Deep-Learning based X-ray Image Classification for Quarantine Items: a Feasibility Study

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As the time goes by, the number of tourist is on the rise, and the illegal imports of quarantine items are increasing accordingly. Quarantine of imported items is carried out through tourist reports, X-ray searches, and detection dogs, but it is necessary to introduce an X-ray image recognition system for fast and efficient quarantine instead of simple visual monitoring. The purpose of this study is to investigate the applicability of the X-ray image recognition system using deep learning algorithm for various quarantine items. For the applied deep learning model in this study, we used convolutional neural network (CNN), which is most commonly used in image classification problem. Images of 21 different kinds of objects were aquired on Gilardoni FEP ME 640 X-ray scanner. To train the proposed model to fit into reality we scanned the objects into 13 different scan types (e.g., single object in basket, multiple object in carrier). 11,517 raw images were aquired in total, all the images were randomly splitted into train, validation and test sets. The proposed model is trained 125 epochs with decreasing learning rate from 0.0005 to 0.00001. Validation were performed each 5 epochs and obtained the overall accuracy. After training, we tested the trained model with testset and obtained the classification probability and also confusion matrix. One of the object with highest classification probability was dracaena (67.57%) and the object with lowest was tree ear mushroom (8.33%). It was found that the classification probability largely depends on the shape and density of the object. Since the dataset had only about 50 images per object scan type, the proposed model seemed to have struggle with generalizing the different object shapes and its labels. However, the confusion matrix showed a clear difference between each object, and tendency for classifying objects.

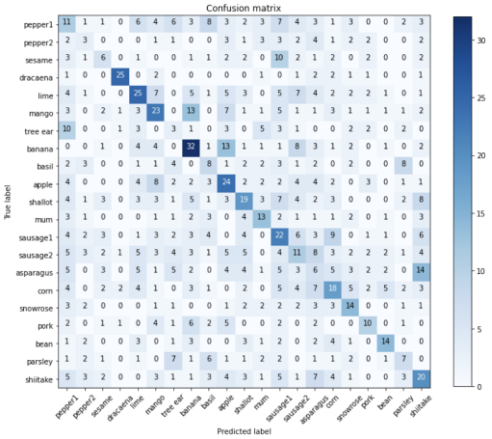

Fig. 1. Confusion matrix from testset of quarantine object.

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