Emotion Detection of Autism Patients

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Date: 22-04-2022

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Abstract

Autism spectrum disorder refers to a neurodevelopmental disorder characterized by repetitive behavior patterns, impaired social interaction, and impaired verbal and nonverbal communications. Autism spectrum disorder begins in early childhood and eventually causes problems functioning in society — socially, in school and at work. A child or adult with autism spectrum disorder may have problems with social interaction and communication skills they lack the ability to convey what their likes and dislikes are to other people and also the care takers or the family of people who are diagnosed with such a disease also have a hard time understanding their emotions. Building a machine learning model to recognize the emotion of a person diagnosed with autism spectrum disorder will be helpful for that person as well as the family or caretaker of the diagnosed person.

Keywords Used

- TensorFlow
- Keras
- Sequential

Content

Objective

The objective of this project is to create a machine learning model to detect emotions of people diagnosed with Autism from the expressions of their face. We are trying to detect mainly six emotions: Happy, Sad, Disgust, Fear, Angry, Surprise and Neutral. Upon Completion of the project, the model will be able to predict the emotion of a person. The Model will be able to detect if a person is happy, sad, disgust, fear, angry, surprise or neutral. Input to the model can be an image. This project can be used in hospitals, orphanage or by people who are in regular contact with a person diagnosed with autism, so that they can understand the emotion of a person diagnosed with autism.

Technology Used

- Python

  Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small- and large-scale projects. Python is open-source, so it is free to use, modify and distribute the python source code. Python is a high-level programming language that has English-like syntax making it easier to read and understand the code also the standard library of python is very big, that any and all function needed for a project can be found minimizing the use of external libraries. Different python packages like Pandas, NumPy will used in the project.

- Machine Learning

  Machine learning is the study of computer algorithms that can improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence. Machine learning algorithms build a model based on sample data, known as training data, in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications where it is difficult to develop conventional algorithms to perform the needed tasks.
  The model which predicts the emotions of people will be built using machine learning algorithm.

Libraries Used

- NumPy

NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high -level mathematical functions to operate on these arrays. NumPy is open-source software and has many contributors.

- Pandas

Pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series. It is free software released under the three-clause BSD license. The name is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals.

- *TensorFlow*

TensorFlow is a free and open-source software library for machine learning and artificial intelligence. It can be used across a range of tasks but has a particular focus on training and inference of deep neural networks. TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries and community resources that lets researchers push the state-of-the-art in ML and developers easily build and deploy ML powered applications. TensorFlow enable us to build and train

ML models easily using intuitive high-level APIs like Keras with eager execution, which makes for immediate model iteration and easy debugging. We can easily train and deploy models in the cloud, on-prem, in the browsers, or on-device no matter what language you use.

- *Keras*

Keras is a deep learning API written in Python, running on top of the machine learning platform TensorFlow. It was developed with a focus on enabling fast experimentation. Keras reduces developer *cognitive load* to free you to focus on the parts of the problem that really matter. Keras adopts the principle of *progressive disclosure of complexity*: simple workflows should be quick and easy, while arbitrarily advanced workflows should be *possible* via a clear path that builds upon what you've already learned. Keras provides industry-strength performance and scalability.

Algorithm Used

I used a Keras built in class called sequential to create the Emotion detection model. The sequential groups a linear stack of layers into a model and also provides training and inference features on this model. Each layer of the sequential model has one input and one output, and the output of one layer is fed into the next layer as input.

There are different types of layers in our sequential model.

- Conv2D layer creates a convolution kernel that is convolved with the layer input to produce a tensor of outputs. Conv2D layers are generally used for achieving high accuracy in image recognition tasks. There are different keyword arguments like kernel_size, padding etc, present in the Conv2D class to manipulate the input and output.
- Batch normalization applies a transformation that maintains the mean output close to 0 and the output standard deviation close to 1. The main job of this layer is to take the outputs from the one layer and normalize them before passing them on as the input of the next layer. It reduces internal covariant shift.
- The max pool layer is similar to convolution layer, but instead of doing convolution operation, we are selecting the max values in the receptive fields of the input, saving the indices and then producing a summarized output volume. MaxPool2D layer performs the max pooling operation on the 2D data.
- Dropout is a technique used to prevent a model from overfitting. Overfitting means that the neural network performs very well on training data, but fails as soon it sees some new data from the problem domain. Dropout works by randomly setting the outgoing edges of hidden units (neurons that make up hidden layers) to 0 at each update of the training phase.

- Flattening is converting the data into a 1-dimensional array for inputting it to the next layer. We flatten the output of the convolutional layers to create a single long feature vector.
- Dense Layer is simple layer of neurons in which each neuron receives input from all the neurons of previous layer, thus called as dense. Dense Layer is used to classify image based on output from convolutional layers.

We have dataset containing collection images of people expressing different emotions. We divide the dataset into two, for training and for validation(testing). The training set consist a total of 32382 images from seven classes and by classes we mean the seven emotions as specified. The test set contains a total of 1432 images from seven classes. We use a Keras class called ImageDataGenerator to manipulate the images in the training set and validation set to our desired specification.

