie (2001) described a real-time Knowledge Based System (KBS) for decision support in the assortment of integrated traffic control plans subsequent to the occurrence of non-recurring congestion. In this study, two algorithms were developed i.e. data fusion algorithm for the analysis of congestion and an algorithm for the selection of control plans. The substantiation results showed that by the use of Traffic Congestion Management (TCM) travel time reduced between 1.9% and 29.0% and typical stop speed reduced between 14.8% and 55.9%.

Faghri and Hamad (2002) studied the use of GPS in traffic management. In their study application of GPS was implicated in collecting traffic data such as travel time, speed and delay on 64 major roads in the state of Delaware. When mean and variance of the results obtained by both the methods were compared and no significant difference was observed. GPS data was found to be 50% more efficient in terms of manpower.

Hernandez et al. (2002) incorporated the use of artificial intelligence techniques in traffic management and gave a multivalent architecture for intelligent traffic management systems. Two multi-agent knowledge based systems, In TRYS and TRYSA2 were developed to perform decision support for real-time traffic management. The performance of both the systems was evaluated and general applicability of multi-agent architectures for intelligent traffic management was given.

Zhenlin et al. (2012) studied the efficiency of the Beijing Intelligent Traffic Management System (ITMS). In this study urban transportation systems, socio-economic system and energy environment system were taken as the input system and the road traffic management efficiency and urban transport putting indicators as the output system. The field data of Beijing from 2000

to 2010 are used for empirical analysis. The results of the study showed that the ITS improved the overall efficiency of the Beijing transportation.

Artificial Intelligence System:

Artificial Intelligence (AI) is the science of making machines or systems do things that would require intelligence if done by men. The main objective of the Artificial Intelligence system is to create intelligent machines and through this, to understand the principles of intelligence. Artificial Intelligence system is suitable when a direct mathematical relationship cannot be established between cause and effect. Artificial intelligence system models capture the uncertainty between real-life cause and effect scenarios by incorporating available knowledge with probabilities and probability inference computations. Artificial Intelligence system is dealing with both qualitative as well as quantitative data. Artificial Intelligence system may be categorised in two types (i) Symbolic which focuses on development of Knowledge Based system (ii) Computer intelligence which includes methods such as neural network, fuzzy system and evolutionary computing.

AI provides these benefits to the Transportation Industry:

Traffic Management: Sensors and camera can be installed at different points down the road. These devices collect data and sent them to the cloud in real-time. Analysis can be done on the inputs of data and by using an AI-powered system. The data can then be processed to offer valuable insights on traffic. For example, data can be collected on the number of vehicles on a stretch of road at a particular time, the types of vehicles and the occasions of accidents if any. A pattern can be identified to provide important predictions on traffic, places of accidents and road blockages.

Flight Delay Predictions: A big predicament faced by Air Transport Industry is the instance of a flight delay. Billions of dollars have been reported as losses because of this. Several tickets have been cancelled and at times air travel operators have even been taken to court as a result of flight delays. Along with financial loss, delay in flights can spoil the flying experiences of travellers. Artificial Intelligence can help overcome these issues. AI and machine learning components can process real-time airplane data, historical records and information on weather. These can be combined with the monitoring of airplanes using computer vision systems. All these can reveal hidden patterns and identify possibilities that can cause flight delays as well as cancellations.

Automated Process: An automated vehicle is a trend that is slowly picking up. But until that milestone is completely achieved, other aspects of transportation can be automated. Devices can be set up at the entrances of public transport which issue tickets to passengers as soon as they board the vehicle. Hence the task of hiring a conductor won't be necessary. Besides the reduction in expenditure, manual process of fares is a tedious process and can be done away with.

Artificial intelligence can help create safer, greener transportation systems:

Artificial intelligence is playing an effective role in helping the transportation sector overcome many challenges including: passenger safety, traffic congestion, accidents, carbon emissions, and costs

Safety with artificial intelligence: Using artificial intelligence, it has become possible to track real-time data which when harnessed provides actionable insights to police personnel who can predict and prevent criminal activities. This enhances passenger security. Similarly, tracking real-time data from autonomous vehicles enables just-in-time interventions to prevent accidents and ensure passenger security. Smart roads that capture pedestrian and vehicular data are helping reduce traffic congestion and minimizing accidents by suggesting alternative routes and estimated wait times at traffic signals.

