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Intelligent Traffic System (ITS)

Atharva Atul Sukale[1], Sunil P Lankennavar[2], Prof. Suraj S. Bhoite[3]
[1, 2]Dept. of Artificial Intelligence and Machine Learning, Savitribai Phule Pune University PUNE
[3]Faculty at ISB&M College of Engineering, Pune

Abstract: One of the main issues of the modern day is effectively monitoring traffic. The influence on automobiles has increased in step with the population's exponential growth during the past century. The current transportation systems are under a great deal of strain as a result of this. Several traffic systems still operate today, ignoring the amount of traffic at that intersection, by assigning set timeslots to each traffic light. Millions of people lose valuable time in traffic as a result, while noise and air pollution also negatively impact the environment. In order to address these issues, we provide a system that controls traffic by using the main element of taking into account traffic density in real time. In order to accomplish its objective, this system makes use of cameras in addition to image processing.
Keywords: *Traffic Management,* ***Smart System, Real-time Monitoring, Traffic Control and Management.***

I. INTRODUCTION

Fuel consumption, air quality, and transportation efficiency are all negatively impacted by traffic congestion, which has grown to be a major problem in urban areas across the globe. The demand on transport infrastructure increases as cities' populations and economies continue to rise.

Because traffic flow is dynamic, traditional traffic management systems which are mostly based on fixed timing or manual control are inadequate.

As a result, creative approaches are desperately needed to improve urban mobility and traffic management. It is clear that traditional traffic control systems have limitations since they are unable to efficiently manage traffic at intersections and adjust to changing traffic circumstances. The smooth operation of cars is hampered by the frequent unneeded delays, extended wait times, and increased congestion caused by the static timing of traffic signals. As a result, there is a need for traffic management that is more data-driven and smarter. In order to optimize traffic flow and lessen congestion at intersections, this research article attempts to create and assess a smart traffic management system that makes use of cutting-edge technology like sensors, communication networks, and machine learning algorithms.

The fusion of internet of things (IoT) infrastructure with artificial intelligence (AI) technology is known as artificial intelligence of things, or AIoT. The objectives of AIoT are to boost data management and analytics, optimise human-machine interactions, and make IoT operations more efficient.

Natural language processing, speech recognition, and machine vision are three common applications of artificial intelligence (AI), which is the emulation of human intelligence processes by computers, particularly computer systems.

II. PROBLEM STATEMENT

Traffic congestion problems consist of incremental delay, vehicle operating costs such as fuel consumption, pollution emissions and stress that result from interference among vehicles in the traffic stream, particularly as traffic volumes approach a road’s capacity.

III.EXISTING SYSTEM

The traffic police are often in charge of overseeing the current traffic system. The primary flaw with this traffic police-controlled system is its lack of intelligence in handling traffic congestion.

A traffic police officer may decide to block a road for an extended period of time or to let traffic on another road to pass; in other words, their decision-making may not be as sound as it may be and it will always be at their discretion. Furthermore, even with traffic lights, there is a set amount of time within which cars will see a green or red light.

It might therefore be unable to address the issue of traffic congestion.

It has been observed in India that traffic police officers are still on duty even in the presence of traffic lights, indicating that this system requires additional labour and is not cost-effective.

IV. THE COMBINATION OF AI AND IOT

We must first examine the benefits of both AI and IoT in order to see the necessity of merging the two ideas.

A. *Artificial Intelligence*

The study of creating intelligent machines that can mimic human intelligence is known as artificial intelligence, or AI. In short, artificial intelligence (AI) seeks to make computers capable of mimicking human senses, reasoning, comprehension, and so forth. Therefore, intelligent systems in a variety of industries rely on the highly disruptive AI capabilities to boost productivity and create new goods and services.

B. The Internet of Things

In contrast, the Internet of Things (IoT) is a network of interconnected items or gadgets that, through the use of software or inbuilt sensors, are able to gather and transmit data in real-time. High levels of automation are made possible by the use of IoT in many different sectors and tasks. IoT devices generate vast amounts of data via sensors or human input. Combining the two ideas—AI and IoT—focuses on applying AI skills to the processing of data produced and gathered by IoT systems. As a result, AI systems integrate machine learning models with the internet of things' connectivity and data transmission capabilities. Stated differently, the integration of artificial intelligence (AI) into Internet of Things (IoT) systems enables them to perform tasks beyond mere data collection and transmission, such as comprehension and analysis.

