TELKOMNIKA Telecommunication, Computing, Electronics and Control
Vol. 18, No. 1, February 2020, pp. 450~455
ISSN: 1693-6930, accredited First Grade by Kemenristekdikti, Decree No: 21/E/KPT/2018
DOI: 10.12928/TELKOMNIKA.v18i1.13262

Intelligent alarm system for hospitals using smartphone technology

Bashar S. Bashar, Marwa M. Ismail
Al-Nisour University College Baghdad, Iraq

Article Info

Article history:

Received May 31, 2019
Revised Jul 17, 2019
Accepted Aug 21, 2019

Keywords:

Alarm system
E-health
Hospitals emergency
Smartphone
Wireless communication

ABSTRACT

During the last decade, attention was paid to detect the accident and call the ambulance as soon as possible, the situation was neglected after the arrival of the patient to the specified service point. This negligence led to an increase in the mortality rate, especially where the highest percentage of deaths occurred during the first hour after the accident. This highest Mortality can be avoided by providing proper health care after the arrival of the patient to the hospital, the proposed system reduces the rescue time after the arrival of a patient to the hospital, and it requires each hospital to be endowed with a reception model responsible for detecting and reporting accident situations to the emergency service. It was be found that there is an urgent need for a web-based hospital management system with a mobile web service to respond immediately to incidents in the event of an accident. This system utilizes the android phone application to connect to the server for transferring the specified data to the hospital and it can be used for comprehensive accident analysis and management. In this paper, a combination of Android phone application, database, and visual studio 2012 was used to develop the system.

Corresponding Author:

Bashar S. Bashar,
Al-Nisour University College Baghdad,
Baghdad, Iraq
Email: bashar.s.eng@nuc.edu.iq

1. INTRODUCTION

Continuous efforts have been made by automobile manufacturers to reduce road accidents (improve traffic safety and reduce mortality) but accidents still occur, rapid response and resource provision have a significant impact on reducing mortality [1, 2]. Thus an intelligent alarm system was implemented. Traffic incidents are difficult to analyze as it exceeds the limits of engineering, human behaviour, and geography [3], statistics indicate that the main cause of death due to injury is road traffic incidents [4] approximately 1.5 million people die every year as a result of road accidents [5, 6], 20 to 50 million people suffer from non-fatal injuries with many suffer from physical disabilities as a result of their injuries [7, 8].

More than 90% of road traffic deaths occur in low- and middle-income countries [9, 10], this percentage is increasing in countries suffering from internal disturbances and wars such as Iraq. In the past decade, more than 66,000 traffic accidents have occurred in Iraq, killing 22,952 people and injuring 79,545 people [11]. Figure 1 represents road accidents from 2011 to 2017 in Iraq. When a traffic incident occurs, early assistance to the injured is crucial to minimize the negative impact on their lives [12]. The mortality rate from traffic incidents are classified into three different stages [13]:

– The first stage includes injuries in the first minutes or seconds after the incident (Approximately 10% of all deaths).

- The second stage occurs during the first hour after the incident. It causes the highest rate of deaths (approximately 75% of the total deaths).
- The third stage occurs during days or weeks after the accident (which causes approximately 15% of the total deaths). Efforts and resources are required to reduce mortality at this stage.

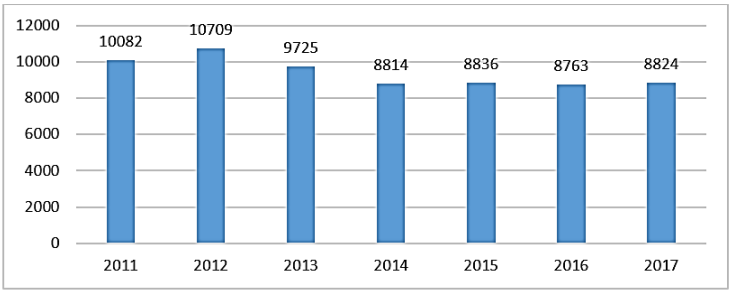

Figure 1. Number of road accidents (2011-2017) [4]

The stage in which more benefits can be achieved by accelerating the rescue time is the second stage. Rapid and effective rescue within the first hour after the incident increases the rate of survivor and reduces the severity of the injury [14, 15]. For a significant reduction in the rescue time, two essential steps must be taken:

- Rapid and accurate reporting of injuries to the specialized hospital.
- Provide the necessary resources for treating the reported cases prior to arrival at the hospital.

