Autism Spectrum Disorder Detection Using MobileNet

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Surya Teja Arvapalli(✉), Sai Abhay A., Mounika D., Vani Pujitha M.
VR Siddhartha Engineering College, Vijayawada, India
suryaarvapalli26@gmail.com

Abstract—Autism Spectrum Illness (ASD), an evolution of the brain disorder, is commonly related with sensory difficulties, such as excessive or insufficient sensitivity to sounds, scents, or touch. Autism Spectrum Disorder (ASD) is evolving at a faster rate than ever before. By screening tests autism detection is very expensive and time consuming. With the advancement of Deep Learning (DL),autism can be predicted from a young age. In this paper we are using Convolutional Neural Network (CNN) with Transfer Learning (TL) models to classify the disease and we will suggest the precautions if it is detected as autism. Here we consider the Autism Master Dataset (AMD) from kaggle.com website, which contains two classes (Autism, Non_Autism). By using this models, we are obtaining good accuracy.

Keywords—CNN, transfer learning, autism, classification

1 Introduction

Because the neuronal assemblages within the the cerebrum coordinates and shapes practical relationships. that are entering a system that has been de-signed, the human cerebrum is an extremely sophisticated biological organ. Because the developed systems share characteristics with other systems based on biological and physical structures, they are inextricably classified as complex systems. Girls are around 4 or 5 times less likely than boys to have the illness, which appears to have a strong genetic component. Autism symptoms can range from mild to severe. Artificial neural networks are another name for deep learning, which is a subfield of machine learning. It's a big neural network that makes use of a data model with a complicated structure that integrates different nonlinear transformations. The deep learning technique, according to LeCun, increases the performance of a number of recent artificial intelligence applications. Deep learning enables computer simulations with several preparation information is learned through layers representations with multiple dimensions of reflection. Aside from that, the deep architecture aspect of many complex artificial intelligence challenges can be solved with deep learning. Deep learning excels in determining complex structures from large amounts.As a result ,deeplearning may be used to solve problems and resolve challenges in a variety of government, corporate, and scientific fields. The 128 channel EEG readings were used to classify ASD and non-ASD patients collected from prior research done by

different researchers. According to the findings, the most intense occuringsynchronising state contains the best distinguish data, and its estimated quality list can be used as an exceptional biomarker for the detection of chemical imbalances. Figure 1 depicts the *categorizing* of ASD using data from fMRI from prior studies. According to Nielsen, multisite functional connectivity research *categorizing* by MRI of autism has been finished, and the following conclusion has been reached: *categorizing* over numerous places, as opposed to datasets from a single location, necessitates extra patients' receptacles for change, inspecting procedures, and equipment. The NITRC dataset was used to categorise autistic and non-autistic people based on brain connection measurements. According to Heinsfeld's research, such Variety is beneficial disturbance to the information on cerebrum imaging, making it difficult to make a mark with the mind's action, which can arrange infection conditions. However, despite the clamour caused by distinct hardware, as well as socioeconomics, the achievement of a dependable arrangement precision shows an assurance for the application of machine learning to datasets from clinical trials for the detection of psychiatricdisorders.

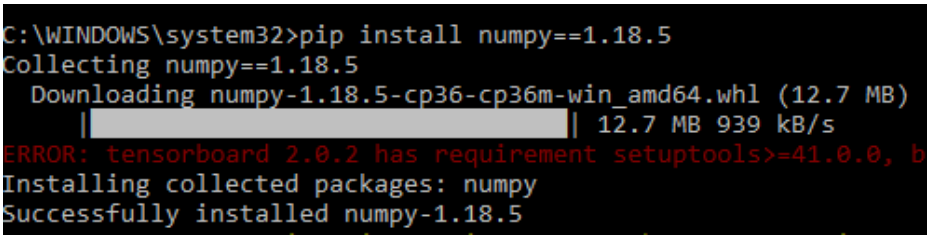

Fig. 1. Downloading the required packages into the system

2 Literature survey

Rad, Nastaran Mohammadian;[1] proposed a system based on the SMM detection. The challenge faced by the author is intra and inter subject variability. The system takes the input as N samples of recorded signals where each direction of sensor will be treated as input channel of data. The three layer CNN plays an important role in the system. The first two layers contains four filters and third layer contain eight filters. Four experiments were conducted in order to test the developed system. The aim of first experiment is to test future extraction and future learning. The third experiment is to test all the complex features of CNN. In the last experiment the transfer learning technique was used. The results of the experiments gave the good results in transfer learning knowledge from one data set to other by pre-initializing CNN. In the future the system can be developed by incorporating other signals.

