

Home Health Smart TV

Bringing E-Health Closer to Elders

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Abstract: In this paper we present the novel platform for accessing multimedia e-health content adapted for elders. ICT solutions offered on market today are not adapted to elder people. Home Health Smart TV was developed in order to solve this issue. Integration with social network features, like video communication and personalized calendar, solves another concern for elder population - social isolation. Elder population is accustomed to TV devices and with this specially designed platform they can access their medical data and communicate with friends, family or medical staff in a simple way that doesn't require computer literacy.

1 INTRODUCTION

An aging population has become a demographic trend of the majority of developed societies (R. Moody, 2006). Due to this trend, it is a known fact that healthcare costs could double among EU member states by 2060 (Kovač, 2014). This problem is addressed in the European Commission's eHealth Action Plan 2012-2020 (EHealth Action Plan, 2012) which states that ICT solutions should be applied to health and healthcare systems to increase their efficiency, improve quality of life and unlock innovation in health markets.

From 2007 to 2013 percentage of the individuals aged between 16 and 75 who used the internet for seeking health-related information in EU increased from 24 to 44% (Eurostat). This trend shows that people are willing to actively participate in decisions that concern their medical condition and active participation is connected with better health outcomes (Heisler, 2015).

Access to medical data for patients is often provided through patient portals. These solutions, although useful for some patients, require substantial technical knowledge which makes them unusable for

elder patients with low computer literacy (Lober, 2006).

Another problem that is of particular concern for older people is social isolation. (Ages, 2013). Finding ways to support people to make and maintain social connections should be a priority for public health particularly in the area of aged care. As such, older adults are potentially at greater risk of becoming socially isolated, and of experiencing the negative health consequences of this. In order to bring ICT solutions closer to elder population it is necessary to address barriers to technology adoption and consequently develop well-designed system that can be used even if the end user is technically illiterate (Independent Age, 2015).

In this paper we present a novel platform "Home Health Smart TV" specifically designed for older people. Using this platform, older people can access their medical data, education materials, history of medical measurements and other medical related information. The platform also addresses problem of social isolation for older people and provides video communication between different users. This way patients can easily communicate with their friends, family and/or medical staff.

In order to minimize the certain fear that older people tend to have regarding technology, the platform is developed for the device older people are familiar with – TV.

2 HOME HEALTH SMART TV

Even though they are technically illiterate, elder people are using TV on daily basis. Studies showed that adults aged > 65 years spent threefold more waking time watching TV than young adults (Depp, 2010). Elder people are interested in their medical conditions but are unable to access that information because technical knowledge is prerequisite (Leist, 2013). Instead of adapting elders to ICT, ICT should be adapted to elders. As a result, Home Health Smart TV platform was developed on Faculty of Electrical Engineering and Computing in Zagreb. Home Health Smart TV is simple-to-use home system, connected to the TV that overcomes the barriers, offers improvement of patient's health care quality and enables easy access to information and data shared between patient and healthcare providers.

Proposed platform addresses two main issues explained in the introduction of this paper. Consequently, the platform can be logically divided into two main domains:

- 1) E-health domain
- 2) Social network domain

In e-health domain, Home Health Smart TV acts as a patient portal for accessing medical data using TV device. It connects to different e-health service providers, retrieves the data, filters it and presents it to the patient.

In social network domain Home Health Smart TV enables direct message and video communication between different users in the system. Patient can navigate through the contact list and initiate or join video call. Video and message communication can be used for everyday communication between patient and family but also for communication with medical staff.

2.1 E-Health domain

2.1.1 Platform

Home Health Smart TV is carefully designed package of Android applications deployed on specific Android device. The package consists of 3 applications:

- Home Health Smart TV application

- Auto Update application
- Home Health Smart TV Launcher

Home Health Smart TV application is core part of the Home Health system. It is used for accessing and displaying patient medical data, playing various multimedia educational content, message communication between patients and health-care professionals, etc. The medical information that is showed to the patient is carefully picked by medical experts. Piling too much information can be counterproductive and make the important information less visible, so it is important to filter the most important data before displaying it to user.

