HTKS Game for executive functions disorder using NAO Robot

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ABSTRACT

This paper proposes the incorporation of Head, Toes, Knees, and Shoulders (HTKS) task switching game using NAO robot for children affected from Executive Functions disorder. In HTKS game children will be instructed to touch either their head, knees, toes or shoulder by imitating the actions performed by the NAO Robot. We have implemented the HTKS task switching game using Choregraphe and python. Following the game, we have implemented evaluation system using Kinect camera and unity engine to evaluate whether children are performing the task correctly. This therapy targets executive functions such as cognitive controls which compromises of attention control, inhibitory control and working memory.

Categories and Subject Descriptors

• Human-centered computing~HCI design and evaluation methods *• Human-centered computing~Interface design prototyping*

Keywords

Executive functions; HTKS; attention control; Nao; Robot;

1. INTRODUCTION

Children learn and remember more with games, especially games with a toy kind of robots [2]. Creating such games with robots, can easily attract their attention [3]. NAO robot is one such robot and it embodies several sensors such as tactile sensor, two cameras, infrared, inertial sensor, sonar, microphones. We have implemented HTKS (Head, toes, knees, shoulder) task switching game using NAO robot for children to aid them in treatment for executive functions disorder(EFD). EFD effects the children's social interaction, particularly in their early ages and it requires effective therapies (Fridin, 2011). The goal of the proposal is to improve the effectiveness of the therapy which is being offered by specially trained educators and psychologists.

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1.1. Executive function

Executive function a set of mental skills that helps you to manage time, pay attention, switch focus, plan and organize, remember details, avoid saying or doing the wrong things and do things based on your experience. Basically they encompass the skills required to plan, organize and perform a particular task as planned. The plan may demands taking a single, or various combination of multiple actions.

2. PILOT STUDY

We have conducted a survey among 26 test users of age between 22 and 30 and got feedback as follows.

- 60% of them accepted that games will capture the attention of kids effectively.
- Kids following the robot will be more effective than direct instruction.
- HTKS game can be considered as therapy to improve behavioral control in early childhood [1].

3. HTKS GAME

Children are asked to play a game in which they will be instructed to touch either their Head, Toes, Knees, or Shoulders. The game has two levels of difficulty.

- Level 1: In this level, first set of tasks will be swapped. For example, If Head and Toes will be swapped, the children have to touch their toes whenever head is called and similarly the opposite way for the toes, they should touch their head.
- Level 2: In this level knees and shoulder will be included to increase the complexity of the game. If children are asked to touch their knees they should touch their shoulders and similarly the opposite way for the shoulders, they should touch their knees.

As shown in Figure 1, a child is performing the task switching game.

Figure 1: Children performing HTKS game during a therapy session. (Cameron Ponitz et al., 2008)

If the children successfully pass level 1, then level 2 will be played. The HTKS task has been conceptualized as a measure of inhibitory control [1]. The child must demonstrate dominant response of following the instructor's actions, attention focusing: children must listen and follow the directions being presented by the instructor and working memory: a child must remember the tasks that have been swapped.

4. IMPLEMENTATION

4.1 Choreogrphe

To work with the NAO robot, we used Choregraphe 2.1.4. Choregraphe is a multi-platform desktop application which allowed us to create animations and behaviors, and test them on a simulated robot. Using Choregraphe, we recreated all the physical positions which included touching head, touching toes, touching hips, touching knees and few more interesting behaviors to make it interesting for the children.

4.2 Task Switching

The task switching logic was implemented using python script and the python script was connected the user interface. As shown in figure 2, is the screenshot of the interface developed for the instructor. The instructor can drag and drop the tasks that needs to be swapped and can set the number of times, the task has to be performed.

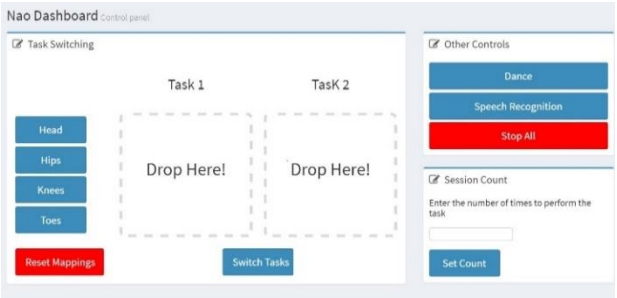

Figure 2: User interface adding a level of difficulty with task -switching

4.4 Evaluation

We have implemented a framework using Kinect camera and Unity Engine to evaluate whether the kid is performing the activities correctly. There will be a Kinect camera setup to monitor the activities of the kid in live. It will be fed to the unity engine. Unity engine has a C# script mapped to it in the backend to match with the predefined positions. By this way we can monitor whether the kid is performing the actions correctly. Figure 3: Is the snapshot of the evaluation program developed in the unity engine.

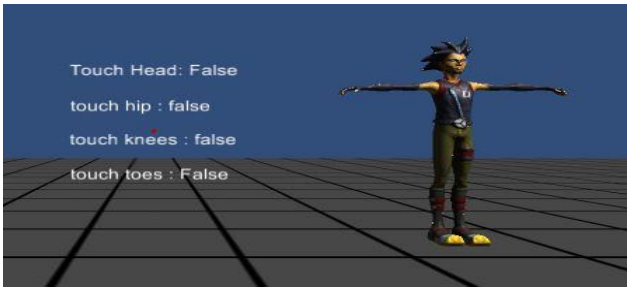

Figure 3: Evaluation program to identify whether the kids are performing correctly

5. PROPOSED FRAMEWORK

The game has an easy level comprising of the simple HTKS movements. The robot will be placed in front of the child in standing position. The exercise will begin with the physician setting the session count and starting the exercise. The child will copy the actions of the robot and the accuracy will be observed by the physician. After the child getting accustomed to the normal task like touching the head, hip, knees and toes, the first level of the game can be started. In the first level the instructor can add a set of tasks to be swapped. For example: A swap between head and toes would ask the children to touch their toes when head is called and to touch their head when toes is called. This makes the instructions harder to follow and challenges the children suffering from executive functions disorder. If the kid passes this level the instructor can move to next level by adding one more swap to make it harder. So in the second level knees and hip will be swapped, so children have to touch their knees when his is called and to touch their hip when knees is called. This swap will be added along with the swap added in the level one. All these actions will be recorded in live using Kinect camera and will be checked whether the kid is performing the tasks correctly or not. The correctness of the activities performed by the kids will be displayed to the instructor after the task is completed.

6. CONCLUSION

In this paper we have created a HTKS game with NAO robot that helps with therapy for children suffering from executive functions disorder. We have implemented this project based on the inputs collected during the pilot study. We will be working on it in the future to improve the video recognition technique used in the evaluation function. We have planned to test the system we developed with the children in the near future to see the results in real scenario.

7. REFERENCES

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