MINI
Project Report 2022-2023

PROBLEM STATEMENT: **Classification and Detection of Autism Spectrum Disorder Based on Deep Learning Algorithms**

TEAM ID:22

PEDDA MEKALA HEMA KUMAR REDDY(1CR21AI040)
HARSHITH JR(1CR21AI027)
PUDI BHEEMESH ANUPAM(1CR21AI042)

Under the Guidance Of:
Ms. Shyamili Das
DEPT OF AIML

Contents:

1.Abstract

Autism spectrum disorder (ASD) is a type of mental illness that can be detected by using social media data and biomedical images. Autism spectrum disorder (ASD) is a neurological disease correlated with brain growth that later impacts the physical impression of the face. Children with ASD have dissimilar facial landmarks, which set them noticeably apart from typically developed (TD) children. Novelty of the proposed research is to design a system that is based on autism spectrum disorder detection on social media and face recognition. To identify such landmarks, deep learning techniques may be used, but they require a precise technology for extracting and producing the proper patterns of the face features. -is study assists communities and psychiatrists in experimentally detecting autism based on facial features, by using an uncomplicated web application based on a deep learning system, that is, a convolutional neural network. With the help of Flask framework build an user friendly interface using HTML , CSS and Javascript.

The dataset that was used to test these models was collected from the Kaggle platform and consisted of 2,940 face images. Standard evaluation metrics such as accuracy, specificity, and sensitivity were used to evaluate the results of the many deep learning models. Sequential model which contain 4 layers achieved the highest accuracy result of 91%.

2.Introduction:

Autism spectrum disorders (ASD) refer to a group of complex neurodevelopmental disorders of the brain such as autism, childhood disintegrative disorders, and Asperger's syndrome, which, as the term “spectrum” implies, have a wide range of symptoms and levels of severity. These disorders are currently included in the International Statistical Classification of Diseases and Related Health Problems under Mental and Behavioural Disorders, in the category of Pervasive Developmental Disorders. The earliest symptoms of ASD often appear within the first year of life and may include lack of eye contact, lack of response to name calling, and indifference to caregivers. A small number of children appear to develop normally in the first year, and then show signs of autism between 18 and 24 months of age , including limited and repetitive patterns of behaviour, a narrow range of interests and activities, and weak language skills. As these disorders also affect how a person perceives and socializes with others, children may suddenly become introverted or aggressive in the first five years of life as they experience difficulties in interacting and communicating with society. While ASD appears in childhood, it tends to persist into adolescence and adulthood. Advanced information technology that uses artificial intelligence (AI) models has helped to diagnose ASD early through facial pattern recognition. Used the convolutional neural network (CNN) algorithm to train data for extracting components of human facial expressions and proposed the use of such algorithm to detect facial ex□pressions in many neurological disorders. In 2018, Haque and Valles , using deep learning approaches, updated the Facial Expression Recognition 2013 dataset to recognize facial expressions of autistic children.

3.Materials and Methods:

This study proposes a deep learning model based Conv2D, Maxpool, Flatten, and activation function such as Relu and Sigmoid to detect autism using facial features of autistic and normal children. Facial features can be used to determine if a child has autism or is normal. -e models extracted significant facial features from the images. One of the advantages offered by deep learning algorithms is the ability to extract very small details from an image, which a person cannot notice with the naked eye. Figure 1 shows the framework of our study, from the data acquisition to the data preprocessing and loading, to the model preparation and training, and to the model performance test.

