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DEVELOPING A WAP-BASED APPLICATION FOR EMERGENCY SERVICE SYSTEM

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Abstract: Wireless Application Protocol (WAP) is one of the most well-known technical standards for mobile devices. In this paper, a WAP based prototype is developed for the Emergency Service of Acibadem Hospital in Istanbul. Electronic health records (EHRs) can be provided by Tablet PCs or workstations. But, cellular phones are compact enough to provide EHRs with WAP service. This paper includes main concepts of the analysis and design methodology of the WAP enabled emergency service system. WAP protocol is studied to investigate querying EHRs in emergency service. Benefits and shortcomings of the WAP based application are concluded.

Key-words: WAP, Electronic Health Records, Mobile Healthcare Information Systems, Patient monitoring

1. Introduction

Wireless application protocol(WAP) is exposed by WAP Forum in 1997 which is originally founded by Nokia, Ericsson, Motorola and Unwired Planet [1,2].

There are some common applications of wireless application protocol in e-shopping, e-banking, games and e-mail [6]. Also there are many projects studied by different groups that demonstrate mobile healthcare systems which can be used by cellular phones and the Internet.

Wireless application protocol (WAP) has an important role for the mobile communication devices. WAP is also going to be a common feature found in future mobile communication devices, so it is worth to research its use in mobile healthcare systems.

In this study, for the prototype developed for the emergency service of Acibadem Hospital, the telecommunication technology is used to display medical treatment, diagnosis and patient care. In this system, the data related with the patient are reachable at the remote terminal instantly after acquirement or the same data can be accessed at a later time [3].It is a healthcare record management that is supported by computer networks and wireless communications.

Development of advanced healthcare systems that conform to basic standards, security and integrating of mobile devices to medical information systems, no doubt, has an important role in providing modern and faultless health service. So, hospital authorities tend to adopt solutions that support mobile data input for increasing the data quality and accessibility.

In addition to instant access, mobile devices are also significant for their ability to integrate with decision support systems [9]. For efficient use of mobile devices, the screen features should be considered during application interface design where human factors engineering methods that are used in usability engineering can be employed.

In recent past, many similar researches are studied by different groups. In 1996, an application is developed which has a connection between PC and a GSM modem to transfer image files of replicated wounds over the system as email attachments [4].

Additionally in 1998, computerized tomography system is experienced by using the wireless connection over a computer network [8]. Similar studies are performed by using personal digital assistants (PDAs).The related studies of Istepanian et al. in 1998 and Hung et al., 2003 are completed over the wireless technology in the parallel of mobile healthcare systems [6, 10].

The fact that the mobile devices are focused in this situation is to provide faster input and querying of data as described in some studies in [14, 15].

Information system specialists are facing difficulties in convincing medical doctors to use mobile devices instead of desktop computers. Authorities should develop strategies to simplify the integration phase of mobile devices to existing medical information systems. Applications developed for these mobile devices should use special interfaces designed using object oriented methods, which will produce a usable, efficient, and user-friendly interfaces for wireless application protocol devices when user oriented processes are used to implemented [16].

The most important advantages of using a WAP based system are low cost and mobility [9]. There is no need to use a computer to complete the required tasks. The only need is a cellular phone with a wireless application protocol support. On the other hand, if a comparison is done between computer and phone for wireless protocol, using a computer would be more powerful because of the memory capacity and resources view.

In this study, a WAP based healthcare system developed to monitor conditions of the patients. In this system, there are two distinct authorized roles; nurses and physicians to view the physical conditions of any patient like heart conditions, observations and etc. by WAP devices.

Basically, this paper includes the implementation and usage of a WAP-based application for emergency service system. In section 2, the system specification, system structure and user task analysis issues are considered. In section 3, the test results and observations about the system are detailed. Finally, the discussions and further recommendations are written in section 4.

2. Methods

2.1. System Specification

Wireless application protocol (WAP) is a global standard which is developed for wireless devices to reach the Internet, phone services and data from associate intranets through public or private IP networks. It is based on existing protocols and standards such as XML, HTML, HTTP and JavaScript. There are some vital components of WAP which includes the transport model that is analogous to the internet model; WML (wireless markup language); browser to parse WML and WMLScript; finally a framework to support advanced phone services [5].

