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Implementation of Artificial Intelligence in Traffic Management

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ABSTRACT: In today's world, transportation is one of the most integral parts of the economy. The advancement in the field of technology has had a significant impact on transportation systems. The number of vehicles has significantly increased over the years leading to frequent traffic congestions especially in urban areas. There are many reasons for road traffic congestions such as poorly planned road infrastructure, bad road conditions Etc. Road traffic congestions can be handled better by the implementation of smart traffic management techniques. These involve use of artificial intelligence-based techniques which mainly aim at avoiding the traffic congestions. The systems make use of cameras to collect data such as images and videos and process them for detecting traffic congestions. Almost all majority of developed cities have cameras on road junctions which would be used for traffic management.

KEY WORDS: AI (Artificial Intelligence), Smart traffic management, AI techniques, cameras, Road traffic detection.

I. INTRODUCTION

Road traffic has increased significantly over the years in Many developing and developed countries. This has led to cities witnessing frequent road traffic congestions especially during the peak hours of the day. Traffic has huge implications on the lives of people and also the environment. People have increased stress leading to many health issues, there is an increase in fuel usage hence leading to more pollution.

Traffic problems require real time solutions using real time data. The timer-based traffic signals which are majorly in use today are mainly just based on timers so there is no real time traffic management, hence these may lead to even more problems than providing solution Therefore, these are not efficient. Smart traffic management systems can be a solution as they may provide real time solutions and are adaptable to the various environments. Artificial intelligence can determine the road traffic density and automate the signals accordingly. AI uses real time data of the number of vehicles on road unlike those used in conventional traffic signals which are based on timers. Traffic prediction in advance can be a significant factor in traffic management. Machine learning which is a part of artificial intelligence can be used for predictability. Predictions can be done using machine learning algorithms.

Also, the traffic management systems can implement the IoT (Internet of Things) devices in traffic signals and traffic lights which can communicate data using communication technologies. IoT devices detect the number of vehicle movement, Average speed of vehicles on road, various traffic patterns throughout the day and mainly presence of emergency vehicles such as ambulance, fire engines, police vehicles etc. all these data are analysed and decisions can be made using algorithms.

II. RELATED WORK

The transportation industry has grown tremendously in recent years. The growing number of automobiles is challenging for current traffic management systems to handle. Traffic issues may be addressed using AI techniques. Many functions, including speech recognition, image processing, facial identification, and problem solving, may be carried out by AIbased systems. AI-based devices can reason, solve problems, learn, and see objects thanks to programming. Traffic lights can be automated using artificial intelligence. AI uses sensors, Cameras, Google Maps etc. to predict traffic and activate automatic traffic signals accordingly. Various cameras count traffic on every road based on analysis of image patterns. A camera with a multidimensional infrared sensor and a colourless sensor is used here. Information such as the number of vehicles, traffic volume, and traffic patterns can be analysed and collected and

stored in the cloud. This information can be used for traffic control and management. In an AI based intelligent traffic management system, cameras and sensors detect vehicles and send the information to the traffic control centre. Traffic control centres use algorithms to calculate traffic on roads based on live camera feeds. Traffic lights are then modified based on real-time traffic congestion.
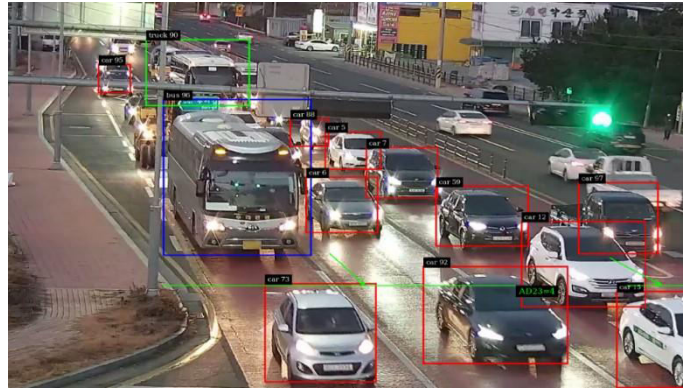

Figure. 1: Traffic Detection

One of the necessities of these AI based traffic management systems is that this type of system requires a significantly huge amount of data to be collected. A lot of these data can be obtained from the existing infrastructure and traffic control systems. We may also obtain information from a driver's or passenger's mobile phone. There are many cameras installed along the road, which is another source of information. Induction loops allow you to detect when a vehicle passes by, so you can get more information. Drivers can send updates using their smartphone's navigation software. Some of these surveillance technologies are already in place, such as inductive loops, while others need to be installed as part of the infrastructure, such as cameras that can track traffic. The main challenge is to use this information effectively. This can be achieved with machine learning algorithms. Intelligent traffic management systems also include features such as highdefinition CC cameras that identify people violating traffic rules and automatic number plate recognition cameras can detect vehicle numbers, by these real time traffic can be monitored effortlessly. Traffic control centres get real time data and hence law enforcement, immediate response to any kinds of emergency can be done in a much faster and efficient manner.

