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Serious games as an aid in the development of people with intellectual disabilities

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Abstract:

This article contains the description of a web application created in order to help children and adolescents with intellectual disabilities. The application gathers simple serious games that are supposed to be an addition to the daily therapy, widening and intensifying its results. The article starts with a quick review of already created serious games for people with the autism spectrum and the Down syndrome. Later, it focuses on formal and technical details of the chosen solution. The main part of the publication contains descriptions of the particular games created for the application. The article explains the rules of each game and depicts it with a screenshot from the application. Finally, the reader can find the results of the tests conducted with the help of the parents of pupils attending one of Cracow's special needs school. The tests, during which the children were encouraged to use the web application in their homes, lasted for a little more than 3 weeks. The final section also contains opinions of the therapists with more than 20 years of experience.

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Introduction

Nowadays, it is fairly easy to think about information technology (IT) only in terms of huge, rich corporations or, to be a little less pessimistic, in terms of more and more high-tech discoveries that allow us to have our duties done while we rest. It is important to remember, though, that the IT industry is also a great means to a beautiful and important goal – such as helping certain groups of people that really need it – uneducated children, people with diseases, the physically and mentally challenged – the list goes on. Of course, such help is being constantly provided – there are more and more mobile apps that can help to remind people of taking medications, various kinds of training provided via video tutorials, or even really sophisticated simulators that can help in recovery after accidents. There is one thing, though, which is too often – completely unfairly – omitted while naming other things that can positively affect people – serious games.

While there are various groups of people that could benefit from playing serious games, those who need it, in particular, are the mentally challenged. First of all, playing such games could allow them to learn and be trained on certain things more often and, as a result, make any kind of rehabilitation more intensive and eventually successful. Besides, it is often easier for autistic people to learn using computers or any other kind of electronic devices than by interacting with other humans. Of course, no kind of game or simulation will replace real-life situations, but in some cases, simplifying things may prove to be the best solution. And finally, even though there are already games focused on helping mentally challenged people, it is still not enough in terms of accessibility and diversity. Lots of them are also designed for preschoolers, which can be really discouraging for teenagers who still have difficulties with simpler tasks.

Keeping that in mind, the purpose of this project is to create a web application that would gather a large amount of simple games addressed to mentally challenged children and youth – primarily to those, but not only, with autism spectrum and Down syndrome. Games are supposed to be designed in such a way that everyone could benefit from them in terms of general development. Moreover, this article contains a quick review of already created solutions and a chapter describing a test phase of the mentioned web application.

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A quick review of existing solutions

Before diving into describing particular serious games, it would be good to define what it really means. While the “game” part of the phrase is pretty obvious (according to Clark C. Abt [1] it is “an activity among two or more independent decision-makers seeking to achieve their objectives in some limiting context”), it is the “serious” part that for some can prove to be confusing. However, the answer is really simple. There are many definitions, but almost all of them can be reduced to the one written in the article called “Classifying serious games: the G/P/S model” [2]: “Games that do not have entertainment, enjoyment or fun as their primary purpose”. There are many further divisions and classifications of serious games (one of them being the G/P/S model from the mentioned article), but it is the “not only entertaining” part that plays the most important role.

Although the situation is still far from ideal, there is a fair number of projects dedicated to designing games and simulations of real life for autistics. One of them has been described in “Facing the challenge of teaching emotions to individuals with low- and high-functioning autism using a new serious game: a pilot study” [3]. The authors of this project have designed a game called JeStiMuLe. It is designed for both high- and low-functioning autistics, and its main purpose is to teach emotions. The games use various kinds of means to achieve that – they not only teach to recognize a certain expression by the look of someone’s face but also by connecting this very expression to some words or pictures.

Similar approach is used by a group led by Erini Christinaki [4]. In the game they have developed, emotions are also depicted not only by facial expressions but also by various words and pictures. In addition, the game is very minimalistic (mainly black and white colors, very little possible distractions), and its players can control it using Microsoft Kinect, not the keyboard or mouse. The research conducted by Sofiane Boucenna [5] and her colleagues proves that computer games are very good for autistic people due to their stability and predictability. Also, as can be read in this research, using such tools as Microsoft Kinect or any kind of virtual reality device simplifies the interaction, as it is more natural.

There are, of course, also games for other mentally challenged people – like those with Down syndrome. The best example would be a series of games called EnCity [6], which consists of various real-life situations which have to be dealt with by the players. The range of these tasks is really wide – from preparing a simple meal to paying the bills. The bottom line of this project is that mentally challenged persons can treat it as a kind of play, and they do not have to be afraid of the results, so they can try to do it as many times as they want.

It may be concluded from the examples above that serious games are only simulations of real-life situations or basically interactive school tasks. But that is not always how games for mentally challenged people look. It is certainly not the case with Millie Moreorless – a game designed and developed by siblings who grew up having a little brother with Down syndrome. With a little bit of help from the brother they created a game set in space in which a player has to overcome obstacles – walls and holes. In order to do so, he must choose – accordingly – pictures with a smaller and higher number of various things. In this example, the “fun” part of the game is clearly more important, but still, players can learn simple mechanics on which mathematics is based on.

Designing the application

In order to make sure that the application gathering serious games for mentally challenged people is accessible for the biggest audience, it has been decided to create an internet website. Thanks to this solution, it can be accessed by almost anyone from any place with internet access – no matter if this person is using a laptop, tablet, or mobile phone. To achieve this, the web application was of course designed and implemented with attention to responsiveness and usability. Wider description of used tools and created features can be found in the master’s thesis “Gry poważne w kontekście rozwoju osób z niepełnosprawnością intelektualną” (Serious games in terms of the development of people with intellectual disabilities) [7].

