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Detection of diseases using facial features with Deep transfer learning

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***Abstract*---**There is always a relation between face and diseases that leads the idea of facial diagnosis. The aim of this project is to predict the diseases using 2 Dimensional facial images. In this study, we are dealing with diagnosis of single and multiple illnesses such as Beta-thalassemia, hyperthyroidism, Down syndrome, leprosy and vitiligo. Accuracy for face recognition is over 90%. In practical collecting disease specific images are complex, expensive and time taking process. Therefore, collecting data sets for face recognition is hard and complicated. So, in deep transfer learning applications we can do facial diagnosis with a small dataset which will be easy process where we can train the pre trained model.

***Keywords*---**Facial diagnosis, beta-thalassemia, hyperthyroidism, down syndrome, leprosy, vitiligo.

Introduction

People in many rural and underdeveloped areas facing many problems because they are unable to find good medical checkup and they don't have proper medical resources, which causes treatment to take longer in many circumstances. Even in metropolises, limits such as high costs, long hospital wait times, and the doctor-patient conflict that leads to medical disputes persist. Deep learning has gained popularity in recent years due to its superior performance, particularly in computer vision. AlexNet, VGGNet, ResNet, Inception-ResNet, and SENet are examples of deep neural network models. Face Recognition is the concept of verifying or recognising persons in photographs by looking at their faces. Face identification is the process of comparing a given face image to the faces in a dataset. The mapping is called as one to many. Face verification is the process of comparing two faces and determining whether or not they are same. It's a one-to-one mapping process. One of the most often used deep learning techniques for face recognition is the convolutional neural network (CNN). CNN models are trained using vast amounts of facial image data sets, and they achieve great accuracy when tested on small datasets. The two processes of face recognition and facial diagnosis are intertwined. In facial diagnostics, we will look for abnormalities in the face and match them to disease symptoms to determine the disease kind. We train different models in conventional learning.

Face recognition can be done by using deep learning techniques. These techniques have worked successfully and this makes us to do this project. For facial diagnosis the existing data is not at all sufficient. So if we educate a neural network from scratch it results in overfitting. Facial reputation and facial analysis are inter related so we will use the statistics of facial recognition via the usage of transfer studying method.

Deep transfer learning means transferring knowledge by using neural networks. Thus, in this paper 2D facial images are used to understand early diagnosis and sickness screening method. in this paper next 5 illnesses are introduced and if the person doesn't have any disease he can be identified as healthy. Thalassemia is a form of inherited blood disorder caused by irregular generation of hemoglobin. It is one of the inherited blood disorder that affects large number of people. When it comes to thalassemia, it's critical to get a diagnosis as soon as possible. Thalassemia is divided into two categories Alpha thalassemia and Beta thalassemia. In this world out of 100,000 1 person is suffering from beta-thalassemia. According to medical researchers, beta-thalassemia can cause bone loss especially on the face. Main features of thalassemia are Eye apertures, A Flat midface, A Short nose, A Thin upper lip, An Undeveloped jaw.

Hyperthyroidism is a common disorder caused by excess thyroid hormones in body, Thyroid hormones that regulates body's metabolism are T3 and T4. If not treated promptly, it can lead to major problems and possibly put the patient's life in jeopardy. Thinning hair, Shining or staring eyes, Less blinking, Fatigue, Nervousness.

Down syndrome is a form of genetic condition that is caused by chromosome trisomy. Every year, it affects one in every a thousand new born. Having a large

head, Slow physical growth, Abnormal nasal bridge, Ears are folded and small compared to others, Small chin Neck is too short. Leprosy is a type of disease which is caused by slow growing type of bacteria. The person who is suffering from leprosy will loss feelings of pain, weakness and poor sight. The person who is suffering from leprosy should need a proper treatment and main characteristics are eye damage, hair loss, facial disfigurement like loss of nose and mouth etc. Vitiligo is a type of disease that makes loss of skin color and occurs when pigment producing cells die or stop functioning of those cells. The main characteristics of vitiligo includes loss of skin color, whitening or graying of hair on scalp, eyebrows, eyelashes or beard and loss of color in tissues inside mouth and nose.

