JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Monkey Pox Detection using CNN

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Abstract: The Monkeypox Pandemic has become a huge concern on public healths due to it's rapid spread in more than 100 countries including Africa. It's difficult to diagnose monkeypox due to the similar symptoms with measles and chickenpox. Cases in which PCR tests are not available, advanced technology like AI and Deep Learning can detect monkeypox at an early stage. The methods of Deep Learning are being found efficient and effective in the detection of skin diseases and are being provided by sufficient training examples. The dataset is collected from Kaggle. To increase the size of the sample Data Augmentation is used followed by EfficientNetB3. The overall accuracy rate came out to be 89.66. A diverse and larger dataset is needed further to enhance the model.

Keywords: Monkey pox, CNN, Dataset, Deep learning

1. Introduction

Monkey Pox is an infectious viral disease that can occur in humans and some other animals in other forms. The disease is caused by monkey pox virus, a zoonotic virus in the genus Orthopoxvirus. An happening outbreak of this disease monkey pox was confirmed on May 2022, emerging with a huge number of cases confirmed in the United Kingdom. The disease occurs mostly in the rain forests of central and western Africa. Please living in those areas have direct or indirect low-level exposure to this disease. Monkey pox has a medical representation like a normal small pox, including flulike symptoms, fever, headache, vomiting, malaise, muscles and back pain. As the world was still recovering from COVID-19 pandemic, the new problem occurred in the world which raised concerns around the globe. The WHO (World Health Organization) declared Monkey pox as an average risk to the worlds health but stopped making it as an emergency situation for the public. Still, the health care organisations as WHN (World Health Network) conveyed that this disease is of serious concern [1] and it needs immediate and strict action around the globe against this disease. Also, the PCR tests are not available in various parts of world till now. Although the case mortality ratio has been 2-5% from the recent outbreak [2]. To limit or reduce the community transmission of this viral disease is early detection of it, immediate isolation and taking medication. In the 21st century, where the AI based technology is enormous,

Automated computer-aided systems may be useful to control the worldwide spread of this disease. In past years, the class of deep neural network of Deep Learning, particularly CNNs (Convolutional Neural Networks), have revolved around many fields in the medical sciences because of it's excellent learning potential. When Deep Learning models are trained with a large number of data or dataset having huge data inside it, then these networks are capable of converting the images into different layers, which inevitably extract features and the ability to learn and identify the fulfilling and maximum representations for a particular task. While detecting monkey pox using dataset create a model using transfer learning with EfficientNetB3. It makes the base model trainable from the outset leads to faster convergence and a lower validation loss. The CN's(Convolutional Network) EfficientNetB3 is an architecture of network which gives a new scaling method that evenly scales each and every dimension of network i.e, depth, resolution and width.

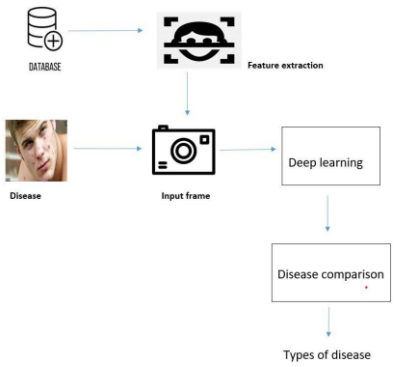

Fig. 1.Above figure is the flow diagram of monkeypox project created.

Presently, there's no proper accessible monkeypox skin image dataset for carrying out automated detection algorithms but we found one dataset from Kaggle. We downloaded the dataset and performed the algorithm on it to detect which images are of monkeypox and which are not. The dataset on the Kaggle is openly accessible, obtaining the images which are picked up from the web of different parts of the body like face, leg, arms, hand, neck of various patients having monkeypox and other similar disease to monkeypox like chickenpox and measles cases. Furthermore, the giant commonness of monkeypox present in the under developed regions of the Africa might establish a partiality in the dataset as containing very huge similarity. Fig. 2. will give a little of idea of how the dataset looks like.

Fig. 2. Stages of the Monkeypox.

2. Background

Monkeypox virus is DNA virus which is of double strand, and is the member of the Poxviridae family, which is deeply connected to the variola virus [2]. Animal species of various types, including rats, mice ,squirrels, non Human primates, dormice, were identified as the first case or natural host of monkeypox disease[2].In the DRC (Democratic Republic of Congo) in 1970 the first case of human having monkeypox disease was confirmed, and recently, in the area of Africa it has been endemic specially in western and central Africa. Total of 116 countries were affected by monkeypox virus.

In the beginning of 2022, outbreaks of this disease were being reported in a number of countries across the globe. Currently,

TABLE 1

DISTRIBUTION OF THE MONKEYPOX SKIN DISEASE (DATASET)

Class Label	No. Of Original Images	No. Of Augmented Images
MonkeyPox	76	124
Others	95	105
Total	171	229

the confirmed cases which have been reported from 29 EU/ EEA countries are around 20744 . With no PCR test or other test and hygiene to the affected and endemic areas, WHO declared this disease as a global health risk because of the rapid increasing of Monkeypox in non affected areas[2].

