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Traffic Control System for Emergency Vehicles Using Artificial Intelligence & IOT

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ABSTRACT

Traffic congestion problem is an instant which procured huge impact to the transportation system in the world. This causes many difficulties, when there are emergency cases at traffic light cross ways busy with many vehicles especially for AMBULANCE. To minimize this major issue, the analyzers opted for intelligent and effective use of existing basic physical systems like infrastructure through adaptive traffic system based on new technologies such as Artificial Intelligence (AI), Internet of Things (IoT), etc. A traffic control system is designed in order to solve these issues. This system was designed by using IR Proximity and Ultrasonic sensors, Wireless Transmitter and Receiver, Arduino Mega and LORA. This proposed system is intended to Increase in Development of Artificial Intelligence on Traffic System and Decrease Rush on Roads and making a Digital City. The major aspect of our model is automation on roads and wireless technology for emergency vehicles to reach the destination on schedule.

Keywords: Traffic Control System, Artificial Intelligence (AI), Internet of Things (IOT), Arduino Mega, IR Proximity sensor, Ultrasonic Sensor, LORA, Digital city, Automation, Emergency Vehicles, Wireless Technology.

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INTRODUCTION

The problem of traffic congestion in road transportation has become an important real time transportation problem in developed and developing countries. Nowadays there are complex systems of various generations utilized for urban traffic control. Using different approaches to the urban traffic signal control problem, each generation provides improved functionality and flexibility than its predecessors. Over the past 30 years of development, improvement and practical application, the existing systems have displayed several

weaknesses, such as: Shortcomings in the accuracy and range of application of traffic prediction models limited capacity for environmental adaptation. The challenges of traffic management include congestion, accidents, pollution, and inefficient use of resources. These issues not only cause inconvenience to commuters but also have of the work which have importance to classifying parts of study. This section provides the understanding about the economic and environmental implications. Moreover, traditional traffic management methods such as traffic signals and road signage are becoming inadequate in handling the growing traffic volumes. To address these challenges, there is a growing interest in the use of artificial intelligence (AI) and Internet of things (IOT) techniques for traffic management. These technologies have the potential to revolutionize the way we manage traffic by providing real-time insights and predictive analytic, enabling proactive decision-making, and optimizing traffic flow[Weil et al, 1998].

Motivation

Traffic congestion is increasing now-a-days. As a result, some main issues arises. The troubles are no traffic, and time delay for emergency vehicles. These problems occur due to slotted authority on traffic. This research will aim to control the traffic according to the magnetic waves with AI technology. The traffic lights that are in extensive use today restrict to do much abstruse reasoning decided that when to change the lights for the various road vehicles are waiting in different lanes. The Traffic signal stays green in one lane and red in another lane is often determined by basic timing that is calculated when crossing is designed. Even though current technologies are robust and performed better when the traffic load is distributed evenly across the lanes in the intersection, the systems are very inefficient. Unnecessary waiting time in the signal can be avoided by determining in which side the green signal should be large during the traffic and also the priorities can be given to the lane dependency upon emergency of the vehicles (ambulance).

Figure 1: Traffic System

A. Objectives

Traffic management has become one of the severe major issues nowadays, more over the growth of industrialization and population. there has been a massive growth in the traffic system.

Therefore, the increase in traffic system arise a number of problems such as heavy traffic loads, violation of traffic rules, buffer in signal lights etc. Ineffective management and traffic congestion also contribute to lengthy wait times, fuel and financial losses, etc. It is mandatory to have a fast in speed working management, economical and efficient trafficcontrol system for national development. There is a way to improve traffic flow and safety of the current transportation system is to apply automation and AI and IOT control methods to roadside infrastructure as well as vehicle

a) Our objectives in the following points

1. Reduce the delay of Emergency vehicles to their destination.
2. Reduce heavy traffic jams.
3. Reduce the waiting time in signals.
4. Avoid Accidents.
5. Reduce the time & cost.