Over the past decade, systems were concerned in reducing the rescue time through the accurate detection of an accident, locating the incidents and sending accident information to the emergency services. To achieve this goal, systems were divided into two parts:

- Hardware component was used by the first one to detect accidents through the measuring of (the acceleration/collision/ severity...etc.)
- The second makes use of smartphone features (accelerometer, magnetometer, gyroscope, GPS…etc) to do the same function, as explained in the next section, which described the literature review.

It was cleared that all the above systems concerned in detecting the accident and calling the ambulance as soon as possible, but neglect the situation after the arrival of the patient to the specified service point. The proposed system intended in reducing the rescue time after the arrival of a patient to the hospital by providing all the necessary resources and reducing routine procedures that take time hence increasing the chances of survival.

The system offers an automated warning system using wireless communication technology (4G). The 4G is an advanced generation of cellular wireless standards, it provides a high data rate to broadband Internet access, mobile, and stationary users. Some of the key features of it are (Global roaming, 10 Mbps to 100 Mbps data rate, IP interoperability for seamless mobile Internet), 4G provides facilities such as Internet Protocol (IP) telephony, online gaming services, ultra-broadband internet access, and High-Definition Television (HDTV) streamed multimedia etc. [16].

This system doesn't focus on reducing the number of incidents but on improving emergency assistance with rapid and effective management of the available resources. It increases the chances of survival for people who injured during incidents [17]. An early warning system consisting of two parts was designed the first system developed for Android-based-smartphones. It sends a message containing the type of accident to the emergency service, the second system received the data from the first system and send a warning message to the specialist doctor.

2. LITERATURE REVIEW

The E-NOTIFY system was presented, it allows rapid detection of traffic incidents through the use of information transfer technology (V2V and V2I communication technology). The system requires the installation of on-board units in the vehicles, which detects incidents and notify them to an external Control Unit that evaluate the severity of the incident and inform the emergency services about the accident [13]. This paper presents a system for the summoning of the ambulance. The system prototype consists of a combination of several components namely (GPS Microcontroller, GSM module, and a crash sensor). It installs as a black box inside the vehicle. This system calls the ambulance once the incidents happen and sends location

information to the emergency contacts [18].

This paper present a system that is developed for Android-based smartphones. The system relies on the microcontroller to sense accidents and on GPS technology to locate the precise place of the incident. The system prototype requires each vehicle to be endowed with an on-board unit (OBU) and a control unit (CU) after an accident is detected the system sends short messages to the nearest hospital [19]. This paper presents a system prototype that is consisting of an incident detection system and an Android smartphone. The incident detection system consists of an accelerometer that senses the tilt of the car and a heartbeat sensor that detect the severity of the incident, the system will make the decision and send the data to the smartphone application via Bluetooth. The Android application sent a text message to the nearest medical center and friends [20].

A system prototype was implemented using a combination of accelerometer and ultrasonic sensors. The accelerometer senses any tilt in the car and the ultrasonic sensor senses the distance between the vehicles. Using data from these sensors, the system detects an incident and sends the information into the Losant IoT platform that sends an alarm to the emergency services and the concerned people [21]. Smartphone application for incident detection integrated with multimodal alert dissemination was presented, accident detection algorithm receives inputs from the smartphone sensors and from the vehicle ODB-II airbag signal, When a 4G or higher acceleration is detected and/or a rollover is detected, a DENM message sends to the vehicles in the vicinity, in parallel with short message and voice call to the emergency service [22].

An accident detection application was designed, this application uses smartphone features like GPS, accelerometer and mobile data as prerequisites. When an accidental collision is detected it sends SMS to the nearest hospital [23]. Go Safe application was presented, the velocity and speed of the vehicle were calculated using accelerometer sensors, if an accident is detected the application notify the nearest Hospitals and Police stations [24]. A computational model was designed to guide the patients to the most appropriate hospital by studying various variables that can be used as a reference by Emergency Medical Services (EMS) and have a role in decision making that will affect patients' lives [25].

