AN EFFICIENT WEB ENABLED AUTOMATIC EMERGENCY MEDICAL ASSISTANCE SYSTEM USING ANDROID

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Abstract- This paper introduces a system to manage medical assisted emergencies in certain areas. At present, Sri Lanka and many other countries in the world face many difficulties in managing emergency medical situations even though telecommunication has been developed and it provides the technology needed for this kind of healthcare systems. Scarcity of Infrastructure and resources needed for such situations is a major problem in many areas of the country and in the world. The probable cause for this is that the relevant authorities do not pay much attention to this problem. As these situations occur abruptly without any warning, the implementation should be mobile. Thus, the mobile part has been developed on android platform. It will automatically send the location to the guardian and the same app will collect the information and the, location of the patient, and it will inform about the problem to the health care centers or the emergency services in the relevant areas. Through this system, public can directly connect to them, and they can get a fast and efficient response from the emergency medical assistance team who will receive patient's information from the web application.

Keywords- Location, GPS, Android, Emergency Medical Assistance, Web-based patient information

I. INTRODUCTION

Despite being a developing country in the 21st century, Sri Lanka faces many health issues, mainly due to the busy life style of people. Among these issues, there can be emergencies where medical assistance is needed immediately. However, unfortunately there are not enough medical assistance to cater the so-called problems in the country due to several reasons, such as the low budget allocation on medical services and public awareness in protecting the patients. At present the common method used to manage those kinds of situations is to give an emergency contact number to the public so that the public can contact the authorities in such situations. It is not a sufficient way to deal with emergencies because so many errors and delays can happen, and it costs lives. That is the main problem identified. These methods are not considered as user friendly as they create serious problems. The hypothesis is that the emergency medical assistance system in Sri Lanka can be improved and it will revolutionize the medical assistance sector in Sri Lanka.

The Information & communication technology can be used for this purpose because right now Sri Lanka does not have a proper ICT based emergency medical assistance system. Members, admins, police, medical officers, and developers can access the emergency medical assistance system I present in this paper. There are various levels of access for users, but the admin only can control the server computer because he only has the admin right to the system.

The "Suraksha" mobile application allows the public to inform the authorities easily and quickly about the locations of the emergency situations.

Anyone can access this mobile application from anywhere by typing their user name and their password. And then

he/she can track the emergency and send it to the nearest health care centre or emergency service. Then user will get a confirmation message whether the tracked location and other information (date and time, username, user mobile number and health related information of the user) are received or not by the relevant health care centre or emergency service.

A. Aim

Aim of this application is to facilitate people who need emergency assistance by providing emergency services and help to those who require a certain need or have a disease and to make their lives easier.

B. Objectives

According to the aim of developing an Emergency Medical Assistance System, the following objectives were identified.

- Analyze the problem and understand the problem clearly.

- Study and identify the technology used before.

- Transforming the requirements into a form implementable using a programming language.

- Conversion of the design into a working code.

- Identify the existence of the faults in the new system.

- Maintain the system after delivering to the user.

- After submitting the proposed system do a research to find out further improvements.

C. Hypothesis

The Emergency medical assistance in Sri Lanka can be improved by developing a mobile-based automated system and it will revolutionize the medical assistance sector in Sri Lanka.

D. Software solution for Emergency Medical Assistance System

The solution proposed in this paper is to develop a mobile-based emergency system to medical related situations which will be more suitable for developing countries. The

introduction of mobile phones in this process will enhance productivity. The system will be developed in two separate components; one part is a mobile-based application and other part is a web-based system that will work as a server for this system. According to the requirements, web application has been developed by using C# and SQL database to run on windows operating system. The mobile application has been developed by using Java, Android studio and MySQL. The mobile application registration part developed by PHP.

E. Resource Requirements

- The mobile application will be compatible with any mobile that runs on android.

- The web server will be developed to be compatible with any computer that runs on Windows operating system.

- The mobile application will be implemented by using Java and XML in android studio.

- The web application will be developed by using the C# language with ASP.net framework in visual studio.

- Web application database will be implemented by using DB forge studio in SQL server.

- The MySQL server is also used to work as a mobile application database server.