B. Background

Basic research helps to understand the importance, Basic study of traffic lights and their management. In addition, we also have a brief introduction to Artificial Intelligence, Internet of Things (IOT) and its techniques.

a) Artificial Intelligence Overview

A scientific field known as artificial intelligence (AI) focuses on teaching machines to solve complicated problems in a more human-like manner. This typically entails taking traits of human intellect and implementing them as computer-friendly algorithms. Depending on the defined needs, a more or less flexible or effective technique might be used, which affects how artificial the intelligent behavior seems. A new technological device called artificial intelligence can store a lot of information and process it quickly. A teletype is used by a human to question the computer. If the person cannot distinguish between a computer and a human on the other end, it passes the capacity to resolve issues Engineering and science of making intelligent machines, especially intelligent computer programs. It is associated with the related endeavor of utilizing computers to analyze human intelligence.

b) Importance of Artificial Intelligence

We can buy machines capable of playing chess at a high level for a few hundred currencies. They contain some AI, but they work well against humans, mostly through brute force calculations, looking at hundreds of thousands of positions.

To beat a world champion using brute force and known reliable heuristics, you need to be able to test 200 million positions each.

i) Voice recognition:

Computer voice recognition became functional for a few uses in the 1990s.So United Airlines replaced the flight information keyboard with a system that uses voice recognition of flight numbers and city names.It's quite realistic.On the other hand, while some computers can be guided by voice, most users have returned to using keyboards and mice because they are even more convenient.

(ii) Computer vision:

The world is made up of three-dimensional objects, but the signals transmitted to human eyes and computer television cameras are two-dimensional.
Some useful programs may operate in only two dimensions, but full computer vision requires a three-dimensional piece of information, not just a set of two-dimensional views. Currently, there are only a limited number of ways to directly represent three-dimensional information, and they are not as good as the explicit ways used by humans.

(iii) Heuristic classification:

One of the most feasible types of expert systems, based on current knowledge of AI, is to classify certain information into one of a fixed set of categories using multiple sources of information. An example is whether to accept offers to buy a credit card.
Information available about the credit card holder, their payment profile, and the item they purchased and the facility from which they purchased (e.g., whether there was any credit card fraud at the establishment or not).

c) Traffic Management in AI

Traffic management, in the context of AI usually refers to the way we handle and distribute requests or data to AI models, services or components in an efficient and effective manner. This is particularly important in AI applications that require time or near real time processing, scalability and reliability. Traffic management in AI includes elements;

1. Load Balancing: We distribute requests across AI servers or instances to ensure that no single server is overwhelmed while others are underutilized. This helps maintain system performance avoid bottlenecks and ensure availability.

2. Scalability: AI applications often need to handle varying levels of traffic. Scalability allows the system to adapt dynamically by adding or removing resources as necessary to maintain performance. This can involve either increasing the number of servers (scaling) or upgrading server hardware (scaling).

3. Resource Allocation: We efficiently allocate resources like CPU, GPU, memory and storage to AI models based on their workload. This ensures that resource intensive models receive the hardware support for performance.

4. Request Routing: We determine the AI model or service for handling incoming requests based on factors such as model capabilities, latency requirements and data characteristics. This may involve directing requests to AI models, for tasks.

By managing traffic in these ways we can ensure operation of our AI systems while maximizing their performance and responsiveness.

Managing Latency; when it comes to AI applications one important aspect is ensuring that latency requirements are met. In the case of traffic management systems it becomes crucial to monitor and control response times so that requests are handled promptly within time frames.

d) Traffic Management in IOT

Traffic system management in the context of the Internet of Things (IoT) involves the use of IoT devices, sensors, and data analytic to monitor, control, and optimize traffic flows in urban areas, cities, highways and transportation networks. IoT technology can significantly improve the efficiency, safety and sustainability of traffic management systems [Yawle R.U et al,2016].