- 3.1. Dataset: This study analysed facial images of autistic children and normal children obtained from Kaggle platform, which is publicly accessible online. The dataset consisted of 2,940 face images, half of which were of autistic children and the other half were of nonautistic children.
- 3.2. Preprocessing: The purpose of the data preprocessing was to clean and crop the images.
- 3.3. Convolutional Neural Network Models: AI has been remarkably developed to assist humans in their daily life, for example, through medical applications, which are based on a branch of AI called “computer vision.” Hence, the CNN algorithm has contributed to the detection of diseases and to behavioural and psychological analysis.
- 3.3.1. Basic Components of the CNN Model: The convolutional neural network (CNN) is one of the most famous deep learning algorithms. It takes the input image and assigns importance to learnable weights and biases in order to recognize the class of the image. -e neuron can be said to be a simulation of the communication pattern of the neurons of the human brain through the interconnection and communication between cells. In this section, we will explain the basic components of the CNN model: the input layer, convolutional layer, activating function, pooling layer, fully connected layer, and output prediction.

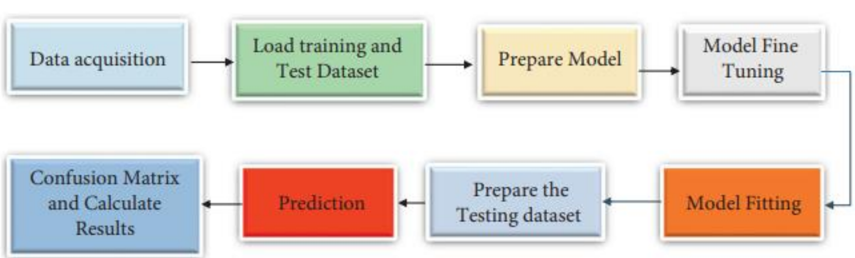


Figure 1: The framework of our study

- 3.4. Deep Learning Models: We used different pretrained models for autism models for autism detection using facial feature images: SEQUENTIAL ,VGG19 and VGG16.The Sequential model gave the best accuracy of 90%.

4.Source Code:

4.1 Installing Dependences:

```
import tensorflow as tf
import os as os
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense,
Dropout, BatchNormalization
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau
```

4.2 Preprocessing:

```
data_dir = '/content/drive/MyDrive/AutismDataset/data'
image_exts = ['jpeg','jpg', 'bmp', 'png']
for image_class in os.listdir(data_dir):
    for image in os.listdir(os.path.join(data_dir, image_class)):
        image_path = os.path.join(data_dir, image_class, image)
        try:
            img = cv2.imread(image_path)
            tip = imghdr.what(image_path)
            if tip not in image_exts:
                print('Image not in ext list {}'.format(image_path))
                os.remove(image_path)
        except Exception as e:
            print('Issue with image {}'.format(image_path))
```

4.3 Load Data:

```
import numpy as np
from matplotlib import pyplot as plt
```

```
data =
tf.keras.utils.image_dataset_from_directory('/content/drive/MyDrive/AutismDatas
et/data')
data_iterator = data.as_numpy_iterator()
batch = data_iterator.next()
batch[0].shape
fig, ax = plt.subplots(ncols=4, figsize=(20,20))
for idx, img in enumerate(batch[0][:4]):
    ax[idx].imshow(img.astype(int))
    ax[idx].title.set_text(batch[1][idx])
```

4.4 Scale Data:

```
data = data.map(lambda x,y: (x/255, y))
data.as_numpy_iterator().next()
batch[0].max()
len(data)
```

4.5 Splitting Data:

```
train_size = int(len(data)*.75)+1
val_size = int(len(data)*.15)
test_size = int(len(data)*.1)

train = data.take(train_size)
val = data.skip(train_size).take(val_size)
test = data.skip(train_size+val_size).take(test_size)
```

4.6 Building the Main Model:

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Flatten, Dense,
Dropout, BatchNormalization
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.callbacks import EarlyStopping, ReduceLROnPlateau

# Create a Sequential model
model = Sequential()

model.add(Conv2D(16, (3, 3), 1, activation='relu', input_shape=(256, 256, 3)))
```

