Mobile App for Optimizing Home Care Nursing

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Abstract. The paper presents a mobile app designed to be used by health care providers, mainly by the nurses that pay visits to the homes of the clients/patients of the health care providers. The app should optimize the nurses activity and also the communication between the nurses and the coordinators and between the nurses and the patients. The described mobile app is part of a larger software platform as will be described in the article.

Keywords: Home care · Home nursing · Health care · Mobile app · Point of care documentation

1 Introduction

As life expectancy grows we are faced with an aging population all across Europe and beyond. The effects of an aging population are expected to become more and more visible over time, as the number of the elderly divided by the working age population grows. It is expected that in 2050, the ratio of elderly to the active population in Europe will reach 2:1 [1].

The elderly need assistance in the daily living, in performing their routine activities and most of them also need health care services, be it for a chronic illness, for a specific incident for a short while or for preventive care.

The care services may be offered a) in an institution: in a nursing home for long term care; b) in the hospital for short term or ambulatory care; c) at home. There are multiple benefits in delivering health care or different care services to the elders at home and avoiding having them long/short term institutionalized. These benefits are related to the quality of life of the elders that get to live in their own homes, in the same environment that they are accustomed with.

There are studies suggesting that living at home with support, compared to getting care at a different location improved health and functional status, mortality rates and, at least, delayed hospitalization and institutionalization in nursing homes [2, 3].

A review of the research regarding the best point of care for elders [3] shows that the results are heterogeneous, depending on the degree of dependency of the subjects. The growth of the user segment of home care services and the diminishing workforce that provides them leads to a need to optimize the delivery of such services.

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The work described in the current paper is part of an ongoing research project implemented in Romania that aims to address this problem: optimizing the activity of home care services providers (HCPs) through an integrated software and hardware platform.

The platform is called CDMS [2] and it presents a multilayered architecture. Components at the top level are designed to be implemented by an agent that offers services to multiple HCPs, so that an HCP may enter the market with minimum investments and start offering services in an organized and optimized manner. At the top level is the center for dispatching and management for multiple home care providers, consisting of servers running dedicated software: web applications dedicated to the home care providers.

The next level is the HCP level and, because of the multiple functionalities implemented at the top level, it consists only of Internet enabled terminals. These terminals do not require high computing power or large storage capacity, as these functionalities are implemented at the CDMS level.

Every assistant that performs home visits is required to use a mobile device during the visits. The device (a smartphone or a tablet) runs a mobile app that communicates with the servers at the CDMS level in order to offer information to the assistant and to record information about the visit. There is also another level consisting of remote monitoring devices designed to be located at the homes of the clients/patients.

A general and functional description of the CDMS platform is available in [4].

The current work presents the mobile app for the nursing staff: a mobile app, called Homeassis, designed for Android and iOS devices, that targets the employees of home health care providers. The app should ease the activity of the nurses that pay home visits to the clients/patients, by providing them with the information and assistance that they need during the visits.

2 State of the Art

As stated in the introductory paragraphs, there is a need for solutions that deal with taking care of the elders. The need is reflected in an abundance of research projects motivated by the problems involved by dealing with an aging society.

Most of the research is split in two major directions: a) independent living at home (aided by home care systems) or b) solutions for nursing homes for the elders. The current work focuses on c) living at home while receiving care from specialized nursing staff. The following paragraphs will study solutions from all three groups, with focus on the latter category: living at home while receiving home care services. Of course, this category does not exclude getting help from solutions from category a) or b) like ambient assisted living or short term institutionalizations in different situations. Also, the main focus will be on the mobile solutions.

The research in category a) is mostly centered on smart home and ambient assisted living solutions. This area has been a research subject for a long time, although the health care aspect is not studied in all the research available, many of them focusing more on user comfort and optimizing energy usage. Research suggests that this type of implementation of technology may have positive impacts on health status and quality of life of the assisted subjects [5–7] although the level of technology readiness for smart homes and home health monitoring technologies is found to still be low [5]. The CDMS

platform also proposes the use of health monitoring solutions implemented in the homes of the clients, but this part of the research is not the subject of the current paper.

Much of the current research considers offering care services in institutions like nursing homes. Again, most of the research is related to ambient assisted living and smart environments. In this paragraph, only solutions related to mobile apps available for care services will be presented. More precisely, to what is called point of care documentation. The work presented in [8] describes an app developed to aid the staff of a nursing home in Portugal and describes all the steps involved in developing the app: starting from analyzing the ICT used by the nursing home before, analyzing the needs of the staff, the activities performed and so on. The app offers access to the electronic health records of the patients at the point of care, replacing the need for handwritten charts and medical records. The technologies used for the development of the mobile app are based on React Native – a Javascript framework developed by Facebook, MySQL for the database and a PHP Rest API to allow the communication between the client – the mobile app and the server side – where the database is stored. There are some commercially available solutions for point-of-care documentation like Medsys2 [9]. Medsys2 is a solution for managing the process of offering health care in any location (hospital or outside of the hospital) tailored for the legislation and workflow of the medical domain in the United States. It allows recording information about the visits performed and, afterwards, reporting it in predefined or customized format pdf documents. By allowing the creation of customized documents, it might allow also reporting of the materials used in each activity.

