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Emergency Ambulance Service with Mapping

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***Abstract*—The primary role of all ambulance services is emergency prehospital medical care and patient transfer; although they generally provide emergency response, patient transfer to a health sector is crucial. In the present world, India being one of the most populated countries, patient transfers are facing a lot of problems. Number of vehicles on the road is increasing day by day. Roads are managed using traffic signals and sometimes the passages of ambulances are delayed due to the red signal. Therefore, for simulating and optimizing traffic control to better accommodate this increasing demand arises. Unlike western countries, Indian cities cannot think of having separate lanes for emergency purposes due to lack of road planning and infrastructure. With the lives of the patients depending on the speedy arrival of the ambulance to hospital, an alternative solution to the above problem is the need of the hour. The problem of an ambulance getting stuck in a traffic jam can be addressed by ensuring that the lane in which the ambulance is traveling is cleared. This project is a mechanism which makes it easy for the ambulance to pass through traffic signals. Here the arrival of the ambulance is to be communicated to the nearest traffic signal, so that it can turn the light to green and hence clear the traffic. The proposed method also has a user interface for the ambulance driver which enables the signals to turn green by selecting the destination route. This could reduce hold-up in the road, thus reducing the rate of death caused due to the traffic in red signals. In addition to the said features, a set of sensors are set up on the ambulance to obtain patient vital data which is then transmitted to the hospital server by making use of a cellular network. These data can be analyzed by the hospital authorities and will be helpful in providing effective pre-hospital aid to the patient to increase his/her chances of survival.**

***Index Terms*— Ambulance, emergency, traffic signal, patient, and hospitals.**

I. INTRODUCTION

For smart cities, the surge in the number of automobiles is a key problem. It increases the number of automobiles on the road and introduces a slew of new environmental and health risks[1]. Obtaining real-time traffic data is a critical step toward increasing efficiency. This data can be utilized for traffic forecasts, vehicle routing, and traffic management, among other things. Due to a lack of sensors and factors that can impact traffic flow, obtaining real-time traffic flow information is difficult. Unforeseen circumstances that can affect traffic flow are another key concern that impedes the performance of traffic flow forecasting. A geofence is a virtual perimeter for a real-world geographic area. Geofencing uses technologies like GPS, or even IP address ranges to build their virtual fence. These virtual fences can be used to track the physical location of the device active in the particular region or the fence area. The location of the person using the device is taken as geocoding data and can be used further for advertising purposes.

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A. General Background

The main goals of ITS are to review, improve, examine, and integrate new sensor, record, and dialogue technologies, as well as algorithms, in order to improve the performance of site visitors. As a result, it may improve environmental satisfaction, save energy, save time, improve safety, and provide comfort to drivers and pedestrians, as well as other traffic corporations[3].

Recent breakthroughs in merging deep neural network designs with reinforcement learning techniques have shown promise in handling complicated control problems with large state and action spaces. These adaptive traffic light control agents emit control signals at each time step based on a snapshot of the present state of a graphical traffic simulator[4]. The value-function based agent, on the other hand, estimates values for all permissible control signals before mapping its observation to the control signal. The agent then chooses the best control action based on its highest value[5].

B. Problem Definition

Traffic congestion is one of the primary issues that the globe is facing as a result of rising population and rapid expansion in the number of vehicles. The major impact of traffic congestion on the emergency vehicle transport system is the focus of our endeavour.

C. Motivation

Due to the general rapid expansion in automobiles and restricted transportation infrastructure, ITS has been a popular research topic, and traffic optimization has been explored in recent decades. Our project EAS: Emergency Ambulance Service with Mapping considers the heterogeneous vehicular traffic network of developing countries with the goal of developing an interface app for ambulances to select the nearest hospitals and provide patient details to the hospital ahead of time, as well as providing an optimal path to reach the hospital on time with the help of the map.

D. Objectives

The goals of EAS: Emergency Ambulance Services are to:

- Reduce vehicle wait times.
- Find the most efficient route.
- The duration of each phase of a traffic light signal is determined using information derived from the vehicular network.

II. Literature Survey

Transportation plays an increasingly important part in our global economy, transporting products and people through increasingly sophisticated, interconnected, and multimodal transportation systems. Because of the rapid expansion in automobiles and restricted transportation infrastructure, ITS has become a popular study topic, and traffic optimization has been explored in recent decades[6].

