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Lifeline-Intelligent Route Clearing for Ambulance

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Abstract - *In this twenty-first millennium, where everything is getting faster we are in a forceful state to rush our self which in turn makes the traffic congestion and accidents an inevitable one. The major emergency service gets affected by this is ambulance service. In order to tackle the problems related to manual clearing of routes based on the siren of ambulances, we introduce 'Lifeline-Intelligent Route Clearing for Ambulance' which provides alerts on the distance and direction of ambulances approaching your vehicle. The route clearing is done by using wireless mesh networking and the hardware used is NodeMCU & GPS module.*

Key Words: **Accidents, Alerts, Ambulance, Emergency Service, Intelligent Route Clearing, Traffic congestion.**

1. INTRODUCTION

Traffic management is one of the serious problems faced by today's society. Congestion is a major problem in developing cities which causes slow-moving traffic, which increases the time of travel. There are so many examples that ambulances got stuck in the traffic load, most of the cases occurred due to the unawareness about the direction of the ambulance approaching. If we can come up with an effective system to overcome this problem a lot of lives can be saved. So here we came with a new idea that impart the functionality of one path clearance i.e. the path in which an ambulance is going will be cleared by giving notification to the vehicles in the path of the ambulance with direction and distance indication.

Using a Wi-Fi module and GPS module the route clearance problem can be solved. The Wi-Fi module used here is NodeMCU which is an open-source firmware and development kit that helps to prototype or build IoT products. The firmware will run on ESP8266 wi-fi soC from the Espressif system, the hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is built on the Espressif Non-OS SDK for ESP8266 and based on the eLua project. Also, ESP8266 can be programmed using the Arduino IDE.

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written on functions of C and C++. This can be used to write and upload programs on boards which are compatible with Arduino. One of the most well performing GPS receivers available is the NEO - 6M GPS module, which built-in 25x25x4mm ceramic antenna, which has the capability to provide strong satellite search. With the power and signal indicators, a GPS module sends the location to track the position of the vehicle in real-time. It is used to provide the best cost efficient solution.

The basic working principle of this proposed system is Ad hoc mesh network. The idea of a mesh network is when the devices or nodes are connected so that at least some, and sometimes all, have multiple paths to other nodes. These multiple routes for information between pairs of users increase the pliability of the network in case of a failure of a node or connection. In the case of a full-mesh topology, each node in the network is connected directly to each of the others. But in a partial mesh topology, only some nodes have multiple connection partners. The traffic pattern of the network overall and the extent to which nodes or connections are at risk of failure are the factors which decide which node is mesh.

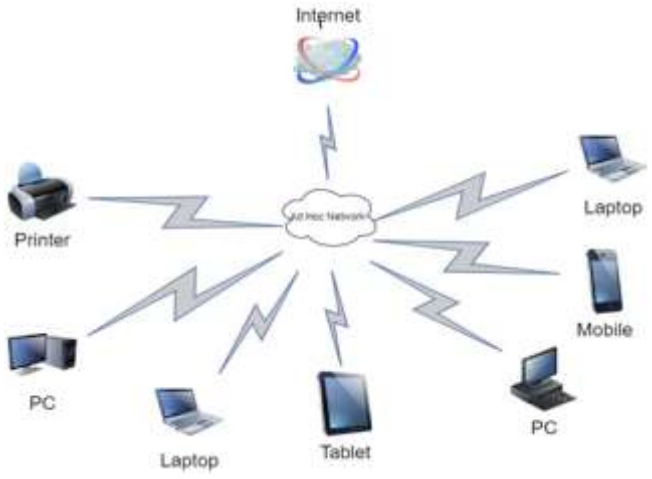

Fig -1: Example of wireless mesh network

1.1 Associated Problems in Existing System

Even the ambulances have sirens, the vehicles in the path still have a confusion, that from where the ambulance is approaching. Due to this problem a lot of ambulances are stuck in road traffic. So there is a need to design a system that gives notification to the vehicles in the path of the ambulance with direction and distance.

