Detection of Autism Spectrum Disorder from a Facial Image using Artificial Intelligence

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OUTLINE OF PRESENTATION

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MOTIVATION

What is Autism Spectrum Disorder?

Autism Spectrum Disorder (ASD) is a broad range of lifelong developmental and neurological disorders that usually appear during early childhood. Early detection of Autism, along with treatment, is crucial to minimize some of the difficulties and symptoms that people with Autism face.

Specialists use techniques such as behavioral observation reports, questionnaires, and a review of the child's cognitive ability to detect and diagnose Autism in children. These screening methods can be time consuming for some families, and even too expensive for low income families.

Considering these factors, I was motivated and inspired to develop an inexpensive but accurate program, that would aid in the detection of Autism at its early stages. With all the technological advances in Artificial Intelligence, we believed that utilizing Artificial intelligence would be a great way to develop this program.

MOTIVATION

Many researchers believe that there is a correlation between facial morphology and Autism Spectrum Disorder. Some of these facial features are wide-set eyes, short middle region of the face, and a broad upper face. Image one provides an example of the facial feature differences between a child with Autism and a child without.

Image 1: Image of Child with Autism (left) and Child with no Autism (right).

MOTIVATION

Goal : The goal of this project is to propose an accurate model that can be used to detect the presence of Autism in children based solely on a facial image analysis.

A deep learning algorithm will be used to develop this inexpensive, accurate, and effective method to detect Autism in children.

MODEL : CONVOLUTIONAL NEURAL NETWORK (CNN)

A Convolutional Neural Network (CNN) is the foundation of most computer vision technologies (1). Unlike traditional multilayer perceptron architectures, it uses two operations called ‘convolution’ and pooling’ to reduce an image into its essential features, and uses those features to understand and classify the image (1). The essential building blocks of Convolutional neural network are (1):

• Convolution layer: A “filter”, sometimes called a “kernel”, is passed over the image, viewing a few pixels at a time. The convolution operation is a dot product of the original pixel values with weights defined in the filter. The results are summed up into one number that represents all the pixels the filter observed (1).

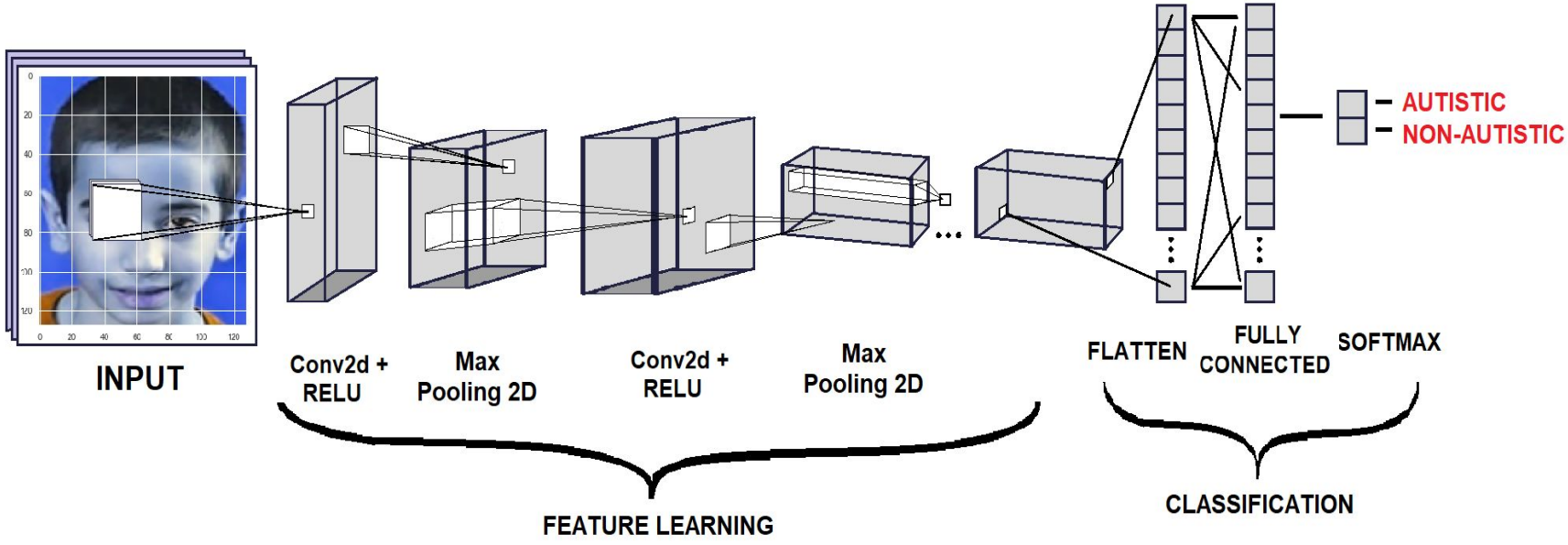
• Activation layer: The convolution layer generates a matrix that is much smaller in size than the original image. This matrix is run through an activation layer, which introduces non-linearity to allow the network to train itself via backpropagation. The activation function is used is the **rectified linear activation function** (ReLU) (1).

