DEEP AND MACHINE LEARNING BASED DETECTION AND CLASSIFICATION OF ACUTE LYMPHOBLASTIC LEUKEMIA

R. SATHYAPRIYA[1], V. PUGAZHENTHI[2]
1 PG SCHOLAR 2 ASSISTANT PROFESSOR
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MAM COLLEGE OF ENGINEERING., TAMILNADU, INDIA

ABSTRACT

Microscopic image analysis plays a significant role in initial leukemia screening and its efficient diagnostics. Since the present conventional methodologies partly rely on manual examination, which is time consuming and depends greatly on the experience of domain experts, automated leukemia detection opens up new possibilities to minimize human intervention and provide more accurate clinical information. This paper proposes a novel approach based on conventional digital image processing techniques and machine learning algorithms and deep learning algorithms to automatically identify acute lymphoblastic leukemia from peripheral blood smear images. The proposed model eradicates the probability of errors in the manual process by employing deep learning techniques, namely convolutional neural networks. The model, trained on cells' images, first pre-processes the images and extracts the best features. This is followed by training the model with the optimized Dense Convolutional neural network framework (termed DCNN here) and finally predicting the type of cancer present in the cells. The model was able to reproduce all the measurements correctly while it recollected the samples exactly 94 times out of 100. The overall accuracy was recorded to be 97.2%, which is better than the conventional machine learning methods like Support Vector Machine (SVMs), Decision Trees, Random Forests, Naive Bayes, etc. This study indicates that the DCNN model's performance is close to that of the established CNN architectures with far fewer parameters and computation time tested on the retrieved dataset. Thus, the model can be used effectively as a tool for determining the type of cancer in the bone marrow. To overcome the greatest challenges in the segmentation phase, we implemented extensive pre-processing and introduced a three phase filtration algorithm to achieve the best segmentation results.

Keywords: Lymphoblastic, Convolutional Neural Network, microscopic images and Leukemia

1. INTRODUCTION

Leukemia is a hematological disorder and type of cancer that weakens the human immune system by generating malignant White Blood Cells (WBC). Leukemia is considered as one of the fatal cancers with a high death rate. Leukemia is usually classified based on myelogenous or lymphoblastic disorders of the WBCs. If the affected cells are lymphoblastic, then the leukemia is called Acute Lymphoblastic Leukemia (ALL). If the affected WBCs are monocytes and granulocytes, then the leukemia will be called Acute Myeloid Leukemia (AML). Leukemia is a blood cancer resulting from an abundance of abnormal white blood cells in humans. Usually, a hematology analyzer is used to diagnose leukemia through manual counting. Cell classification usually depends on the morphological characteristics of the cells and requires a skilled medical operator. This procedure can be time-consuming, tedious, and costly. Moreover, the manual analyzer may sometimes lead to the incorrect counting and classification of leukocytes. Undoubtedly, this manual examination mechanism can be replaced by machine-learning-based automated techniques that can save precious time and significantly reduce human effort and error. Deep learning algorithms are powerful and versatile algorithms used efficiently in significant research areas such as medical image processing, supercomputing, investment modelling, and fraud

