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Malaria Detection Using Convolution Neural Network

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Abstract: *Malaria a disease which is infected from the bites of mosquitoes which are transmitted to the people caused by the parasites. The qualified technicians examination the microscopic blood smears for the parasite-infected red blood cells from the standard diagnosing method for malaria. The person who is doing the examination have to know the diagnosis method which is inefficient and the malaria which depends on the knowledge and experience. Using deep convolution neural network we have some of our recent research on highly accurate information of malaria which is infected the blood cells. The deep learning methods which have the advantage of being able to learn the features from the input data given. The CNN process is used with more accurate in determining the results and reduces the computation time. The cells of the microscopic images which are used for identifying the presence of malaria-infected parasites using image processing techniques, type of parasite and their stages of the malaria misdiagnosis can be considerably minimize the number deaths occurred.*

Keywords: Convolution neural network, Deep learning, Malaria, Plasmodium, Machine learning

1.INTRODUCTION

Infectious disease result about 25% of deaths in the worldwide and in recent papers. According to recent report of the World Health Organization (WHO) in 2017 435,000 deaths were estimated due to malaria. The malaria infection, if detected at an early stage, can be cured and the infected person's life can be saved. According to the same report children who are aged under 5 are most affected by this disease with the rate of about 61%. There are numerous shortcomings it is aimed to detect with microscopic analysis. Therefore, this analysis directly depends on the experience of the pathologists. At the same time, this is a time-consuming process and results are difficult to reproduce. This disease is manually detected with the help of a microscopic by observing the parasite genus plasmodium. It depends upon the quality of blood smear and the expertise of pathologist in examining the blood smears. As it has been found that there are many types of malaria parasites, the blood smear sample needs to be analyzed thoroughly to check if multiple kinds of parasites that are kept in the sample.

If a large number of individuals get infected by malaria in a particular region, diagnosing a large number of smear samples rapidly will not be possible by the pathologists and such delay in diagnosis results can be fatal for the malaria patients. This classifier we will use in this process is Deep learning algorithm CNN. This system which will be identified in the different types of parasites using neural network library like tensor flow.

The mosquito disease which is caused by the bit of female "Anopheles" mosquito. These mosquitoes after biting the human being they sporozites and enters the blood of the human and it effects the liver first and then the matured sporozites burst and that are formed as parasites which affects the RBC.

There are four types of malaria infected parasites are there namely- Plasmodium Falciparum(which is dangerous because it's incubating disease duration is about 6-14 days), Plasmodium Vivax(attacks the humans that causes to malaria deaths), Plasmodium Malaria and Plasmodium Ovale.

There are mainly 3 stages: Tropozoites, Schizonts, Gametocytes which spread for any type of malaria parasite. Detection of the malaria parasite is still a challenging issue. Without the help of examiner, the stage decision of the malaria parasites becomes a crucial task in diagnosing , because in each stage of the parasite consists of so many issues like shape, structure, size occupancy in the RCB and count of the parasites.

In this work, Malaria detection we use Machine learning which is the most attractive research area in computer engineering. In recent years, the increasing computational power of the computers, the learning mechanisms have introduced a new concept that is Deep learning. Deep learning is a most attractive research area which can reduces the disadvantages in machine learning and can increases the overall accuracy of the system.

In this, there are different deep learning algorithms, they are Convolution neural network, Recurrant Neural network. CNN is deep neural network approach which is specific type of artificial neural network which can take an input image to various aspects in the image which currently suits for the research area and topic. Therefore in this paper, it is aimed to identify the diagnosis process of malaria disease with the help of CNN.

2.BACKGROUND KNOWLEDGE

As a we know that machine learning is a important topic in artificial neural networks, where machine learning has a history as old as humanity. Machine learning is to train the machines in a particular way.

According to the IT world there are several considerations when it comes to users trust in the internet. Where machine learning is used more often in products and services .When addressing AI it includes

socio-economic impact, bias, accountability, and issues of transparency are the major issues .Where it focuses on the considerations of safety & ethical issues; and how AI facilitates the creation of new ecosystems .In this complex field there are specific challenges like a lack of interpretability & transparency are the several problems facing in AI.

