IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

FACE EMOTION BASED TRAINING SYSTEM FOR CHILDRENS WITH AUTISM

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Abstract. : As of today, children diagnosed with Autism Spectrum Disorder (ASD) are becoming an increasingly common occurrence in our schools and society. Consequently, this increases the need to develop assistive devices for ASD children. This paper shows the development of a system designed to facilitate learning in ASD children. This Arduino- based game is equipped with common components such as touch sensor, MP3 player and LEDs to increase replicability. A research was done based on the Early Intervention module to develop a game that could help improve cognitive skill of ASD children. Early Interventions for children with ASD has proven to be effective in reducing ASD symptoms. With the advancement of technology, a wide range of auto- mated tools are now used to teach children with autism. One of the widely used therapies for children with Autism Spectrum Disorder is Applied Behaviour Analysis (ABA) training that focuses on improving a wide range of behaviours like communication, adaptive learning skills, social skills and a variety of motor skills. Thus, the objective of this arti- cle is to design and develop a gaming application for autistic children for improving their cognitive skills The cognitive development (in terms of gaming scores) of a child over the time can be stored and analyzed using this application. A light-weighted evaluation study was carried out; and found that the proposed gaming application is usable, effective and useful for autistic kids to improve their cognitive skills.

Keywords: Autism spectrum Disorder ASD, Assistive Devices, Face detection

1. Introduction

Autism spectrum disorders (ASD), is a neurological disorder that affects social interaction, communication, and behaviors. ASD children may display behavior that is repetitive or rigid during play. For example, a toddler with ASD may spend more time arranging their toys in a particular manner instead of actually playing with the toys [1]. The Centers for Disease Control and Prevention (CDC) estimate that “the global prevalence of autism increased twentyfold to thirtyfold since the earliest epidemiologic studies conducted in the late 1960s and early 1970s”, by early 2000s the prevalence rates increased to 1-2 in 100 children [2].

As the term spectrum already means “wide range”, it is a disorder in which their symptoms and severity vary widely across the core characteristic symptoms, meaning that not everyone will have the same symptoms. They may share similar difficulties while growing up, however these symptoms affect their lives differently.

No two individuals with autism are the same, each of them will have different degree of difficulties. [3] . There is no medical cure that can help ASDC to permanently make their symptoms disappear. Currently, various methods of interventions, mainly behavioral are currently used to help these children. The most common method of early interventions (EI) are Applied Behavioral Analysis, Sensory Integration Therapy and LEAP.

Behavioral intervention has This proposed system helps to improve Autism children behaviour as they often observe their facial expressions and predict facial emotion. If the Predicted facial Emotion is happy, then we will play some Interesting Audio to them using Python Audio API . Cognitive skill development is an essential phase of any child's gradual growth process which primarily involves building attention, memory and thinking. Chil- dren with autism are the ones who go through a different development cycle than the ones who are normal by birth. Autism or Autism Spectrum Disorder , refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviors, speech and nonverbal communication . The common thread are the differences in social skills, communication, and behav- ior compared with people who aren't on the spectrum

2. Scope of Project

Scope of this project is to Develop .a Module to Understand the Emotion of Kids with ASD (autism spectrum disorder) and to provide Quality Learning System which works according to their Emotions .which helps them understand the Learning Better. We have tested this project Based On the Facial Emotion Whenever the child Sad, we Play Encouraging Audio to help to Motivate and Whenever tneir Emotion is Happy ,We play Encouraging Audio to help to Motivate and whenever their Emotion is Happy ,we play Rhymes so that they can recognize and understand Better.

3. Proposed Methodology

This proposed system helps to improve Autism children behaviour as they often observe their facial expressions and predict facial emotion. If the Predicted facial Emotion is happy, then we will play some Ryhmes Audio to teach Autism Children in efficient Manner using Python Audio API .