• Pooling layer: “pooling” is the process of further down sampling and reducing the size of the matrix. A filter is passed over the results of the previous layer and selects one number out of each group of values. This allows the network to train much faster, focusing on the most important information in each feature of the image (1).

• Fully connected layer: A traditional multilayer perceptron structure. Its input is a one-dimensional vector representing the output of the previous layers. Its output is a list of probabilities for different possible labels attached to the image. The label that receives the highest probability is the classification decision (1).

ARCHITECTURE

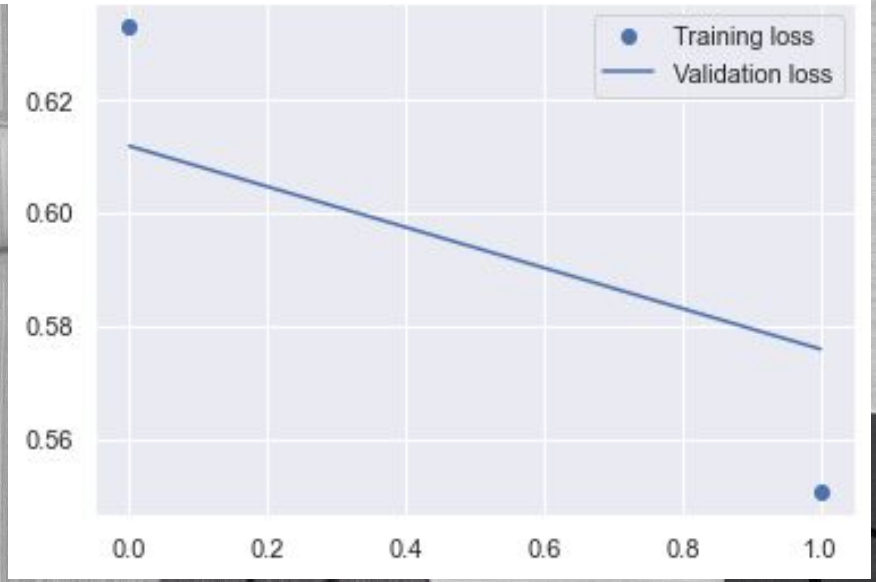
Figure 1: Architecture of utilized Convolutional Neural Network Model.



RESULTS

Figure 2: Results after Execution

This image shows the validation accuracy and loss, and the training accuracy and loss.



Training Accuracy: 0.719
Validation Accuracy: 0.68

Training Loss: 0.55
Validation Loss: 0.576

CONCLUSION

- This work aimed to deliberate on developing a classification model on a dataset of pictures utilizing deep learning methods like convolutional neural network.
- The accuracy received from the model was approximately 68%. We aimed to obtain 95% accuracy.
- More work on the current study could provide a novel way to deal with diagnosing Autism with the facial picture, which can be utilized as a kind of perspective for future examination.
- In the future, this CNN model can be used with a larger dataset and combined with transfer learning to obtain better accuracy. This would create a much better model that could potentially be used to detect Autism in children.

TAKEAWAYS FROM REU EXPERIENCE

- By participating in this program I was introduced to whole world that I never knew existed.
- I have learned to work with various programs such as python, nanoHUB, visual studio code, and jupyter notebook.
- Lastly, I have learned how to challenge myself, and push to the end despite any challenges.

- Link to my project: https://github.com/cybertraining-dsc/su21-reu-378/blob/main/project/index.md

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REFERENCE

(1). Jahanara, S. and Padmanabhan, S., 2021. Detecting autism from facial image. Volume 7, Issue 2 - V7I2-1181.

Thank You For Listening!