```
model.add(MaxPooling2D())
model.add(BatchNormalization())

model.add(Conv2D(32, (3, 3), 1, activation='relu'))
model.add(MaxPooling2D())
model.add(BatchNormalization())

model.add(Conv2D(16, (3, 3), 1, activation='relu'))
model.add(MaxPooling2D())
model.add(BatchNormalization())

model.add(Flatten())

model.add(Dense(256, activation='relu'))
model.add(Dropout(0.5))  # Adding Dropout for regularization
model.add(BatchNormalization())

model.add(Dense(1, activation='sigmoid'))

# Compile the model
model.compile(optimizer=Adam(lr=0.001),
              loss='binary_crossentropy',
              metrics=['accuracy'])

# Load your training and validation data using train_datagen

# Set up callbacks
early_stop = EarlyStopping(monitor='val_loss', patience=5,
restore_best_weights=True)
reduce_lr = ReduceLROnPlateau(monitor='val_loss', factor=0.2, patience=3,
min_lr=1e-6)

# Train the model


model.summary()
logdir='logs'
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir=logdir)

history = model.fit(
    train,
    epochs=50,
    validation_data=val,
    callbacks=[early_stop, reduce_lr])
```

4.7 Plot Performance:

```
fig = plt.figure()
plt.plot(history.history['loss'], color='red', label='loss')
plt.plot(history.history['val_loss'], color='orange', label='val_loss')
fig.suptitle('Loss', fontsize=20)
plt.legend(loc="upper left")
plt.show()

fig = plt.figure()
plt.plot(history.history['accuracy'], color='teal', label='accuracy')
plt.plot(history.history['val_accuracy'], color='orange', label='val_accuracy')
fig.suptitle('Accuracy', fontsize=20)
plt.legend(loc="upper left")
plt.show()
```

4.8 Evaluate:

```
from tensorflow.keras.metrics import Precision, Recall, BinaryAccuracy

pre = Precision()
re = Recall()
acc = BinaryAccuracy()

for batch in test.as_numpy_iterator():
    X, y = batch
    z = model.predict(X)
    pre.update_state(y, z)
    re.update_state(y, z)
    acc.update_state(y, z)

print(pre.result(), re.result(), acc.result())
```

4.9 Saving the model:

```
from tensorflow.keras.models import load_model

model.save(os.path.join('DL models','autism(1).h5'))

new_model = load_model('autism(1).h5')
```

4.10 APP.py:

```
import os
from flask import Flask, request, render_template
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
import numpy as np
from werkzeug.utils import secure_filename

app = Flask(__name__)

model = load_model('autism (1).h5')

def preprocess_image(img_path):
    img = image.load_img(img_path, target_size=(256, 256))
    img_array = image.img_to_array(img)
    img_array = np.expand_dims(img_array, axis=0)
    img_array /= 255.0
    return img_array

@app.route('/', methods=['GET', 'POST'])
def index():
    if request.method == 'POST':

        file = request.files['image']
        filename = secure_filename(file.filename)
        if file:
            img_path = os.path.join('static/uploads', file.filename)
            file.save(img_path)


            img_array = preprocess_image(img_path)
            prediction = model.predict(img_array)

            if prediction > 0.015:
                result = 'Non Autistic'
            else:
                result = 'Autistic'
            return render_template('index.html', img_path=img_path,filename=filename,
result=result)

    return render_template('index.html', img_path=None, result=None)


if __name__ == '__main__':
    app.run(debug=True)
```

4.11 Index.html:

```
<!DOCTYPE html>
<html>
<head>
    <title>Autism Prediction App</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            background-color: #a3bee8;
            margin: 0;
            padding: 2;
        }
        .page {
                width: 21cm;
                min-height: 29.7cm;
                padding: 2cm;
                margin: 1cm auto;
                border: 1px #951d9b solid;
                border-radius: 5px;
                box-shadow: 10px 10px 10px rgba(90, 11, 78, 0.1);
        }
        @page {
            size: A4;
            margin: 10px;
        }
        header {

            font-size: 30px;
            font-weight: 600;
            text-align: center;
            background-image: linear-gradient(to left, #553c9a, #b393d3);
            color: transparent;
            background-clip: text;
            -webkit-background-clip: text;
        }
        .container {
            max-width: 800px;
            margin: 0 auto;
            padding: 2em;
            background-color: white;
            border-radius: 10px;
            box-shadow: 0 2px 4px rgba(0, 0, 0, 0.1);
            padding-bottom: 20px;
        }
```