4. System Architecture

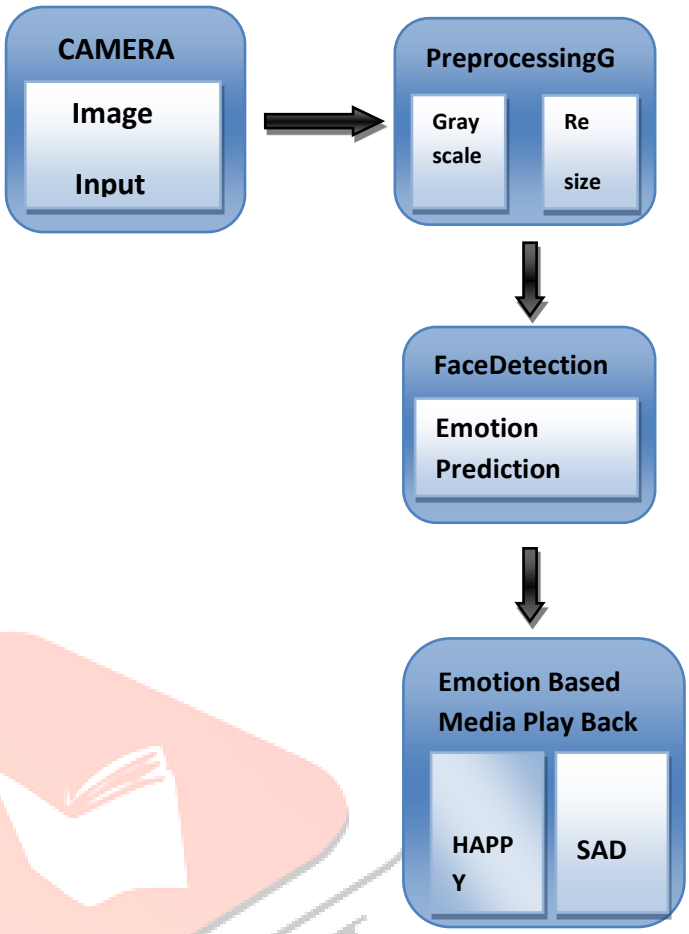

Fig.1.System Architecture

5. Module Description

(i) Face Detection
(ii) Haar Casacades
(iii) Facial Feature Extraction
(iv) Running OpenCV

5.1 Face Detection

Face detection is a type of application classified under "computer vision" technology. It is the process in which algorithms are developed and trained to properly locate faces or objects (in object detection, a related system), in images. These can be in real time from a video camera or from photographs. An example where this technology is used are in airport security systems. In order to recognize a face, the camera software must first detect it and identify the features before making an identification. Likewise, when Facebook makes tagging suggestions to identify people in photos it must first locate the face. On social media apps like Snapchat, face detection is required to augment reality which allows users to virtually wear dog face masks using fancy filters. Another use of face detection is in smartphone face ID security.

In this project, I implemented a system for locating faces in digital images. These are in JPEG format only. Before we continue, we must differentiate between face recognition and face detection. They are not the same, but one depends on

the other. In this case face recognition needs face detection for making an identification to "recognize" a face. I will only cover face detection.

Face detection uses *classifiers*, which are algorithms that detects what is either a face(1) or not a face(0) in an image. Classifiers have been trained to detect faces using thousands to millions of images in order to get more accuracy. OpenCV uses two types of classifiers, LBP (Local Binary Pattern) and Haar Cascades. I will be using the latter classifier.

5.2 Haar Cascades

A sequence of rescaled "square-shaped" functions which together form a wavelet family or basis. It is based on the Haar Wavelet technique to analyse pixels in the image into squares by function. This uses machine learning techniques to get a high degree of accuracy from what is called "training data". This uses "integral image" concepts to compute the "features" detected. Haar Cascades use the Adaboost learning algorithm which selects a small number of important features from a large set to give an efficient result of classifiers.