detections. Convolutional Neural Network (CNN) is a popular subcategory of deep learning algorithms, specially designed for visual pattern recognition Among all types of blood cancers, leukemia is the most common form of malignancy in different age groups, especially in children. abnormal phenomenon is caused by excessive proliferation and immature growth of blood kidneys, and then metastasize to important tissues of the body. there are different types of leukemia that haematologists in cell transplant aboratories can differentie diagnose based on microscopic images. If the slide is correctly stained, some types of leukemia can be more easily identified and distinguished than others, but more equipment is needed to determine underlying leukemia. shows the stained slides of the most common different types of leukemia. An early diagnosis of leukemia has always been a challenge to researchers, doctors, and hematologists. Enlargement of lymph nodes, pallor, fever, and weight loss are the symptoms of leukemia, but they can also be associated with other diseases. Leukemia diagnosis is difficult in its early stages due to the mild nature of the symptoms. most common leukemia diagnosis method is the microscopic evaluation of PBS, but the golden standard for leukemia diagnosis only involves taking and analyzing bone marrow samples. In the last two decades, various studies have adopted machine learning (ML) and computer-aided diagnostic methods for laboratory image analysis, hoping to overcome the limitations of a late leukemia diagnosis and determine its sub groups. these studies have analyzed blood smears images for diagnosing, differentiating, and counting the cells in various types of leukemia. ML is a well-known branch of artificial intelligence, comprising algorithms and mathematical relations, which was quickly introduced to the domain of clinical research. ML enables computers to be programmed without explicit experience and learns from that experience. the outcome of using these methods in medical data processing has been extraordinary, and they have made remarkable success in disease diagnosis. Research indicates that, in medical image processing, ML methods greatly aid complex medical decision-making processes by extracting and then analysing the features of these images. As the number of medical diagnosis tools increased and a large volume of high-quality data was produced, there was an urgent need for more advanced data analysis methods. Traditional methods could not analyse such a large volume of data or find data patterns.

2. ARTIIFICIAL INTELLIGENCE

Artificial intelligence (AI),digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to carry out very complex tasks—as, for example, discovering proofs for mathematical theorems or playing chess—with great proficiency. Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines, and voice or handwriting recognition.

3. MACHINE LEARNING

Machine learning is a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy. Machine learning is an important component of the growing field of data science. Through the use of statistical methods, algorithms are trained to make classifications or predictions, uncovering key insights within data mining projects. These insights subsequently drive decision making within applications and businesses, ideally impacting key growth metrics. As big data continues to expand and grow, the market demand for data scientists will increase, requiring them to assist in the identification of the most relevant business questions and subsequently the data to answer them. machine learning algorithm into three main parts.

1. **A Decision Process**: In general, machine learning algorithms are used to make a prediction or classification. Based on some input data, which can be labelled or unlabeled, your algorithm will produce an estimate about a pattern in the data.
2. **An Error Function**: An error function serves to evaluate the prediction of the model. If there are known examples, an error function can make a comparison to assess the accuracy of the model.
3. **A Model Optimization Process**: If the model can fit better to the data points in the training set, then weights are adjusted to reduce the discrepancy between the known example and the model estimate. The

algorithm will repeat this evaluate and optimize process, updating weights autonomously until a threshold of accuracy has been met.

4. DEEP LEARNING

Deep learning is a machine learning technique that teaches computers to do what comes naturally to humans: learn by example. Deep learning is a key technology behind driverless cars, enabling them to recognize a stop sign, or to distinguish a pedestrian from a lamppost. It is the key to voice control in consumer devices like phones, tablets, TVs, and hands-free speakers. Deep learning is getting lots of attention lately and for good reason. It's achieving results that were not possible before in deep learning, a computer model learns to perform classification tasks directly from images, text, or sound. Deep learning models can achieve state-of-the-art accuracy, sometimes exceeding human-level performance. Models are trained by using a large set of labeled data and neural network architectures that contain many layers.

5.LITREATURE SURVEY

1.Automatic Detection of White Blood Cancer from Bone Marrow Microscopic Images Using Convolutional Neural Networks DEEPIKA KUMARI, NIKITA JAIN1, AAYUSH KHURANA1, SWETA MITTAL1, SURESH CHANDRA SATAPATHY.

