

ABSTRAK

Anemia merupakan masalah kesehatan global yang banyak dialami remaja putri akibat kadar hemoglobin di bawah 12 g/dL, sementara metode skrining konvensional melalui pemeriksaan darah bersifat *invasif*, memakan waktu, serta membutuhkan biaya. Penelitian ini bertujuan merancang sistem deteksi dini anemia dan non-anemia secara non-invasif berdasarkan citra mata konjungtiva menggunakan metode *Convolutional Neural Network* (CNN) yang diimplementasikan dalam bentuk *website real-time*. Dataset penelitian terdiri atas 374 citra konjungtiva mata, mencakup 180 citra anemia dan 194 citra non-anemia, bersumber dari data *primer* hasil pengambilan langsung menggunakan kamera *smartphone* serta data *sekunder* dari *platform Kaggle*, yang kemudian dibagi dengan rasio 80:10:10 menjadi data latih, validasi, dan uji. Tahapan *preprocessing* meliputi *resize* citra menjadi 150×150 piksel, augmentasi data (*flip*, *rotasi*, *zoom*, *translasi*, dan *brightness*), serta normalisasi piksel. Model CNN dirancang dengan tiga lapisan konvolusi (32, 64, dan 128 filter) yang dilengkapi *max pooling*, *dropout*, dan lapisan *fully connected* dengan fungsi aktivasi sigmoid pada *output* untuk klasifikasi biner, dilatih menggunakan *optimizer Adam* dan fungsi *loss binary crossentropy* hingga *epoch* ke-19. Hasil pengujian menunjukkan model mampu mengklasifikasikan citra konjungtiva dengan akurasi sebesar 83,78%, *precision* 0,85, *recall* 0,84, dan *F1-score* 0,84. Model tersebut selanjutnya diintegrasikan ke dalam *REST API* berbasis *Flask* dan diimplementasikan pada sistem *website real-time* yang memanfaatkan *MediaPipe Face Landmarker* untuk deteksi *Region of Interest* (ROI) konjungtiva secara otomatis melalui kamera maupun unggahan citra. Sistem yang dikembangkan terbukti mampu melakukan deteksi anemia secara cepat, praktis, dan mudah diakses, sehingga berpotensi dimanfaatkan sebagai media skrining awal anemia bagi remaja putri di lingkungan sekolah maupun fasilitas kesehatan tingkat dasar.

Kata Kunci: Anemia, Konjungtiva, *Convolutional Neural Network*, *MediaPipe*, *ROI*, *Real-Time*.

ABSTRACT

Anemia is a global health problem that affects many adolescent girls due to hemoglobin levels below 12 g/dL, while conventional screening methods involving blood tests are invasive, time-consuming, and costly. This study aims to design a non-invasive system for the early detection of anemia and non-anemia based on conjunctival images using a Convolutional Neural Network (CNN) method implemented as a real-time website. The research dataset consists of 374 conjunctival images, including 180 images of anemia and 194 images of non-anemia, sourced from primary data collected directly using a smartphone camera as well as secondary data from the Kaggle platform, which were then divided in an 80:10:10 ratio into training, validation, and test sets. The preprocessing steps include resizing the images to 150×150 pixels, data augmentation (flip, rotation, zoom, translation, and brightness), and pixel normalization. The CNN model was designed with three convolutional layers (32, 64, and 128 filters) equipped with max pooling, dropout, and a fully connected layer with a sigmoid activation function at the output for binary classification; it was trained using the Adam optimizer and the binary cross-entropy loss function until the 19th epoch. Test results show that the model is capable of classifying conjunctival images with an accuracy of 83.78%, precision of 0.85, recall of 0.84, and an F1-score of 0.84. The model was subsequently integrated into a Flask-based REST API and implemented in a real-time web-based system that utilizes MediaPipe Face Landmarker to automatically detect the Region of Interest (ROI) of the conjunctiva via camera or uploaded images. The developed system has proven capable of detecting anemia quickly, practically, and with ease, making it a potential tool for initial anemia screening among adolescent girls in school settings and primary healthcare facilities.

Keywords: *Anemia, Conjunctiva, Convolutional Neural Network, MediaPipe, ROI, Real-Time.*