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ASTUTE Routing System for Emergency Vehicle

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ABSTRACT: Road traffic congestion is considered as a major problem in urban areas, which have caused many inconveniences for the emergency vehicles like ambulance and fire brigade. Because of this many casualties occur. GPS systems have been used so far for the location of the vehicle but it did not provide the appropriate and congestion free routes. The vehicle also used sirens and flashing lights for making the path free for the vehicle to pass. Other system found a way for pre-empting the traffic signal as the vehicle approached but lacked of shortest path. Many systems were developed and studied for aiding the emergency vehicle. Our project contributes to aiding of these emergency vehicles by finding the optimal path as well as making the road congestion free in real time. In this case, the ambulance van in three steps viz. finding the nearest ambulance, finding the shortest path for the ambulance to reach the accident spot, finding the shortest path to the hospital with minimum amount of congestion on the way(the primary concern) and also the traffic clearance. Traffic clearance can be done by switching the traffic lights so that vehicles in front of ambulance will be moving on and no traffic congestion will be present. Even traffic police will be communicated about the traffic lights switching.

KEYWORDS: Dynamic path Planning, Signal Preemption, Routing Mechanism, GPS Location.

I. INTRODUCTION

India is a densely populated country housing around 1.2 billion people. Cities like Pune have seen a constant in-flux of people. With an ever inflating population routing traffic around the city becomes arduous. In Indian cities traffic lights work on a pre-programmed logic. This logic being static does not alter with the change in traffic density neither does it identify emergency vehicles. In many cases theses traffic lights are responsible for more congestions, and thus require human interference. Emergency Vehicles are the biggest victims of such congestions. There have been many cases where delay due to traffic congestion had fatal consequences.Prompt movement of the emergency vehicles from the accident spot can greatly increase the probability of saving the life. There are many barriers in prompt moving of this vehicle from path selection to make free the path. The main factor in preventing the traffic related delays is that the traffic flow in a direction of choice cannot be controlled or diverted during the need.Years of development of different technologies, approaches for solving emergency vehicle routing lead to its evolvement. Sirens and flashing lights were initially used for the purpose but turned inefficient as a standalone system. Traffic lights on other hand can help to guide the vehicles to make path free for the emergency vehicle. The D-GPS mad it easy to identify the arrival of vehicle at a point or location.The above mentioned system's has some drawback or the other and we in this project will overcome this and form a new system. Our system will find the shortest path with pre-emption of traffic by using traffic lights. Traffic lights here have the functionality of reading the signal from the vehicle and before its arrival at an intersection it will free the path. At the same time the path information that is selected is sent to traffic police of that region so as to make the system more efficient. The synchronization of this different entity can result in congestion free path for the emergency vehicle.

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II. LITERATURE SURVEY

1. While coming up with a solution to tackle this problem, many proposed projects where researched. Some papers talk about a system wherein RF transmitters and receivers are used to communicate between the EV (Emergency Vehicle) and the traffic lights. Zigbee based communication is used to create an intelligent network between all the traffic lights in close proximity and create a failsafe system that gave higher priority to the EV's. However this system is expensive and difficult to incorporate with already installed traffic management systems in India.

2. In the paper proposed by Sachin Grover [3] and PratyushParida [4] they utilized a dual tone multi frequency (DTMF) circuitry along with a microcontroller which enabled the EV to preempt the traffic signal. The driver calls the cellular phone that is installed in the signal and prompts it to override the signal by dialing in the password. The DTMF detects and cross verifies the password and changes the signal accordingly allowing the EV to pass. Here every signal need to have a cell phone, an GSM SIM and a DTMF circuit for it to work which makes the entire system expensive.

3. Even early systems were using the strobe lights which were coming from the vehicles and were detected by the receivers on the traffic lights. But this requires the clear line of sight even it is not feasible in the bad weather condition or when traffic lights are not in a working condition. This was proposed by Schwab, Bruce B. [1](1959) in his project.

4. Present generation uses the GPS system for real time data of the vehicle location. This helped to detect the location of the emergency vehicle accurately and start the traffic light co-ordination earlier. For communication between the traffic lights and the emergency vehicle radio transceivers were used. The GPS data of the emergency vehicle were directly transmitted to the central server so that dynamic preemption of the traffic lights will be present along emergency vehicle's route. This was proposed by Aaron D. Bachelder, Conrad F. Foster [2] in 2002 in their project.

5. A* is an informed search algorithm means it finds all the possible paths by searching and among all the possible paths shortest path is used. For finding the shortest path A* uses heuristic function [h (n)] which gives direct cost from current position to the destination. It was proposed by Peter Hart[6],and Bertram Raphael [7]of Stanford Research Institute in 1968. It is an extension of Dijkstra's algorithm. But it does not give the dynamic path planning and also it has more execution time.