An Android application was designed, it provides immediate help to the victim, the application suggests nearby hospitals that will scan the victim's QR Code and provide treatment according to the relevant information as well as send emergency text messages to nearby police stations and user friends [26]. An Android application was developed. It detects incidents using the OBII airbag signal and smartphone accelerometer. When the airbag signal is triggered or when a 5G or higher acceleration is detected, an email and SMS containing important information are sent to emergency services [27]. In the black spots in northwest Iran, many incidents have been reported. A method has been proposed to identify and prevent accidents in black spots without relying on warning signals in the area. One of the preventive methods is the warning systems. The results showed that the difference between warning and non-warning in the black spots was marked with a confidence level of 95% effective warning in reducing the speed of the black spots. Most drivers are very satisfied with the warning using car speakers [28].

A system was designed to develop the transportation infrastructure in major cities, taking into consideration the problems of traffic congestion and the optimal design of the roads. Based on these problems, a wireless video surveillance system was introduced to monitor the flow of traffic by relying on a base of digital panoramic images [29]. A tree diagram was developed to locate the most appropriate hospital location based on a summary of researchers' and scientists' knowledge, the analysis was performed through the analysis of the selected site and numbering matrices based on the tree diagram. The results with an average of 1.31 of 2 indicate that the field specified is suitable for building a hospital from a positioning perspective [30].

3. PROPOSED SYSTEM

Figure 2 shows the basic structure of the Hospital emergency system. The system consists of several components with different functions:

3.1. Android application model

Android studio is used to develop the Android application, it is an open source that is originally provided by Google. The Android Emulator is used to simulate various android devices so that different applications can be tested without the need to have each physical device. An Android virtual device (AVD) is used to specify the Android version and hardware characteristics of the simulated devices as shown in Figure 3.

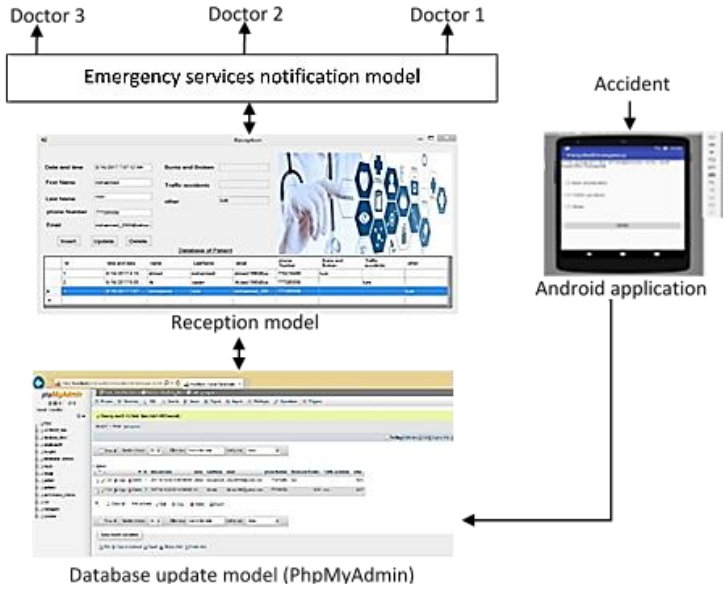

Figure 2. System architecture

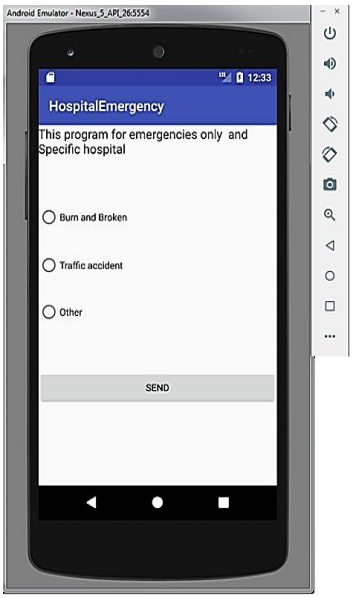

Figure 3. Android application model

3.2. Client-server model

PhpMyAdmin website is used to store data about the accident and it represents an easy-to-use interface that allows easy visualization of historical information and incident situations that require immediate assistance.

