
Implementation of Data Augmentation and ResNext-Based Transfer Learning for Dental Caries Detection

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Abstrak

Karies gigi adalah salah satu masalah kesehatan mulut yang paling umum di seluruh dunia. Proses diagnosis karies gigi secara manual membutuhkan keahlian khusus dan sering kali membutuhkan waktu yang cukup lama, sehingga pendekatan berbasis *Artificial Intelligence* (AI) menjadi solusi potensial untuk meningkatkan efisiensi dan akurasi. Penelitian ini bertujuan untuk mengimplementasikan metode *transfer learning* berbasis ResNext, dikombinasikan dengan teknik augmentasi data, untuk mendeteksi karies gigi dengan lebih akurat dari dataset gambar intraoral. Metodologi penelitian meliputi pengumpulan dataset intraoral, membagi data ke dalam set pelatihan, validasi, dan pengujian, dan melakukan augmentasi data menggunakan teknik seperti teknik rotasi, flipping, zoom, dan penyesuaian kecerahan. Model *transfer learning* menggunakan ResNext50 dan ResNext101 dengan bobot awal dari ImageNet, sementara ResNet50 digunakan sebagai *baseline* untuk perbandingan. Evaluasi model dilakukan berdasarkan metrik akurasi, presisi, recall, dan *F1-score* dengan menggunakan *confusion matrix*. Hasil percobaan menunjukkan bahwa ResNext50 dengan 3 layer mencapai hasil terbaik dengan akurasi 90% dan skor *false negative* 1 yang meminimalkan diagnosis karies yang terlewat.

Kata kunci: karies gigi, *artificial intelligence*, *transfer learning*, ResNext, augmentasi data.

Abstract

Dental caries is one of the most prevalent oral health problems worldwide. The manual diagnosis process for caries requires specialized expertise and often takes a considerable amount of time, making Artificial Intelligence (AI)-based approaches a potential solution to improve efficiency and accuracy. This study aims to implement a transfer learning method based on ResNext, combined with data augmentation techniques, to detect dental caries more accurately from an intraoral image dataset. The research methodology includes collecting an intraoral dataset, dividing the data into training, validation, and testing sets, and performing data augmentation using techniques such as rotation, flipping, zooming, and brightness adjustment. The transfer learning model employs ResNext50 and ResNext101 with initial weights from ImageNet, while ResNet50 is used as a baseline for comparison. Model evaluation is conducted based on accuracy, precision, recall, and F1-score metrics using a confusion matrix. The experimental results shows that ResNext50 with 3 layers achieved the best results with an accuracy of 90% and a false negative score of 1 which minimizes missed caries diagnoses.

Keywords: dental caries, *artificial intelligence*, *transfer learning*, ResNext, data augmentation

1. Introduction

Background

Oral and dental health is an integral part of overall health that cannot be neglected. Poor oral and dental health can cause negative impact on overall health [1]. One of the diseases that can arise due to poor oral hygiene is dental caries. Dental caries is a progressive dental disorder that starts when bacterial acids breaks down tooth enamel, which makes it the leading cause for tooth loss [2]. Dental caries can be caused by various factors, most commonly are poor dental hygiene, consumption of sugary foods, and sugary drinks [3].

According to the Global Burden of Disease (GBD) 2017 study, dental caries in permanent teeth was identified as the most common out of 328 diseases assessed. Globally, around 2.3 billion people suffer from caries in their permanent teeth, resulting in 1.62 million Years Lived with Disability (YLDs), a 9.4% increase from rates in 2007 [4].

During the diagnosis and treatment of oral and dental diseases, dentists need to interpret panoramic radiographs and record specific symptoms of problematic teeth in the patient's medical records [5]. However,