Android Application for Remote Monitoring of the Elderly's Parameters

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ABSTRACT

According to the latest predictions, the average age in Europe in 2050 will be 49, whereas today it is only 39 years [3]. Europe, therefore, faces quite a significant population problem. With insufficient numbers of young workers, we need technical, economic, and political solutions to help the elderly maintain vitality and independence. The aim of technical solutions is to delay the departure of the elderly to a retirement home and to help maintaining the economic stability of the country. In this paper, we describe an application that helps the elderly and relieves the society and economy. We present the technical specifications and features of the Android application, which was developed as part of the project ISE-EMH (Insieme) with the collaboration of IPM Digital within the project HoCare 2.0. The Android application is created and intended for usage for the pairs: one elder and one caretaker (e.g relatives, nurses, paramedics).

KEYWORDS

Android application, care for the elderly, elder, caretaker, fall detection, easy to use, ISE-EMH, Insieme, HoCare 2.0

1 INTRODUCTION

Due to the development and introduction of so-called MEMS (Microelectromechanical systems) technologies in mobile devices, these became smarter in terms of tracking and perceiving the environment [1]. This is achieved by using accelerometer, GPS, gyroscope, proximity sensor, and many other sensors. These sensors allow us to monitor the movement of a person, location and brightness of the room in which a person is located. This comes in handy in the research field of ambient intelligence. In our case, we developed an application for the elderly and their caretakers which allows us to use these technologies. In this paper, we will describe the application and its technical features. The paper is thus divided into two central sections. The first describes the functions that an elderly person can use and the second describes the functions caretaker can use. Finally, we describe the advantages and disadvantages of the developed application, which were highlighted by the elderly in the performed focus group.

1.1 Basic information about the project

As part of the Insieme project, we implemented a unified EMH (Electronic and Mobile Health) platform together with software for smart devices. The platform includes new diagnostic approaches, advanced sensors, including wearable devices that monitor vital signs, and sophisticated computer algorithms and artificial intelligence methods that gain new knowledge from data. The main problem regarding the introduction of EMH remains the transfer of innovative services from laboratories into practice, as there is a lack of support services in terms of both ICT systems and human partners and their integration. As a rule, researchers can not find commercial partners for even the most excellent academic prototypes, while the prototypes are rejected due to inertia, despite the indisputable advantages of both ICT and knowledge. It is difficult to implement novel ICT solutions to the elderly. The key purpose of this project is to accelerate the cooperation of Italian and Slovenian stakeholders in the field of EMH and the transfer of knowledge, systems, and services of EMH from the academic sphere to actual use. The other purpose is to enable better connections between users and providers. While anything can be found on web, it is often difficult to find proper information. Bearing these specifications in mind, several applications are being included in the platform, one of them being the Android application presented here.

1.2 Chosen Android OS and programming language

According to the global market share in Table 1, obtained in May 2021, the most used OS for smartphones is Android OS with about 72% market share [2]. Therefore, Android OS was chosen as the operating system for our application. Regarding the programming language, we were deciding between Kotlin and Java. As Kotlin is a fairly new language, we had chosen Java. Java is still a versatile and general programming language that runs inside Java Virtual Machine environment[1].

Table 1: Global market share for mobile phone's OS

Operating system	Market share in procent
Android OS	72.18%
iOS	26.96%
Samsung	0.43%
KaiOS	0.19%
Unknown	0.14%
Nokia Unknown	0.03%

1.3 Overview of the functions

Here is a list of all functions implemented.

The elder has access to these functions:

- reminders,

[1]The Kotlin also uses virtual environment

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- contacts,
- SOS function,
- settings,
- fall detection,
- pedometer,
- alarm when searching for mobile phone,
- alarm as a reminder to charge the battery.

The caretaker has access to these functions:

- overview of elder's parameters,
- history,
- exact location of the elder,
- sandbox settings,
- enable/disable the settings for the elder.

All functions for both the elder and the caretaker will be described in more details in the following sections. The application runs on two advanced mobile phones with Android OS. The general idea is that the elder needs help, support and monitoring of the caretaker, and the mobile phones enable the needed functionality.

2 THE INITIAL SCREEN

First, user has to confirm and enable access to the services of the phone. The user has to grant application permissions of:

- accessing the contacts,
- accessing the location of the device,
- accessing the multimedia and files,
- recording and taking photography,
- sending SMS messages,
- making telephone calls,
- audio recordings.