Chauhan, Rahul;[2] implemented a model for image recognition on the MINIST dataset and used the CIFAR-10 dataset for the object detection. The MINIST dataset contains 70,000 images out of which 60,000 images are the used for training and remaining for testing. The NxNimage is applied with FxF filter so that the image is convolved into the required size. The Pooling layers performs two types of pooling

and simplifies the output after convolution then the regularization and data augmentation techniques are used to reduce over fitting and under fitting problem. The accuracy of MINIST is about 99.6% but the accuracy of CIFAR is 80%. In future CIFAR's accuracy can be enhanced by adding more hiddenlayers.

Pan, Haihong;[3] proposed a model combining both transfer learning and MobileNet. The classification of welding defects can be improved along with its accuracy. The model is named as TL-MobileNet. The experimental data set named GDXray contains 88 different types of weld defect images. The main outcome of the model was to identify the defect features and classifying them. In the future the model can be improved in order to identify the online images, which requires more amount of training with different production environments.

Kong, Yazhou; [4] developed diagnosis method, In the first step the preprocessing of the MRI images is done to avoid the motion correction. In the second step the study about brain parcellate where it contains 148 regions. After that the feature ranking (F-Score method was used here) is done to identify the required features and also the dimensionality requirements.The deep neural networks are applied on the top ranked features based on the hidden layers and the input and the output layers. The results are clear that the developed diagnosis method was very effective in classification of theASD.

M. Shaha and M. Pawar; [5] compared and analyzed different CNN architectures. The dataset consists of 22000 images. Three experiments were done to get the conclusion on the architectures. In the first experiment the dataset consists of 500 images in each of the 20 classes. The experiment is helpful in the analyzing the VGG19 architecture and the AlexNet and VGG16 are tested on the different dataset inorder to get the analysis correct.Based on this experiment the AlexNet gives 96.88 precision and 96.56 F-score values which are more than remaining two architectures. In the second experiment the database consists of 256 classes with 80 images in each of them. The results show the same as AlexNet is better but the accuracy value and F-Score values decreases. The comparison of three architectures are mainly based on three parameters they are precision, F-Score and recall. In future some more features like object detection can be implemented with these models.

Zheng, Zhi; [6] develops a system with a child sitting in the chair surrounded by many monitors. The monitor displays the child name to grasp the attention. Some cases the child will never responds to the name the process will continue until the child responds to the surrounding actions. The red flag will be displayed after the 10 attempts, generally the children with ASD takes more attempts. The developed ASOTS system provides the better results and can grasp the attention of the Autism affected children. The system can be improved in future by conducting longitudinal experiments by using the different protocol (In this system RTN protocol was used), the social orientation aspects can also be incorporated in the future systems.

Zheng, Zhi; [7] developed an architecture for training children those are suffering from Autism. The architecture was named as RISTA contains four modules. Graphical User Interface is on the top and the supervisory controller acts as the communicator between GUI and Gesture sensing, Gesture Demonstration modules. Different gestures are considered in order to evaluate the humans some of them are

rising one hand, waving two hands, reaching to the target. The Robot recognizes all the gestures that are defined and provides feedback based on the speed and accuracy of the gestures. The experiment was conducted on 7 adults and 3 developing children; each person performs any given 4 gestures 10 times. The results make sure that the Autism effected children pays more attention to the robotic administration than the human. In future the architecture can be improved by increasing the interaction time frame.

M. T. Tomczak et al; [8] developed a measuring system to measure the stress levels in Children with Autism disorder. The stress can lead to various factors like increase in blood pressure, heart rate and cutaneous vasoconstriction. The device is wearable which generates automatic reports which can helpful in Autism effected child for their therapy. The model works with starting event by calculating reference level during sleep if short-term change occurs in levels then stress event is generated else checks long-termchange the process will be recursive. The importance of the proposed The system was tested and accept by the personnel that are in charge of the caretaking with the ASD individuals.

Orasa Sirasakamol; [9] The majority of marathon deaths are caused by sudden cardiac arrest, which affects roughly one out of every 100,000 runners. In such instances, urgent resuscitation of the first relevant resource, including the use of an automated external defibrillator (AED) on runners by a scientific workforce, is required. However, in a select cases, such as admission to hospital with positive signs and symptoms, the runner's personal data is necessary to enhance the scientific workforce's clinical decision-making. This paper designed a mobile-healthcare emergency aid utility for safety and prevention in marathon activities to make marathon events more secure. This project has three levels: registration, data analytics, and walking stages.

