A Seminar report on

Facial Diagnosis

Submitted in partial fulfillment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

in

Computer Science& Engineering

By

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SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

Certificate

This is to certify that the Technical Seminar report entitled Facial Diagnosis is the bonafide work carried out by **S. TASNEEM** bearing Roll Number **184G1A05A4** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering** during the academic year 2021 - 2022.

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ABSTRACT

The relationship between face and disease has been discussed for thousands years, which leads to the occurrence of facial diagnosis. The objective here is to explore the possibility of identifying diseases from uncontrolled 2D face images by deep learning techniques. We propose using deep transfer learning from face recognition to perform the computer-aided facial diagnosis on various diseases.

We are going to perform the computer-aided facial diagnosis on diseases (beta-thalassemia, hyperthyroidism, Down syndrome, and leprosy) with a relatively small dataset. The overall top-1 accuracy by deep transfer learning from face recognition can reach over 90% which outperforms the performance of both traditional machine learning methods and clinicians in the experiments. In practice, collecting disease-specific face images is complex, expensive and time consuming, and imposes ethical limitations due to personal data treatment. Therefore, the datasets of facial diagnosis related research are private. The success of deep transfer learning applications in facial diagnosis with a dataset could provide a low-cost and non-invasive way for disease screening and detection.

Date: signature of the guide

INTRODUCTION

Thousands years ago, Huangdi Neijing , the fundamental doctrinal source for Chinese medicine, recorded "Qi and blood in the twelve Channels and three hundred and sixty-five Collaterals all flow to the face and infuse into the Kongqiao (the seven orifices on the face)." It indicates the pathological changes of the internal organs can be reflected in the face of the relevant areas. In China, one experienced doctor can observe the patient's facial features to know the patient's whole and local lesions, which is called "facial diagnosis". Similar theories also existed in ancient India and ancient Greece. Nowadays, facial diagnosis refers to that practitioners perform disease diagnosis by observing facial features. The shortcoming of facial diagnosis is that getting a high accuracy facial diagnosis requires doctors to have a large amount of practical experience. Modern medical research indicates that, indeed, many diseases will express corresponding specific features on human faces.

Nowadays, it is still difficult for people to take a medical examination in many rural and underdeveloped areas because of the limited medical resources, which leads to delays in treatment in many cases. Even in metropolises, limitations including the high cost, long queuing time in hospital and the doctor-patient contradiction which leads to medical disputes still exist. Computer-aided facial diagnosis enables us to carry out non-invasive screening and detection of diseases quickly and easily. Therefore, if facial diagnosis can be proved effective with an acceptable error rate, it will be with great potential. With the help of artificial intelligence, we could explore the relationship between face and disease with a quantitative approach.

In recent years, deep learning technology improves the state of the art in many areas for its good performances especially in computer vision. Deep learning inspired by the structure of human brains is to use a multiple-layer structure to perform nonlinear information processing and abstraction for feature learning.deep learning has become one of the newest trends in artificial intelligence research.Face recognition refers to the technology of verifying or identifying the identity of subjects from faces in images or videos. It is a hot topic in the field of computer vision. Face verification is the task of comparing a candidate face to another, and verifying whether it is a match or not. It is a oneto-one mapping. Face identification is the task of matching a given face image to one in a database of faces. These two can be implemented by separate algorithm frameworks, or they can be unified into one framework by metric learning. With the development of deep learning in recent years, traditional face recognition technology has gradually been replaced by deep learning methods. Convolutional Neural

Network (CNN) is the most commonly used deep learning method in face recognition.

