Mobile Learning System with Mobility Applied in Medical Sciences

Dusan Tatic and Dragan Jankovic
Faculty of Electronic Engineering
Aleksandra Medvedeva 14, 18000 Niš
Serbia
{dule_tatic@yahoo.com} {dragan.jankovic@elfak.ni.ac.rs}

ABSTRACT: *For effective learning, educational administrators use many multimedia systems. This work provided a multimedia system for patient education implemented on mobile devices. The design we have developed permitted the application of different programs for patient's education in different healthcare institutions. We have achieved the standard system which is obtained by including a Content management subsystem which allows an easy change of content was created for the intended applications which make. The mobility that the work provides the opportunity to the patients to consult the content at any time and any place. We have applied the mobile system to various applications in medical sciences.*

Keywords: Mobile Health (mHealth), Medical Informatics, Education, Multimedia, Content Management

Received: 22 August 2021, Revised 30 October 2021, Accepted 14 November 2021

DOI: 10.6025/jet/2022/13/1/17-23

1. Introduction

It is recognized that an adequate education of patients greatly contributes to the successful treatment. The insufficient number of health professionals in healthcare institutions in Serbia, which are constantly overloaded with the number of patients they have to deal with, does not allow to paid due attention and time to education of patients.

Information technology could have a significant impact on improving patient education programs. Different systems have been developed for this purpose [1]. Many such systems are designed based on touch screen technology implemented as information kiosks [2], as well as systems that are used on mobile devices [3]. A large number of projects, initiated in terms of health promotion, are implemented on smart mobile platforms [4]. The usage of mobile devices allows patients to easily obtain the required medical information.

A previous version of this educational system has been developed for desktop machines and was intended to be installed as information kiosks for patients in healthcare institutions [5]. System was well accepted by patients who found it useful during

their medical treatment. An interest to have such a system accessible more frequently and at any time was recognized. This desire was a motivation for the transformation of the system from static to mobile educational platform oriented to individual and specific usage according to a patient need. Primarily requirements of the system were modified and improved for this purpose. In this paper, we propose mobile multimedia system solutions for patient education in the form of multimedia touch screen application that expresses a high level of adaptability for applications in various healthcare institutions. The system is designed and implemented on an analysis based on real needs of healthcare institutions in Serbia, as well as on a study of current trends in this area abroad [6]. The primary requirement is that the system should be independent of the medical field for which the training is done. A special attention is paid to the simplicity of creating new and maintaining of the existing educational contents.

The paper has the following structure. Section 2 discusses functionality of the system. The architecture of the system is discussed in detail in Section 3. Implementation of the system is illustrated and related details explained on the example of a system for patient education at the Clinic of Endocrinology in Section 4.

2. Functionality of the System

The proposed system for patient education is realized as a mobile platform for preparation (by medical doctors) and usage (by patients) of various educational contents in medicine. The system should serve for education of a wide range of population structures in order to implement different knowledge programs in health care. The system is designed to be independent of the branch of medicine where it is applied.

The proposed system for patient education consists of two main parts. The user's part is intended for providing information and guidance for patients, while the other part supports creating and management of the educational content.

Accordingly, the basic functionality is retained as in the preliminary version reported in [5], but it is enriched with additional options for individualization of the usage by taking into account specific requirements of each patient. Therefore, we will show some similarities and differences between the systems. Main differences between these two systems are given in Table I and discussed in later text.

Kiosk system	**Mobile system**
Different patient / Multiple patients	Personalized application
Static system /implemented in the waiting rooms	Mobile system / patient can bring it with him
Content management of one application	Content management of different applications
Multimedia content prepared for different patients/ large content	Material adopted to the needs of a particular patient / reduced content

Table 1. Kiosk Vs Mobile System

Users part. When exporting the former system for mobile devices, the following specific parameters were taken into account. The basic system requirements on client side are:

• The system is intended for patients of all ages and different education levels.

• The system should be easy to use, the patient without previous training can in an intuitive manner manipulate with the content.

• It should provide greater interactivity between the patient and the system. The patient according to his needs select contents of his interest.

• System must enable the viewing of multimedia educational content, including video materials, images, and text.

In comparison with the previous system which was static, positioned in the waiting rooms, system should be portable and implemented on various mobile platforms (Table I). Therefore, it is implemented on mobile devices so that can be used at any time and every place. Due to that, the usage of the education system is adapted to daily routine of patients.