Theerapon Tangsuwanaruk, Nantanan Jengsuebsant [10], Inorder to test application performance by the rapidity and reliability of code evaluation by the use of Triagost by comparision of the ITEMS or medical personnel emergencies only. The controlled crossover that was randomized by comaparing the triagist mobile app.By the experienced medical personnel emergency and using the mobile triage application has shown the more accurate results (95%)more than the method which is conventional.

Suma K V, Sethu Selvi, Pranav Nanda [11], At present days the most commonly occurring metabolic disorder is diabetes 400 million members in the world are affected due to diabetes. Based on the NFC an approach is proposed for the diabetes detection some of the qualitative parameters are considered for this approach an 600 images are collected that relates to diabetic. The capillary images are obtained by the use of NFC for the detection of capillary loops and classifies them into five classes. It helps in progression and severity of disorder for the medical practioners

3 Requirements

The project needs windows 10 opeartingsystem;for the designing of the application front end designing technologies like JavaScript, HTML, CSS and Python for the server side Python IDE like pycharm specifically used for python programming language.

Installation of packages:

The packages like Numpy, Pandas, seaborne, scikit learn, matplotlib, pyplot are essential for the project for installing these follow the below step:

Open command prompt and type "Pip install package name" Ex: pip install Numpy.

4 Implementation

4.1 Create dataset

Searching of the dataset is done with the help of internet. For example, the kaggle website used mainly for the datasets. If data is unavailable in the website data is created with a technique called data augmentation.

4.2 Data augmentation

It is the technique used to increase the amount of data of already existing data by adding slightly modified copies It acts as an emulate and helps to decrease over fitting when training a machine learning model. The size of overall dataset is 92.9 MB. The data is divided into Training_images, Testing_images, where the Training_images dataset size is 85.6 MB and Testing_images size is 7.34MB.

4.3 Data pre-processing

Both test and train dataset images are resized into 224x224, setting the color into RGB and dividing the data into batches.

4.4 Data training

By using the pre-processed training dataset to train the model using CNN algorithm with pre-trained model.CNN algorithm consists of 4 layers: Input layer, Convolution Layer, pooling layer, Flatten layer and dense layer. In input layer images are considered as input.

Pre-trained model MobileNet is used in the input Layer. In Convolution layer, the image is converted into matrix format. Here matrix size is 1024 X 1024 (rows X columns).In the pooling layer the numerical values will be stored. To change the numerical data to binary data, the machine learning algorithm named Softmax is used

(supervised learning algorithm). In Softmax layer it will convert the numerical data to binary. In flatten layer and dense the classes of total dataset (2 types) is stored which will be in the binary dataformat. Fit_generator method is used for saving the data in the form of .h5. Here model is a format for storing the binary data.

4.5 User

The application created is used to classify the images.It loads the model that which was created from the training part, choose the images from the system. And then the image is changed into array using img_to_array method.For changing binary values, it performs matrix division operation. After converting the binary values then the load the binary converted data to model for prediction.

After Detection it will give two [Autism, Non Autism] values. But finally it will classify only one image at a time. For this argmax method is used to get the highest value from the four classes. Finally, the highest value will be the classified image along with remedies will be displayed.

5 Proposed system model

In proposed system, a Deep Learning technologies that automatically recognizes images using Convolution Neural Network (CNN) with transfer learning models can be very beneficial in such problems. By using these techniques we can easily detect and identify the diseases.

First the process starts from collecting the data from various resources; the pre processing of data is done by checking whether there is any noisy and missing data. Later it splits the data into training and testing datasets. After completion of training part , an application is designed which is used detect autism and non-autism from the images by giving the input as the image from the user.