A. Fuzzy Inference Enabled Deep Reinforcement Learning Model

The three-tuples model of reinforcement learning is well-defined (S, A, R). In terms of a vehicular network scenario, this section defines all three parameters.

States(S): The state of traffic at an intersection is described by two parameters: the vehicle's position in the vehicular network and its speed. The entire traffic junction is divided into square grids of the same size, each with a length of c. The most key thing to remember while establishing a grid is that no two vehicles will be on the same grid. The integral gain can be changed to suit the situation. The state space of each grid is defined by two-tuples (position, speed) of the vehicles present within the grid region.The location is a binary number, as shown in Fig. 2.1, with zero (0) indicating no vehicle located inside the grid and one (1) indicating the existence of a vehicle. The speed dimension is a float value that represents the vehicle's current speed in meters per second.

Action Space(A): Based on the present traffic scenario, an operator is responsible for selecting an appropriate action to ensure the smooth flow of cars at the junction. The agent in this system monitors the traffic situation and picks one of two actions: 0 indicates that the traffic signal phase should not be changed, and 1 indicates that green lights should be turned on for the following traffic light in the sequence[7].

Rewards(R): In a reinforcement learning model, the importance of the reward is to offer feedback based on the previously conducted action so that subsequent actions can be taken efficiently. A higher reward signifies that the action performed is substantially more important[8]. The provided benefits to an operator can be positive or negative in each iteration. As aforementioned, the agent tries to reduce average waiting time, delay, and queue length, as well as maximize average speed for vehicles at the intersection. As a result, two observations are taken during each iteration, one before the action is executed and the other after the action is executed. If r1 is the reward before the action is performed and r2 is the reward after the action is completed, the ultimate reward, R(= r1 r2), may be calculated as follows:

$$r1={}^{n}\sum_{i=1}{}^{x}\sum_{j=1} W_{ij} * (NWT_{ij}-NS_{ij})+{}^{nL}\sum_{k=1} W_k\ (ND_k+N_qL_k)[1]\ (2.1)$$

$$r1={}^{n}\sum_{i=1}{}^{y}\sum_{j=1}+W_{ij} * (NWT_{ij}-NS_{ij})+{}^{nL}\sum_{k=1}W_k\ (ND_k+N_qL_k)[1]\ (2.2)$$

where n and nL are the number of traffic intersections and lanes in the vehicular network, respectively, and x and y are the number of vehicles in the junction before and after an action. The weight of jt h vehicle in it h junction is Wij, and the normalized waiting time and speed of jt h vehicle in it h intersection are NWTij and N Sij, respectively. The lane weight (total of cars on the lane), normalized delay [9], and queue length [9] are represented by Wk,NDk, and NqLk respectively. X is the normalizing parameter (NWTij, N Sij, N Dk, and NqLk). The maximum and minimum values for each element represent the highest and lowest values achieved for that parameter during the current iteration. The favourable value of R implies that the specified action is the most suitable for the traffic state space.

B. Dynamic Intelligent Traffic Light Control System(DITLCS)

N. Kumar et al.[1] provide an article that addresses the heterogeneous vehicle traffic networks of emerging countries in order to design a dynamic and intelligent traffic light signal scheduling system.
Working:

1. Sensors are used to collect traffic data.
2. The data collected is sent to the cloud.
3. The cloud uses FIS to process the data and returns an execution mode (FM/PM/EM).
4. The traffic light controller receives the execution mode.
5. Using the learned DQN model, the traffic controller creates signal phases according to the mode of execution.
6. The generated signal phases are controlled by the traffic light.

C. Novel Fuzzy Bat Based Ambulance Detection And Traffic Counting Approach

The proposed system in the article[10] The novel fuzzy Bat based ambulance detection and traffic counting approach is composed of the following five fundamental building phases: Fuzzy Bat based optimization, image acquisition, object detection, counting the connected objects, and finally ambulance detection[11].

(1) Fuzzy Bat based optimization phase: This phase comprises the following three steps: extracting Gabor filters from ambulance samples, Fuzzy Bat based Gabor filter optimization, and generating a template matrix which includes a more optimal collection of filters for ambulance detection.

