AUTOMATIC AMBULANCE RESCUE SYSTEM

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Abstract—**Traffic congestion and tidal flow management were recognized as major problems in modern urban areas, which have caused much thwarting for the ambulance. Moreover road accidents in the city have been incessant and to bar the loss of life due to the accidents is even more crucial. To implement this we introduce a scheme called AARS (Automatic ambulance rescue system). The main theme behind this scheme is to provide a smooth flow for the ambulance to reach the hospitals in time and thus minifying the expiration. The idea behind this scheme is to implement a ITS which would control mechanically the traffic lights in the path of the ambulance. The ambulance is controlled by the central unit which furnishes the most scant route to the ambulance and also controls the traffic light according to the ambulance location and thus reaching the hospital safely. The server also determines the location of the accident spot through the sensor systems in the vehicle which encountered the accident and thus the server walks through the ambulance to the spot. This scheme is fully automated, thus it finds the accident spot, controls the traffic lights, helping to reach the hospital in time.**

Keywords: - AARS, Traffic signal control, GPS, GSM, Dijkstra

I. INTRODUCTION

There is loss of life due to the delay in the arrival of ambulance to the hospital in the golden hour. This delay is mainly caused by the waiting of the ambulance in the traffic signals. It would be of great use to the ambulance if the traffic signals in the path of the hospital are ON. Thus we propose a new design for automatically controlling the traffic signals and achieving the above mentioned task so that the ambulance would be able to cross all the traffic junctions without waiting. Every traffic junction will have a controller controlling the traffic flow**.** The traffic junctions are referred to as nodes and each node will have a GSM modem connected to the controller. The nodes are controlled by a main server by sending the control messages to their GSM modems. When a node is controlled and its traffic signal is made to be green for the ambulance to pass through without waiting, it is said to be in ON STATE. 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 co-ordinates are also stored in the database. Thus using these data the ambulance is guided to the hospital by the server through the shortest route.

II. AUTOMATIC AMBULANCE RESCUE SYSTEM

Our system consists of four main units, which coordinates with each other and makes sure that ambulance reaches the hospital without any time lag. Thus our system is divided into following four units,

- The Vehicle Unit
- The Main Server
- The Ambulance Unit
- The Node Circuit.(Traffic Junction Unit).

The vehicle unit installed in the vehicle senses the accident and sends the location of the accident to the main server. The main server finds the nearest ambulance to the accident spot and also the shortest path between the ambulance, accident spot and the nearest hospital. The server then sends this path to the ambulance. Also using this information the server controls all the nodes in the path of ambulance and make it ON, which ensures that the ambulance reaches the hospital without delay. The architecture of this system is shown in the fig 1.

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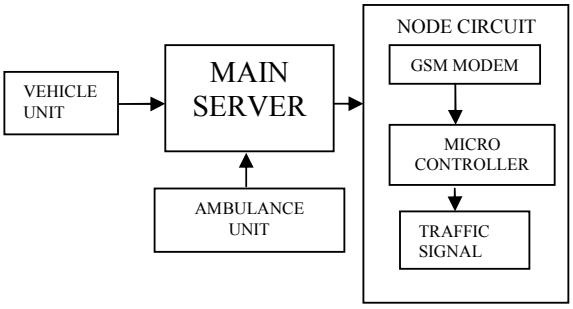
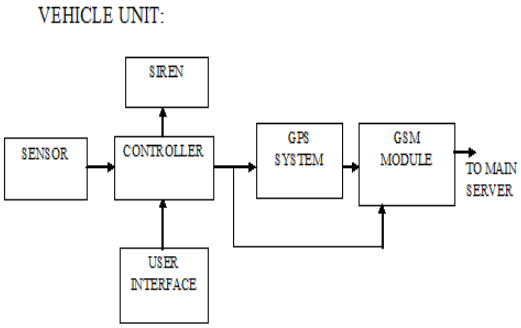


Fig .1

III. VEHICLE UNIT

According to our system, every vehicle should have a vehicle unit. The vehicle unit consists of a vibration sensor, controller, siren, a user interface, GPS system and a GSM module. The vibration sensor used in the vehicle will continuously sense for any large scale vibration in the vehicle [1]. The sensed data is given to the controller.