Literature survey

Bo Jin, Leandro Cruz et al. [1] proposed using deep transfer learning and used for detecting single and multiple diseases like beta thalassemia, hyperthyroidism, down syndrome, leprosy using facial 2D images.
Alex. K, G. E. Hinton et al. [2] trained a deep convolutional neural network to classify high resolution images. To make training faster author used non saturating neurons.
C. Szegedy, W. Liu et al. [3] made an architecture that is the improved utilization of resources inside network. This architectures are based on Hebbian principle.
Andrew Z, Karen et al. [4] made two best performing ConNet models to facilitate further research on use of deep visual representations.
K. He, X. Zhang et al. [5] explained that deep neural networks are difficult to train so they used a residual learning framework for training of networks. Author used deep residual learning for image recognition.
F Schroff, James Philibin et al. [6] presented a system called FaceNet, that automatically learns to map from face pictures to the Euclidean intersection where distance measures directly the similarity of a face.
Y. Taigman, M. Yang et al. [7] uses few steps for face verification. They are detect,3D face modelling, classify to derive a face representation from nine layer deep neural network.
J. liu et al. [8] proposed the two stage approach that combines multi patch deep CNN and metric learning that extracts discriminative features for face recognition and face verification.
B. Zhang, X. Wang et al. [9] computerized facial diagnosis using facial and texture elements are removed from the face blocks representing the image of the face.
Elham S J Abu alhaija et al. [10] identified cephalometric and facial features of patients suffering from beta-thalassemia major. This paper detects beta thalassemia and other 54 thalassemic diseases suffered by patients by using their photographs.
Peter N. Taylor, Colin M et al. [11] detected Hyperthyroidism, hypothyroidism. Thyroid hormones are very essential for growth, reproduction but hyperthyroidism and hypothyroidism are main diseases that are caused by excess of thyroid hormones.
Qian Zhao, Dina Zand et al. [12] detected down syndrome from facial photographs. In this paper author used the machine learning techniques for detection of down syndrome disease, patients with down syndrome disease can have heart diseases which leads to severe problems. So, this project helps in early detection.

Zhao Q, Okada K et al. [13] proposed a easy and automated framework for detecting down syndrome based on particular facial patterns and symptoms. This paper detects the down syndrome and other genetic syndromes.
Harald J Schneider et al. [14] proved that acromegaly can be diagnosed by using photographs of face.
Xiangyi Kong et al. [15] acromegaly is identified by using facial photographs which will lessen the prevalence and increase the probability of person to cure.

Proposed system

This project is used for facial diagnosis where by using convolutional neural networks different diseases are detected. Every different disease is having different symptoms so feature extraction can be done and disease detection happens. Our project is a website where the user have to register through login credentials and can upload an image. By clicking on prediction user can detect their diseases.

Methodology

In Convolutional Neural Network there are different steps to be processed for finding the exact output. Step1a: convolutional operation: The convolution procedure is the very first step. We will speak about feature detectors in this level, which are more crucial the neural network's filters. We will also go through feature maps and how to use them, including how to calculate their parameters, recognise patterns, detect layers, and plan out your discoveries

Step 1b: Rectified linear unit Layer: The Rectified Linear Unit, or Relook, will be used in the second half of this process. In the framework of Convolutional Neural Networks, we will talk about Relook layers and linearity functions.
Step 2: Pooling Layer: During this phase, we'll study all about pooling and how it works in general. Our nexus, on the other hand, will feature a unique type of pooling: maximum pooling. We will, however, discuss several reaches, that includes mean pooling. This portion will come to a close with a visual interactive tool-based presentation that will cover the entire subject
Step 3: Flattening This gives clear explanation about process of flattening and it gives idea of how we transfer from pooled to flattened layers.
Step 4: Full Connection During this phase, we'll study all about pooling and how it works in general. Our nexus, on the other hand, will feature a unique type of pooling: maximal pooling. We will, however, discuss several reaches, including mean pooling. This portion will come to a close with a visual interactive tool-based presentation that will cover the entire subject.
Steps to be followed are:

1) Required packages are installed
2) Model is defined.
3) Load the dataset for training.
4) Pre-processing of data set for training process.
5) Train the custom model based on symptoms.
6) Load the pre-trained models. That models is Mobilenet

7) Train the pre-trained model for extra features with our own dataset.
8) Process of detecting the performance.
9) Creating a user module

Modules

This project is a webbased application where the user can register using particular details and can login using those credentials. The user can login and upload image by using upload option later he can get the result by clicking on predict button.

System

Create Dataset: We are using the internet to look for the dataset. For instance, the kaggle website is mostly used for datasets. If data isn't available on the internet, we use a technique called data augmentation to develop it ourselves. Data Augmentation: Data Augmentation: In data analysis, data augmentation refers to methods for boosting the amount of data that can be analyzed and data by adding slightly changed copies of current data or creating new synthetic data from existing data. When training a machine learning model, it functions as a regulazier and helps reduce overfitting. It is closely related to data analysis oversampling.

Data Pre-Processing: Data pre-processing is used for converting raw data into useful format. It is a type of data mining technique. (a). Missing Data: While dealing with a problem if we don't find some data in the predefined dataset then it is called as missing data. We can solve this issue by following various ways. (b). Noisy Data: Noisy data is a type of data which is not relevant and cannot be accepted by systems. Data Training: We're utilising a CNN technique with a pre-trained model to train our model using a pre processed training dataset. Input layer, Convolution Layer, Pooling Layer, Flatten Layer, and Dense Layer are the four layers that make up the CNN algorithm.

