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Development of hybrid convolutional neural network and autoregressive integrated moving average on computed tomography image classification

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ABSTRACT

One of the deadliest diseases in humans is lung cancer. Radiologists and experienced doctors spend much more time investigating the pulmonary nodules due to the high similarities between malignant and benign nodules. Recently, the computer-assisted diagnosis (CAD) tool for nodule detection can provide a second opinion for the doctor to diagnose lung cancer. Although machine learning technologies are extensively employed to identify lung cancer, the process of these methods is complex. The numerous researches have sought to automate the diagnosis of pulmonary nodules using convolutional neural networks (CNN) to aid radiologists in the lung screening process. However, CNN still confronts some challenges, including a significant number of false positives and limited performance in detecting lung cancer from computed tomography (CT) images. In this work, we proposed a hybrid of CNN and auto-regressive integrated moving average (ARIMA) for lung nodule classification using CT images to address the classification issue. The proposed hybrid CNN-ARIMA can classify CT images successfully with test accuracy, average sensitivity, average precision, average specificity, average F1-Score, and area under the curve (AUC) of 99.61%, 99.71%, 99.43%, 99.71%, 99.57%, and 1.000, respectively.

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1. INTRODUCTION

The most common cause of mortality worldwide is lung cancer. In comparison to other cancers, lung cancer is responsible for roughly 1.8 million fatalities (18.0% of all cancer deaths) in 2020 [1]. If lung cancer is detected earlier, it can be treated effectively and even cured. The pulmonary nodules are the abnormal development of lung tissue and are generally the first sign of lung cancer. As a result, it is critical to detect and diagnose lung nodules earlier to reduce lung cancer mortality [2]. Radiologists utilize a variety of diagnostic techniques to detect lung cancer, including magnetic resonance imaging (MRI), computed tomography (CT), chest X-ray, and other methods. However, a CT scan is the most reliable screening approach due to its low noise and robustness in determining tumor size [3]. With the widespread use of CT scanning technology, the need for medical image analysis has risen and causes an increased workload for radiologists [4]. Traditionally, achieving an accurate radiologic diagnosis requires the expertise of the radiologist throughout the analysing process. The emergence of computer-aided tools has relieved the burden on radiologists and offered a second opinion for doctors to diagnose lung cancer [5]. In traditional methods, there exist various techniques for feature