Automated Assessment System for Embodied Cognition in Children

(Project Proposal - Computer Vision)

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1 Abstract

The main idea of this project is to automate computer vision system in understanding cognitive abilities in children. We plan on building an automated assessment system for Activate Test for Embodied Cognition (ATEC)[1], a test which measures cognitive skills through different physical tasks. More specifically, we focus on the Ball-Drop-to-the-Beat task and implement vision and deep learning techniques to identify if a child is correctly performing the task or not. The ground truth to test our models would be manual annotations for the video frames. The main goal is to classify which of the given tasks is performed by a child.

2 Introduction

There are different ways to assess cognitive abilities in children and one of them is to make use of executive functions for analysing if a child has any kind of Attention-Deficit/Hyperactivity Disorder (ADHD). Executive functions [2] are high-order cognitive processes involved in multitasking, time management, attention, planning, inhibition, self-regulation, and memory. Children with ADHD exhibit weaknesses in executive functions, specifically response inhibition, planning, vigilance, and working memory.

We already have the visual data collected from different children and will work on implementing computer vision and deep learning methodologies to build an automated system that classifies the correctness of a task performed by a child. The data has been collected by placing a camera in front of a child performing certain tasks. The task we are interested in is called the Ball-Drop-to-the-Beat[1] task. Here, the child has to perform one of the three different movements: Pass the ball, Raise the hand with the ball, and Do nothing. We plan to identify

these movements by training a classifier model that classifies a video segment to one of these classes.

Our initial focus will be in training CNN models on top of RNN layers and also applying different image processing techniques to enhance the inputs to our models. The other techniques that can be implemented for enhancing results would be pose estimation[3] of children and using body key points to track their movements. By doing this, we can trace the ball or wrist joints of children to see if they performed the task properly or not. The scope of our project is contingent to the progress made through the semester.

3 Work Division

This is the initial planned work division for the project and may change as the project progresses:

Ashish: Work on data preprocessing and deep learning models

Lalit: Work on image processing techniques to enhance performance of the models

References

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[2] Joel T Nigg Stephen V Faraone Erik G Willcutt, Alysa E Doyle and Bruce F Pennington. Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. pages 1336–1346, 11 2005.

[3] Tomas Simon Shih-En Wei Zhe Cao, Gines Hidalgo and Yaser Sheikh. Openpose: realtime multi-person 2d pose estimation using part affinity fields. 2018.