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Deep learning approaches for prevention of Japanese local monkey trespassing in a sweet potato field

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As human-wildlife conflicts escalate in our area and around Japan, safeguarding crops and farmers from animal intrusions becomes paramount. This research introduces a deep learning approach to prototype a prevention system against monkey trespassing in sweet potato fields. The proposed system was motivated by the idea of developing wildlife identification and assisting local farmers in protecting their sweet potato fields in the autumn of 2022 and 2023.

This research project explores the complexities of utilizing deep learning algorithms to monitor monkey activity in real-time within agricultural settings. We evaluated deep-learning models based on the you-only-look-once (YOLO) algorithm version 4, which can simultaneously classify and localize images to identify local monkeys. Our prototype was designed to detect live monkeys in images from a real-time streaming Protocol (RTSP) Camera and automatically notify farmer group members via the Line application. We successfully installed and tested the system at a sweet potato field in Hakusan, Ishikawa, using four cameras and a solar power system to ensure 24-hour operation from September through November of 2022 and 2023. We collected data from trail cameras installed around the sweet potato fields to train the model and used the deep learning software called CiRA CORE (https://www.cira-ai.com/en).

Furthermore, this research emphasizes the significance of performance analysis and system tuning to optimize the efficacy of the proposed deep learning-based prevention system. A comprehensive evaluation of the system's performance metrics, including detection accuracy, response time, and false positive rates, is conducted. Using the k-fold cross-validation method, we find the skill set of the local model/monkey picture dataset on new pictures and videos. The findings inform the iterative system tuning process, where adjustments are made to improve overall performance and minimize false alarms.

The research emphasizes the need to optimize the deep learning-based prevention system by conducting a comprehensive evaluation of its performance metrics, such as detection accuracy, response time, and false positive rates. The study used the k-fold cross-validation method to determine the system's skill set on new pictures and videos and used the findings to inform the iterative system tuning process. This resulted in adjustments made to improve overall performance and minimize false alarms.

In conclusion, the prototype was successfully trained and operated on a Windows PC with 32 GB RAM, 64-bit Operating System, and Intel(R) Core(TM) i9-9900K CPU@3.60GHz with Nvidia GeForce RTX 3080 10 GB graphics processing unit (GPU). The model demonstrated high performance in terms of classification and accuracy with a real-time streaming camera. The system can provide advance notification to farmers to prevent damage caused by monkeys.

Moreover, This research provides a comprehensive exploration of the application of deep learning in preventing monkey trespassing in sweet potato fields. In this study, we look into the importance of performance analysis and system tuning, and the study offers a holistic perspective on developing and optimizing an effective and practical solution for mitigating human-wildlife conflicts in the local agricultural environment.

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