Home Health Smart TV application is divided in 5 fragments:

- Home
- Messages
- Education
- Measurements data
- Social networking

Home fragment is used for providing general information to the patient. Patient can check information about the doctor, read the weather report and check if there is any new message in his mailbox.

Message fragment is used for reading received messages from healthcare experts. In the current version, patients cannot reply to the received messages but in future version, set of predefined answers will be available for patient to select. These kind of message exchange can be used for cancellation of appointments or requesting new e-prescription from doctor.

Education fragment is used for browsing educational content stored on the device and displaying the selected content to user. Education material is categorized by types of illnesses which helps patient to focus on specific problem. Education material can be in a form of video, text, photo or presentation. In the future, educational material can be stored on remote server and patients could access it through the internet.

Measurements fragment shows medical measurements displayed as timeline chart. Medical measurements are displayed in a period of 1 year. This way patients can see the progress they are making by regularly exercising, following diets and advices from medical staff which is a great way to empower and motivate the patients. Without having graphical representation of the progress patients can have difficulties to feel any improvements in their medical condition which results in demotivation and thus quitting the regular healthy routines.

Social networking fragment shows the list of contacts user can interact with. Every contact is represented by name, relationship to the user (family, friend, nurse, etc.) and network status (online, offline). Using this fragment, patient can establish video communication with any contact that is online or leave a notification to offline user.

The main application is accompanied with 2 more extensions: Autoupdate Application and Home Health Smart TV Launcher. Autoupdate application, as the name suggests, is used for automatic update of the application without any user input. The application checks the application version deployed on the server. If there is a new version deployed on the server, the Autoupdate application will fetch and install it without any intervention of user. Usual solutions for updating the application, such as Google Play service, can't be applied for Home Health Smart TV platform because updating of the application must occur even if the application is executing. This way we ensure that the latest version of the application is installed on every active device which is very important for users without technical knowledge.

The last application from Home Health Smart TV platform is Home Health Smart TV Launcher. Smart TV Launcher is used as default Android Launcher. Using this custom launcher, we ensure that users cannot exit the Home Health Smart TV application. Making Smart TV Launcher as a default Android Launcher will also provide us automatic start of the application after the boot process.

2.1.2 Design

Primary requirements for application designed for elders is simple design, intuitive navigation, filtered content and user interface adapted to overcome the lack of computer literacy and the physical barriers such as visual impairment. The main input device inside the application is remote control. In order to simplify use of remote control, most of the buttons were disabled, leaving only 8 buttons functional.

Navigation within the application is pretty intuitive. Navigation bar is located at the bottom of the screen. The title located in the middle is the title of currently shown fragment. The titles on the left and the right of the navigation bar show which fragment will be displayed to the user if matching navigation button is clicked.

2.1.3 Integration with e-health service

The application is connected to Ericsson Mobile Health which provides patients personal medical data through Medical node REST API. The

interoperability is a great challenge (Vida, Lupse, Stoicu-Tivadar, 2012) when it comes to e-health services. Market is filled with various e-health solutions from different service providers. In order to make the Home Health Smart TV platform adaptable for different environments and e-health services, a special focus is put in adding the module for processing HL7 CCD standard for medical data exchange. The Continuity of Care Document (CCD) is a joint effort of HL7 International and ASTM (HL7 CCD). CCD fosters interoperability of clinical data by allowing physicians to send electronic medical information to other providers without loss of meaning and enabling improvement of patient care. CCD establishes a rich set of templates representing the typical sections of a summary record, and expresses these templates as constraints on CDA. These same templates for vital signs, family history, plan of care, and so on can then be reused in other CDA document types, establishing interoperability across a wide range of clinical use cases.