Figure 1 presents the initial screen of the Android application. The elder and the caretaker enter their role. The selected role is set once for the application, and to change it, the application has to be installed again. On the initial screen, the user can select the language. The application is available in Italian, English, and Slovene. There is also a button on the bottom of the initial screen. By pressing it, a user can start or stop a function of searching the mobile phone by vocal call.

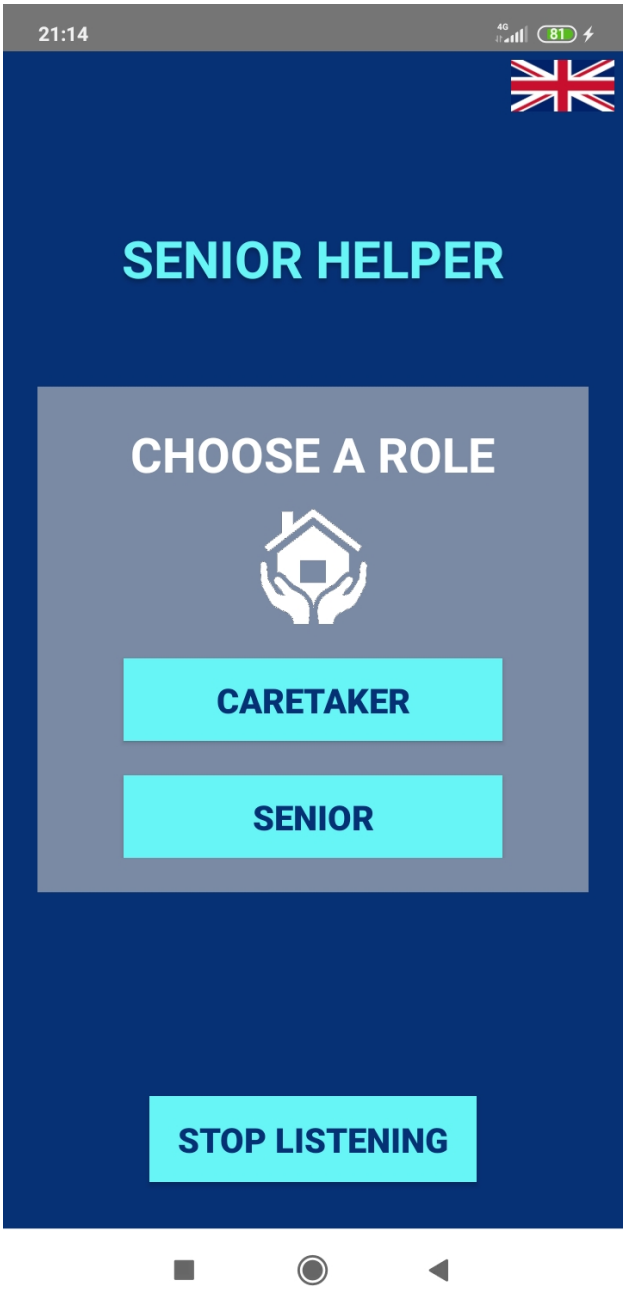

Figure 1: The initial screen, shown during the first use of the application.

3 THE ELDER'S HOME VIEW AND FUNCTIONS

3.1 Sandbox

Sandbox is a term that denotes the area of elder's home, residence or a safe place defined by the elder during the initialization of their profile. When the elder leaves the sandbox area, the caretaker is notified via SMS message. The elder or caretaker can arbitrarily set the radius of a sandbox area from minimum of 0 meters and a maximum of 500 meters. Changing the distance by elder is only possible when the caretaker allows it in the settings.

3.2 Battery

The elder is alerted when the battery charge drops to 20%. In case the elder does not connect their phone to the charger, the application warns them about it every 5 minutes.

3.3 Mobile phone location and vocal search

The application is periodically sending the location of the mobile phone to the central server. From there, the information is transferred to caretaker's mobile phone. In case the elder's phone has no internet connection or GPS service turned on, the last location on the server is displayed to the caretaker.

The elder can also enable the search for mobile phone function. If enabled, the mobile phone is constantly listening to its environment. In case the elder forgets the location of the mobile phone and wants to find it, they should say the keyword "TSUNAMI" loudly and clearly. The mobile phone will start to vibrate and ring in order to reveal its location.

