RESEARCH ARTICLE OPEN ACCESS

Concept Of Self-Driven Ambulance Synchronized With Live GPS Feed For Faster And Safe Transport Of Patients

Varun Gowda S[1], Sameer Shah[2], Balakumar Gardampaali[3]
1, 2 Department of Mechanical Engineering, Sir M. Visvesvaraya Institute of Technology, Bangalore – 560064
3 Department of Mechanical Engineering, Sir M. Visvesvaraya Institute of Technology, Bangalore – 560064
Corresponding Author : Varun Gowda S

ABSTRACT
Whenever there is an emergency and patients are needed to be transported by means of ambulance to the hospitals, there always a delay observed in this process. This delay can be either extra time taken to find the patient's home; or time lost when ambulance is stuck in traffic or due to some other unavoidable reasons. This often complicates the health of the patient or sometimes results in death. To solve this problem, a self-driving ambulance equipped with on-board position, proximity and other sensors to allow easy travel in traffic. Its propulsion will be controlled by an ECU which is in turn controlled by a central Microprocessor which is connected to GPS. The vehicle is fed with pick-up point and final destination i.e. hospital. This allows us to set the shortest route for travel via GPS. Based on the real time feed, the vehicle keeps a track of alternative routes and predicts further traffic congestion on its route. This allows vehicle to make decision to take a better alternative route and save time. The ambulance can either be powered by an IC Engine or an Electric Motor. The vehicle so selected for the job is now made to run on streets by GPS feeds and independent driving by microprocessor. The ECU controls driving, control and combustion conditions. When further jamming conditions are sensed, the traffic signals can control the flow of traffic such that it won't allow other vehicles to pass through it, after the ambulance and would make way for ambulance on main or alternative route. This would prevent ambulance getting stuck in traffic and hence providing easy passage for ambulance. The whole system requires integration of ECU, Microprocessor, Traffic Surveillance and signal light control, Live GPS feed and warning to further vehicles in the path.
Keywords - Self-Driven, Microcontroller, Safety.

Date Of Submission:16-11-2018 Date Of Acceptance:30-11-2018

I. INTRODUCTION

Emergency situations in case of road accidents or health related issues such as heart-attacks which often require immediate hospitalization is carried out by means of ambulances. An ambulance is capable of providing on-board emergency services such as oxygen supply, medical attender doctor or in some cases defibrillation. They pick up the patient from the location and transport them immediately to the nearest hospital.

In most of the cases the victim calls up the nearest hospital for medical support. The complaint is registered and the response time of ambulance to reach the victim becomes unpredictable due to various reasons like delay, traffic, time in searching the victim etc. This In most of the cases the victim calls up the nearest hospital for medical support. The complaint is registered and the response time of ambulance to reach the victim becomes unpredictable due to various reasons like delay, traffic, time in searching the victim etc. This results in loss of crucial time which either results in complication in the victim's health or might even lead to death.

The following statistics is taken from Ambulance Service Department of New South Wales.

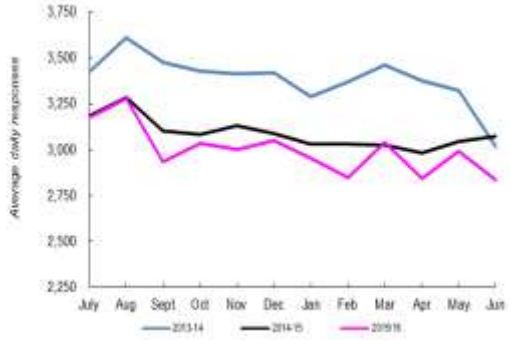

Fig 1: Average Daily Response of Ambulance

It shows the Average daily response time of Ambulance over a span of one year. In 2014-15 the number of emergency cases varied and the response of ambulance fluctuated. This was due to various factors such as response time, traffic conditions etc. This fluctuation was high in 2015-

16 due to increase in traffic which led to decrease in daily responses covered by the ambulance and hence some of the victims were not covered.
Also as per National Center for Health Statistics Medical Care Survey 2013

Table 1: Medical Care Survey 2013

Total Number of visits	130,400,000
Number of injury-related visits	37,200,000
Number of emergency department visits resulting in admission to critical care unit	1,500,000
Number of emergency department visits resulting in hospital admission	12,200,000
Percent of visits resulting in hospital admission	9.3% (12,090,000)
Percent of visits with patient seen in fewer than 15 minutes	29.8% (38,090,000)

Emergency Health Services Statistics from American Ambulance Association. 2008 Ambulance Fact Sheet.