A. SCALABLE URBAN TRAFFIC CONTROL (SURTRAC)

An intelligent traffic management system that integrates traffic theory with AI is called Surtrac. Based on current traffic circumstances, Surtrac technology manages traffic signals. Surtrac facilitates smoother traffic flow by assessing real-time traffic on the road to optimise traffic signal performance. Surtrac can adjust to changes in traffic. It has been demonstrated that Surtrac is more effective than conventional timerbased traffic control systems. Surtrac technology schedules junction traffic lights by considering the intersection controller as a single device. A traffic control system powered by sophisticated AI is used in real-time by Surtrac technology. It has been used in the real world and has had excellent outcomes. Here's the way Surtrac traffic management system works: Surtrac technology works in the following steps:

Surtrac uses infrastructure such as cameras, radar, andinduction loops to record traffic at intersections.
Planning software is used to process information andmake schedule charts.
Issue instructions to the controller to adjust the lights inaccordance with a planned schedule charts.
Surtrac also communicates this data to its neighbourhoodsystems so that they may collaborate to create an optimisation strategy. Additionally, this data is sent to the linked cars, passengers, and pedestrians who might require it.
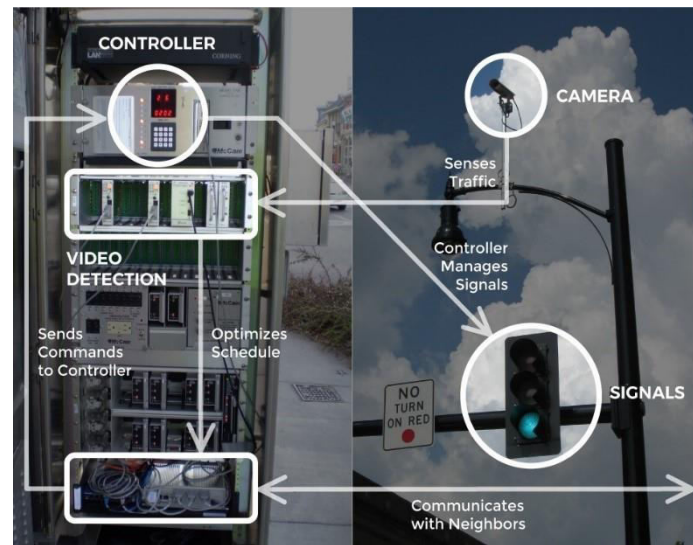
Figure. 2: Surtrac System

Surtrac technology performance report: Surtrac technology is used at 50 intersections in Pittsburgh. After using the surtrac technology, the following changes were seen:

- Thanks to surtrac technology, travel times are cut by a significant amount, and people reach their destinations 25 times faster than before.
- 40 percent reduction in waiting time: waiting time at traffic signals has been reduced by 40 percent.
- 30 percent fewer stops: Frequent stops due to traffic jams have decreased significantly.
- 20 percent reduction in emissions: reduced hazardous emissions from our vehicles by 20 percent, thereby decreasing pollution levels and improving the environmental quality.

B. USE OF INTERNET OF THINGS FOR TRAFFIC MANAGEMENT

The Internet is expanded via the usage of the Internet of Things. IoT may be used to access communication channels between numerous items, including automobiles, activators, cameras, and consumer gadgets as well as security sensors and cameras. In order to construct smart cities, IoT is being utilised to produce a variety of apps and offer a variety of services to the public and private sectors. Smart industries, hospitals, and households are just a few examples of these services. The Traffic management system uses algorithms to properly guide vehicles and handle traffic. This algorithm is used when congestion is detected. IoT devices communicate with systems using various wireless communication methods such as WiFi. Based on current traffic conditions, it uses appropriate algorithms to calculate the best route for the vehicle to avoid traffic jams.

The following steps described below illustrates the traffic congestion problems.

Step: 1 Collect all necessary data with wireless communication technology.
Step: 2 Track vehicle data when the vehicle is stuck in traffic.
Step: 3 compensate the congestion accordingly using an appropriate algorithm.
Step: 4 AI technologies will be implemented to allow vehicles to travel on different routes to avoid traffic jams.
Step: 5 using an IoT device, the vehicle is sent route instructions such as on which lane it should drive.