This disease itself is a escalation disease; people suffering from this have the symptoms which last for 2 to 5 weeks. The main target of this disease was the young people in the world, as they were getting affected by it badly. How much severe Monkeypox is totally depends upon the extent of the exposure of virus, the complications occurring during the period, and patient's health status. 5 to 20 days is the evolution period of the virus [2]. When the person is affected by this disease then the symptoms which start occurring (0-5 days) are fever, severe headache, swollen

lymph nodes, physical weakness, and muscle ache. Within 1 to 3 days of fever, the rashes will start on the body which is mainly noticeable on the palms of the hands, face and under the feet. However, the rashes can begin from the eyes, mouth, and genitals [2]. In the lumps formation phase i.e, around 2 to 4 weeks, the lumps follow the four stages that are; macules (lesions with a flat base) to papules (raised firm painful lesions) to vesicles (filled with clear fluid) to pustules (filled with pus) followed by encrustation. The diagnosis of the virus, monkeypox, is by virus isolation and histopathology. The confirmation of the virus can be diagnosed by PCR test. Eventually, If the person is suffering from Monkeypox and these diagnostic test i.e, PCR or other tests, are not available at that time, early

knowing of the virus through clinical examinations will be advantageous for the patient. Now living in the advanced and high tech world we have smartphones with us which can be advantageous, as skin detection systems based on AI and Deep Learning can help in diagnosing the diseases.

3. Prepared Dataset

The Monkeypox skin disease dataset was available on Kaggle website, from there we downloaded the dataset which contained images and augmented images to increase the size of the dataset. In this work, we mostly focus on splitting the cases of Monkeypox [2] from the other cases which are similar to Monkeypox but are of different disease. Thus, the dataset includes the images of skin diseases that are represented as 'Other' images as measles and chickenpox and then for the binary classification the dataset is prepared.

All the skin disease images were cross referenced with online sources and were verified on Google's Reverse Image Search. After going this process, the low quality images and low resolution images were removed from it and only high quality and unique images were kept in the dataset. The size of the images are 224 x 224 pixels.

The total images in the dataset are 171, among which 76 images belong to 'Monkeypox' and the rest 95 images belongs to 'Others' i.e, (chickenpox and measles). In this total augmented images created are 229 and the length of augmented data frame becomes 400.

Fig. 3. Sample of the dataset containing images. These are categorised as the 'Monkeypox' class which are on left side and Images from the 'Others' class (chickenpox and measles) which are on right side.

A few images as sample are shown above in the Fig. 3. Since, this is the starting of eruption of the disease - monkeypox so the data kinda insufficient. So, various tools or methods of data augmentation, like rotation, jitter, shear, hue, saturation, translation, noise, contras, scaling, brightness has been applied to increase the size of the dataset. In Table 1 a proper detailed segmented dataset is given.

4. Experiments

A. Overview of Model

In this project the pre-trained model have been selected that is known as CNN architecture namely, EfficientNetB3. This is chosen as it have shown

Fig. 4. Original skin image of monkeypox and its 5 augmented versions for training. There were a total of 13 augmented images but we have shown 5 of it.

excellent execution across the various fields of deep learning and computer vision, involving medical images. EfficientNetB3 is used for uniformly scaling all the dimensions of depth/width/resolution. Others are VGG16, RestNet etc. We even used LR_ASK which is a Keras callback that allows you to continue training for epochs to halt training.

B. Implementation Details

Images inputed were of dimensions (224,224,3). Firstly, we read in the images and create a dataframe of image paths and class labels. We also show how my original images are of Monkeypox and others and how many augmented images are present in the dataset. While training the dataset we create augmented images to balance the training data. After that we create a function to show example training data. The maximum images shown at a time will be 25 images along with the detection of the images as monkeypox or others. The font size will be 14. We then create a model using transfer learning with EfficientNetB3. Afterall making the base model trainable from the outset leads to faster convergence and a lower validation loss for the same number of total epochs. Epochs is when all the training data is used at once and is defined as the total number of iterations of all the training data in one cycle of training the ML model. In this, halt training helps to stop the training process whenever we like it to. The training will proceed until epoch 5 then we will be asked to halt the training or continue it by entering the number of epochs to run. We even plot the training data which shows the training and validation loss. Confusion matrix is also generated by the accuracy rate of the tests run. When we run the program. We tested for 29 tests and there were 3 errors and the accuracy rate came out to be 89.66 which is quite impressive.

5. Discussion

In this project, by using the dataset we have distributed the images as Monkeypox and Others using CNN. The images in the dataset are not that sufficient but if more images like in the dataset can be added in it with better clarity, gender distribution etc. An worldwide collaboration and effort is required to obtain a large dataset which can provide excellent and accurate results.

6. Conclusion

This project ,contains “MonkeyPox Disease Detection using CNN” with the help of dataset presented on Kaggle for detection of monkeypox from images of different body parts and have performed a study with the help of epoch, EfficientNetB3 to enhance the efficiency of this project. Despite having a small dataset, we formed augmented images as to get a proper result. We hope that this project will help the people to examine the problem by staying home and taking the further steps needed. Cases where the testing methods like PCR are not available or are not present at that time over there the detection of Monkeypox in the early stage will help them. We ensure by taking this on next level by creating a well designed application which will help people more to detect early signs of monkeypox.

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