The proposed app described in this paper is using native technologies for each of the two targeted platforms: Android and iOS. The communication with the server is based on a PHP Rest API. Along with access to the patients' electronic charts, the proposed app offers aid in performing the required procedures and in registering information on the necessary supplies.

The proposed solution offers more than point of care documentation by offering support to the assistant in: contacting the patient, navigating to the patient's home, keeping track of the used supplies, allowing integration of medical documents generated by other health care providers. Also, the integration of the proposed app in a more complex ecosystem of hardware and software components offers other advantages not just to the nursing staff but also to the administrative personnel of an HCP.

3 General and Functional Description

The proposed mobile app is designed to run on Android and iOS devices: smartphones or tablets that the home assistant wears during the home visits.

The app is designed to act as a client in the architecture of the whole CDMS platform, Fig. 1. It will be used by the assistants during home visits and it will synchronize the acquired data with servers located at the CDMS level.

For the moment, as the research project that funds the development of the CDMS platform and of the presented mobile app is a Romanian research project, the app's interface is designed in Romanian language, but during the programming stages, internationalization tools have been used to allow for easy translation of the strings presented on the screens of the app.

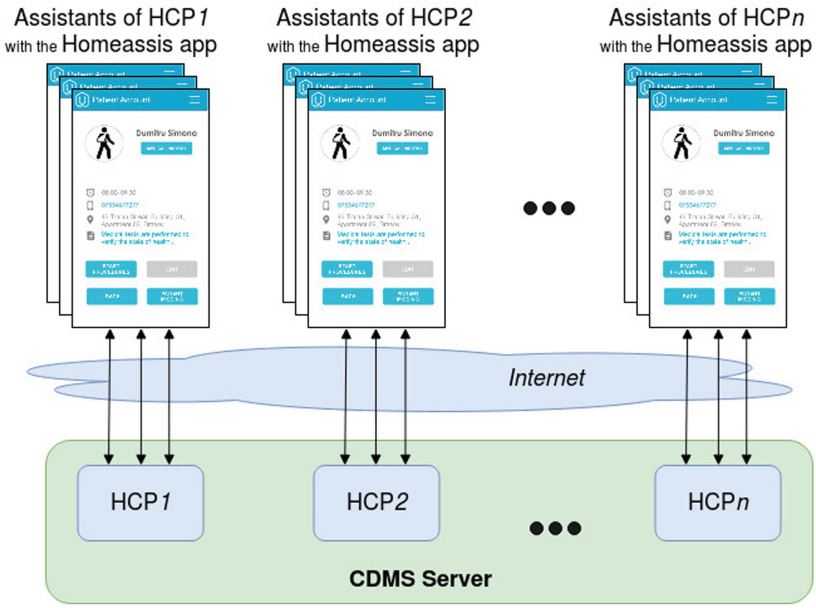

Fig. 1. CDMS platform with the Homeassis app for the assistants of each HCP

The database used for the app is SQLite, encrypted using AES128. Data are only temporarily stored on the device and deleted after each successful upload to the server. For security reasons, communication between the CDMS server and the device (the client) is performed only on mobile data, not on Wi-Fi. The server is offering an HTTPS connection.

The app allows access to information about the clients/patients, information about the visits or help regarding certain procedures. In the first stages of the project, multiple research visits were conducted in the field in order to interview and gather data from HCPs and home assistants, so that the functionalities reflect the needs of the intended users. All along the development of the whole CDMS platform, feedback from HCPs has been received: in the design, development and testing phases, to ensure the fact that the platform meets the needs of the intended users.

The app offers the following functionalities:

- View of the program of the visits for the current day;
- Navigation using the GPS to the homes of the clients/patients;
- Management of the applied procedures:
  - Log details about the applied procedures;
  - Edit the elements about the supplies used for the procedures.
- Record physiological measurements;
- Add medical documents to the electronic charts of the patients.

Figure 2 presents different screens of the mobile app. The usage scenarios may be synthesized as in the following paragraphs.