The CNN architectures such as MobileNet ,VGG-Face,Resnet get inspired from a ImageNet Classification Large Scale Visual Recognition(ICLSR).. If we train a deep neural network from scratch, it will inevitably lead to overfitting. Apparently face recognition and facial diagnosis are related. Since the labeled data in the area of face recognition is much more, transfer learning technology comes into our view. In traditional learning, we train separate isolated models on specific datasets for different tasks. Transfer learning is to apply the knowledge gained while solving one problem to a different but related problem. According to whether the feature spaces of two domains are same or not, it can be divided into homogeneous transfer learning and heterogeneous transfer learning. In our task, it belongs to homogeneous transfer learning. Deep transfer learning refers to transfer knowledge by deep neural networks. Thus, transfer learning makes it possible that identifying diseases from 2D face images by deep learning technique to provide a non-invasive and convenient way to realize early diagnosis and disease screening. In this paper, the next four diseases introduced and the corresponding health controls are selected to perform the validation.

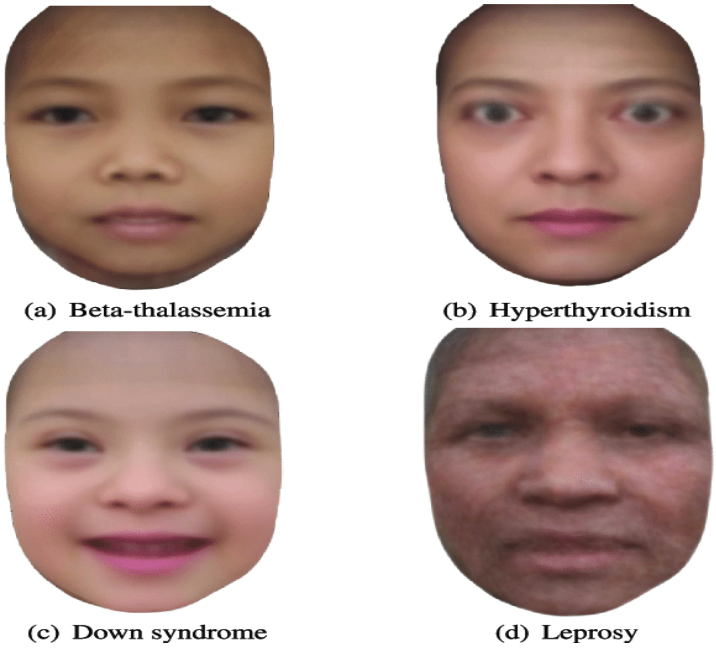
Thalassemia is a genetic disorder of blood caused by abnormal hemoglobin production, and it is one of the most common inherited blood disorders in the world. It is particularly common in people of Mediterranean, the Middle East, South Asian, Southeast Asian and Latin America. Since thalassemia can be fatal in early childhood without ongoing treatment, early diagnosis is vital for thalassemia. There are two different types of thalassemia: alpha (α) and beta (β). Beta-thalassemia is caused by mutations in the HBB gene which provides instructions for making a protein named beta globin on chromosome 11, and is inherited in an autosomal recessive fashion. It is estimated that the annual incidence of symptomatic beta-thalassemia individuals worldwide is 1 in 100,000. According to medical research, beta-thalassemia can result in bone deformities, especially in the face. The typical characteristics of beta-thalassemia on the face include small eye openings, epicanthal folds, low nasal bridge, flat midface, short nose, smooth philtrum, thin upper lip and underdeveloped jaw.

Hyperthyroidism is a common endocrine disease caused by excessive amounts of the thyroid hormones T3 and T4 which can regulate the body’s metabolism by various causes. The estimated average prevalence rate is 0.75% and the incidence rate is 51 per 100,000 persons per year by the metaanalysis [14]. If it is not treated early, hyperthyroidism will cause a series of serious complications and even threaten the patient’s life. The typical characteristics of hyperthyroidism on the face include thinning hair, shining and protruding or staring eyes,

increased ocular fissure, less blinking, nervousness, consternation and fatigue. The characteristic hyperthyroidism-specific face.

Down syndrome (DS) is a genetic disorder caused by the trisomy of chromosome 21. DS occurs in about one per one thousand newborns each year. The common symptoms include physical growth delays, mild to moderate intellectual disability, and the special face. The typical characteristics of DS on the face include large head compared to the face, upward slant of palpebral fissures, flattened nasal bridge, Brushfield spots, epicanthal fold, low-set, small, folded ears, short, broad nose with depressed root and full tip, a small oral cavity with broadened alveolar ridges and narrow palate, small chin and short neck. The characteristic DS-specific face.

