Road Accident Auto-dialer via Pressure Sensor

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Abstract. An accident sometimes goes unnoticed, for example, falling into a ravine. Thus no one is able to make emergency calls to the relevant authorities. Airbags in vehicles are designed to inflate when serious accidents occur. However, reliance an airbag alone may not be sufficient. This research explores developing a prototype using crash and pressure sensor as a parameter to trigger auto-dialer to call a pre-programmed list of numbers when an accident occurs. Global Positioning Satellite (GPS) and Global System for Mobile Communications (GSM) modules are integrated to track vehicle location and send information. A Short Message Service (SMS) will be sent containing the vehicle registration number and GPS location, to the authorities or even the insurance agent. This life-saving system which can be placed in the black box of a vehicle to report incidences and thus reduce the time needed to relay accident location information to the relevant authorities.

Keywords: Accident, airbag, pressure sensor, auto-dialer, GSM, GPS.

1 Introduction

In Malaysia, rate of road accidents, casualties and deaths have been increasing. Based on Malaysian Institute of Road Safety Research (MIROS) newspaper article released in 2009 [1], the number of crashes involving men drivers were 2.4 times more than women drivers. Men scored 1,351.74 crashes per 100,000 male populations, while women were 537.97 crashes per 100,000 female populations. Table 1 shows the number of accidents by year and gender, based on reports from Royal Malaysia Police Force, analysed by Malaysian Institute of Road Safety (MIROS) [1].

Table 1. Number of accidents by year and gender

	2006	**2007**	**2008**	**2009**
Male	145,502	161,763	190,788	244,336
Female	52,167	60,079	73,241	103,153

Some accidents need immediate medical attention. Delay in relaying information will delay medical attention probably cause deaths. Reducing the time taken from when the accident happened and for responders to be dispatched is crucial as it

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decreases mortality rate by 6% [2]. As stated by [3], each minute that an injured crash victim does not receive medical care, it widens the gap of their survival rate. Analysis showed that reducing accident response time by 1 minute, it correlates to 6% difference in the number of lives saved. Airbag technology does not efficiently curb fatalities. Also, drivers tend to panic and fail to handle the situation effectively.

We propose a system that is aimed to make them feel a degree safer when travelling. This research will develop a prototype that combines crash and pressure sensors with auto-dialer to allow the system to call a pre-programmed list of emergency numbers. GSM and GPS communication modules will send information and for track vehicle location. However, the scope of this paper is to develop a simulation system to simulate pressure sensor and trigger auto-dialer to call the authorities.

2 Related Work

This paper [4] researched on an in-car terminal, combining GPS, GSM and a control module to detect car incidences. CCTV is used to verify the incident when a report is obtained. In an accident, an alarm report is triggered and sent to the Transport Management Center (TMC) via GSM and GPRS. There are two ways incidences could be reported, manual and automatic incident detection. In manual incident detection, spectators, CCTV or the conscious driver can report the incident. The disadvantage is the accuracy of witnesses in relaying location information. This can be overcome using GPS module. In automatic detection method, when the driver is unconscious and no witnesses were around, the auto-alarm can be triggered by one of the in-car sensor, for example the airbag. However, it did not specify if any information was sent, but rather just an alert signal. It was also mentioned that GPS has the most accurate navigation system, but it does have problems in transmitting signal through large objects like buildings. Capacitive Sensing (CPS) Module was suggested as a solution as it is more widespread and has less blind zone. However, the positioning error is larger. Thus, they used these two technologies interchangeably. Our research will focus on using airbag as a main triggering mechanism to indicate that an accident has taken place and it is somewhat severe. In [5], the researchers researched on automotive airbag suppression based on occupant classification. It was mentioned by [3] that airbags will be triggered if acceleration is over 60G. Airbags can also cause fatal injuries if the occupant is a child smaller (in weight) than a normal size of a 6 year old. Using machine vision-based occupant classification system, with less than 5 seconds, it is able to identify whether the occupant is rear-facing infant seat, child, adult or an empty seat. Accuracy rate was approximately 95% which was extensively tested with 21,000 real-world images of occupants in vehicles.