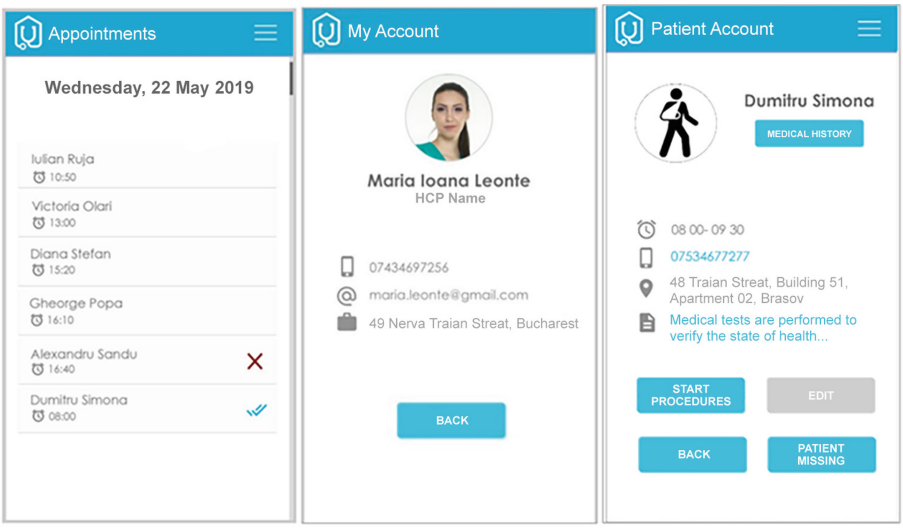

Fig. 2. Different screens of the mobile app: a) list of the scheduled appointments; b) profile screen of the logged in caregiver; c) patient information screen (Color figure online)

3.1 First Time Usage of the App: Authorization of the Device on the CDMS Platform and User Login

In order to use the app, the mobile device must be authorized by an HCP. The authorization of a device is based on a two factor authentication. At the first usage of the app, the user is requested to input the URL of an HCP (in a screen of the app only available if the device is not paired with any HCP). An administrator of the HCP must then use the web app available through the CDMS platform to generate a validation code that must be input in the mobile app.

After the authorization of the device, the user – a caregiver must authenticate by using a username and a password. After a successful login, the user data stored on the server are synchronized on the device. The data consist of the following appointments along with the information regarding them: the required procedures, the necessary materials, information about the patients (contact information like address and phone number, medical history of the patient).

After this first data synchronization, next synchronizations take place after each successful login, after each visit, daily at midnight or at a user request for synchronization.

3.2 Manage the List of Scheduled Appointments for the Current Day

An authorized caregiver consults his list of scheduled appointments. This is the first screen available to the user after a successful login.

An example of this screen is depicted in Fig. 2a). Already performed visits are marked with a tick and visits that could not be performed (for different reasons: client refused certain procedures, client was not at home/not available) are marked with a red cross. Once a visit has been performed, it is moved to the end of the list. There is the case that there is no appointment scheduled for the day, in this case a message is shown to the user, along with a button that allows for a resynchronization with data on the server.

Starting from this screen, by pressing on a client's name, a caregiver may view information about the visit and about the client that is to be visited, as seen in Fig. 2c).

3.3 Perform a Visit at a Client

Presuming a caregiver is logged in and has synchronized the data on the device with the CDMS server, he may start performing the scheduled visits.

Starting from the screen presented in Fig. 2c) the user may get all the information needed to perform a visit. The screen presents information about the patient and about the visit: scheduled time of the visit and client's address.

Also, the screen allows the caregiver to directly make a phone call to the client, start the navigation app to see the recommended route to get to the client's home, see the medical chart of the patient; mark the patient as unavailable for the visit or start applying the requested procedures.

In order to record the performed procedures, the assistant selects the "Record procedures" button shown in Fig. 2c) and a list of the procedures requested by the client/recommended by the medic is shown. For each procedure the assistant may view a description, record it as applied or refused, input comments/observations about it and record the supplies used for the procedure. New procedures may be added to the list of already requested procedures, following a request from the patient or as considered necessary by the caregiver.

The app allows the assistant to input the vital parameters measured during the visit, parameters like: arterial tension, glucose level, pulse, temperature and others. The app allows the input of several predetermined vital parameters. The list of vital parameters that may be recorded was defined by medical personnel consulted during the design phases of the whole CDMS platform (and, implicitly, of the mobile app). The list of available procedures to be performed is also predetermined and developed during the design phase of the platform after consulting with medical personnel and home nurses. Using the web components of the CDMS platform (not directly through the described mobile app) new procedures and new physiological parameter types may be added to the corresponding lists.

For each of the medical procedures the necessary materials along with typical quantities are predefined. The assistant may change these values according to each situation.