Wireless markup language (WML) was designed to describe content and format for presenting data on limited-bandwidth devices such as cellular phones. It is based on the extensible markup language (XML) to provide a tool to make web pages reachable from wireless devices. WML is telecommunication awareness and allows users to switch between making calls and getting Internet information without any difficulty.

WAP and WML together form an open architecture for mobile Web services [12]. Both are used to provide services which are based on markup languages reached by different mobile devices equipped with WAP browsers.

A typical WAP network consists of three components which are these devices compatible with WAP, WAP gateway and the WAP application server.

The working principle of these components with each other is following the procedure of sending request from the user to the application server. Then the request is received by application server firstly, and translates to HTTP and heads the request to the destination server. The application server returns the output taken by WML and inserts HTTP headers to the gateway. Before returning the response to the WAP user, WML and HTTP are converted to binary form by the gateway. Finally, the WML is resolved by the browser of the device and displays the requested contents [11].

Mobile devices are classified into three categories according to the display sizes that are valued from 48 x 48 pixels to full VGA and input methods. The categories are named as smart phones, communicators and feature phone [13]. For the communicators, the input method is standard keyboards. On the other hand, a keypad is suggested to be implemented for a smart phone [11]. The first WAP devices are appeared on the markets in 1999 designed by Nokia and Ericsson.

Advantages and effectiveness of the WAP devices should have benefited in the emergency service system for a mobile purpose.

But this kind of devices has limited processing power, battery life, memory,

display size and resolution, low bandwidth, delay between requests and responses [7].

2.2. System Structure

Data quality is crucial in medical information systems. Accurate data gathering techniques is so important for an emergency service of any hospital.

Continuity of medical information systems mostly depends on correct and reliable storage of medical information extracted from hospital processes.

Healthcare information systems that support high quality EHRs should be considered as a part of hospital information systems. Usable user interfaces provides more reliable data which is used to improve quality of electronic health records [8].

In the field of medical informatics, issues of usability have become to the fore, with the ultimate acceptance and rejection of systems such as computerized patient records depending to a large extent on their degree of usability. It is also mentioned to cope with the challenge of designing systems that provide desired functionality, and that are easy to learn and use, a variety of techniques from the study of human-computer interaction have emerged and become key in the general software industry [9].

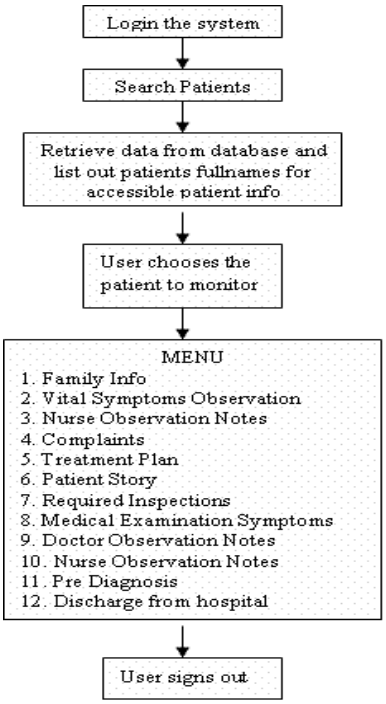

Fig.1. Flow for patient information menu

The application used in this study is the mobile version of the automation system developed for Emergency Service of Acibadem Hospital in Istanbul which is compatible with any kind of PDA and WAP based cellular phones. By this system, authorized users such as physicians, nurses and hospital managers can log in the system and complete the predefined tasks.

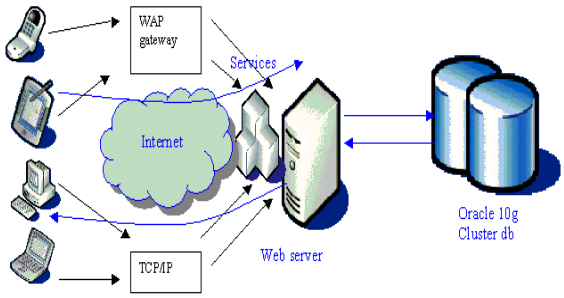

Fig. 2. Structure of the system

In login interface, the user can be active in the system by entering needed username and password. The prototype is developed by using the mobile application technologies of Microsoft .NET and the relational database model is developed in ORACLE.