- The login and registration of mobile application server side is handled by PHP language.

II. LITERATURE REVIEW

The review will be focusing on the procedure and available practices in previous Emergency Medical Assistance Systems.

Emergency Services Using GPS Navigation(Sarkar, 2016); the main aim of this project was to make sure the patient reaches the hospital as soon as possible. There are two main systems integrated in this system to become a functional system. They are Arduino based GPS module system and android based software solution. In this system the GPS module is planted on the ambulance so that the hospital management can keep track of the ambulance and in case of emergency they can directly send the ambulance to the patient's location.

The Emergency Medical Help System Using OSM (Burkul et al., 2015) project has android based mobile system developed for detecting nearest hospitals for the user. The system has a database as a central server. It has the detailed information about the hospitals. The android application is installed in the user mobile device. The application will show the nearest health care centers to the user using open street map. It has a special functionality for the visually impaired people. it will provide directional audio information of the location to the patient.

Most of the emergency alert systems are installed on android or any other type of system device and wired or wirelessly linked to a gateway and then connected to a hospital. Most of these systems are divided into two systems as mobile and embedded, but this is not an effective way to build a system, because running two systems in same time is a wastage of resources. Therefore, the best strategy is to install the system on a mobile device. (Jadhav et al., 2016). The emergency alert system must be clicked manually or automatically. The alarm then sends the emergency message to all registered patient families and the doctors and with that info, it will carry the location information of the user using GPS system.

In India, the number of road accidents has rushed in a very drastic manner. In addition, after a further observation, the researchers understood that this problem is very much severe in modern urban areas. In this paper they proposed an automatic ambulance management system (Anand and Flora, 2014) and this system is reinforced by the intelligent transport system which would control the traffic light systems. So, the system will detect the location of the accident occurred, and then the system sends the nearest ambulance to the situation. When travelling to the incident the system will control the color lights and make path to the ambulance, and after the ambulance gets the patient, the system will clear the path to the nearest hospital for the ambulance by changing color lights. This will reduce the time significantly when getting the patient to the hospital.

There are many tracking systems but most of them are expensive, so these developers tried to develop a Cost-Effective GPS-GPRS Based Object Tracking System (Hasan et al., 2009) which will record the positions of the object using GPS and will show the location using an

embedded google map. In this system, the SMS technology is used to communicate with other devices.

The previous researchers have done a tremendous amount of work to develop a proper emergency medical assistance system. They done a good job too. However, the development of technology has made those systems out dated, much complicated, and very expensive to implement and maintain. Therefore, this proposed system is a timely requirement for health care sector.

III. METHODOLOGY AND EXPERIMENTAL DESIGN

A. Survey

Before developing the system, the authors decided to do a survey to get a brief idea about the user requirements, previous systems, popular mobile OS, suggestions for new system and so on. After doing this survey (81 responses), the authors developed the initial planning for the new system.
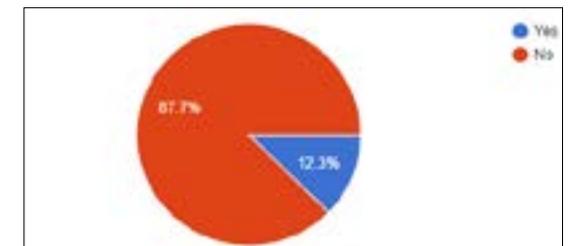
Figure 1. previous Medical assistance systems developed in Sri Lanka
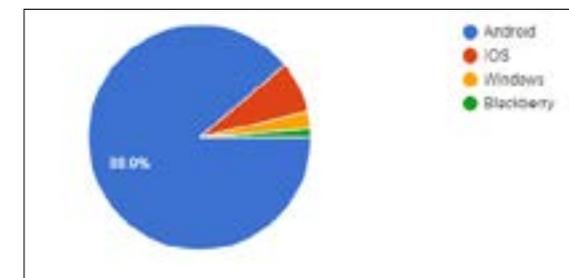
Figure 2. The favourite mwobile OS type

Figure 3. Suggestions for Medical assistance System

B. Data Gathering

Qualitative and quantitative data required for designing the requirement specification for the Emergency medical assistance system was gathered through observation, surveys and document review techniques that were carried out with various types of people around Sri Lanka. Face to face interviews with lecturers and students were also conducted in the process. A survey was conducted by distributing a questionnaire among students, lecturers and public, and then the answers were gathered accordingly.

