



**DEVELOPMENT OF E-HEALTHCARE SYSTEM
FOR AUTISM SPECTRAL DISORDER**

¹Pragadeesh S ²Venkatalakshmi R ³Sarah Ruby Christina Alexander
⁴Sindhuja K ⁵Anjitha N K

¹ Department of EEE, PSG College of Technology (Autonomous), Coimbatore-
641020

Pdeesh367@gmail.com

² Assistant Professor- Department of ECE, Rathinam Technical Campus, Coimbatore-
641021

venkatalakshmi.r@gmail.com

³ Assistant Professor- Department of BME, Rathinam Technical Campus, Coimbatore-
641021

sarahalexjas@gmail.com

⁴ Assistant Professor- Department of ECE, Theni Kammavar Sangam College of
Technology, Theni-625534

sindhudas91@gmail.com

⁵ Department of ECE, Rathinam Technical Campus, Coimbatore- 641021

anjuakhu16142000@gmail.com

Abstract— A neurodevelopmental illness called autism spectrum disorder (ASD) impairs behavior, social interaction, and communication. Effective ASD intervention and therapy depend on early diagnosis. In this project, I'll suggest creating a machine learning algorithm that uses convolutional Early ASD diagnosis using neural networks (CNN) and vocal analysis of children's noises. The proposed algorithm will use audio recordings of children's vocalisations—including screams, coos, babbles, and words—to extract spectral elements like pitch, prosody, and formants that are connected to ASD. The features will be used as input for a CNN that will be trained to distinguish between typical and atypical recordings. We will collect audio recordings from two groups of kids to train and test the algorithm.

Index Terms— Convolutional neural network (CNN); classification; speech emotion recognition (SER); autism spectrum disorder (ASD).

I. INTRODUCTION

Communication, social interaction, and behaviour are all affected by the neurodevelopmental disease known as autism spectrum disorder (ASD) behaviour. Because the symptoms and intensity can vary greatly from person to person, the illness is known as a "spectrum" disorder. Although it's usually feasible to identify ASD in early childhood, in certain situations it might not be until much later in life. Effective ASD intervention and assistance depend on early diagnosis [1]. According to the Autism and Developmental Disabilities Monitoring Network (2016), one in 59 children in the United States has been diagnosed with ASD (CDC, 2016). Traditional techniques of diagnosis, however, frequently depend significantly on arbitrary observations and can be time- and money-consuming. The precise causes of ASD are not yet fully known and understood, although there is currently no known treatment for ASD, early intervention and support can assist those who have the disorder in gaining social, communication, and adaptive skills as well as enabling them to have happy, fulfilled lives. Treatment may include a combination of therapies, including behavioural therapy, speech therapy, occupational therapy, and medication to treat symptoms like anxiety, depression. Treatment options include a variety of Large volumes of data can be analysed by machine learning algorithms to find patterns that might not be visible to human eyes.

II. LITERATURE REVIEW

Nabila Zaman explains. Autism spectrum disorder is identified by the presence of restricted or repetitive activities, as well as a disability and impairments in social communication. It has been identified as a behavioural disorder. To make a diagnosis and provide an autistic child with the care and support they need to attain their full potential. Therefore, we are creating a system that will be able to diagnose Autism and reach a trustworthy decision even without the aid of a specialist. We anticipate that this approach will be very beneficial for both professionals and worried parents who are concerned about their child's development and activities [1].

Yukthi explains The medical disease known as autism spectrum disorder (ASD) significantly impairs the neurology of the autistic person. A child with autism has trouble answering to their name, avoids sustaining eye contact, and is unable to express their feelings. Because humans are social creatures, ASD's restrictions stunt a person's entire growth. Brain imaging is typically used to diagnose ASD in children. However, it turns out that this is very time consuming and expensive. Recent research has demonstrated that face photos can be used to identify ASD. In this study, deep learning models are pre-trained to categorise toddler facial photos as potentially autistic or healthy [2].

Anastasia Sharma Autism is defined. The autism spectrum disorder (ASD) is a severe, pervasive developmental condition that is characterised by repetitive behavior, nonverbal communication, and attention deficits. ASD is increasing at a faster rate recently, necessitating early diagnosis.