The controller compares it with a threshold value which is an empirical value (for an accident) 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 accident, the passenger probably would not need the service of the ambulance, and can therefore switch off the siren before the timer counts to zero, by resetting the entire vehicle unit through the user interface, which is connected to the controller. Or else, if he is unconscious or fatally wounded and needs an ambulance, then the siren is left ON and when the timer counts to zero, it would trigger both the GSM MODULE and the GPS SYSTEM inside the vehicle. The GPS SYSTEM finds out the current position of the vehicle (latitude and the longitude) which is the location of the accident spot and gives that data to the GSM MODULE. The GSM MODULE sends this data to the MAIN SERVER whose GSM number is already there in the module as an emergency number. The vehicle unit is shown in the fig 2.

IV. MAIN SERVER

The main server is the central brain of our ITS. It communicates as well as controls every part of the system [3]. The server objectives can be mainly classified into:

- FINDING THE NEAREST AMBULANCE TO THE ACCIDENT SPOT
- SENDING CO-ORDINATES TO THE AMBULANCE
- CONTROLLING THE NODES IN THE SHORTEST PATH

A. *FINDING THE NEAREST AMBULANCE TO THE ACCIDENT SPOT*:

When a vehicle meets with accident, it immediately sends its GPS location to the Main server. The server maintains a database of the ambulances available. The server selects the nearest ambulance to the accident spot using the database containing the details of free and busy ambulances at that point of time. Then the server scans the locations of the free ambulances in the database. It calculates the distance between the accident spot and each ambulance. Then it compares all the distances calculated and selects the nearest ambulance [2].

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

- An Ambulance database - contains list of free and busy ambulances at that time.
- A NODE database – The Main Server allocates a unique ID for each node and has a database to containing all the nodes' IDs, GSM numbers and their GPS co ordinates.
- A Hospital database - containing their locations (GPS coordinates) with their GSM numbers.

1) *SHORTEST PATH USING DIJKSTRA*:

As the nodes in the given region are fixed points and the distance between the nodes are predetermined, the shortest path between the nodes can be selected using the DIJKSTRA algorithm. Consider a case when the ambulance travels from

accident spot to the hospital. 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 source and the hospital is taken as the destination. The node next to the accident spot and the node in the path to hospital must be traced. So that accident node is taken as source and the hospital node is taken as destination and the DIJKSTRA algorithm is applied for these nodes. 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.

B. SENDING CO-ORDINATES TO THE AMBULANCE:

The server will also find the nearest hospital and calculates the shortest path connecting the ambulance's current location, the accident spot and the nearest hospital. The shortest path will contain nodes in the path. The server takes the GPS co-ordinates of all the nodes in the shortest path from the NODES database and along with GPS co-ordinates of the accident spot and the hospital; it transmits it to the ambulance unit in a format specified below.

The nodes' coordinates alone are sent to the ambulance. The format for sending the nodes' coordinates is:

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 hospital location respectively.

C. CONTROLLING THE NODES:

A node can possibly operate in two modes namely, the normal mode and the ambulance 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 [4]. In the ambulance mode, the direction in which the ambulance heads is given importance and is kept in the ON state, till the ambulance leaves the junction (node). This is done by

- The node will receive a START SIGNAL from the main server as an control message which contains the direction that must be kept in ON state so that the ambulance 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 co-ordinates of the ambulance and the node matches i.e. when the ambulance crosses then node. The node then will return to its normal mode of operation.

1) INTERRUPT SERVICE ROUTINE ALGORITHM

- WAIT FOR THE RECEPTION OF START MESSAGE ALONG WITH THE DATA
- RETRIEVE THE DATA ABOUT THE SIGNAL TO BE MADE GREEN
- MAKE THE CORRESPONDING SIGNAL TO BE GREEN
- WAIT FOR THE RECEPTION OF NEXT MESSAGE OR STOP SIGNAL
- IF THE MESSAGE IS RECEIVED RETURN TO NORMAL MODE

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

2) *NODE ACCESS AND CONTROL*:

