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ARTIFICIALINTELLIGENCE BASED AUTOMATEDTRAFFIC MANAGEMENT SYSTEM

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Abstract

Transportation is the cornerstone of our economy. The advancement in computer technologies plays an important role in the evolution of the smart transportation system. As there is a vast increase in the number of vehicles, the probability of occurrence of traffic congestion is also more. This traffic problem continues to be a major problem in many of the developing cities throughout the world which occur due to the poorly planned road network. This problem mainly occurs at peak times that may be going to offices, colleges or schools and way back to home. This traffic problem can be avoided by implementing smart transportation management techniques. When the problem occurs the smart traffic monitoring approach is used to avoid congestion. By using this approach the status of the emergency vehicles can be identified which can reduce the congestion. The main aim is to get rid of congestion. The traffic congestion can also be detected by capturing the images using cameras which are present at various locations in the developing cities.

I.   INTRODUCTION

In most of the developing countries, the biggest mode of transport is roadways. In many countries, mostof the transport is carried outthrough roads. This includes both industrial transport as well as passenger transport. With the fast-growing world the number of vehicles is also increasing. Traffic jams affect our modern, fast-moving lives.According to a study the average person spends about 42 hours going to and coming back from work every year. In metropolitan cities, the number is very big. A study says that on average, a person spends 30 minutes to two hours of their day for driving. This means, 360 hours per year. Traffic jams cause a lot of stress and unnecessary burden on people. Everyday people struggle a lot to avoid traffic, pollution and rash drivers which is one of the main causes of stress and psychological problems. And a lot of money is spent on fuel idling in traffic. The number of vehicles in the world may become double in the coming years due to this traffic congestions may increase further. It is expected that the number of vehicles in the world in the year 2035 may reach 2 billion. Even with the construction of new roads and bypasses, it is

not possible to dodge traffic in cities due to increasing vehicles.Traffic problems in cities require real-time, high solution data. Hence they require modern traffic management systems. The jam bursting measures used currently react slowly to changes in weather conditions and road conditions. The traffic signals that are used today are based on timers. They are not efficient to reduce traffic problems as they are based on synchronization hence stopping the vehicles from moving freely. The number of vehicles on the road varies from time to time. It is not always the same. For instance, the traffic during weekdays may not be the same as the traffic during weekends or vacations. The traffic lights used today work based on timers irrespective of the number of vehicles waiting at the junctions. Hence traffic lights based on timers are not efficient. Self-driving cars are a solution to traffic problems because these vehicles react faster than humans and drive less erratically thereby avoiding accidents. But they take a lot of time to make an impact on our roads. Meanwhile, it is necessary to cope with increasing vehicles. Modern traffic management systems are required to keep all the vehicles moving. The system must be adaptable and react instantly.

The problems that cause traffic congestion vary from one city to another. The traffic is affected by various factors. So, a single solution cannot solve traffic problems. Unfortunately, there are many solutions that are capable of solving traffic problems. The aim is to reduce the traffic by developing advanced and smart traffic signals using Artificial Intelligence that can determine the density of traffic on the roads and automate signals accordingly. Artificial intelligence-based systems work according to the volume of traffic on roads, unlike the convectional traffic signals that work based on timers.

Artificial Intelligence is being used at various places in the name of innovation. Artificial intelligence can solve multiple problems. Artificial intelligence is capable of solving most of the world's problems. New communication technology can be combined with Artificial intelligence to process large amount of data in real-time. It helps us to free blocked roads so they can cope with the increasing number of vehicles. A single solution cannot fix the world's traffic problems. To reduce traffic congestions the traffic must be predicted first. Traffic prediction is always a big challenge as it must be very accurate. Machine learning is a part of artificial intelligence. With deep machine learning, we can improve predictability. We can predict the traffic by using machine learning algorithms. In the proposed system, the objects on road like traffic signals, traffic lights, are equipped with Internet of Things (IoT) devices. The IoT devices collect traffic-related information which can be communicated by using new communication technologies. IoT devices detect the number of cars passing through the road, the number of traffic jams, the average speed with which

the vehicles are moving, anomalies in traffic patterns and the presence of ambulance, fire engines or any law-enforcement vehicles. The information is analyzed and used to make decisions using algorithms based on traffic intelligence.

A. Artificial Intelligence To Solve Traffic Problems

The means of transportation have evolved a lot in recent years. The existing traffic management systems have difficulty in coping with the increasing number of vehicles. Though we are in driver's seat or passenger's seat we face the same kind of situation during traffic jam the signals that never change, the long queues of vehicles, the stress of reaching on time. AI methods can be presented as a solution to traffic problems.