Autism can be found using a variety of expensive and time-consuming screening tools. Predictive analytics, which includes a variety of mathematical models, has gained popularity in recent years. In the field of medicine, machine learning and pattern recognition are two diverse study fields that offer efficient methods for diagnosing ASD. This paper's primary goal is to compare and analyse the many Machine Learning techniques utilised by researchers, including SVM (support vector machine), Random forest scan, decision trees, and logistic regression [3].

John Megha According to a WHO research, autism spectrum disorder affects one out of every 160 children worldwide, and one out of 500 children in India, according to estimates. During their first few years on earth, they would tremendously benefit from early identification; yet, recognising and diagnosing ASD is usually delayed. Therefore, it is crucial to create a detection model for diagnosis that relies on interactions between anatomical or functional brain regions, such as in ASD. This enables medical professionals to analyse the child's behaviour and developmental history in order to make a diagnosis. Here, identifying existing ASD detection techniques and summarising their similarities and differences lead to speculative assumptions that can be supported by relevant research [4].

Toby Malani The identification of Autism Spectrum Disorder (ASD) has always been difficult. Modern technologies like Machine and Deep Learning (ML/DL) can focus on a variety of behavioural changes that an ASD patient exhibits to help with the diagnostic process. This can aid in an accurate early diagnosis and speed up the entire process for doctors, from doing any tests or making a detailed precise diagnosis to putting in place the necessary treatments. This study aims to train, validate, and compare a number of models (Decision Tree, Random Forest, SVM, KNN, and Gated Recurrent Units or GRUs) [5].

III. PROPOSED METHODOLOGY FOR

AUTISM SPECTRAL DISORDER DETECTION

A. BLOCK DIAGRAM

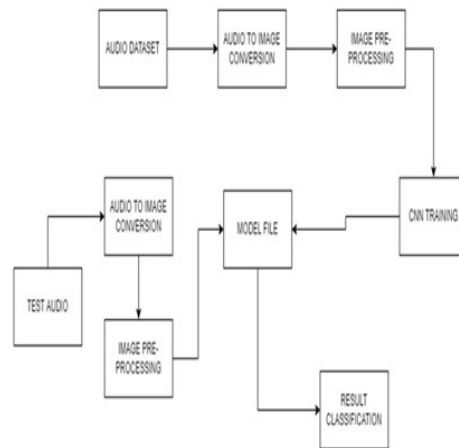


Fig 1. Block diagram

B. DATABASE: The sound signals of children with autism who are positive and negative can be classified using this database. The samples from Kaggle, which are very dependable, were used to generate the dataset. There are roughly 40 audio files of autistic people and 40 audio files of typically developing children. In addition to this, the dataset also includes certain sound waves whose normality or autism are unknown.

C. PREPROCESSING TECHNIQUES:

GRAY SCALE: Instead of working directly with colour photos, grayscale representations are employed for descriptor extraction since they simplify the procedure and need less computing power.

MEDIAN BLUR: The median filter is a filtering method for signal and image noise reduction. Since the median filter is well known for maintaining edges during noise removal, it is extremely important in the field of image processing.

HISTOGRAM EQUALIZATION: A computer image processing method called histogram equalisation is used to enhance contrast in photographs. It achieves this by evenly distributing the intensity values with the highest frequency.

FEATURE EXTRACTION: When fewer resources are required for processing without losing crucial or pertinent data, the feature extraction procedure is helpful. Additionally, feature extraction can help an analysis by reducing the amount of redundant data. Additionally, the machine's efforts to generate variable combinations (features) and the reduction of the data speed up the learning and generalisation stages of the machine learning process.

D.CONVOLUTIONAL NEURAL NETWORK: The patterns in the input image, such as lines, gradients, circles, or even eyes and faces, are very well recognised by convolutional neural networks. Convolutional neural networks are extremely effective for computer vision because of this quality. Convolutional neural networks do not require any preparation and can operate immediately on a raw image, in contrast to older computer vision methods.