Leukocytes, produced in the bone marrow, make up around one percent of all blood cells. Uncontrolled growth of these white blood cells leads to the birth of blood cancer. Out of the three different types of cancers, the proposed study provides a robust mechanism for the classification of Acute Lymphoblastic Leukemia (ALL) and Multiple Myeloma (MM) using the SN-AM dataset. Acute lymphoblastic leukemia (ALL) is a type of cancer where the bone marrow forms too many lymphocytes. On the other hand, Multiple myeloma (MM), a different kind of cancer, causes cancer cells to accumulate in the bone marrow rather than releasing them into the bloodstream. Therefore, they crowd out and prevent the production of healthy blood cells. Conventionally, the process was carried out manually by a skilled professional in a considerable amount of time. The proposed model eradicates the probability of errors in the manual process by employing deep learning techniques, namely convolutional neural networks. The model, trained on cells' images, first pre-processes the images and extracts the best features. This is followed by training the model with the optimized Dense Convolutional neural network framework (termed DCNN here) and finally predicting the type of cancer present in the cells. The model was able to reproduce all the measurements correctly while it recollected the samples exactly 94 times out of 100. The overall accuracy was recorded to be 97.2%, which is better than the conventional machine learning methods like Support Vector Machine (SVMs), Decision Trees, Random Forests, Naive Bayes, etc. This study indicates that the DCNN model's performance is close to that of the established CNN architectures with far fewer parameters and computation time tested on the retrieved dataset. Thus, the model can be used effectively as a tool for determining the type of cancer in the bone marrow

2. Leukemia Diagnosis Based on Machine Learning Algorithms. Patil Babaso S, S.K. Mishra, Aparna Junnarkar.

Leukemia is brought about by the quick generation of unusual white platelets. The high number of strange white platelets are not ready to battle contamination, and they impede the capacity of the bone marrow to create red platelets and platelets. Machine Learning techniques are widely used in the dignosis and classification of different leukemia types in the patients. In this paper, we have described the different machine learning algorithms like Support Vector Machines, k-Nearest Neighbour, Neural Networks, Naïve Bayes and Deep Learning algorithms which are used to classify leukemia into its sub-types and presented a comparative study of these algorithms.

3.Machine Learning based System for Automatic Detection of Leukemia Cancer Cell. Supriya Mandal, Vani Daivajna, Rajagopalan V.

In recent years, blood cell classification with the help of image processing techniques has attracted many researchers to build an automated system that assists doctors for diagnosis of cancer. Also, it's very challenging to differentiate cancer cell from normal cell as they look similar in initial stages. In this manuscript, we have presented an approach for cancer cell detection by extracting important features from the blood cell images and learning multiple classifiers. We have observed that Gradient Boosting Decision Tree classification algorithms give better result than Support Vector Machine. We have also derived few important features like presence of adjacent nuclei and measure of irregularity in the shape of a nucleus, which has significant impact on cancer cell detection. Our techniques can be used in a limited computing environment without a Graphics Processing Unit.

We have achieved 85.6% of F1 score on validation data. This approach also identified an important feature for the images that can help doctors or technicians for better understanding of stained images to aid diagnosis of leukemia patients.

6. EXISTING SYSTEM

This existing study provides a robust mechanism for the classification of Acute Lymphoblastic Leukemia (ALL) and Multiple Myeloma (MM) using the SN-AM dataset. Acute lymphoblastic leukemia (ALL) is a type of cancer where the bone marrow forms too many lymphocytes. On the other hand, Multiple myeloma (MM), a different kind of cancer, causes cancer cells to accumulate in the bone marrow rather than releasing them into the bloodstream. Therefore, they crowd out and prevent the production of healthy blood cells. The model eradicates the probability of errors in the manual process by employing machine learning techniques, namely k-beast algorithm. The model, trained on cells' images, first pre-processes the images and extracts the best features. This existing study indicates that the model's performance is close to that of the established K-beast algorithms architectures with far fewer parameters and computation time tested on the retrieved dataset.

7. PROPOSED SYSTEM

In the proposed methodology, the image of blood smear goes through different stages. First the input image undergo segmentation. Then the image cleaning operation is performed. After that features are extracted from the image. Finally, these features are classified by a classifier. The objectives of proposed method are developing automated and accurate method to find whether the blood image is leukaemia affected or not. if leukaemia is affected then it is classified the leukaemia is Acute Lymphoblastic Luekmia (ALL) or Multiple Myloma (MM). It includes identification and classification of leukocytes. Also find the best method which classifies the leucocytes among three classification methods. The proposed method also aims in analysing performance of Decision Tree and 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 on 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. The model, containing three types of layers, namely convolution layer, max pool, and fully connected layer, is trained on the training set, and then it is used for prediction on the testing set.