While performing a visit, the assistant may add documents specifically to the current visit or to the electronic file of the patient, by adding a file: a picture or a different type of file considered relevant to the visit, or to the medical history of the client.

4 Results

An experimental model of the whole platform has been deployed as an experimental model at a possible CDMS center in Alba County, Romania. For the moment, the platform is tested by the personnel of the CDMS and the mobile app by the personnel of an HCP. Neither is being used with real clients' data.

The potential users have expressed requests for alterations either directly for the app or alterations for the platform that are reflected in the app. These functionalities are currently being implemented and testing activities are performed in close relation to the development activities.

The prototype of the whole platform, containing also the model app is scheduled to be released in March 2020. Different screens of the app are available in Fig. 2. As observed during use of the experimental model, the designed features improve both the activity of the home nurses and of the adminsitrative personnel of HCPs.

One of the most important advantages that arise from using the proposed mobile app is a clear and standardized workflow that all nursing staff must adhere to, which also leads to fewer errors in performing and reporting the activities and in filling information in the patients' medical charts. It also improves communication between different nurses attending to the same patients and between patients and the nursing staff. It also aids reporting and monitoring the activity of the nursing staff and optimizing and monitoring the use of needed supplies for the home care procedures.

5 Conclusions and Future Work

In conclusion, the paper presents a mobile app for Android and iOS devices, designed to be used by health care providers, mainly by the nurses that pay visits to the homes of the clients/patients of the health care providers. The app should optimize the activity of the nurses by allowing them to: remotely access clients'/patients' data; manage the applied/requested procedures for each patient; record the supplies used for every procedure.

Also, the app facilitates the interaction between workers and coordinators and between workers and patients. The usage of the app optimizes and eases the activity of the home nurses and also the activity of the administrative personnel of the HCP, by allowing for a better and close to real time knowledge of the visits and procedures applied by their nurses and of the supplies used during visits.

As mentioned before, the app is currently in testing, as it is deployed as part of the experimental model to a CDMS and HCP in Alba County, Romania.

Although multiple targeted users were consulted during the design phase of the platform and of the app, during the first months after deploying the experimental model, multiple requests have been made by the users regarding different functionalities of the app and these requests are currently being implemented.

The testing and polishing of the experimental model continues until March 2020 when a pilot for the whole platform is programmed to be released at the same CDMS and HCP in Alba County. A training period is scheduled for the pilot through multiple workshops planned for the employees of each HCP.

The pilot is set to run until September 2020, when the implementation of the research project is over.

After that, there are plans for translating the software into more languages, as internationalization was taken into account during the development phase of all the components of the CDMS platform, including the presented mobile app. Further developments include creating a mobile app dedicated for the patients and several improvements to the web components of the CDMS platform, which may reflect in changes in the presented mobile app.

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References

1. Eurostat: People in the EU -population projections – Statistics Explained (2019)
2. Boland, L., et al.: Impact of home care versus alternative locations of care on elder health outcomes: an overview of systematic reviews. BMC Geriatr. **17**, 20 (2017)
3. Markle-Reid, M., Browne, G., Weir, G., Gafni, A., Roberts, J., Henderson, S.: The effectiveness and efficiency of home-based nursing health promotion for older people: a review of the literature. Med. Care Res. Rev. **63**, 531–569 (2006)
4. Sandulescu, V., Puscoci, S., Petre, M., Soviany, S., Chirvasa, M., Girlea, A.: Dispatching and management center for optimizing home care integrated services. In: Proceedings of the 5th International Conference on Information and Communication Technologies for Ageing Well and e-Health ICT4AWE, vol. 1, pp. 255–261. Scitepress, Heraklion (2019)
5. Liu, L., Stroulia, E., Nikolaidis, I., Miguel-Cruz, A., Rincon, A.: Smart homes and home health monitoring technologies for older adults: a systematic review. Int. J. Med. Inf. **91**, 44–59 (2016)
6. Memon, M., Wagner, S., Pedersen, C., Beevi, F., Hansen, F.: Ambient assisted living healthcare frameworks, platforms, standards, and quality attributes. Sensors **14**, 4312–4341 (2014)
7. Queiros, A., Dias, A., Silva, A., Rocha, N.P.: Ambient assisted living and health-related outcomes—a systematic literature review. In Informatics, MDPI (2017)
8. Esteves, M., Esteves, M., Abelha, A., Machado, J.: A mobile health application to assist health professionals: a case study in a Portuguese nursing home. In: Proceedings of the 5th International Conference on Information and Communication Technologies for Ageing Well and e-Health ICT4AWE, vol. 1, pp. 338–345. Scitepress, Heraklion (2019)
9. Medsys2: Work flow process. http://medsys2.com/?page_id=1960. Accessed 01 Sept 2019