Here are some key aspects of traffic system management in IOT:

1. Traffic monitoring sensors:
Deploy different types of sensors such as cameras, infrared sensors, ultrasonic sensors and magnetic sensors at key points in the road network to collect real-time traffic data. These sensors collect information about vehicle numbers, speeds, congestion levels and road conditions.

2. Traffic light control:
Deploy a smart traffic light control system that can adjust lighting schedules in real time based on traffic conditions. IoT- enabled traffic lights can communicate with vehicles equipped with Vehicle to Infrastructure (V2I) technology to optimize traffic flow.

3. Smart traffic signs:
Use IoT-enabled digital displays to display real-time information to drivers, such as traffic alerts, road closures, detours, and estimated travel times. These panels can also be controlled and updated remotely.

4. Urgent response:
Integrate IoT systems with emergency services to automatically detect accidents or incidents and notify emergency responders.
IoT devices can also help manage traffic during emergencies by rerouting traffic and providing real-time updates to drivers.

5. Public transport management:
IoT can be used to monitor and optimize public transportation systems, such as buses and trains. Real-time vehicle tracking enables better planning and passenger understanding.

6. Security and privacy:
Deploy strong security measures to protect IoT devices and data from cyber-attacks. Ensure that data collected from IoT devices is anonym zed and used according to privacy regulations.

LITERATURE SURVEY

This chapter provides a detailed understanding of traditional traffic management systems. Added to this is the key issue of traditional traffic light management. Additionally, we list the disadvantages of traditional traffic management.

a) Traditional Traffic System:

The traditional traffic light system, also known as traffic lights, is a device commonly used at intersections and crossroads to control the flow of traffic and pedestrians. It consists of a set of lights arranged vertically or horizontally on a pole or elevated structure. These lights emit colored signals, typically red, yellow (or orange), and green, each with a specific meaning

b) Advanced traffic management:

In more complex intersections or congested areas, traffic lights can be equipped with sensors,

cameras, and traffic management systems that can adjust the timing of lights on in real time based on traffic conditions. pine. Priority for emergency vehicles: Some traffic light systems are equipped to respond to emergency vehicles by giving them priority to quickly cross intersections. Traditional traffic light systems are a fundamental part of traffic control and road safety. They help regulate traffic, reduce the risk of accidents and ensure efficient use of road infrastructure. Modern advances, such as the integration of sensors and adaptive control algorithms, have made traffic lights more responsive to changing traffic conditions, further improving their effectiveness.

PROPOSED WORK

This chapter contains the methodology and proposed algorithm for explaining the required system.

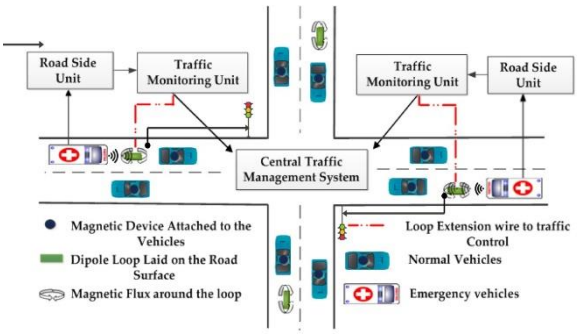

Figure 2: Small Traffic Light Controller

a) System overview

Recommended operation of smart traffic light controller. Infrared sensor is mounted in the middle to detect vehicles. The presence or absence of vehicles is detected by sensors mounted on the median strip. The ultrasonic sensor will detect the number of vehicles parked on the road (by transmitting ULTRASONIC SOUND transmitted by the transmitter module and detected by the receiver module), this will help EXPOSURE SENSOR INFRARED, because the CONTACT SENSOR can detect objects in certain places. specific fields. length or if a vehicle passes in front of the sensor, the infrared beam will not be able to penetrate the vehicle and accurately read the TRAFFIC on the road. LORA (LONG RANGE Controller), is used for more advanced TRAFFIC SIGNALS, it is used for ADVANCED EMERGENCY MANAGEMENT SYSTEM [Aswani, and Padma,. 2016].

