Acute Lymphoblastic Leukemia Detection using Convolutional Neural Network

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Abstract:
Acute Lymphoblastic Leukemia (ALL) is a severe case in Sri Lanka, a large number of young people and children are becoming patients of this blood cancer type. This project is focused on preventing the spreading of cancer through the children's body. Prompt detection of the ALL cells is essential to treatments for the children. Also, this system was used to detect ALL cells in blood slides of the patients as support for this case. In this system, Convolutional Neural Network (CNN) used to detect ALL cells in the stained blood sample slide. This system can be reduced the time, and the cost goes for the microscopic observations, also the ALL identification system support for the Medical Laboratory Technologists to identify the ALL fast.

Keywords: Acute Lymphoblastic Leukemia, Convolutional Neural Network, Image Processing, Machine Learning.

I. INTRODUCTION

Cancer is a disease that results when cellular changes cause the uncontrolled growth and division of cells among healthy cells. Some types of cancer cause rapid cell growth, while others cause cells to grow and divide at a slower rate [1]. Among different types of cancers, Leukemia takes a significant place. Leukemia is a cancer of the blood. Leukemia begins when healthy blood cells change and grow uncontrollably. The 04 main types of Leukemia are acute lymphocytic Leukemia, chronic lymphocytic Leukemia, acute myeloid Leukemia, and chronic myeloid Leukemia. From above 04 types of Leukemia, ALL is the most common cancer type that can be seen in the young age children. Acute Lymphoblastic Leukemia (ALL) progresses rapidly, replacing healthy cells that produce functional lymphocytes with leukemia cells that can't mature properly. Quick detection ALL is crucial to the treatments of cancer. Therefore, image processing and machine learning can be used for that kind of quick detection. Aim of this research is to applied image processing, and machine learning techniques to extract from blast cell image and classify ALL. This system was helpful to identify and classify ALL quickly.

II. RELATED WORKS

Analysis of blood samples for counting leukemia cells using Support Vector Machine (SVM) has been developed by Chatap, N. and Shibu, S [2]. They have discussed the concept of SVM and Nearest Neighbor concept. It explained about identifying and counting blood cell within the blood smear using classification techniques. It is quite possible to detect so many diseases. If one of the new classifiers is used, i.e. nearest neighbour and SVM, it is quite possible to detect the cancer cell from the blood cell counting. Automatic blood cancer detection using image processing has been developed by Harun et al. [3]. They have discussed an idea to develop an automated method of analysis of Acute Myeloid Leukemia (AML) blast cell images and to include in image-processing software, which enables the haematologist to diagnose AML more effectively and efficiently. It mentioned that haematologists often face difficulties identifying the subtypes of AML, due to the similarities of their morphological features. Following AML detection, blast cells need to be classified into Acute Myeloid subtype 3 (M3) or one of the other subtypes. The reason for targeting M3 is that its treatment differs from the treatment of the rest, requiring All-Trans Retinoic Acid (ATRA) medication, which used for the treatment of acute Leukemia to be added to the initial chemotherapy. The statistical data about cancer in Sri Lanka [4], categorized the most common types of cancer in Sri Lanka according to the gender and age limits. The most frequent cancer is Leukemia. Out of that, more than 40% of ALL, which mainly occurs to teenagers were age between 0 to 14. The main feature of the ALL is overgrowing rather than other types of Leukemia, during a few days. Also, if error or fault happened during the microscopic observation, it should repeat and cost for that kind of diagnosis is very high in private hospitals in Sri Lanka. Quick detection of ALL helps to reduce the time and the cost of the diagnosis. Also, it helps with the treatments and saves their lives.

III. METHODOLOGY

The diagnosis and classification of ALL generally consist of several stages. These include image acquisition, image segmentation, feature extraction, feature selection and classification. The first stage of the project is image acquisition, which is an essential step for the diagnosis of ALL. A prerequisite to efficiently diagnose ALL is to set up a standard methodical procedure under which an extensive collection of good quality, crisp and well-contrasted blood sample images could be captured. The second stage of the project is image segmentation. The purpose of the image segmentation stage is to separate the blast cells from the other surrounding blood components such as red blood cells, platelets, and blood plasma. Feature extraction stage is the next stage to extract several
features or measurements from the blast cell and its components such as shape, texture, and colour. Finally, the above features were learned to the ALL identification system by taking 100 blood samples diagnosed by Cancer Hospital using python programming. Figure 1 is shown the block diagram with the details about the significant parts of the system and connecting. This block diagram has the main four parts. Image acquisition, image processing, machine learning, and display the result.

In this system, Convolutional Neural Network (CNN) is used to detect ALL cells in the stained blood sample slides. CNN is a network which built of several interconnected neurons. The neurons are simple processing units that change their internal state, or activation, based on the current input and produce an output that depends on both the input and current activation [6]. CNN is constructed by having many of these neurons working in parallel and connecting some neurons to others through weighted connections, creating a weighted and directed network of different layers. It is by adjusting these weighted connections and the internal activations of the neurons the CNN can be improved or trained. Four layers of CNN is used with activations to train, which are distinguishing between the ALL cells and other cells. Then, the training module is used to identify the ALL cells accurately. Figure5 is shown the CNN architecture.

The ALL blood slide images were acquired in the Red, Green, Blue Colour Space (RGB colour space). For segmentation and extraction of the ALL cells, used Hue, Saturation, Value Colour Space (HSV colour space) method [5]. To detect and extract the image of ALL and other cells, used a track bar with a mask to adjust the Lower HSV values and Upper HSV values. For this, track bar used to adjust Upper and Lower HSV values to extract purple colour and a mask used to remove background as shown in Figure2.

After HSV Colour Space method for image segmentation and extraction, can be separated two types of cells such as ALL cells and other cells (White Blood Cells, Destroyed Cells) that is shown in Figure3 and Figure4.
For CNN training, 17 epochs were used to get the high training accuracy. Neural network training accuracy is increased, and training loss is decreased with the number of epochs that used. Training accuracy depended on the number of layers which were used to CNN and number of images (both ALL and other cells) that used for training. In the resulting image of the system, green colour contours show the ALL cells and red colour contours show the other cells in the image that capture by the camera is shown in Figure8.

In this system, has not recognized the cells in edges, because that cells are not complete cells. The accuracy of this system can be developed by using images more than 1000 or above. By training ALL cells and other cells system identify both kind of cell with high accuracy and low errors. The system takes 30seconds to identify the cells. By using the correct number of epochs and the correct number of layers and activations can be reduced the time and can be increased accuracy. Increasing the number of epochs were used to get better results to detect ALL cells in the image.

V. CONCLUSION

The primary purpose of this research is to identify the Acute Lymphoblastic Leukemia detection using CNN can use to help for the technologists in Haematology Labs in hospitals. This system is helped to reduce the cost and time that taken for the identification of Acute Lymphoblastic Leukemia by using Microscopic observations in the Haematology Labs. Convolutional Neural Network is good enough to detect ALL cells and other cell identification systems. This system helps to increase the number of ALL experiment by automatically rather than doing manually in the hospitals.

VI. ACKNOWLEDGEMENT

It is delightful in submitting this paper on “Acute Lymphoblastic Leukemia using Convolutional Neural Network”first and foremost. I express my grateful thank to Dr Shashikala Suresh (Consultant Hematologist) and Mr B. B. I. N. Priyankara (Medical Laboratory Technologist) of Apeksha Cancer Hospital, Sri Lanka, for pointing this research about ALL. Also, they have advised me to keep improving my knowledge and supporting me for the lab technical works.

VII. REFERENCES

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