The success of the system is coming from the effective user-interfaces and the fast wireless connection. Usability, motivation and acceptance tests are completed over the end-users.

In the technical background of the system, .NET mobile and mobile control libraries are used intensively to increase the system performance at maximum level by completing the optimization of data transmission sizes between the system and the database. In Figure 3, the log-in screen of the mobile application can be seen in design stage.

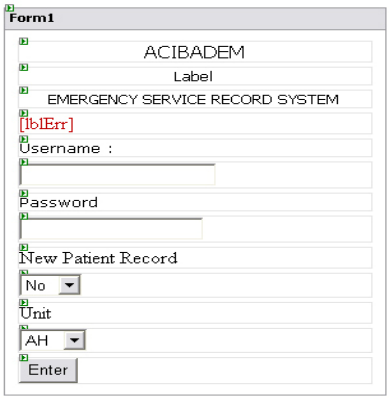

Fig. 3. The log-in screen of the application (in design stage)

2.3. User and Task Analysis

In an emergency service of any hospital, there are two main roles, nurses and physicians to monitor the conditions of any patients from mobile emergency information system. After the registration, each patient have an identification number or protocol number.

Although in the previous version of this system which is developed as a web application, entering new data by the nurses is available. In this WAP version, all authorized users are just activated to monitor the conditions of patients.

For both versions, the menu systems are designed according to the printed emergency service forms. Also the menu structures are similar with each other. The task sequence of the physicians for the system is given in Table1.

Table 1. Physicians' Task Sequence

Task code	Task detail
Td1	Complaint
Td2	Patient story
Td3	Family History
Td4	Medical examination sym.
Td5	Doctor observation notes
Td6	Pre-diagnosis
Td7	Treatment plan
Td8	Required inspections
Td9	Requests and applications
T10	Vital symptom observations
T11	Observations of nurse
T12	Discharged from hospital

On the other hand, for the physicians, in this prototype the mostly used task sequence is S={Td1, Td2, Td3, Td4, Td5, Td6, Td7, Td8, Td9, Td10, Td11,Td12}. Each S task sequence starts from Td1 for the physicians to monitor the searched patient, then the system automatically passes to the next task. Also the other roles, nurses and managers have similar task sequences as given.

3. Test Results

The application is tested with an actual WAP supported phone by different users which can be a nurse or a physician to control and get the conditions of any selected patient. The abilities of wireless application server provide a full control over the application with effective interfaces. To understand the operating principle of the system, a scenario for a physician is sampled as a process.

In the first step, as it is stated in the previous section of the paper, a login screen is displayed for a doctor. It is given in Figure 4 below.

Fig. 4. Login Screen

After entering the required data for username and password field, the inputs must be matched with the rows in the database which keeps the records of user's information.

In the next interface, the search of the needed patient can be done and the results will be shown as a list in alphabetic order. From the list that is taken as an output, any patient can be selected by the active physician in the system to get all related information. It can be seen in Figure 5 and Figure 6.