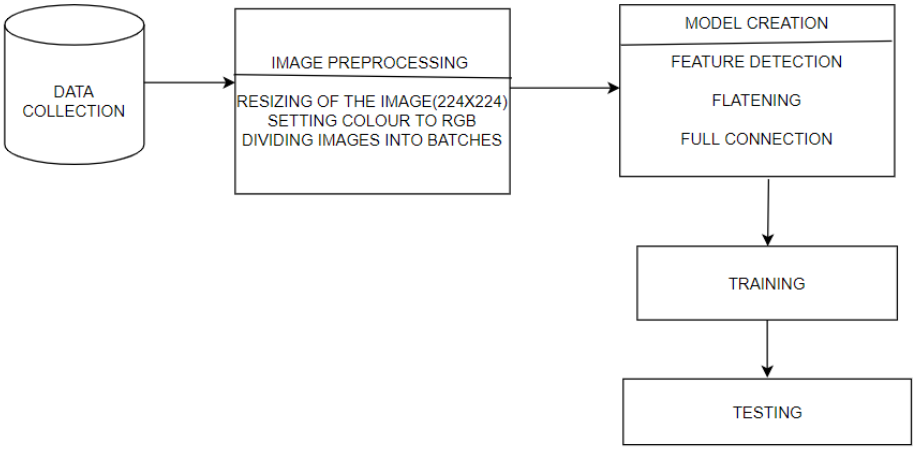

Fig. 2. Describes the flow of the system model

6 Architecture

The image taken from phone is uploaded by the user to website. The uploaded image is stored in a file because image cannot be directly decoded without storing it in a file. Later, the image from file is taken as input for classifying image by using cnn algorithm, mobilenet pre-trained model as autism and non-autism.Some suggestions are given for people who are suffering from the disease.In addition, users who are not willing to upload photo can provide the pre defined symptoms by which system can give whether a person is suffering from the disease or not.

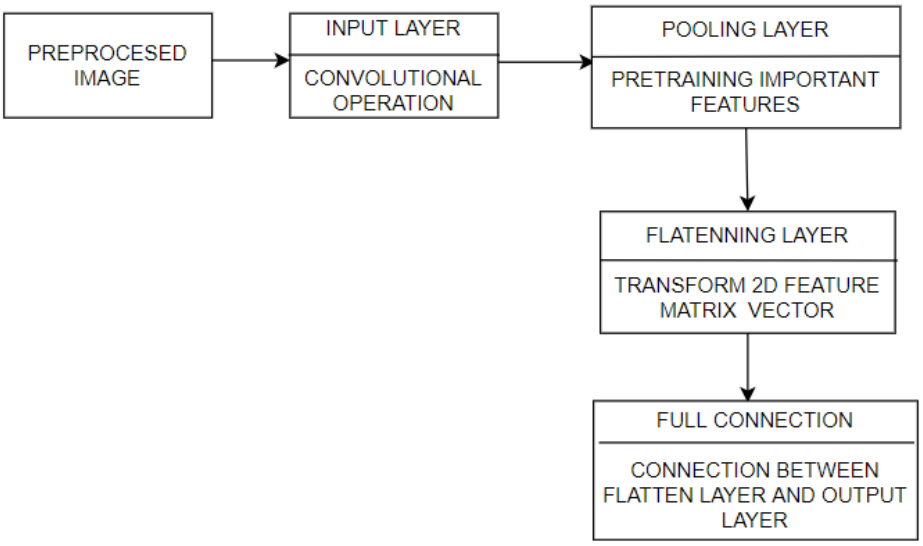

Fig. 3. Describes about the architecture

7 Methodology and algorithms

7.1 Step1: Convolutional operation

The first step is convolution operation. this step describes about feature detectors, which obey neural network's filters and about maps with special features, learning the parameters of such maps, detecting patterns, layer detection, and mapping out the results.

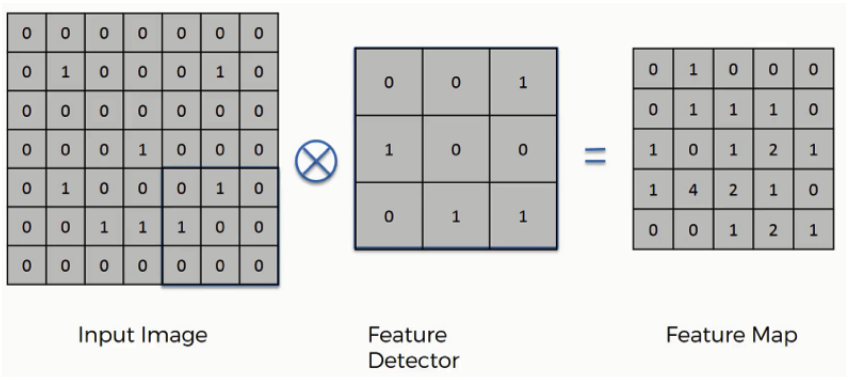

Fig. 4. Extraction of feature map from input image

7.2 Step 2: Pooling layer

This part describes about pooling and its working. The max pooling is used here for the polling specifically.