This paper explains when an ambulance is in service, on approaching a vehicle or signal an alert message will be passed to the drivers in that Wi-Fi circle along with the direction and distance it is far from the ambulance. The vehicle has an extra hardware system which consists of NodeMCU and GPS module. That hardware can receive the alert and direction. If the distance between them is within Wi-Fi range, alert is given with direction. Every signal has a similar hardware detecting ambulance before traffic signal and will display the green light which will help to clear the route for the ambulance. Simultaneously red will display which will indicate other people to make a side for the ambulance or to stop until it passes away.

2. LITERATURE REVIEW

There is no implemented solution for route clearing of ambulances. The current implemented system is listening to alarm and giving way for vehicles. But there are a lot of ideas and research developing in this field.

2.1 Emergency Ambulance Route Clearing System

The population is largely increasing worldwide. Obviously the reason for mobility is high, traffic problems are also, and unwanted changes in the environment are becoming major problems. The sensor implemented in a traffic junction will detect the ambulance and displays blue light to make way for it. The IR sensor spots the ambulance and gives signals to the microcontroller as it passes and the LED shows blue light along with LCD Display If the blue LED blinks simultaneously green will blink which will indicate other people to make a side for the ambulance. Thus the proposed EARCS (Emergency Ambulance Route Clearing System) design helps to control the traffic efficiently by giving priority to the emergency vehicles. The loss that is created due to traffic problems can be solved to a great extent by this approach i.e., by using 'EARCS' technology with 'IR SENSORS' where EARCS is used for object density detection. The muddle about the direction of the ambulance still exists which will result in loss of time. This system also fails in a junction without a traffic signal [1].

2.2 Advanced Traffic Clearance System for Ambulance Clearance using RF-434 module

This paper talks about using wireless communication for easing the passage of ambulances without traffic congestion. In this system, the Ambulance is having an RF Transmitter which is controlled by a microcontroller. The Traffic Light is also having an RF receiver and microcontroller controls the Traffic signals based on the receiver data. The RF transmitter transmits the signal when the ambulance turns on the siren and RF receiver in the traffic signal stand receives it and simultaneously switches to green light for the passage of ambulance. The primary aim of the proposed system is to prevent the ambulance from getting stuck in traffic. This paper presents an intelligent system for traffic management using wireless communication technology. The proposed system consists of an arduino module, Android GSM mobile, LCD, transmitter and receiver module. The existing system simply suggests an alternative route in huge traffic situations. This system can immediately stop vehicles in all other lanes and allow the ambulance to pass through safely and quickly [2].

2.3 A Study on Design of Ambulance Tracking and Route Clearing using GPS, GSM, RFID

The fundamental idea driving the paper is to give a smooth stream to the emergency vehicle to achieve the healing facilities in time and consequently limiting the postponement caused by activity clog. The Micro-controller based RFID framework is utilized to modify the movement lights upon its landing in rush hour gridlock light intersection which would spare lives at basic time. This includes a little chip and a receiving wire. The little chip is installed with data about tolerance's status and the rescue vehicle current path. RFID in each movement flag examines the data from the RFID locator carefully. To maintain a strategic distance from pointless activity flag transforms, cross elude the rescue vehicle ebb and flow area and persistence's condition utilizing portable application enrolled by the emergency vehicle driver. If there should be an occurrence of system disappointment, the RFID takes the entire control.

In this life saver project the android app that connects both the ambulance and the traffic signal station using GSM network is used. GPS is used to track the ambulance and also it fetches the actual location of the ambulance. The RFID (radio frequency identification) technology is used to implement intelligent traffic signal control. The major idea behind the proposed model is, if the Ambulance gets stuck on the way, RFID fitted at the traffic signal tracks the ambulance with RFID tag and sends the relevant information to the cloud. After receiving the acknowledgement through the mobile app for the user, the particular signal is made Green for some time and after the ambulance passes by, it resumes its original flow of

sequence of signaling. If this scheme is fully automated, it finds the ambulance location, controls the traffic lights and thus it acts as a life saver project [3].

2.4 Traffic Clearance for Emergency Vehicles using Priority mode

This paper focuses on providing a smart way of controlling traffic light timing during peak hours and also to provide smooth passage for the ambulance to reach the hospital without any delay .They have implemented a new mode called "ambulance mode" which would control the traffic lights in the path of the ambulance. This is not preferred only for ambulances. It is preferable for other emergency vehicles such as fire engines. The objective in this paper is to design a system of traffic clearance for emergency vehicles using image processing in MATLAB especially by using a new mode called blue mode. In this system, they first control the normal traffic using sensor based density management. There is a special mode called AMBULANCE MODE, in which there will be an additional indicator which is in blue. By this everyone on the path will get an alert and thus can make way for the emergency vehicle. All these processes are combined and make the lifesaver to reach the hospital in time [4].