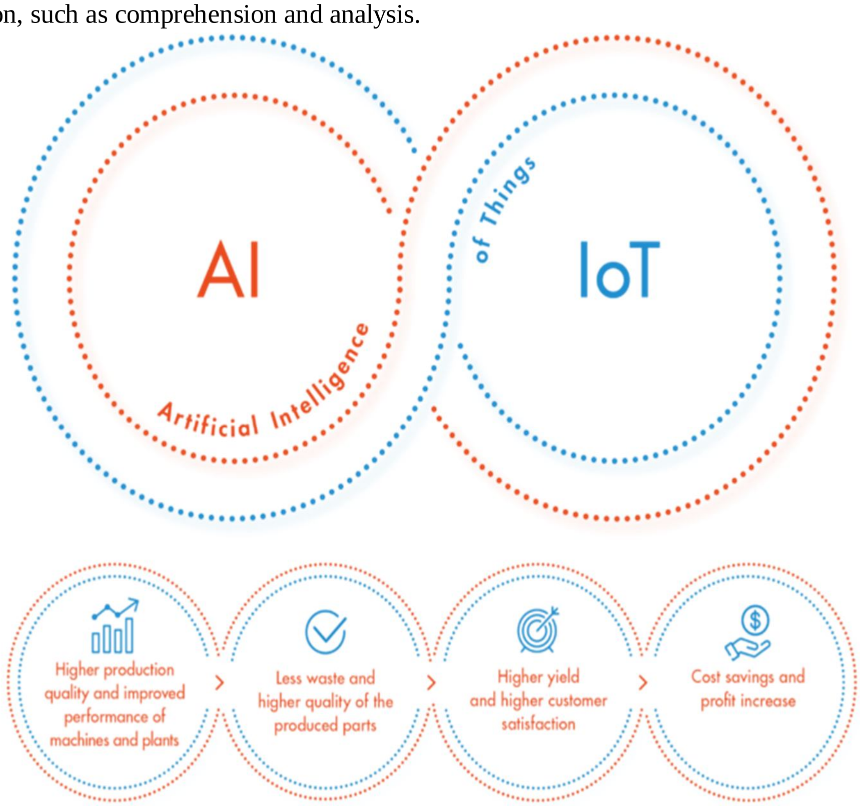

Fig 1. Artificial Intelligence of Things

V. TRAFFIC MANAGEMENT

Diverse technologies are employed by Traffic Management Systems (TMS) to regulate traffic patterns and the consequences of gridlock on the transportation infrastructure. The consequences of accidents, slow-moving or queuing traffic, scheduled events, and severe weather on traffic management are addressed by traffic management systems. The TMS comprises adaptive traffic signal control, vehicle activated signage, adaptive lane management, ramp signaling, variable speed limits, and incident detection. In order to maximize benefits, many of the systems are often integrated. Since building new roads will not keep up with the growth of urban traffic, managing the distribution of road space is a crucial issue that is becoming more and more significant.

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VI. SYSTEM REQUIREMENTS

A. Hardware Requirements

1) Raspberry Pi

The credit-card-sized Raspberry Pi is an inexpensive computer that can be used with a regular keyboard and mouse and is connected to a TV or computer monitor. A powerful small tool, it lets users learn how to programme in languages like Python and Scratch and explore the world of computing at any age. Everything a desktop computer should be able to perform is there, including word processing, spreadsheet creation, playing games, and internet and high-definition video browsing.

Fig 2. Raspberry Pi

2) Web Camera

To capture images and videos on the Raspberry Pi, you can use a regular USB webcam instead of the camera module.

Fig 3. Web Camera for Raspberry Pi

3) Speaker

Raspberry Pi robot can speak and make noise thanks to the Speaker. You may play music, hear announcements, and use this speaker by connecting it to the Raspberry Pi's aux port. It may be charged via the USB connector to power up its own power supply.

Fig 4. Speaker for Raspberry Pi

4) Mic

A mic is a used to give commands based on the video captured by the web camera. A mic which is connected to the Raspberry Pi is a small USB mic.

Fig 5. Mic for Raspberry Pi

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B. Software Requirements

1) Python

Python is a high-level, interpreted, object-oriented language with dynamic semantics. Its dynamic typing and dynamic binding, along with its high-level built-in data structures, make it an appealing language for Rapid Application Development and for usage as a scripting or glue language to join existing components. Because of its straightforward, basic syntax, Python emphasises readability, which lowers programme maintenance costs. Python's support for packages and modules promotes code reuse and programme modularity.

Python is an easy to start with high-level language, and it is an integral part of the Raspberry Pi's operating system.

2) Machine Learning

A branch of artificial intelligence called machine learning (ML) gives computers the capacity to autonomously learn from data and past experiences, finding patterns to enable prediction-making with little to no human involvement.

