Notifying Accidents Detection System with Optimal Route for Rescue Team

Nay Win Aung
Minster's Office
Ministry of Construction
Nay Pyi Taw, Myanmar
naywinaung@ucsy.edu.mm

Thin Lai Lai Thein
Data Analytics Lab
University of Computer Studies, Yangon
Yangon, Myanmar
tllthein@ucsy.edu.mm

Abstract*—Accident rescue services perform a key role in rescuing victims from traffic accidents in expressway. To improve the quality of rescue operations, modern technologies such as (permanent monitoring and reporting systems, sensing technologies) can track the current palace of injured persons and send user's data to the nearest rescue center to carry out daily rescue operations. In this paper, describe the selected methodology and algorithms developed to identify locations and conditions of vehicle crash, send quick messages to the nearest rescue center and provide directions to the nearest route. The Motion Sensing Method obtains the values of built-in smartphone's sensors to detect the occurrence of traffic accidents and determine the accident levels of damage by critical, major or minor. The Difference Angle Method calculates the GPS points and shows the exact directions of the vehicle. In order to access the detail results, Modern Positioning Method use the signal received from the smartphone to find the exact location of the traffic crash and track the victims. The Object Detection in Fence Algorithm searches for the location of the nearest emergency team and sends information of the victims to provide quick medical assistance. System designed to be an easy-to-use, the choice methods and algorithm developed are based primarily on the functions of the smartphone's built-in sensors. Mobile networks and GPS, GIS, Geofence technologies are making connections, the rescue alert system for detecting traffic accidents can check the location of victims, analyze crash severity levels, send quick messages in time to get rescue services, and identify the nearest route.

***Keywords*—Accident Detection System, Sensors, Dataset, Rescue Team, GPS, Geofence**

I. Introduction

It must be distinguished that the number of traffic accidents that occur on expressways in today's time is directly related to the growth of the world's population. The increase in the death rate in traffic accidents makes it difficult to quickly identify the location of accident and due to the delay in the rescue teams receiving accident on time. Therefore, quick and immediate actions are important to consider as a key factor in saving injured people from traffic accidents.

Useful methods and techniques to reduce the rate of death due to traffic accidents on the expressway are used to identify the information of the victims and notification SMS will be send to the emergency team. Therefore, through the use of high-tech equipment such as smart-phones with built-in sensors, efficient use of time for rescue procedures and effective rescues can be carried out.

In this paper, the accident detection system will validate the traffic crush with the values from the sensor obtained from the sensors such as accelerometer, gyroscope and GPS. The Motion Sensing Method serves to decrease the rate of false alarms and to detect the level of traffic accidents. The Difference Angle Method and the Modern Positioning Method are applied to improve the performance and efficiency of Accident Detection System and to certify the correct and accuracy of the traffic accident position. The Object Detection in Fence Algorithm searches for the nearest rescue team after receiving the traffic accident confirmation, quickly sends information of the accident case, and provide directions to the nearest route.

II. Related Work

Marwan Abboud., Lina Mariya Abou Jaoude. Ziad Kerbage. [5] identified processes to achieve "Real Time GPS Navigation System" in 2004. Geometric representation on the map to guide driving routes instead of using each point. The downside is that it cannot provide accurate guidance to users outside of Beirut City, and only in good weather conditions can the system help the system to know where it is with GPS support.

In 2005, Huub HC Bakker, Ken A Mercer and Wyatt H Page. [4] "A Review of Position Tracking Methods". In this case, the advantages and disadvantages of various position tracking methods are compiled. The main point is that the object's node and base center must be synchronized to collect the perfect outcome of the object's location. Therefore, due to varying distances and measurements, wrong locations will be obtained, so that the numerous base stations are required to obtain accurate locations.

In 2011, Chris T., White J., Dougherty B., Albright A. and Schmidt DC. [1] designed "WreckWatch", the smart device-based client/server architecture cannot verify if the speed of the automobile does not meet the criteria to measure whether or not an accident has occurred.

III. Functions Of The Detecting System

Accident detection and rescue alert system, there are two main phases of operation, the one phase is to collect and process the sensor's data and the next phase is to search and contact the nearest rescue team. Obtaining the values from Gyroscope, the receiving the sensor's data is then compared to a predefined dataset and analyzed for the crash severity level to critical, major or minor. When the traffic crashes have been validated by the system, the values of GPS are collected from the dataset. Using Geofence Technology to generate polygons centered around the location of the car crash. Finally, the system refers information about the victims of the accident to the nearest rescue team which is searched within the polygon, so that rescue operations can be carried out as soon as possible.