Based on previous requirements the system is realized in the form of a mobile multimedia touch screen application. A user, the patient, has available a touch screen which displays educational content. Built-in interactive menu allows the patient to select by a simple touch of a finger the desired content according to his needs. The system can be used by the patients in accordance with their available time and personal interests because it is implemented on a mobile device.

Management part. Content management is part of the system that allows the system administrator to set and regulate the educational content. This part of the system is characterized by the following features:

Universality – The system is designed to be independent of the medical field for which the education is conducted. This allows the contents to be completely adapted to the healthcare institution which uses the system.

Adaptability – The usage of the system is entirely adapted to the needs of healthcare professionals. For them, it is not necessary to have a preliminary IT knowledge or experience in order to be able to create the contents or maintain and update the system. The system has integrated templates which are used to define the layout of the screen.

Efficiency - Maintenance (add/delete/change) of the contents is simple. The concept of the system, is based on the use of databases, allows a simple and easy system maintenance. It also enables to create and display a unlimited number of educational facilities.

Main differences with previous system management concerns the content implementation (Table 1). Each patient requires information according to his medical treatment. Due to that only specific material will be transferred to the patient device instead of static system that had all materials for different patients. The implementation requires smaller size according the material but many installations for the different users and their mobile platforms.

3. System Architecture

The mobile system for patient education consists of three components: mobile application, external storage, administration subsystem (Figure 1). These components are designed to work independently of each other. Thanks to this approach, where the content, design, and control are independently implemented, the universality of the system is achieved. In this way, the system can be easily adopted to specific needs of any health institution with no restrictions.

The system is realized using the Adobe Integrated Runtime (AIR), which is intended for the development of multimedia applications. The Adobe AIR is a cross platform runtime that enables to create a rich experience for Windows and Mac OS desktops as well as iOS and Android mobile devices. For the implementation of the system Adobe Flash and ActionScript 3 programming language are used.

3.1. Mobile Application

The mobile application is designed to establish communication between the user and the system. This component is organized in three modules: *User interface, Interaction, and Display*.

User interface interprets and displays the graphics design of the application from data obtained from a database. This refers to elements such as logo, address, layout and appearance of the user menu screens.

Interaction module establishes a relation of the user with the system and connection of the system to a database. Based on the user selection through the user interface, this module issues the appropriate query to the database. Result of the database query is to obtain the information about selected multimedia educational content which is stored in the Repository.

Components for displaying multimedia content have been implemented in the module Display. To view the video material, a video player is created. Video player allows displaying a variety of file formats (mp4, mpeg, flv, mov). Other information can be displayed in the form of text using html and txt format.

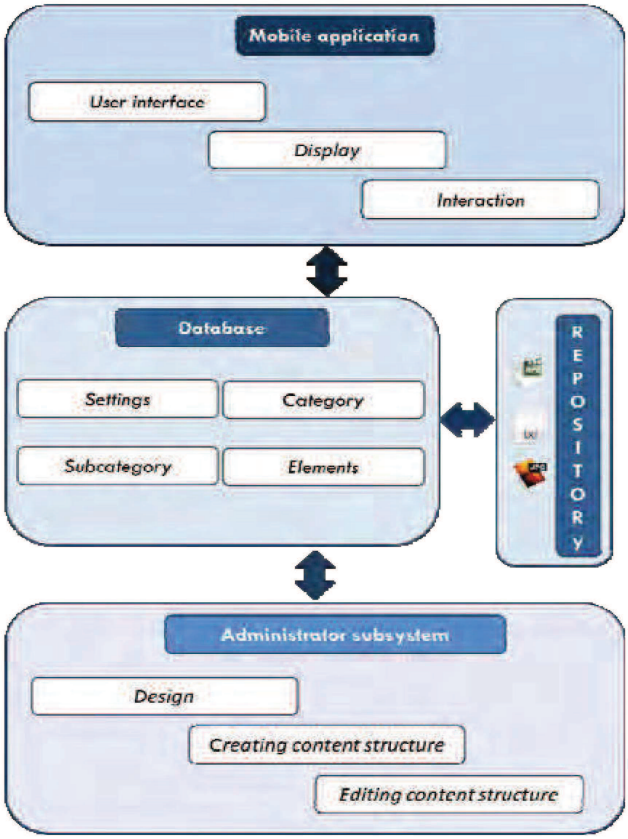

Figure 1. Architecture of the system

3.2. External Storage

External storage represents the educational material stored at the patient's mobile device. It consists of an SQL database that describe the material stored in the Repository.