2.5 An Approach to Make Way for Intelligent Ambulance using IoT

In this system ambulance is having an additional hardware that consists of an ARM processor, GPS, GSM module, Optocouplers and RF Transmitter. GPS traces the location and sends the location updates to traffic control management. GPS is connected to the ARM processor and GSM module to send the message to the traffic management system and also to get the acknowledgements from the receiver side. This communication should take place with high security and information is encrypted and this process is carried away by the internet of things. With the help of IoT information is sent to the signal logic gate by the GSM module. By using Optocoupler circuit all the information is passed and is controlled by PC .Thus the traffic controlling takes place to reduce the loss of property and lives due to the traffic congestion [5].

2.6 Traffic Management for Emergency Vehicle Priority Based on Visual Sensing

This paper introduces a technique to schedule the emergency vehicle in traffic. It includes the measurement of the distance between the emergency vehicle and an intersection with the help of visual sensing methods, vehicle counting and time sensitive alert transmission within the sensor network. The distance is calculated for comparison using Euclidean distance, Manhattan distance and Canberra distance techniques. The experimental results have shown that the Euclidean distance yields better results compared to other distance measurement techniques. The collected emergency vehicle is delivered to the Traffic Management Center (TMC) using a Medium Access Control (MAC) protocol with less delay.MAC layer in WSNs helps to prioritize the emergency vehicle data and to reduce the transmission delay for emergency messages.PE-MAC protocol, which is a window adjustment scheme that is used to achieve low broadcast delay for these messages. A VANET model for the UTMS is developed and simulated in NS-2.The NS-2 simulation results have shown that PE-MAC protocol outperforms when estimating average end-to-end delay, throughput and energy consumption also [6].

2.7 IoT based Traffic Signal Control for Reducing Time Delay of an Emergency Vehicle using GPS

This proposed system makes use of GPS system IOT application and Android application. The android application not only focuses on traffic light control but also sends messages to the hospital and the concerned doctor so that the arrangements are ready at the hospital. The hospital will assign priorities to the patient, to assign priority the information is to be given by the staff with the ambulance. The chaos that may be created by changing lights among the minds of people waiting at the signal will be taken care by the concept of Blue light which is an indication that the signals are changed. This paper improves the state of the art in emergency vehicle routing by introducing dynamic path planning combined with traffic light preemption. As our results demonstrate, dynamic path planning has proven to reduce the emergency vehicle's travel time [7].

2.8 Low Cost Traffic Control System for Emergency Vehicle using ZigBee

The system proposed here has the ambulance as the main unit and with a number of subunits that includes vehicles and traffic control units; a trans-receiver is mounted on each unit which sends and receives data. The main unit is the vehicle-to-vehicle protocol communication for providing a free lane during emergency scenarios. The main unit will interact with the nearest vehicle and sends information regarding the presence of the main unit i.e., emergency vehicle, this message is further commuted with the further vehicles on the lane and so on. During the inch-by-inch moving heavy traffic this interaction can be used to clear the lane by finally interacting with the traffic control unit. Vehicle information is delivered to the signal control unit at an intersection without time delay. The information about the usage of the lane by emergency vehicle is transmitted by ZigBee protocol using ZigBee transmission. It is economically cost effective and simple in design aspects compared to other GPS based preemption systems. Pressure sensor is attached to the bed to take out the fault signal transmission. So only if the

patient is present in the ambulance the signal is transmitted. The traffic signal comes back to its original relay when the ambulance passes the traffic signal and traffic comes to normal [8].

3. PROPOSED SYSTEM

Intelligence route clearance can be done using hardware consisting of NodeMCU and GPS. When the emergency vehicle (Ambulance) and the other vehicles approach in a Wi-Fi range the hardware in the ambulance will send the location of the ambulance to other vehicles. The arrival of the ambulance is always a panic situation for the drivers. Such a situation can be avoided by this system since this provides the direction of the ambulance, in addition to the alert.