Computers can function independently without the need for explicit programming thanks to machine learning techniques. Applications for machine learning are continuously given fresh data and have the ability to learn, grow, evolve, and adapt on their own. By using algorithms to find patterns and learn iteratively, machine learning extracts valuable knowledge from massive amounts of data. Instead of depending on any predefined equation that may be used as a model, machine learning algorithms (ML) use computation techniques to learn directly from data.

VII. SYSTEM DESIGN

The Architecture system consists of:
1) Raspberry Pi
2) LED lights which are used for the purpose of signalling.
3) Traffic cameras which are used for monitoring traffic.
4) Node MCU Microcontroller

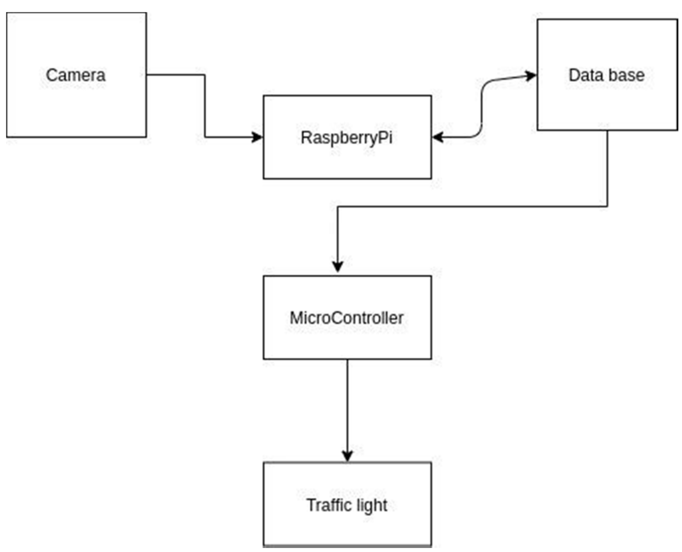

Fig 6. System Design

VIII. DATA COLLECTION AND ANALYSIS

Analysis and data gathering are essential parts of the suggested smart traffic control system. They make it possible for the system to collect traffic data in real time and derive insightful information that can be used to optimize traffic flow and make wise decisions. The process of gathering data entails combining data from several sources and integrating different sensors. Following collection, the data is analyzed using sophisticated algorithms and methodologies to extract pertinent traffic condition data.

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A. Sensor Data Acquisition

Various types of sensors, including microwave sensors, infrared sensors, inductive loop detectors, and video cameras, are positioned throughout the road network to gather information on variables including vehicle density, speed, volume, and occupancy. At particular places, such as crossroads or stretches of roadway, these sensors record data in real time about the motion and behavior of automobiles.

B. Communication and Data Transmission

For additional processing, the sensor-collected data is sent to a cloud-based platform or a central control unit. Data from the sensors is transferred to the control unit seamlessly when there is a strong communication infrastructure in place, such as wired or wireless networks.

C. Preprocessing

Preprocessing the gathered data may be necessary to remove noise and anomalies. Data normalization, data cleansing, and data quality checks are performed in this step to guarantee the dataset's accuracy and dependability.

D. Data Analysis

The methodical process of turning raw data into insightful patterns, trends, and insights that help with decision-making, problem-solving, and improvement across a range of industries is known as data analysis.

E. Learning

Learning from data is the process of taking information, insights, and patterns out of datasets using statistical and computational methods that are essential to data science, artificial intelligence, and machine learning.

F. Decision

A key component of data-driven decision-making is making choices based on the information gathered. Those who systematically collect, process, and evaluate data are better able to make well-informed decisions.

G. Action

The following stage is to act and carry out the selected course of action after a choice has been made based on data analysis. To get the intended result, a decision must be implemented properly.