Number of Ambulance Services:	15,276
Number of Ground Ambulance Vehicles	48,384
Number of EMS Personnel	840,669

Table 2: Ambulance Fact Sheet 2008

The total number of ambulance in USA was 48,384 when compared to total population of USA which was 304.1 Million. NCHS stated 130.4 Million people were hospitalized annually that was 1/3rd of the population. That corresponds to 25,790,000 victims annually who need ambulance assistance. So a total of 25,790,000 victims have to be transferred to hospital by 48,384 ambulances. So it becomes 534 victims per vehicle annually.

So therefore from above calculations roughly each vehicle has to transfer at least 2 victims daily whether it is for a minor stroke, accident, severe cardiac arrest etc. The time taken from ambulance to reach the victim and then transport him/her to hospital is variable and depends on the various factors.

II. FACTORS WHICH CAUSES DELAY IN AMBULANCE RESCUE SERVICE

The following is a procedure to call and acquire emergency services

Fig 2: Flow chart of the emergency service procurement process

In the above procedure the main instances where the crucial time is lost is in Step 2, 3, 4 and 5.
Step 2 = Delay in registering complaint and initiating ambulance service. Chances of Human Error in noting down the address.
Step 3 = Heavy Traffic conditions causes delay. Human error such as driver fatigue, negligence etc. might also contribute to delay.
Step 4 = Searching the Victim's house or accident location also leads to delay. Delay in Picking up and stretcher deployment
Step 5 = Heavy Traffic conditions causes delay. Human error such as driver fatigue, negligence etc. might also contribute to delay.
The major factors which cause delay are Traffic Condition, Human Error and Negligence. In this paper, the concept of self-driven ambulance has been introduced which is guided by GPS and is self-driven and hence is capable of predicting traffic jams and takes logical decisions to reach the hospital in least time.

III. CONCEPT

The fig 3 shows the concept of self-driven ambulance. It consists of an ambulance which consists of systems such as collision avoidance system, lane shift assist, vehicle to vehicle communication, cloud connectivity etc. This technology makes the ambulance to cover long distances and carry out the health rescue operations without interruption and human intervention, hence making it self-driven.

Fig 3: Concept

IV. CONSTRUCTION

The Vehicle is installed with an on-board ECU which receives feed from various sources and sensors. These inputs are in the form of electronic signals and are later fed to the ECU. Sensors are attached to the vehicle's periphery such as proximity sensors, ultrasonic sensors, thermal sensors etc. ECU is also equipped with advanced Bluetooth transponder and Wi-Fi technologies which helps in V2V and V2X connectivity. They are also linked to Cloud services and hence make full use of Information systems which makes it susceptible to changes.

The Ambulance consists of a Stretcher compartment with auxiliary oxygen support, first aid, portable defibrillator, chair, surgery kit, cold pack, glucose kit etc. These things are basic essentials. Apart from these there are certain other automated systems such as real-time location indicator, pre analysis reporting system which informs the hospital well in advance about the further medical procedures which should be followed in hospital when patient arrives in the hospital to save crucial time.

There are on-board medical instruments which record the crucial parameters of the patient such as heart rate, breathing rate, Blood Pressure etc. this data is recorded instantaneously inside the ECU and is transmitted to the nearby vehicles stating the seriousness of emergency. This data is also sent to hospital which continuously monitors the health of the patient. An accompanying doctor is present to attend the patient whereas the vehicle is self-driven. The vehicle is either powered by an IC Engine or Electric Motor. The propulsion of the vehicle is regulated by the ECU.