The platform makes periodic requests to the adapter service which then polls the REST APIs of different service providers. Adapter service is used for adapting internal methods to various external APIs. The communication process is secured using HTTPS protocol. During the first boot and initialization of the device, user enters his credentials for e-health services he is using. The credentials are then locally stored using *AccountManager* class. Entering passwords using remote control is a very difficult and time taking process, so instead of entering passwords on every device boot, patients can secure the access to their medical information using PIN which they can enter after the device initialization. PIN is not mandatory because memorizing it can be an issue to elder people and can be a reason for ceasing the use of the service.

2.1.4 Customizing Android ROM

Even after integrating all previously mentioned modifications, users still need to configure Android OS settings to be able to use Home Health Smart TV platform properly. Although these are minor adjustments, they still require technical knowledge that elder people don't possess. Since the goal of this project is to make platform that is fully adapted to the needs of elder people, Android ROM had to be customized. Default Android ROM is filled with different applications which are not necessary for functioning of Home Health Smart TV. On the other hand all those applications can interfere with normal functioning of the application. All the applications

that are not needed for normal functioning of the system were removed. The buttons that are not used inside the application were disabled. The script that executes on first boot of the device was modified with methods for configuring the device settings such as Wi-Fi configuration, time zone configuration, default launcher selection, etc.

2.1.5 Devices

Home Health Smart TV is bundled with 2 devices: Android Set-top box for executing the Home Health Smart TV platform and Wi-Fi 3G Router for internet connection.

Android device was chosen for its ability to connect to different types of TVs. Newer TVs can be connected to the device using HDMI and the older ones can connect using composite video interface. The device is equipped with web camera which will be used in future upgrades of the platform as a way for direct video communication between different stakeholders. Customized Android ROM contains the information about Wi-Fi Router which enables internet access without any additional configuration of the Android OS.

2.2 Social network domain

In a modern society, where social media has altered the basic rules of communication, gap between generations is largely caused by different perception of technology. Main issue of today's communication solutions, such as social networks, smart phones and applications, is that they are adapted to younger population and require technical knowledge. This phenomenon is known as digital divide and is topic of numerous researches done in past years (Norris, 2001) (Broos, Roe, 2006) (Vie 2008).

Statistics show significant difference in percentage between age groups of people that use internet to connect to social networks. While 85% of people between the age of 16 and 25, and 52% of people aged between 25 and 54 used internet to connect to social network in 2014, only 16% of people older than 55 did the same (Eurostat).

Since elder patients are major part of healthcare in every country, integration of e-health with social network has multiple benefits; displaying chosen medical content to patients over internet saves money and time to medical staff, while enriching e-health system with some features that users can find interesting and useful increases usage of the system, but ultimately end user/patient is the one who benefits the most.

2.2.1 Design

Designing social network that doesn't depend on platform is imperative. This way younger population can use smart phones or PC's to access the application, while elders can use TV platform. User interface must provide easy navigation and optimal viewing experience across wide range of devices. Most applications address this issue with responsive web design, which solves the problem of displaying content on different screen sizes, but adaptation to TV platform, where remote control is main input device, is more challenging.

One of the challenges is how to provide content that will attract both, younger and older. Since the final goal is to resocialize elders and make them use modern technologies for communication with their beloved ones focus is set on satisfying their needs, but in order to foster communication between generations younger population must find this application usable as well. Establishing video communication between parties regardless of device type and location is one of the most important built-in functionalities. This is accomplished via high quality communication library. Although it is possible to connect with other users by manually adding them to your network, smart grouping system is applied to facilitate interconnection. Different characteristics, like geographic location, affiliation to certain organization or similar interests, can be used to form a group. Users within a group can chat, share files or make a conference video calls. Personalized calendar for appointments and reminders with external data import support enables easy time tracking. These features along with messaging and news services, unavoidable options for any social network, form the basis of a desired virtual society.

