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## Image Regression Classification of Air Quality by Convolutional Neural Network

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As living standards have improved, people have been increasingly concerned about air pollution problems. Taiwan also faces the same problem, especially in the southern region. Thus, it is a crucial task to rapidly provide reliable information of air quality. This study intends to classify air quality images into, for example, “high pollution”, “moderate pollution”, or “low pollution” categories in areas of interest. In this work, we consider achieving a finer classification of air quality, i.e., more categories like 5-6 categories. To achieve our goal, we propose a hybrid model (CNN-FC) that integrates the convolutional neural network (CNN) and a fully-connected neural network for classifying the concentrations of PM<sub>2.5</sub> and PM<sub>10</sub> as well as the air quality index (AQI). Despite being implemented in many fields, the regression classification has, however, been rarely applied to air pollution problems. The image regression classification is useful to air pollution research, especially when some of the (more sophisticated) air quality detectors are malfunctioning. The hourly air quality datasets collected at Station Linyuan of Kaohsiung City in southern Taiwan form the case study for evaluating the applicability and reliability of the proposed CNN-FC approach. A total of 3549 datasets that contain the images (photos) and monitored data of PM<sub>2.5</sub>, PM<sub>10</sub>, and AQI are used to train and validate the constructed model. The proposed CNN-FC approach is employed to perform image regression classification by extracting important characteristics from images. The results demonstrate that the proposed CNN-FC model can provide a practical and reliable approach to creating an accurate image regression classification. The main breakthrough of this study is the image classification of several pollutants only using a single shallow CNN-FC model.

**Keywords:** PM<sub>2.5</sub> forecast; image classification; Deep learning; Convolutional neural network; Fully-connected neural network; Taiwan