mHealth: Blood Donation Application using Android Smartphone

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Abstract— **mHealth is new horizons for health that offers healthcare services by utilizing the mobile devices and communication technologies. In health care services, blood donation is a complex process and consumes time to find some donor who has the compatibility of blood group with the patient. We developed android based blood donation application as mHealth solutions to establish a connection between the requester and donor at anytime and anywhere. The objective of this application is to provide the information about the requested blood and number of available donors around those localities. It assists the requester to broadcast the message across the maintained volunteer blood donor network by our application and update the requester at the same time who is willing to donate the requested blood. To evaluate our application, we created requester-donor profiles and analysed that it will help to improve the timely access of the information and rapid response in emergency situation.**

Keywords— **Blood donation, mHealth, Smartphone**

I. INTRODUCTION

mHealth is the branch of eHealth that utilize mobile phones, information, and communication technology for the delivery of health services. It enables individuals to monitor their health status, send healthcare data to the doctors, reduce the costs, and bringing potential advances through data sharing. The applications includes appointment reminders, community mobilization and health promotion, mobile telemedicine, public health emergencies, patient monitoring and many more [1]

In both developed and developing countries, numbers of smartphone users are increasing day by day. For example: there are more than 29 million smart phones owned by Turkish and estimated to reach more than 35 million by 2019 [2]. Smartphone runs a complete operating system and provides a platform for application developers and users. Google Android is one of the most competitive markets due to its open source platform. Hundreds of applications have been developed ranging from the interactive games to healthcare domain. Especially the medical domain applications enable the users to interact with the system to provide real time user assistance and help to improve the human life's style [3] [4].

Blood transfusion is an essential component of health care. It contributes to saving millions of lives each year in both routine and emergency situations. Furthermore, it dramatically improves the life expectancy and quality of life of patients with a variety of acute and chronic conditions [1]. Blood transfusion services are based on voluntary blood donation. During the next 5-10 years, availability of the blood will be essential to meet the demands of ageing populations [5]. Similarly, in case of operation or treatment, hospital workers asked the patient's relatives for the blood donation or relatives need to find some donor who has the compatibility of blood group with the patient. This emergency situation raises many challenges to find the donors.

New approaches are required to meet the demand of the society. We developed android based blood donation application that keep the record of volunteer blood donors. In case of emergency situation, application can broadcast the message along the blood group and hospital information to all the registered donors for donation. We utilized the cloud computing service for keeping the application data available anywhere and anytime. The superior feature of our application is to use it as a volunteer blood donor as well requester. Requester can broadcast the message along urgency sign of required blood to the registered users and notification message will send to all the volunteer blood donors. Once a volunteer blood donor will confirm the blood donation then it will be marked as donor found in the receipt list. Our application may help to provide timely access to the blood donors and requester to handle the emergency situation. This paper present details of development and prototype of proposed architecture.

We structure our paper as follows: Section II outlines relevant research projects of mHealth and the ability of smartphone to develop different kind of health care applications. In section III, we present architecture for blood donation application and identify a number of requirements the system should fulfil. Section IV describes the implementation details and application interfaces. Finally conclusions are reported in Section V.

II. RELATED WORK

A large number of mHealth solutions have been developed for the provision of healthcare. In this series, Chen *et al.* [4] presented patient monitoring use case of mHealth to highlight

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the new requirements in terms of data access control, location awareness, prioritization and mobility levels while developing the mHealth solution. Kirtava *et al.* [6] presented mHealth solution for cardiac patients. They reported feasible methodology to monitor cardiac arrhythmia in outpatients in Georgia, promoting earlier discharge of nonlife-threatening cases, improving patients' comfort of life and increasing their mobility with enhanced safety. Similarly, Karagiannaki *et al.* [7] presented the conceptual design and prototype development of mMamee, a mHealth platform for monitoring and assessing the environmental exposures of women in maternity. The core objective is to provide a way to the physicians for monitoring and alert services for the benefits of the patient.

Rahman et al. [8] presented location-aware mobile phone based blood donor recruitment, information retrieval and management system that aims to ensuring the quality of the blood and increasing the efficiency of operation management. Similarly, Islam et al. [9] developed blood donation service. Their solution is SMS-based to query for a blood group. The server matches the blood type and location with the profiles of registered donors, retrieves the information and sends it to the client along mobile number of the registered donors. Their solution is one-way communication and user needs to reach these donors by making phone call. Our solution is ubiquitous and donor will receive information alert about the requested blood and if he/she is willing to donate the blood at the moment then response immediately. Furthermore, once request is fulfilled our service will update the status of the requested blood to be completed. The details of our mHealth solution is given below.

III. The Proposed Approach

We investigate the requirements in terms of communication, storage, processing and smart phone development platform to make it an acceptable solution. The proposed architecture of blood donation application is illustrated in Figure 1. It is divided into three sub-components volunteer blood donors, cloud computing and blood requester.