Deep Learning:-Deep-Learning, which we can describe as a sub-group of machine learning. Artificial neural network are the machine learning algorithm. Algorithms are composed of processing units by which we can perceive & simulate the human brain .Deep-Learning models are more unique where these models are specified for unstructured data, whenever we are not able to solve the problems in machine learning then we will go for the Deep-Learning to get solutions for all those problems.

As we know that the CNN plays a major role in Deep-Learning. According to the computer vision tasks CNN's have proven to be really effective. The key layers in a CNN model include convolution & pooling layers. By using these key layers we assume that you have some knowledge on CNN's.From the unstructured data Convolution layers learn spatial hierarchical patterns for the image recognition. Which are also translation invariants, thus they are learn different aspects of images. For example the first convolution layer will learn small & local patterns such as edges &corners. The second layer will learn larger patterns based on the features from the first layers.

This allows CNN's to automate feature engineering and learn effective feauture which generalize well on new data point. As we already know that the pooling layer is the key layer of the CNN by this it help with dawn sampling, dimension reduction .Artificial neural networks is an algorithm which collects the weighted values and sends them to threshold function. Whenever the value is exceeds then the threshold function is added to the next layer. Where AI is an area of computer science which creates the machines and train them like . a intelligent machines which are reacts like the humans. By using the backup Propagation algorithm the error can be calculated between actual address &estimated value of a neural networks & the coefficient are updated.

CNN (convolution neural networks)

In contrast of ANN, CNN performs convolution process here perceptron plays a major role it is like a kernel. We know that the perceptron is a simple model of biological neuron in an ANN. It is the name which is given by the early algorithm of binary classifiers. According to this CNN is used for image recognition where it finds the specific weights and determine the properties of image. Another thing is that the RNN also plays a important role. Where it is the class of ANN consists of links which processing the units from a directed loop. This algorithm is uses to allows to understanding of time dependent changes and sequential structures.

CNN is better as compared to RNN. In the artificial neural networks CNN is used for image recognition &object classification. Where CNN take advantage of local coherence in the input to cut down on the no of weights .Where RNN is used to process the sequential structured data. RNN works on the principle of saving the output and feeding the information back to the input to predict the output layers.

As we know that the convolutional neural network having two key layers according to those layers it is going to work. Where the layers are of convolution and pooling layers .As we seen in the fig 1 we can easily understand the working of both layers.

Convolution layers are the core building block of a Convolutional Network does most of the computational heavy lifting.

Pooling layers function is to progressively reduce the spatial size of the representation to reduce the amount of parameters and computation in the network, and control overfitting.

In a fully connected layer have full connections to all in the previous layer, as seen in regular Neural Networks.

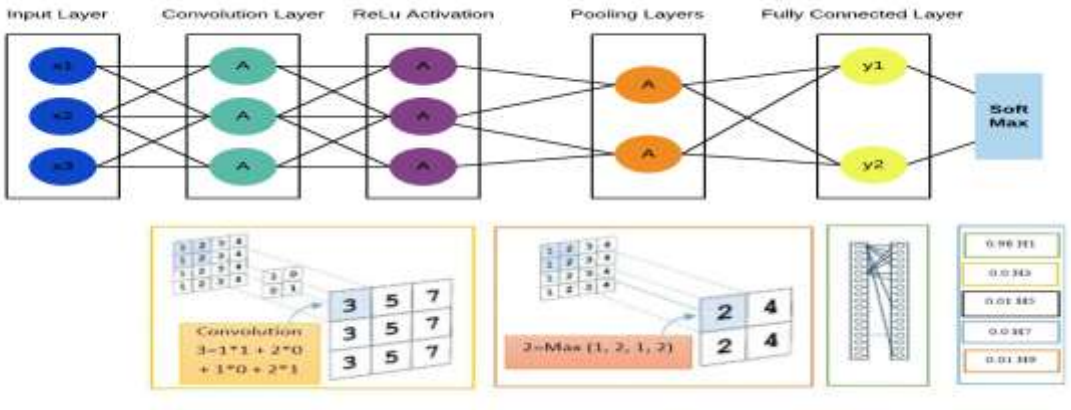

Fig 1 *:Internal process of convolution neural network*

3.LITERATURE SURVEY

Soner Can Kalkan et.al[1],says that Machine learning is best research area but there are some disadvantages to solve this type of model to overcome this Deep learning algorithm such as Convolutional Neural Network which gives better result.