- In input layer we consider images as input.
- Here we considering the input layer is the pre-trained model MobileNet.
- We turn the image into matrices in the Convolution layer. 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, we use machine learning algorithm named Softmax (supervised learning algorithm). In Soft max layer we will convert the numerical data to binary.
- In flatten layer and dense the classes of total dataset (5 types) is stored which will be in the binary data format.
- We use fit generator method for saving the data in the form of .h5. Here model is a format for storing the binary data

User

1) Register The user needs to register for the application and the user data is stored in database.
2) Login Once the user is registered for the system then he/she can login by using valid credentials

3) About-Project This is the first page that displayed after the user gets login to the system. Here the project details and disease classification get displayed.
4) Upload Image Here the user is asked to upload the image for which he needs to predict the disease. There will be a button called upload image where user can click it and browse the images from his system and can upload images.
5) Prediction This prediction can be done by the system based on the Symptoms of face. After the image get uploaded within few seconds the disease of the image gets predicted.
6) Logout Once the prediction of disease is over then the user can logout of the application

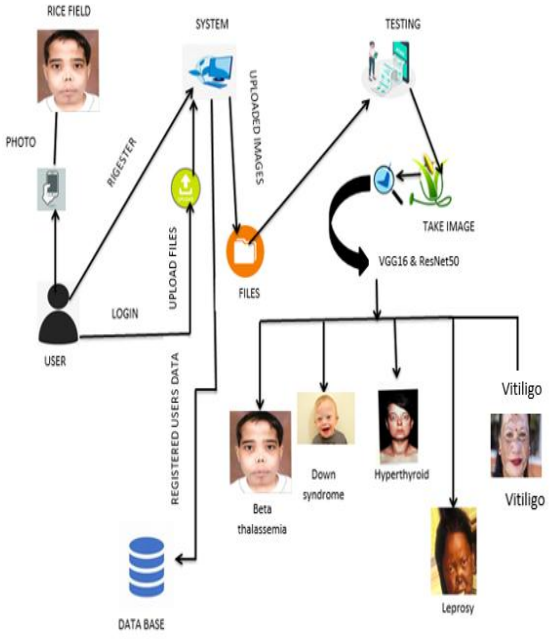

Fig.3: system architecture

Result and Discussions

From doing the above project, the detection of diseases beta-thalassemia, down syndrome, hyperthyroidism, leprosy, vitiligo are detected using facial images. We have used multi classification task for detecting those diseases. The web page created for detecting the diseases looks like