Leprosy (also known as Hansen's disease) caused by a slow growing type of bacteria called Mycobacterium leprae is an infectious disease. If the leper doesn't accept timely treatment, leprosy will cause losing feelings of pain, weakness and poor eyesight. According to the World Health Organization, there are about 180,000 people infected with leprosy most of which are in Africa and Asia until 2017. The typical characteristics of leprosy [16] on the face include granulomas, hair loss, eye damage, pale areas of skin and facial disfigurement (e.g. loss of nose). The characteristic leprosy specific face.



(a) Beta-thalassemia (b) Hyperthyroidism

(c) Down syndrome (d) Leprosy

Identifying above diseases from uncontrolled 2D face images by deep learning technique has provided a good start for a non-invasive and convenient way to realize early diagnosis and disease screening. In this paper, our contributions are as follows:

(1) We definitely propose using deep transfer learning from face recognition to perform the

computer-aided facial diagnosis on various diseases.

(2) We validate deep transfer learning methods for single and multiple diseases identification on a small dataset.

(3) Through comparison, we find some rules for deep transfer learning from face recognition to facial diagnosis.

Literature Survey

[1] . Bo Jin, Leandro Cruz, and Nuno Goncalves, "Deep Facial Diagnosis by Deep Transfer Learning ", *IEEE Access*, 29 June 2020

Training a CNN which is end to end learning from scratch will inevitably lead to over-fitting since that the training data is generally insufficient for the task of facial diagnosis. Transfer learning is applying the knowledge gained while solving one problem to a different but related problem.Deep transfer learning (DTL) is to transfer knowledge by pre-trained deep neural network which originally aims to perform facial verification and recognition in this paper. Thus the source task is face recognition and verification, and the target task is facial diagnosis. In this case, the feature spaces of the source domain and target domain are the same while the source task and the target task are different but related.The pretrained CNN is for end-to-end learning so that it can extract high-level features automatically. Since deep transfer learning is based on the fact that CNN features are more generic in early layers and more original dataset-specific in later layers, operation should be performed on the last layers of DCNN models.

[2]. Haihong Pan, Zaijun Pang, Yaowei Wang, Yijue wang , And Lin Chen , "Image recognition combining Transfer learning and MobileNet model", *IEEE Access*, July 9, 2020.

Deep learning has been successfully applied to image analysis and target recognition. However, the use of deep learning to identify welding defects is time-consuming and less accurate due to the lack of adequate training data samples, which easily cause redundancy into the classifier.In this situation, we proposed a new transfer learning model based on MobileNet as a welding defect feature extractor. By using the ImageNet dataset (non-welding defect data) to pre-train a MobileNet model, migrate the MobileNet model to the welding defects classification field. This article suggested a new TL-MobileNet structure by adding a new Full

Connection layer (FC-128) and a Softmax classifier into a traditional model called MobileNet.

In this Paper, They proposed a new image recognition and classification method for welding defects, which combines the transfer learning algorithm and MobileNet model, namely TL-MobileNet model. This TL-MobileNet model has three advantages. (1) It can solve the problems of low prediction accuracy and time-consuming, which are induced by insufficient welding defects in learning samples. This model combines transfer learning theory with trained MobileNet model form a welding defects feature extractor. (2) It has an enhanced feature extraction capability, since it added a new Fully Connected layer (FC-128) and a Softmax classifier after the MobileNet.

[3]. Maciej Geremek and Krzysztof Szklanny , "Deep Learning-Based Analysis of Face Images" *Sensors 2021, 21, 6595*.