IV.METHODOLOGY

A.IMPORTING THE DATASET: The three categories' datasets were gathered from the Kaggle data science website. These data are gathered, organised into distinct folders with the names of the relevant diseases, and uploaded for pre-processing.

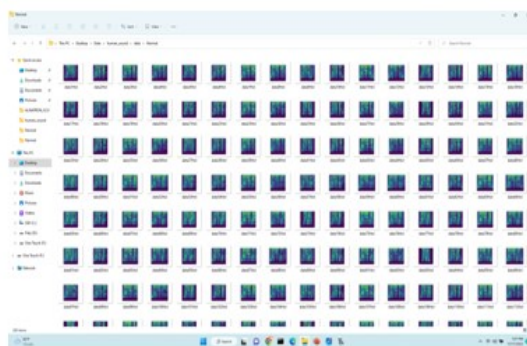


Fig 2.Dataset

B.PREPROCESSING: Resizing, patching, and augmentation steps made up the pre-processing steps. The input photos' sizes are normalised in the first pre-processing stage. Almost majority of the images were excessively huge rectangles with varying heights (median matrix size: 1,800). As a result, we used a combination of maintaining aspect ratios and zero-padding to scale all photos to a uniform 224x224 pixel square. Because the research of deep learning effectiveness depends on the input data, input photos were pre-processed using a patch (a cropped portion of each image) in the second processing stage. A region that had enough normal and accident segmentation for analysis was retrieved using a bounding box. The training dataset alone was used for data augmentation, which was done using mirror images.

```

money
1 import numpy as np
2 import os
3 from matplotlib import pyplot as plt
4 import cv2
5 import random
6 import pickle
7
8
9 file_list = []
10 class_list = []
11
12 DATADIR = "data"
13
14 # All the categories are used to train neural network for default
15 CATEGORIES=["Autism","Normal"]
16
17 # The size of the images that our neural network will use
18 IMG_SIZE = 256
19
20
21 training_data = []
22
23 def create_training_data():
24     for category in CATEGORIES:
25         path = os.path.join(DATADIR, category)
26         class_num = CATEGORIES.index(category)
27         for img in os.listdir(path):
28             try:
29                 img_array = cv2.imread(os.path.join(path, img), 1)
30                 # img_array = cv2.imread(img)
31                 img_array = cv2.medianBlur(img_array, 1)

```

Fig 3.preprocessing

C.TRAINING: The spectrogram approach is used to convert the audio dataset into images, and once each image has undergone pre-processing to improve it, it is submitted for convolution neural network training. The model file is formed after the training phase, and during the testing step, the test audio is converted to an image and compared to the model file using CNN to determine the final classification.



Fig4: Training and validation Accuracy



Fig5: Training and validation loss

D. TESTING: Once the testing audio has been fed, converted to an image using a spectrogram, and given to the model file, the testing process is finally started after training using the model file, and the end result is classed.

V. PREDICTION: To use image processing and machine learning methods to determine the emotion in autistic youngsters. The creation of a Real-time Speech Emotion Recognition (SER) model, which analyses audio signals to identify emotions.