The website has been created with tools including but not limited to React, Express, and MongoDB. The decision to choose them has been made not only due to their flexibility but also because of their popularity. Creating such a platform is certainly possible when working alone, but to keep it running for a longer period of time, it would be preferable to have a community support. That would mean adding not only new questions or tasks but also programmatic support with creating new games or maintaining the website. That is why using common solutions and tools is so important in this project.

Following the trail of games mentioned in the previous chapter, all the games created for the application are rather minimalistic in terms of design and focused on securing the best possible game experience. That includes limited colors used in images illustrating particular tasks, as well as the possibility to change the background hue from three possible options. This way, every player can personalize his own experience and choose the settings that suit him best. In order to remember the fun elements in the games, after each correct answer, the

player sees an animation of a vibrating star and hears an encouraging sound. Sound can be turned off though. It is also possible to choose the number of tasks for each game so that no one would have to spend too much time using a computer or any other electronic device. Finally, all key words and sentences in the game can be heard by using the speaker button present in every in-game screen.

As for the particular tasks used in the games, they were all consulted with a therapist who has a lot of experience in working with children with special needs and are based on actual exercises which are being done during the therapy or inspired by games found during the research. It is because this project is not supposed to design some new innovative games or techniques of therapy but create an environment whose purpose would be to increase the results of treatment and make sure that people with special needs have access to training not only during classes but also during their free time.

Games created for the application

All games designed for the web application were meant to be simple, possible to finish in a few minutes, and positively influence a general evolution of the player and yet be focused on a certain branch of development. Hence, there is a game focused on basic mathematical skills, as well as a game that teaches grammar or helps to understand descriptive sentences. Detailed description of each game created for this project's purposes can be seen below. Further information concerning these games can be found in [7].

Mathematical game

In this game the player is supposed to choose a picture with a greater number of elements. The schema is of course inspired by the previously mentioned game "Millie Moreorless". The elements are things like skateboards or mobile phones, which are more familiar to young people, who are the target of the game. After choosing the correct picture, the player is supposed to count the elements and choose the correct number. Pictures used in this game come from the website flaticon.com.

Speech therapy game

This game is meant to help the players to distinguish similar phones in the Polish language. That is why at first the player is supposed to arrange three different words from scattered phones and, finally, having all three words in one picture, match missing phones to the correct word. In this game, pictures also come from the flaticon.com website.

Understanding sentences game

It is the most complex game in the application, mostly for high-functioning autistics. The player sees a picture depicting a simple real-life situation and a sentence describing it. Based on it, he is supposed to answer four questions about different parts of the sentence – subject, predicate, complement, and modifier. Then, after the sentence vanishes, the player is supposed to recreate it from scattered words.

Grammar game

In this game, similarly to the second one, at first the player is supposed to arrange a word from scattered phones. Later, the player is asked to choose the correct grammatical version of a word and put it in a not fully written sentence.

Tests of the application

The tests were conducted [7] with the consent of parents of 11 pupils attending one of the special needs schools in Cracow and lasted for 3 weeks. The parents were asked to encourage their children to use the application

after school and were supposed to fill the survey at the end of the phase test. At the same time, children were using the application during classes with therapists from the mentioned school. The therapists were also asked to write an opinion about the application.

The survey showed that the children were using the application very willingly for the whole period of the test-phase. Usually, it was 2–3 times per week. Moreover, almost everyone (10/11) used a laptop or a computer at least once, a little less than a half (5/11) chose a tablet, and only one child was using a mobile phone. The therapists, on the other hand, agreed in their opinions that this application can be really helpful due to the fact that children tend to do electronic exercises more willingly. It is also really important that they can do them at home with little caregiver involvement.

In general, it may be concluded (not only from the survey results but also from private conversations) that such a platform would be a great addition to a daily therapy and would increase the results of the children. Effectiveness of the exercises has not been measured due to too few examples and too short period of time, but all tasks were designed based on already existing quests so that should not be a problem. The aim of this project was to show that the children would use such tools willingly and that this application would allow them to exercise much more often than they have done so far.

The presented platform was tested by students of the second year of medicine at the Jagiellonian University's Medical College during the course entitled "Telemedicine with Aspects of Medical Simulation"



Figure 1: Screen from mathematics game [7].



Figure 2: Screen from speech therapy game [7].

The task on this picture is to assign phones to correct words. Correct solutions (beginning from the left picture): CIASTKO (a cookie), CYTRYNA (a lemon), and CZAJNIK (a kettle).



Figure 3: Screen from understanding sentences game [7].



Figure 4: Screen from grammar game [7]. The exercise here is to put the word “ulica” (a street) in correct grammatical case into the sentence, which says “The boy is walking down the street”. Possible answers are: “ulicy” (a street in the dative), “ulicą” (a street in ablative case), or “ulicę” (a street in the accusative). The correct option is the second one.

Devices on which the application was used

- Mobile phone and tablet
- Laptop/computer and tablet
- Only laptop/computer

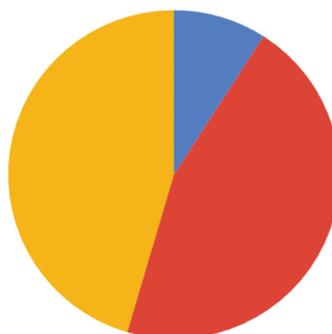


Figure 5: Chart showing percentage of devices used to play the games [7].

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