MOBILE COMPREHENSIVE EMERGENCY SYSTEM USING MOBILE WEB SERVICES

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ABSTRACT

This paper is an application of Mobile Web Services into the health sector and specifically to the emergency system where the communication between a number of parties is critical in terms of time, efficiency and errors. The proposed application is to implement a mobile system based on cellular phone network in ambulances and to equip doctors with mobile devices that have the capability to be connected to the Internet network with a bandwidth that makes it feasible for the doctor and the ambulance to access the health record of a patient from the database and to communicate with hospitals with enough speed. This paper will show the new proposed Mobile Comprehensive Emergency System (MCES) application that is based on Web services provided by static and mobile servers. The implementation of this new system will enhance the current system communication and makes it more reliable, consistent, and quick and free of human errors as the system will take over from the humans.

Keywords: Mobile web services, ambulance, hospital, Mobile application, mobile devices

1. INTRODUCTION

Most of the existing communication systems set to communicate between ambulances and hospitals rely on radio communications. Some new systems include a Computer System as tool to help in the management of communications like the Aided Computer Dispatch (CAD) that implemented in 1995 in Victoria – Australia. This system was enhanced with a Medical Priority Consultant's Advanced Medical Priority Dispatch. The computer version of the new assistance was introduced in April 1998. The Victorian system considered as one of the best emergency system in the world in providing clinical information about the patient to the hospital and recommending some cares from the hospital to the ambulance. The system is also backed by an automatic vehicle location system to locate the ambulances [1]. Another advanced system called Hospital & Emergency Ambulance Link (HEAL) that is implemented in Singapore. HEAL system is based on wireless data communication between ambulances and hospitals and it assists hospitals and doctors at the emergency departments of the hospitals with information about patients provided by ambulances. HEAL also assists ambulances with medication recommendations from Doctors. This system has been built on the public wireless network and is based on Server client architecture [2].

The proposed new system is more comprehensive than any existing emergency systems in terms of the number of parties involved, and it is more advanced in terms of technology proposed. The new system is also intelligent when it comes to find the right ambulance, hospital and doctor that are suitable for the conditions and location of the accident. The main advantage and strength of the new system comes from the Mobile Web Services technology that would be used in the system [3]. This technology can overcomes any problems of interoperability between systems running different applications based on different programming languages on different platforms [4]. More details of the new system will be found in next sections of this paper.
2. APPLICATION OF MOBILE WEB SERVICES TO A COMPREHENSIVE EMERGENCY SYSTEM

In this section, the new system business process will be explained in details followed by the technical details about the new technology applied.

2.1 Case Study

In case of a car accident for instance, and when we dial 000 (in Australia) for emergency and we ask for ambulance, the current operator (human) that is a phone-based system tries to find the nearest available ambulance to be sent to the accident location. After picking up the patient, the ambulance officer heads for the nearest and suitable available hospital.

In this paper, the proposed system is a comprehensive emergency system based on Mobile Web Services. As shown in Figure 1, when there is a car accident, any nearby mobile holder can enter information about the accident such as how many cars involved, how many injured people, and how far the caller is from the accident. The mobile phone (First Informer) will send this information to an operator, which is a Web Services centre. The operator will access the situation based on the incoming information from the First Informer Mobile Phone (FIMP).

**Figure 1:** Comprehensive emergency system

Let us imagine the following scenario in which police, fire brigade and ambulance are needed. The Web services based operator (Emergency operator/WS) will look through its service directory which is timely updated based on the mobile system locator to find the nearest available
police car, the nearest available Fire brigade, and the nearest available ambulance. The operator will send electronic emergency requests to the selected police car, fire brigade and the ambulance and request confirmation from their systems. The systems of the police car, fire brigade and ambulance can be based on mobile or wireless system. To simplify the case study, only the communication with the ambulance will be explained. This communication scenario is applicable to the police and fire vehicles.

After personal intervention from the ambulance officer, the system can send confirmation that the ambulance is heading for the accident location. The operator (a proxy server that processes services from providers and send back to the client application) will calculates the distance and the time needed for the ambulance to reach the accident place and this information can be transferred to the FIMP through the operator. In case of unavailability for unknown reasons, the operator can look down into the list at the second available ambulance. The same scenario is applicable to the police car and the fire brigade. Once the ambulance has reached the accident and its officers assisted the patient or the injured, they will input into their mobile system the patient’s conditions. This information will be electronically sent to a Hospital Operator (web services server), which instructs the ambulance to go to the suitable hospital (nearest hospital, specialised in the patient injuries with available beds and doctors) and passes on the patient heath conditions to that hospital. At the same time, doctors and nurses at the emergency department of the selected hospital would prepare for the coming patient and they would know from the system the expected time to arrive. The hospital system and the ambulance can access also the patient health record to be passed to doctors. If there are no doctors available within the hospital to treat the coming patient, the hospital will search the operator for the right doctors outside the hospital through their mobile systems and the doctor can receive information about the patient from the ambulance and then recommends to the ambulance officers some medications to be given to the patient before reaching the hospital after accessing the patient health record on his/her PDA. The doctor can also discuss with others doctors the case of the patient. The emergency department will be informed about the time the doctor can reach the hospital at. The ambulance system and the patient health record also will assist automatically the officers in giving the right medications and avoid some allergic problems or history diseases [5].

