Skripsie Mini-Proposal

Project Title

Unmanned Wildlife Tracking using Drones

Project Aims

The project aims to monitor wildlife areas for various sorts of activities and movement using a drone. This could include tracking and classification of game on large game reserves, farm animals on farms, as well as humans on reserves, such as poachers. Only one of these options would be chosen as the focus of the project due to time constraints, however the success of one of these would, in theory, provide initial proof-of-concept for the others.

The drone will be autonomously flown outdoors, and the land area below it will be monitored using thermal and/or optical cameras. The recorded data will be fed into a real-time processor, which will do on-the-site classification and rough localization of the detected object(s). Ideally, this information would then be wirelessly sent back to a base-station, which could theoretically be used for tourism and wildlife conservation purposes (e.g. an app indicating the location of the animals, or to detect poachers).

Method

To achieve the above goals, the project will be broken down into multiple phases of development:

- Equipment purchasing. It would be ideal to purchase a drone as soon as possible, so that data can be acquired. A Raspberry Pi would also be needed, however this would only be used in the later stages of development.
- Data acquisition. Footage of wildlife and farm areas can be acquired from the internet, and (ideally) manually recorded using the drone. There are several farms in Stellenbosch who I believe would be more than willing to help, as well as private game reserves (one of which I have personal contact with) with enough game for testing.
- Algorithm development. The algorithm to detect and classify the wildlife from the existing data can then be developed offline. Popular computer vision and machine learning libraries such OpenCV and TensorFlow can be utilized (of which I have experience in both).
- Autonomous flight control. The autonomous control of the drone will be relatively simple, as there are many frameworks online which allow easy connection to and control of the drone using code, such as "PX4 Autopilot" and "Clover". The drone will simply follow a path using GPS technology. Optionally, feedback from the cameras can also be utilized.
- System integration. At this stage, the developed algorithms, as well as the drone control software, can be integrated onto the Raspberry Pi and tested.
- Testing. Finally, the drone can be re-flown in similar areas as before, and the algorithm evaluated.
- (Optional) If time allows, a wireless communication link and smartphone application could be setup which allows real-time monitoring of the results.

Equipment

The equipment needed would be:

- A software-controllable drone. Entry-level drones are inexpensive (R500-R1000) but lack features such as a longer battery life. Further research would need to be done as to which features in the drone would be needed. My father does run a company named SmartTech, which specializes in aerial photogrammetry software, and they have expressed interest in investing in a more expensive drone for the project, given that it would be kept by them afterwards.
- A Raspberry Pi. The Pi 4 (upper range) costs around R1400.
- Thermal camera. These begin at around R500. The Adafruit AMG8833 is currently R867.

Evaluation

The algorithm can be tested both offline and offline:

- Offline testing would follow the classic machine learning approach, where the classification algorithm would be tested on unseen data which has been labelled (e.g. by a human) and its total accuracy and recall scores measured.
- Online testing would require knowledge of the location of animals on a plot of land. While this would be more involved, it would be possible to conduct multiple tests at various timeframes, and then to manually review the classifications made by the algorithm.