White et. al. [2] introduced an approach to eliminate delay between accident occurrence and the first responder dispatch through in-vehicle automatic detection and notification system. Sensors are placed on smartphones to detect accidents and notify emergency personnel. G-forces acceleration experienced by the vehicle is recorded, which includes acoustic signatures from air-bag deployments or accident noises. By using a combination of data like sensor data such as accelerometer and acoustic

information and intelligent sensor data filtering, the detection system could reduce false positive signals. It was reported that it is not able to detect minor accidents, as filters were used to reduce false positives. Valente et. al. [6] research on trucks transporting dangerous goods, such as radioactive chemicals, is monitored to ensure safety to the driver and other vehicles. Real-time monitoring of parameters inside the cargo bay (i.e. temperature, ionizing radiation level) using wireless sensors were used to detect and prevent dangerous situations. GPS is used to detect the location of the vehicle. These data are then sent via General Packet Radio Service (GPRS) to a main station, where it will monitor the mechanics of the trucks. General Motors Co., uses GM's OnStar [7] system to notify the relevant authorities about an accident that is triggered by in-vehicle sensors like airbag. Transmission of the accident information is through built-in cellular radios. If an accident occurred, OnStar will automatically place a voice call to the relevant authorities so that the authorities can inquire about the condition of the car occupants, provide guidance and predict whether an ambulance should be sent to the scene of accident.

Authors in [8, 9] defined situational awareness as a condition where a person is being informed of the environment in time and is able to predict the future outcomes within the environment. In fact, [10] claims that in times of mass emergency, people use Twitter to gather and disperse information. Context has to be placed for people to better understand their surroundings. Training machines are used to identify valid tweets and extract tweets that will contribute to situational awareness. This shows how important situational awareness is in times of an emergency. The novelty from our work is the use of auto-dialer after crash sensors are triggered. GPS module will capture the accident location and send an SMS containing car registration number and GPS coordinates.

3 Results and Discussion

Fig. 1 shows the process flow of the proposed prototype. When an accident happens, it will activate the auto-dialer. The auto-dialer will call a pre-programmed set of numbers through GSM network to inform of the accident via voicemail. An SMS will be sent, containing the car registration number and GPS location of car. Once a report is obtained, the phone operator receiver will have a system to display time/date record, car registration number and will show the location in a map for the operator to contact the nearest relevant authorities.

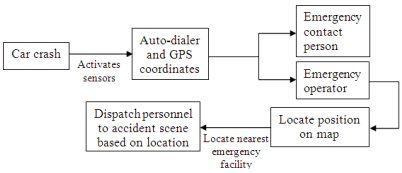

Fig. 1. Process flow

Our conceptual model has a little modification. An extra connection of pressure sensor will be fixed in addition to the crash sensor. The reason is to avoid any possible form of failure in the auto-dialer, which is directly affected by airbag function. This ensures only a defined amount of pressure is considered severe to demand for medical and emergency attention. This is to avoid activating the auto-dialer, for minor fender-bender incidences.

Fig. 2 below shows the conceptual design of our prototype. The pressure sensor will be set to a predefined threshold sensing level. Once the pressure sensed exceeds the threshold, it will trigger the auto-dialer. The auto-dialer is integrated with GSM and GPS modules. If that area has poor GSM network reception, the government allocated bandwidth for emergency calls can be utilized. Therefore, the emergency call number in the system can still go through but emergency contact person will not be reachable.

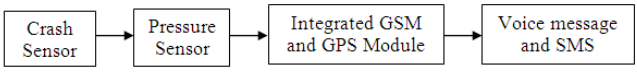

Fig. 2. Proposed design

For the proposed design, a computer application is developed to simulate such event (Fig. 3). The pressure level during idle is slightly above 5. The pressure threshold level is set to 6. Fig. 4 shows the event when pressure is above the threshold level of 6. Thus, the SMS is triggered to be sent to the two preprogrammed numbers. In our simulation, two numbers were pre-programmed. However, more numbers can be added depending on individual's need, whom some of them may include friends and insurance agents.