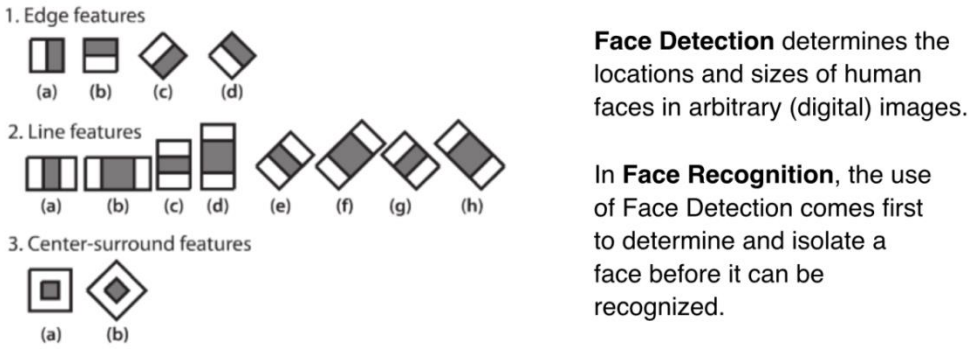

Fig.2 Haar cascades

This is a brief illustration of Features Extraction and the difference between Face Detection and Face Recognition. Face detection is about locating, while face recognition is about identifying.

5.3 Facial Feature Extraction

Haar Cascades use machine learning techniques in which a function is trained from a lot of positive and negative images. This process in the algorithm is feature extraction.

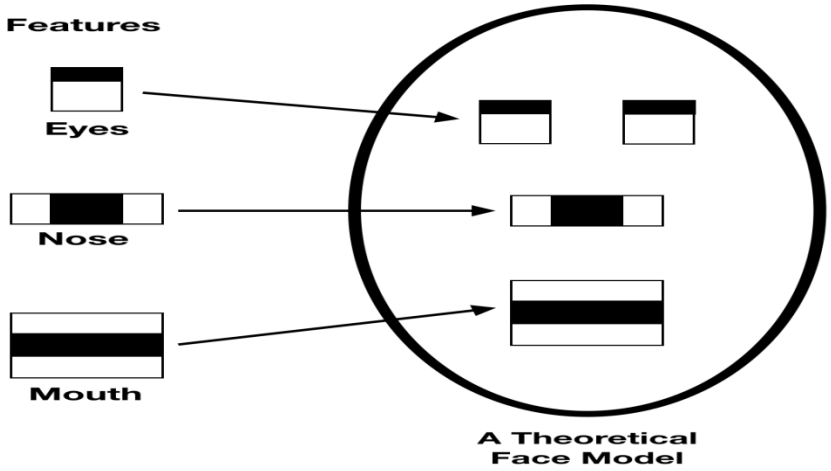

Fig.3 Facial Feature Extraction

In feature extraction, the algorithm uses training data to best identify features that it can consider a face. The training data used in this project is an XML file called: haarcascade_frontalface_default.xml

5.4 Running OpenCV

For this project I prepared a directory where I dumped all the files needed. You will need to put in this directory the following:

- face_detection.py (the name I gave to the Python program that contains code. This name can be changed.)
- haarcascade_frontalface_default.xml (Haar Cascade training data)
- photos

6. Algorithm and Technique used

- TensorFlow and Kera's with OpenCV's Deep Neural Network

- TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google, TensorFlow is Google Brain's second-generation system.

- Kera's is an API designed for human beings, not machines. Kera's follows best practices for reducing cognitive load: it offers consistent & simple APIs, it minimizes the number of user actions required for common use cases, and it provides clear & actionable error messages. It also has extensive documentation and developer guides. Kera's contains numerous implementations of commonly used neural network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with image and text data easier to simplify the coding necessary for writing deep neural network code.

- OpenCV (Open-Source Computer Vision Library) is an open-source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of the-art computer vision and machine learning algorithms.

6.1 Convolution Neural Network:

A convolution neural network is a special architecture of artificial neural network proposed by yannlecun in 1988. One of the most popular uses of the architecture is image classification. CNNs have wide applications in image and video recognition, recommender systems and natural language processing. In this article, the example that this project will take is related to Computer Vision. However, the basic concept remains the same and can be applied to any other use-case!