(2) Image acquisition phase: This phase is the first phase in the workflow sequence of any computer vision system. Different methods of processing can be applied, after the image has been obtained. We put a camera on a pole in this phase looking down on the traffic scene with multiple orientations, after that the best orientation is chosen to capture the live video real time frame.

(3) Object detection phase: There are six steps in this phase:
    1. Background subtraction
    2. Pre-processing
    3. Binary conversion of the image
    4. Detection of linked objects Steps
    5. Smoothing.
    6. Filling up gaps and joining blobs in close proximity

(4) Counting connected things: Counting connected objects. It's a simple task because each thing has its own label. The number of related items is represented by the number of vehicles.

(5) Ambulance detection: In this stage, a similarity metric is utilized to quantify the resemblance between two items. The similarity measures between each Gabor filter and Gabor filter parameters extracted from the detected object (extracted from the input image) and those in Template Matrix (especially the key filters with the highest membership values) are calculated using the Euclidean distance algorithm for each detected object, and the results are then stored in an error matrix. Finally, the ambulance is detected using a predetermined threshold.

D. 5G-Network Enabled Smart Ambulance: Architecture, Application, And Evaluation

- 5G Communication Network
- Remote Video Communication
- Telemedicine Medical Data Exchange are the architectural components of the 5G-enabled smart ambulance suggested by Zhai et al[2].

a) 5G Communication Layer:
Vehicle-mounted location terminals, video communication equipment, and multi-monitor acquisition equipment can all connect to the 5G network. For the implementation of the pre-hospital emergency system, the 5G network meets the demand for bandwidth, delay, and other network performance characteristics. The major benefits are reflected in a variety of ways[12]. For starters, precise and fast access to geographic location, as well as real-time vehicle positioning, can provide accurate real-time spatial location. Second, at the accident scene, virtual reality (VR) glasses are deployed. Doctors at the destination hospital are given access to real-time patient and accident scene information. Third, real-time vital signs data, such as patient blood pressure, blood sugar, and other patient medical records data, are collected via on-board medical equipment and supplied to a hospital doctor for real-time advice and treatment.

b) Remote Video Communication:
Hospital doctors can grasp the state of patients in transit in real time using VR glasses and multimedia processing technology, as well as audio and video interactive technology. Emergency and critical patients can be among the first to receive expert rescue guidance, allowing ambulance doctors to improve the quality and efficiency of their rescues while reducing rescue time and achieving seamless connectivity before and in the hospital, allowing emergency patients to receive better treatment; improve the success rate of emergency and critical patient rescues; and create a more convenient platform.The main benefits of employing remote video communication include real-time tracking of patients in ambulance treatment, and remote video communication initiating remote consultation while a patient is in transit through VR glasses or a video terminal.

c) Telemedicine Medical Data Exchange:
This layer enables users to record, store, and process patient information in the HIS, LIS, PACS, hospital resource information database, and geographical resource information database. This will also allow for the online input of previous diagnosis and treatment information, patient vital signs data, rescue on-site video information, and rescue information, as well as achiever-time data interchange and sharing among various healthcare systems. Furthermore, the telemedicine medical data exchange supports the functions of real-time vital sign data acquisition, online transmission of medical images and video on-site pictures, and online storage of patients' medical records information, as well as providing medical data support for multi-linkage of doctors and hospitals.

III. CONCLUSIONS

In today's world of major roads, traffic lights are essential in saving a person's life. According to the Times of India, nearly 30% of deaths are due to ambulances turning up late to the hospital. The lag in arrival of an ambulance has an impact on humans. In the golden hour, the ambulance is unable to reach the hospital. It gets tangled up in the traffic lights. We are attempting to shorten the ambulance's wait time under the suggested system. We attempted to create a route to an ambulance in this project so that time on the road may be saved. The indicator turns green when an ambulance has been detected. This can be expanded to any number of indicators along the ambulance's journey, allowing for immediate service of emergency situations. We could also make the signals green at a specific time. This allows the ambulance to get through the traffic intersection as quickly as feasible.
Our project EAS: Emergency Ambulance Service with Mapping takes into account the heterogeneous vehicular traffic networks of developing countries with the goal of developing an ambulance interface app that allows the ambulance to select the closest hospitals and provide patient information to the hospital ahead of time, as well as provide an optimal path to the hospital using the map.

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