C. TRAFFIC CONGESTION FORECASTING SYSTEM US-ING ARTIFICIAL NEURAL NETWORKS

Artificial neural networks are described as "computing systems inspired by the biological neural networks that constitute animal brains" (Artificial Neural Networks, or ANNs for short). This technique makes use of techniques replicating biological neural network by guiding vehicles to avoid congestion and so guaranteeing optimal traffic flow, this type of AI can be used to assess the condition of traffic on the road, both longterm and short-term depending on the programme. Smooth traffic flow can be ensured by implementing these techniques.
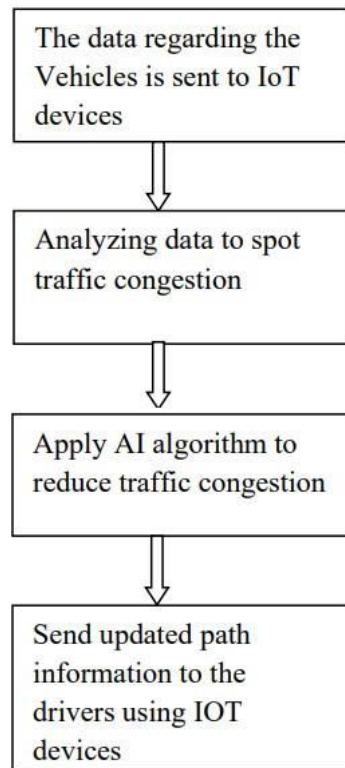
D. MACHINE LEARNING FOR TRAFFIC PREDICTIONS

Figure. 3: Flowchart of IoT for Traffic Management.

Artificial intelligence includes machine learning, which is crucial. The usage of related machine learning methods enables software applications—which are not externally supplied by users to generate absolute outcomes for each given computation. Artificial intelligence machines have the ability to develop results and conclusions based on information, recognise patterns, and make decisions without any human involvement. Due to the fact that the input is always being uploaded concurrently, the related result is likewise updated without human contact.

Trying to forecast traffic is really difficult. There are various ways to minimise traffic, including controlling traffic lights, keeping an eye on traffic via CCTV cameras, and other techniques. These traffic prediction approaches cannot resolve issues if there is a user emergency to respond to and a significant percentage of available data is meaningless. Machine learning techniques are utilised to give guidance and forecast real traffic. Prediction of traffic patterns is one of the key elements that can be a solution to traffic congestions.

III.ADVANTAGES OF USING AI IN TRAFFIC MANAGEMENT

Many traffic operations can be greatly enhanced. The traffic light system operates in accordance with a predetermined pattern that is fully independent of the present traffic condition, yet every driver who must wait at a traffic light for minutes at a time can relate to this.

Figure. 4: Iot Implementation.

- Using artificial intelligence, Machine learning and IoT techniques Helps eliminate traffic congestion Problems for traffic lights to function on the basis of number of vehicles on road at a given point of time.
- Use of intelligent traffic congestion management has Proven to reduce wait times, number of Signals, travel time and vehicle emissions.
- Using machine learning techniques Traffic forecast helps predict more accurate traffic. Other method are not this effective and accurate to estimate traffic jam.
- As there is less involvement of humans, thus the amount of error in traffic predictions and management will also be reduced.
- AI-enabled systems are also being implemented in many self-driving cars tesla for example. This also uses techniques for traffic congestion avoidance.

IV. LIMITATIONS OF USING ARTIFICIAL INTELLIGENCE

For AI to learn things, it first needs data. In this respect, AI and machine learning are similar. Both require large amounts of high-quality data to monitor behavioural patterns and trends, as well as the ability to rapidly adjust and maintain the accuracy of conclusions drawn from analysing the data. So, when you get the data, you get the AI. Such systems do not need as much information as humans do. Hundreds of thousands of times more information is required to understand a concept or recognize a function

- AI cannot work completely independent, needs human interaction: Artificial intelligence are not completely independent systems as they would also require human assistance and support.
- Requires Experts for Implementing AI tools: AI implementation would require people to adapt to the new technology and gain skills in them for systems to work efficiently.
- Data security: AI based systems collect an enormous amount of data. Hence there may be misuse of the data which are collected. It is not easy to monitor such large amount of data and keep track of them.
- Implementation is difficult: Implementation of such systems cost higher and implementation of these smart traffic systems especially in developing and underdeveloped countries are difficult.
- Error Detection: Although AI can be reliable, it is not always completely reliable as errors can be encountered in AI based traffic management systems too. Recognition of these errors and resolving them are a huge task.

V. CONCLUSION

Like all technologies, A.I. has its strengths and weaknesses. AI has been in development for years and is trending across all fields. As of 2023, Artificial intelligence is bigger and wider than ever before. People these days can use AI. to change their lives and make life easier and more luxurious. AI is being heavily used to solve next-generation transportation problems. It plays an important role in alleviating traffic congestion and improving people's lives. The presently implemented AI based traffic management systems have shown good results. Video detection technology became a new milestone in of Traffic management because of its dependability. However, the cost of implementation of artificial intelligence-based traffic management systems, installations, maintenance, can be higher. But implementation on a larger scale and increasing efficiency of these systems may overcome such limitations.

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