Reduction in response time of ambulance Services using VANET and NavIC

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***Abstract*— The focus of this paper is to analyze and reduce the response time of the ambulance on national highways. We use the amalgamation of two technologies in this paper: VANET and NavIC. Collectively these technologies can be used to condense the time taken by the emergency service to reach the accident site. Using VANET we can connect to the ambulance system on the highways instantly without the need of any human interaction (Automated). Using Sensors installed on the roads to act as routers to send the message to the ambulance receiver. We propose to replace the GPS by NavIC. NavIC devised by the Indian Space Research Organization (ISRO) is a much better solution and highly reliable to provide the ambulance the precise location of the accident spot even in mountainous regions (where usually network is not available) thanks to the geostationary satellites of NavIC. By installing both these technology chipsets in cars the fatal rates due to poor response time of emergency service after road accidents can be reduced drastically.**

Keywords*— VANET, NavIC, Sensors, Automated, Replace GPS, chipsets

I. INTRODUCTION

The Indian ministry of road and highways released a statement saying that in 2018 there was a rise in road accidents by 0.46% compared to 2017.

As described in [13], Over 4, 66,000 accidents have been reported in 2018 in which 1, 51,477 lost their lives and almost 4, 69,418 people suffered injuries. Out of this 30.4 %, accidents occurred on national Highways and 25% on State Highways.

India Ranks number 1 for the highest number of road accidents in 199 countries as per the world road statistics followed by China and the US on numbers 2 and 3 respectively.

India accounts for 11% of the total world accidents according to the WHO Global Report. Now that we know that more than half of the accidents occur on highways in the nation lets focus on that.

For Example, purpose, we are using the Mumbai-Pune highway here in this paper.

The best thing to do after an accident is reaching out for an ambulance. The problem is that it is not always possible to do so. Out of so many accidents that happen only a 71% call for an ambulance and only 34% of the time, the ambulance can reach the patient and take him/her on time to the hospital. This is a troublesome fact and we are in desperate need to find a method that is more effective and automated
to increase chances of success.

Another major problem is that the other travelers are not always looking forward to helping the person in an accident. This may be due to the laws where the person who calls has to go to the hospital and answer an inquiry from the police. This becomes a factor for the delay of the ambulance for reaching the spot.

Another major issue stated by a survey by the students of AIIMS in 2016 stated that more than 70,786 calls are unanswered every year in Delhi city itself.

Our research in this paper is focused on tackling problems like these and make the response time and accuracy much better than before.To be able to do this we Propose the idea of using VANET (Vehicular ad hoc network) and NavIC (Indian Regional Navigation Satellite System) together to design and create a complete navigational and communication system.

VANET is used now to navigate between traffic but is still not adopted by the ambulance system.It can help it to save considerable time during emergencies. NavIC is used to navigate and find the exact location of the accidental spot even in a low network connectivity region (such as hilly or mountainous regions).

This leads to straight connectivity between the ambulance and the caller thus eliminating the middle connections which lead to saving valuable and precious time.

II. II.LITERATURE SURVEY

As we know ambiance reaching an accident location on time is a big problem. But a very accurate solution is found for this problem. The "model for emergency medical service for road and highway accidents by [1] gives a very profound way where they took Mumbai Pune Expressway as example and found SIX most effective location for ambulance in the 195 km road to be parked to reach any accident spot within 6 min of reporting. The locations they found were “Yashwant Nagar, Somatane, Malavli, Lonavala center, Panvel Bypass & Bavdhan Budruk “. The algorithms best used for such analysis is “clustering” and “mean-shift” algorithm to find the centroid of the cluster.

Another way used to make an ambulance reach the accident spot on time is explained in [19]. They have used the “DIJKSTRA’S SHORTEST PATH METHOD” to find the quickest and most appropriate route for the ambulance using sensors installed in traffic signals.

VANETs is a Vehicular ad hoc network. It provides high-speed transmission, unlimited computation ability, power and a large-scale communication system its main applications are enhancing road safety and reducing traffic accidents. The time taken by the emergency system to reach an accident spot can be trimmed using Vanet.Li et al. and Jiang and Wang proposed a secure and efficient communication system with the establishment of an authentication key and the preservation of privacy for vehicular ad hoc networks using asymmetric

encryption. The VANET system is divided into different parts i.e. Certification Authority (CA), Roadside Transportation Authority (RTA) and Road Side Unit (RSU) [6]

A Secure Ambulance Communication Protocol for VANET

The system is built in a way that when there are a traffic accident and the traffic situation is not clear. When someone informs the hospital about accident hospital sends an event report to RTA and requests the session key between the ambulance and RTA. When the RTA receives the accident message, the session key is generated and sends it to the hospital and the hospital sends it to the session key to the ambulance. The ambulance uses that session key to hide the communication message and sends it to the RTA. After receiving the message from ambulance the RTA finds the shortest path and sends it to the ambulance to reach the accident place faster.

