National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: A Deep Learning Framework for Classification of Optical Microscopy-based Blood Cell Images
Speaker	: Shaik Ahmadsaidulu (Rollno : 521bm1012)
Supervisor	: Earu Banoth
Venue	: BM Department Seminar room
Date and Time	: 30 May 2025 (11.00 AM)

Abstract : Accurate and prompt microscopic blood cell image classification is essential for detecting a wide range of hematological disorders, including infectious diseases such as malaria, dengue along with malignancies like leukemia or lymphoma. Traditional manual classification of microscopic blood cell images is often inherently subjective, susceptible to inter-observer variability, and computationally slow, thereby impacting diagnostic accuracy and timeliness. To address these challenges, automated techniques using deep learning are employed to enhance computational speed and accuracy in blood cell image analysis facilitating early detection of hematological disorders. Moreover, these automated systems are suitable for deployment in low-resource settings and clinical laboratories, enabling high-throughput screening in public health initiatives.

This work primarily focuses on developing object detection architecture based deep learning framework for robust blood cell classification and disease-specific diagnosis from microscopic cell images. The research employs YOLO (You Only Look Once) object detection algorithms with a series of architectural enhancements for superior feature extraction and enhanced recognition of minute cellular features. The architectural enhancements include employing a self-attention mechanism convolutional transformer (C3TR) into the backbone of YOLOv5 for efficient feature extraction of object and suppressing the background noise. Bidirectional feature pyramid network (BiFPN) architecture is incorporated into the neck to facilitate the multi-scale feature fusion capability bidirectionally (low to high resolution and vice versa). An extra detection layer is utilized in the head to detect small objects like blood cells. These architectural enhancements the proposed custom YOLOv5 framework to address different microscopic image classification challenges like efficient white blood cells (WBCs) classification, accurate complete blood count (CBC) classification along (with WBC subtypes) and malaria-infected cell classification. A specialized Small Object Detection (SOD) module in the neck of enhanced-YOLOv8 model along with C3TR module in the backbone introduced to classify acute lymphoblastic leukemia subtypes (benign, malignant early pre-B, pre-B, pro-B). The proposed deep learning frameworks demonstrated high accuracy, precision, and recall on the standard BCCD and ALL datasets.

A Graphical User Interface (GUI) was also developed to enable real-time diagnostic support through remote access. The proposed framework achieves a peak accuracy of up to 99.4% in WBC classification,96.3% in CBC classification, and 99.2% in malaria detection. The proposed C3TR-SOD-YOLOv8 framework achieves 98.7% in ALL subclassification accuracy while maintaining significantly reduced model sizes and faster inference speeds compared to conventional CNN-based models. The results underscore the effectiveness of the deep learning framework in automating blood smear analysis, setting the stage for next-generation AI-enabled point-of-care diagnostic tools in clinical hematology.