Artificial Intelligence is a branch of computer science that deals with building smart machines that are capable of solving problems that require human intelligence. Artificial Intelligence is the simulation of human intelligence by machines that gives them the ability to solve problems take automated decisions and to act rationally. AI- based machines can perform many tasks such as speech recognition, image process, face recognition and problem-solving. AI-based machines are programmed to be capable of solving problems, reasoning, gaining knowledge, perceiving things.

Applying artificial intelligence methods in traffic management can help to solve many existing problems. The AI-based traffic management system can be installed as a part of the road and traffic infrastructure before self-driving vehicles are launched. In the existing situation, traffic police on the road operated the traffic signal. He leaves the way open for equal minutes to allow the traffic to flow freely. However, all ways don't have the same volume of traffic. So the ways should be opened for a particular amount of time depending on the density of traffic it has. Traffic signals can be automated by using Artificial intelligence. AI uses sensors, CC camera feeds near the signals, induction loops, Google Maps to predict traffic and make automated traffic signals to work accordingly. A large number of cameras will count the volume on all roads based on image patterns analysis. Here cameras with multidimensional infrared and colorless sensors are used. The information such as the number of vehicles, volume, and traffic pattern can be analyzed and collected on the cloud. This information can be used to control and manage traffic. In the smart traffic management system, traffic cameras and sensors detect vehicles and the information is sent to the traffic control room, where algorithms are used to calculate the volume of traffic on roads using the camera live feeds. Then the traffic light is changed based on the real-time congestions.

This model requires a lot of data. However, there is abundant data. We can get a lot of data from the infrastructure, traffic control system. We can also get information from

the mobile phones of drivers or passengers. There are many cameras along the roads which is another source of information. Induction loops can be used to get further information because when vehicles pass over them they can detect it. Motorists can send updates by using the navigation software on their phones.Some of this monitoring technology like induction loops already exists while others like cameras capable of tracing traffic must be installed as a part of the infrastructure. The biggest challenge is using this information effectively which can be done using machine learning algorithms.

The smart traffic management system also contains features such as high-resolution CC cameras to identify people breaking traffic rules and automated number plate recognition cameras to find the vehicle numbers. LED boards can be installed and signed with AI software and cameras to display real-time information about traffic conditions.

B. Surtrac Technology

Surtrac is a smart traffic management system that combines the power of AI and traffic theory. Surtrac technology controls the traffic signals based on the real-time traffic. Surtrac improves the performance of traffic signals by analyzing real-time traffic that is actually on the road allowing smoother traffic flow.
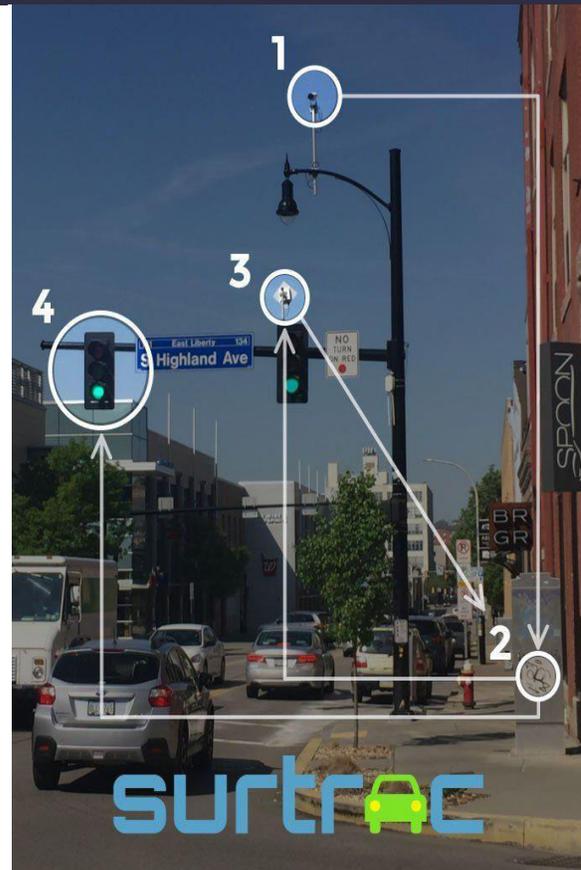
Surtrac can adapt to changes in traffic. Surtrac has proven to be efficient than traditional traffic management systems based on timers. Surtrac technology works by treating the junction control as a single machine scheduling the junction's traffic signal. It is also able to schedule neighbors ahead for the visibility of future input jobs.

