INTISARI

Tuberkulosis (TB) merupakan penyakit menular yang masih menjadi tantangan global, terutama di negara berkembang. Deteksi dini berperan penting dalam menekan laju penularan, namun keterbatasan fasilitas laboratorium dan tenaga ahli di wilayah terpencil kerap menghambat akurasi dan kecepatan diagnosis. Pemeriksaan mikroskopis sediaan apus dahak yang lazim digunakan bersifat manual, memakan waktu, dan rentan kesalahan, terutama karena ukuran bakteri TB yang kecil dan tumpang tindih dalam citra mikroskopis.

Penelitian ini mengembangkan sistem deteksi otomatis AFB pada citra *sputum smear* berbasis model YOLOv8 yang dimodifikasi dengan mekanisme *channel attention* untuk meningkatkan kemampuan deteksi objek kecil. Strategi augmentasi data diterapkan guna memperkaya informasi dalam pelatihan model, sedangkan metode pemotongan citra menjadi patch kecil digunakan untuk mengatasi tantangan resolusi tinggi. Model hasil pelatihan kemudian diimplementasikan pada sistem tertanam agar dapat dioperasikan tanpa koneksi internet.

Evaluasi menunjukkan bahwa model varian model YOLOV8 yaitu YOLOv8s dengan tambahan mekanisme *attention* mencapai kinerja terbaik dengan precision 0,852, recall 0,788, mAP@50 0,820, dan mAP@50:95 0,380. Meskipun terdapat sedikit peningkatan waktu inferensi, peningkatan akurasi dan efisiensi pemrosesan menjadikan sistem ini potensial untuk diterapkan dalam mendukung diagnosis TB secara otomatis, khususnya di wilayah dengan sumber daya terbatas.

Kata kunci : deteksi objek, mekanisme *attention*, tuberkulosis, sistem tertanam, *sputum smear*

ABSTRACT

Tuberculosis (TB) remains a persistent public health challenge, especially in developing countries where early and accurate diagnosis is essential to control transmission. In remote areas, limited laboratory infrastructure and shortages of trained personnel contribute to delays and inaccuracies in TB detection. One of the most common diagnostic techniques, the sputum smear microscopy test, involves manually identifying acid-fast bacilli under a microscope that is labor-intensive, time-consuming, and prone to human error. The small size of TB bacteria and their tendency to overlap in smear images further complicate detection, making conventional methods insufficient in resource-limited settings.

To address this issue, this study proposes an automated TB bacteria detection system using the YOLOv8 object detection model, enhanced with a channel attention mechanism to improve small object recognition. To compensate for limited training data, data augmentation techniques were applied to enrich the model's learning. Furthermore, high-resolution smear images were divided into smaller patches to make the tiny bacteria more detectable during training and inference. The final model was deployed on an embedded system, enabling standalone operation even in areas with minimal infrastructure and without internet access.

Experimental evaluation shows that the proposed YOLOv8s model achieved the best performance, with a precision of 0.852, recall of 0.788, mAP@50 of 0.820, and mAP@50:95 of 0.380. Although inference time slightly increased, the model's overall detection accuracy and processing efficiency make it a promising solution. This system has strong potential to support TB diagnosis in remote and underserved areas through reliable, automated detection.

Keywords : attention mechanism, embedded system, object detection, sputum smear, tuberculosis