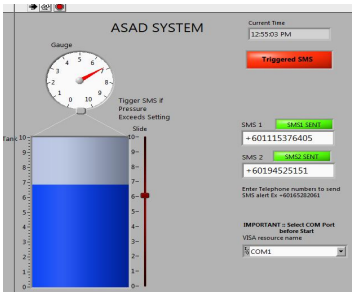

Fig. 3. Main system interface

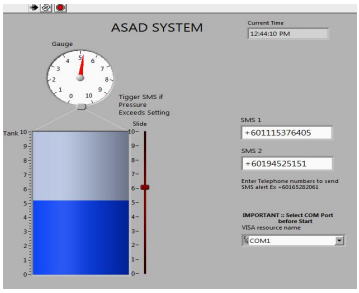

Fig. 4. Pressure level above treshold and Notification of SMS sent

In this simulation, we managed to get the SMS module to work properly. Our next steps would include developing a full scale prototype to be fitted in remote control cars for testing. The proposed system is aimed to provide quicker medical attention to the accident victim.

4 Conclusion

A conceptual model was proposed to include pressure sensor to trigger the auto-dialer when accident happens. A computer application was developed to simulate the proposed design. Only with predefined amount of impact will pressure sensors be triggered. SMS module has been developed and is fully operational. This invention would help to reduce the time taken for police or ambulance to receive information regarding accidents and improve the response time of relevant authorities. Our future works would include developing the complete prototype and placed it in remote control for real world test scenarios. Development of the full prototype will be discussed in future papers.

References

1. Mohd Sadullah, A.F.: Gender and risk on roads (March 20, 2011), http://www.miros.gov.my/web/guest/photo?p_p_id=101_INSTANCE_TmPd&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=rightbar&p_p_col_pos=1&p_p_col_count=4&_101_INSTANCE_TmPd_struts_action=%2Ftagged_content%2Fview_content&_101_INSTANCE_TmPd_redirect=%2Fweb%2Fguest%2Fphoto&_101_INSTANCE_TmPd_assetId=173379
2. White, J., Thompson, C., Turner, H., Dougherty, B., Schmidt, D.C.: WreckWatch: Automatic Traffic Accident Detection and Notification with Smartphones. Journal of Mobile Networks and Applications 16, 285–303 (2011)
3. Evanco, W.: The impact of rapid incident detection on freeway accident fatalities. Mitretek Systems, Inc. (2006), WN96W0000071
4. Li, C., Hu, R., Ye, H.: Method of freeway incident detection using wireless positioning. In: IEEE International Conference on Automation and Logistics 2008 (ICAL 2008), Qingdao, China, pp. 2801–2804 (September 2008)
5. Farmer, M.E., Jain, A.K.: Occupant classification system for automotive airbag suppression. In: Proc. of the 2003 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR 2003), Washington, DC, USA, pp. 756–761 (June 2003)
6. Valente, F., Zacheo, G., Losito, P., Camarda, P.: A telecommunications framework for real-time monitoring of dangerous goods transport. In: 9th International Conference on Intelligent Transport Systems Telecommunication (ITST 2009), pp. 13–18 (2009)
7. Unknown, OnStar (2011), https://www.onstar.com/web/portal/home
8. Endsley, M.R.: Toward a theory of situation awareness in dynamic systems. Journal of the Human Factors and Ergonomics 37, 32–64 (1995)
9. Sarter, N.B., Woods, D.D.: Situation Awareness: A Critical but Ill-Defined Phenomenon. International Journal of Aviation Psychology 1, 45–57 (1991)
10. Vieweg, S.: Twitter communications in mass emergency: contributions to situational awareness. In: Proc. of the ACM 2012 Conf. on Computer Supported Cooperative Work Companion (CSCW 2012), pp. 227–230. ACM, New York (2012)