CNNs, like neural networks, are made up of neurons with learnable weights and biases. Each neuron receives several inputs, takes a weighted sum over them, pass it through an activation function and responds with an output. The whole network has a loss function and all the tips and tricks that we developed for neural networks still apply on CNNs. In more detail the image is passed through a series of convolution, nonlinear, pooling layers and fully connected layers, then generates the output.

In deep learning, a convolutional neural network (CNN, or ConvNet) is a class of deep, feed-forward artificial neural networks, most commonly applied to analyzing visual imagery. Convolutional networks were inspired by biological processes in that the connectivity pattern between neurons resembles the organization of the visual cortex. CNNs use relatively little pre-processing compared to other image classification algorithms. CNN is a special kind of multi- layer NNs applied to 2-d arrays (usually images), based on spatially localized neural input. CNN Generate 'patterns of patterns' for pattern recognition.

Each layer combines patches from previous layers. Convolutional Networks are trainable multistage architectures composed of multiple stages Input and output of each stage are sets of arrays called feature maps. At output, each feature map represents a particular feature extracted at all locations on input. Each stage is composed of: a filter bank layer, a non-linearity layer, and a feature pooling layer. A ConvNet is composed of 1, 2 or 3 such 3-layer stages, followed by a classification module.

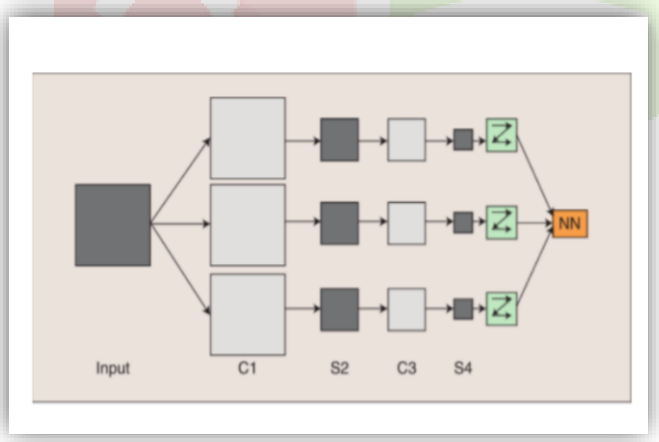

Fig.4 CONVOLUTION NEURAL NETWORK

Basic structure of CNN, where C1, C3 are convolution layers and S2, S4 are pooled/sampled layers.

7. Sample Result:

The proposed system was implemented and tested. The Neutral sign represented that autism children is Quiet are shown in Fig.5 below