The hardware can be implemented in the ambulance, other vehicles, also in traffic signals. The hardware in the ambulance has access by admin. That admin can only activate the hardware in the ambulance. When the Ambulance is on the service, the admin will activate the hardware. When the other vehicles come in the Wi-Fi range of the ambulance the location of the ambulance will be shared to hardware in the vehicle. Similarly, the location of the ambulance will be shared with the hardware in the traffic signal when they are in the Wi-Fi range. The drivers will get the direction of an ambulance by calculating the direction using the received location of the ambulance to make a smooth way for the ambulance. The traffic light turns green for the corresponding direction of the ambulance and turns red for all the other directions.

For unauthorized access and to prevent security breaches, an admin module is provided who controls the database containing ambulance's information. The live and disabled status is set by this admin.

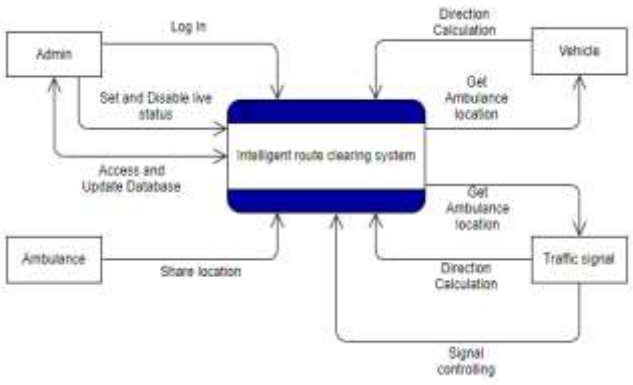

Fig -2: Data flow Diagram

3.1 In Vehicles

When a vehicle comes in the Wi-Fi range of the ambulance, the hardware consisting of NodeMCU and GPS module in the ambulance shares the location of it. The similar hardware in the vehicle receives the location and then a mathematical calculation is performed to find out the direction of the ambulance concerning the vehicle. The direction calculation is performed using the bearing angle [3.1.1] and the driver will get an alert along with the direction of the ambulance as audio. Then the driver can make way for it accordingly. Drivers can know about the direction at the earliest and this is a significant advantage of the proposed system.

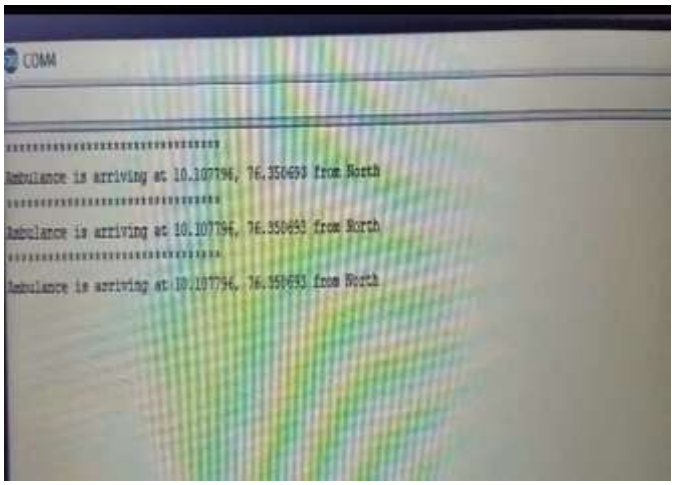

Fig -3: Serial monitor display of vehicle

3.1.1 Bearing Angle

Here bearing angle is used to find the approaching direction of the ambulance.

There are four main directions of a compass known as cardinal points. The four main directions are north (N), south (S), West (W) and East (E). The half-cardinal points are north-east (NE), north-west (NW), south-east (SE) and south-west (SW).

- North representing 0 or 360
- East representing 90
- South representing 180
- West representing 270

The true bearing to a point is the angle measured in degrees from the north line in the clockwise direction. Here, true bearing simply as the bearing.

Considering an example, Let R is a point and the bearing of the point is 25^0 which denote the number of degrees in the angle measured from the north line to the line which joining the centre of the compass at O with the point R in the clockwise direction (i.e. OR). The bearing of point S is 200^0 which is the number of degrees in the angle measured from the north line to the line joining the centre of the compass at O with the point Q in the clockwise direction (i.e. os).