b) Proposed Model

Our proposed system aims to present a traffic light controller based on IR Proximity and Ultrasonic sensors, Wireless Transmitter and Receiver, Arduino Mega and LORA that can adapt to the current traffic situation. It uses ultrasonic sensors at traffic junctions for detecting the emergency vehicles at the signal and setting the green signal time accordingly. We have used object detection like LORA, wireless transmitter and receiver, IR proximity sensor and ultrasonic sensor in order to detect the number of vehicles for each direction. We then set the timers of these traffic signals according to vehicle density in each direction and hence the system becomes adaptive. As a result, traffic is cleared much more quickly than with a static system, which helps to maximize the green signal timings and decreases unwelcome delays, congestion, and waiting times.

c) Component Description

The various component need to fulfil the requirement for this model.

(i) Wireless Transmitter and Receiver

Wireless Transmitter and Receiver are used to communicate the project remotely. In the project the use of wireless modules is for emergency purpose. Suppose an emergency vehicle get stuck in heavy Traffic Jam then the ultrasonic sensor on the IR proximity circuit will detect the emergency vehicle siren where the ambulance is and the traffic light turns from Red to Green, if it is green it will extend the time by which all the emergency vehicle can reach the destination as soon as possible.

(ii) IR Proximity sensor

IR, short for infrared, detects the presence of an object by emitting a beam of infrared light.It works similarly to an ultrasonic sensor, but

instead of using sound waves, infrared rays are transmitted.The infrared proximity sensor consists of an emitting infrared LED and a light detector to detect reflections [Sharma, E.P.,. et al.,2015]

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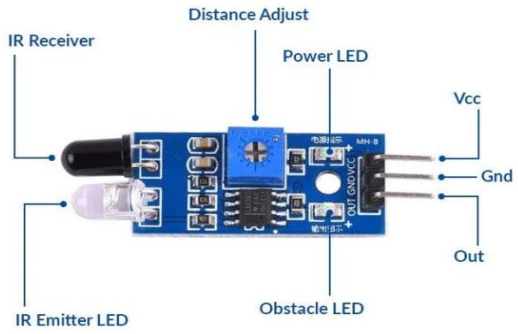

Figure 3: Infrared Proximity Sensor

iii) Ultrasonic sensor

An gadget known as an ultrasonic sensor uses ultrasonic sound waves to gauge a distance to an item . Ultrasonic sensors use transducers to send and receive ultrasonic pulses that relay information about the distance of an object[unpublished)]

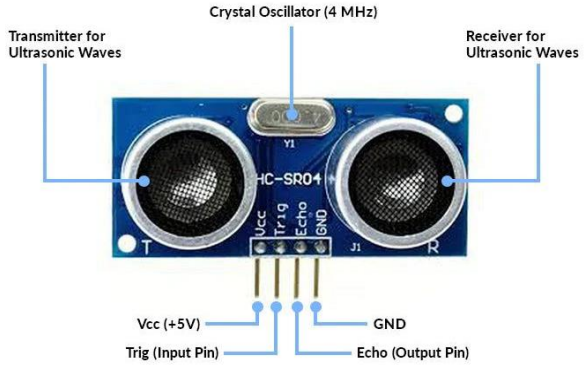

Figure 4: Ultrasonic Sensor

iv)Arduino mega

The Arduino Mega is a microcontroller based on the ATmegas 2560. It is the largest Arduino series with 54 digital input and output pins, of which 14 are used as PWM outputs. It has 16 analog inputs and 4 UART ports for serial communication. Additionally, it has a 16 MHz crystal oscillator, USB connector, reset button, ICSP header, and power jack. It includes everything required for the microcontroller's functionality.. Arduino Mega is compatible with all Arduino designs.