After this step we train the model. We specify the number of epochs and steps per epochs for training. An epoch means training the neural network with all the training data for one cycle. In an epoch, we use all of the data exactly once. A forward pass and a backward pass together are counted as one pass. Steps per epoch It is used to define how many batches of samples to use in one epoch. Usually steps per epoch is considered as the

Total number of Data/Batch Size

And during each epoch we use a model checkpoint to save the model when the validation accuracy increases.

After the training is finished, we predict the emotion in the image in the validation set and check the accuracy of our trained model.

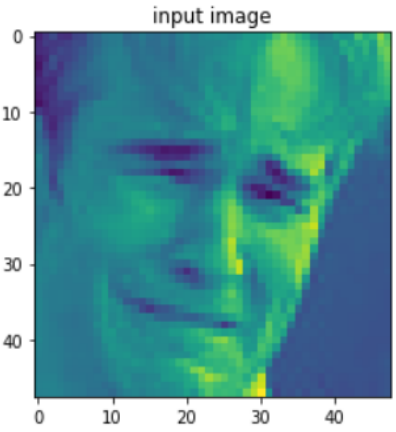
Data Collection

Data is mainly collected from internet. Relevant data can be obtained from websites like Kaggle, GitHub etc.

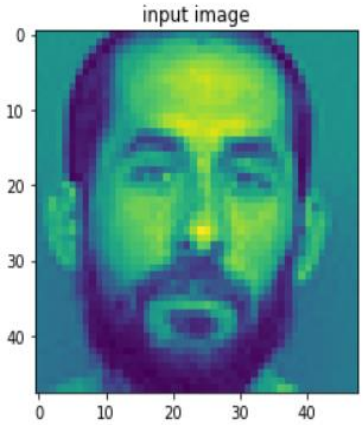
Result

We Successfully created a machine learning model capable of predicting emotion expressed by a person from an image. The Emotion detection model has an accuracy of 67%.

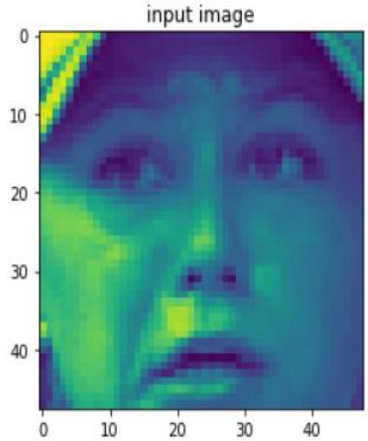
The emotion of the person in the image is sad



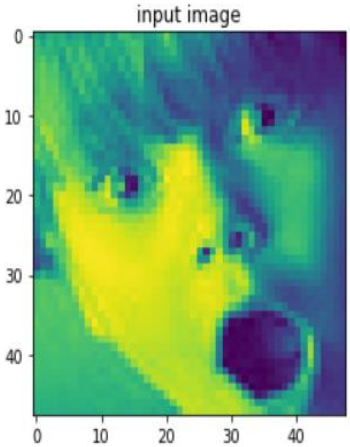
The emotion of the person in the image is neutral



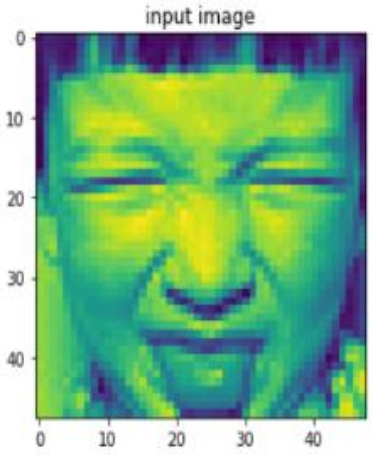
The emotion of the person in the image is fear



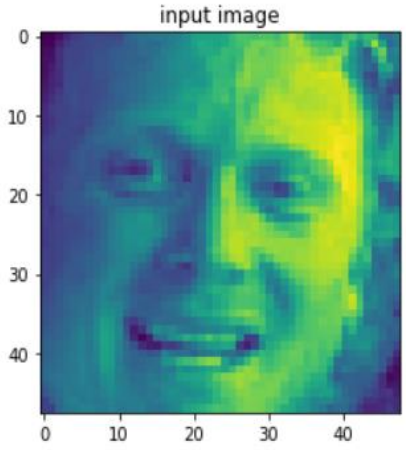
The emotion of the person in the image is surprise



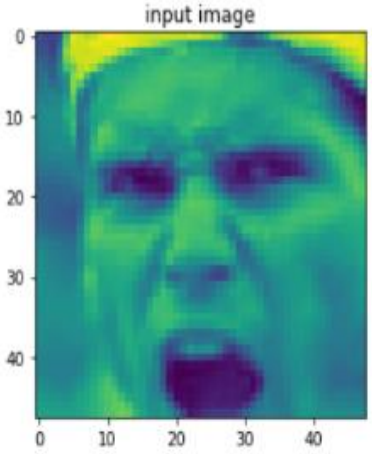
The emotion of the person in the image is disgust



The emotion of the person in the image is happy



The emotion of the person in the image is angry



Conclusion

The aim of this project was to create a machine learning model capable of detecting the emotion of a person. The idea behind this project was to enable a person to recognize the emotion of another person diagnosed with autism or other mental disability with ease, so as to provide them with better care. The model which was created was able to detect the emotion of a person from an inputted image with an accuracy of 67%.