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Skin Cancer Classification using Convolutional Neural Network with Autoregressive Integrated Moving Average

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ABSTRACT

Machine Learning (ML) and Deep Neural Network (DNN) based Computer-aided decision (CAD) systems show the effective implementation in solving skin cancer classification problem. However, ML approach unable to get the deep features from network flow which causes the low accuracy performance and the DNN model has the complex network with an enormous number of parameters that resulting in the limited classification accuracy. In this paper, the hybrid Convolutional Neural Network algorithm and Autoregressive Integrated Moving Average model (CNN-ARIMA) have been proposed to classify three different types of skin cancer. The proposed CNN-ARIMA able to classify skin cancer image successfully and achieved test accuracy, average sensitivity, average specificity, average precision and AUC of 96.00%, 96.02%, 97.98%, 96.13% and 0.995, respectively which outperformed the state-of-art methods.

KEYWORDS

Autoregressive Integrated Moving Average, Classification, Convolutional Neural Network, Deep Neural Network, Skin Cancer

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1 INTRODUCTION

According to the National Cancer Registry data, skin cancer account for 2.6% among all the cancer cases which consider as minor cases in Malaysia [1]. The most common type of skin cancer in Malaysia are basal cell carcinoma with 34.9%, followed by squamous cell carcinoma in 20.6% cases and melanoma with 5.4% of the patients diagnosed [2]. The early detection and skin cancer diagnosis are the most effective way to produce more successful treatment. Normally, the dermatologists utilized different skin lesion evaluation guidelines such as ABCDE rule (A –asymmetry, B –irregular borders o, C –uneven distribution of colour, D – diameter, and E-evolution) [3] and 7-point checklist [4] to recognize the melanoma lesion. However, these techniques only able to identify two classes (benign and malignant) and also quite challenge to diagnose other type of skin cancer through visual features.

Recently, Computer-aided diagnosis (CAD) systems have become predominant in early detection of skin cancer due to the reliable and accurate detection of CAD system that allow for earlier treatment which could save patient lives [5-6]. Therefore, the advent of Convolutional Neural Network (CNN) allowed CAD systems to outperform in the classification tasks of skin cancer [7]. The beauty of CNN is this architecture able to classify the skin lesions based on the high-level features rather than the conventional approach that incorporate the visual information of low-level dermoscopic which require a segmentation step before the extraction of those features.

In addition, Autoregressive Integrated Moving Average (ARIMA) model also show the significant performance in forecasting task recently via the statistical analysis. Thus, the combination approach of CNN and ARIMA has been proposed for skin cancer classification problem and believe that the proposed method able to distinguish between three different common types of skin cancer such as melanoma, basal cell carcinoma and squamous cell carcinoma. The purpose of this paper is to evaluate the performance analysis of CNN-ARIMA model for skin cancer classification among Malaysian.

2 RELATED WORK

Conventionally, the skin cancer detection framework was proposed by Barata et al. [8] which was according to the feature extraction and classification tasks. This paper provides the review of several classes of feature such as hand-crafted, deep learning, dictionary-based and clinically inspired that are extracted from the input image. After that, different machine learning approaches such as neural network, SVM, k-nearest neighbors, logistic regression, etc., have been applied in the classification task. In [9], Yu et al. developed the deep learning feature approach by using ResNet and combination of SoftMax and SVM as classifier. This approach shows the promising performance with the accuracy of 85.50%. Filali et al. [10] proposed the study of segmentation, feature selection and classification approach on skin lesion. The best performance in this work is Otsu method as segmentation approach, chi2 method, Recursive Feature Elimination (RFE), ReliefF and Correlation based Feature Selection (CFS) as a feature's selection and SVM with quadratic

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