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Smart Traffic Control for Emergency Vehicles Using RF Sensors

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Abstract
Traffic management of emergency vehicles is needed in the urban centres due to the fact that any emergency responding to a delay might be very detrimental. To allocate emergency vehicle travel over crossings, this paper provides a new machine learning-based emergent traffic recovery system of an emergency vehicle. The proposed system involves application of visual sensors, light-emitting diodes, buzzers, and Wi-Fi modules to allow emergency cars to clear rapidly and efficiently. In ESP 32 module, a sensor sends a signal to the module when an emergency vehicle is approaching the first intersection. To create space to the emergency vehicle, the module then switches the LED traffic lights to green and acts as alert to the other vehicles by sounding a buzzer. Once the vehicle is detected as an emergency the system applies a blue light to the traffic signal to make it even more visible to the traffic. To prevent wasting time, the NodeMCU ESP8266 module will also connect to a Wi-Fi module at the second cross over and ensure that the change of the red light of the traffic lights precedes the arrival of the emergency vehicle.

Keywords: Multi Stream, Fusion, Traffic Prediction.

INTRODUCTION

Traffic management within the suburbs is very critical and especially in cases of emergency where fire-fighting machineries and ambulances need promptness since delays in them can be very dangerous. Traditional systems often do not give these cars priority therefore creating delays. To assist the emergency vehicles drive through traffic at a faster speed, this study proposes a smart machine learning-driven traffic recovery model. The program develops the best paths to be used by emergency vehicles using congestion predictions and altering of the traffic lights based on the real-time data obtained through cameras and traffic sensors. The proposed technology aims at enhancing the efficiency of emergency response and saving lives by optimizing response time through real-time traffic flow optimization.

The high demand on the quality of life pushes people to seek viable and effective solutions to the ordinary problems. These are transport related challenges that include the delay in services, traffic congestions, environmental issues, and noise. Proper traffic management of the signals can also be considered a possible solution to the traffic issue. Unless timing of the traffic lights, phase arrangement, and so on are suitably fixed according to the needs of the environment, the problems might arise. As opposed to this, nature is more likely to embrace efficiency in case there is a clear policy. The primary objectives of an efficient traffic policy are to address the said issues and improve performance. More so, it is an important policy to decide the viability and precision of a policy. By the basic requirements of a successful traffic policy, there should be demand without number of traffic bottlenecks, delays and waiting time including line. Consequently, it is important to ensure that a proper model is instated and monitored based on a

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clearly articulated policy. In other words, to measure the model performance, regarding expectations, an efficient evaluation method is needed.

RELATED WORK

Missing data is a common and inevitable problem in intelligent transportation systems that are based on data (data-driven ITS). Recovery of lost traffic data has undergone a considerable research study during the past decade, yet the question on how to comprehensively use the spatiotemporal patterns of traffic to achieve the best recovery results remains. The focus of the paper is on the spatiotemporal characteristics of the data of traffic speed endeavors to identify the missing data as a problem of a matrix renewal and reveals a challenge of implementing the hidden feature analysis method in completing traffic information in a spatiotemporal way. In this process, the underlying structures and spatiotemporal trends of incomplete data are identified to achieve the recovery process. To have the main underlying features of individual dimensions, we then incorporate spatial and temporal correlation. Finally, the traffic data can be retrieved in terms of the latent feature with the help of latent feature analysis. In comparison to the experimental data and the assessment, the model works better since the value of evaluation criterion is low. The findings have proven the effectiveness of the model in estimating continuous missing data [3]. The frequent phenomena of abnormalities and data missing that are random in nature often occur in intelligent transportation systems (ITS) resulting in the low quality and low usability of the data. This is a major obstacle to real life ITS applications. Most studies on traffic data recovery assume that the original data is clean or complete, but in reality, these two issues often have each other due to unavoidable failures in the measurement of data including detector failures. In this study, our novel form of completion of tensors (termed SCPN) is formed of the tensor Schatten capped p norm which is a unified representation of the many elements of the tensorial norm with significant flexibility and utilizing fully the algebraically low-rank character of the traffic data in space and time. We further leverage the diffuseness of unstructured outliers to extend the proposed approach to a resilient one (referred to as RSCPN) to recreate ground-truth values using incomplete, and corrupted measurements. Finally, optimization solutions that are related are resolved with the help of the alternating direction multiplier method. In both corrupted data recovery and missing data imputation, our proposed models are found to be quite better than the existing state-of-the-art models, under a variety of simulated conditions based on large sets of experiments executed on four datasets [4]. Traffic signal control of a large-scale traffic network is one of the more challenging issues in intelligent transportation systems (ITS). At some intersection points, effective use of traffic lights often requires large communication overheads. We are interested in this study in recovering the state of the global traffic at each intersection in real-time through the knowledge of the traffic state observed at the local intersection in this study, therefore, these communication overheads are avoided at intersections distributed spatially. In every intersection controllers, the traffic information recovery method that relies on the generative adversarial networks (GANs) is particularly presented to recover the global traffic state. Training the recommended GAN with a few statistics about other intersections would further enhance the precision of state recovery of the traffic. Numerous statistical data reveal the success of the proposed plan in the restoration of the global traffic scenario [5]. High-speed rail networks that suddenly come to a standstill may also lead to multiple delays of trains and a considerable decrease in the quality of service provided. Our work proposes rescheduling the trains in the case of disturbances with the help of a deep reinforcement learning (DRL) technique. The states in our DRL model are taken to be the positions of trains in the system, the actions are the possible paths (e.g., its straight travel, its use of the side tracks, waiting time till other trains move past, and so forth), and the reward is taken to be the delay time and possible conflicts depending on the specific arrangement of the tracks. In an effort to enhance the deep

