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ISSN : 0976-8491 (Online) | ISSN : 2229-4333 (Print)
IJCST Vol. 5, SPL - 1, Jan - March 2014

Automatic Movement of Emergency Vehicle to Accident Spot- (EVMS)

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Abstract
The public or emergency services do not know the nearby location and the level of services. The lack of such information may cause several causalities. Hence, the research question arises in a way to answer how to direct the emergency vehicle to reach the accident spot in right time. So, routing the vehicle and making traffic signal control as per vehicle movement is necessary. There is loss of life due to the delay in the arrival of Emergency vehicle to the accident place. To achieve these required conditions we suggest implementing a System called Emergency Vehicles Monitoring System (EVMS) Emergency vehicle monitoring System can integrate GPS, GSM, GIS services. The GPS devices deliver the data concerning the Emergency vehicle position and their shortest route. As an input of the main server the Google map allows to choose shortest route between emergency vehicle and accident spot. The Traffic preemption Device is often used for various emergency vehicle recognition. Traffic preemption devices can be installed on emergency vehicles, operated by remote control from the main server. Among them emergency vehicle .their traffic control signal abilities can implemented for traffic control signal for emergency vehicles.
The idea behind this scheme is to implement an Intelligent Transportation System (ITS) which would control the traffic lights in the path of the emergency vehicle. The server determines the location of the accident spot; through the sensor systems in the emergency vehicle/, the server using shortest path method can guide the emergency vehicle to the accident spot.

Keywords
Global Positing System, Global System for Mobile communication, Geographical information System, Intelligent Transportations System, Shortest Path Method, Traffic Preemption Device, EVMS.

I. Introduction
There is loss of life due to the delay in the arrival of emergency vehicle to the accident place. This delay is mainly caused due to the waiting of the emergency vehicle in the traffic signals. It would be of great use to the emergency vehicle if the traffic signals in the path of the accident place are ON. Thus we propose a new design for automatically controlling the traffic signals and emergency vehicle monitoring achieving the above mentioned task so that the emergency vehicle would be able to cross all the traffic control signal without waiting. Every traffic junction will have a controller controlling the traffic flow.
The traffic control are referred to as nodes and each node will have a GSM (Global System for mobile communication) modem connected to the controller. The nodes are controlled by a main server by sending the control messages to their GSM (Global System for mobile communication) modems. When a node is controlled and its traffic signal is made to be green for the emergency vehicle to pass through without waiting, it is said to be in ON STATE as mentioned by Athvan and Jagdeeshwaram in (2012). For Easy access the server maintains a database for each node, and hence each node will have a unique ID for addressing it and its GPS (Global Positing System) Coordinates are also stored in the database as by Athvan and Jagdeeshwaram in (2012). Thus using these data and shortest path method as mentioned by Deo Pang (1984). And the Emergency vehicle is guided to the accident place by the server through the shortest route.
The Traffic preemption Device is often used for various emergency vehicle recognition. Traffic preemption devices can be installed on emergency vehicles, operated by remote control from the Main server.

II. Emergency Vehicle Monitoring System
Emergency vehicle monitoring System can integrate GPS, GSM, GIS services. The GPS devices deliver the data concerning the Emergency vehicle position and their shortest route. As an input of the main server the Google map allows to choose shortest route between emergency vehicle and accident spot. The Traffic preemption Device is often used for various emergency vehicle recognition. Traffic preemption devices can be installed on emergency vehicles, operated by remote control from the Main server. Among them emergency vehicle .their traffic control signal abilities can implemented for traffic control signal for emergency vehicles.
Our system consists of three main units, which coordinates with each other and makes sure that emergency vehicle reaches the place without any time lag. Thus our system is divided into following units,

- The Emergency Vehicle Unit
- The Main Server
- The Traffic control Unit(TJU)/Traffic Preemption Device