Deep learning models have demonstrated improved efficiency in image classification since the ImageNet Large Scale Visual Recognition in 2010. Classification of images has further augmented in the field of computer vision with the dawn of transfer learning. To train a model on a huge dataset demands huge computational resources and adds a lot of cost to learning. Transfer learning allows to reduce the cost of learning and also help avoid reinventing the wheel.This paper demonstrates image classification using pretrained deep neural network model VGG16 which is trained on images from ImageNet dataset. After obtaining the convolutional base model, a new deep neural network model is built on top of it for image classification based on a fully connected network. This classifier will use features extracted from the convolutional base model.Transfer learning allows to transfer the knowledge gained by previously learned task and apply it to similar another task . With transfer learning the base network which consists of different layers depending upon the architecture is trained on the base dataset and the learned parameters are transferred to another network. Convolutional neural network models have layered architecture where different features are learnt at each layer. Therefore, transfer learning can be easily accomplished with convolutional neural

networks, where the lower layer acts as a feature extractor and the final layers are used to extract more specific features.

[4]. Barlian Khasoggi, Ermatita, Samsuryadi, "Efficient mobilenet architecture as image recognition", Master of Informatics Engineering,Sriwijaya University, Indonesia, Vol. 16, No. 1, October 2019.

The introduction of a modern image recognition that has millions of parameters and requires a lot of training data as well as high computing power that is hungry for energy consumption so it becomes inefficient in everyday use. Machine Learning has changed the computing paradigm, from complex calculations that require high computational power to environmentally friendly technologies that can efficiently meet daily needs. To get the best training model, many studies use large numbers of datasets. However, the complexity of large datasets requires large devices and requires high computing power. Therefore large computational resources do not have high flexibility towards the tendency of human interaction which prioritizes the efficiency and effectiveness of computer vision. This study uses the Convolutional Neural Networks (CNN) method with MobileNet architecture for image recognition on mobile devices and embedded devices with limited resources with ARM-based CPUs and works with a moderate amount of training data (thousands of labeled images). With the level of accuracy and efficiency of the resources used, it is expected that MobileNet's architecture can change the machine learning paradigm so that it has a high degree of flexibility towards the tendency of human interaction that prioritizes the efficiency and effectiveness of computer vision. The MobileNet model is based on depth wise separable convolutions which is a procedure of factorized convolutional which factorizes a regular convolution into a depthwise convolution and a 1 × 1 convolution named a pointwise convolution.. A final average pooling reduces the spatial resolution to 1 before the fully connected layer. Counting depthwise and pointwise convolutions as separate layers, MobileNet has 28 layers.

PROBLEM DEFINITION

It is still difficult for people to take a medical examination in many rural and underdeveloped areas because of the limited medical resources, which leads to delays in treatment in many cases. Even in metropolises, limitations including the high cost, long queuing time in hospital and the doctor-patient contradiction which leads to medical disputes still exist.

The early detection and prediction of diseases is the best way rather than making it worse.These diseases show the instant reaction on our faces and make it clear understanding of the disease.The cost of equipment is high ,as well as its treatment when used. These diseases should be predicted with more accuracy to perform the best treatment.The machine learning algorithm has efficiency but less accuracy when used.

To overcome the existing problems, Computer-aided facial diagnosis enables us to carry out Non-invasive screening and detection of diseases quickly and easily with less error rate.We are going to use deep transfer learning from face recognition to perform the computer-aided facial diagnosis on various diseases.This CNN models outperform the machine learning algorithms and clinical equipments and give the best accuracy .Transfer learning is applying the knowledge gained while solving one problem to a different but related problem.Deep transfer learning (DTL) is to transfer knowledge by pre-trained deep neural network which originally aims to perform facial verification and recognition.Face recognition is done by observing the faces from the images.And,it predicts the classes of diseases as Beta-Thalassemia,Hyper-Thyroidism,Leprosy,Down Syndrome.