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neural network training efficiency, we also design a greedy approach as well as a value function approximation technique that uses deep learning. We repeat various rounds of experiments whereby the China-Zhangjiakou high-speed rail system was represented as the simulation scenario. As we have demonstrated, the developed DRL may reduce the train delay time, and eliminate possible conflicts [6] in comparison to a greedy algorithm. To overcome the issue of vehicle positioning caused by congestion in the intelligent transportation system (ITS) traffic, a vehicle position estimation architecture is proposed in this paper. The matter of the presented architecture is three unmanned aerial vehicles (UAVs) with uniform linear arrays (ULAs) and information systems (ITS) centres as well as position estimation terminals. The UAVs receive the data of the ULA, the centre where data is stored is through the ITS centre, and the algorithm to run the destination terminal that processes the estimate of the position of the vehicle is the estimation of the direction of arrival (DOA) algorithm. Necessary DOA estimation the essential issue in the given architecture the problem of sparse recovery is resiliently proposed based upon optimal weighted subspace fitting, in the presence of direction-dependent unknown mutual coupling. To begin with, a data model can be obtained with the help of a novel transformation technique. Then estimations of intended DOas are obtained by a sparse recovery method applying to subspace fitting [7] using weights. Traffic is one of the major issues of the third world and developing countries. Traffic management is a frightening problem to resolve because, the society bears serious traffic problems, including environmental and life hazards, following the inadequate and uncontrolled increase in the size of the traffic. Traffic management may cause various outcomes, which are not only potentially fatal but the outcomes are also traffic congestion, accidents, pollution and so on. This work is a solution to traffic jam and gridlock through smart identification and prioritization of automobiles and non-vehicles. The use of the Point Tracker Algorithm is part of the research. The algorithms are also enhanced with the enhanced traffic management that determines the nature of the transportation, and gives the traffic with and without cars priority depending on the emergency conditions, size and the type of vehicle, and offers the priority to clear a stalemate. Also, the proposed enhanced Point Tracker Algorithm provides another route to the adjacent vehicles and non-vehicles and emergency detection in the case of collision [8]. Traffic data is the source of intelligent transportation construction data base. Nevertheless, this information is often lost in the process of traffic data collection because of adverse weather conditions and a malfunction of the equipment and this is one of the major obstacles to the development of smart transportation construction. As the result, traffic data recovery has become a rather burning problem in the framework of intelligent transportation. In this work, it is proposed to use a traffic data recovery model based on the tensor filling and tensor matrix association analysis to solve the problem that the accuracy of existing methods to recover traffic data significantly drops to low values in extreme missing conditions. The proposed traffic data recovery model in this paper is capable of significantly enhancing recovery precision of missing statistics and being substantially stable when the data loss is extreme, as depicted in the consequences of the experiment joined with the real taxi GPS positioning statistics alongside Kunming point of interest (POI) statistics [9]. The use of traffic information can enhance traffic management and a transportation plan in the long term to facilitate traffic efficiency and safety. The presence of the data with the missing and the deviating data will likely influence the quality of the traffic statistics significantly and can even lead to other wrong analytical outcomes. To recover traffic data under distorted and incomplete measurements, we propose an exclusive data recovery algorithm in this study termed as spatial-temporal tensor robust principal component analysis (ST-TRPCA). Specifically, we consider the use of a tensor factorization and low-dimensional representation to improve the computational efficiency, as well as fully capture the nature of traffic data by the space-temporal traits of the data to enhance the accuracy of data recovery. The overall experimental findings obtained using a real-life traffic dataset using diverse conditions prove that