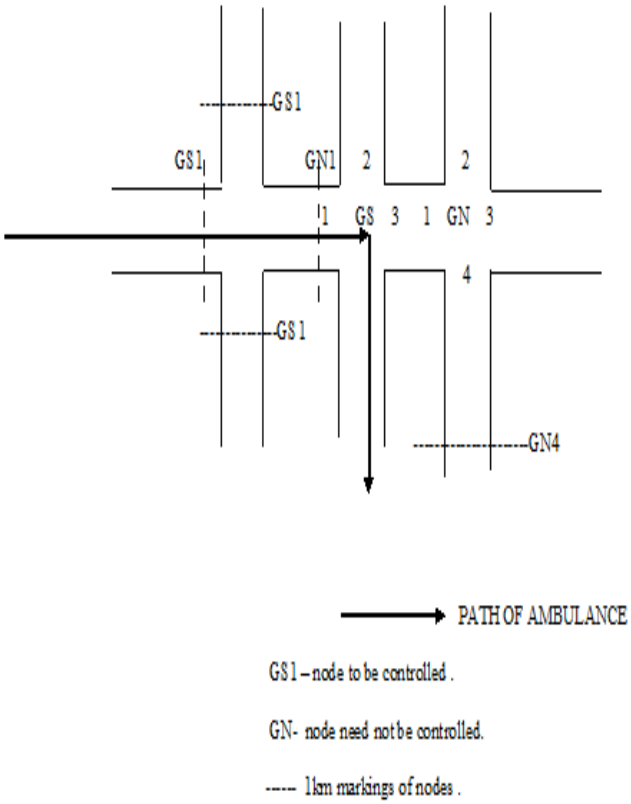
The nodes in the shortest path are accessed and **controlled only when the ambulance reaches a distance of around say 1km from the node**. These locations are stored as the 1km markings. Since the signal should not be kept in ON state for a long time, the node access control is done in the following steps:

- The server first plots a map with the nodes needed for the shortest path and makes 1km markings for each node.
- The locations of 1km markings' (latitude and longitude) are taken from the map and stored in the NODES database.
- When the ambulance's GPS location and location of any one of the 1km markings matches, the corresponding GSM ID with the signal direction from the map is taken by the server and is compared with the shortest path nodes' GSM IDs.

- If that node is present in the path, the START SIGNAL is sent to that GSM ID.
- Now, the node is kept in ON state till the ambulance 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 resolution of the GPS coordinates is that 1 second represents a 101.2ft in latitude and 61.6ft in longitude**. Thus in every comparison with respect to ambulance unit, it is enough to note the GPS co-ordinate till the accuracy of second's.

Consider a simple case where there is intersection of three junctions as shown in the figure. The two junctions are marked as GS and GN. The distance between these two junctions is less than 1km. Due to this both the junctions are prone to be considered. Thus for instance if the ambulance is travelleling towards the node GS, there would be three 1km markings as the path in the direction 1 contains a four way junction. Also as said earlier one of the 1km markings of GN comes in the same path to be travelled. When the ambulance approaches the node GS, it also crosses GN's 1km 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 1km 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.

CASE -NODE SELECTION :

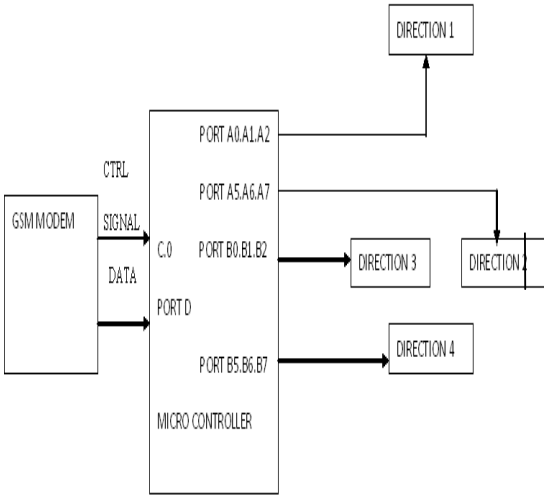


The code below is used for implementing the node control. The ambulance mode is started when an input is got in the C.0 pin of the micro controller from the GSM modem. Consider a signal, similar to message alert in a cell phone, is given to a JK flip flop with its inputs high, so that the output toggles whenever a message is received. Thus when the first message is received, the controller enters into ambulance mode. The data is collected through port D and the corresponding direction is put ON. When the next message is received the controller returns back to the normal mode.