## 8. BLOCK DIAGRAM
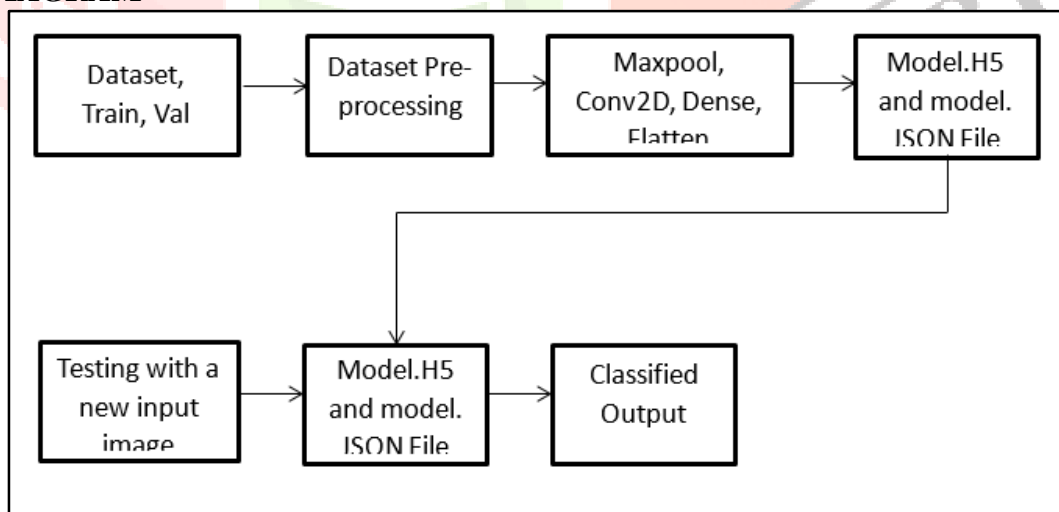
9. IMPLEMENTATION

The design overview of the proposed methodology is depicted in below images. The proposed framework begins with the acquisition of microscopic images of blood samples. Later on, the data augmentation techniques are employed to overcome the problem of fewer data since in deep neural networks more data are required for their training and superior performance. Lastly, a