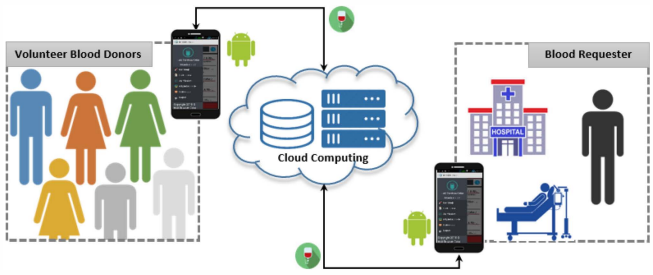

Figure 1. The Proposed Architecture

A. Volunteer Blood Donors

In the proposed architecture, voluntary blood donor is viewed as an intelligent agent that receive the information alert about the requested blood through a smartphone application as shown in Figure 1. Initially, each donor registered him/herself with our developed mHealth platform. Once they become valid donors, they are able to receive the information about the required blood type, hospital information, requester contact details and urgency of blood. We highlight the urgency of blood in our application with red, yellow and green color by giving the priorities as high, normal and low respectively. Donors will be able to realize the emergency situation and will be encouraged to donate blood eagerly. Furthermore, to make the information available about the donors under the low cost and high availability, we take the advantage of cloud computing paradigm.

B. Cloud Computing Infrastructure

Cloud computing is one of the potential and powerful solution to provide dynamically scalable and virtualized resources as a service with pay-as-you-go manner [10]. By pooling the various life care IT resources into clouds, mHealth solutions can reduce the cost and increase utilization as the resources are delivered only, when they are required. For instance: Amazon S3, Microsoft Windows Azure, OpenStack and Rackspace are the few names. We utilized cloud computing as Infrastructure as a Service (IaaS) to provide processing power and storage space for our proposed blood donation application. Each user's information is stored and retrieved when it required to broadcast the blood donation message to all the volunteer donors. Web services are the communication bridges between the donor and requester via cloud server. The identification of the roles is based on user IDs registration for distinguishing the users and corresponding response. Web services contains register user, authenticate user, broadcast alert messages, and update response functions which are called by our smartphone application to make the timely access of the information.

C. Blood Requester

A blood requester/recipient as shown in Figure 1 require to register with our proposed mHealth application by specifying required blood group, hospital and type of urgency. The cloud server is responsible to broadcast the information to all the registered voluntary blood donors. We defined two way communication scenario in our proposed system. Firstly, recipient request the blood donation along urgency status either high, normal or low. Any available volunteer blood donor can response the requested blood and requester will get the notification message about the available volunteer donor. Secondly, mHealth application will update the blood request status as complete for all other registered users.

IV. Implementation

We developed the mHealth blood donation application in open source development tool android studio [11]. Our application has two modes (i.e., donor and requester) to interact with the proposed mHealth application. In voluntary donor mode, system will ask necessary information about the name, surname, user name, password, city, age and blood group (i.e., Figure 3(a)). In case of requester mode, application ask patient

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name, age, blood type, urgency of blood, hospital name, and contact information and optional small note as shown in Figure 3(f). It can be seen from Figure 2, our system starts from user registration and then classify the users as blood donors or requester. Blood requester can broadcast the blood request and donor will access this request anywhere anytime through cloud server. Volunteer donor will response to the request and requester will be notified about it.