3.3. Database update model

The information collected from the incident are stored in the database of the program (PhpMyAdmin website) and updated continuously to increase the knowledge about the accident domain.

3.4. Reception model

The data collected from the accident must be received by the reception unit in the hospital. So, there should be a model available to access messages and their fields.

3.5. Emergency services notification model

A warning message containing the type of injury should be sent to the emergency service and the specialist doctor who will prepare the resources of receiving the patient and provide possible assistance.

4. SYSTEM ALGORITHM

4.1. The client/server system algorithm

The operation of the client/server system is shown in Figure 4. In this model, the user needs to login to the system, if the login was successful the user will select the case of the incident and send the type of the injury to the specified hospital server and if the login was failed the system will close automatically and the user must log in again.

After sending the data through the application, the system stores the information in the database (PhpMyAdmin), which will be available for updating and modifying by the hospital admin and can be obtained through its special program on the computer, some of the information saved are: the selected case, the caller ID and the date of sending the data..etc.

4.2. The reception/emergency service algorithm

The operation of the reception/emergency service system is shown in Figure 5. The system model was developed for Windows with different versions, visual studio 2012 was used to develop the system. In this model, the employee needs to register to the system using a predefined username and password, if the registration was successful the data stored in the database (PhpMyAdmin) that containing the type of the accident, its time and the patient's information will be received from the main server through the hospital

reception program and if the registration was failed the employee must reregister for 3 times before the system is closed.

The program sends a warning message to the doctor concerned according to the type of injury and disease, the doctor receives the message of alert through the special program on his computer and prepares the resources necessary for the patient treatment. If the doctor is busy it will send the message to another doctor. This will reduce the time necessary for saving patients life who needs emergency treatment. After treatment, the hospital reception employee fills the patient's information's (first name, last name, phone number, email), update/delete them and the patient's information is stored in PhpMyAdmin database so that it can be easily searched and retrieved using the patient's ID.

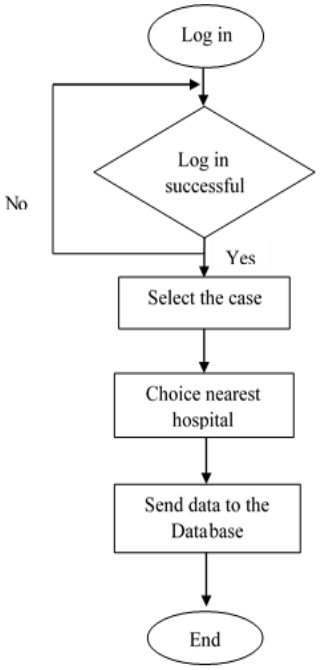

Figure 4. Client/server system flowchart

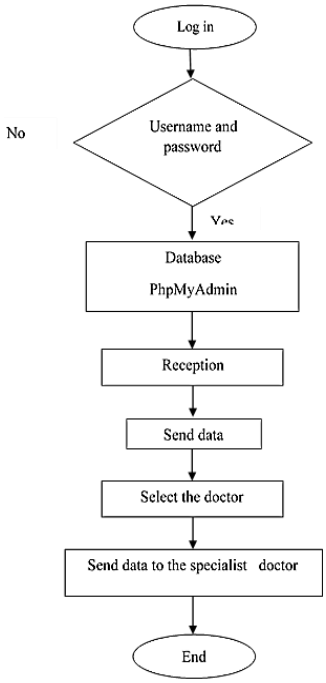

Figure 5. Reception/emergency system flowchart

5. CONCLUSION

Failure to respond to immediate emergency calls leads to increased mortality. It has been observed that even in response, deaths continue to occur as a result of increased rescue time during the first hour after the accident, in this paper, an early warning system consisting of two parts was designed. The first system is a client-server prototype that developed for Android-based- smartphones. It sends a message containing the type of the incident to the emergency service, the second system is reception/emergency service prototype that received the data from the first system and sends a warning message to the specialist doctor. The system allows patients to communicate directly with hospitals during emergencies to minimize routine procedures that take time. It provides easy and fast access to the patient's data that can be shared between medical rules via the internet. The system can reduce deaths efficiently, and this will save a lot of lives by sending the patient's data earlier to the hospital and the specialist doctor to take all measures to rescue the injured after reaching the emergency services point. Further research needed to be done to enable the system to connect geographically to the nearest hospital in addition to increasing the number of critical cases it can handle.