3) *CODE FOR CONTROLLING THE NODES*:

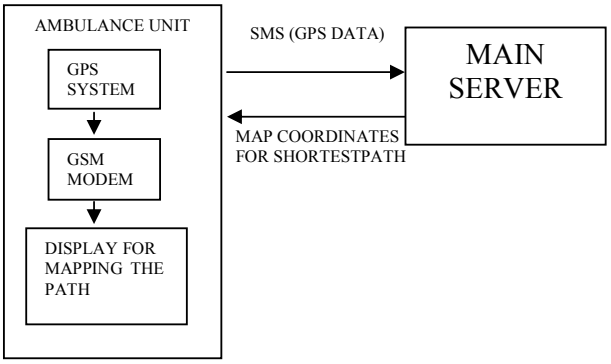
```
main () // normal mode
{
int i, n, x;
Red(0);
Red(1);
Red(2);
Red(3);
Green(0);
```

```
Dela(60);
i=0;
while(1)
{
n=i mod 4;
Yellow(n);
Dela(5);
Red(n);
x= (n+1) mod 4;
Green(x);
Dela(60);
i++;
}
}

// for switching on yellow signal in direction x
Yellow(int x)
{
switch(x):
{
case 1:port A0.A1.A2=0;
port A1=1;   //yellow light in direction 1
break;
case 2: port A5.A6.A7=0;
port A6=1;
break;
case 3: port B0.B1.B2=0;
port B1=1;
break;
case 4: port B5.B6.B7=0;
port B6=1;
break;
}
}

// for switching on red signal in direction x
Red( int x)
{
switch(x):
{
case 1: port A0.A1.A2=0;
port A2=1;   // red signal in direction 1
break;
case 2: port A5.A6.A7=0;
port A7=1;
break;
case 3: port B0.B1.B2=0;
port B2=1;
break;
case 4: port B5.B6.B7=0;
port B7=1;
break;
}
}

// for switching on green signal in direction x
Green( int x)
{
switch( x)
{
case 1: port A0.A1.A2=0;
port A0=1;   //green signal in direction 1
break;
case 2: port A5.A6.A7=0;
port A5=1;
break;
case 3: port B0.B1.B2=0;
port B0=1;
break;
case 4: port B5.B6.B7=0;
port B5=1;
break;
}
}
Dela(int z)
{
for(int i=0 ; i<z ; i++)
{
if (C.0==1)      /* check for reception of START SIGNAL for every second */
Ambulance ();
Call delay;     //1 sec
}
}
Ambulance ()    //ambulance mode
{
int y= port D; /* port D is input port to get the signal direction to be switched ON for the ambulance*/
Red(1); Red(2); Red(3); Red(4);
switch(y)
{
case 1: Green (1);
break;
case 2: Green (2);
break;
case 3: Green (3);
break;
case 4: Green(4);
break;
}
/*wait for reception of STOP SIGNAL to return to normal mode*/
while (C.0==1)
{
}
}
```



V. AMBULANCE UNIT

The ambulance unit has a GPS SYSTEM and a GSM MODEM for transmitting GPS data to the Main Server. The server receives the GPS data sent by the ambulance at regular intervals of time. The server sends the co ordinates of all the nodes' in the path to the ambulance. The last two coordinates (Xn-1, Yn-1) and (Xn, Yn) will indicate the accident location and the hospital location respectively. The ambulance unit on receiving the co-ordinates plots them on to a map with the last two co ordinates as the accident spot and the hospital location to get the shortest path to the hospital.



VI. CONCLUSION

In this paper, a novel idea is proposed for controlling the traffic signals in favor of ambulances during the accidents. With this system the ambulance can be manoeuvred from the accident spot to the hospital without time lag. The AARS can be proved to be effectual to control not only ambulance but also authoritative vehicles. Thus AARS if implemented in countries with large population like INDIA can produce better results. The AARS is more accurate with no loss of time. But there may be a delay caused because of GSM messages since it is a queue based technique, which can be reduced by giving more priority to the messages communicated through the server.

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