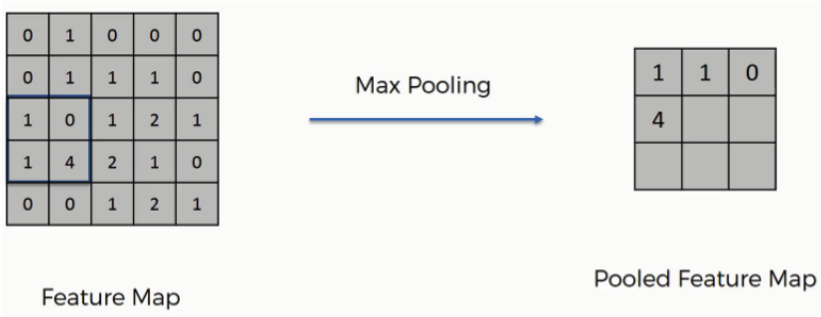

Fig. 5. Extraction of pooled feature map

7.3 Step 3: Flattening

It involves about the flattening and how it is converted from pooled to flattened layers while working with Convolutional Neural Networks.

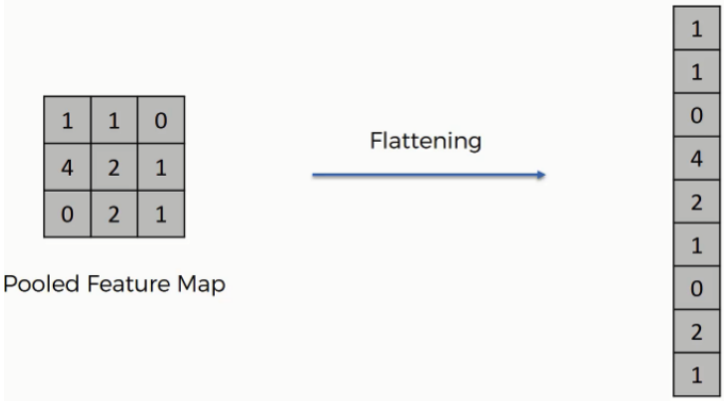

Fig. 6. Conversion of 2D matrix into vector

7.4 Step 4: Full connection

In this step, everything is integrated which was done in previous ones. From the training, there will be a clear view about how Convolutional Neural Networks work and how the "neurons" that are eventually created learn how to classify photos.

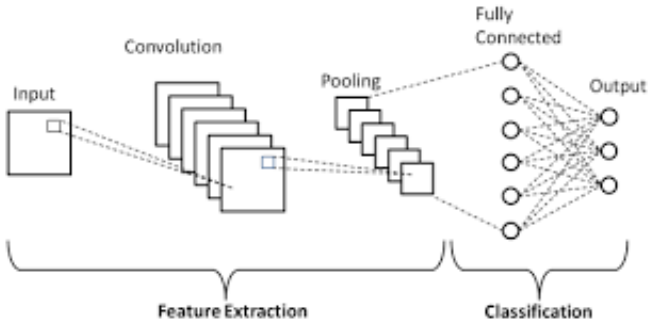

Fig. 7. Full connected link is established

8 Performance evaluation

The following Figure 8 displays the accuracy on a graph of testing and training.

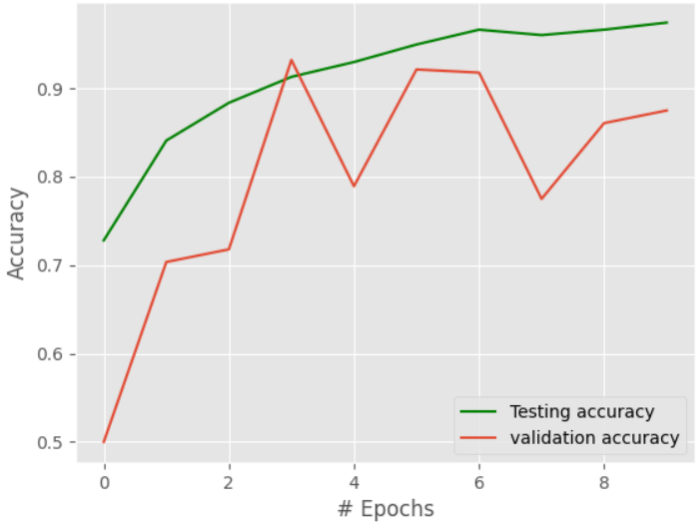

Fig. 8. Accuracy of training and testing

The following Figure 9 shows the accuracy of loss in training and testing in the form of a graph.