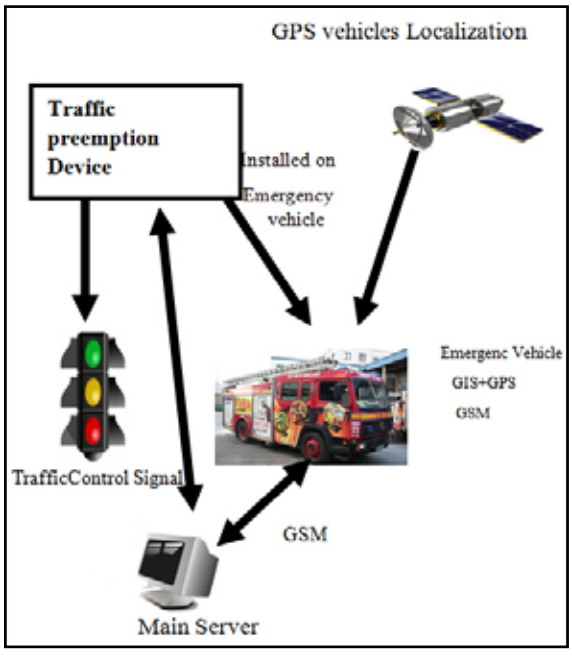

Fig. 1: Emergency Vehicle Monitoring System

A. Emergency Vehicle Unit

According to our system, every emergency vehicle should have a emergency vehicle unit number. The emergency vehicle unit consists of a vibration sensor, controller, siren, a user interface, GPS (Global Positing System) system and a GSM (Global System for mobile communication) module. The vibration sensor used in the vehicle will continuously sense for any large scale vibration in the vehicle as mentioned by Wei and Hanbo in (2011). The sensed data is given to the controller.

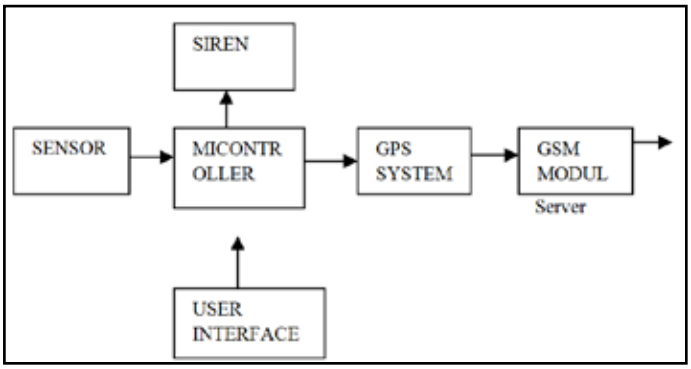

Fig. 2: Emergency Vehicle Unit

The controller compares it with a threshold value which is an empirical value (for an accident place) and if it equals or exceeds that, then the controller automatically switches on a siren inside the vehicle. A programmed timer is also triggered. In case of a minor emergency, the passenger probably would not need the service of the Emergency vehicle, and can therefore switch off the siren before the timer counts to zero, by resetting the entire Emergency vehicle unit through the user interface, which is connected to the controller. If he is unconscious or fatally wounded and needs an emergency vehicle, then the siren is left ON and when the timer counts to zero, it would trigger both the GSM (Global System for mobile communication) MODULE and the GPS (Global Positing System) SYSTEM inside the Emergency vehicle. The GPS (Global Positing System) SYSTEM finds out the current position of the Emergency vehicle which is the location of the emergency spot and gives that data to the GSM (Global System for mobile communication) MODULE. The GSM (Global System for mobile communication) MODULE sends this data to the main server whose GSM (Global System for mobile communication) number is already there in the module as an emergency number. The vehicle unit is shown in the fig. 2.

B. Main Server

The main server is the central brain of our ITS(Intelligent Transportation System). It communicates as well as controls every part of the system. The Traffic preemption Device is often used for various emergency vehicle recognition. Traffic preemption devices can be installed on emergency vehicles, operated by remote control from the Main server.

The server objectives can be mainly classified into:

- Finding the Nearest Emergency vehicle to the Accident Spot.
- Allotting Shortest Path for the Vehicle from Source to Destination.
- Controlling the Nodes/Traffic Light in the Shortest Path

1. Finding the Nearest Emergency Vehicle to the Accident Spot

The main server maintains a database of the emergency vehicle available. The server selects the nearest emergency vehicle to the accident spot using the database containing the details of free and busy emergency vehicle at that point of time. Then the server scans the locations of the free emergency vehicle in the database. It calculates the distance between the accident spot and each emergency vehicle. Then it compares all the distances calculated and selects the nearest emergency vehicle that is to be directed for reaching the spot as mentioned by Tawara and Mukai in (2010).