deep CNN architecture-based squeeze and excitation learning is proposed to diagnose leukemia from the inputted microscopic images of blood samples. Each step is explained in-depth in the following subsections of methodology:
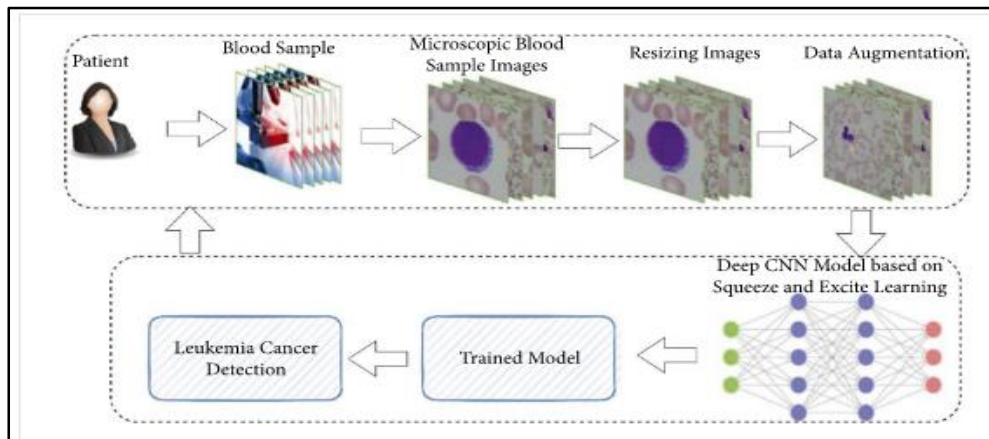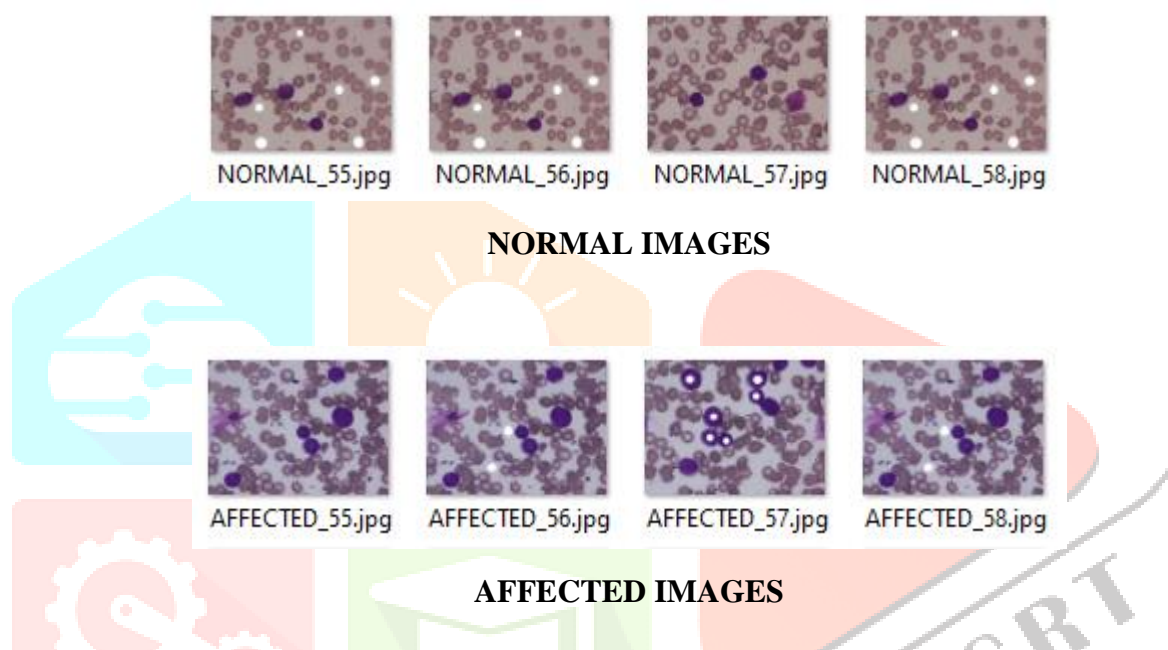
10. ACTUAL IMAGE
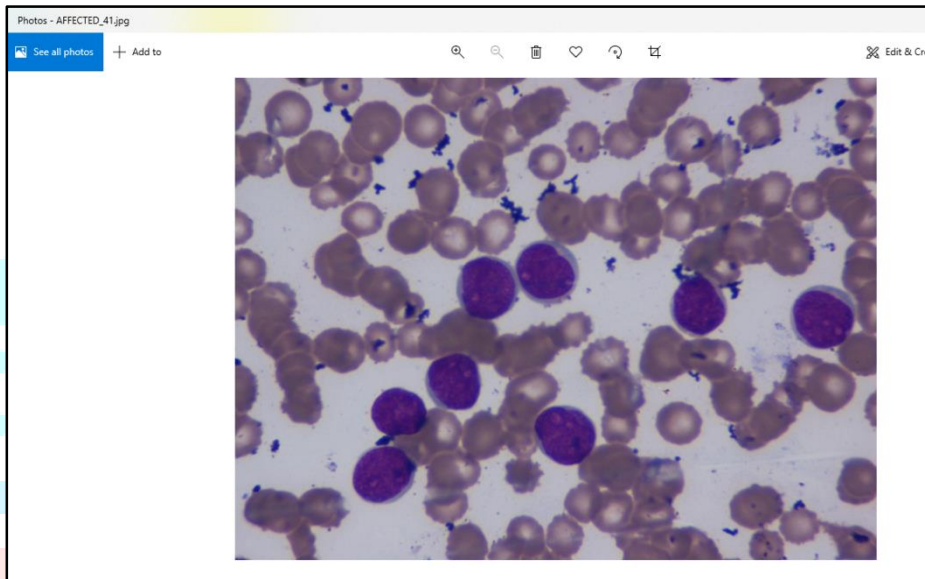
11. ROTATED IMAGE
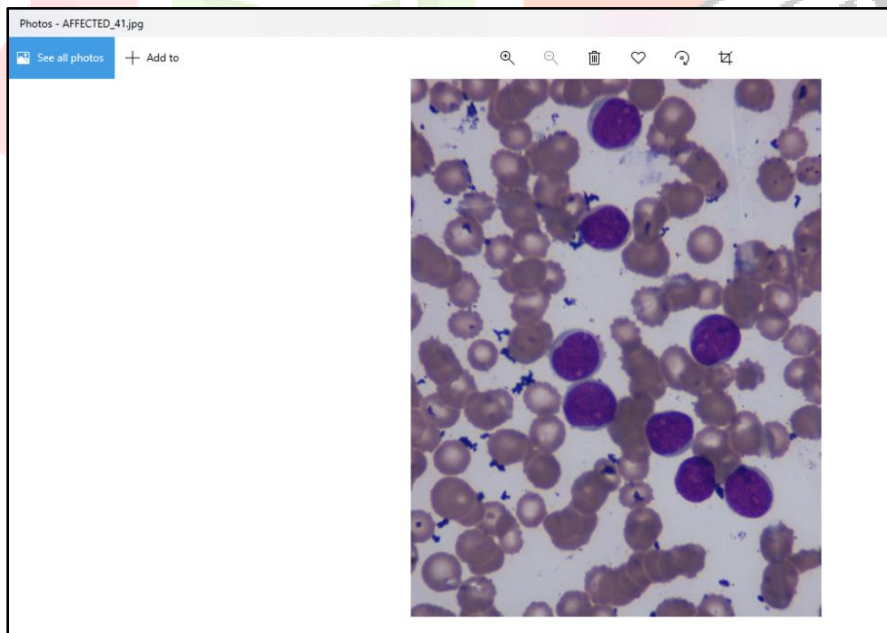
12. CONCLUSIONS