The SQLite relational database is selected due to its simplicity and easiness of communication with the application and it is supported by the Adobe AIR software tool. The database is defined by four tables: Settings, Categories, Subcategories, and Elements. Table Settings determines the design of the application (menu appearance, name, logo and other visual elements). Tables Category, Subcategory, and Elements define the hierarchical structure of the user menu.

Multimedia contents are stored in the Repository (Figure 1) which is connected to the database via the table elements. Method of forming a repository is explained in the next section.

3.3. Administrator Subsystem

Its function is to form a system and to create/maintain the educative contents. Installation is done on the administrator computer and connected to the device used for medical education. Upon establishing connection with external storage on mobile device the administrator of the system can organize and copy the content according to the patient needs. The organization of content is realized by means of the following modules: Design, Creating, and Editing the content structure. Usage of these modules is done through the Administrator Panel

Design. The module Design is used to define visual component of the system. By using this module, the table Settings is formed. This table contains information about the type of template that is selected, the name of the system, and logo. Thus, designed table is used by the module User interface that can retrieve and interpreted data on the client side. Templates represent the layout of the menu on the user's screen. Template uses the landscape orientation of the mobile device. Currently, templates

are organized for tablet devices. Selection of the templates depends on the structure of the educational content and can be changed.

Creation. This module allows definition of the hierarchical structure of the content that is organized in categories and subcategories. Categories can be created by giving desired names. Each Category can be assigned to several Subcategories with their name. Categories and sub-categories represent a hierarchical structure of the system menu. They are used to get access to the desired educational content. The number of categories and subcategories is unlimited and depends of the user screen size. Each subcategory is connected with the Element that represents a specific educational content. In this way, the structure of the educational content of the system is formed.

The described activities are realized through the Administrator Panel. In this way, they form the corresponding tables in the database. Also, with these activities it is possible to remove or modify Categories, Subcategories, and Elements. All selected actions automatically update the corresponding tables in the database.

Editing. Through this module, the Repository is formed copied to the external storage of the mobile device by using the Administrator panel. The formation is performed in the way that each defined Element joins some of the multimedia content. In this manner, an unambiguous correlation is determined by all the elements in the system. Between SQL database and Repository elements on the external storage of mobile device.

4. Education of Patients with Diabetes

Implementation of the described system will be explained on the example of the Clinic for Endocrinology application. For the purposes of the Clinic for Endocrinology, Clinical Center Niš, we developed a mobile multimedia interactive system for the education of patients with diabetes.

The system is realized in the Adobe Air SDK software tool for IOS and Android mobile devices. This system is implemented and tested on the Android software platform by using Asus transformer EEE pad tablet. The goal is that instead of conventional written instructions, the patient is guided by an interactive application on his mobile device. Bu using it, patients are able to follow the medical education material and raise their healthcare knowledge in a modern and simple to use way.

The educational material is prepared and determinate for each patient in cooperation with medical experts. A detailed analysis of educational materials in the context of system design is extremely important in order to define the optimal layout of the user screen. Implementation of the system consists of several steps.

4.1. Step 1

Step 1 serves to define the visual elements of the system. Using the module Design, which is a part of the Administrator subsystem, template was selected. The choice of templates in this case was influenced by the fact that the number of titles (categories) is smaller than in the captions (sub-categories). In this manner, the basic layout of the application was determined to better arrange elements on the user screen. Also, as a part of this step, the table Settings was formed in the database.

4.2. Step 2

In this step, the construction of the hierarchical structures of the system is done. The module Creation structure is used to form the structure of the system. Categories and the corresponding subcategories are defined in accordance with the educational content. Also, in this step, tables category, subcategory and elements are formed in the database.

4.3. Step3

Step 3 is used to connect the system structure with the educational content. Each element is linked to the corresponding multimedia content by using the Edit content module. In this way, the Repository is formed and thereby an unambiguous relationship is determined between all elements in the system.

