Medical Image Processing

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***Abstract*—Medical Image Processing has a lot of applications in today's lives .It has picked up its pace in the recent decade due to the wide availability of the data. The following research paper covers study of blood samples using image processing.**

***Keywords*—Medical Imaging, Convolutional Neural Netowork, Deep Learning, Computer Vision, Blood cells**

I. INTRODUCTION (*HEADING 1*)

Most of the pathological tests carried out even today are done manually.This leaves it susceptible to human error. In order to avoid this, our purpose is to come up with intelligent systems to aid the process. The research was done in 3 areas-

- Classification of white blood cells
- Predicting cardio vascular diseases
- RBC count using Circular Hough Transformation algorithm

CLASSIFICATION OF WHITE BLOOD CELLS

.There are five types of white blood cells as follows

- **Monocyte**- They have a longer lifespan than many white blood cells and help to break down bacteria.
- **Lymphocytes.** They create antibodies to defend against bacteria, viruses, and other potentially harmful invaders.
- **Neutrophils.** They kill and digest bacteria and fungi. They are the most numerous type of white blood cell and your first line of defense when infection strikes.
- **Basophils.** These small cells appear to sound an alarm when infectious agents invade your blood.
- **Eosinophils.** They attack and kill parasites, destroy cancer cells, and help with allergic responses.

The classification was done on only the four types of WhiteBlood Cells(Eosinophil, Lymphocyte, Monocyte, Neutrophil).As soon in the Figure 1,the dataset consisted of around 12,000 images with a bounding box around each image. Convolutional Neural Network, a deep learning architecture was used for classification. Keras,a high level framework of tensorflow was used to implement CNNs.

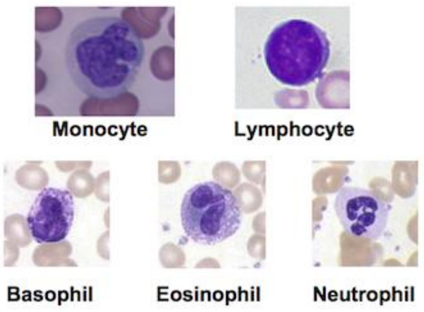

Figure 1(Types of Wbcs)

Image Pre-Processing

The dataset was free of noise so not much pre processing was required.The images were resized to 128*128 along with three channels.

Architecture

The architecture implemented is shown in Figure 2.

Accuracy

Due to limited computing facilities the model was trained for 60 epochs and the validation accuracy obtained was 75 percent.

Detection of Heart Disease

Cardio vascular diseases are on the rampant rise in the modern times. Therefore early detection can be extremely helpful in saving lives.

Dataset and Pre-processing

The database, taken from UCI machine learning repository originally contained 76 attributes, but only 14 features were used for classification. The classification was on a 0 to 4 scale where 0 indicates the no heart disease and 4 indicates a high probability of disease.the 14 features used were:

- Age
- Sex
- Chest pain type(3 values)

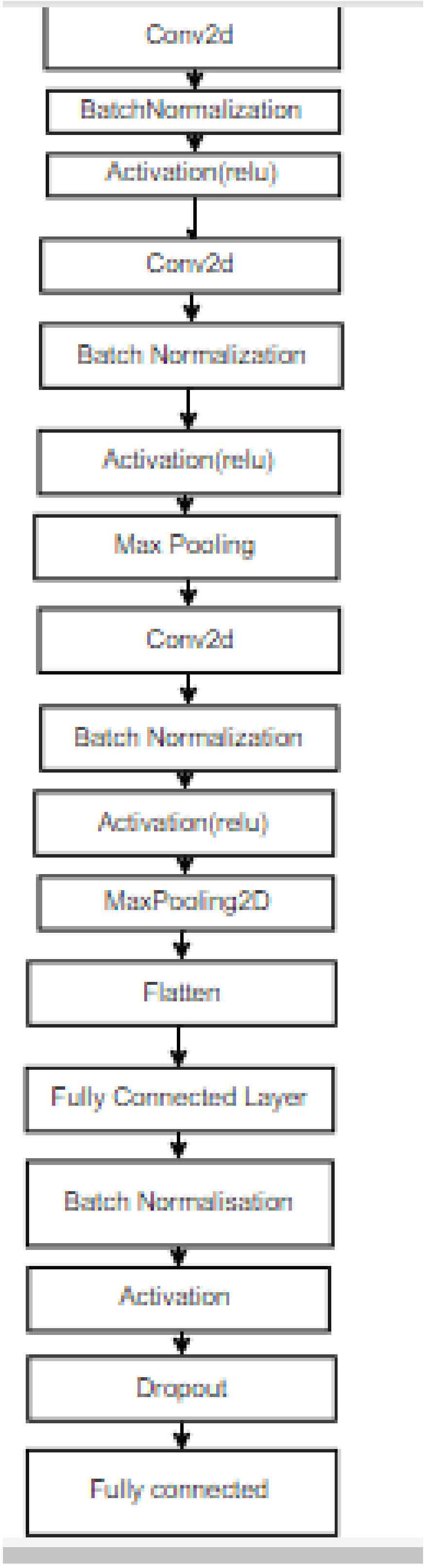

Figure 2(Architecture of CNN)

- Resting Blood Sugar
- Serum cholestoral in mg/dl
- Fasting blood sugar>120 mg/dl (1=True,0=False)
- Electro cardiograph Result(3 values)
- Thalach-Maximum rate achieved
- Exang-Exercise introduced angina(1=Yes,0=No)
- Oldpeak: ST Depression caused by exercises.
- Flourosopy: The number of colored large vessels (3-0)
- Slope: the slope of the peak exercise ST segment
- Thal(3:Normal,6:fixed defect,7=reversible data)

Results:

Various algorithms were used to detect heart diseases. The compiled results are shown in the table below.