Acute Lymbhoplastic Leukemia (ALL) and Multimyloma (MM) is a hematological disorder and type of cancer that weakens the human immune system by generating malignant WBCs. In this work, we have proposed the CNN-based model to identify ALL and MM in microscopic blood images and compared its performance with the CNN based model in Precision, Recall, Accuracy, and Quadratic Loss. CNN model is composed of two convolutional, two maximum pooling, and three FC layers. In contrast, the CNN model has five convolutional, three maximum pooling, and three FC layers. Based on results, it is concluded that CNN performed well with high accuracy compared to LeNet-5-based model. CNN was able to classify 88.9% images correctly with 87.4% precision and 98.58% accuracy, whereas LeNet-5 correctly identified 85.3% images with 83.6% precision and 96.25% accuracy. CNN algorithm is a competent and well-known deep learning algorithm that can be used efficiently in significant research areas, especially medical image processing. CNN can analyze and detect important features from different medical images such as CT scans, X-rays, MRI, PET, ultrasound, and hematological images. In the future, we are planning to apply the CNN architecture for other types of leukemia cell detection, such as Acute Lymphatic Leukemia (ALL), to get high accuracy.

NORMAL_55.jpg   NORMAL_56.jpg   NORMAL_57.jpg   NORMAL_58.jpg

NORMAL IMAGES

AFFECTED_55.jpg   AFFECTED_56.jpg   AFFECTED_57.jpg   AFFECTED_58.jpg

AFFECTED IMAGES

13. RESULTS AND DISCUSSION

This paper is mainly focused on classify the cancer called leukemia. The leukemia is a most dangerous cancer for humans to affect the bones and bone morrows. this project we use machine learning to detect leukemia using image classification techniques called decision tree. in case the person is affected by leukemia cancer, we use deep convolutional nueral network for classify the leukemia types. lukeamea is classify by his severity. first level of leukemia is called Acute Limbo Plastic Leukemia and the second one is Multiple Myeloma. this project we use Deep Convolutional Neural Network to classify the leukemia cancer types.

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