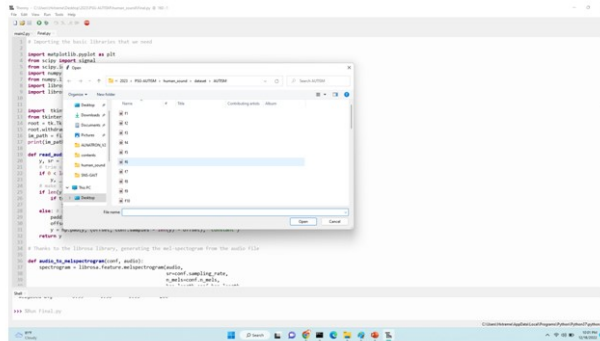


Fig6. Select data set

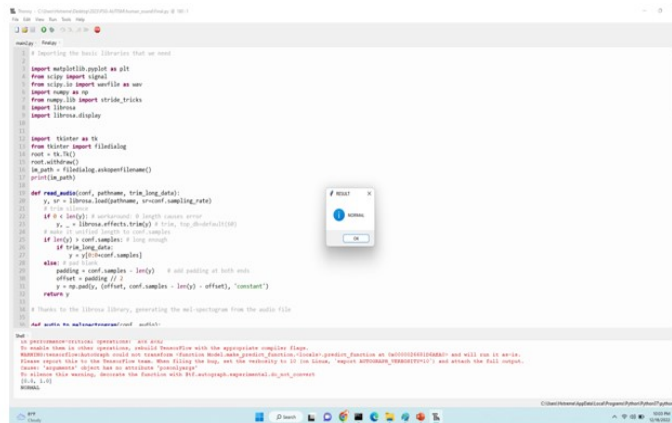


Fig 7.Predicts Normal

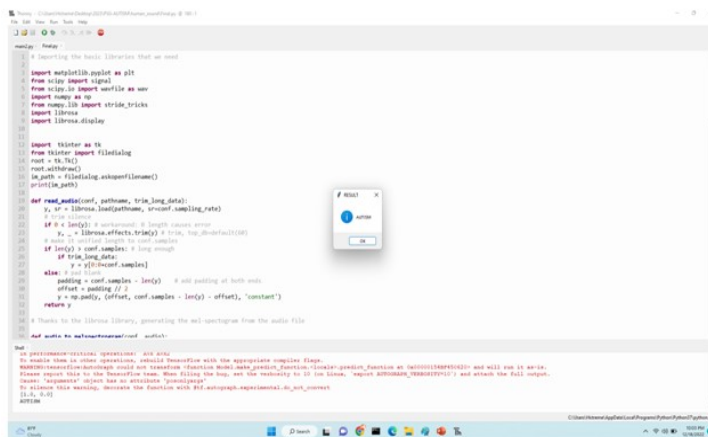


Fig 8.Predicts Autism

VI.RESULTS

SOUND TO IMAGE CONVERSION :

- Use spectrogram technology to turn sounds into a frame.
- On each window, perform the Short Time Fourier Transformation.
- A vertical line showing the magnitude vs. frequency can be seen in each

window that results.

- Convert the resultant window to decibels.

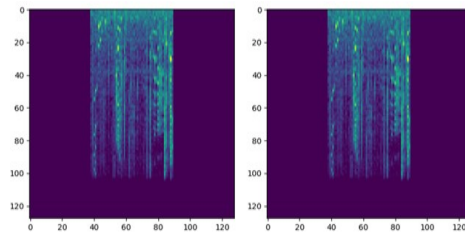


Fig9.Autism sound wave to spectral image

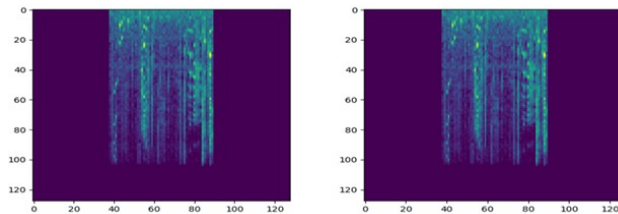


Fig10:Normal sound wave to spectral image

VII.CONFUSION MATRIX:

Matrix of Confusion in Machine Learning The performance of the classification models for a certain set of test data is evaluated using a matrix called the confusion matrix. Only after the true values of the test data are known can it be determined. Although the matrix itself is simple to understand, some of the terminology used in connection with it might be.



Fig 10.Confusion matrix diagram

Classes	TP	FP	FN	TN	Accuracy= $(TP+TN)/(TP+TN+FP+FN)$
Autism	40	0	0.15	58	0.998471727
Normal	40	0	0.15	59	0.998487141

Fig11.Total accuracy calculation

VIII.CONCLUSION

To determine whether certain characteristics would be able to distinguish between children with autism spectrum disorder and typically developing children, we should collect the voices of both groups of kids and compare them.

IX.FUTURE EXTENSION

To detect autism spectrum disorder with the highest degree of accuracy, CNN's deep learning networks are used. Other disorders like retinopathy, cardiac arrest, and other conditions can be predicted using these algorithms.

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