Therefore for performing the above functions, the server must have the following databases:

- Emergency vehicle database - contains list of free and busy emergency vehicle along with the unique emergency vehicle number.
- NODE database – The Main Server allocates a unique ID for each traffic light nodes and has a database to containing all the nodes' IDs, GSM(Global System for mobile communication) numbers and their GPS (Global Positing System) coordinates.

2. Shortest Path Using Dijkstra Algorithm

A node can possibly operate in two modes namely, the normal mode and the emergency vehicle mode. Normal mode is usual traffic control by a micro controller and traffic preemption device in a junction. In normal mode, traffic flow in each direction of the mode will be given equal importance as mentioned by Panahi and Delavar in (2009). In the Emergency mode, the direction in which theEmergency vehicle heads is given importance and is kept in the ON state, till the Emergency vehicle leaves the junction (node). This is done by

- The node will receive a START SIGNAL from the main server as a control message which contains the direction that must be kept in ON state so that the emergency vehicle can pass through the junction without waiting.
- The direction retrieved from the control message is given to the micro controller.
- That particular direction is kept in the ON state as long as another message (STOP SIGNAL) is received from the main server.
- The STOP SIGNAL is generated when the GPS (Global Posting System) coordinates of the Fire Brigade and the node matches i.e. when the Fire Brigade crosses then node. The node then will return to its normal mode of operation.

By this way each node in the path to the Destination is controlled by the server. This function can be divided into two phases:

The shortest path between the nodes can be selected using the DIJKSTRA algorithm. Consider a case when the emergency vehicle travels from source to accident spot. The database in the server as said earlier contains the node and the distance between the adjacent nodes to which it is connected. The accident spot is taken as the destination and the emergency vehicle location is taken as the source as Mentioned by Nazari and Meybodi in (2008). The node next to the emergency vehicle spot and the node in the path to destination must be traced. So that emergency vehicle node is taken as source and the accident node is taken as destination and the DIJKSTRA algorithm is applied for shortest path finding. There may be several paths between these nodes and the algorithm finds the shortest path. There may be one way roads along this path, therefore this must be a vector quantity. The server finds nearest node from source and marks it as visited. Then that node is considered as source and the procedure is continued till the destination. Initially, the source doesn't know the distance to

destination, so it will be infinite and after complete computation the shortest path along with the distance will be known.

3. Allotting Shortest Path for the Emergency Vehicle from Source to Destination

The server will also find the nearest destination and calculates the shortest path connecting the Fire brigades current location, the accident spot and the nearest destination. The shortest path will contain nodes in the path. The server takes the GPS (Global Positing System) coordinates of all the nodes in the shortest path from the NODES database and along with GPS (Global Positing System) coordinates of the accident spot and the Destination it transmits it to the emergency vehicle unit in a format specified below. The nodes coordinates alone are sent to the Fire Brigade. The format for sending the node coordinates is:

Table 1:

X1,y1	X2,Y2	..	...	Xn-1,Yn-1	Xn,Yn

The last two coordinates (Xn-1, Yn-1) and (Xn, Yn) will indicate the accident location and the destination location respectively.
The nodes in the shortest path are accessed and controlled only when the emergency vehicle reaches a distance of around say 100m from the node. These locations are stored as the 100m markings. Since the signal should not be kept in ON state for a long time, the node access control is done in the following steps:

- The server first plots a map with the nodes needed for the shortest path and makes 100m markings for each node.
- The locations of 100m markings are taken from the map and stored in the NODES database.
- When the Fire Brigade's GPS(Global Positing System) location and location of any one of the 100m markings matches, the corresponding GSM(Global System for mobile communication) ID with the signal direction from the map is taken by the server and is compared with the shortest path nodes' GSM(Global System for mobile communication) IDs.
- If that node is present in the path, the START SIGNAL is sent to that GSM (Global System for mobile communication) ID.
- Now, the node is kept in ON state till the Emergency Vehicle crosses the node. Once it crosses the node, the server sends a STOP SIGNAL to the node which brings the node to normal mode of operation