If the rescue team is not found in the first polygon, the system will use Geofence technology to create a wider polygon and search again until another rescue team is found. The system will then send a notification to the rescue team about the accident point and the information of the driver and passenger.

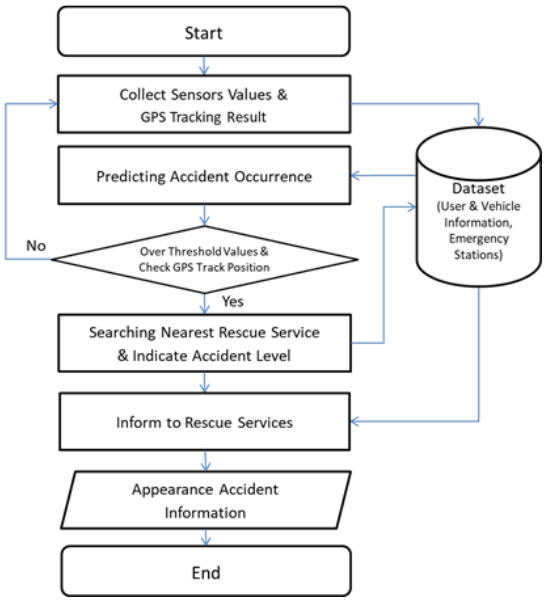

Fig. 1. Depiction of System Functions

IV. Methodology Of Detecting And Searching

A. *Motion Sensing Method*

Motion Sensing Method to reduce data deficiency sensors. It is a problem of data discontinuity between respective sensors, in method develops the steady of data by merging data collected from sensors. In earlier research, data obtained from individual automated sensors was known to be inaccurate in calculations. In the Motion Sensing Method, the data obtained from automatic and non-automatic sensors is compared with the previous data stored and analyzed to get the good quality result. It is relevant to collect the highest good data for use in system, and based on the results obtained from the experiment, the threshold value of both sensors is set to 20 m/s2 within system.

```
AMx, AMy, AMz = getAccelerometerValues();
GSx, GSy, GSz  = getGyoscopeValues();
Pred_Marks = 0 ;
While_(true)
AMx, AMy, AMz = sensor_value;
GSx, GSy, GSz = sensor_value;
If_not A_x, A_y, A_z in_range_of AMx, AMy, AMz
      PredMarks += 1 ;
If_not G_x, G_y, G_z in_range_of GSx, GSy, GSz
      Pred_Marks += 1 ;
If_Pred_Marks > 0
      Alert_AccidentDetection
```

B. *Difference Angle Method*

Difference Angle Method is chosen to be used in conjunction with the Motion Sensing Method to get the corroboration of the precise result of the traffic crash. GPS provides the lat and long, but cannot indicate the vehicle's direction. The sensor's rate is stored in the smart-device and the update GPS value is equated with the past value when the accident.

Although the values from accelerometer and gyroscope exceed the predefined threshold value for accident of the system, according to the checks included in the system, if the most update GPS value is consistent with the previous GPS value and continues to move, it will not be considered as an accident but will be considered as a false warning and will prevent false information.

$$Slope1 = \frac{||Y_B - Y_A||}{||X_B - X_A||}$$

$$Slope2 = \frac{||Y_C - Y_B||}{||X_C - X_B||}$$

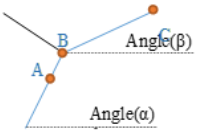

Fig. 2. Calculation of Difference Angles

C. *Modern Postioning Method*

The Modern Positioning Method uses a check of all available receivers available from the device to verify the exact location of the user. By using between velocity, time and distance sent by the mobile device, the user's position can be obtained, and by correlating origins of the signal, collector calculates the user's point. The equation of this method is:

$$d = v.t$$

D. *Object Detection in Fence Algorithm*

When the traffic accident has been confirmed, a polygon with a perimeter of one thousand sqm is formed and the crash location is set as the midpoint. If the nearest rescue team is not found within the 1st polygon, the system will use Geofence to newly create a polygon with a wider perimeter and search until the rescue team is found with the algorithm assistance. When the nearest team has been detected, the optimal route to reach to the crash point will be provided at the same time. It will then send a message of the incident location and its shortest route information to the nearest rescue team shown in figure [3]. Object Detection in Fence Algorithm is as below:

```
Algorithm:
Input:  C is accident, G is polygon, R is rescue,
        W is shortest_way
C give accident location
buf is a bufferdistance
Output: true if R fallin G, otherwise_false
    count = 0
    R is infinite_rayin +y_dir, origin at C
    for all perimeter_in G do
        if R is within_buf of ex then
            ex,buf = ex-2*buf
            function W(C, R)
            shortdist[C]:=0
            For each W in G
        else if R is within_buf of p or pbuf then
            return false
```

