THE DESIGN OF INTELLIGENT AUTO ACCIDENT ALARM SYSTEM

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ABSTRACT:

Road accidents are one of the major causes of mortality around the world and over 1,300,000 people are killed annually in the road accidents. Most of fatal accidents occur on the roads outside the city. Some of the casualties are killed in the crash moment and the others after the accident, mostly due to late arrival of rescue groups. The late arrival of rescue groups is mostly because of the lack of rapid and timely notice from accident. For this reason, this paper proposes the employment of location-based service to develop a system that can be used easily to locate an accident more quickly and inform emergency service to accelerate the transfer of victims to medical centers. This system is composed of two parts. The first part of the system is activated when something hits the impact sensors embedded in the vehicle and then it captures the location of vehicle via GPS. Employing GSM, the first part of the system sends an SMS which contains the location and other necessary information of vehicle to the second part of system which is situated in the emergency center. After the SMS is delivered, the system is able to locate the accident on the map and dispatch the rescue groups to the place of accident.

1. INTRODUCTION

Road accidents are one of the major causes of mortality around the world and over 1,300,000 people are killed annually in the road accidents. These accidents usually reported by people who are close to the accident scene or by the traffic police are in the roads. This increases the time of accident reports and so increases the time of positioning the accident scene by police and rescue group.

The main objective of this paper is to design a system in order to reduce the time required to report an accident and to determine its location more fast and precise. This will reduce the time required for the police and the emergency personnel to reach the accident location. The proposed system will make the location identification automatic and hence will be more precise and take less time. So it will reduce the loss of life resulting from road accidents.

1.1 Related Works

Advanced Automatic Crash Detection Systems are those systems that automatically notify emergency centers of vehicle crashes. These systems are commonly equipped with sensors distributed in all directions of the vehicle and used to collect crash severity information (Alkhateeb et al. 2010).

OnStar (Carrigan et al. 2005), which is one of such systems, has been designed in 1996 to deliver safety, security and information services using wireless technology and the Global Positioning System (GPS) satellite network. This system supports services such as notification of air bag deployment, stolen vehicle location assistance, emergency services, roadside assistance with location, and remote door unlock. But OnStar services are not limited these services. It also allows drivers to make and receive voice-activated wireless calls and access a wide range of other information services through a nationwide cellular network.

However, such systems are installed in specific vehicles. For example, OnStar is a wholly-owned subsidiary of General Motors. Therefore, they cannot be directly applied in countries like Iran.

Other systems, usually called traffic Accident Recording and Reporting Systems (ARRS) such as (Wells & Toffin 2005), (Ki et al. 2006), (Ki 2007) and (Shehata et al. 2008) are vision-based traffic accident detection systems. Such systems are either image-based or video-based and used for automatically detecting, recording, and reporting traffic crashes. They consist mainly of a charge coupled device (CCD) camera (located at intersections, traffic lights, or bridges) to obtain a view of accidents and/or a digital video recorder (DVR) that can be used for recording all the situations at a given place, and finally an image processing unit that detects images which could be related to a traffic crash.

Figure 1. Snapshot of Accident Recording and Reporting Systems (ARRS).

Such systems analyze traffic images and report accidents to Traffic Monitoring Center (TMC) as illustrated in Figure 1 (Alkhateeb et al. 2010).

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Nonetheless, the usages of such systems are limited since cameras (CCD) and digital video recorders (DVD) cannot be distributed everywhere (for example, along roads, highways, subways, etc.). Consequently, it will be useful for the detection and reporting of accidents in some hot spots like intersections.

2. LOCATION BASED SERVICES AND THEIR APPLICATIONS

As a result of the huge numbers of mobile phone users, it becomes possible to use the mobile in specifying the location of the mobile users. One method that can be used to accomplish this task is the use of location based services (LBSs). A location-based service (LBS) is an information service that can be accessed using mobile devices through the mobile network and utilizes the ability to make use of the geographical position of the mobile device (Steiniger et al. n.d.), (Adams et al. 2003). There are a number of services included in LBS such as specifying other people positions, other resources, and the position of the user itself, etc. The primary service is obtaining the position of the user itself in order to use a given service such as finding the nearest restaurant.

The LBS applications are divided into four main areas (Sadoun & Al-Bayari 2007):

1. Information and Navigation services*:* These services provide data directly to end-users, in particular destination location and criteria for trip optimization.

Moving map displays guided by navigation GPS receivers are provided by the Automobile manufacturers as a new option in their modern vehicles. Many rental car companies have GPS-equipped vehicles that give directions to drivers on display screens and through synthesized voice instructions. Moreover, the displays can be removed and taken into a home to plan a trip. A new international industry is born (such as Navtique and Tele Atlas), which is specialized in preparing the maps and voice guidance for navigation system to be used in old and new modern vehicles.

2. Emergency Assistance: This type of service provides the location of mobile users in case of distress and need for assistance such as: E-911 in US and E-112 in Europe. GIS capabilities are essential in such services.