As a result of the action described above, the user screen is formed as shown in Figure 2. The layout of multimedia elements is displayed on the user's screen in the form of images. These images have the appropriate title and an icon which defines the type of multimedia content (text, image, or video). To view educational content, we created a video player that enables manipulation of various formats (mp4, mpeg, flv, mov). Video is displayed in a dedicated window intended for multimedia elements (Figure 3).

In addition, it is possible to completely control the video content. To view the textual content, txt and html files are used.

Figure 2. User interface with categories, subcategories and elements

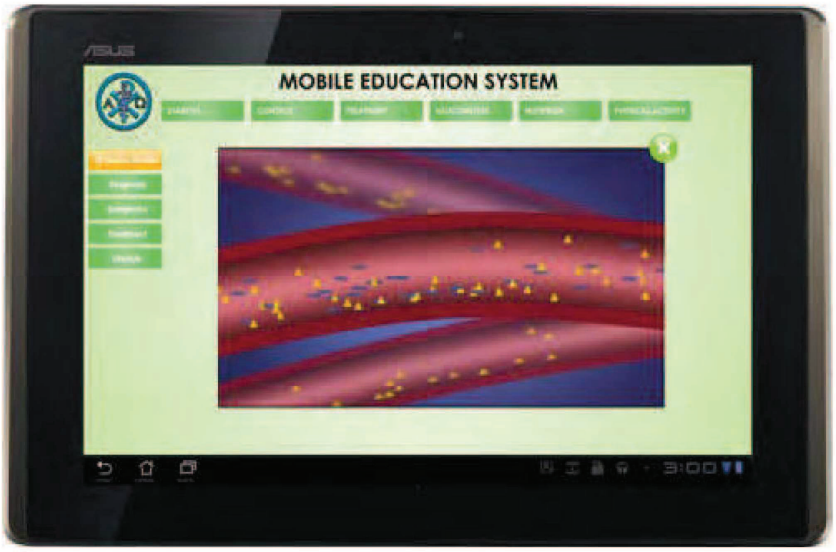

Figure 3. User interface with selected video

5. Conclusion

In this paper we present a mobile multimedia system for patient education. The system is implemented as an independent platform for use of educational content in medicine in form of multimedia handheld device. The hardware part of the system is based on smart phone technology for various platforms (IOs, Android, and Windows) that includes a touch screen while the software is implemented by using Adobe Flash software tool binding Adobe Integrated Runtime (AIR) application. The architecture of this system is organized into functional components which assures adaptability to different requirements for its formation. The universality of the system is achieved by implementing a content management subsystem. Educational content can be presented in various multimedia formats (video, text, images). A purposely designed video player enables viewing the content in various formats. To view the textual content, txt and html files are selected.

A pilot version of the proposed system is implemented at the Clinic for Endocrinology, Clinical Center Nis. The functionality and universality of the system is tested by implementing specific requirements specified by the medical experts in this clinic.

After simple modifications, the proposed can be applied in other spheres of education (schools, municipalities, public administration, etc.).

Acknowledgement

The work presented in this paper was supported by the Serbian Ministry of Education and Science (project III 044006).

References

[1] Troshani., Indrit., Nilmini Wickramasinghe. (2013). e-Health trends. *In: Pervasive Health Knowledge Management*, 57- 66. Springer New York.

[2] Joshi, A., Trout, K. (2012). Heath Kiosks as an Equal Opportunity Resource for Better Health: A Systematic Review, In GLOBAL HEALTH 2012, *The First International Conference on Global Health Challenges*, 66-70.

[3] Martínez-Pérez., Borja, Isabel de la Torre-Díez., Miguel López-Coronado. (2013). Mobile health applications for the most prevalent conditions by the World Health Organization: review and analysis. *Journal of medical Internet research,* 15 (6).

[4] Malvey., Donna., Slovensky, Donna J. (2014). mHealth Products, Markets, and Trends. In *mHealth*, 65-94. Springer US.

[5] Tati, Dušan., Dragan Jankovi., Dragan Tati. (2014). *Multimedia system for the education of patients*, Infoteh, 662-665.

[6] Liu, C., Zhu, Q., Holroyd, K. A., Seng, E. K. (2011). Status and trends of mobile-health applications for iOS devices: A developer's perspective, *Journal of Systems and Software*, 84 (11) 2022-2033.