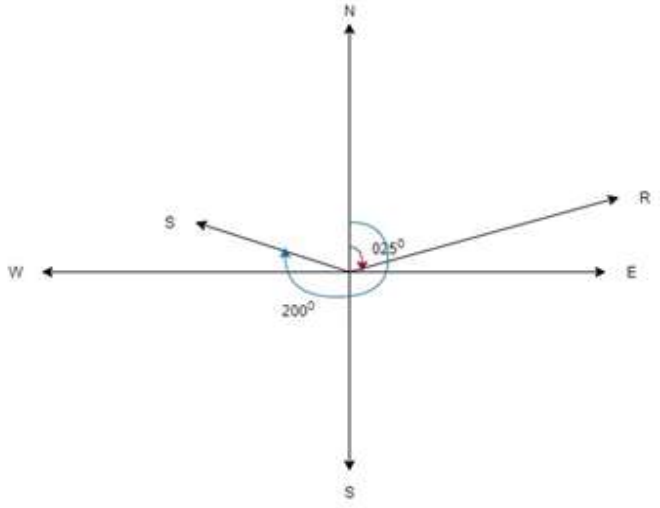

Fig -4: Bearing Angle

3.2 In Traffic Signal

When the emergency vehicle (Ambulance) is near a traffic signal junction, that is both the traffic signal and the ambulance are in Wi-Fi range. The location of the ambulance is sent to the traffic signal by the GPS module in the ambulance's hardware. The hardware in the traffic signal will receive the location and then calculate the direction [3.1.1]. Then the signal light in the direction of the ambulance turns to green. Other signal lights turn red. So other vehicles which are not in the direction of the ambulance have to stop to give way. Also, the drivers in the same direction will get alert and direction indication [3.1] and can give way easily.

(Example: if the ambulance is approaching from the North direction the signal lights facing the north direction will activate green light and red light will be activated in the signal lights facing east, west and south direction.)

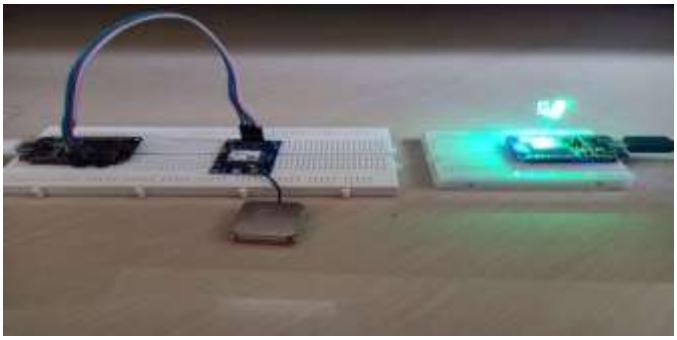

Fig -5: Change in signal light on receiving message from ambulance

3.3 In Ambulance

The hardware (NodeMCU and GPS) in the ambulance shares the location of it to other slave nodes (vehicles) and to signals, when they come within the Wi-Fi range. This starts sharing location when it is set active by admin and stops on reaching destination, correspondingly status of ambulance is updated in the database.

Fig - 6: Schematic diagram of proposed system

4. FUTURE ENHANCEMENT

In future work, this can actually be used for 'Kanivu108' - Kerala's free ambulance network for its route clearing. And as an extension, this system can also be developed with a provision to provide alerts to nearby police stations when there is any violation of route clearance for emergency vehicles. Similarly, on detecting an ambulance in a vehicle's Wi-Fi limit, the complete inactivation of music systems in the vehicle during the cautionary time is also a point of thought to enhance this system.

5. CONCLUSIONS

Tremendously growing vehicle population demands an exclusive change in the existing route clearance systems for emergency vehicles. In urban areas, there are systems which use image processing technology for efficient traffic management. But they are unquestionably complicated and money consuming on a large scale basis. Here, the proposed system uses an Ad hoc mesh network for clearing the route for ambulances and overcomes all the

issues more easily, in less time and cost using a simple global positioning system. This uses Geocoding and Distance matrix API to find the distance and true bearing angles to find direction. So if such a system comes into use, it will be really helpful for all that come under the category of emergency vehicles such as: Fire Engines, Army and Police vehicles, VIP vehicles etc.

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