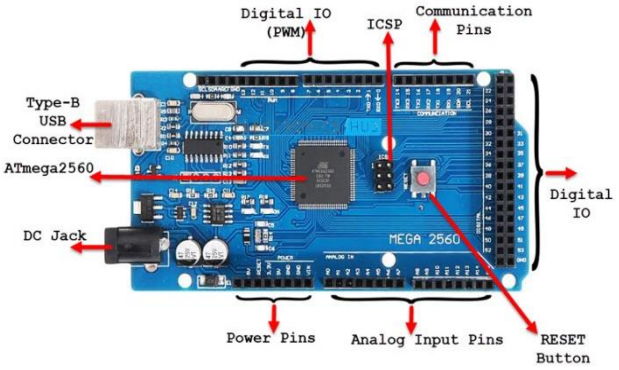

Figure 5: Arduino Designs

v) LORA

LoRa, which means "Long Range", is a wireless communications technology designed for long-range, low-power communication between devices in the context of the Internet of Things (IoT). This is a type of low-power wide area network (LPWAN) technology that allows devices to communicate over relatively long distances while consuming very little power. LoRa is commonly used for applications where devices need to send small amounts of data over long distances, such as remote sensor monitoring, smart agriculture, asset tracking, and more.

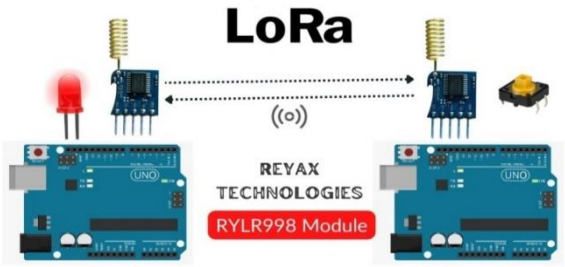

Figure 6: LORA

CONCLUSION

In this research, we studied the optimization of a traffic light controller in the world using Arduino, IR proximity sensors, LORA etc. these are helps to change the signal lights through the magnetic waves mainly when the ambulance across in one lane automatically that signal lights will be change for reach the destination faster than the

ordinary duration. Accordingly, Implementation smart traffic light artificial intelligence and IOT technologies is to save time to reduce human effort, enhance development of artificial intelligence(AI) and make our digital city revolution and reduce rush on the road.The main feature in our model is route automation as well as wireless technology that allows all emergency vehicles(ambulance) to reach their destination as quickly as possible.In addition, this sensors are not only focused on the emergency vehicles and also counting the number of the vehicles on the one lane density because, in these circumstance emergency vehicles are stuck on the same lane as distance as signals then emergency sound waves are converted to electromagnetic radiation waves integrated with the sensors diurnal this process helps to remain increases the duration(green light). The green light is triggered in the signals with an 800 millisecond delay when there is a detected vehicle density in either of the roadways at the intersection, giving the lights a flickering appearance. And this system helps to the Ambulance Vehicle to reach Hospital without stuck at the Traffic Signal.In this work, a density-based traffic light control system was developed to control traffic at "+" road intersections in order to minimize unnecessary time loss and minimize injury the developed system is a possible tool for traffic control and the combination of Monitoring will help reduce traffic accidents caused by road users ignoring traffic signals.The proposed system aims to hold and save the number of man-hours withered at the signals and hence making effective utilization of time.Avoiding conditions of extreme traffic jams is highly important in the current situation. Specifically, we present a software solution for traffic control functions based on traffic density on each lane at the intersection.This project, while very ingenious enhanced by: incorporating renewable energy sources so that the system operates 24/7.

FUTURE SCOPE

The main objective of the proposed works is to reduce the problem of congestion on the roads. Therefore, a new model is made and designed. This mode is efficient and accurate and can be used for a variety of tasks. Based on the usefulness of the proposed AI technique, the following future of work is suggested:

1. The system aims to provide better flexibility to manage the Traffic for purpose of emergency vehicles.
2. It is possible to automated traffic transmission system because emergency vehicles can communicate wirelessly with the traffic system and make their own decisions, turning into autopilot mode reality.

Through this paper we have been able to present and implement a smart solution for emergency cases in traffic to give maximum preference to lives at stake.This project can replace the current transportation system and open more lanes for a future-ready world.

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