```
        img.uploaded-image {
            max-width: 100%;
            height: auto;
            margin: 1em 0;
        }
        .result {
            font-size: 1.5em;
            font-weight: bold;
            margin-top: 1em;
        }
        .upload-form {
            text-align: center;
        }

        .upload-button {
            background-color: #007bff;
            color: white;
            border: none;
            padding: 0.5em 1em;
            border-radius: 5px;
            cursor: pointer;
        }
        color{
            color: #edeef0;
        }
        h3{
            color: #210f6b;
        }
        button:hover
        {

            color:rgb(35, 35, 187);
        }
        button:active
        {

            color:purple;
        }
    </style>

</head>
<body class="page">
    <header>
        <h1>Autism Prediction App</h1>
    </header>
```

```
    <h3>
        <center>
            PROJECT TITLE:
        </center>
    </h3>
    <p>
        <center>
            <b>Classification and Detection of Autism Spectrum Disorder Based on Deep
Learning Algorithms.
        </center>
    </p>
    <h3>
        INTRODUCTION:
    </h3>
    <p1>

        Autism spectrum disorder (ASD) is a type of mental illness that can be detected
by using social media data and biomedical images.
        <color>Autism spectrum disorder (ASD) is a neurological disease correlated with
brain growth that later impacts the physical impression
        of the face. Children with ASD have dissimilar facial landmarks, which set them
noticeably apart from typically developed (TD)
        children.</color>

                <br/>
                <br/>
                Novelty of the proposed research is to design a system that is based on
autism spectrum disorder detection on social
        media and face recognition. <color>To identify such landmarks, deep learning
techniques are used.</color>
    </p1>

    <div class="container">
        <form class="upload-form" method="post" enctype="multipart/form-data">
            <input type="file" name="image" accept="image/*" required>
            <button class="upload-button" type="submit">Upload and Predict</button>
        </form>
        {% if img_path %}
        <hr>
            <h2>Uploaded Image</h2>
            <img src="{{ url_for('static',filename='uploads/'+filename) }}"
alt="Uploaded Image" style="max-width: 100%;">
        <p class="result">Predicted Result: {{ result }}</p>
        {% endif %}
    </div>
```

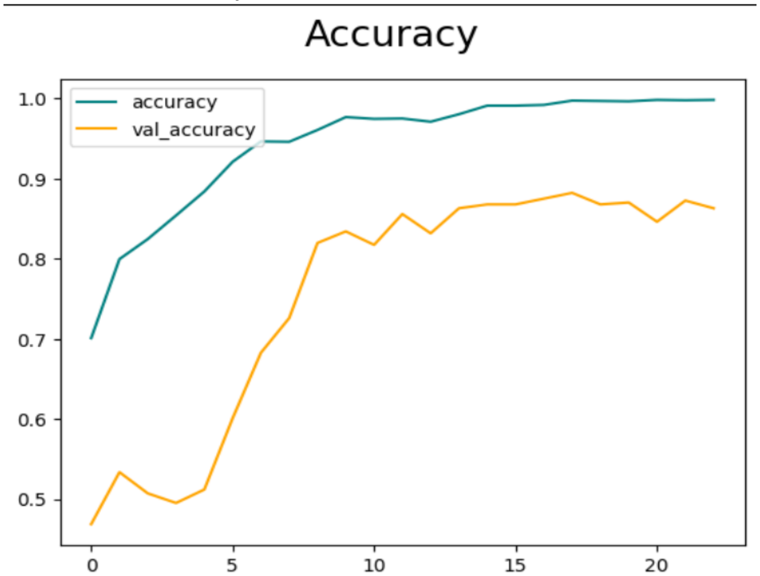
```
    <h3>
        TEAM MEMBERS:
    </h3>
    <p3>
        1.PEDDA MEKALA HEMA KUMAR REDDY<color>(1CR21AI040)<br/></color>
        2.PUDI BHEEMESH ANUPAM<color>(1CR21AI042)</color><br/>
        3.HARSHITH JR <color>(1CR21AI027)</color><br/>
    </p3>
    <h3>
        TEAM MENTOR:
    </h3>
    <p3>
        Ms.SHYAMALI DAS
    </p3>