Vikas Kashtriya et. al.[2], Medical experts who can analyze that the RCBs using the proposed model had just taken the high resolution in the image of blood smear which will successfully identify presence or absence of malaria infection with 98.3% accuracy.

Aimon Rahma et. al.[5], Conduct a series of experiments based on end-to-end deep learning to improve malaria classification from segmented red blood cell smears.

David pan et. al.[4], Described the workflow of classification of the red blood cell images and discussed in detail the data argumentation methods we proposed to deal with the issue with training deep CNN with dataset.

Kaameshwaran. G.S et.al[5], Creating a system which enables the practitioner to find the infected malarial cells in the microscopic images of patient's blood sample and produces the output with the classification of their stages of the parasites and their type present in the image

They proposed CNN architecture supplies accuracy 94% which can say the best classification results achieving the classification accuracy[6].

Most of the studies says that using od deep learning for automatic detection of malaria diagnonsis from microscopic images of stained blood cells to avoid human mistakes[7].

They proposes a method for detecting Plasmodium using CNN model in thin blood smear images based [8].

A convolutional neural network (CNN) is a class of deep learning ,the feed-forward artificial neural networks that use a variation of multilayer perceptron designed to get desired minimal preprocessing[9].

CNN reduces the overall task of domain expertise in developing efficient feature extraction and classification of malaria. This includes multi-stage processing layers in which image analysis filters are applied[10].

4.PROPOSED SYSTEM

Malaria Diagnosis actually based on Cell images of person. So we used Cell images as a dataset for model. With in deep learning there are different neural networks for image classification Convolution neural network is successful. So we used convolution neural network for our model. in order to detect classify the network made up of neurons with learnable weights and biases. Each specific nerve cell receives various inputs and so takes a weighted add over them, where it passes it through an activation function and responds back with an output .The image is passed to the convolution network .After the process completed the extracted features passed to the artificial neural network. The output is estimated with actual value and then again the network values updated and pass back. This will continue until we get optimized solution.

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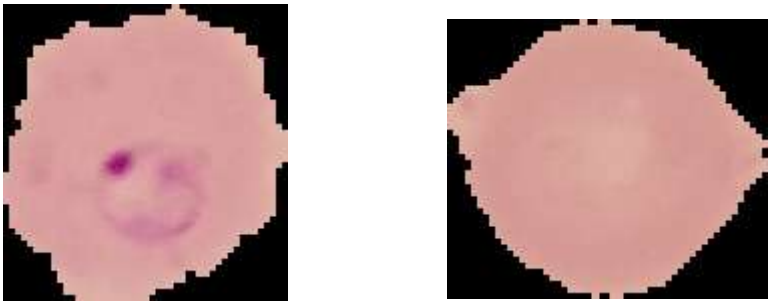

a)infected *b)uninfected*

Fig 2.Cells

The dataset we taken form Kaggle website which consists of 27,558 cell images as two folders infected and uninfected.All images are defined with RGB color space and their size varies .For example we can see infected cell image in Fig 2.a and uninfected cell image in Fig 2.b. Before we pass the data for training to neural network we have to normalize the image to improve brightness and contrast.After normalization we reduced the image size as (128,128) and pass to entire neural network.