Today VANET is used in very few cities such as Bangalore where a girl who needed a heart transplant was taken from Bangalore to another city within 6 hours using NavIC. The word around is that NavIC is going to be used for traffic control in a Smart city. NavIC usually uses 2 types of communication :

1)V2V (Vehicle-to-Vehicle)

2) V2R (Vehicle-to-Roadside unit)

These methods can transmit signals in real-time data much more efficiently, and quicker. It is so efficient because it can handle the transfer of signals efficiently even in heavy signal traffic areas.Routing of these signals is majorly done by the RSU's(Roadside unit)[9]. The ability to communicate becomes much more Robust with the use of DSRC(“Dedicated Short Range Communication") technology. It provides low-latency and secured transmission. The DSCR has its spectrum at "5.9GHz". It is good at controlling the rapid flow of messages and also immune to bad weather. RSU technology is used for v2r communication. It has an approximate range of 1km. it means that the RSU sensors have to be within 1 km of range from each other. The ambulance, when located at the base point, needs to communicate with only one RSU(the nearest one) but when it's traveling it also has to communicate with the hospital RSU using vehicles (v2v communication) using a "Multi-hop communication" system.NavIC is an "Indian Regional Navigation Satellite System" (IRNSS). It is a system developed by

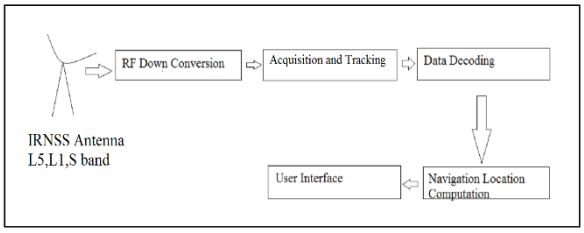
Type	Country	Satellite	Life time of each satellite	Precision
GPS	US	31	10 years	10 meters
GLONASS	Russia	24	10 years	5 - 10 meters
Galileo	European Union (EU)	40	12 years	1 meter
BeiDou	China	35	12 years	10 meters
IRNSS	India	7	10 years	10 meters

ISRO("Indian space research Organisation) to replace the use of GPS in India and other neighboring countries such as Pakistan, Sri Lanka, Bhutan, etc.

Countries that have their own navigation system:

According to the paper of S. Zaminpardaz · P.J.G. Teunissen · N. Nadarajah[11], there are 7 satellites used for NavIC named from IRNSS-1A to IRNSS-1G. out of these 7 satellites, there are 3 geostationary satellites and 4 geosynchronous satellites. The orbital period of one satellite is 23hours and 56minutes precisely.

Reciver Chip



NavIC chip architecture begins its cycle from the IRNSS antenna. The antenna catches the signal from the satellite. The Satellites transmits signals on 2 frequency bands – S & L [L1 and L5].

The L1 band has a frequency of 1.58 GHz, L5 band has a frequency of 1.17GHz & S-band has a frequency of about 2.5GHz.

Then the signal which is received by the antenna goes through the RF down converters. The RF down converters are designed to convert microwave signals to an intermediate frequency (IF). RF downconverter is used in combination with RF LNA i.e. Low Noise Amplifier. This combination is known as LNB i.e. Low Noise Block Converter.

This converted signal toes for the next step that Is Acquisition and Tracking. The acquisition is used to get a rough timing estimate within a duration of a chip, that is timing uncertainty is ±Tcs and Tracking means finding and maintaining fine synchronization.

The next step is data decoding where, the data or the signal which is received by the antenna is then decoded and using navigation the location is computed. Decoding means converting code into plain text or any format that is useful for subsequent process

And finally, the user and a computer system interact, in particular, the use of input devices and software using the User interface.

NavIC provides extremely accurate real-time positional and timing services. For the use of the civilians, it uses the Standard positioning service. It is accurate up to 12 meters. This makes India one of the first 5 countries to have its navigation system. It is said that NavIC is better than America's GPS because NavIC works on "S" and "L" band frequency whereas the GPS only works on the L Band Frequency. Thus many times the smaller frequency signals get mixed with the GPS which leads to less Precision and speed in the GPS.to overcome this the GPS needs to be updated regularly, [12].

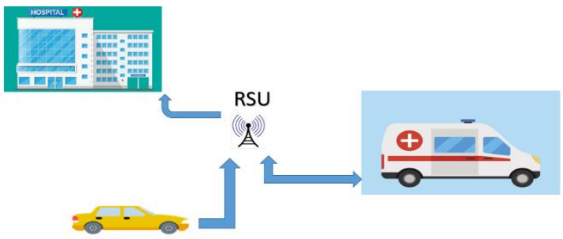
For working of navic is basically very complex and a very simplified version of it is that NavIC uses the 15 IRIMS existing in our country to receive the signals from the seven NavIC satellite. One of which is also in PUNE. The receivers basically transform the signals into code and measurements.

The codes are then converted into Binary format. For post-processing of this data it is changed again into its ASCII format and in RINEX (Receiver Independ Exchange) file format. The file consist of 2 parts: Header and Data section. The data section consist of Information such as satellitenumber,currentepoch(Year,month,week,day,hour,minute,second) and satellite clock information followed by coordination detail such as longitudinal axis and latitudinal axis.