</body>
</html>
```

5.Result and Output:

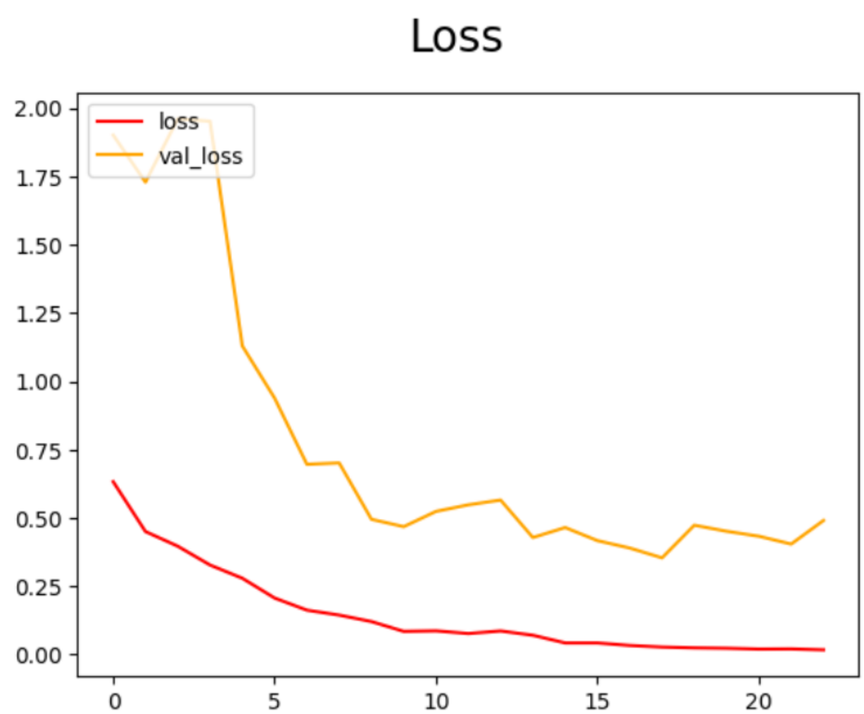
People with autism face difficulties and challenges in understanding the world around them and in understanding their thoughts, feelings, and needs. The world surrounding a person with autism seems to him like a horror movie, and he finds some sounds and lights and even smells and tastes of foods frightening and sometimes painful. -us, when a sudden change occurs in their world, they are terrified that no one else can understand.

Diagnosing autism is very important to save the lives of many children. Developing an intelligence system based on AI can help identify autism early. In this study, three advanced deep learning models, namely, Sequential ,VGG16, and VGG16 were considered for use in diagnosing autism. The empirical results of these models were presented, and it was noted that the Sequential model attained the highest accuracy of 91%.

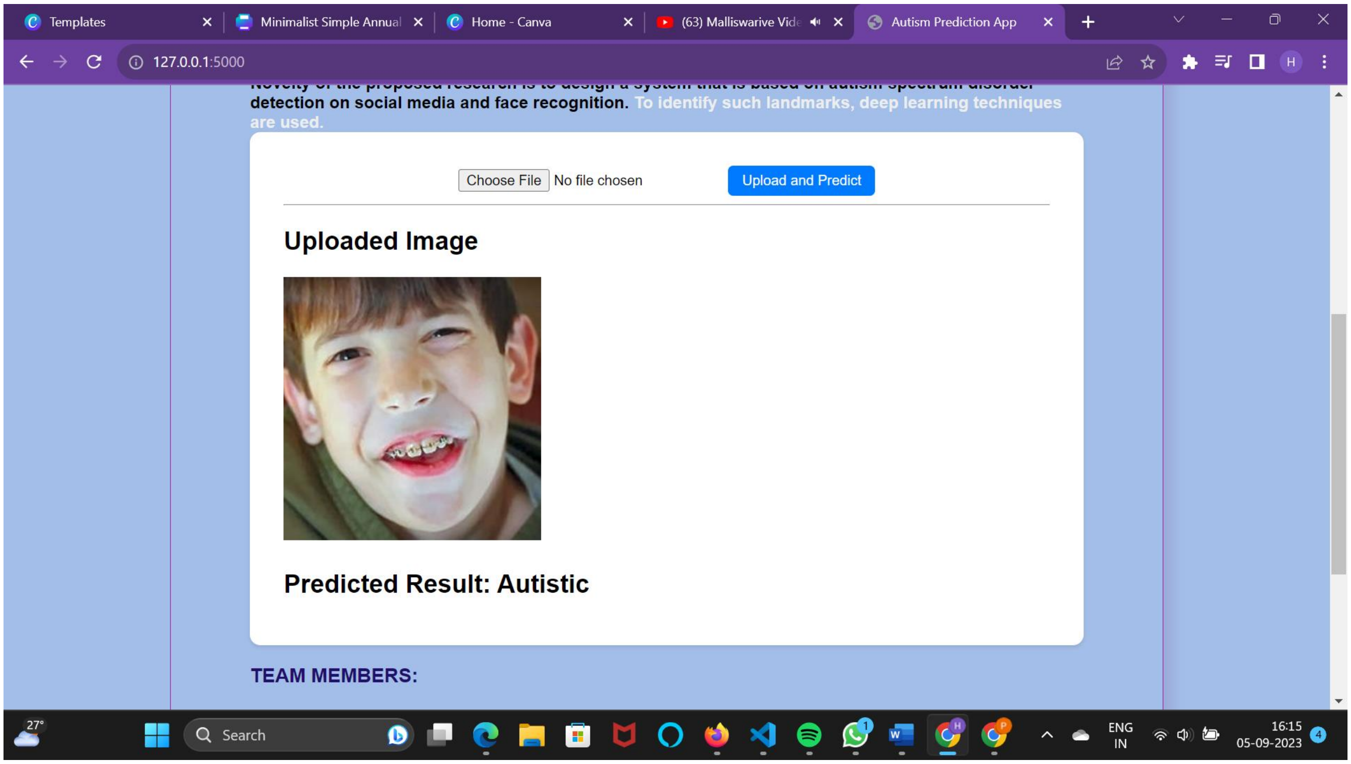
5.1 Accuracy:



5.2 Loss:



6.Final User Interface:



7. Conclusion:

Interest in child autism has risen due to the advances in global health know-how and capacities. Moreover, the number of autistic children has increased in recent years, due to which researchers and academics have intensified their efforts to uncover the causes of autism and to detect it early in order to give autistic people behavioural development treatment programs that should help them integrate into society and leave the isolation of the autistic world.

8.Dataset:

The dataset used to support the findings of the study are available at https://www.kaggle.com/datasets/cihan063/autism-image-data

9. References:

9.1Articles Referred:

- Hindawi Computational Intelligence and Neuroscience
  Volume 2022, Article ID 8709145,
  10 pages,
  https://doi.org/10.1155/2022/8709145

9.2 Youtube Referred:

- https://youtu.be/jztwpsIzEGc?si=EOVS4VIskJvC-Jdm
- https://youtu.be/0nr6TPKlrN0?si=u3HBS-uzPV6B4GCJ
-