International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 03 | Mar 2020 www.irjet.net p-ISSN: 2395-0072

Detection and Classification of Leukemia using Convolutional Neural Network and Updation in IoT

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Abstract - *Leukemia is a type of blood cancer that affects the production of WBC from the bone marrow. Either an increase or decrease in the count of WBC indicates leukemia. This project deals with the detection and classification of leukemia types using microscopic blood smear images. The blood smeared image undergoes many image processing techniques like pre- processing, segmentation, and a feature based classification technique. The set of images are trained to form a dataset as we use a supervised learning method and the classification algorithm used is the convolutional neural network which is majorly used in image and signal processing techniques. The output is obtained to give whether the given blood smeared input image is acute or chronic or normal. From there, actions like controlling, monitoring and prevention of diseases can be done by further diagnosis and treatment. Since the laboratory based microscopic images are expensive and time consuming process, switching over to methods like this very efficient and simple to determine the leukemia. At present there is no cloud based monitoring technique to update the results in a server using Iot. This project incorporates the use of Iot to store the results using a specific username and a password*

***Key Words*: Leukemia, Acute, Chronic, Convolutional Neural Network, Iot**

Abbreviations: CNN (CONVOLUTIONAL NEURAL NETWORK), Iot (Internet Of Things), RGB(red green blue),UART(Universal Asynchronous Receiver/Transmitter), ESP Module(Espressif Module).

1. INTRODUCTION

The use of medical imaging in the recent years has increased enormously due to its efficiency and simplicity towards the diagnosis and identification of various types of diseases and disorders. Diseases are to be identified and cured at the beginning stage of its occurance. The laboratory results for incorporating various methods to produce the output of a sample needs to have high accuracy, less error rates, and knowledgeable human skills. The use of Medical imaging or image processing technique enables to identify and diagnosis the diseases at an early stage. Some can also be used in the therapeutic stages. This has led to a huge growth in the application of digital image processing Techniques for solving medical problems. The most important aspect in using imaging processing method is to incorporate the right technique for specific applications to integrate a particular system specifically.

Design, implementation, and validation of complex medical systems require a tight interdisciplinary collaboration between physicians and engineers. The most initial step is to detect the Disease as early as possible. If the detection process is carried in a medical laboratory, then it charges a reasonable amount of cost and consumes time for detection. Main objective of analyzing through images is to gather information, detection of diseases, diagnosis diseases, control and therapy, monitoring and evaluation. As processing the blood smeared images require more time and needs high skilled and trained technicians or laboratrician, even a small mistake in the correct manipulation of a result can lead to wrong diagnosis and treatment. In order to that, it requires expensive machines and the testing samples need to be processed correctly. Hence the use of digital image processing techniques can be implemented where a vast variety of many algorithms can be used in order to enhance the quality of output results.

All image processing methods have five stages: Image acquisition, pre processing, segmentation, feature extraction and image classification. Each method incorporates many sub methods to transform the given input image in order to obtain the desired output image. The main algorithm used in the paper is the Convolutional Neual Network which is a classification technique that is widely used in many applications such as natural language programming, machine learning, deep learning and most importantly image and signal processing applications. The purpose of this paper is to review some work done in blood cell recognition and to overview the proposed approach to be used in this research. In this paper, we will propose convolutional neural network to classify the different types of leukemia. The input images use median filter in pre-processing step to remove the noise and to enhance the quality of the image as well as to preserve the edges in an image. Gray level, image binarization and adaptive thresholding methods are used in the segmentation method. As the supervised learning method is used, the set of images are trained to obtain a dataset or database of imges. By using CNN approach, a large number of training dataset can also be used.

1.1 OBJECTIVE

- To detect the type of leukemia to a given input image.
- To design a program using convolutional neural network.
- Classifying the output based on CNN algorithm.
- Updating the results in a server using Iot.