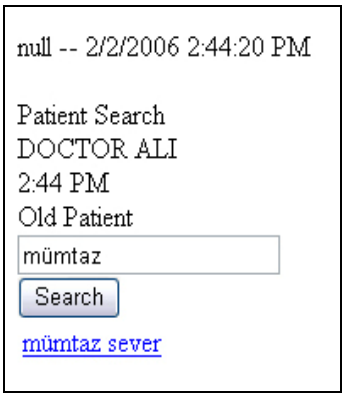

Fig. 5. Search module of the application

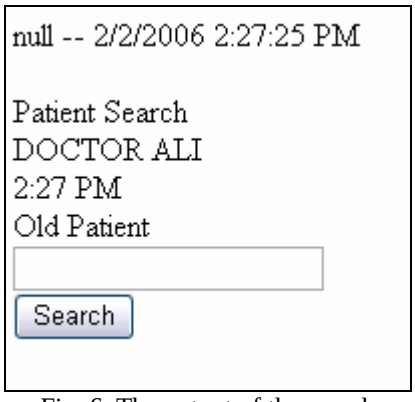

Fig. 6. The output of the search

The information about the any patient includes patient history, required inspections, observation notes, complaints, family history, vital symptoms, treatment plan, medical examination symptoms, pre diagnosis and discharge from hospital. The interface that a user can access any of the data about a specific patient after search menu is given in Figure 7 and Figure 8. This screen below provides a menu to reach all predefined data about selected patient by the user.

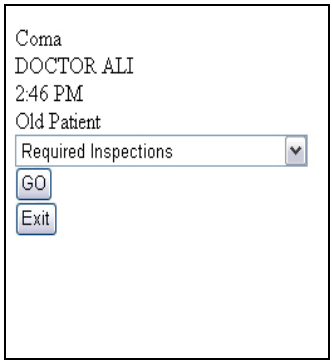

Fig. 7. Main Menu

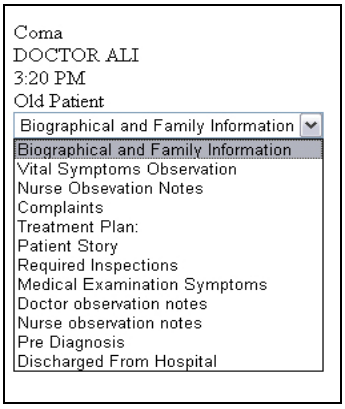

Fig. 8. Main menu of the application about a specific patient

Any fault at the data entry or display of the information which is not compatible with WAP version are taken into system logs and stored. The error messages are notified to the system administrator with the reference numbers because of the application is in development stage. Figure 9 shows such a scenario like that.

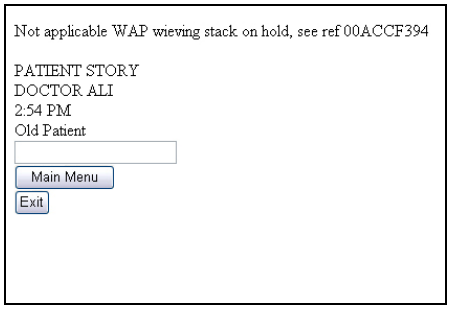

Fig.9 Error message

The observations done by the physicians and nurses in past can be displayed for a specific date and hour with the inspection consequences. The screen about it is given in Figure 10.

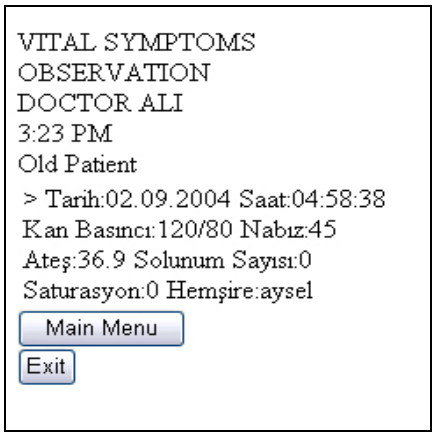

Fig.10. Observation done by physician

4. Conclusion

In this study, the wireless application protocol based mobile healthcare system is developed for monitoring the patients one by one in detail and tested. The predefined data about any specific patient were successfully searched, retrieved and displayed on a WAP supported phone.

As it can be clearly understood, the long response time can be counted as the main disadvantage of the system but in the newer versions of the application developed for third generation mobile phones would provide more resources like high rate of data. Also security is another important point for a system like

that. There are many levels available yet Wireless Transport Layer Security (WTLS) protocol is implemented mostly by WAP which is just connected between the phone and wireless application protocol gateway. A private gateway is implemented to make the system more secure. As a result, WAP is a considerable technology that obtains connection between the mobile world and the Internet. In future, the usability analysis of this WAP based application will be completed from the view of different methodologies.

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