Pre-Capture Intelligent Trapping System With Multi-Feature Animal Re-Identification

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Trap-Neuter-Return (TNR) is a widely used strategy for managing feral cat populations. However, a major challenge in TNR programs is redundant capture, in which already neutered cats (even with ear-tipping) are unintentionally trapped again. Approximately 1.5 million stray cats entered shelters and at least 18% of captured cats have already been sterilized. As each TNR operation involves costs related to equipment, transportation etc... Redundant trapping is estimated to cause around USD 5.7 million in annual economic losses, while also wasting manpower, reducing trapping efficiency, and increasing animal stress. To address this problem, we propose a Pre-Capture AI Trapping System with Animal Re-Identification. A novel multi-dimensional animal re-identification model is developed by fusing facial features, body features, and geometric priors, enabling robust identity recognition under real-world conditions. The proposed model achieves a Top-1 accuracy of 97.91%, providing reliable identity verification for pre-capture decision-making. We also design a semi-enclosed, den-like trapping system that replaces traditional metal wire traps. The enclosure leverages the natural shelter-seeking behavior of feral cats to reduce entry resistance and alertness. A dual-stimulus luring mechanism, combining a reusable catnip sphere with food dispensing, is incorporated to enhance attraction and increase entry rates. During capture, a low-noise sliding door replaces conventional gravity-triggered mechanisms to minimize acoustic startle responses and reduce acute stress. Visual occlusion further prevents bystander cats from observing the capture event, reducing socially learned trap avoidance within the colony. The proposed system enables humane, efficient, and scalable TNR operations.

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