ABSTRACT

Automatic Number Plate Recognition (ANPR) systems are applied in many fields such as automatic electronic toll collection, car park management and access control, logistics and vehicle tracking, traffic law enforcement and crime resolution amongst others. Motion blur, plate orientation, lighting changes and image noise severely lower the detection speed and recognition accuracy of these systems. The incorporation of machine learning algorithms in ANPRs has seen Convolutional Neural Network (CNN) being used to develop ANPR models with improved performance in license plate detection. CNNs are best suited for image data where the number of features is large such as license plate detection. This is attributed to their design architecture which enables them to perform feature extraction automatically. However, their speed of execution is slow as the model has to learn a lot of features. Support Vector Machine (SVM) is a supervised machine learning algorithm suitable for classification and regression problems with datasets that have a small number of features. It doesn't scale up well for large datasets with many features. It has demonstrated high speed and accuracy when used for classification in small datasets such as character recognition. The final stage in ANPR is a character recognition phase and involves few features. These two algorithms have been deployed independently, however the concept of combining the two algorithms for ANPR models remains highly unexplored. The research therefore combines the two models (CNN and SVM) to come up with an efficient hybrid ANPR system with improved number plate recognition accuracy. The two models were developed using a deep cascade framework; a CNN with a SoftMax classifier and a hybrid CNN with a SVM classifier. The Universidade Federal do Paraná (UFPR-ALPR) dataset was used to train validate and test the models. Recognition accuracy, precision, recall and F1 score metrics were used to evaluate the model. The hybrid CNN-SVM model had a recognition accuracy of 91.25% against 89.07 % from the pure CNN model. The weighted average precision, recall, and F1-score of the hybrid CNN-SVM was 92%, 91% and 91% respectively, which was better compared to that of pure CNN. The hybrid model was tested for external validity using the Smart Sense Laboratory (SSIG) dataset. The hybrid CNN-SVM model had a recognition accuracy of 91% against 89 % from the pure CNN model. The weighted average precision, recall, and F1 score of the hybrid CNN-SVM was 91%, 91% and 91% respectively which was better compared to that of pure CNN, which had 90%, 89% and 89% respectively.