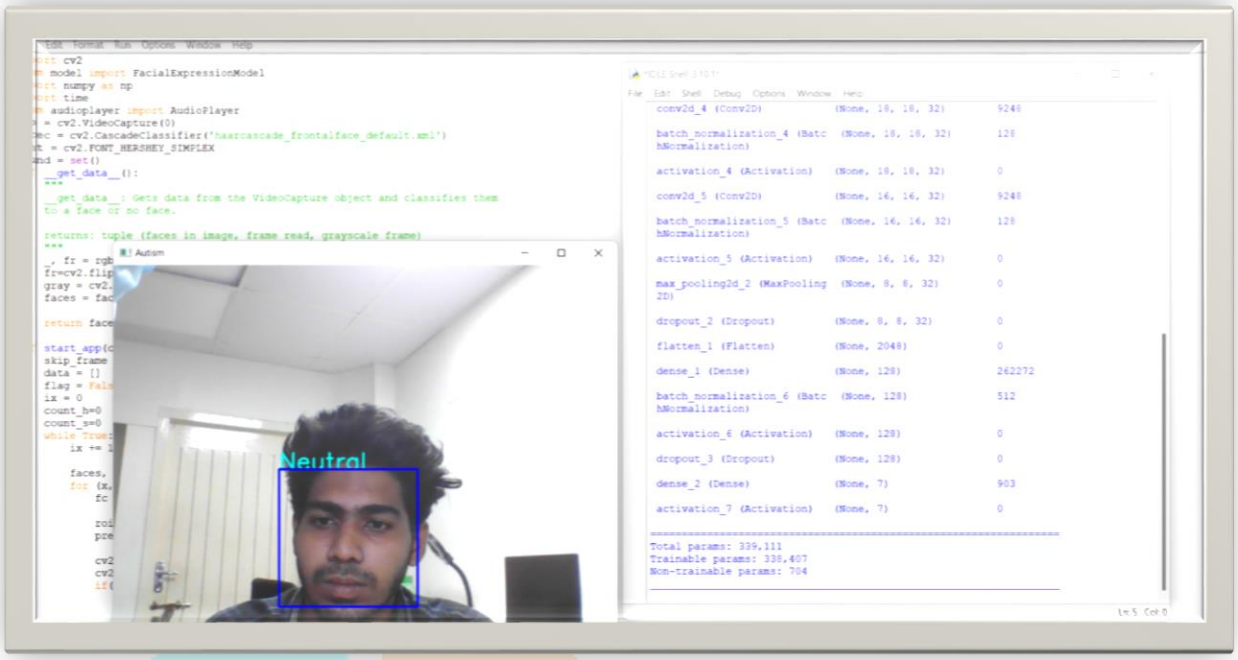

Fig.5 Neutral Emotion

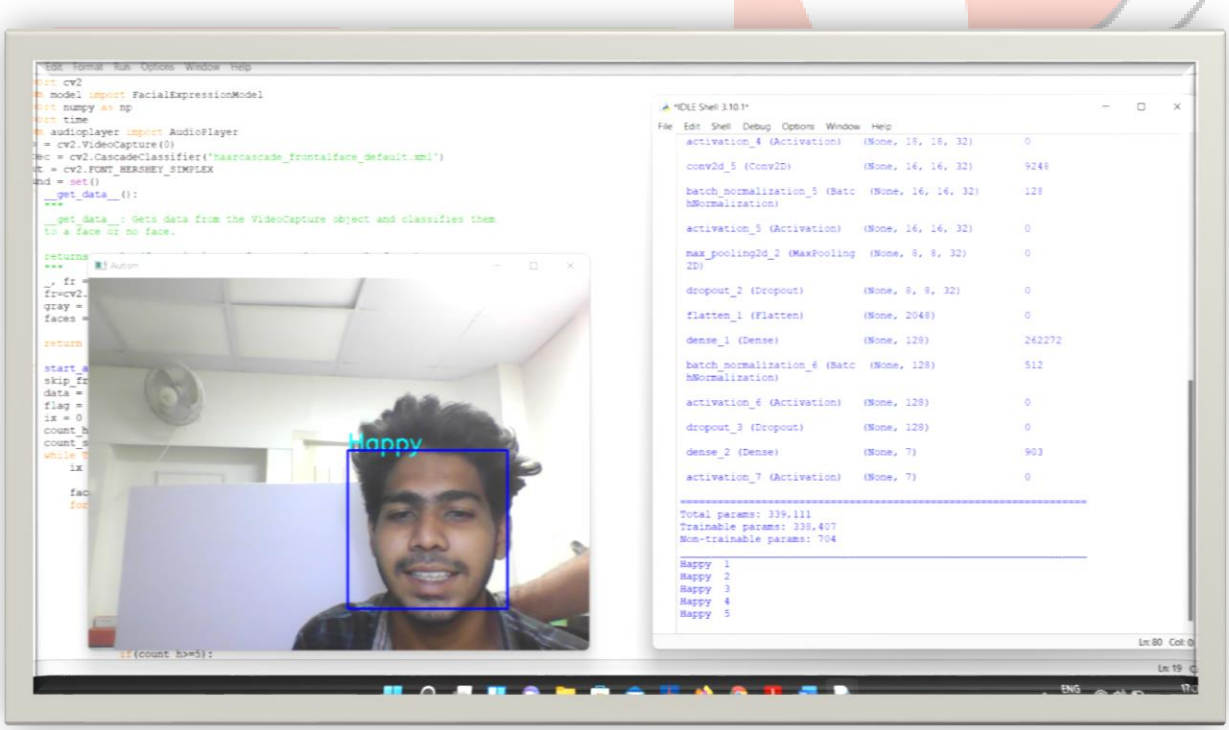

Fig.6. Happy Emotion

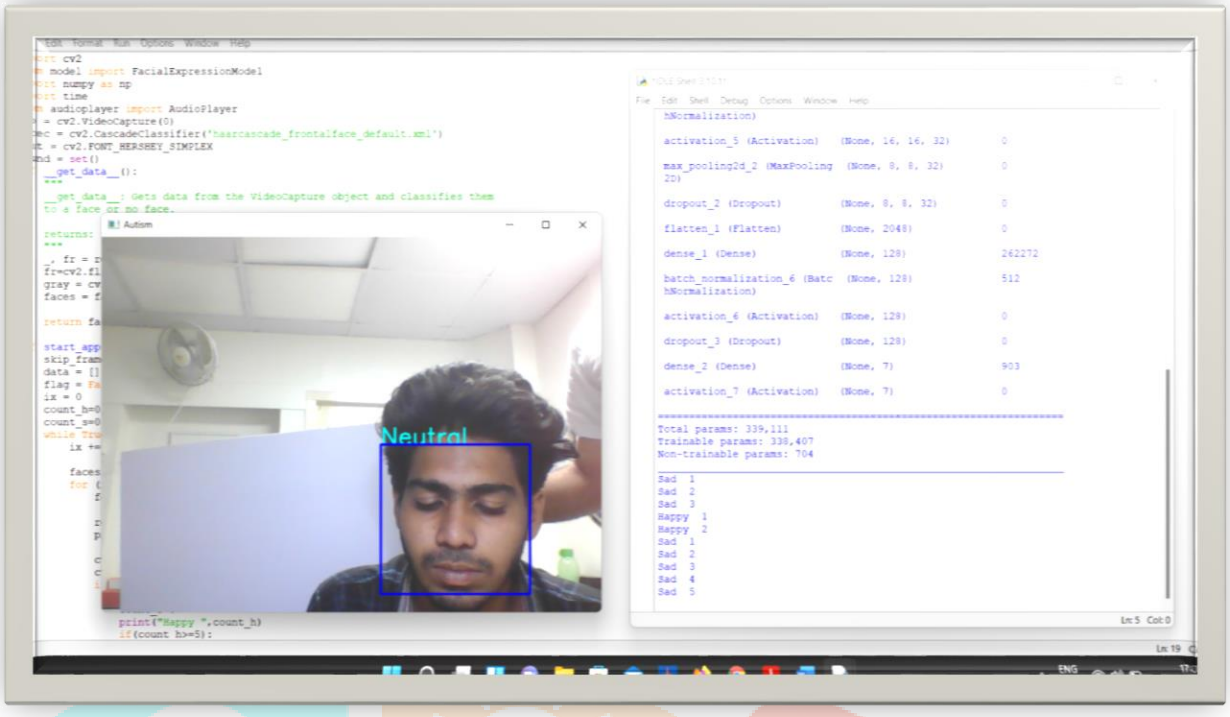

Fig.7.Sad Emotion

8. Conclusion

In this work has explored the possibility of embedding conventional therapy modules into assistive technologies. This step is important in helping ASD children learn effectively and to help lessen therapist's workload in order for them to be able to focus more on the child. themselves. For researchers, this study has offered for additional data and insight into how technologies, even games can be assistive in nature and with therapeutic uses. Simple devices such as these may not always be immediately recognized as assistive technology, but it is able to help therapists by providing an alternative to conventional therapy and data-taking. This work has explored the possibility of embedding conventional therapy modules into assistive technologies. This step is important in helping ASD children learn effectively and to help lessen therapist's workload in order for them to be able to focus more on the child.

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