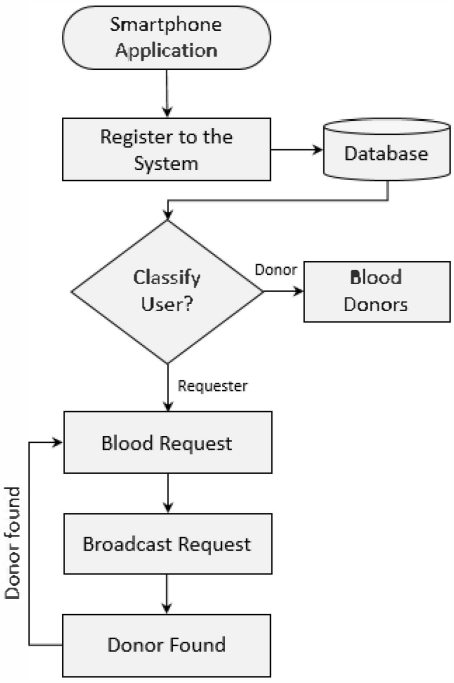
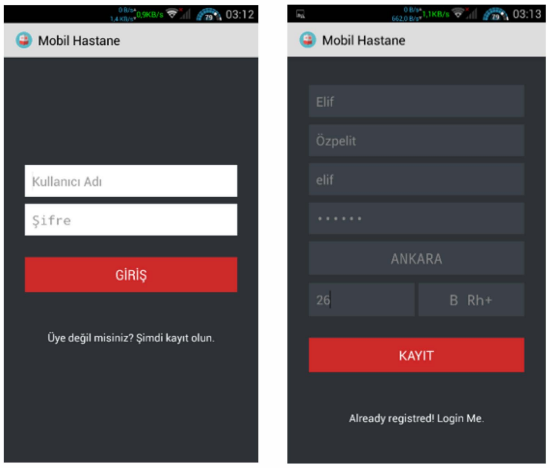
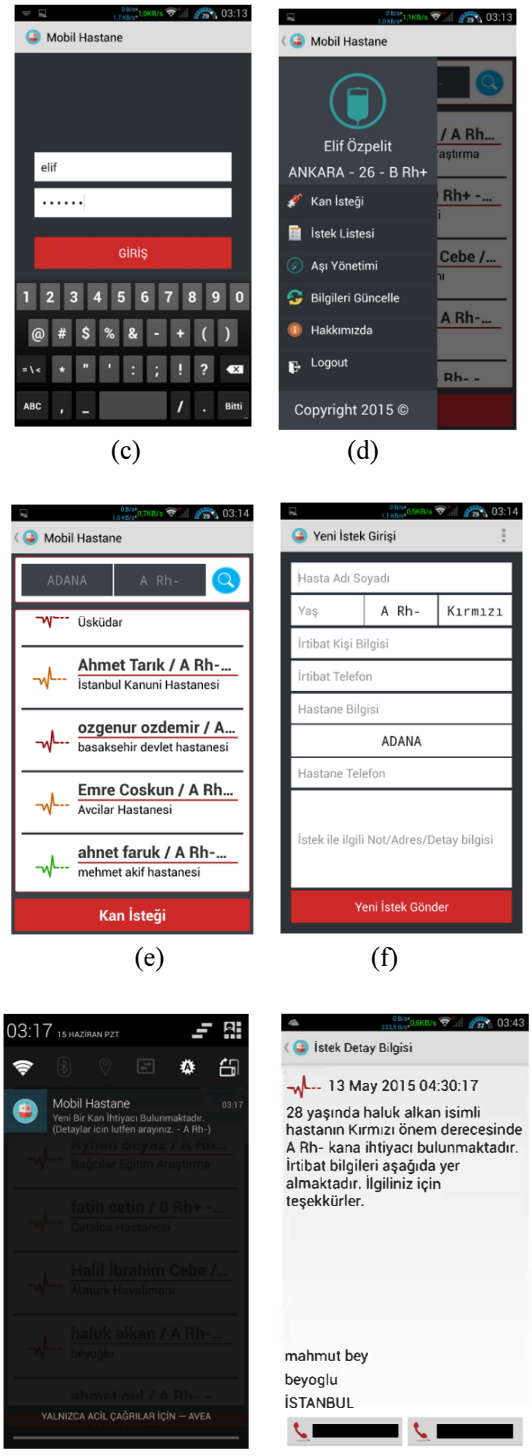


Figure 2 Flow chart of application information flow

The proposed architecture (presented in Figure 1) adopts the design principle of human computer interaction to design user friendly interfaces. Figure 3 presents screenshots of the mHealth blood donation application.



(a) (b)



(c) (d)

(e) (f)

(g) (h)

Figure 3 User interface for blood donation application

Where, figure 3(a) presents the login activity to enter the application by providing the credentials. In case of new user, he/she can sign in by providing the information about the name, surname, user name, password, city, age and blood group as shown in Figure 3(b). Once user will register to blood donation application he/she can see the panel as shown

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in Figure 3(d) and existing requested blood as shown in Figure 3(e). User can ask for blood donation by filling the application form shown in Figure 3(f). Once user will request for the blood an alert message will be deliver to all the register volunteer donors and shown in Figure 3(g) and details in Figure 3(h) respectively. In order to evaluate our system, we create the requester and donors profiles. In the system, "Elif Özpelit" is one of the donor profile along all required information and shown in Figure 3(a). She can access the requester information about the blood and also make search about the specific city or blood group. A requester "Mahmut" made a blood request about blood group "A-" and asking for donation with short note message shown in Figure 3(h). Once he made a request all the register donors get the alert about this broadcasted information. We showed that the system is applicable in the real-life scenario to make sure timely access of the blood donation.

V. CONCLUSION

mHealth is one of the best possible concept for the provision of healthcare services and improve quality of life. This paper presented the conceptual design and prototype development of mHealth application for blood donation. We investigate the requirements in terms of communication, storage, processing and smart phone development platform to make it an acceptable solution. We believe that our application is ubiquitous solution and may provide timely access to the blood donors and requester to handle the emergency situation. In the future work, we have plan to add vaccination calendar and public service messages to our application. We also have plan to enhance the functionality of the application by removing a valid donor from the information alert list for 89 days after receiving information about last donation date.

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