C. Data Analysis

The data which were gathered during the data gathering phase was analyzed by using various analyzing techniques. By analyzing the data, the group could reveal the extent procedure, problems, limitations, suggestions of the students and lecturers for the emergency medical assistance system. The drawbacks that were identified in the existing solutions are: not sufficient server systems to handle user requests, only the mobile device shows the way to medical care center and it is a very risky approach to handle patients; using outdated technologies like SMS to send the location of the hospital (its address) as a message; some systems are developed to handle only one type of emergencies like vehicle accidents; some systems are not completely developed and so on. Concluding the analysis section, the authors finally decided to design an emergency medical assistance system with the ability to alleviate all the above- mentioned drawbacks.

D. Approach

In the Emergency medical assistance system process, first the user should login to the Mobile application by providing user's name and phone number to the system. Then the mobile application will track the coordinates (longitude and latitude) of the location where the user is in (where the emergency occurs). Then that information: user name, user mobile number, date and time, coordinates and health related information of the tracked emergency will be sent to the web server which is in the health care centre or emergency service. After taking the information from the mobile application those details will be displayed on the emergency service web server. The location of the emergency will be displayed on a map according to the coordinates that were sent from the mobile application. Then the assigned people will be sent to those places to collect or treat the patients. The web application will send a notification to the user whether the information was sent successfully or not and will give a compliment for the sender for his service. Each information that the users send will be stored in SQL server database successfully. A continuous internet connection is required to carry out the functions of the application.

E. Technology Adopted

It is very important to use acceptable tools to develop a productive system. Use of any inappropriate tools can solely affect the developed system with unnecessary errors and faults and use of those erroneously chosen technologies additionally can cause the new system to be crashed on the implementation stage. Correctly chosen technologies will enable manufacturing a system with top quality. These technologies may result in developing a system that do not spend lots of time and resources to perform a task that is anticipated by the system. It is very important to use applicable programming language and the other necessary tools to develop a productive system. Further, these technologies and tools can help to develop the system within a minimum development time. The most important objective of developing this type of an application is to produce a more efficient working system, instead of using manual approach. Hence, we should use the most applicable tools available in the market to develop the system. Technological considerations followed during the development of the system are efficiency and performance, re-usability and flexibility, and object-oriented development support. So according to the Emergency Medical Assistance System, java,

android studio and MySQL server are used to develop the mobile application module. The mobile application server configuration is done by PHP and is hosted by xampp server. C# language and SQL Server 2014 are used to develop the database for this project. The web application is hosted on IIS server. This chapter includes the details about the technologies that we are going to use to develop Emergency Medical Assistance System.

F. Application server (web)

The programming language that is going to be applied as the main developing language for the system development will turn into significantly trusted accuracy and performance. When considering all the technologies that can be associated with the proposed system, it can be identified as a web-based technology.

The .NET Framework contains the common language runtime and the .NET Framework class library. This class library is a complete, object-oriented collection of reusable types that you can use to develop applications like traditional command-line or even graphical user interface (GUI) applications, to applications based on the latest innovations provided by ASP.NET (A child of a .Net frame work), such as Web Forms and XML Web services. It is a very powerful framework and a solid platform to develop web-applications.

The CLR is the implementation by Microsoft for the common language infrastructure (CLI). It helps to create execution and development environments in which languages, and libraries work together without any flaw. CLR provides other services such as automatic garbage collection, exception handling, and resource management.

Those concepts used to incorporate with the emergency medical assistance system for better functionality with web services is a key feature in this solution.

G. Mobile Application

Android gives you the freedom to put into effect your own device specifications and drivers. The hardware abstraction layer (Hal) presents a well-known approach for developing software hooks among the android platform stack and your hardware. The android working machine is likewise open source, so you can contribute

your own interfaces and improvements. Android is an open source, Linux-based software stack created for a wide array of devices and form factors.

