NEW YORK INSTITUTE OF TECHNOLOGY

# Emotion Recognition Assistance for Children with Autism

## Proposal

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New York Institute of Technology
March 9th, 2022

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## Introduction

Autism spectrum disorders (ASD) affect the brain structure and impact the development of the child. In other words, they do not have the ability to fully comprehend emotions and tend to lack social awareness. With standard therapy there is a progression in emotional intelligence in the users, however, children still have difficulty in noticing more subtle expressions. As a solution, interactive applications can help autistic children learn about different emotions and gain better social skills. With an emotion recognition application, children with autism can learn and practice recognizing facial expressions. This would help in their development and navigation of social situations. Therefore, the goal of our project is to create an enhanced interactive educational application to improve the emotional intelligence of an autistic user.

## Background

In this project, we will use datasets and machine learning to develop an application that can detect and classify facial expressions. We will gather datasets consisting of facial expressions and, with feature extraction, we will determine the emotion shown according to facial landmark points. For the front end design, we plan to create a simple and engaging interface. Our target audience are autistic children, therefore, the app must look appealing and easy to use.

The primary goal of our application is to be educational for users. Users have the ability to look at an image or video and the app will tell the user which emotion is being displayed and details why. For example, if the image shows a person smiling, the app will say that the emotion is happy and state a smile indicates this emotion. The remainder of this paper highlights the features and methods for the project.

## Motivation

Autistic children lack the ability to understand the emotions of others or acknowledge their own. Despite the physical complications, autistic children can gain an understanding of emotions through behavioral and social therapy. An application that simulates different behaviors and teaches children about the emotion being expressed on the screen would be helpful in adjusting and learning to navigate social environments.

**Existing Studies**

Noldus Information Technology offers FaceReader. This system uses a deep learning algorithm with artificial neural networks to identify face models and categorize the facial expression. According to the white paper written by Dr. Leanne Loijens and Dr. Olga Krips, the program can classify facial expressions ranging from happy, sad, angry, surprised, scared, disgusted, and neutral as well as arousal and valence. It is possible to account for custom expressions. FaceReader also includes models for East-Asians and babies. Additional modules can be added for facial expression analysis, muscle group usage for facial expressions, and blood volume changes for heart rate measurement. It does not distinguish between staged and genuine expressions either. Unfortunately this program is not readily made available for everyone as a quote must be requested with a specified description for the intended use of FaceReader. An online version is available at the cost ranging from $2,420 to $10,340 per year for usage with full service insight reports as an additional cost. This version utilizes Microsoft Azure, adding even more costs to use. While Noldus' FaceReader shows potential, the costs to acquire and use the technology make it difficult for the average user.

**Proposed Idea**

Our idea is to use machine learning and feature extraction to detect facial expressions and accurately classify the data. A feature of the application we plan to implement is an analysis of facial expressions and output to the user the emotion displayed. In addition, as mentioned in the introduction, many autistic children struggle to distinguish subtle facial expressions. To help educate children, we would like to implement different levels of emotion recognition. For example, the first level teaches kids about happiness using an image of an individual with a large visible smile. As the child progresses through the levels, the facial expressions become more subtle when expressing emotions, which helps the child gain a better understanding of real world encounters.

Another feature is a quiz to test the child's ability to recognize emotion. The quiz can be arranged into levels (easy, medium, hard) and will display an image or video, then the child must select the correct choice of emotion shown. The results of the quiz are displayed under the "Profile" section of the application. In addition, children learn best when they are fully engaged in the learning process. Therefore, we plan to create a game within the application that

challenges children to practice their own facial expressions. In the game, the child is given a word of an emotion to express and they will make the face using their camera. The application will then scan the child's face and determine if the child is making the correct expression.

**SE Model**

We will use the spiral model with aspects of the V model. While mitigating and managing risk, we will provide verification and validation every step of the way. When something is created, we will have another person give it a quality assurance lookover before moving on to the next item in the timeline.

This combination of development models is likely going to slow us down, but it will provide us with the best possible product immediately upon deployment. If the app has many bugs upon release, there may be less trust and interest from the user. The constant verification and validation while mitigating risks every step of the way will ensure the creation of a stellar product.

**Model**

In the project, emotional recognition will be performed using machine learning, specifically, neural networks are used to recognize patterns. Facial expressions are determined according to the way certain features are positioned. For example, narrow eyebrows represent anger and upwards eyebrows represent surprise. With a neural network, the images in the training data will be used to train the network to detect different emotions.

**Tools/ Technologies**

The tools we plan to use for this project will be Java with the Weka3 and OpenCV libraries, and Python for machine learning.

**Dataset**

This is the dataset we are considering for the project.
**https://www.kaggle.com/chiragsoni/ferdata (has test and training sets)**

**Users**

The application targets children with autism. With the quiz and facial recognition features, children can practice their own facial expressions and gain more of an understanding of emotions.

**Timeline**

Week 1. Choose a project topic and a SE Model to be used throughout project development

Week 2. Using model, create plan for the necessary features in our application. If we have time, we can add additional features. Decide on the technologies/tools and begin learning the tools.

Week 3. Software development

Week 4. Meet on a regular basis or as needed to discuss project progress or issues. Continue software development and documentation.

Week 5. Test application and apply any fixes if needed.

Week 6. Prepare a presentation and report.

Week 7. Present.

**Resources**

[1]"MorphCast - Best Face and Emotion Recognition AI SDK | Face Recognition Javascript", *MorphCast*. [Online]. Available: https://www.morphcast.com/sdk/.

[2]S. Rucker, "Emotion Demo", *GitHub*. [Online]. Available: https://github.com/kairosinc/api-examples/blob/master/python-demo/static/docs/emotion/Emotion.md.

[3]"Micro Expressions Training Tools", *Paul Ekman Group*. [Online]. Available: https://www.paulekman.com/micro-expressions-training-tools/.

[4]"Face Recognition Features from Kairos", *Kairos*. [Online]. Available: https://www.kairos.com/features.

[5]"Autism Spectrum Disorder", *National Institute of Mental Health (NIMH)*. [Online]. Available: https://www.nimh.nih.gov/health/topics/autism-spectrum-disorders-asd.

[6] Forkyknight, “Facial emotion recognition,” *Kaggle*, 30-Jul-2020. [Online]. Available: https://www.kaggle.com/datasets/chiragsoni/ferdata.

[7] Maenner MJ, Shaw KA, Bakian AV, et al. *Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2018. MMWR Surveill Summ 2021;70(No. SS-11):1–16. DOI: http://dx.doi.org/10.15585/mmwr.ss7011a1*