2. LEUKEMIA

Leukemia is a type of blood disorder or cancer that affects the White Blood Cells in the bone marrow. Bone marrow is the major site for the production of blood cells. Whwn the production of WBC decreases, the cells produce blast cells or turn into leukemia cells. Symptoms of leukemia may include bleeding and bruising, feeling tired, fever, and an increased risk of infections. These symptoms occur due to a lack of normal blood cells. Once these symptoms occur, it is best advised to visit a doctor or physician to diagnose the risk at an early stage.

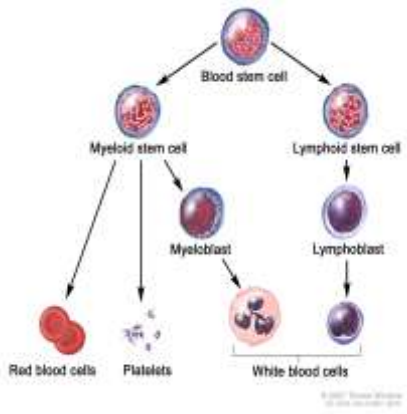

Figure 1 . Production of Blood Cell

Clinically and pathologically, leukemia is subdivided into a variety of large groups. The first division is between its acute and chronic forms:

Acute leukemia is characterized by a rapid increase in the number of immature blood cells. Immediate treatment is required in acute leukemia because of the rapid progression and accumulation of the malignant cells.

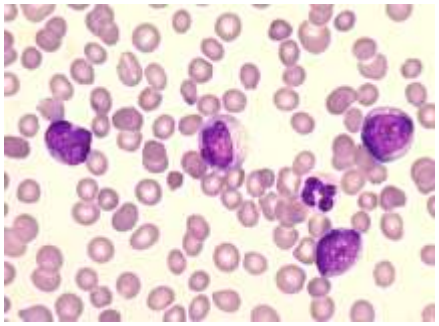

Figure 2. Acute Leukemia

Chronic leukemia is characterized by the excessive buildup of relatively mature, but still abnormal, white blood cells.. Whereas acute leukemia must be treated immediately, chronic forms are sometimes monitored for some time before treatment to ensure maximum effectiveness of therapy.

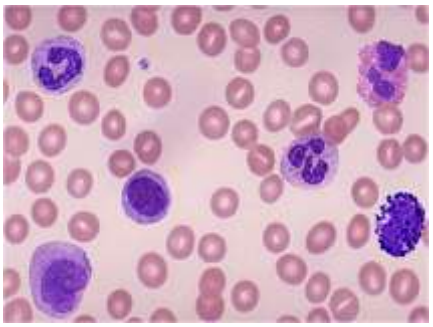

Figure 3. Chronic Leukemia

Additionally, the diseases are subdivided according to which kind of blood cell is affected. This divides leukemia into lymphoblastic or lymphocytic leukemia and myeloid leukemia:

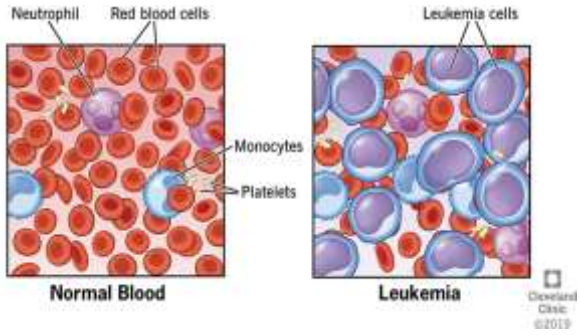

Figure 4. Normal vs Leukemia Cell

3. HARDWARE & SOFTWARE REQUIREMENTS

Hardware:

- 120 Gb Hard disc space
- 4Gb RAM

- i3 Processror
- Iot module : ESP8266

Software :

- MATLAB R2018a
- Language :: C

System Requirement:

- Windows 7 (32 or 64 bit)
- Windows 8 (32 or 64 bit)

4. RESEARCH METHODOLOGY

The following block diagram shows the steps carried out in image processing techniques to acquire the output determining whether leukemia is present or not.

