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# An approach to diagnose cognitive deficits: gamifying ADHD children diagnosis questionnaire

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## **Abstract**

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common childhood disorders is affected 5.9% to 7.1% of children. inattention and lack of concentration, doing the excessive activity, having impulsive behaviors are the problems that ADHD children suffer from and can affect different aspects of the children's lives such as Learning, educational growth, social skills development and etc. therefore it seems that early diagnose of ADHD can prevent the number of negative impacts on their life. level of motivation is an ADHD children assessment issue. by gamifying the traditional approaches, we can motivate children to participate in the diagnostic test. The purpose of this study is to design a game to diagnose ADHD in children between the ages of six and eight years. In this paper, we present an assessment tool that is being developed to diagnose ADHD children by gamifying standard and clinical questionnaire

## **Author Keywords**

ADHD; Diagnostic tool; serious game; gamifying

## **ACM Classification Keywords**

J.3 - LIFE AND MEDICAL SCIENCES: Computer Applications

## **Introduction**

One approach to assess ADHD in children is their behaviors based diagnosis. In this approach, Psychologists and experts diagnose ADHD by assessing the questionnaires which filled by parents and teachers or observing child behaviors in the cognitive test [1, 2]. There are some problems with this approach including the tedious, rigorous and repeatability of the assessment process, the lack of positive feedback [3], Hawthorne Effect [4] and disagreement between teachers and parent's answers to each question [5] Due to the extensive use of games and various game features, such as the motivation and attraction, by gamifying the questioners it can be possible to diagnosis ADHD based on their behaviors. In this work, we are attempting to develop a serious game in order to set up a diagnostic tool by gamifying standard and clinical questionnaire. In section 2 we give a short definition of ADHD. In section 3 the game as a diagnostic tool is noted. Relying on our studies in this field, our approach is illustrated. In final section outlines of this project are explained

## **Game as an ADHD diagnostic tool**

Games by using their attractive stories, rewards, and challenges can provide a situation in which players can get a good experience that is hard to get it in their daily life [6] games have different genres; they have been designed for different purpose. One of the game's genre is a serious game. In this genre, the goal is not just an entertainment. The game is designed for a special purpose such as learning, advertisement, training and etc [7]. According to Pascal and et al, in 2012, one usage of the game is employing them as a diagnostic tool by implementing traditional tools and psychological tests in the form of a game, by increasing the Children motivation we can diagnosis ADHD at the early age [8].

## **Current Project Approach**

In this section, we illustrate the steps will be taken to develop a game as a diagnostic tool Based on the valid ADHD diagnostic questionnaires. In order to assess and diagnose ADHD, different aspects such as working memory, response inhibition, executive functions, time estimation, reaction time and waiting behavior should be investigated. As mentioned above, the ultimate goal of this project is to design a serious game to diagnose ADHD. This game must be able to classify players into three groups: healthy children, children with the disorder, and children suspected to have the disorder. specific purposes of this project are keeping and increasing the children's motivation, Diagnose ADHD at the early age and have a game that both ADHD children and control group can play it. To reach these goals, we will use research through design and iterated extensively in the design and development phase, which have five phase. It is worth to mention that in this project the order of phases is important. If there is a problem in each phase Backtracking method will be used. This means that, during the project life cycle, in each phase may be necessary to go back to the Previous phase to fix the problems.

### *The first phase: writing scenarios*

designing a game according to ADHD symptoms makes it necessary to do a comprehensive study on ADHD questionnaires. By the time the ADHD statements were categorized, the various possible scenarios have been written

### *the second phase: game design*

When the scenarios are gotten confirmation, the mini-game will be designed. in the design phase, participatory design model (PD) and a user-centered design approach (UCD) will be used to understand and realize what children are really like. Participatory design model will be used to make it more user-friendly and final game meet users need.

#### *The third phase: implementation*

In implementation phase which is the longest phase of the development lifecycle, we have two main steps: development and debugging. In a first step, by using the appropriate game engine, we will start to develop the game. Mini-game modeling, log system implementation and graphics and sound design are the main processes of this step. After the game development is completed, debugging step will start. In this step, any error or bug will be detected and debug will be done. If there is a problem Backtracking method will be used.

#### *The fourth phase: calibration*

We want control group whose health status is clear, to play the game. Their performance during the game will be saved without them knowing about it. By using the artificial intelligence approach such as machine learning technique on the data which have been saved in the log file we will design the diagnosis model.

#### *The fifth phase: test*

In order to test the game and estimate of its accuracy to diagnose ADHD, we will select a community as a control group. A control group is a group of children aged between six and eight who have been diagnosed as having Attention Deficit Hyperactivity Disorder or being healthy through clinical evaluation tests. Through comparing the results of our game with the traditional methods the game's accuracy will be investigated.

#### **Pilot study: AGE1**

As a pilot project, we have been successful to design a game to diagnose ADHD in children based on 18 statements of DSM-IV. AGE1 consists several mini-games. Each mini-game can measure different cognitive functions depend on ADHD symptoms have been gathered in DSM-IV. For example, all irrelevant mouse clicks are measured and thus give information on impulsivity and hyperactive behavior of the child.

Furthermore, the following mini-games are assembled to assess different impairments (symptoms). In the following, one of the mini-games is described.

#### ONE OF THE MINI GAMES

In this mini-game 16th statement of DSM-IV, ADHD questionnaire was gamified. This statement expresses a situation in which the child often blurts out answers before a question has been completed. To gamify this statement, a story which describes a street is told to the player and three different pictures is shown on the screen that one of them are related to the story. Game character is asked the player to listen to the story and choose the right picture. Although, the player can choose the answer during the story is being told, if he/she wants to choose the right one, he must listen to the story until the end. Player's score is calculated based on his choice and response time.

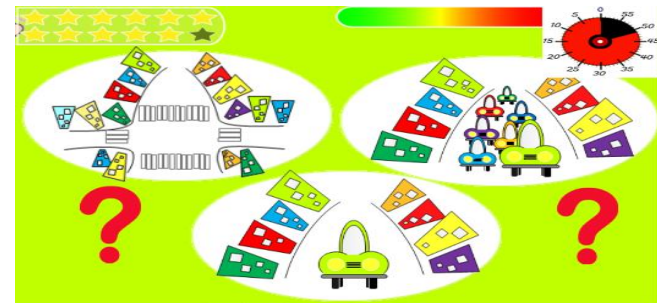


Figure 1. Screenshot of the 8<sup>th</sup> mini-game

#### **Outlines**

At the end of this project, we have a game that can engage children to participate in the assessment test. This game will be configurable. ADHD children are categorized into three types so by configuring the time

and difficulty of each level, we can get more accurate diagnostic information.

### Conclusion

Experts and Psychologists use different approaches to diagnose ADHD. one approach to diagnose ADHD is gamifying the traditional diagnostic tools. In this article, our approach to gamifying a clinical test such as different questioner based on the DSM-IV is presented. In our opinion game can be an effective tool to use as a diagnostic tool. Previous studies in the field of diagnosis through the game imply that It is not far from reaching the desired result by using gamified questioners.

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