GPS location fall detection using acetometer and using two web servers are novel concepts used to incorporate with the emergency medical assistance system for better functionality and it is the key feature in this solution. In android the developer can freely access those functionalities easily because of the open source license.

H. Database Selection

Consistent with the above eventualities most of the structures use the square database to keep facts because it is simple to control and perform. Therefore, the database that put in force on the server must be able to supply efficient operations. Consequently, the proposed emergency medical assistance system is using the Microsoft SQL server 2014 as server. SQL server is the inspiration of Microsoft's data base platform, delivering challenge critical performance with in-reminiscence technology and quicker insights on any information, whether on-premises or in the cloud, and Microsoft SQL Server is an application used to create computer databases for the Microsoft Windows family of server operating systems. Microsoft SQL Server provides an environment used to produce databases that can be accessed from workstations, the Internet, or other media too. Database management or DBMS, stores user's data and enables the information to be transformed into statistics. However, the mobile application login process will be handled by the MySQL database. It is a very light weighted database system that can call upon request from user. It is very easy to use with java and PHP languages that are used to develop mobile application, so it is a vital functionality for the system.

I. Software Design

Programming the Android Application: For the programming of the Android App, the Android Studio 2.1.1 is used. It is a well-recognized developing platform for android development.

Programming the Web Application: For the programming of the Web application, the Visual studio 2015 is used. It is the Microsoft recommended platform to develop web applications in windows. When it comes to development,
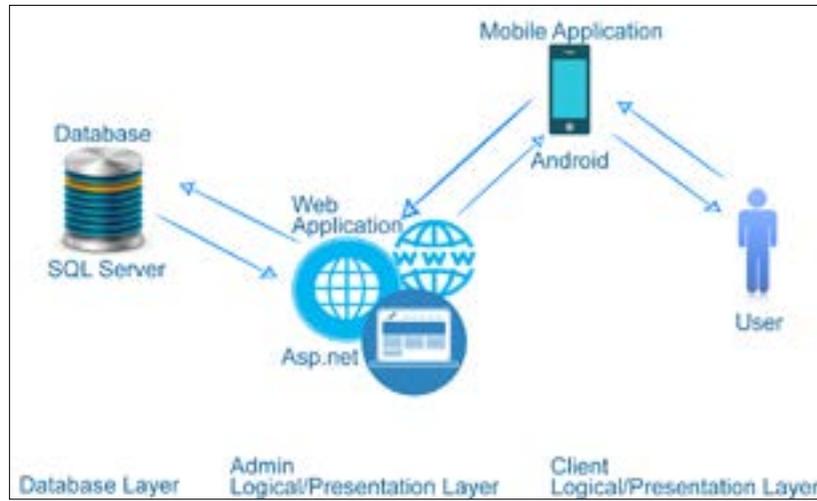
Figure 4. Overview of the proposed system

it is an unmarked territory to the developer, so the resource materials are vital for the visual studio. There is a good availability of resource materials.

To develop the mobile application, server side is developed by PHP scripting language; most of the coding is done using the sublime text editor because it is good in suggesting required words in required time.

IV. THE PROPOSED SYSTEM

Figure 4 shows the architecture of the proposed system. The system is based on a smartphone application that continuously detects whether there is an emergency, using the built-in accelerometer. In the case of an accident, the location is identified using the built-in Global Positioning System (GPS). The system then sends a message to emergency services and to the registered emergency contacts notifying them of the user's information, accident, and its location.

The system consists of two main components: an android

application and an application server. Each is described below.

A. Mobile Application

The mobile application, as shown in Figure 5, is with a built-in accelerometer and supporting smartphone

Figure 5. Screen shots of the mobile application.

location services like built-in GPS / GSM triangulation and fall detection. In the registration, the application allows a user to enter their personal information including name, ID, blood type, and phone numbers of individuals to inform in case of an accident. If an accident occurs, the application immediately sends an SMS to the guardian and emergency services, with user's information and geo-location. Before sending SMS, the application alerts the user about the fall-detected alert on smartphone screen. The application also gives the user an option to stop a false alarm.

