Project ARDVARK

Autonomous Reconnaissance Drone for Vehicles, Animals and Rangers in Kenya

1 INTRODUCTION

Wildlife populations have been drastically dropping in many regions of the world, with elephant populations declining at an estimated 8% annually [1]. The main causes of this decline has been the unprecedented poaching for the illegal ivory trade as well as the loss of natural habitat, resulting in human-elephant conflict. The poaching epidemic extends to numerous other species. Rhinos are particularly affected and considered critically endangered. Some sub-species, such as the Northern White Rhino have reached the brink of extinction, with the last male passing away in March 2018. Giraffe populations have also plummeted by 40% in the last three decades to less than 100,000 remaining with three of the nine subspecies listed as either endangered or critically endangered. [2]

Accurate and reliable census and tracking of these animal populations are vital tools in the fight against poaching and wildlife loss as they provide valuable information to the national wildlife agencies and numerous charities fighting to prevent these species from slipping away into extinction. However, population estimates often vary due to the reliability of survey techniques used. Many are ground based systems whilst other rely on aerial spotting of the animals from light aircraft. This can be a hugely expensive endeavour and is a major hinderance to reliable and effective surveying of animal populations. What is proposed from Project ARDVARK is a cheap and accurate method of animal tracking and census taking via aerial footage. This will be achieved using an autonomous, fixed wing, unmanned aerial vehicle (UAV). The UAV will be fitted with a HD camera to be used in conjunction with a neural network trained to recognise and classify various large animal species. It will be capable of patrolling large distances within national parks and private game reserves and providing up-to-date information on the location and size of many of these endangered animal herds.

An additional feature would also be the detection of vehicles and people, which would allow for early warning systems of potential poachers. The UAV would be capable of providing a much larger coverage of surveillance for poaching activities than traditional ground-based patrols at a fraction of the cost. This added recon capability would allow for a faster response of rangers to prevent the killing of animals as the UAV would be capable of providing exact GPS co-ordinates and aerial footage of both the potential poachers as well as any nearby herds of elephants which might be potential targets of illegal poaching. Thermal imaging would also allow for recon flights to be undertaken at night, when the majority of poaching activity is performed.

There are numerous challenges that will be faced in the design and implementation of such a UAV. Harsh weather, massive distances and low budgets are all barriers that will need to be accounted for. To address these issues, the design of the UAV will need to be focussed on the following aspects: reliability, ease-of-use, durability and cost. The final aim will be a cost-effective means of animal tracking and a vital tool in the fight against poaching.

[1] IUCN International Union for Conservation of Nature, “African Elephant Database | IUCN.” [Online]. Available. [Accessed: 15-Jul-2019].

[2] Born Free Foundation, “GIRAFFE SUBSPECIES LISTED AS CRITICALLY ENDANGERED.” [Online]. Available. [Accessed: 15-Jul-2019].

2 PROJECT STRUCTURE

There are clearly numerous aspects of the project that will require dedicated teams and expertise to achieve. The main division of the project is between the design of the UAV (hardware and autonomous flight control) and the computer vision aspect. There are evident links between the requirements of the two projects such as weight of payload for the camera hardware and altitude control for optimal detection, but the two can still be considered separate projects with both being an important step towards the overall project. To aid in project proposal, potential objectives and key requirements for each division are listed below.

2.1 UAV DESIGN

Objective:

Design of a fixed wing UAV to be used as a long-range reconnaissance drone, fitted with a stabilised, high resolution camera. Suited to a group of students as a design challenge or large coursework.

Key Requirements:

- Autonomous flight capabilities.
- Range >20 Km
- Durable materials for harsh weather flight.
- Cost effective components.

2.2 OBJECT DETECTION

Objective:

Implement a deep-neural network algorithm for real-time detection of various species of animals from aerial photography. Suitable to an individual Master's Project.

Key Requirements:

- Detect at minimum the following objects:
    - Vehicles
    - Humans
    - Elephants
    - Giraffes
    - Rhino
- Store GPS location and relevant image of each detected entity for later analysis.
- Optional feature would be to differentiate between individuals based on size, significant markings, tusk size etc.
- Optional feature to rely key information such as potential poaching activity over mobile network or other means.