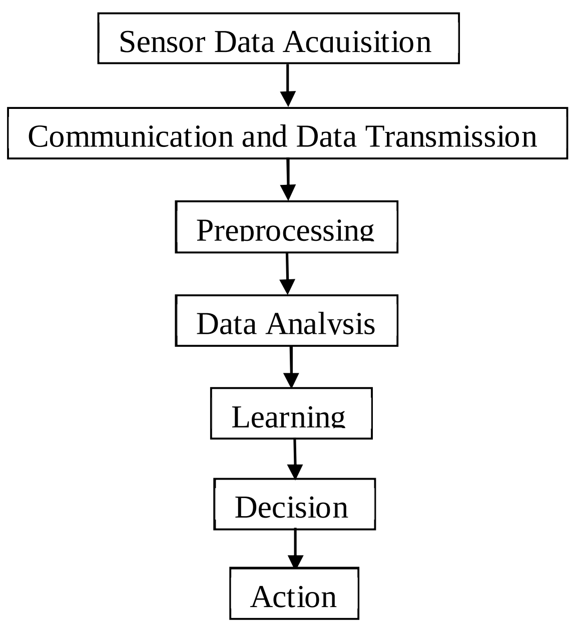

Fig 7. Data Collection And Analysis

IX. COMPARISON BETWEEN EXISTING AND PROPOSED SYSTEM

With improved time-based monitoring, the suggested system outperforms the current one in a number of ways, including fewer accidents, lower fuel costs, remote controllability, and so on. The suggested method is made to be able to both track the quantity of vehicles and manage traffic congestion. To manage the system, the system administrator can access the local server.

X. KEY FEATURES OF ITS

A. Traffic Jam Detection

By utilizing sensors, cloud connectivity, and CCTV cameras to continuously monitor intersections, experts are able to remotely monitor every street in real-time from the city's traffic control room.

B. Connected Vehicles

Direct communication between intelligent vehicles and junctions can be facilitated by connecting roadside tracking sensors to a smart traffic system that uses Internet of Things technology.

C. Modular Control

The technologies in place to manage traffic signals, express lanes, and entrance alarms dynamically adapt when real-time congestion sensing occurs.

D. Road Safety Analytics

Systems that are capable of detecting patterns can quickly identify instances of excessive driving.

XI. ADVANTAGES OF ITS

A. Detection of Congestion and Reduction of Traffic

The traffic control unit detects traffic congestion by gathering data from sensors and peripherals. The system makes decisions for itself and reduces traffic based on the detection.

B. Traffic Light Timing in Real-time

Real-time traffic signal operation is facilitated by the intelligent traffic management system. Traffic is automatically operated according to traffic congestion.

C. Safety from Road Accidents

This system's implementation can reduce the likelihood of traffic accidents.

D. Reduction in Pollution

Pollution can be decreased since traffic flow is well managed. People have the ability to conserve gasoline, and thus reduces pollution.

XII. RELATED WORK

1) With population increase and technology innovation occurring at previously unheard-of speeds, our world is changing quickly. Because of the increase in traffic, particularly in countries with large populations, the government is responsible for managing and building new roads. Still, it might be difficult for unassisted law enforcement officers to control traffic on holidays and other busy days. In order to meet these pressing needs, we carefully investigated how to help ambulances in congested areas and autonomously manage traffic. Our research suggests using machine learning (ML) technology to address these problems. Computer programs like Python simplify complex computational tasks like object recognition and picture processing. We used a number of computations, data sets, and methodologies.[1]
2) One of the main issues of the modern era has been effectively monitoring traffic. Vehicle usage has expanded in tandem with the population's exponential growth during the past century. The current transportation systems are under a great deal of strain as a result. Many traffic systems still in use today ignore the volume of traffic at a given intersection in favor of operating with set time periods connected to each signal light. Millions of people lose valuable time in traffic as a result, while noise and air pollution also negatively impact the environment. The toll that this waiting takes on commuters' mental health is another effect. In order to address these issues, we suggest a traffic management system that bases its decisions mostly on real-time traffic density.[2]

3) Nowadays, traffic congestion is one of the major concerns for residents in smart cities like Delhi, Bangalore, Mumbai, Hyderabad, and so on. These days, it seems like a daily struggle to deal with this. Road congestion has led to a significant increase in accidents throughout the city, making the lives lost in these incidents even more significant. Emergency vehicles, including ambulances and fire trucks, are unable to arrive on time because of the traffic jams on the roadways. This leads to a significant loss of life. In this study, we provide a solution that addresses these problems to a large degree. We may address these problems by establishing "Green Corridors" for emergency vehicles using IoT-enabled technology.[3
4) Urban dwellers made up 54% of the world's population in 2014. It was predicted that growth would increase by over 2% year until 2020, putting additional strain on the city's transportation infrastructure. Rather than just expanding or adding more roads, cities should be improving the efficiency of their routes. This brings us to the suggested system, which tracks the number of vehicles using a Raspberry Pi and a camera to provide time-based system monitoring.[4]
5) Research on intelligent traffic management is extensive. It is possible to make a lot of changes to the roads to improve the flow of urban traffic. The growing usage of private automobiles and public transit as a result of technological advancements creates difficult traffic situations for people all over the world. As a daily issue for human resources, traffic congestion impedes national development by impacting both the economics and productivity of the nation..[5]

XIII. CONCLUSION

It is obvious that the predetermined timings used by the current traffic control systems at traffic intersections are insufficient to provide a smooth journey. They will require a significant overhaul to become effective because they have numerous shortcomings.

