A Serious Game for Android Devices to Help Educate Individuals with Autism on Basic First Aid

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Abstract. Within the group of individuals with autism, we can find a certain number of people who interact well with mobile devices and other types of technology. To improve their knowledge on first aid, the main aim was to create an application composed of a set of Serious Games oriented towards first aid education: i.e. how to handle specific situations, basic knowledge about healthcare or medical specialties… all employing the use of current technologies such as Smartphones or Tablets, specifically running the Android operating system. Not only technological results have been investigated, but also feedback was taken from opinions and experiences by both users and specialists taking part in the practical validation and testing of the application.

Keywords: autism, First Aid education, Serious Games for health, Android.

1 Introduction

Autism is not a disease; it is a syndrome, a cluster of symptoms that characterize a degenerative disorder of the bio-psycho-social. This disability is a developmental disorder, permanent and profound, and significantly affects and alters the areas of communication, social interaction and behavior. Often these symptoms are accompanied by abnormal behavior, such as activities and interests of repetitive and stereotypical rocking movements, and an unusual obsession towards objects or events [1].

Appears during the first three years of life and it will drastically limit the life of the person who has it besides causing significant stress in the family [2].

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Studies in North America, Europe and Asia have identified individuals with autism with an approximate prevalence of 0.6% to over 1% [3]. A recent study in South Korea (May 2011) [4] reported a prevalence of 2.64%, i.e. 1 child out of every 38 suffers it. There have also been estimates that between 1 in 88 and 1 in 240 with an average of 1 in 110 children in the United States have autism [5].

The percentage of individuals who have sufficient capacity to live independently (or partially independent) is relatively low, and most of them require a great help throughout life. But it's established, that if they receive appropriate resources and support, are able to co-exist into society properly, improving their quality of life, and acquiring a greater degree of autonomy.

Due to these reasons, this study aims to improve quality of life of individuals with autism and enhance autonomy as much as possible through the use of the latest technologies in mobile devices such as smartphones and tablets, implementing Serious Games [6].

The computer games have been increasingly mediated via mobile devices, such as smartphones, tablets and other touch-based devices. One of the main advantages is that they allow users to use multi-touch and gestures to receive rapid device feedback.

Studies suggest that computer-assisted instruction incorporating multimedia elements, and particularly, visually-rich elements, can be used to engage and effectively teach children with autism [7-9].

The Serious Games have been designed so that, besides their pure entertainment value, they convey relevant ideas or messages about various aspects not related to the gaming industry. A Serious Game is associated with the education and learning of new concepts and skills, but can also works as training and simulation of various activities of real life. In other words, a serious game should have an evident connection between the real and virtual world, and a purpose beyond the scope of just playing a video game.

The project will be aimed at individuals with autism themselves (who study or work) and people who work with them, such as psychologists, instructors, assistants and family members.

These specialists will be provided with objective reporting of activities through a single web application. This kind of information will help them to achieve greater influence on people with this disability.

2 Objectives

The overall objective of this project is to create an application composed of several Serious Games oriented towards first aid education, minor diseases, and knowledge of medical specialties, using Android operating system.

This general approach can be broken down into several specific objectives, as described below:

1. Develop a "Serious Game" aimed at learn how to deal with first aid situations in a fun and dynamic way.
2. Identify and evaluate a range of objective variables such as: the movements made by the user, the level of success or the time needed.
3. Design an interface that suits the needs of the autistic population, making use of ICT, specifically through the use of touch-enabled mobile devices such as smartphones and tablets.
4. Promoting e-inclusion: equal opportunities for access and participation of people with autism in the Information Society.

For the accomplishment of these goals and due to ethical constraints, consent forms were signed by the parents of all children participating in the experiment.

3 The Application

The architecture used to develop the application is a three-layer one. The main goal of the architecture is the segmented design, which separates the logical layer from the business layer. This means that tasks can be divided in order to work comfortably by levels, abstracting some levels from others and coming up with a big scalability and modifiability.

3.1 Architecture Description

The three layers are described below:

- *Presentation Layer*. The various multimedia elements making up the application are situated in this layer. They display and capture the user information in order to deliver it to the business layer.
- *Business Layer.* This layer houses the internal logical needed to provide core functionality of the mini-games. Having an independent business layer provides great adaptability to the application because it allows the incorporation of new mini-games to this Serious Game without compromising other system components. Each mini game is independent, although they can easily communicate between them.