2.2.2 Video communication

Video communication is the cornerstone of introduced social network. It is used for sharing live video and audio streams between two or more actors in the system. By introducing different roles in the system, video communication becomes even more powerful tool. Everyday communication with family and friends can be extended to remote consultations with medical personnel or social services, remote diagnosis, second opinion, remote consultations and therapies to multiple patients at same time and more.

Patients can also join different groups, depending on their medical condition where they can share experiences and advices. It is important to establish community where patients will interact on daily basis and support each other in dealing with their diseases.

Figure 2 shows example of establishing video conference between patient, his doctor and one of his family members.

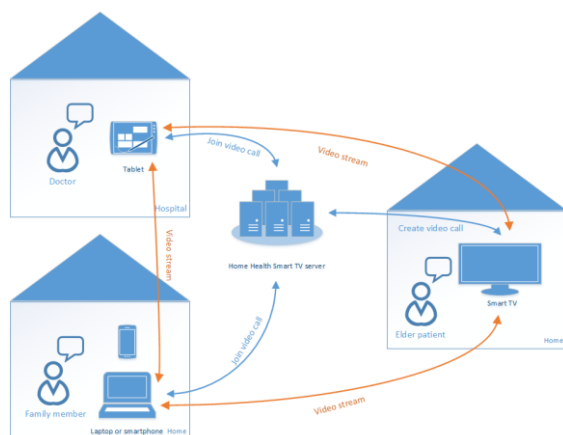


Figure 1: Establishing video communication

2.2.3 Personalized calendar

Following therapies accurately is essential and in a case where there are several therapies prescribed, tracking them can present a challenge, especially for elder patients that tend to be forgetful. The same is true for doctor's appointments that can be scheduled months in advance and patients have to take a note of that.

To enable easy time tracking interactive personalized calendar is available. Every doctor's appointment or therapy is imported in calendar automatically and reminder is triggered before each event.

Some simple processes, like extending continuous therapy, can be very time consuming for both, patient and medical staff. To avoid this problem additional feature is added so the communication between medical staff and patient can be established via calendar.

Extending continuous therapy via calendar is done in four steps:

- Patient chooses therapy he wants to extend
- Medical staff receives request and process it
- Patient is notified after the decision has been made
- If extending continuous therapy is approved calendar is automatically updated and prescription is issued

2.3 Pilot

Home Health Smart TV platform will be tested in pilot project. 50 elder patients that are suffering from at least 2 chronic diseases are included in pilot from which 20 will receive the Home Health Smart TV platform while others will receive mobile device for accessing their medical data. Pilot project will last for 16 months. For this purpose, special service for statistical analysis was developed and deployed on server. Server will receive information about every action users have made. After the 16 months, a lot of valuable data will be gathered from which we will be able to conclude in which direction future work needs to be focused.

3 CONCLUSION

E-health systems and services offer an important complement to routine clinical care. They have become a necessity in most countries and the result is health market filled with numerous ICT solutions. Many of these solutions offer patients access to their medical data through patient portals but the use of these services requires technical knowledge and therefore they are not adapted for elder population. Finding ways to support people to make and maintain social connections should be a priority for public health particularly in the area of aged care. Even though social networks are not complex applications, accessing them can represent a challenge for elders because they require platform-specific knowledge. The solution for these problems is adapting ICT to elders and not vice-versa. A platform was developed on Faculty of Electrical Engineering and Computing in Zagreb in order to address this issue. Home Health Smart TV is simple-to-use home system, connected to the TV that overcomes the barriers and offers improvement of patient's health care quality and enables easy access to information and data shared between patient and healthcare providers. Integration with social network and introduction of new features, such as video communication and personalized calendar, increases usability and functionality of the system and thereby improves well-being of the patient. The functionality of the platform will be tested in the pilot project which will last 16 months and will gather valuable information about the usage of the platform. The information will then be used as guidelines for future work on this project.

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