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ST-TRPCA is superior to other advanced methods in identifying anomalies and recovering missing information, especially under the condition of the traffic data being severely polluted [10].

EXISTING SYSTEM

The delays may occur to emergency vehicles due to the use of the set timers in the traffic lights of the current system of traffic management. Intersection handling by traffic police is sometimes done manually, which is a tedious and inefficient process. The driver in other vehicles reacts differently, and the use of lights and sirens as an indicator that the authoritarian road needs the right-of-way mainly occupies the emergency vehicles. Also Emergency Vehicle Pre-emption (EVP) systems attempt to cut down delays by automatically turning green the traffic lights in the approach that oncoming emergency vehicles are approaching. The high implementation costs and the fact that the system is not commonly available, however, limits the ability of these systems to accelerate the emergency response times.

DISADVANTAGES OF EXISTING SYSTEM

- It can take a while for traffic cops to manually control junctions.
- Dependency on Signals of Emergency.
- The influence of Emergency Vehicle Pre-emption (EVP) systems is limited by their selective implementation and high cost.
- Cost and Infrastructure Issues

REQUIREMENT ANALYSIS

Evaluation of the Rationale and Feasibility of the Proposed System

This initiative is aimed at reducing the times that emergency vehicles (e.g. fire engines and ambulances) take to navigate through the traffic in urban areas. Traffic congestion may lead to dangerous delays in these cars, and this may be fatal. The overall goal is to come up with an intelligent traffic system using machine learning that would be able to regulate traffic lights and decide the most optimal path to take in case of emergency cars. The system can adjust signals and provide faster paths using real-time data of the traffic sensors and cameras. This reduces the response time and improves the safety of the people. This project will see one way of ensuring that the cities are safer by ensuring that emergency vehicles are able to reach their destinations in a timely and efficient fashion.

PROPOSED SYSTEM

The proposed approach will assist the emergency vehicles in moving through the cities more quickly through the use of modern technologies as WI-FI, LED, buzzers, and crossing sensors. Sensors allow a NODEMCU ESP8266 module to alert in case of an emergency vehicle arrival. Besides activation of the traffic lights to green at the first crossing intersection alongside the safety of emergency vehicle, the module issues a buzzer to alert vehicles. The blue light of the traffic signal tells the rest of the cars that they are at the mercy of the emergency vehicle. At the intersection, the NODEMCU esp8266 communicates with a WI-FI unit, and it switches its NODEMCU lights to red beforehand to avoid blocking the traffic. This technology aims at enhancing emergency response rate and safety on roads by reducing the number of intersection delays.

ADVANTAGES OF PROPOSED SYSTEM

- Unambiguous Priority
- Signal Cost-effective

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- Traffic Flow Savings
- Adaptable Use

SYSTEM ARCHITECTURE

The proposed approach will assist the emergency vehicles in moving through the cities more quickly through the use of modern technologies as WI-FI, LED, buzzers, and crossing sensors. Sensors allow a NODEMCU ESP8266 module to alert in case of an emergency vehicle arrival. Besides activation of the traffic lights to green at the first crossing intersection alongside the safety of emergency vehicle, the module issues a buzzer to alert vehicles. The blue light of the traffic signal tells the rest of the cars that they are at the mercy of the emergency vehicle. At the intersection, the NODEMCU esp8266 communicates with a WI-FI unit, and it switches its NODEMCU lights to red beforehand to avoid blocking the traffic. This technology aims at enhancing emergency response rate and safety on roads by reducing the number of intersection delays.