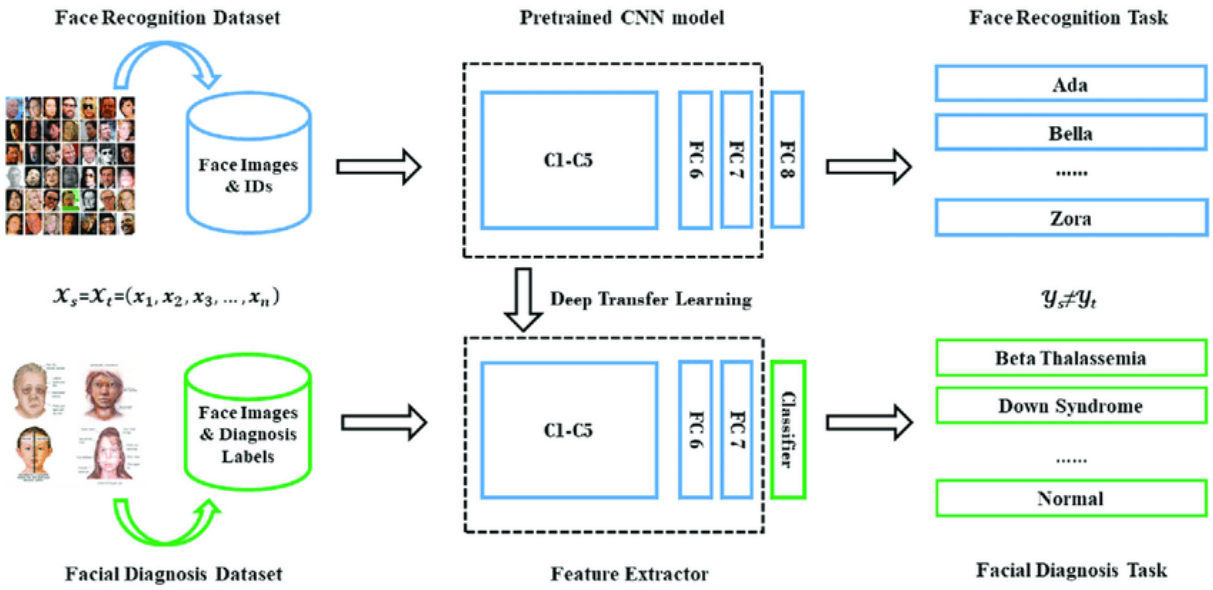


Fig 1:The schematic diagram of facial diagnosis by deep transfer learning

The Images from the dataset is given as input to the Convolutional neural network models with labels. Each image classification is done in the layers of the model.We avoid training the model from the scratch by the help of deep transfer learning ,which extracts the pretrained model knowledge and passes to new tasks with the same domain and makes it train from end-end. After extracting the features from the model .The classifier classifies the data points and predicts the output as the four disease classes.

REQUIREMENTS

1. **IDE -** PyCharm
2. **Coding Language -** Python
3. **Libraries**:

   a. **NumPy**:

   NumPy, which stands for Numerical Python, is a library consisting of multidimensional array objects and a collection of routines for processing those arrays. Using NumPy, mathematical and logical operations on arrays can be performed. NumPy is a Python package. It stands for 'Numerical Python'.

   b. **Tensorflow**:

   TensorFlow is a free and open-source software library for machine learning and artificial intelligence. TensorFlow provides a collection of workflows to develop and train models using Python or JavaScript, and to easily deploy in the cloud, on-prem, in the browser, or on-device no matter what language you use.

   c. Keras:

   Keras is a powerful and easy-to-use free open source Python library for developing and evaluating deep learning models. Keras acts as an interface for the TensorFlow library. It is written in Python and is used to make the implementation of neural networks easy. It also supports multiple backend neural network computation.

   d. **Pandas**:

   pandas is a software library written for the Python programming language for data manipulation and analysis.pandas is a fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language.

4. **Dataset**:

The Dataset consists of over hundreds of Diseased Faces.The Face Images with four disease classes such as Beta-Thalassemia, Down Syndrome, Hyper-Thyroidism, Leprosy. The images are labeled and preprocessing techniques are used for predicting with the model performance and accuracy.

5. Model:

MobileNet model is used for facial diagnosis based on deep transfer learning on face recognition.MobileNet is a type of convolutional neural network designed for mobile and embedded vision applications. We train our model by a dataset with images , and predict which type of disease it is.