Problem Definition

Senior Design I

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Problem Definition

Introduction:

Wildlife monitoring is an essential tool in the arsenal of ecologists and biologists around the world. It is very useful for learning more about wild animals by keeping track of their movement patterns, habitat and demographics.

Current animal tracking method involves a collar with an RF (radio frequency) transmitter that is put on the animal and a RF receiver. In conjunction with a H-directional antenna the direction the signal is coming from can be captured and the location coordinates of the animal can be deduced. However very economical, this method suffers from limited signal detection range of about 2 km (1.25 miles) on the ground, which is crucial in wildlife habitats that may cover thousands of square miles. This range can be greatly increased by the use of a conventional aircraft, however it is very expensive and not always easy to coordinate.

This project builds upon discussed methods and introduces a middle ground between price and detection range. It involves using a drone, with attached radio equipment, as a link between the tracked animal and the researcher on the ground. Scott Creel from the ecology department of MSU has a prototype system discussed above; however it does not work as intended.

The goal of this project is to remove the design flaws that are preventing proper operation and to design a new system that will build upon the current design to meet the needs of the client.

Needs Description:

The purpose of this project is to find a solution to eliminate interference of information gathered by a directional antenna picking up VHF signals sent to the ground by a 5.8 GHz link, as well as to create a system that can receive VHF signals under typical field conditions from a range altitudes of at 300-3000 feet.

The Product is comprised of a remote-controlled quad-copter drone capable of carrying a VHF (very high frequency) receiver, directional antenna, GoPro camera, and a 5.8 GHz transmitter. The antenna is intended to pick up a VHF transmitter attached to a collar of a wild animal. The collar consists of an omni-directional transmitting antenna that relays a VHF “beep” on a specific frequency every 1.2 seconds when the animal is moving, and every 2 seconds when the animal is still. The intended purpose of this product is to be able to hover to at altitude to gain a bearing and direction of a collared animal through the signal gained on the directional antenna. The increase in altitude results in the VHF receiver’s ability to pick up the transmitting collar from farther away than if the receiver was on the ground. The transmitter is able to relay the audio and video signal recorded by the quad-copter to the ground on a 5.8 GHz relay that is commercially available. Generally, this information is gathered on a conventional aircraft that is expensive to rent, whereas the quad-copter is inexpensive to fly and also obtains similar information.

It is essential for this information to be gathered through VHF, because of cost-effectiveness. There is collar that uses GPS (ground positioning system), however they cost thousands of dollars and have a shorter operation life and have been used for more specific information regarding an animal’s behavior. If information is required on a much broader scale where numerous collars are needed, it is more cost effective to relay the information through VHF frequencies.

This product has not been achieved or used commercially because of undiscovered sources of interference which causes the signal from the antenna to be degraded. It is suspected by the client that the source of interference is a result of the quad-copters' GPS assisted flight stabilization system. This system is used to keep the quad-copter in the user's intended position through unpredictable conditions (i.e., a gust of wind). This theory was derived from previous testing done on the quad-copter system. The client has stated that the system has no interference when the quad-copter is at rest however when the quad-copters' GPS assisted flight stabilization system begins to operate, the interference initiates. The project's main concern is eliminating this interference.

Stakeholder List:

Ecologists, biologists, researchers and people that are generally interested in wildlife would benefit from this project. Increasing the tracking range can potentially save countless hours of driving through the wilderness, gas, personnel money and improved efficiency of collecting data. This will allow researchers to focus more on data analysis instead of data collection.

In particular the success of this project will benefit our client, Scott Creel, and the Montana State University Ecology Department. The design would immediately be put into use by the Ecology Department on various projects.

Project Goals:

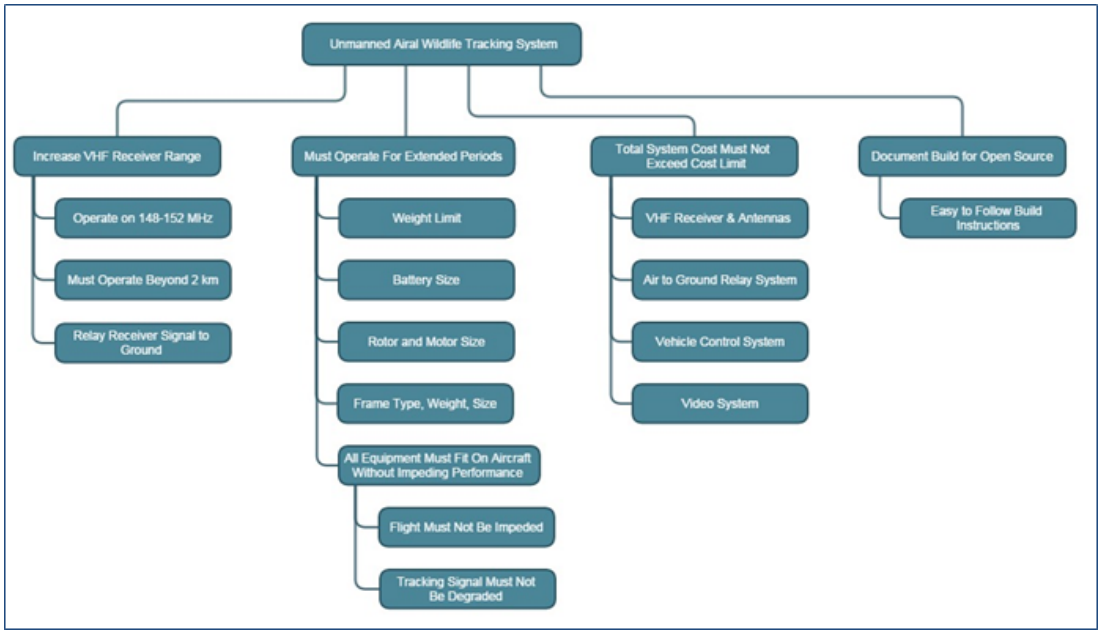

Figure 1.1: Objective tree which demonstrates the functional requirements of the project.

Project Constraints:

- **Must Operate in a VHF frequency Bandwidth**
    - Ideally, the design will use the same VHF frequencies as are currently in use (148-152 MHz)
- **Must Minimize Power Consumption for Sustained Flight**
    - Power for the design must be provided with battery(s) mounted on the quad-copter
- **Must Minimize Weight**
    - Any weight must be within the limits of the quad-copter's loading capacity
- **Must Contain Entire System on a Small Platform**
    - All components must be small enough to fit on the quad-copter
- **Must Remain Within Designated Budget**
    - The price of the project must be approved/within the budget of the Ecology Department

- **Work in Conjunction with Existing Collars Parameters**
    - Design must ultimately work with the existing collars already in use
- **Documentation For Open Source Community**
    - System must have documentation that can be easily understood by an audience of non-technical personal which outlines build and operation instructions