3.4 Alarms and reminders

The elder has an option of adding one-time or periodic alarms. One-time alarms are designed for non-daily tasks such as visiting

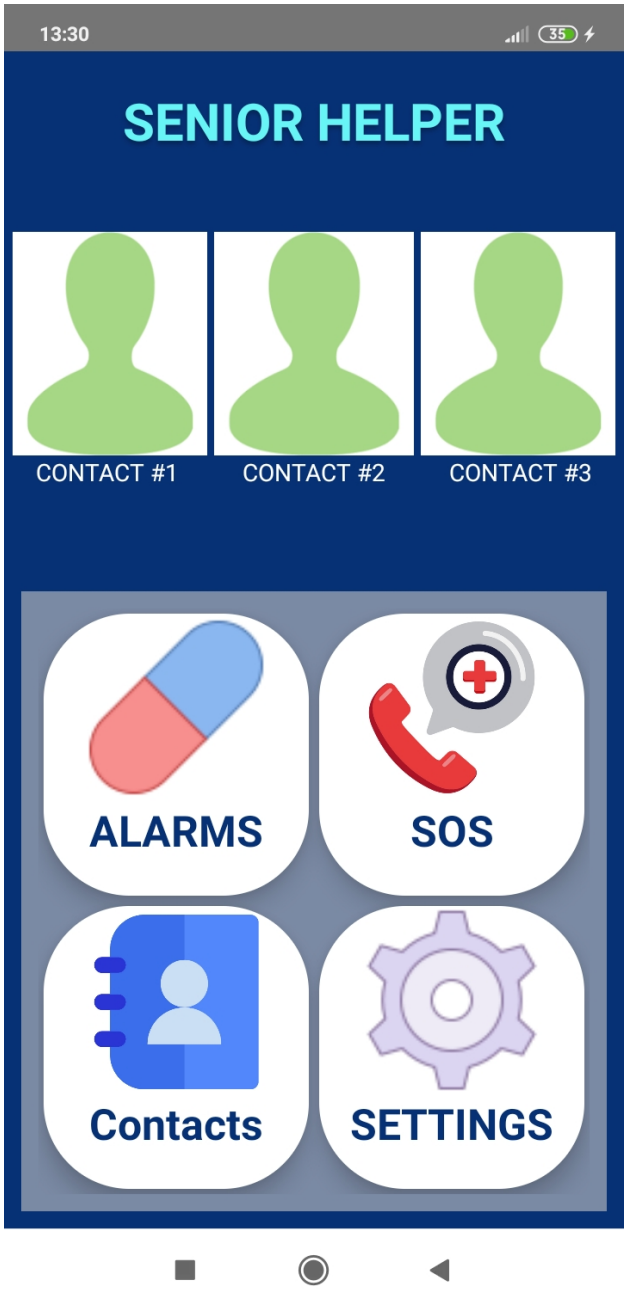

Figure 2: The elder's home view, after they enter their personal data

a doctor. Periodic alarms are designed for daily tasks such as taking medications at a specific time. When the alarm goes off, the elder must confirm it. This sends a confirmation to the central server, from which the caretaker can check the status of alarms. The elder's access to the alarms can be seen on elder's home page, depicted on Figure 2.

3.5 SOS function and fall detection

In the event of problems such as nausea or feeling unwell, the elder can press the "SOS" button, which triggers a call for help by successively calling the contacts on the list. The application calls contacts by the list order, i.e. priority. In case there is no response to the call of the first contact, it calls the second, and so on. The elder can add a maximum of three contacts to the SOS call list.

The application has an implemented algorithm that detects the falls of the elder using the phone's accelerometers. In order to do that, the elder must have a phone that has a built-in accelerometer. In case of false detection, the elder can press the "Cancel Fall" button. A SMS message is sent to the caretaker that either a fall or a false fall has occurred.

3.6 Phone book and pedometer

The elder has the option of storing existing or new contacts in the app's phone book. By arranging the contacts in the directory, priorities are assigned to the individual contacts for the SOS function.

The app measures the number of steps that the elder has taken. Depending on the refresh interval, the application sends the data to the central server, from which the values can be read by the caretaker.

4 THE CARETAKER VIEW AND FUNCTIONS

The motivation for the caretaker's application is that it enables the caretaker to monitor and communicate with the elder. The elder's application, on the other hand, has two modes of work: in case of elder's inability to set technical functions, the elder has access to limited set of functions, such as calls, SOS button and similar. If the elder is still able to control the settings of the application, then all options are enabled. The caretaker has full control of all functions.

4.1 Sandbox

In case of the caretaker, the sandbox area is denoting the home, residence, or safe place of each specific elder separately. The caretaker can arbitrarily change the radius of sandbox area from the minimum of 0 meters and the maximum of 500 meters. They do this by entering the more options extension of settings and using the slider to select the desired distance. In the menu, they can also enable access to the settings of a particular elder.