3. Tracking Services: In general, an AVL system consists of a GPS receiver integrated with GSM/GPRS module mounted on the vehicle, communication link between the vehicle and the dispatcher, and PC-based tracking software for dispatching.

4. Network Related Services: Location can be achieved by integrating a GPS receiver in the mobile phone (handheld solution) or by using the communication network itself, where knowledge of user's position improves communication services.

3. THE STRUCTURE OF THE INTELLIGENT AUTO ACCIDENT SYSTEM

In this section, we present a novel system called the Intelligent Auto Accident Alarm System. The structure of the Intelligent Auto Accident Alarm System is as shown in Figure 2.

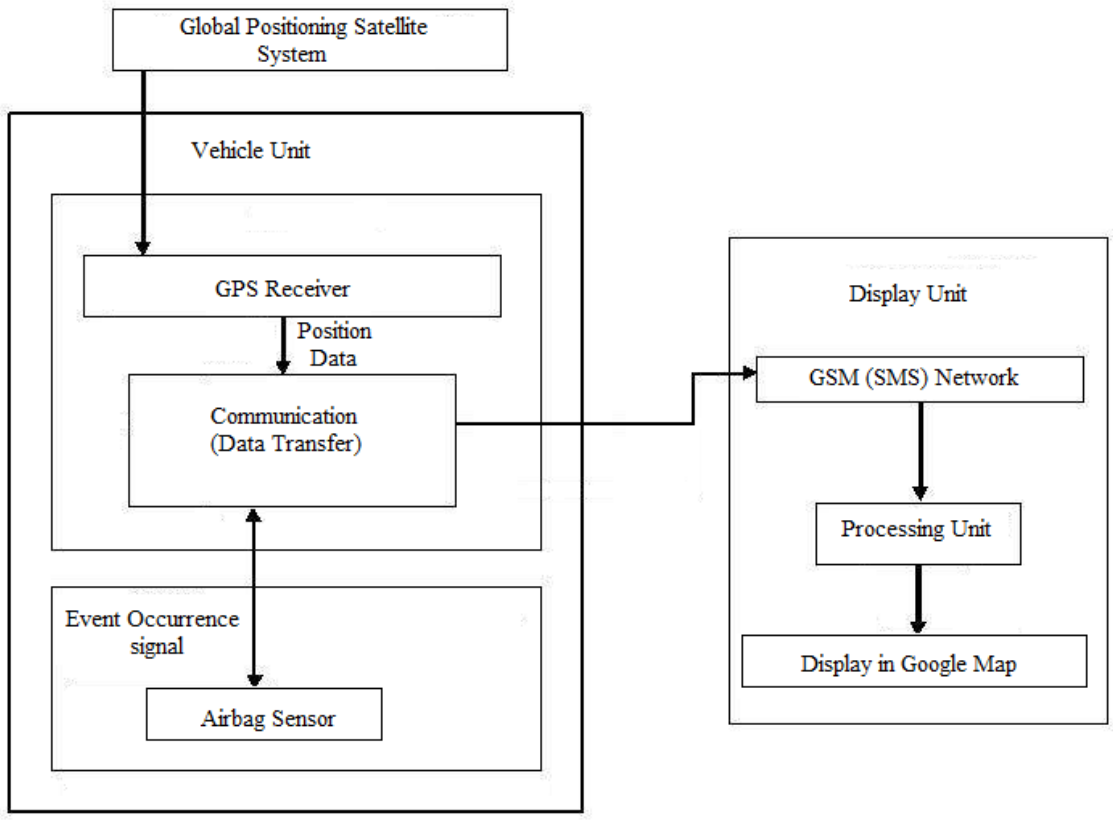

Figure 2.The structure of the Intelligent Auto Accident Alarm System.

This system is composed of two main parts. The first part embedded in the vehicle and its task includes:

1- Determining vehicle position continuously and save it in a text file
2- Receiving signal from the airbag sensor
3- Sending information to the emergency center.

Second part located in the emergency center and its task is receiving information from the vehicle and displaying location of accident in monitor. The principle sketch of the Intelligent Auto Accident Alarm System based on GPS/GSM(SMS) is as Figure 3 shown.