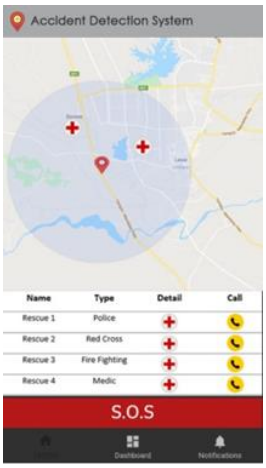

Fig. 3. Optima Route Information for Rescue Team

V. Results And Discussion

The main purpose of this research is for tracking the vehicle location by utilizing information from the accident detection system embedded in the smartphone. It is to check the accident situation and classify the accident level. In order to decrease the occurrence of receiving false alert messages and save the victims in time, the rescue team will be notified and guided to arrive by the shortest route.

Motion Sensing Method is accelerometer and gyroscope values are collected and provided to calculate the accidental state. Sometimes, the sensor's value exceeds the limit of the possibility of an accident due to fall of the smartphone from its original position and error. To reduce the incorrect results in the process of confirming the accident.

While GPS provides its Lat and Long, the Difference Angle Method calculates the heading way of the automobile. Combined with accelerometer, gyroscope sensor values and GPS angle results, it calculates minor, major or critical accident ratings shown in figure [4]. The Accident Detection System will carefully analyze and calculate the received sensor's values and GPS values, and then connect with the rescue team verified in polygon.

		GPS Track Angles Result		
		Low	Medium	High
Predict Threshold Values	High	Major	Critical	Critical
	Medium	Minor	Major	Critical
	Low	Minor	Minor	Major

Fig. 4. Classifying the levels of accident

If the sensor's values exceed the predefined threshold values, a message will be sent to the user to confirm its vehicle crash condition, and 20 seconds waiting time is set for the user to confirm the condition, it will consider the crash point as the center and automatically create a polygon using Geofencing and use Object Detection in Fence Algorithm to easily locate the nearest rescue team and the shortest way to reach there.

VI. Conclusion

After investigating the rescue programs applied all over the world, existing accident detection processes have some defects such as insufficient predefined data for speed limits and loss of automatic control, increasing the risk of receiving false accident alerts.

In this paper, the Accident Detection System is able to process various training datasets, which can solve the above-mentioned disadvantages. When the datasets that are being well-trained validated in the system, it will monitor the current situation of the persons on the expressway and update the dataset, in addition by using Geofencing, it will quickly find for the nearest emergency team to the exact crash point, and send the information of the victim and the optimal route to reach to the crash point to the nearest rescue team in time. The system is waiting for a reply from the user even if the user is unconscious. After that, using Geofencing technology, it will search for the nearest rescue team and send alert SMS automatically.

Acknowledgment

Firstly, I would like to many thanks my supervisor Dr. Thin Lai Lai Thein, Professor of Data Analytics Lab and Faculty of Information Science (FIS) from University of Computer Studies, Yangon. Also, I would like to thank concerned institutions for giving me the opportunity to carry out my research work with full confidence and smoothly.

References

[1] Chris T., White J., Dougherty B., Albright A. and Schmidt DC., "WreckWatch: Traffic Accident Detection and Notification", International Journal of mobile network and application, Springer, Hingham, March 2011.

[2] Danish karim and Jaspal Singh., "Development of Automatic Geo-Fencing and Accidental Monitoring System based on GPS Technology", August 2013.

[3] Huub HC Bakker, Ken A Mercer and Wyatt H Page., "A Review of Position Tracking Methods" International Journal of 1st International Conference on Sensing Technology, November 21-23, 2005.

[4] Marwan Abboud., Lina Mariya Abou Jaoude. Ziad Kerbage. "Real Time GPS Navigation System", February 2004.

[5] Nay Win Aung, Dr. Thin Lai Lai Thein., "Traffic Accident Detection and Rescue Alert System for Highway in Myanmar", International Journal of International Conference on Science, Technology and Innovation (IcSTIM 2019), September 2019.

[6] Sneha R.S. and Gawande A.D., "Crash Notification System for Portable Devices", International Journal of Advanced Computer Technology (IJACT), June 2013.