Long-Range human detection through drones for first responders

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Abstract

Drones are increasingly used by first responders for victim detection, logistics, and emergency response. Previous research by Heemskerk (2024) trained an AI model for human detection in drone footage, but the results showed a high number of false negatives/positives, making the system unreliable in real-world conditions. This study builds on that work by investigating better data, alternative AI models, and improved detection workflows. We aim to enhance AI-driven human localization, supporting first responders in crisis situations.

Introduction

In recent years drone usage for first responders has been increasing, because drone-captured footage can aid in victim detection, optimize logistics, and assist in locating missing persons (e.g.,(Khan & Neustaedter, 2019)). Last year, a student of Utrecht University of Applied Science Utrecht has worked on training an AI-model to automate the proces of detecting humans in the drone images (Heemskerk, 2024).

The results found in the research of Heemskerk (2024) were not outstanding. With a large amout of false negatives in the results could be problematic, as missing persons are an important factor in rescue operations. Therefore the problem statement I propose is:

AI models struggle to detect humans effectively in long-range drone footage.

With this in mind, I propose the following research question:

How can the localization of humans in dronecamera footage be improved in order to further positively impact the decision-making process of first responders?

Literature review

Previous research has focused on short-range human detection, such as CCTV footage (Nguyen et al., 2016), but models often fail in long-range scenarios where humans appear as small objects (Lin et al., 2014). Heemskerk (2024) demonstrated the potential of AI in drone footage but reported high false negatives, limiting its reliability. Techniques like YOLOv8 (Wang et al., 2023) and t-SNE clustering (van der Maaten & Hinton, 2008) combined with ResNet-50 preprocessing (He et al., 2016) offer promising solutions. This study builds on these methods to enhance long-range human detection.

Methodology

To improve human detection, we experiment with different AI models and data. We test various detection strategies to assess their impact on accuracy. Additionally, we will ivestigate to introduce feedback mechanisms to reduce false positives and false negatives, ensuring a more reliable system.

Model performance is evaluated using different validation strategies, such as F1-Score. Furthermore, qualitative feedback from first responders is incorporated to assess practical usability and real-world relevance.

Preliminary Considerations

By optimizing dataset quality, refining AI models, and introducing error-feedback mechanisms, this study aims to significantly improve human localization in drone footage. These improvements could lead to faster emergency response times and better decision-making for first responders.

Conclusion

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