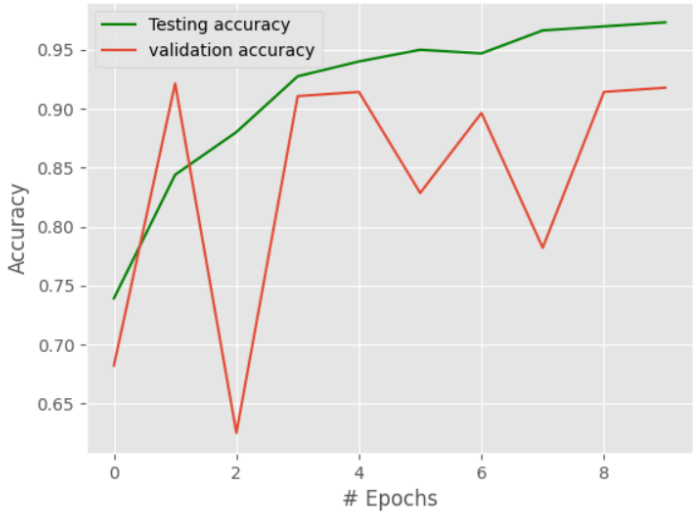

Fig. 9. Loss in testing and training

9 Results

9.1 Detection page

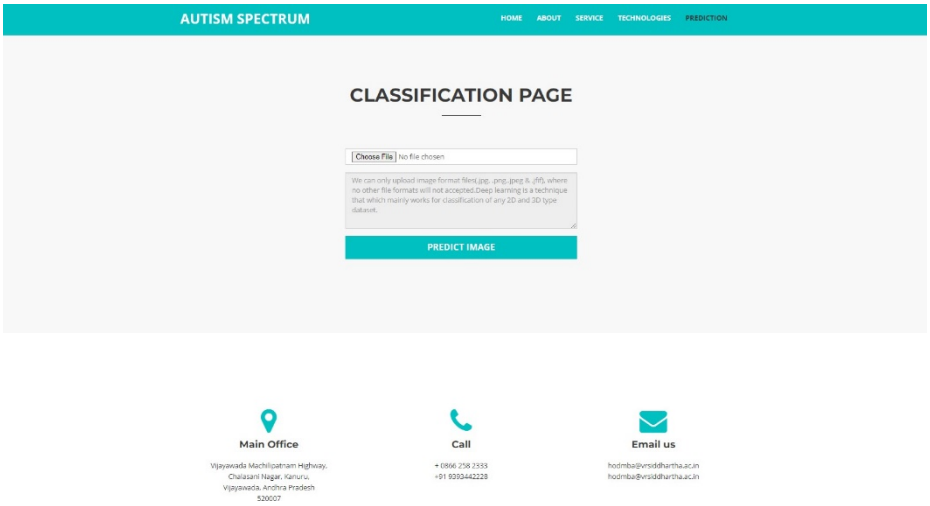

Fig. 10. Detection page of the application for inputting the image for detecting autism

