World Academy of Science, Engineering and Technology
International Journal of Computer and Information Engineering
Vol:16, No:06, 2022

Preparation of Papers - Developing a Leukemia Diagnostic System Based on Hybrid Deep Learning Architectures in Actual Clinical Environments

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Abstract : An early diagnosis of leukemia has always been a challenge to doctors and hematologists. On a worldwide basis, it was reported that there were approximately 350,000 new cases in 2012, and diagnosing leukemia was time-consuming and inefficient because of an endemic shortage of flow cytometry equipment in current clinical practice. 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. One of these methods was the AI approach. This approach has become a major trend in recent years, and several research groups have been working on developing these diagnostic models. However, designing and implementing a leukemia diagnostic system in real clinical environments based on a deep learning approach with larger sets remains complex. Leukemia is a major hematological malignancy that results in mortality and morbidity throughout different ages. We decided to select acute lymphocytic leukemia to develop our diagnostic system since acute lymphocytic leukemia is the most common type of leukemia, accounting for 74% of all children diagnosed with leukemia. The results from this development work can be applied to all other types of leukemia. To develop our model, the Kaggle dataset was used, which consists of 15135 total images, 8491 of these are images of abnormal cells, and 5398 images are normal. In this paper, we design and implement a leukemia diagnostic system in a real clinical environment based on deep learning approaches with larger sets. The proposed diagnostic system has the function of detecting and classifying leukemia. Different from other AI approaches, we explore hybrid architectures to improve the current performance. First, we developed two independent convolutional neural network models: VGG19 and ResNet50. Then, using both VGG19 and ResNet50, we developed a hybrid deep learning architecture employing transfer learning techniques to extract features from each input image. In our approach, fusing the features from specific abstraction layers can be deemed as auxiliary features and lead to further improvement of the classification accuracy. In this approach, features extracted from the lower levels are combined into higher dimension feature maps to help improve the discriminative capability of intermediate features and also overcome the problem of network gradient vanishing or exploding. By comparing VGG19 and ResNet50 and the proposed hybrid model, we concluded that the hybrid model had a significant advantage in accuracy. The detailed results of each model's performance and their pros and cons will be presented in the conference.

Keywords : acute lymphoblastic leukemia, hybrid model, leukemia diagnostic system, machine learning
Conference Title : ICAIMLHA 2022 : International Conference on Artificial Intelligence and Machine Learning for Healthcare Applications
Conference Location : San Francisco, United States
Conference Dates : June 02-03, 2022