3. SERVICE CONSUMERS AND PROVIDERS

In Figure 1, both operators play the role of Web services registerer, where the service provider and the service consumer are registered and authorised to use the system. The accident mobile or the FIMP is a service consumer that uses the unique available service to report the accident; it can also request a response when FIMP is part of the accident. FIMP is a service provider also, as it provides the Emergency Operator with its location automatically. The selected hospital will be a service provider when it provides its location to the emergency operator. The selected ambulance will use also a client application to consume services provided to the hospital operator by hospitals to determine the right hospital. The ambulance mobile system provides services to hospital and doctor when it transfers information about the patient’s conditions. The selected hospital system provides services about its availability to the ambulance. The doctor system has a mobile client application to consume services provided by the national health records system and hospitals.

The nature of this system is distributed system; this is one of the reasons, mobile web services have been chosen to be implemented. On the other hand, Web services have many advantages over previous technologies such CORBA and COM+ in distributed systems or interactions between different systems using different platforms or different programming languages. The communications between systems that are based on web services use Simple Object Access Protocol (SOAP) as a communication protocol. SOAP is an eXtensible Markup Language (XML) Document, carried by HTTP. That makes web services very flexible and practicals technologies [4].
4. BENEFITS OF THE PROPOSED SYSTEM

The followings are the advantages the new comprehensive emergency system can have over the current existing emergency systems;

The new system:

- Represents an application of a new technology (Mobile Web Services)
- Presents a complete computerised system based on MWS
- Is completely based on the new wireless cellular network (It should use at least 3G or 4G [6]
- Is based on intelligent system in terms of deciding on selecting the ambulances, Hospitals and doctors.

5. AVAILABLE TECHNIQUES

Currently, a few tools are available to build mobile applications on mobile devices to consume Mobile Web services. The most popular available tool is the Microsoft Mobile Internet Toolkit that is an additional part of Microsoft Visual Studio.NET. Other tools like Java or IBM are also available [6].

6. THE MICROSOFT MOBILE INTERNET TOOLKIT

Microsoft, using .NET framework and Visual Studio .NET, makes it simple to build Web Services and develop mobile client applications to consume them. In order to be able to develop a mobile application that can consume WS, a free package called “Microsoft Mobile Internet Toolkit” needs to be download and installed from Microsoft.com. Figure 2 shows the start page of the Visual Studio .NET where you can create a new project, select the language you want to use and the appropriate template.

![Image](figure2.png)

**Figure 2:** The new mobile web application project from Visual studio .NET
Figure 2 shows that C# has been selected as a programming language and Mobile Web Application has been selected as a template to build a mobile web application.

Figure 3 shows a simple mobile application built to report an accident. It includes two selection lists controls to select the number of vehicles involved and the number of injuries and whether or not you are involved in the accident.

Figure 3: Building a mobile web application to report an accident from your mobile device

It is shown in Figure 3 a mobile phone emulator on which the application is displayed as it would be implemented into real mobile devices.

A proposed FIMP mobile Application appears in an emulator as shown in Figure 4. The application was built to suit a mobile phone, PDA or any other mobile devices, as it is simple, small and easy to access and there is no need to enter any data, the user needs only to select the available data.

Figure 4 demonstrates that FIMP indicates that there are 3 vehicles involved and there are 2 injuries as a result of the accident. FIMP has also selected the option as it is involved in the accident, this way FIMP will receive a report back from the operator about the estimated time the ambulance needs to reach the accident location.
Once the operator has received the message about the accident, and found the right ambulance and police car, it will report back to FIMP, if it is involved in the accident. Figure 5 shows the report and the estimated time needed for the ambulance and the police to be there on the accident scene. It shows the ambulance will reach the accident location at 10:32 and the police at 10:35. It should be noted that there is no need for Fire brigade to be dispatched, and this is estimated automatically by the system.

Figure 4: Mobile device emulator of FIMP

Figure 5: The received results from the Emergency Operator at FIMP
It should be noted that .NET framework doesn’t provide tools to build services to be provided on mobile devices. This issue is outside the scope of this paper. Anyway, there is a new proposed system for that purpose available in the literature.

CONCLUSION

This paper, proposes a complete and comprehensive emergency and medical assistance system based on web services and mobile web services. In this system, mobile devices have been used to support mobile services, as service providers and mobile client applications capable of consuming web services and mobile web services. The implementation of this system will reduce dramatically the price and the time of current communication systems between all parties, mentioned above and the most important benefit is the automatic search carried out for the right and available service at a reduced time. The accuracy is also one of the great benefits the system can offer. What we haven’t looked at closely is the security of the system and particularly the authorization to access the public health records. The basic security the system will adopt is the implemented authentication in the mobile device by Subscriber Identity Module (SIM) card used in GSM system. More security measures for the whole system will be further investigated.

REFERENCES


