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Artificial Intelligence in Medical Healthcare and Rural Development

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Abstract - *Irie is a medical system designed to help medical practitioners for recognition and treatment of various diseases. The system takes medical images such as X-ray, CT-scan, etc. as inputs. The inputs use Deep Learning algorithms such as CNN for disease detection. The images go through the system for segmentation, feature extraction and then the disease classification process. The system maintains the database of the hospitals in the country and the treatment they provide. If the treatment is not available in the area then the system can be used to find suitable hospital/clinic nearby.*

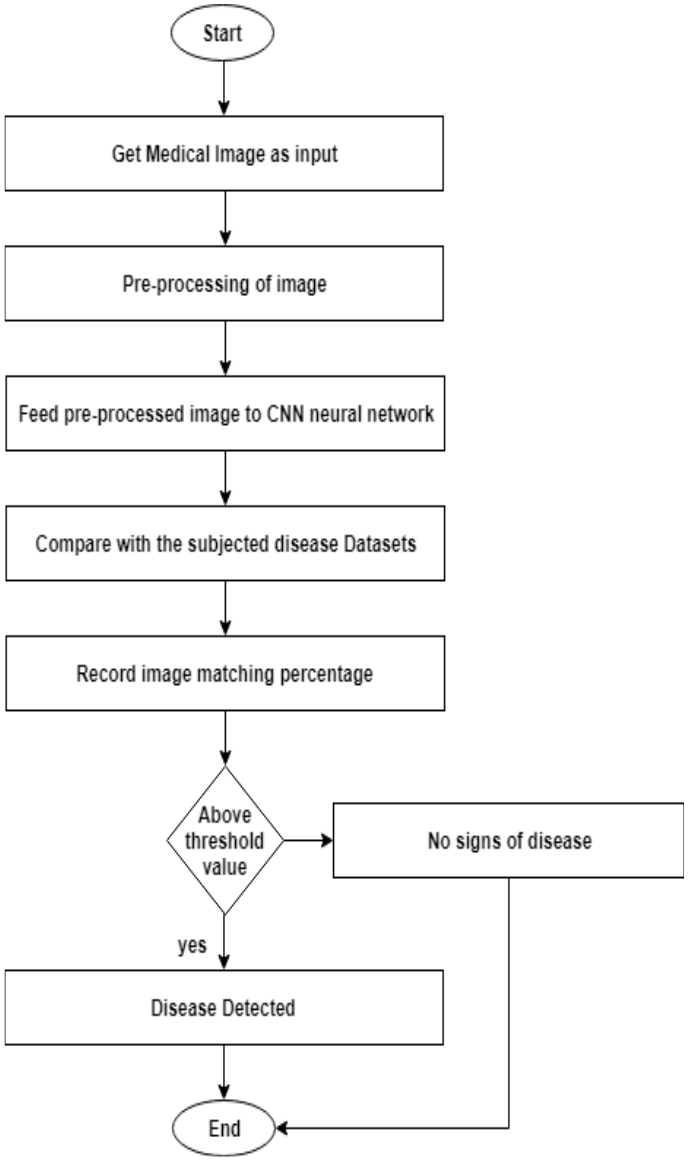
Key Words: *disease, treatment, CNN.*

1. CURRENT METHODS OF DETECTING DISEASE

The methods used for detecting disease in our country as mostly traditional. The method is to get images of internal organs, tissues or bones by using X-ray, CT-scan etc. The doctor uses his learning and experience in disease detection and seldom computer applications are used to view the images on monitor. The problem with this system is that the humans are prone to errors and may not remember all previous cases or documented details related to the disease. In this situation the system can detect disease by image processing and all history related to the given disease. This will lead to the accurate detection or prognosis of disease and hence the correct treatment.

2. INTRODUCTION

For disease detection process, the doctor will feed the system with medical images taken by standard methods like X-ray, MRI. The images will be processed using image processing techniques in Deep Learning, architecture used for creating the neural network would be CNN. If required the images can also be pre-processed into 3D images using 2d-to 3D imaging technique. The algorithm will apply segmentation and other various functions to the image to extract the significant features which will be required for disease detection. Say for MRI scan of the brain. Along with a targeted area such as the lobe of the brain there are various other matter which exist in brain. These other things need to be eliminated from the output image. For this we may apply edge detection and image segment isolation. This will help us to get image of only the affected area. This image is then compared with the already available datasets of images. The input image is compared with these images in the datasets which are classified into different categories. The percentage is then recorded for each of the categories or classes in the CNN. The classes which have a threshold percentage above a certain number are then considered for further prognosis by the doctor. Once the detection is done, then the doctor can start the further treatment for the patient. If in case the treatment for the disease is not available in the area, the system can be looked up for the potential hospitals in the nearby area and the patient can be sent to that hospital. This system will help in efficient disease detection and will also save patient time and money by spending in correct treatment.



3. WORKING

3.1. Pre-processing of medical images

Before feeding the image for classification in neural network we need to pre-process it for image enhancement. These medical images tend to have poor noise to signal ratio and low resolution because of which its hard even for the doctor to identify different structures in an image. So, this step is necessary for enhancing the quality of an image for correct detection of disease.

The important steps in pre-processing of medical image are image reconstruction and image restoration. The neural networks such as Hopfield NN is widely used image pre-processing. The image is enhanced by increasing the noise-to-signal ratio to reduce noise and to get more detailed image which helps in better performance of neural network.