Many people find it difficult to drive after work. In such cases autonomous vehicles can ensure tired personnel get a break from driving and can snooze in the car without risking themselves or others on the road. Similarly, artificial intelligence powered autonomous vehicles can be beneficial for people who find it difficult to drive at night. Artificial intelligence also helps track patterns to identify and catch the erring drivers—drink and drive cases or texting behind the wheels—which makes roads safer for everyone.

Management and maintenance: Not just private vehicles, artificial intelligence can also benefit public transport by enabling decision-makers to leverage data and schedule public transport fleets smartly. Smarter algorithms in traffic lights can help gain insights into the traffic patterns of a given location at a given time. This is helping schedule and reroute traffic for better traffic management and decongestion of roads. Further, using high-end image processing techniques, artificial intelligence can help identify passages, pavements or bridges that need immediate attention and prioritize maintenance and rehabilitation activities. In addition to autonomous trucks, electric vehicles, and driverless trains, smart rails that run on virtual painted tracks monitored using the software on board the train are being tested in many countries.

The benefits of artificial intelligence in transport are not limited only to land-based transport systems. Unmanned, remote-controlled freight ships are being developed with a view to eliminate the need of crew being onboard and to allow more space for freight. This helps keep the land-based crew out of the dangers of the sea. Similarly, artificial intelligence is powering facial scanning of passengers at airports to allow them to onboard planes without the need to carry passports.

Curbing environmental pollution: One of the biggest challenges the transportation sector faces is that of environmental pollution. Decongestion of roads using artificial intelligence allows for the reduction in environmental pollution. Further, the development of innovative engineering techniques is making it possible to manufacture electric vehicles and other low emission vehicles. In addition, data tracking is enabling the identification of polluting vehicles to enforce appropriate action.

Reduce costs, enhance efficiency: By improving manufacturing processes, automating routine tasks, and enabling predictive maintenance, artificial intelligence is helping vehicle manufacturers to reduce costs and improve efficiency.

With greater adoption of the latest technologies such as 5G, edge computing, cloud, and IoT in the transportation sector, we can expect device-level decision-making, which will help make a safer, greener and sustainable transportation system of the future.

Advantages of the Artificial Intelligence in developing transport system:

Some of the advantages of the Artificial Intelligence in developing transport system may be summarised as follows:

- Artificial Intelligent is useful solution for design, construction, maintenance, and time scheduling of transport system.
- It can be used better and faster models for solving complex problems of transport system involving huge volume of data such as airways, roadways, railway and waterways.
- It can be formulated and adopted to ensure proper use of available resources.
- It helps to converting traffic sensors into intelligent agents that can automatically detect and report traffic accidents or predict traffic conditions.
- It is more reliable system for assessing and predicting traffic conditions.
- It can be used to review and evaluation of transport technology.
- It can be used to analysis of traffic demands and analysis & simulations of pedestrian and herd behaviour.

Challenges in implementing Artificial Intelligence System

However, there are a number of challenges involved in developing and deploying Artificial Intelligence in smart cities in India. Artificial Intelligence System face a range of challenges, including system interdependency, network effect, scale, funding, political, institutional and other challenges. Some of the challenges in implementing Artificial Intelligence System in India are as follows:

- Artificial Intelligence System challenges include a lack of expertise within local and regional transportation agencies with regard to the technologies underlying intelligent transportation systems and their implementation.
- A lack of technical standards for Artificial Intelligence technologies makes it difficult to ensure that systems purchased by different localities can be integrated.
- Establishing Artificial Intelligence System standards and comprehensive data collection system for applicable throughout the urban and rural sections of India.
- Designing an Artificial Intelligence System that encompasses the heterogeneous vehicle population.
- Government setting up rules and regulations of traffic that will aid in Artificial Intelligence System implementation.
- Setting up active interaction between academia, industries and governmental agencies.