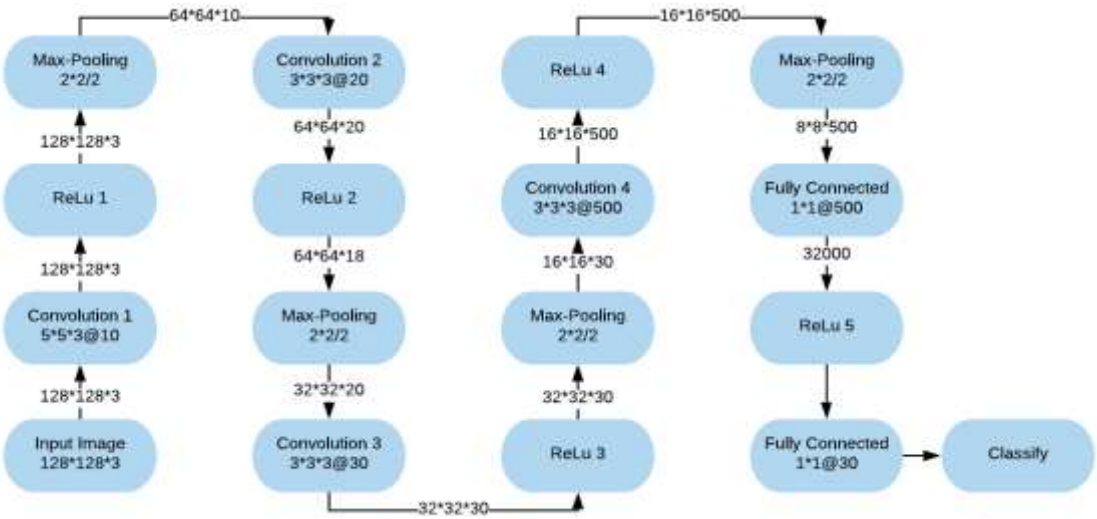

Fig 3.*Architecture*

The Our convolution neural network consist of 4 convolution layers followed by maxpooling layer ,flatten layer ,dense layer and then output layer. From Fig 3 we can see the layer and change in image size .In all the convolution Layers we used Relu activation function which is used for classification .The important feature of Relu function is it does not active all neurons at same time .The neurons value which are zero or less than are replace with zero and the values above zero are taken as linear function .There is no negative after passing through Relu function.By reducing discrete structure between normalization value, optimization they compose the kernels .In our network kernel sizes are 2*2,5*5.

5.EXPERIMENTAL RESULTS

The main of our proposed system is to find out the malaria infected cell using our convolution neural network model .So it is necessary to train the neural network to get more accurate results .For processing this system we have to create a appropriate test environment .The section will discuss about requirements and results as shown in Table-1.

TABLE -1: EXPERIMENTAL ENVIROMENT

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Experimental Environment	Specifications
Operating System	Windows
Development Environment	Google Colab
Model Package	KERAS 2.2.4
Backend	Tenserflow 1.14.0

In the training process the artificial neural network took long period of time.In neural network we have todo parrale processing.At the end the network optimally works on tensor processing units hardware which are designed for deep learning.We trained our artificial neural network on GPU.The operating system we used is Windows 10.The development environment is Google ColabThe experimental environment is developed with KERAS and backend is Tensorflow . Keras is a python package provides a library that helps us to speed up the training of arbitrary neural networks created with Keras using importance sampling. Importance sampling is a full of life research field for Deep Learning and your mileage may vary because this library is undergoing development. Low-level libraries can also use it It act as wrapper to those low level libraries. The low-level libraries like TensorFlow or Theano. Advantages of keras are offers the broad adoption, support for an oversized range of production deployment options, integration with a minimum of 5 back-end engines (TensorFlow, CNTK, Theano, MXNet, and PlaidML), and powerful support for multiple GPUs and distributed training .Google colab is free cloud service .We used it to run our python programs .In Below Table-2 you can se the specifications and experimental environment.