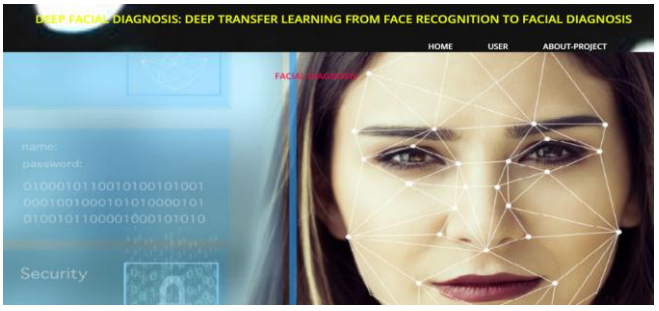

Figure1: Home page

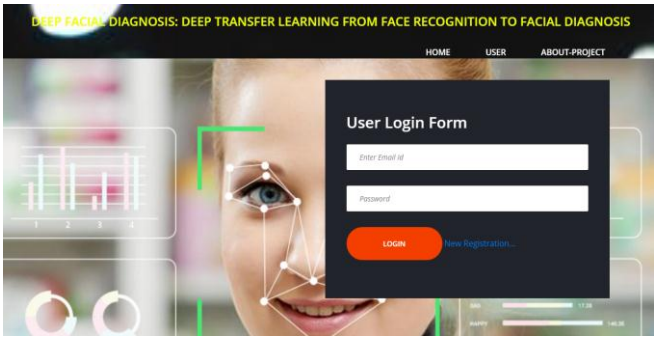

Figure2: Login Form

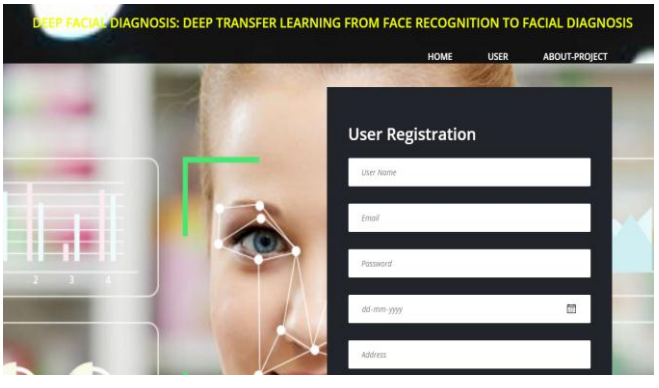

Figure3: Registration page

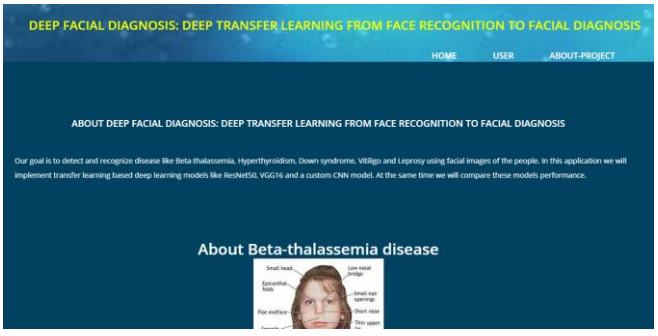

Figure 4: About the project page

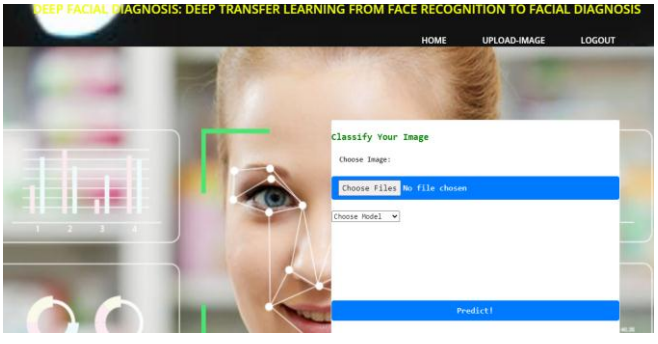

Figure 5: Upload an image

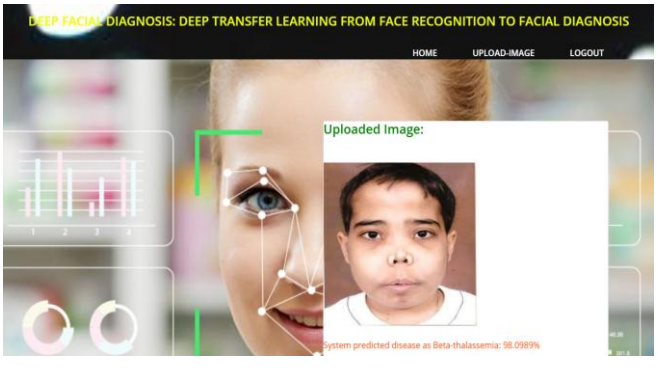

Figure 6: Result

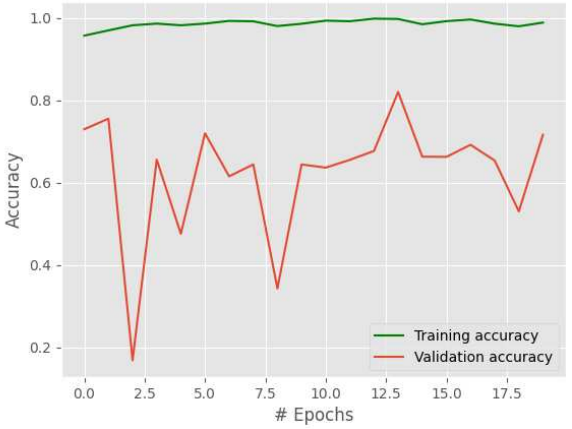

Figure 6: Training accuracy

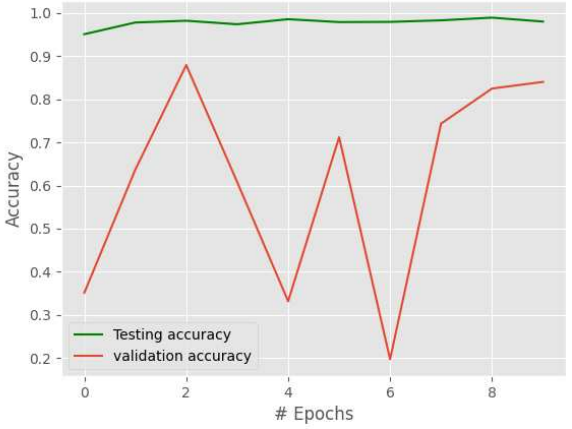

Figure 7: Testing accuracy

Conclusions

In this paper, we proposed an automatic facial diseases detection using CNN. The method that we proposed was working good and getting accurate results. The results that were produced decided that our project has good potential for automatic detection of diseases from facial images useful for early screening and prevention of disease spreading. This will give a new path in the medical field.

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