B. Web Application

As shown in Figure 6, the admin web application is built using IIS, C#, and SQL server. The application server provides the following services.

* Real-time reporting of emergency with geolocation

* Various reports showing current emergency and their locations.

* Showing the patient information that is needed to treat him or her.

The login password is encrypted using the SHA-1 (Hash functions are intended to achieve a "one-way transformation" the original message cannot be recovered from the digest, at all.). There are two choices for the admin: either he or she can access the information that is sent by the user or he can directly access the map that has the exact locations of the patients; or the information sent by the user are displayed in a table. The last raw of the information table contains the location link. By clicking that, the admin can access the location of the user in the map.

Figure 6. Screen shots of the web-application application

The mobile web application is a web-based application without an interface-built. It functions using Apache, PHP, and MySQL server. The application server provides the following services.

* Real-time user registration.

* Saves the user information to the server.

* Retrieves information from the server when needed.

V. EXPERIMENTAL RESULTS

The fall detection was executed on each of the test cases to make a prediction about the actual state. The results are shown in the form of a confusion matrix in Table 1. The confusion matrix shows the comparison of predicted vs. actual results. For example, in Table 1,

out of 50 no-accident cases, 46 were predicted correctly by the application and only 4 cases were false positives. Furthermore, all 150-accident cases were predicted correctly as accident cases.

As the Table shows, the fall detection module was able to achieve an overall performance of (46+150)/100 = 98% accuracy in distinguishing between a no emergency and an emergency state.

Table 1. Confusion Matrix for System Testing

Predict \ Actual	No emergency	emergency
No emergency	46	0
emergency	4	150

VI. EVALUATION

Summative evaluation was used as the evaluation method to find how the system functions and whether it is up to the expected level to fulfil the users' requirements.

The intended target group of the emergency medical assistance was not employed for testing purposes as a safety measure, since the objective of this project is to design and construct a prototype emergency medical assistance. Therefore, its functionality was tested with the help of colleagues who supported in the testing and evaluation by giving their opinions after using the emergency medical assistance, module by module.

Several colleagues were given mobile phones with the installed mobile application and they were connected to a same Wi-Fi router so the distance from one user to another is low. When the user initiated the application, it worked very accurately and faster than expected. Sometimes the users sent requests at the same time and it worked fine even on that. Some coordinates of other countries were given for test purpose. Even in global scale, the system worked fine. According to the colleagues who used the system, they were very satisfied with it.

As this system focused on designing and constructing a prototype of emergency medical assistance, comparatively cheap Wi-Fi router was used with a fixed IP address. When

implementing the actual medical assistance system, it is recommended to use public IP with a higher accuracy to minimize errors in sending messages to the correct server.

VII. CONCLUSION

The author's ambition was to develop a cost-effective emergency medical assistance system for public. The developer implemented this system to determine its ability to satisfy the entire functional and non-functional requirements with special qualities such as flexibility, reliability and efficiency. Another aim was to overcome the drawbacks identified in the existing systems and new system.

There is a mobile application and a web-enabled system, so this mobile application offers the user to install the application and enter data. In the Web-application, admin monitoring records are sent earlier. Data storage and retrieval will become faster and easier to maintain because data is stored in a systematic manner and in a database. Decision making process would be greatly enhanced because of faster processing of information since data collection from information available on computer takes much less time than a manual system. The system designed and constructed in this project employing state of the art technology is at a reasonable low cost, enhancing that the functions the emergency assistance system already provides for the user can be done by using new advancements in technology. This approach makes it possible to overcome the shortcomings of the legacy systems developed before.

Even though the approach seems promising, it needs to be tested in the field using real time simulation and detection systems. One key advantage of this approach is that it only requires the user to download and run the application on their smartphones without any extra equipment or cost. This system can be used anywhere without the need for expensive systems.

Integrating Google Maps directly into the desktop application will make the navigation part even easier than it is in the current systems. Development of cloud computing can be used to do the processing on the cloud and instantly gives the feedback to the user. This will alleviate the problem of having to do a massive amount of processing in the phone. New features can be added based on IoT and Internet of Everything.

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