Surtrac technology is a real-time application of the smart AI-based traffic management system. It has been implemented in real-world and has given significant results. It has proved to be much efficient than the existing traffic management systems.

How surtrac technology works:

Surtrac technology works by using the following steps:
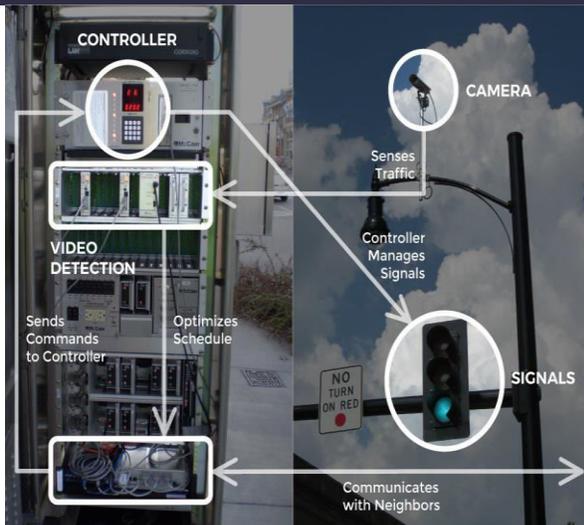
1. Surtrac senses the traffic at the junctions by using the infrastructure such as cameras, radars or induction loops.
2. The information is processed and the schedule is created by using scheduling software.
3. It sends commands to the controller to change the lights according to the optimized schedule.
4. Surtrac also sends this information to the neighbors so that they can co-operate and make their optimization plans accordingly. It also sends this information to connected vehicles, passengers and pedestrians who might need this information.

Performance report of surtrac technology:

Surtrac technology is used in Pittsburgh at 50 intersections. After using surtrac technology, the following changes have been noticed.

- **Journey time has reduced by 25%**
  After using surtrac technology, people reach their destinations 25% faster than before.

- **Delay decreased by 40%** waiting times at signals reduced by 40%.

- **Stops reduced by 30%**
  Frequent stops due to traffic jams have reduced.

- **Emissions reduced by 20%**
  The release of harmful emissions from vehicles has reduced by 20% hence improving the quality of the environment.

C. Internet of Things In Traffic Congestion

By using Internet of Things the internet gets extended. IoT can be used to access the communication channels among a wide range of devices such as monitoring sensors, vehicles, activators, surveillance cameras, and home appliances. Thus, IoT's are used for the development of a wide range of applications for providing varied services for both private and government sectors that result insmart cities. Such kind of services includes smart homes, smart hospitals, smart industries, and smart grids.

The system makes use of an algorithm to guide the vehicles in a proper manner so that the traffic can be managed. This algorithm is used when the congestion is sensed. By using different wireless communications such as Wi-Fi the IoT devices communicate with our systems. According to the current traffic conditions, the suitable algorithm is used to calculate the best possible route in which the vehicles should travel to clear the congestions.

The below described pseudo-code provides an explanation for traffic congestion problems.

STEP: 1 Through wireless communication technologies gather all the required data.

STEP: 2When vehicles are stuck in the congestion then track the data of the vehicles.

STEP: 3The corresponding algorithm is used to balancethe congestion accordingly.

STEP:4Artificial Intelligence techniques are implementedso that the vehicles can travel in different paths to avoid the congestion.

Step:5By using IoT devices the directions are sent to the vehicles in which path they have to travel.

(1). Structure for traffic congestion reduction

The below flowchart shows the structure that can be used to reduce traffic congestion
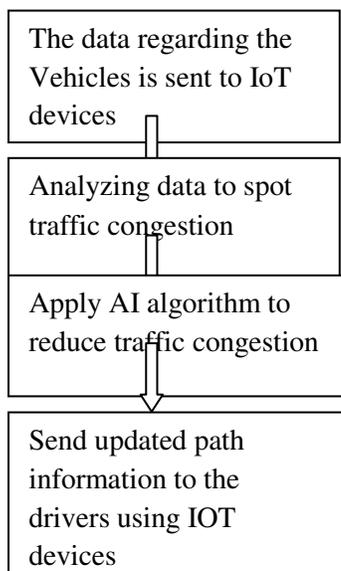
The IoT devices are also present at vehicle drivers. When the traffic congestions occur due to a vast increase in the number of vehicles, due to accidents or any other reasons then the IoT devices that are present at the drivers gets connected to the available free Wi-Fi hotspot near the signal and collect the information regarding the congestion to display. Based on that information the Artificial Intelligence algorithm is used to find a suitable route. So the traffic congestion can be balanced. By using the algorithm the current status of the congestion is transmitted to the other vehicles that are traveling to that road so that those vehicles can choose another route. This can be useful to reduce congestion.

