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SOUND EVENT DETECTION OF WILDLIFE RESERVE INTRUSION DETECTION USING HYBRID CONVOLUTIONAL NEURAL NETWORK AND RANDOM FOREST

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ABSTRACT

The wildlife reserve is a sanctuary for many endangered species with a high value. Therefore, wildlife reserve intrusion by poachers and illegal loggers needs to be stopped before they cause a disturbance. Commonly available security solutions require a high cost to area coverage ratio for the vast forest environment. Implementing modern technology might allow more cost-efficient solutions to this problem. Intruders often emit sounds from their very distinctive forest activities. Sound Event Detection (SED) is expected to be able to assist in the detainment of intruders. This research should act as an extension to increase the performance of wildlife security in Malaysia. To the best of our knowledge, the application of SED in the Malaysian Forest environment for security purposes has not yet been explored. Machine Learning (ML) method for surveillance in forest environments seems viable. The use of Mel-log Energies are sound features formidable for the task and Convolutional Neural Networks (CNN) have shown good performance with SED in urban environments. However, sound events frequency overlapping leads to a high correlation of features between SED classes, leading to a high false positive rate. Hence, this study embarks on research on ML capabilities and sound features methods for SED. The CNN model was tested on first-hand forest environment sound data to measure its true performance. Multiple models including a hybrid CNN - Random Forest (RF) hybrid model were formulated to find the best performance. Several parameters were also used to tune all models to achieve the best outcome. In addition, a post-processing layer was applied to cater false alarms to an acceptable level by using threshold decision making. The research finding showed that SED can detect intruders within 100m radius. It demonstrated that the CNN-RF model outperformed by a small margin compared to other models. It produced up to 0.8215 F1-Score while having a false prediction rate of approximately 10%. The study aimed to help more advanced research for SED application in the forest for wildlife reserve security. Hence, it may lead to improvements in protecting wildlife from danger by providing effective surveillance solutions

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