V. CONCEPT REALIZATION ON ARDUINO UNO R3 MICROCONTROLLER PLATFORM

The concept of self-driving ambulance was demonstrated on Arduino microcontroller platform using UNO R3 board, Infrared proximity sensor, U3 Potentiometer, Camera and a GSM Shield. The circuit connections have been made and microcontroller has been programmed to function in various logical conditions of self-driving, signal acquisition from nearest hospital and stopping in case of any obstacle on road.

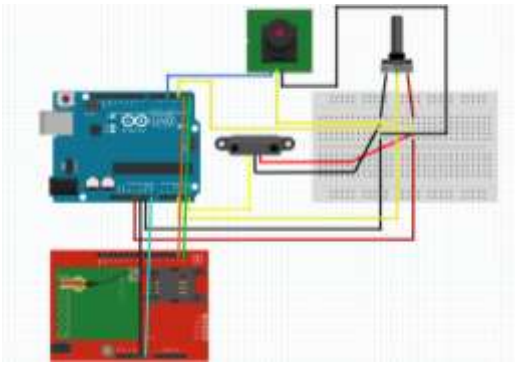

Fig 4: Circuit Diagram of Concept realized on Arduino Microcontroller platform.

VI. WORKING

When the complaint is made by the patient, the nearest hospital notes down location of the patient and initiates the Ambulance. The important data regarding the location, address, patient information and type of emergency is fed to the ambulance through the cloud network.

The ambulance leaves to attend the patient and the propulsion of vehicle is regulated by the ECU. The input location and the destination are routed to the ambulance via GPS. The GPS directions regarding the turns are fed to ECU. ECU then controls the steering, throttle, braking and safety systems of the vehicle. Once the vehicle reaches the destination, the rescue services are carried out. After this the vehicle again traces back the path to the hospital.

Crucial time is saved by continuously rerouting the direction and updating the route in case of heavy traffic. Also in case of accidents, if there are other victims on the way to hospital, it will cover them as well. This will ensure proper optimization of the ambulance service. These sensors records signals from various sources in different situations. These sensors are placed to perform a specific task. They provide an input to govern a particular system. When ECU receives signals from these sensors, based on the algorithms the ECU takes the decision and performs the particular task.

Block Diagram of the Concept

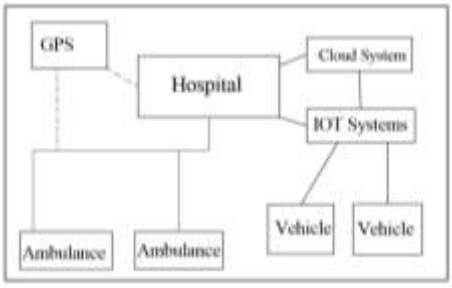

Fig 5: Block Diagram of Self-Driven Ambulance

The following data is sent to the hospital

1. Vehicle Location
2. Estimated time
3. Medical Condition of Patient
4. Heart rate, breathing rate etc.
5. Route of the Vehicle

These important data about the ambulance is sent to the hospital which records it and keeps it for reference. The data gives the complete details about the vehicle and the patient and it becomes easier for the hospital authorities to operate the victim. Horn and Ambulance Siren also helps to alert the traffic in the vicinity.

The same data is also shared on a Cloud Network which makes sure that the vicinity is informed regarding the position of ambulance. This becomes easier to operate in case of Smart Cities.

This particular system is effective and works with the help of GPS. If a particular ambulance is on the way to hospital and can attend another emergency, it can stop and initiate the rescue operation.

VII. IMPLEMENTATION IN SMART CITIES

Developing Smart Cities are the future inhabitation facilities which are being developed to integrate multiple information and communication technology and internet of things. This Self-driven Ambulance can be implemented with Intelligent Traffic Management system ensure better car navigation, traffic signal control, parking guidance system etc. These technologies have been emerging as a result of blending the road safety concepts with the advanced electronics.