9.2 Detect disease by giving text

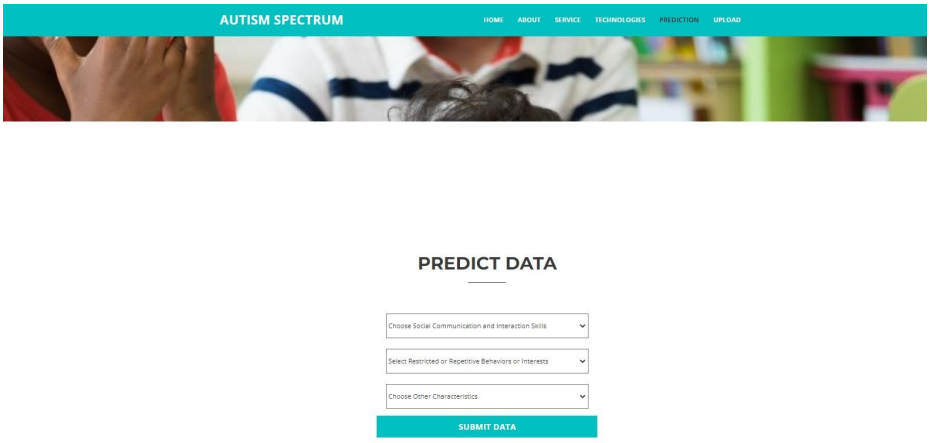

Fig. 11. The page is used for detecting the autism using symptoms

9.3 Uploaded image is autism

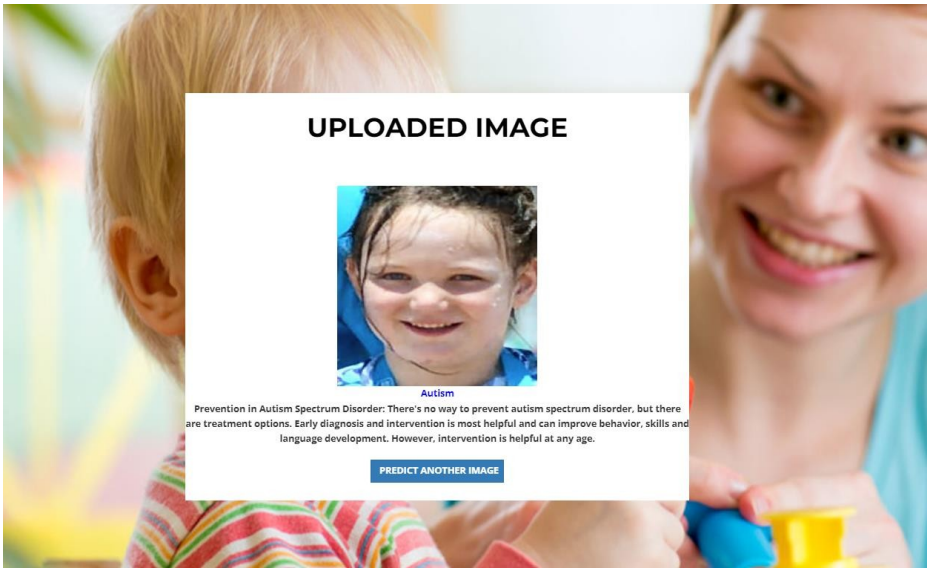

Fig. 12. The page results that the uploaded image has the autism

9.4 Predicted image is non autism

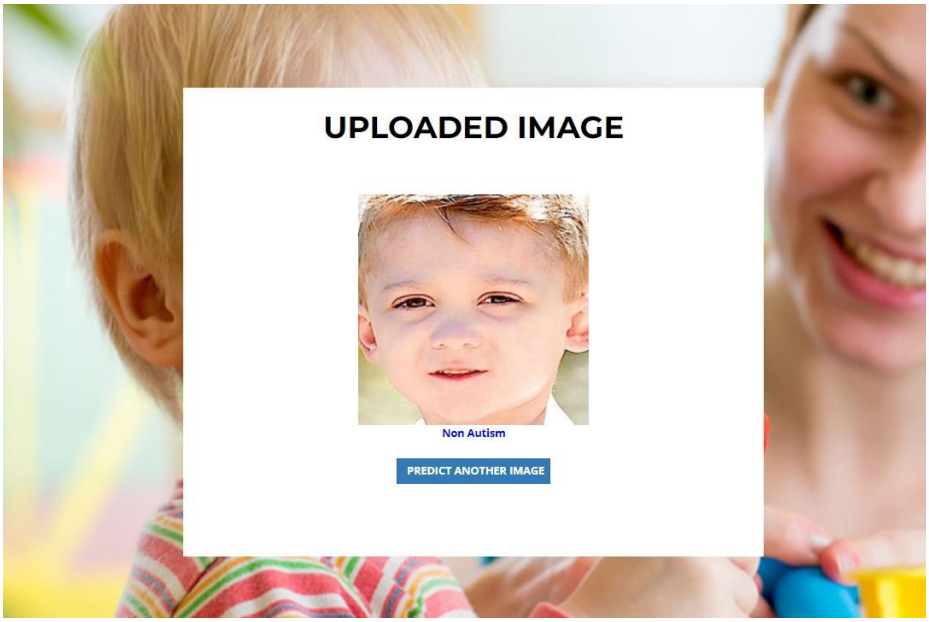

Fig. 13. The page results that the uploaded image has no autism

10 Conclusion

The primary goal of this research is to use a deep learning algorithm to categorize ASD. The findings suggest that deep learning is effective at classifying ASD. The image data is pre- processed in the following order: collecting, segregating, and the dataset's normalisation. The The pre-processed dataset is then sent into the CNN algorithm using the Pycharm Ide in order to identify ASD and non-ASD; and the processes for putting CNN into practise using transfer learning techniques are clearly outlined. Finally, a report on categorization and statistical graph are used to assess the algorithm's effectiveness based on performance accuracy. In addition, for more validation results, more comparisons with a variety of Other machine learning methods will be developed, as well as numerous performance indicators. Finally, combining statistical hypothesis testing with expert analysis is a smart idea. Deep learning as a preferable way of distinguishing ASD and non-ASD is the subject of thisstudy.

11 Future work

The following might be done in the future feature can be provided in the application, if the image uploaded by the user is other than an face image it should display an error.

