ABSTRACT

Structural Health Monitoring (SHM) is an important thing to do to prevent a reduce on efficiency, be damaged, or even destruction of an infrastructure such as bridges. SHM using Wireless Sensor Network (WSN) can be a solution to one of the problems experienced by conventional SHM applications, which is expensive. However, the use of WSN has consequences, that is, it requires huge resources. The implementation of a system capable of detecting vehicles based on certain criteria so that WSN will only perform sensing when needed can be a solution to the resource problem experienced. This research offers the use of YOLOv8 as an object detection system capable of detecting objects based on specific criteria. This research applies transfer learning to build a custom trained models that can detect vehicles that have a significant impact on bridge structures. In addition, the study also applied compression models as a method used to streamline models so that they are lighter in terms of size and computing requirements. Based on the tests that have been carried out, the custom trained model that has been built has precision figures of 0.949, recall of 0.952, mAP50 of 0.978, and mAP-50-95 of 0.822. These figures indicate that the application of transfer learning is able to produce models with good performance in performing objects detection tasks especially vehicles that affect the bridge structure. In addition, the application of compression models with quantization and pruning techniques as comparators, is able to streamline the size of the model and computing requirements. Based on the tests that have been carried out, the technique can cut the model size by 50.93%. Whereas pruning with prune-rate 0.7, can cut to 68.44%. In addition to that, the inference time cutting done by the pruning technique with prune-rate 0.7 is also able to cut the computing needs that initially took 213.1ms to do the detection on one image, becoming only takes 67.32ms, which is better when compared to the cutting performed by the quantization technique. However, the decrease in performance experienced by refined models using pruning techniques is more significant when compared to quantization technique. This is showed by a decrease in mAP50-95 to 8.64%, which is greater when compared to the quantization technique, which has experienced a reduction of only 1.46%. Based on these tests, model efficiency using model compression with quantization techniques is able to outperform pruning because it is able to trim the model size well without experiencing a significant decrease in accuracy.

Keywords : Structural Health Monitoring, Object Detection, YOLOv8, Transfer Learning, Model Compression, Quantization, Pruning