Serial Number	Algorithm	Accuracy(in percentage)
1	SVM(Support Vector Machine)	70.5
2	ANN(Artificial Neural Network)	98.59
3	Boosting	57
4	XG Boosting	67
5	Random Forest	60

Multi class classification to Binary classification

Since the data was skewed, we decided to convert the multiple classes to just two classes where 0 stands for no heart disease and 1 stands for heart disease. The results are shown in the table below.

Serial Number	Algorithm	Accuracy(in percentage)
1	SVM	83.33
2	XG Boosting	80

Conclusion:

Traditional machine learning algorithms give better results than deep neural networks when the dataset is small.We have used upsampling to make the dataset balanced. Smote algorithm was used and suprsingly,artificial neural network ended up giving the best result which was far better than other algorithms.

The accuracy indicates that deep learning has a lot of scope in healthcare ,making it affordable and accessible to millions.

RBC Count

Rbc count is done often at pathological centres. It is tedious to do it manually. Our focus is to implement image processing techniques to count red blood cells. In this Rbc count is calculated using Circular Hough Transformation.

Data Pre-processing:

As seen the figure 3,it is observed that the regions are not filled properly and this results contours formed inside circles, leading to false count .In order to avoid this, region filling algorithms were used. As seen in Figure 3, the number of circles to be counted is very small which makes it quite difficult for Circular Hough Transformation to detect circles. In order to overcome this, the image was zoomed in and divided into 4 different images. The images were binarized and complemented which gave the best results.

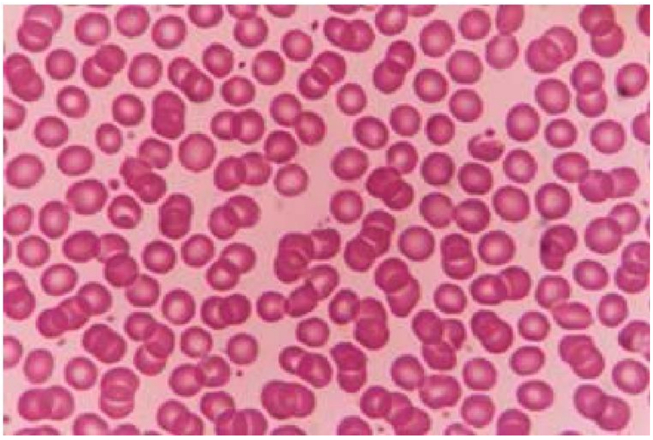

Figure 3(Microscopic Image of RBCs)

Results:

As seen in the Figure 4, the circles can be detected quite accurately. These circles are the red blood cells. The same technique cannot be extended for white blood cells since they do not have a circular shape.

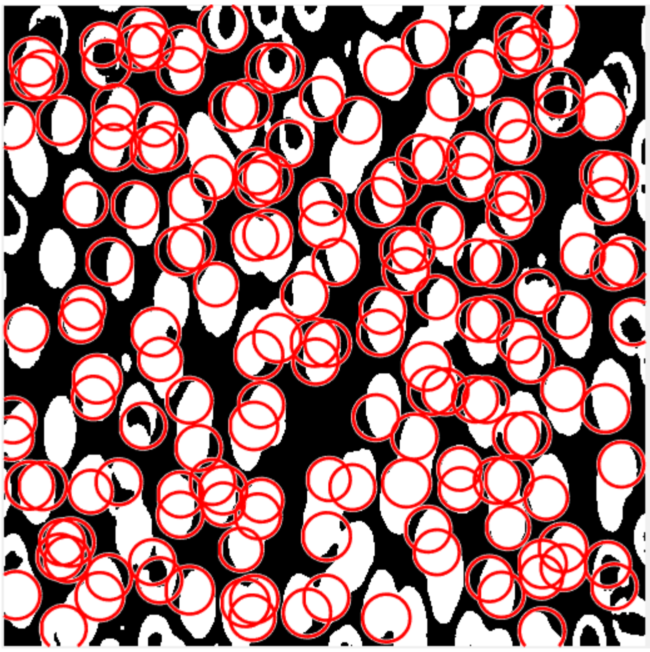

Figure 4(Processed image of RBCs being detected)

Conclusion

Accuracy can be improved if different connective algorithms are used for region filling because of overlapping blood cells.

REFERENCES

White Blood Cells dataset https://www.kaggle.com/paultimothymooney/blood-cells

Heart Disease dataset

http://archive.ics.uci.edu/ml/datasets/Heart+Disease

Abbas Nasrabadi & Javad Haddadnia Predicting Heart Attacks in patients using artificial intelligence methods Modern Applied Science; Vol. 10,No. 3,2016 ISSN 1913-1844 E-ISNN 1913-1852

Circular Hough Transformation for counting circles

https://in.mathworks.com/help/images/ref/imfindcircles.html

Image of Red Blood cells

https://www.uwosh.edu/med_tech/what-is-elementary-hematology/red-blood-cells

Smote Algorithm

https://www.cs.cmu.edu/afs/cs/project/jair/pub/volume16/chawla02a-html/node6.html