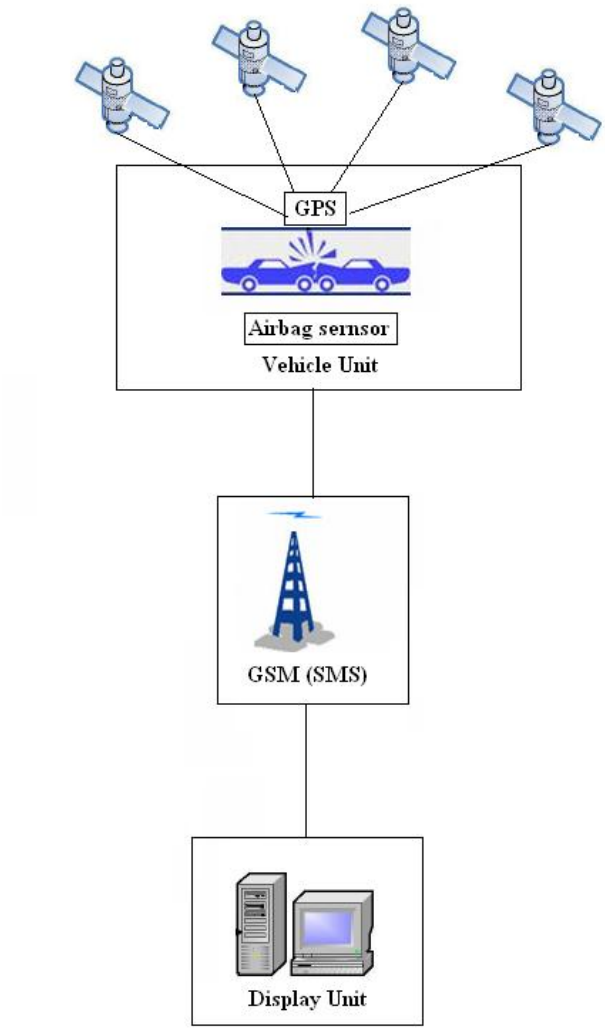

Figure 3. The principle sketch of the Intelligent Auto Accident Alarm System based on GPS/GSM(SMS).

3.1 Part I: Embedded In Vehicle

This part is composed of two main units: Positioning unit and Wireless information transfer unit. This part detects accident using airbag sensors in vehicle and sends last recorded coordinates and GPS time to part II that located in the emergency center.

3.1.1 Positioning Unit

The task of the positioning unit is specifying geographical coordinates of the vehicle. There are many kinds of technologies that can be used in the vehicle terminal, such as the GPS technology, the GLONASS technology, GSM cell phone positioning technology and etc. The precision and the application fields of all the positioning technologies are shown in the table 1 (Liu et al. 2006).

Positioning techniques	Positioning precision	Application fields
GPS Technology	10-25 meters	Vehicles ships and planes all over world
GSM mobile positioning technology	400-500 meters	The monitor of long distance freight
GOLNASS technology	10-25 meters	Fewer applications
The integration of GPS and GLONNASS	10-20 meters	Vehicles ships and planes all over world

Table 1. The precision and the application fields of all the positioning technologies.

From table 1, the GPS technology can be found out that it is the most extensive used in the vehicle monitoring and navigation. For this reason, this technology is used in this system. To use this technology GPS receiver should be used. The GPS receiver receives signals from satellites in global positioning satellite system. These signals are processed to identify the geographic location of the GPS receiver that embedded in vehicle. Positioning of the receiver is done automatically once every ten seconds and always the 100 last coordinates of the GPS receivers with GPS time is recorded in a text file. The last recorded coordinate with GPS time in the text file used in areas where GPS receiver cannot connect to GPS satellites.

3.1.2 Wireless Information Sending Unit

In monitoring systems that deal with vehicles using a wireless information sending system is essential. With the development of electronics, computer science and information technology, the development of the communication system has experienced vast changes, from wired communication to wireless communication. There are many communication networks and methods that can be used in the Intelligent Auto Accident Alarm System Such as: GSM, GPRS, satellite communication and etc. Different application chooses different modes of wireless communication according to the actual demand.
At present, Iran GSM network is most extensive and most reliable system in Iran for using in the Intelligent Auto Accident Alarm System. SMS is one of suitable data transfer methods in GSM networks. So this method selected for data transfer in the Intelligent Auto Accident Alarm System.

3.2 Part II: Located In The Emergency Center

This part located in emergency center. When an accident occurred which by the vehicle airbag sensor being detected, receives information with GSM modem from part I that embedded in vehicle and displays the location of crashed vehicle in Google map. Figure 3 shows a snapshot of part II located in emergency center.

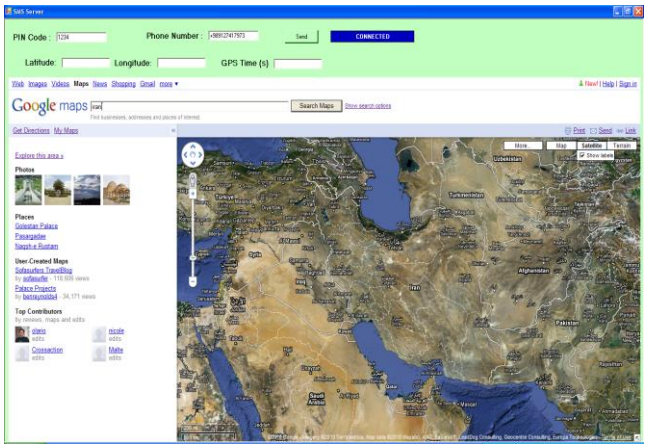

Figure 4. Part II Located In the Emergency Center.

4. CONCLUTION

In this paper, we peresent a novel system for fast reporting and precise positioning of road accidends. This system reduces the time of accident reporing and reports precise location and time of accidents. The one the advantages of this system is its automation; Namely this system in spite of other systems that must activated by people near the accident scene, completely reports accidents automatically. Also this system by some changes can have another applications such as anti teft system, vehicle monitoring system and etc.

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