III. Proposed System

We know all the limitations that are there for the ambulance to reach the accident spot on time and how they are overcome, but still everyone has skipped the most important factor in the delay of the ambulance to reach on time.The biggest factor is the problem of connecting to the ambulance service on highways.

If a person is traveling alone and is injured brutally he/she is not going to be able to call the ambulance for themselves. In such a case they are dependent on the other commuters to call an ambulance for them which may take longer than expected sometimes. To overcome this problem, we have found an automated dependable system to connect to the emergency service providers instantly as and when required.



Our System comprises two independent technologies which when used together provide outstanding results for the benefit of the society.

These 2 technologies are:

1) Vehicular ad hoc networks (VANET)
2) Navigation with Indian Constellation (NAVIC)

We are using VANET not for just navigating between traffic but also to send a distress signal from the car directly to the ambulance services.

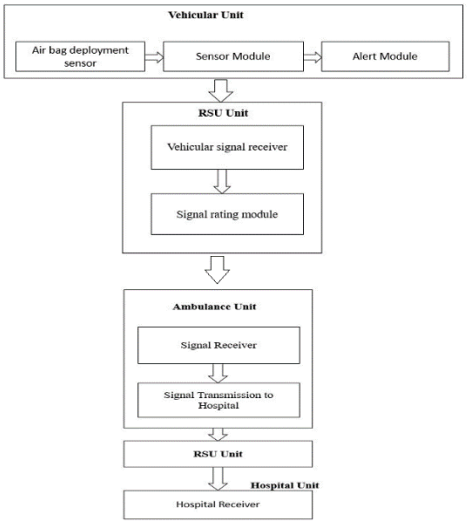
We install a chip supporting VANET in the car. Now when the accident of that car will occur the VANET chip senses this and sends a distress signal to the ambulance service. It is not possible to send the signal directly to the ambulance if the distance between the accident spot and the ambulance is greater than a threshold range. Thus it uses the other VANET sensors on the way as routers to find its way to the ambulance receiver. The other VANET sensors are present on the sidelines of the road, The street Lamps, Toll-Nakas, etc.

The only Limitation of VANET is that it is battery operated.It needs to be replenished now and then.

This limitation can easily be overcome in cars as we can connect the VANNET chip to the car battery. Thus it is always charged.

Upon receiving the signal from the car the ambulance sets off.it can back-trace the signal to find where it comes from but to find the precise location this method is not satisfactory. To find the exact location we suggest our 2nd technology that is NavIC. The NavIC sensor in the car enables the ambulance to trace the exact location of the car that had to send the distress signal.

The ambulance sends a message to the hospital about its location to alert the hospital to prepare for the patient. The message sent by the ambulance is via VANET to the hospital and the hospital can trace the live location through NavIC.



The detailed Model which we are proposing is discussed below: The Vanet chip is activated by a sensor which senses the deployment of the air bag system.So first we will talk about the air bag system:This system is used in many luxury cars today suvh as Mercedes, Audi, jaguar etc. Basically there is a sensor which detects a few parameters on the baes of which it decides to deploy air bags in the car.Few of these parameters are:The car has to be above the speed of 60, The angle of the stearing axis is measured,there are sensors on the front of the car, if they get damaged istantlty the air bags are deployed. Once the air bags are deployes the 2nd sensor senses this change and immediately activates the Vanet chip installed in the car.

Vanet chip: The chip sends out an “SOS” message towards the ambulance using the V2V communication.

For the V2V communication to be successful over a long distnce it needs to use the RSU unit along the way . The RSU unit as we know can transmit the signal over 1kmdistance. Each RSU will re-Route the SOS signal towards the nearest Central RSU. Each Central RSU is where the ambulance are parked on the highway(The location for the ambulance is decided using the theory of “model for emergency medical service for road and Highway accidents),[1].The RSU unit use the “Multi-Hop” method for data transmission.The ambulance gains this signal from the Central RSU using the Reciever unit.Ambulance unit: The ambulance informs the hospital about an emergency and leaves immediately towards the destress call.It Identifies the Location of the accident using Navic.Once the Ambulance reaches the spot it sends a Informed Message to the hospital informing about their arrival

time so that they can keep a doctor and an operating room and other resources required available for the patient.

Hospital Unit: The hospital has a server room that keeps a track of all the messages sent by the ambulance on road and informs the appropriate authority about it.It basically has a Reciever that catches all these signals and Decodes them to get the required information.

IV. CONCLUSION

In this paper we plan to improve the Response time of ambulance service on Highways. To do so we proposed a new Hybrid system involving the use of 2 Technologies "VANET" and "NavIC". We have taken in account the 6 best spots on the Mumbai-

Pune highway already found for the ambulance system to make base points and then decided to use VANET to connect with them.

By using VANET not only we are making the system completely Automated and efficient but also completely instantaneous. The NavIC developed by ISRO is used to replace the GPS system as it is more efficient and an upcoming technology which will soon be made compulsory in our country. It helps the ambulance to find the exact spot of the accident even if the accident has occurred in low Network region such as the Lonavala Ghats.

With the Amalgamation of both these technologies in our system it is safe to say that by using our proposed idea, the response time for the ambulance system can easily go below 6 minutes.

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