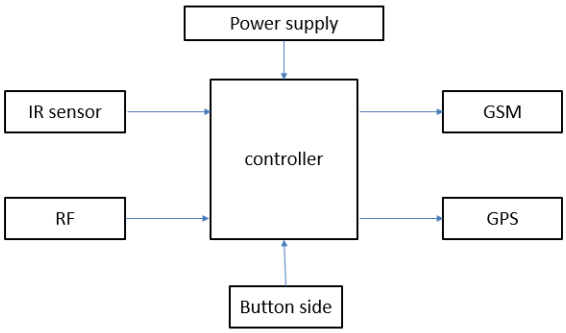

FIG 1: TRANSMITTER SECTION

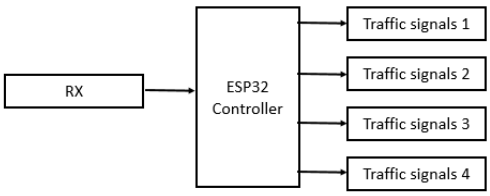

FIG 2: RECEIVER SECTION

SYSTEM METHODOLOGIES:

ARDUINO IDE

The general description of the product features is related to the sense of the preconditions and the established request of the serious degree of the contraption. The architectural design described and designed many web pages and their connections. Principal software elements are identified, subdivided into processing blocks and notion registers and the relationship which do exist among them is clarified. The modules that come with it are described by the proposed framework. The Arduino electronics platform is an open-source platform based on easy to use hardware and software. Arduino boards can receive input,

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e.g. a light on a sensor, one finger on a button or a tweet, and process it into an output, e.g. switch on an LED, post something online or move a motor. Your microcontroller can be told what to do by offering it a series of instructions on your microcontroller board. This is done by the Arduino software (IDE), an implementation of Processing, and the Arduino programming language, an implementation of Wiring. Arduino has been the brainchild of millions of projects over the years, both simple and complex scientific tools. It is around this open-source platform where a global community of makers (students, enthusiasts, artists, programmers and even professionals) have coalesced whose contributions have amassed a remarkable amount of readily available knowledge that can prove to be highly valuable to the beginner as well as the expert. The Arduino was developed at the Ivrea Interaction Design Institute as a simple prototyping platform that students could use without having prior background in electronics or based on any programming language. The evolution of the Arduino board into the new demands and challenges commenced immediately after the popularization of the project, as simple 8-bit boards were replaced by wearable technology, embedded systems, 3D printing, and Internet of Things solutions. Millions of applications and projects have been done using Arduino due to its user-friendly interface. The Arduino software is easy to operate to beginners, and when used by more skilled individuals, it provides enough flexibility. It can be used with Linux, windows and Mac. Teachers and learners use it to be able to create simple scientific devices at low cost, illustrate physics and chemistry principles, or learn how to program robots and create a robot. Interactive prototypes are developed by architects and designers, and it is to be used by artists and musicians to experiment with new instruments or to design installations. Of course, it is used by the makers as the part of creating many of the best achievements that can be seen at such events as the Maker Faire.

SYSTEM MODULES

ESP32 MICROCONTROLLER MODULE:

FIG 3: ESP32 MICROCONTROLLER MODULE

The ESP32 is a potent open-source Internet of Things (IoT) platform built on the ESP32 Wi-Fi and Bluetooth SOC. It can be used to operate a variety of electronic devices and facilitate quick, secure network communication between them. It supports both Bluetooth (BLE) and Wi-Fi connectivity. Complex IoT and real-time applications can benefit from the ESP32's increased processing capability, additional GPIO pins, and sophisticated capabilities like dual-core processing

RF SENSOR:

A device can connect with surroundings in an array of ways. An RF sensor is a useful device for wireless detection. Without making physical contact, an RF sensor uses radio frequency waves to detect tags, cars, or items at a distance. RF signals are frequently utilized in smart systems where prompt and precise detection is necessary due to their ability to move through air and cover greater distances. RF technology has been integrated into current design techniques to improve wireless device connectivity. It facilitates

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position monitoring, emergency vehicle identification, and real-time data transfer. The RF sensor is a crucial component of many intelligent designs and smart systems because of its capacity to function even in the presence of objects.