TABLE-2: Parameters

Parameters	Values
Loss Function	Binary cross-entropy
Batch Size	512
Epoch Number	10
Optimization Algorithm	ADAM optimizer
Execution time	0.2 seconds
Iteration Time	5 seconds

In our model it has to the image is infected or uninfected like binary 0 or 1 .The loss function used for binary decisions is Binary crossentropy . It will evaluate the predicted probability of a binary class is good or bad. In addition, optimization algorithm we used is ADAM(Adaptive Moment Estimation). For training deep learning models it is a replacement optimization algorithm for stochastic gradient. The properties of the AdaGrad and RMSProp algorithms are combined in Adam to provide an optimization algorithm which can handle sparse gradients on noisy problems. Adam uses the squared gradients to scale the learning rate like RMSprop and it takes advantage of momentum by using moving average of the gradient instead of gradient itself like SGD with momentum .Another important parameter which effect the efficiency and accuracy model is Batch size .We cannot give the entire dataset to the neural network which is complex to network to execute so we have to divide the dataset into batches .The neural network which we constructed has a batch size 512. The output of our model shown in below Fig 4.Finally we select the test-split for validating. Our model accuracy is 96% you can see in Table-3.The graph analysis is shown in Fig 5.

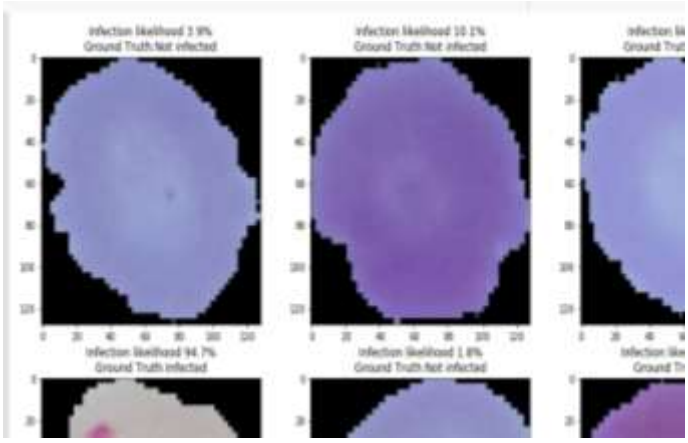
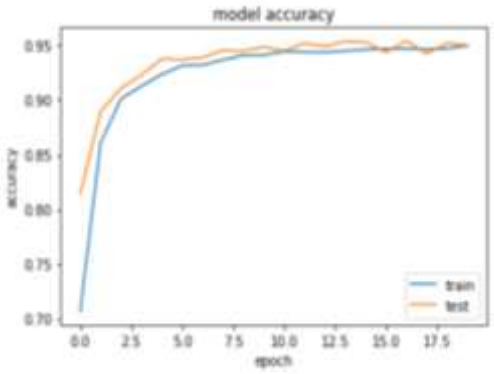
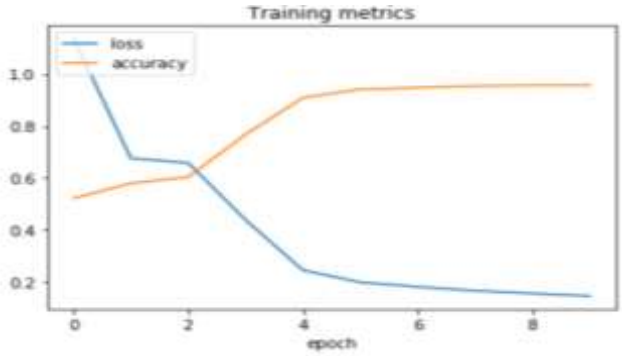


Fig 4: *Output*



5.1 Accuracy score of the model



5.2 Changes in Accuracy and Loss of model

Fig:5 Graph Analysis

TABLE-3: RESULTS

	Precision	Recall	F1-score	Support
0	0.94	0.98	0.96	1407
1	0.98	0.93	0.95	1349
Accuracy			0.96	2756

6.CONCLUSION

Malaria is a life threatening disease which was caused by Aneopholis Mosquito which was occurring in the tropical climatic conditions. Generally it will identify by the pathologist who was identify the symptoms of the disease with the help of microscope. Later on after happening of evolutions in science this was become easier because now a days automated system came into the existence for diagnosis and decision support system for the pathologist become easy with the algorithms of the computer and sophisticated objects .Here in this project we process the slide images for the blood cells which was infected and uninfected by the disease and this process will done without any human interference. By applying the technique the pathologist will get the better results and will help for decision support system for doctors and it given accurate results and the inspection will be done quickly or in a less period of time.

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