  The resulting information is sent to be displayed in the presentation layer, on the phone screen, or to be used in concurrence with the database, to store all the data generated during the last session.
- *Database Layer*. This layer is made up of the database manager, which will back up the business layer in the storing and data-obtaining processes. In the database some parameters will be stored like the name of the user, the actual date and hour, the number of right and wrong combinations, time needed… etc.

The diagram of Fig. 1 explains in more detail how the application works:

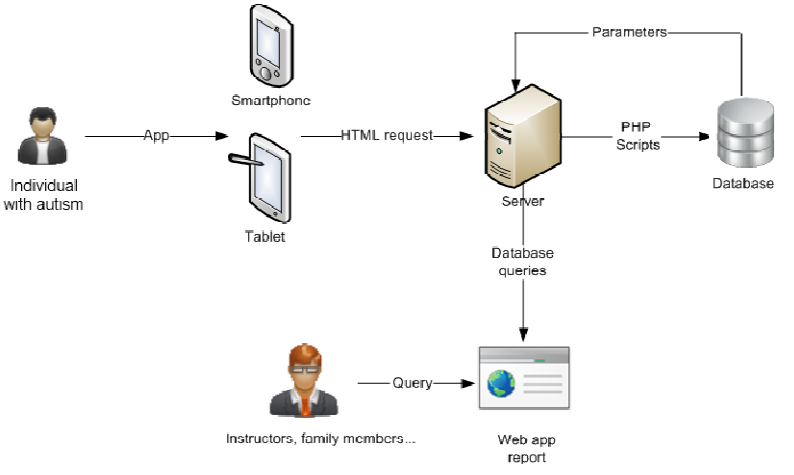

Fig. 1 First Aid Serious Game's General Diagram.

The logic of the application is as follows: First of all, the user has two sets of mini games or activities to choose from, each one with different levels of difficulty.

After finishing the activity, the application (from the phone) will connect to the server using HTTP / HTTPS connection requests. It will request access to the database, store the data generated during gameplay and finally update the record for that user, if necessary. Once the data has been saved, the application will generate a more detailed report about the user, explaining in which activity errors have been made, and what the reason might related to. The instructors can review the reports in a web page to evaluate the improvement grade and also assist them in real life activities for which they failed or had obtained a lesser score.

Encryption

Because private data about the activities of each user is sent through the Internet, it is desirable to encrypt this information.

This module is responsible for signing the data from your phone for later verification by the server, and decrypting the datagrams from the latter. This results, in a security layer for the obtained data to make sure no malicious theft can occur.

It uses an asymmetric encryption system, with a private key that is housed on the server and a public key in the application.

As an independent module, the encryption algorithm can easily be altered without much impact on the other modules of the application. Situations where this might be needed are a security breach or the emergence of more robust or optimized algorithms for mobile devices.

3.2 Description of Mini-Games/Activities

At the beginning of each mini game, the user will be asked to enter the name (like a login method) which will be referenced in the final report. They can also choose a picture from an avatar (an image from a girl, boy, a person who wears glasses, an student or worker) which identifies them during gameplay.

The application consists of two sets of mini-games:

- 1. Order the sequences (see Fig. 2):

It consists of ordering sequences of previously scrambled images being di played at the top of the screen. In order to guess the correct sequence, they can simply touch the images on the screen in the order they desire. The current order selected by the user will be shown in the bottom portion of the screen.

These sequences are related to various aspects of first aid such as: what to do when you get a cut, headache or what to do to call a doctor or to prevent a bur. All the pictures have a little explanation down.

The player will have a limited time to solve as many sequences as possible and get a good score. If the order is right, the user will carry on with more difficult sequences and finally he will obtain his score.

The user playing (or his/her instructors) can choose whether or not to include a time limit. The inclusion of this constraint should depend on the kind of person who is playing in the specific session, their autism grade and his/her level of stress while playing.

Upon completion of this activity and after storing the appropriate parameters in the database, a new report associated with that user will be generated. This report will state the most important data, i.e. everything which is necessary to help the family members or psychologists to know what sequences the user has difficulty understanding or interpreting.

- 2. Images association and medical specialties (Fig. 3)

In this game you are playing:

- To identify the roles of people in a hospital using the color of uniforms they are working in.
- To identify a medical specialty, by choosing which area of the body that it deals with.
- How to move inside a hospital or a health center identifying the indications inside.

