Malaysia is overflowing with waste nowadays. The amount of waste generated last year is about 1.17 kg each day. This figure is doubled compared to the year of 2005, whereas the waste generation is about 0.8kg each day by an individual according to the Solid Waste Management Public Cleansing Corporation (SW Corp). The growing trend of waste will affect the sustainability of the environment and cause pollution. Waste segregation is a process where separate the wastes accordingly into their specific categories. Each waste goes into its category at the point of dumping or collection. Waste segregation is an important step to improve the effectiveness of waste management and recycling. In Malaysia, the recycling rate is low because people lack awareness about waste segregation. Moreover, this process is normally done manually by human hand picking which is less efficient and might endanger human's health. Thus, an intelligent vision system is proposed to improve the efficiency of waste segregation and also the recycling rate in Malaysia.

According to literature review, CNN appeared to be a promising way to develop an intelligent vision system for waste segregation. In this project, a study on the types of household waste generated in Malaysia is conducted. The identified wastes are divided into 6 different classes which are glass, metal, cardboard, plastic, paper, and other wastes. Two different datasets which are the TrashNet dataset and 0528qsw dataset are collected to train the deep learning models that we proposed in the project. Firstly, several famous CNN architectures such as VGG-19 and Inception V3 are proposed and experimented in this project to benchmark with the other state-of-the-arts. The test accuracy of the VGG-19 model is the best among the other methods. The VGG-19 model can score above 91% and 93% respectively in both datasets we used in our project. Although the VGG-19 model has a great performance in waste classification, a VGG-19 model has long run time. This is because a conventional CNN model needs backpropagation learning methods to optimize the weights and biases in each layer. In consideration of implementing the system for real-time application where the computational time is crucial, we have proposed a novel method which is the hybrid CNN-ELM model. The hybrid model aimed to improve the efficiency of the system in real-time application. The Inception V3+ELM model that trained by using 0528qsw dataset can achieve an accuracy of 90%. Throughout the experiment, we can prove that the hybrid InceptionV3 +ELM model has higher computational efficiency compared to the VGG-19 model which trained in the same dataset because there are just 3% of difference in test accuracy between these two models and the computational time of the Inception V3 +ELM model is 720 times faster than the VGG-19 model.

In short, as the volume of waste is increasing gradually and there are urgent needs of methods for environmentally friendly waste processing. An intelligent vision system for household waste segregation is proposed which aims to process the waste and improve the efficiency of recycling process. The proposed system is definitely economically and environmentally beneficial to the global.

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