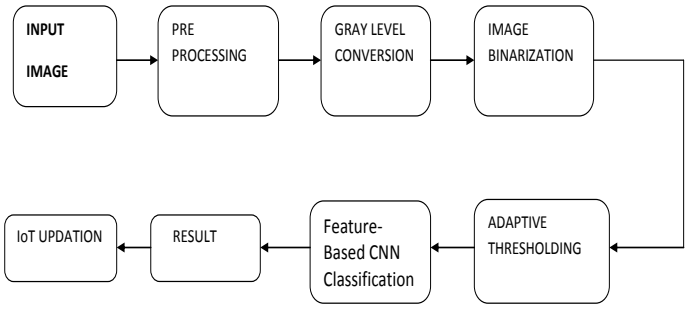

Figure 5. Block Diagram

4.1 PRE PROCESSING

Blurring is used in preprocessing steps, such as removal of small details from an image prior to object extraction, and bridging of small gaps in lines or curves. It replaces the value of every pixel in an image by the average of the gray levels in the neighbourhood defined by the filter mask. It uses a typical Median Filter which removes the noise and enhance the quality of the image as well as preserve the edge boundaries of the image.

4.2 GRAY LEVEL CONVERSION

Gray scale transformation or gray level conversion is the process of converting an RGB image into a gray scale image. It operates directly on pixels. The gray level image involves 256 levels of gray and in a histogram, horizontal axis spans from 0 to 255, and the vertical axis depends on the number of pixels in the image.

4.3 IMAGE BINARIZATION

It is the process of taking a grayscale image and converting it to black-and-white, reducing the information contained within the image from 256 shades of gray to 2: black and white, a binary image.

4.4 ADAPTIVE THRESHOLDING

Adaptive thresholding typically uses a grayscale image as input and gives a binary images as the output. In this method the threshold value is calculated for smaller regions and therefore, there will be different threshold values for different regions.

4.5 CLASSIFICATION BASED ON CNN

Convolutional neural network (CNN) is a tpe of artificial neural network that is most commonly used in all application of image processing widely. It is a multilayer neural network, and it is based o n supervised learning method. It is a complex feed forward neural network. It is used for image classification and recognition because of its high accuracy and small error rates. The following is the steps involved in the CNN method to produce a classified output.

- Input: Input is a collection of images; each image is trained to become a training set or databasethis is done by using a typical software employed in the CNN method.
- Learning: This step is to use the training set to learn the different types of datasets into which class they belong to.
- Evaluation: The classifier is used to compare the labels predicted by the classifier with the real labels of the image.

4.6 INTERNET OF THINGS

It is a sensor device which talks to the cloud through internet connectivity. The purpose of Iot is that, once the data gets to the cloud, software processes it. Then it performs an action such as sending an alert without the need of the user. Internet of things examples extend from smart connected homes to wearables to healthcare. It can be accessed by using a username and password connected through an iot device that consists of UART cable, microcontroller and wifi module ESP 8266.

5. RESULTS AND DISSCUSSION

The results obtained from our paper is that the use of blood smeared images has many overlapped cells into which the image processing techniques are applied. During segmentation, the overlapping cells do not form an arbitrary shape of the blood cells and may result in improper segmentation due to the abnormal shape and structure of the WBC. The CNN classification method is a typically a complex one that requires only a trained set of input data and the samples required to train the data needed is more.

6. CONCLUSION

This research involves detecting the types of leukemia using microscopic blood smear images. The system will be built by using features in microscopic images by examining changes on texture, geometry, colors and statistical analysis as a classifier input. The system should be efficient, reliable, less processing time, smaller error, high accuracy, cheaper cost and must be robust towards varieties that exist in individual, sample collection protocols, time and etc. Information extracted from microscopic images of blood samples can benefit to people by predicting, solving and treating blood diseases immediately for a particular patient.

7. FUTURE SCOPE

The future scope of this project is that the system can implement a more simple form of algorithm than CNN that requires only a minimal amount of images to be trained into a dataset. The use of Iot can be enhanced by enabling the updation of patient details along with their name, age, gender etc.

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