References

[1] Fahmi, I., & Nurachmah, E., "Implementation Of Internet-Based Emergency Medical Service (EMS) At Out-Of Cardiac Arrest Hospital (Ohca): A Solution To Improve Cardiac Arrest Response Time And Its Potential Application In Indonesia," *Belitung Nursing Journal*, vol. 4, no. 6, pp. 530-536, 2018.

[2] Al-Khafajiy, M., Kolivand, H., Baker, T., Tully D., & Waraich A., "Smart Hospital Emergency System Via Mobile-based Requesting Services," *Multimedia Tools and Applications*, vol. 78, pp. 20087-20111, 2019.

[3] Zarrinbashar E., & Mahmud A. R., "Intelligent GIS-Based Road Accident Analysis and Real-Time Monitoring Automated System using WiMAX/GPRS," *International Journal of Engineering*, vol. 2, no. 1, pp. 1-5, 2010.

[4] U. Khalil, T. Javid and A. Nasir, "Automatic road accident detection techniques: A brief survey," *2017 International Symposium on Wireless Systems and Networks (ISWSN)*, pp. 1-6, 2017.
[5] U. Khalil, A. Nasir, S. M. Khan, T. Javid, S. A. Raza and A. Siddiqui, "Automatic Road Accident Detection Using Ultrasonic Sensor," *2018 IEEE 21st International Multi-Topic Conference (INMIC)*, pp. 206-212, 2018.
[6] Amin S., Reaz M. B. I., & Nasir S. S., "Integrated vehicle accident detection and location system," *TELKOMNIKA Telecommunication Computing Electronics and Control*, vol. 12, no. 1, pp. 73-78, 2014.
[7] Bhatti F., Shah M. A., Maple C., & Islam S. U., "A Novel Internet of Things-Enabled Accident Detection and Reporting System for Smart City Environments," *Sensors*, vol. 19, no. 9, pp. 1-29, 2019.
[8] Bangare P. S., Petare Y. S., Chaudhari A. P., Jadhav R. D., & Bangare S. L., "Survey on accident monitoring system," *International Journal of Information and Computing Science*, vol. 6, no. 4, pp. 8-18, April, 2019.
[9] World Health Organization website "Road traffic injuries," [Online], Available: https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries.
[10] Khan A., Bibi F., Dilshad M., Ahmed S., Ullah Z., & Ali H., "Accident Detection and Smart Rescue System using Android Smartphone with Real-Time Location Tracking," *International Journal Of Advanced Computer Science And Applications*, vol. 9, no. 6, pp. 341-355, 2018.
[11] Iraqi Traffic Police, "Road Traffic statics," [Online] Available: http://itp.gov.iq/ar/%D8%A7%D8%AD%D8%B5%D8%A7%D8%A6%D9%8A%D8%A7%D8%AA.
[12] Bangare P. S., Petare Y. S., Chaudhari A. P., Jadhav R. D., Bangare S. L., Pradeepini, G., & Patil S. T., "Developing Accident Monitoring System Using Wireless Application," *International Journal of Information and Computing Science*, vol. 6, no. 4, pp. 1-7, April 2019.
[13] Fogue, Manuel, Piedad Garrido, F. Martínez, Juan-Carlos Cano, C. Calafate, and Piatro Manzoni. "A realistic prototype for automatic accident detection and assistance through vehicular networks," *IEEE Vehicular Technology Magazine*, vol. 7, no, 3, pp. 90-100, 2012.
[14] A. Parashar, V. Maheshwari, and A. Shrivastava, "Enhanced n-wheeler post accidental rescue system connecting to the correct person at the correct time," *2016 IEEE Region 10 Humanitarian Technology Conference (R10-HTC)*, pp. 1-4, 2016.
[15] Gadekar A., More A., Patil S., & Hiray S., "Smart Application For Post Accident Management Using IoT," *International Journal of Advanced Research in Computer Science*, vol. 9, no. 2, pp. 684-687, 2018.