The user will have to choose between different pictures, which appear randomly on the screen, which one has the correct association, by tapping the corresponding images. As in the other activity, choosing the right answer will lead to more difficult associations and the user can choose whether or not to include a time-limit.

3.3 Description of the Final Report

This part of the application is aimed at instructors or family members of a specific user. The main objective of this module is to show those people the continuous evolution of the users.

For the design of this module the MVC (Model View Controller) architectural pattern has been proposed. A web page has been created showing a table, with all the usernames that have played, will load. The names displayed here are identical to the ones input by the user at the start of the application. Each name is presented in the form of a link, and clicking it will cause data to be show regarding that specific user: i.e. date, total time, number of the failed sequence, number of errors in each sequence, total errors, time to resolve each sequence…etc. In addition, to prevent unauthorized access, an access control module has been added to the page.

4 Results

This section describes the results obtained in two facets: technical results and the feedback received from the user satisfaction questionnaires completed by the pilot users and experts.

- Test Execution

The users chosen by the experts to participate in the evaluation were 10 children and adults, both male and female.

All people who participated in the pilot demonstrated the ability to perform activities independently. However during testing, monitors were there to assist testers in case of problems.

Testing was performed using a smartphone and two tablets (with 7" and 10" screens).

- Technical Results

Individuals with autism are involved in different situations in their daily life, the game shows most of the typical ones.

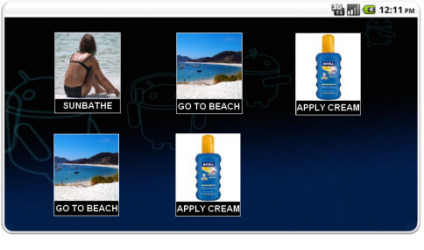

Fig. 2 Playing with the 1st mini-game

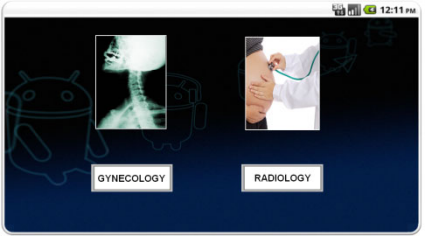

Fig. 3 Image from the 2nd mini-game

Whenever the user starts an activity, he is given instructions on how to play, after which the training exercise starts. The instructions are presented in the form a set of videos with additional written explanations, which the users are able to understand with ease.

- Satisfaction Results

The opinions from the instructors were sought in a simple personal interview, in which they were asked the following questions, answering on a scale from 1 to 5.

Table Instructors questionnaire

	QUESTION	SCORE (average)
1-	Did you enjoy using the tool?	3,0
2-	Was the user interface easy to use for individuals with autism?	4,0
3-	The instructor can easily understand the report?	3,5
4-	Is a good idea to use text and images in the video tutorials?	3,2

After the test, participants answered several questions, and following data were obtained:

- 70% of them prefer multi-touch screen to a screen with keyboard.
- 60% like using tablets with big screens instead of smartphones.
- 20% don't like to play with games or use smartphones/tablets.

5 Conclusions

The presented game is a project with real applications aimed at the collective of individuals with autism who has a high degree of independence.

When designing interfaces for learning games, developers should 1) not assume that individuals with autism have the same preferences as most people or 2) that autistics children are a "type," with rigidly defined characteristics. Autism is a spectrum disorder, which means that while affected individuals may show common learning challenges and strengths, they will do so to varying unique degrees.

The application has proved that it is possible to enrich and increase the education/therapy impact through the introduction of information and communication technologies.

Individuals with this disorder have accepted the mobile devices well, but the results are even better with the tablets because of their larger size.

After the experiment and the evaluation of the project, the following benefits can be underlined:

- Social Benefits:
- The concept therapy is changed by game concept, to improve the children motivation [10].
- With educational games, individuals with autism feel more relax doing the activities.
- Medical Benefits:
- The application collects some parameters relevant to the therapy, which permits an objective evaluation of learning/therapy process.

Specialists have recently been demanding that Serious Games of this kind be included in their daily practice because they provide a more recreational vision on activities assessing and measuring the progress of certain therapies.

This paper reflects only the first results. In the nearby future it will increase the number of people with autism who use the application and users will be extended to other groups.

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