They cannot, therefore, serve as a long-term solution to the problem of managing the steadily increasing number of vehicles on the road.

Our suggested system considers every issue that exists today and determines the best course of action. It will also alleviate people of the ongoing stress that comes with commuting, cut down on the number of traffic infractions that are reported, and require them to wait far less at signals.

The main benefit is that it will significantly lessen noise pollution and ensure that less petrol is consumed at traffic signals. It's fantastic that the suggested approach is fully automated in addition to being intelligent. What distinguishes it from the other existing systems is its consideration of traffic density in real time.

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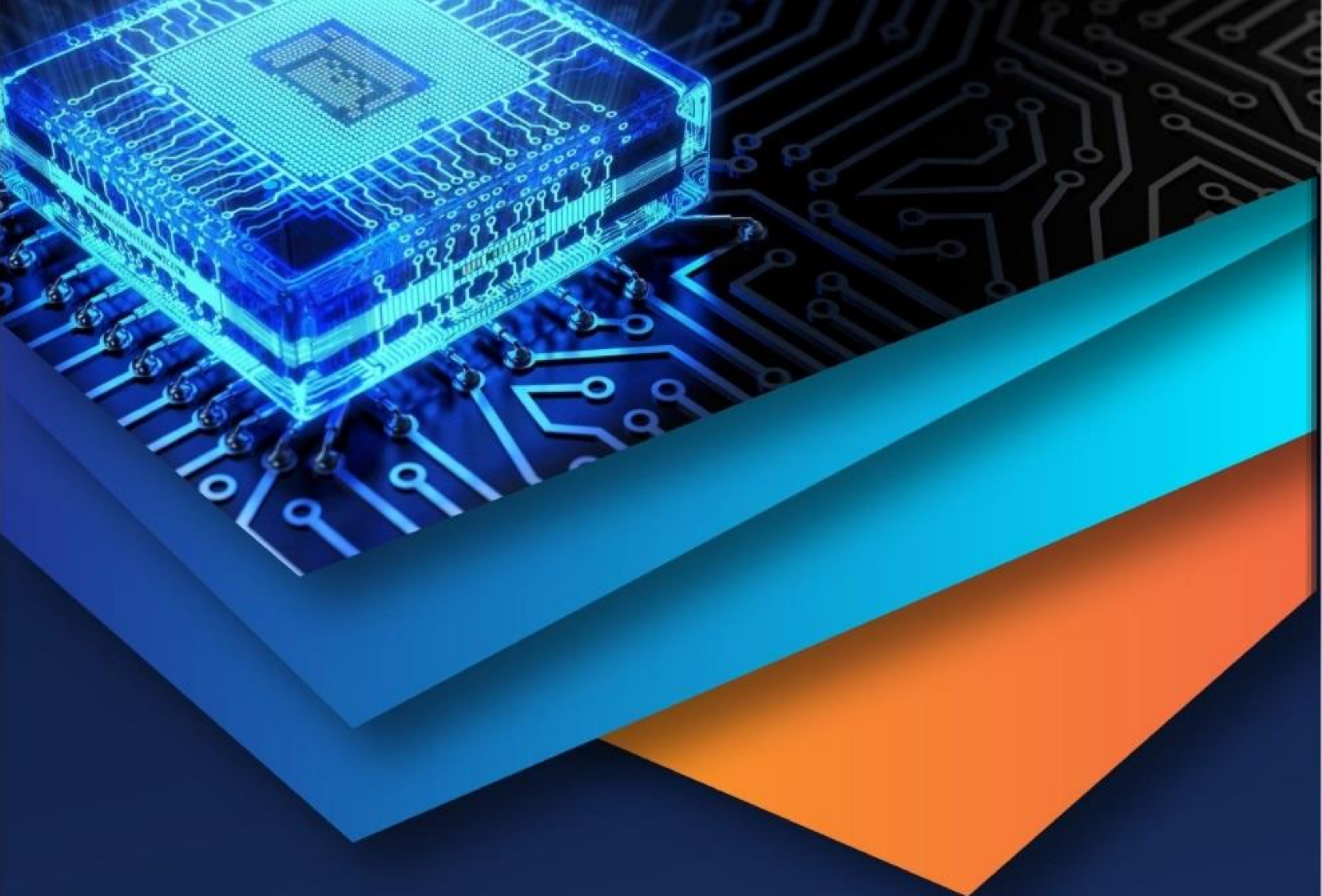

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