12 References

[1] N. M. Rad and C. Furlanello, "Applying Deep Learning to Stereotypical Motor Movement Detection in Autism Spectrum Disorders," 2016 IEEE 16th International Conference on Data Mining Workshops (ICDMW), 2016, pp. 1235-1242. https://doi.org/10.1109/ICDMW.2016.0178

[2] R. Chauhan, K. K. Ghanshala and R. C. Joshi, "Convolutional Neural Network (CNN) for Image Detection and Recognition," 2018 First International Conference on Secure Cyber Computing and Communication (ICSCCC), 2018, pp. 278-282. https://doi.org/10.1109/ICSCCC.2018.8703316

[3] H. Pan, Z. Pang, Y. Wang, Y. Wang and L. Chen, "A New Image Recognition and Classification Method Combining Transfer Learning Algorithm and MobileNet Modelfor Welding Defects," in IEEE Access, vol. 8, pp. 119951-119960, 2020. https://doi.org/10.1109/ACCESS.2020.3005450

[4] Kong, Yazhou; Gao, Jianliang; Xu, Yunpei; Pan, Yi; Wang, Jianxin; Liu,Jin (2018). Classification of autism spectrum disorder by combining brain connectivity and deep neural network classifier. Neurocomputing, (), S0925231218306234. https://doi.org/10.1016/j.neucom.2018.04.080

[5] M. Shahaand M. Pawar, "Transfer Learning for Image Classification," 2018 Second International Conference on Electronics, Communication and Aerospace Technology (ICECA), 2018, pp. 656-660. https://doi.org/10.1109/ICECA.2018.8474802

[6] Z. Zheng et al., "Design of an Autonomous Social Orienting Training System (ASOTS) for Young Children With Autism," in IEEE Transactions on Neural Systems and

Rehabilitation Engineering, vol. 25, no. 6, pp. 668-678, June 2017. https://doi.org/10.1109/TNSRE.2016.2598727

[7] Z. Zheng, E. M. Young, A. R. Swanson, A. S. Weitlauf, Z. E. Warren and N. Sarkar, "Robot-Mediated Imitation Skill Training for Children With Autism," in IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 24, no. 6, pp. 682-691, June 2016. https://doi.org/10.1109/TNSRE.2015.2475724

[8] M. T. Tomczak et al., "Stress Monitoring System for Individuals With Autism Spectrum Disorders," in IEEE Access, vol. 8, pp. 228236-228244, 2020. https://doi.org/10.1109/ACCESS.2020.3045633

[9] Orasa Sirasakamol, Pakinee Ariya, Wanvimol Nadee, Kitti Puritat," Development of a Mobile -Healthcare Application for Safety and Prevention in Emergency Assistance at Marathon Events: A Case Study in CMU Marathon" in International Journal of Online and Biomedical Engineering (iJOE): https://doi.org/10.3991/ ijoe.v18i06.29515

[10] Suma K V, Sethu Selvi, Pranav Nanda, Manisha Shetty, Vikas M, Kushagra Awasthi ," Deep Learning Approach to Nailfold Capillaroscopy Based Diabetes Mellitus Detection", VOL. 18 NO. 06 (2022), " in International Journal of Online and Biomedical Engineering (iJOE): https://doi.org/10.3991/ijoe.v18i06.27385

[11] Nantanan Jengsuebsant,Borwon Wittayachamnankul,Parinya Tianwibool,Theerapon Tangsuwanaruk,Wachira Wongtanasarasin ,Krongkarn Sutham," Efficiency of Mobile Application of Thai Criteria Based Dispatch: A Randomized Controlled Crossover Trial", VOL. 18 NO. 06 (2022). https://doi.org/10.3991/ijoe.v18i06.28307

13 Authors

Arvapalli Surya Teja is a student of vrsiddhartha engineering college currently pursuing 4/4 B.Tech in Computer Science Engineering. He had published two papers in IEEE conferences.

D.Mounika is a student of vrsiddhartha engineering college currently pursuing 4/4 b.tech Computer Science Engineering .She had published a paper in conference (email: 188w1a0515@vrsiddhartha.ac.in).

Akunuri Saiabhay is a student of vrsiddhartha engineering college currently pursuing 4/4 B.Tech in Computer Science Engineering.He had published a paper in IEEE conference (email: 188w1a0501@vrsiddhartha.ac.in).

Madala Vani Pujitha has been waged as an Assistant Professor having 15 years of experience in Computer Science and Engineering Department, Velagapudi Rama Krishna Siddhartha Engineering College, Vijayawada, India. She has 13 years of teaching experience and she published 8 journal papers (email: pujitha@ vrsiddhartha.ac.in).

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