D. Machine Learning Methods For Traffic Prediction

Machine learning is one of the best parts of Artificial Intelligence. The algorithm related to machine learning is used which allow the software applications that are not externally added by the users to produce the absolute results for any particular computation. Without any human interaction, the Artificial Intelligence machines can produce the result and come to a conclusion based on the input, identifying patterns, and making decisions. As the input is always being uploaded simultaneously then the corresponding result is also updated without the involvement of human beings.

Traffic prediction is always a great challenge. To reduce the traffic there are many solutions like managing the traffic light, monitoring roads by using CCTV and many others. If there is an emergency to respond to the users and a large amount of data which is present is useless then these traffic prediction techniques cannot solve the problems.The algorithms related to machine learning are used to estimate the live traffic and provide navigation.

E. Advantages

- The use of artificial intelligence, machine learning methods, and IOT can help to solve traffic congestion

problems as the traffic signals work based on the volume and density of traffic.

- The use of smart traffic management has proved to reduce waiting times at signals, journey times as well as vehicle emissions.
- Use of machine learning methods for traffic prediction helps to predict traffic more accurately. Other methods are not efficient to estimate the traffic.
- As there is very less involvement of humans there will be very less errors in traffic predictions or estimations.
- An AI-enabled traffic management system can provide greater flexibility to the self-driving vehicles as they can then be directed and controlled more by the external environment.

F. Problems Faced By Artificial Intelligence

Artificial Intelligence is capable of doing anything and everything from image recognition to robotics. The problems associated with AI also includes-we cannot create an AI which serves us more than one task,it consists of vast amounts of data and lack of knowledge about the working of the systems. In 2016,machine learning introduced many bright tools which are expensive to train and difficult to express. They are even suspicious to their creators.

(1). Different Development approach

In the traditional system environment,the development inculcates basic phases like planning,analyzing,designing,building,testing and deployment. The environment in which the AI operates is very different and development is often finding data sources,collecting the required content,cleaning the obtained data and curetting it. The proceed towards this need divergent skills,thinking power/mind sets and methods as well. The systems working under AI environment should be trained in a specific domain.

(2).A system is only as good as the data it learns from

To learn about the things,firstly AI requires data. AI and machine learning both are similar in this aspect. Both need huge amounts of data with good quality to monitor the behavior patterns and trends,and also it must be able to quickly adapt and maintain the accuracy of the conclusion which are obtained by analyzing the data. In other words, when we get the data,we get AI. Systems like these don't need little amount of information like humans. They require hundreds of thousands of times more information to understand the concepts or recognize features.

This is good.
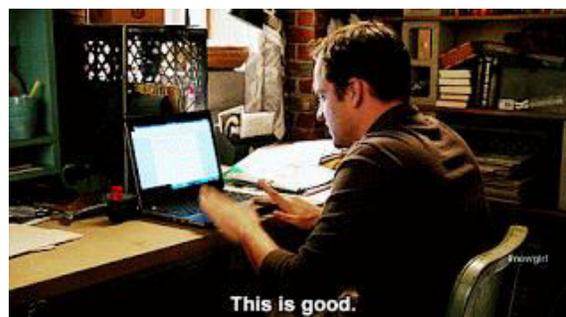
On the other hand,the quality of the data is also very important to train forecast models. The data sets should be represented as well as balanced,or else the systems adopt bias which the data set has.

(3).No clear view on how insight is generated

Artificial Intelligence hides its experimental behavior. It is difficult to measure the

development it brings to projects. Thus it is almost impossible to estimate ROI. It makes the concept difficult to understand for everyone. A skilled team can be utilized for optimizing the result. They should be able to adapt or write algorithms which are available publicly. The right algorithm must be selected to obtain the desired result and optimization of the result can be done by combining such algorithms.

II.   CONCLUSION

Just like all other technologies A.I. too has its own advantages and disadvantages. A.I. is being developed over the years and is trending among all the professions. From 2018, A.I. is being enlarged and spreading its wings as never before. People are nowadays realizing how A.I. can change their lives and also how it can make life easier and luxurious. A.I. is greatly used for solving the traffic problems of the next generation. It plays a major role in reducing traffic congestions hence making people's lives better. The existing AI-based traffic management systems have shown great results.

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