[16] Singh, Shashank, and Pankaj Kumar, "Challenges and Prospects of Wireless Network in 4G," *International Journal of Computer Applications*, vol. 133, no. 11, pp. 1-5, 2016.
[17] Sujatha M., Kiran P. E., Sandeep Y., Kumar P. R., & Bhargav K. S. R., "Life Saving System Using IoT Technology," *International Journal of Pure and Applied Mathematics*, vol. 118, no. 20, pp. 335-343, 2018.
[18] S. Karthikeyan, S. R. Srinivasan, J. Syed Ali and A. K. Veeraraghavan, "Smart Summoning Of Ambulance during a Vehicle Accident," *2018 Second International Conference on Green Computing and Internet of Things (ICGCIoT)*, pp. 418-423, 2018.
[19] Javale, Purva, Shalmali Gadgil, Chinmay Bhargave, Yogesh Kharwandikar, and Vaishali Nandedkar, "Accident Detection and Surveillance System using Wireless Technologies" *IOSR Journal of Computer Engineering (IOSR-JCE)*, vol. 16, no. 2. pp. 38-43, 2014.
[20] N. Kattukkaran, A. George and T. P. M. Haridas, "Intelligent accident detection and alert system for emergency medical assistance," *2017 International Conference on Computer Communication and Informatics (ICCCI)*, pp. 1-6, 2017.
[21] R. K. Kodali and S. Sahu, "MQTT based vehicle accident detection and alert system," *2017 3rd International Conference on Applied and Theoretical Computing and Communication Technology (iCATccT)*, pp. 186-189, 2017.
[22] B. Fernandes, V. Gomes, J. Ferreira and A. Oliveira, "Mobile Application for Automatic Accident Detection and Multimodal Alert," *2015 IEEE 81st Vehicular Technology Conference (VTC Spring)*, pp. 1-5, 2015.
[23] Khan, Anisur Rahman, Pranav Suri, Supriya Patil, Tejaswini Sonawane, and Tejashree A. Paigude, "Automatic Accident Detection," *International Journal of Engineering Science and Computing*, vol. 8, no. 3, pp. 16456-16458, 2018.
[24] Khot, Isha, Madhura Jadhav, Abhijeet Desai, and Vaibhav Bangar. "Go Safe: Android application for accident detection and notification," *International Research Journal of Engineering and Technology (IRJET)*, vol. 5, no. 5, pp. 4118-4122, 2018.
[25] Agrawal, Sanjay A., and Shrikant B. Chavan, "EMS: An Android Application for Emergency Patients," *International Journal of Computer Science and Information Technologies*, vol. 5, no. 4, pp. 5536-5538, 2014.
[26] Ingle, Nilesh, Gangadhar Bhise, Sahil Handoo, Vyankatesh Javalge, and Miss Rachana Mudholkar, "Android Application for Accidental Management System Using QR Code," *International Journal of Mathematics and Computing Techniques*, vol. 1, no. 5, pp. 32-35, 2017.
[27] J. Zaldivar, C. T. Calafate, J. C. Cano and P. Manzoni, "Providing accident detection in vehicular networks through OBD-II devices and Android-based smartphones," *2011 IEEE 36th Conference on Local Computer Networks*, pp. 813-819, 2011.
[28] Yazdani, Mirbahador, and Amir Abbas Rassafi. "Evaluation of Drivers' Affectability and Satisfaction with Black Spots Warning Application," *Civil Engineering Journal*, vol. 5, no. 3, pp. 576-586, 2019.
[29] Kalistratov, Dmitry, "Wireless Video Monitoring of the Megacities Transport Infrastructure," *Civil Engineering Journal*, vol. 5, no. 5, pp. 1033-1040, 2019.
[30] Khotbehsara, Elham Mehrinejad, and Hossein Safari, "A Systematic Review of Affective Factors on Locating Specialized Hospitals," *Civil Engineering Journal*, vol. 4, no. 9, pp. 2210-2217, 2018.