Implementation of Self-driven Ambulance in Smart Cities would be easy and beneficial because of the available infrastructure and IOT systems which would enable the effective information transfer and would also notify the nearby pedestrians. The information can not only be used by the authorities but also a warning will be issued to all the pedestrians. Also the transfer of information in Smart Cities will be faster and efficient and will also supplement the vigilance operations by means of CCTV cameras as well as other advanced system such as Video vehicle detection, road weather information system, scalable urban traffic control and vehicle communication systems.

Current smart cities such as Seattle, Stockholm, London, Seoul etc have various advanced technologies which are at its peak. Upcoming Smart Cities in Singapore and India have great potential where Self-driving ambulance can be integrated and implemented.

VIII. ADVANTAGES OF SELF-DRIVEN AMBULANCE

The ambulance services are of prior importance as it helps to carry victims from the site of accident to the hospital. This is done by various means such as land, air or sea. The ambulance can be integrated with any smart cities or IOT systems and can be used anywhere either on a small area or a whole city. It provides faster health and rescue service without wasting crucial time.

The following are the advantages of self-driven ambulance

1. It helps in transporting victims from home to hospital.
2. It can be used by Military and Government organizations to provide health services.
3. It can also cover the victims who are on the hospital route.
4. It provides on-board emergency and health services.

It can be developed on microcontroller platform coupled with Smart and IOT systems

IX. CONCLUSIONS

A new concept of Self-driven Ambulance has been demonstrated in this paper. This system aims to reduce the crucial time which is lost when the patient is transferred from accident site to hospital. There is scope for future development and implementation of self-driven ambulance by various Military and Government organizations and Intelligence Agencies.

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command, and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

ACKNOWLEDGMENT

We would like to thank the Department of Mechanical Engineering for carrying out the project. We thank our faculty members for their guidance. We would also like to thank the Principal, Sir MVIT for his support.

REFERENCES

[1]. Current, R., Moore, P., Green, J., Yannaccone, J. et al., "Crash Testing of Ambulance Chassis Cab Vehicles," SAE Technical Paper 2007-01-4267, 2007, doi:10.4271/2007-01-4267

[2]. Levick, N. and Grzebieta, R., "Ambulance Vehicle Crashworthiness and Passive Safety

Design: A Comparative Evaluation," SAE Int. J. Commer. Veh. 1(1):464-472, 2009, doi:10.4271/2008-01-2695.

[3]. Sinha, A., Kusumo, R., Hogan, P., and Laycock, K., "An Automated System Framework for Pre-Mission Success Evaluation of Medical Emergency Helicopters Operations – Derived Mission Capability Sub-Module," SAE Technical Paper 2002-01-2965, 2002, doi:10.4271/2002-01-2965.

[4]. Han, W., Zhang, X., Yin, J., Li, Y. et al., "Architecture of iBus: A Self-Driving Bus for Public Roads," SAE Technical Paper 2017-01-0067, 2017, doi:10.4271/2017-01-0067.

[5]. Soloiu, V., Augusma, I., Lucien, D., Thomas, M. et al., "Self-Driving Intelligent Vehicle to Increase Road Safety, Lower Congestion Rates and Decrease Emissions," SAE Technical Paper 2016-01-0161, 2016, doi:10.4271/2016-01-0161.

[6]. Rupp, J. and King, A., "Autonomous Driving - A Practical Roadmap," SAE Technical Paper 2010-01-2335, 2010, doi:10.4271/2010-01-2335.

[7]. Feilhauer, M., Haering, J., and Wyatt, S., "Current Approaches in HiL-Based ADAS Testing," SAE Int. J. Commer. Veh. 9(2):63-69, 2016, doi:10.4271/2016-01-8013.

[8]. Hirose, T., Kitabayashi, D., and Kubota, H., "Driving Characteristics of Drivers in a State of Low Alertness when an Autonomous System Changes from Autonomous Driving to Manual Driving," SAE Technical Paper 2015-01-1407, 2015, doi:10.4271/2015-01-1407.

Varun Gowda S "Concept Of Self-Driven Ambulance Synchronized With Live GPS Feed For Faster And Safe Transport Of Patients"International Journal of Engineering Research and Applications (IJERA) , vol. 8, no.11, 2018, pp 32-36