Development of Intelligent Transport System in Cities:

- Smart Public Transport System
- Intelligent Traffic Management and Control System
- Smart Traffic Information System
- Safety Management and Emergency Systems
- Smart Parking Management System
- Smart Pavement Management System

Application of Artificial Intelligence for development of transportation systems:

- Artificial Intelligence system include applications such as automatic vehicle location which enable transit vehicles, to report their current location, making it possible for traffic operations managers to construct a real-time view of the status of all assets in the public transportation system.
- It can be used for monitoring the vehicles which will be useful to reduce traffic congestion and thus, saving the travelling time.
- It can be used to provide commuters and operators with current information so they can avoid congested routes.
- It can be used to provide commuters with arrival and departure information of transit vehicles.
- It can be used to make public transport system more attractive option for commuters by giving them enhanced visibility.
- It can be used to represent an emerging new infrastructure system, from which new products and services are likely to emerge.
- It can be helpful for transit network operators to take decision, for choosing the route when to travel.
- To deploy and enable a communications infrastructure that supports vehicle to infrastructure as well as vehicle to vehicle.

Conclusions:

The important conclusions based on this study are summarized as follows:

- There is an urgent need for developing smart cities in India that can cope with the challenges of urban living.
- Transport system in smart cities should be accessible, safe, environmentally friendly, faster, comfortable and affordable without compromising the future needs. The Indian cities largely lacks of intelligent transport system and there are various problems such as inefficient public transport system, severe congestion, increasing incidence of road accidents, inadequate parking spaces and a rapidly increasing energy cost etc. Therefore, development of intelligent transportation system is essential for smart cities due to concerns regarding the environmental, economic, and social equity. Artificial intelligence system is a key technology to resolve these issues. Therefore, there is an urgent need to adopt artificial intelligence system for development of intelligent transport systems to better understand and control its operations in smart cities.
- This study reviews the basic concepts of Artificial Intelligence. This study also identifies various sub-systems of Intelligent Transport System i.e. smart public transport system, intelligent traffic management and control system, smart traffic information system, safety management & emergency system, smart parking management and smart pavement management system in smart cities. This study also presents application of Artificial Intelligence for development of intelligent transport systems in smart cities in India.

- There is an urgent need to develop smart public transport system for smart cities in India. This study identifies various sub components for developing such a system. These components are en-route public transit information, automatic vehicle location, smart travel security and smart revenue management which enable transit vehicles to construct a real-time view.
- There is an urgent need to develop intelligent traffic control and management system for smart cities in India. This study identifies various sub components for developing such a system. These components are intelligent traffic control, traffic demand management, emission testing and mitigation, electronic payment management and incident management for effectiveness of the use of existing infrastructure.
- There is an urgent need to develop smart traffic information system for smart cities in India. This study identifies various sub components for developing such a system. These components are pre- trip travel information, en-route travel information, and route guidance to provide real-time travel and traffic information such as transit routes and schedules, navigation directions, and information about delays due to congestion, accidents, weather conditions and road repair.
- There is an urgent need to develop a smart parking management system for identification of vacant spaces for parking and even allow drivers to reserve spaces in for parking for smart cities in India.
- There is an urgent need to develop safety management and emergency system for smart cities in India to increase the efficiency of service in an emergency situation and to improve the safety of travel.
- There is an urgent need to develop smart pavement management system for redesign and management of street as per the requirements of different transport modes in smart cities.

The application of Artificial Intelligence in developing intelligent transport system in smart cities will involve a joint effort of transportation experts and computer engineers. It is expected that this study will be useful for planners and engineers so that AI system can be formulated for development of intelligent transport system in smart cities in India.

This study concludes that Artificial Intelligence system needs to be adopted to develop smart public transport system, intelligent traffic management and control, smart traveller information system, smart parking management and safe mobility & emergency system in smart cities. It is expected that this study will pave the way for development of Intelligent Transport System in smart cities in India.

There is scope for evaluating existing ideas in different and challenging traffic scenarios, innovate new solutions and empirically evaluate ideas in collaboration with public and private sectors

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