RF TRANSMITTER MODULE:

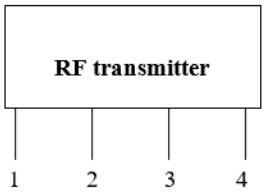

FIG 4. RF TRANSMITTER

RF RECEIVER MODULE:

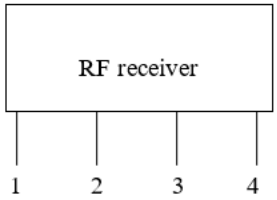

FIG 5: RF RECEIVER MODULE

IR SENSOR MODULE:

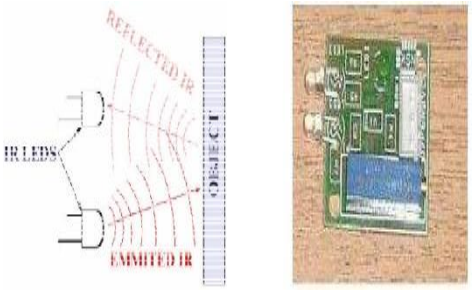

FIG 6: IR SENSOR MODULE

A radiation-sensitive optoelectronic component having a spectral sensitivity in the infrared wavelength range of 780 nm to 50 µm is called an infrared sensor (IR sensor). These days, IR sensors are frequently found in motion detectors, which are utilized in alarm systems to identify unwanted visitors or in building services to turn on lights.

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GSM MODULE:

FIG 7: GSM MODULE:

The GSM (Global System for Mobile Communication) module enables wireless communication over cellular networks. In this project, it is responsible for sending SMS alerts and making emergency calls when the panic button is pressed. Once triggered, the GSM module contacts the nearest police station or predefined family members and shares location details. It can transmit text messages containing GPS coordinates and alert notifications. GSM modules operate using a SIM card and standard mobile networks, ensuring wide coverage. This module ensures immediate communication during emergencies, reducing response time and improving overall public safety and reliability of the system.

GPS MODULE:

FIG 8 GPS MODULE:

The GPS (Global Positioning System) module provides accurate real-time location data in terms of latitude and longitude coordinates. In this project, it tracks the user's exact position when an emergency occurs. When the panic button is activated, the GPS module captures the current location and sends it to the microcontroller. This information is then transmitted through the GSM module to police authorities or emergency contacts. GPS technology uses satellite signals to determine positioning, ensuring reliable outdoor tracking. Accurate location sharing helps authorities respond quickly and efficiently, making the system more effective in crime-prone or unsafe areas.

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POWER SUPPLY UNIT:

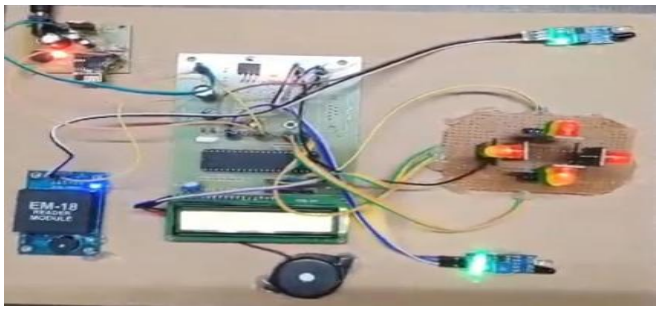
FIG 9: POWER SUPPLY UNIT

A power supply unit (PSU) is a piece of equipment that controls the DC yield voltage for current-registering components and transforms AC power into DC power. PSUs are used in desktop computers to supply power to internal parts such as the CPU, graphics cards, hard drives, and motherboard. PSUs are a necessary part of every server. In order to provide accessible DC, AC, and result voltage ranges, PSUs are categorized by applications.

RESULT & DISCUSSION

As a result, we draw the conclusion that this method will reduce the likelihood of traffic rule violations and accidents. Additionally, emergency services vehicles will arrive at their destination with minimal delay. As a result, sufferers will arrive at hospitals on time via ambulance, and fire extinguishers will arrive at their target on time. People will be more socially conscious of the importance of following traffic laws. The traffic system will become more organized as a result.

SCREENSHOT



CONCLUSION

By giving emergency vehicles' passage through intersections priority, the suggested intelligent traffic recovery model improves response times. The system identifies emergency cars and modifies traffic signals in real time using vision sensors, LED traffic lights, buzzers, and Wi-Fi modules. Priority is shown by a blue light on the traffic signal, and a clear road ahead is ensured by intersection communication. Emergency personnel are safer and there are less delays as a result. The system provides a scalable and reasonably priced urban traffic management solution. For even more efficiency, future upgrades might incorporate it with larger citywide systems.

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