3.2. Convolutional neural network

Convolutional Neural Network(CNN) are one of the most widely used neural network in image processing technique. The success of this neural network has lead its implementation in many image and video recognition applications.

The CNN being a supervised type of neural network requires a large training data for developing a potential neural network for object recognition. The medical field generates a large amount of data and the data doubles every year. So, these data can be used for building a good neural network.

CNN are the neural network which has one input layer, one output layer and multiple hidden layers. The greater the hidden layer, the better is the performance of neural network. But too many hidden layers also require more memory and also lead to slow processing. CNN takes the input image, processes it to find patterns in the image for feature extraction. CNN works at the image pixel level and extract features from the group of pixels. It only passes the valuable features parameters to the other connected layer of the CNN. This helps in reducing the overall convergence time.

Broadly CNN are classified into two parts, first the feature extraction part which consist of Convolution Layer, Relu Layer and Pooling layer and second the classification part which has fully connected layer. All the layers are explained in brief below.

The important steps in CNN are

a.) Convolution Layer: The main work of this layer is to extract feature from the input image. A filter is applied on a section of image to extract feature. After the same filter is slide towards the other sections of the image to extract feature. In this way the whole image is scanned. We apply a function also called as convolution to combine the result of all the sections scanned by the filter and the output of convolution goes into a feature map.

b.) Relu Layer: Relu layer also called as Rectified Liner Unit Layer. The extracted pattern from convolution layer is built up using Relu layer and pooling layer. The Relu layer uses non-linear functions for the activation of outputs of the CNN neurons. The output of the Relu layer is of the same size as that of input of this layer.

Relu layer assigns any negative value in the input element i.e., the element of feature map to zero. It helps in keeping the network running by removing all negative values and hence saving the network going towards infinity.

To add non-linearity to the network Relu activation function is used and other than that tanh and sigmoid function can also help. Non-linearity functions help in better learning of the real-world conditions which is not possible using linear functions.

c.) Pooling Layer: The pooling layer is used to reduce the dimension of the output of Convolution layer and Relu layer. It helps the neural network to focus on the significant patterns by reducing the other insignificant ones. This helps in reducing the overall memory usage and the processing time.

d.) Fully Connected Layer: The patterns we got from the above three layers makes no sense to the neural network. So, for classification of the object the last layer i.e., the fully connected layer is used. The neurons in this layer are connected to every other neuron in the previous layer. This layer helps in classifying and recognizing the object.

The above layers can be repeated several times based on the requirement of the neural network.

3.3. Available datasets

To train the CNN the main requirement is the availability of the dataset. For medical image analysis, already various open source datasets are available for classification of the disease. There are different datasets available for various different diseases. Some significant datasets available are NIH which has over 100,000 chest x-rays, Kaggle Data Science Bowl 2017 which is the dataset for lung cancer detection, OASIS consist of cross-section of MRI images, and so on. Using such dataset will help in correct classification of the input data hence correct disease detection.

4. DATABASE OF HOSPITALS

After diagnosis, it is also an important task to find which hospital provide what treatments. For this the system will maintain a database of the hospitals available, along with the treatment they provide. This is necessary, as the rural areas there is not only lack of hospitals but also the

doctors. So, this feature can help patients to find the nearby hospital around them.

To search for the hospital the user first has to give input of their location and the disease. This will help to find the nearby hospitals which gives treatment for the disease accurately. If they do not wish to disclose their location they can choose the area/ city and based on that the system will find nearly located hospitals.

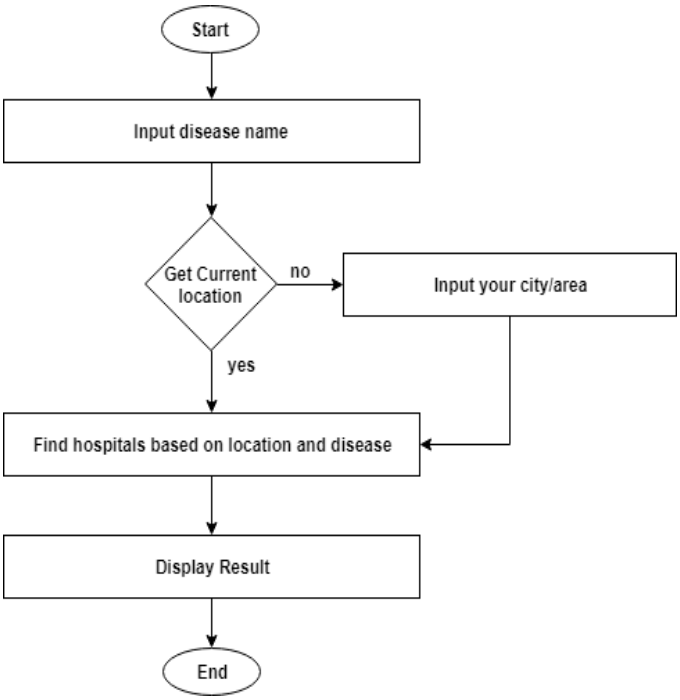


Fig -2: Searching Hospital

5. CONCLUSION

There is a lot of medical data being generated but never used or not being used properly. So, we can make use of this data to build systems where learning can happen from the data and help in correct detection and treatment of disease. In rural areas due to shortage of doctors and places where doctor cannot be reached this system can help. As the saying goes 'health is wealth'. Hence the health of people, be it in rural or urban area, is important and will only help in the progress and development of our country.

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