III. PROPOSED SYSTEM

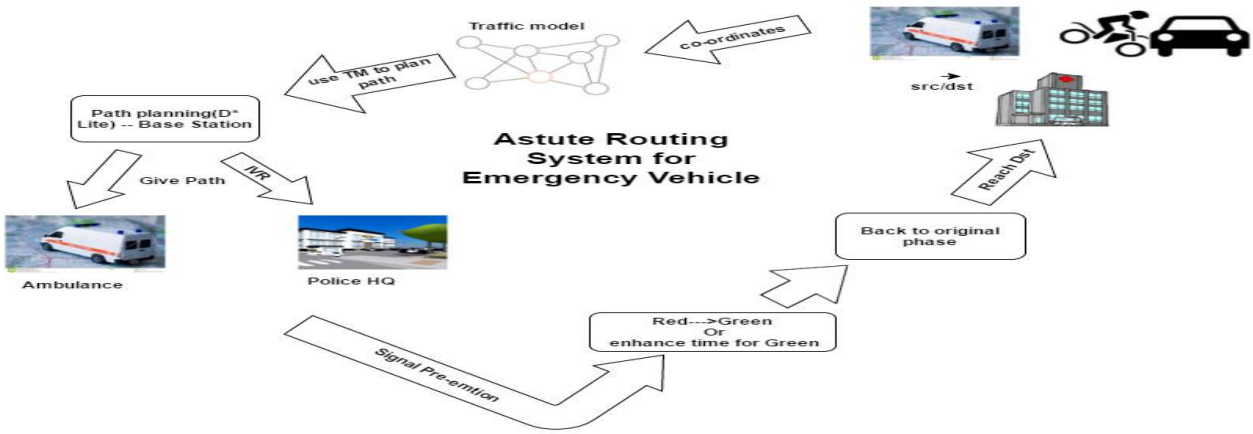

Fig. No 01 Proposed system

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1) ASSUMPTIONS: For our proposed system we are going to have some assumptions which will make the system more flexible and effective. Firstly we assume that the traffic signals are centrally co-ordinated and also the traffic police central control room for communication. Secondly, the ambulance is going to have the GPS tracker which will give the current location. Also the ambulance is going to have the transmitter which will change the traffic lights from red to green or if it is already green then time will get enhanced for clearing the traffic flow. For changing the traffic signals as ambulance is having transmitter same receiver will be placed on the traffic signals.

2) SOLUTION SYSTEM: In our proposed system we are reducing the emergency vehicle's travel time as well as their cost. In our assumptions we are combining the traffic light preemption and dynamic path planning which will decrease the reaching time of the ambulance to the destination. Even the preemption is going to be communicated to the police radio channel so that in worst case it will be helpful. For communication to the police we are assuming that the police have a central room for communication.For dynamic path planning we are going to use the d* lite algorithm which computes the shortest path between current location and destination. When ambulance is 500m away from the traffic signal the traffic lights will automatically get changed to green so that traffic flow in front of ambulance will be moving and no traffic jam will exist. After passing of the traffic signal, the traffic light will come back to the existing situation. We are maintaining the database of the current location and the status of the ambulance i.e. filled or empty. Our system is also going to suggest the nearby hospital based on location database.

IV. METHEDOLOGY

1) DYNAMIC PATH PLANNING: D* Lite is an informed or heuristic search algorithm invented by Koenig and Likhachev [7] in 2002 and then it has been used in different applications for dynamic path planning. This heuristic is selected specific to the problem domain and guides the search. The heuristic is nothing but the direct distance from current position to the destination. D* Lite is derived from another incremental informed search A*, and specifically Lifelong Planning A* (LPA*). Most of the D* Lite properties are inherited from LPA*. LPA* does only forward search whereas D* Lite also do backward search. It searches backward means starting from the goal to the start state. This property makes repairing the current plan easier in D* Lite because the goal stays fixed and the start node keeps moving around.
D* Lite is a simpler version of the D* algorithm which was previously invented by Stentz [7]. There is not much difference between the D* and D* Lite except the number of lines of code. D* Lite maintains two types of node's costs. One is 'g' and other is 'rhs'. 'g' is the objective function value and 'rhs' is the one step look ahead objective function value. A node is consistent till these two values are equal. If a node is not consistent it is added to a priority queue for processing. Nodes are added and processed each depending on its priority or key (k) which is defined depending on the heuristic and the two estimates of the node.

2) SIGNAL PREEMPTION: Signal preemption is nothing but extending the current phase of traffic lights or directly switching the current phase to the safety phase. When vehicle is 500m away from traffic signal the signal will automatically get switched to green signal so no traffic jam will exist and ambulance will move on. When ambulance passes the signal the traffic lights will automatically get switched to the original phase.
If in case traffic signal stops working in that case traffic police will be helpful for passing the ambulance. As traffic police has received the signals from the control room of the traffic police.

V. ADVANTAGES

1. Provides the path to the ambulance to reach the estimation in less time.
2. Provides status of the ambulance and its current location.
3. Preemption of the traffic signals in emergency.
4. Traffic police co-ordination in worst case.

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VI. CONCLUSION

This paper provides the system which is centrally based and does all the communication and dynamic path planning. Traffic signals preemption is done at the time of emergency so that no traffic congestion will be present and ambulance will reach the destination in less time and with less cost.

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