The two junctions are marked as GS and GN. The distance between these two junctions is less than 100m. Due to this both the junctions are prone to be considered. Thus for instance if the Emergency Vehicle is travelleling towards the node GS, there would be three 100 markings as the path in the direction 1 contains a four way junction. Also as said earlier one of the 100m markings of GN comes in the same path to be travelled. When the emergency vehicle approaches the node GS, it also crosses GN's 100m marking. Thus this situation is rectified as follows. The node GN's ID is taken by the server from the database, but in actual case this node doesn't need to be controlled. Therefore to eliminate this, the server first compares each node ID taken from the database with the list of nodes' IDs in the shortest path. If the node's ID is present in the list, only then the corresponding node is controlled. So when the GS 100m marking is reached, the green light is made ON in the direction 1 and the GN node is not disturbed. Thus, always the every nodes ID is compared with the database containing the nodes ID in shortest path and hence only when the particular ID is matched the node is considered and the traffic light is adjusted according to the need.

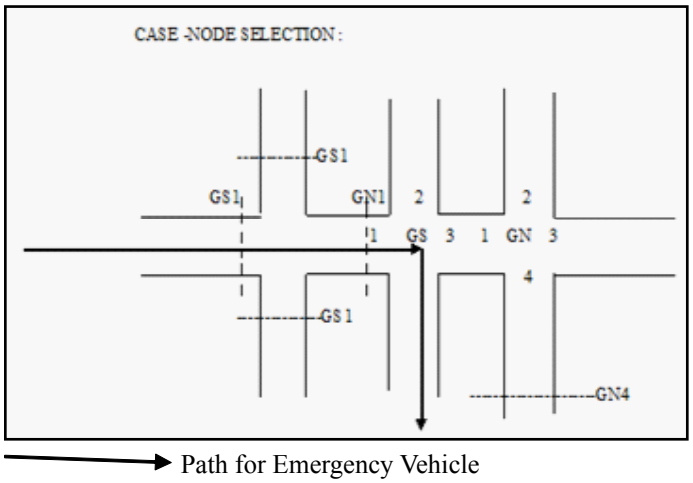

Fig. 3: Path for Emergency Vehicle

C. The Traffic Junction Unit/Traffic Preemption Device

The responsibility of this is to manipulate traffic signals in the path of an fire emergency vehicle, stopping conflicting traffic and allowing the emergency vehicle right-of-way to help, reduce response times and enhance traffic safety.
TCU implements Traffic Signal Preemption system. It is a type of system that allows the normal operation of traffic lights to be preempted, often to assist emergency vehicles.
Traffic lights must be equipped to receive an activation signal to be controlled by any system intended for use in that area. A traffic signal not equipped to receive a traffic preemption signal will not recognize an activation, and will continue to operate in its normal cycle.
Traffic preemption devices can be installed on fire emergency vehicles, operated by remote control from the fire station. Here we implement GPS-based traffic preemption system. These systems require software and a communications platform to determine where the activating vehicle is located, in which direction it is headed, which traffic lights should be preempted, and the ability for the central application to activate the desired traffic lights promptly.
Traffic signal preemption systems sometimes include a method for communicating to the operator of the vehicle that requested the preemption that a traffic signal is under control of a preemption device, by means of a notifier. This device is almost always an additional light located near the traffic signals. It may be a single light bulb visible to all, which flashes or stays on,
A node can possibly operate in two modes namely, the normal mode and the Fire Brigade mode. Normal mode is usual traffic control by a micro controller in a junction. In normal mode, traffic flow in each direction of the mode will be given equal importance.
In the Fire Brigade mode, the direction in which the Fire Brigade heads is given importance and is kept in the ON state, till the emergency Vehicle leaves the junction (node). This is done by

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- The STOP SIGNAL is generated when the GPS (Global Positing System) coordinates of the emergency vehicle and the node matches i.e. when the emergency vehicle crosses then node. The node then will return to its normal mode of operation.

III. Conclusion

This paper proposes for controlling the traffic signals in favor of emergency vehicle movement at the time of emergency call. With this system the emergency vehicle can be reached to the accident spot without time lag. The emergency vehicle can be equipped with some devices such as traffic preemption device and a tablet which would help them to find emergency location and manipulates traffic lights. The EVMS can be proved to be effectual to control all authoritative emergency vehicles. Thus EVMS if implemented in a state with large population like Chhattisgarh in india can produce better results. Chhattisgarh include large number of tribal area and the propose system can be used in providing services to tribal people .EVMS is more accurate with no loss of time.

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