4.2 Battery

At 15% charge of the elder's battery, the application automatically sends a SMS message to the caretaker. The message contains a warning that the battery status of the elder's mobile phone is low. This gives the caretaker the chance to contact the elder and remind them about charging the phone.

4.3 Mobile phone location and vocal search

The caretaker can see the last known location of the elder by pressing the "Show exact location" button. A Google map opens, where a blue dot indicates the last known location of the elder. If the elder has internet connection and GPS location turned on, the last known location is also the current location of elder's phone. The caretaker does not have the option to perform vocal search for their mobile phone.

4.4 Alarms and reminders

The caretaker sees the confirmation of specific elderly person's alarms.

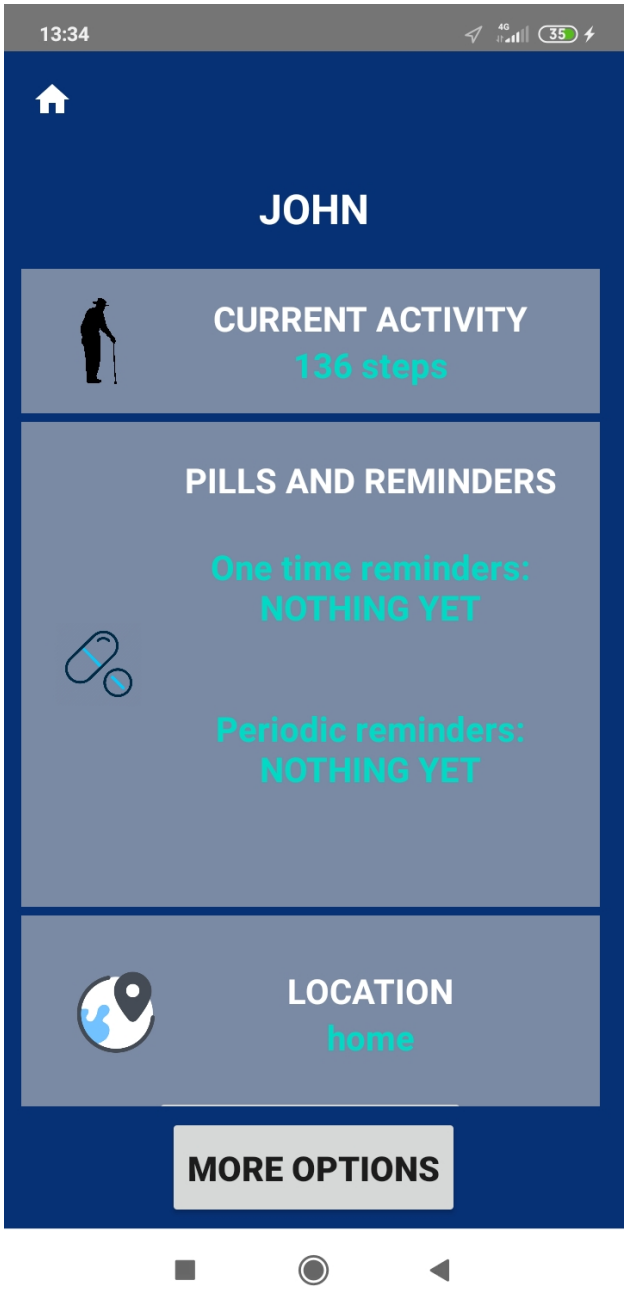

Figure 3: The caretaker's home view

4.5 SOS function and fall detection

The caretaker or elder's relative or anyone on the elder's SOS list receives a call for help. In case of a fall, the caretaker receives an SMS that there was a fall of the elderly.

4.6 Phone book and pedometer

The caretaker does not have a phone book, but a list of the elderly they take care for. The caretaker has the option to call a specific elder by pressing their contact. For the caretaker, the application does not measure the number of steps made. However, the caretaker has the ability to review the number of steps for each elder they take care for. The caretaker can see all the key information of each elder they take care of, e.g. Figure 3.

5 CONCLUSION

We developed the Android application for the elderly and their caretakers. This article describes the features of the application. Sensors integrated into today's smartphones and special software enable us to create applications which help the elderly live more independently. The drawbacks of the software which is now available on Google play market are: complicated usage, high price, lack of features. We designed the application bearing in mind ease of use for the elder and features that allow the caretakers to monitor the elderly anywhere anytime. Also, after the application is fully tested, it will be available for free.

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