Autonomous Small UAV Project Proposal

1 Introduction

The recent proliferation of the unmanned aerial vehicle (UAV) makes a strong argument for the usefulness of aerial surveillance. This project explores the use of available motion and location sensors to develop an automated control system for an existing aerial platform in order to conduct surveillance without the need of a human operator.

2 Problem Description

Existing UAV technology has a high cost barrier to entry and requires constant supervision for control. The Raven system currently employed by many U.S. Army field units costs around $200,000 for the airframe alone, and needs a remote operator. A more practical approach would involve uploading a pre-defined mission track to an autopilot and having the UAV fly it autonomously, allowing the operator to focus only on gathering the required intelligence, rather than on flying the aircraft to and from the target area. Additionally, we wish to demonstrate that such a system could be produced at a much lower cost.

3 Proposed Solution

We will use an existing remote control aircraft to provide the aerial surveillance platform. An inexpensive GPS receiver, such as the kind found in most modern cell phones, as well as accelerometers may be used as sensors to guide a microcontroller-driven autopilot to fly the aircraft on a predetermined track. This aircraft will carry a CCD camera and wireless transmitter to send the surveillance data back to the user in real time.

4 Demonstrated Features

The proposed UAV will be capable of receiving a set of GPS waypoints prior to flight. It will be launched by hand, and once airborne, aircraft control will be handed over to the autopilot remotely. The autopilot will fly to the desired waypoints at a specified altitude, and be capable of loitering over a specified area. The on-board camera will wireless transmit surveillance data back to the operator. After a certain time, the UAV will return to the launch location to be recovered either by manual control, or through a failsafe system, such as setting a specified flight attitude, or by using a parachute.

5 Available Technologies

The following is a list of specific technologies that will provide the functions required in this project:

- Hobbyking Bixler EPO ARF Aircraft Kit - $70
- Turnigy 9 Channel Radio - $40
- 12 Channel 900Mhz Tx/Rx video system with CCD camera - $57
- 3 Axis Accelerometer - $25
- GPS module - $40
- Microcontroller board - $50

This is a total of $282. This project could be further expanded by purchasing solar cells to extend the endurance of the aircraft, which are available specifically for this application for around $30.

6 Engineering Content

This project deals mainly with being able to interface the UAV with a microcontroller. The microcontroller will accept information from an accelerometer and GPS module and determine how to fly the aircraft. We will have to develop an autopilot system which will allow the microcontroller to determine which servo motors to turn off and on in order to fly the plane to the desired location.

The engineering content required to get these systems to work is sufficiently challenging. In order for us to safely test this autopilot system, we will need to develop a method of being able to switch to manual controls in flight just in case there is a software issue. One fail safe method that will be implemented in case the plane completely fails to respond is a parachute that will be deployed to safely land the UAV. In addition to the various sensors, the plane will have an onboard camera, making it capable of recording video and photographic surveillance. This data can either be sent wirelessly or downloaded from the plane on retrieval. Due to the increased weight of the payload, and the additional power consumption, we will have to work with very tight weight and power constraints. We can expand the engineering content in this project by adding a solar or fuel cell to extend the flight time of this UAV to increase flight time by providing solar energy. Over all, most of the engineering content will fall under control theory and power generation.

7 Conclusions

This project expands the usefulness of UAV technology by making it more automated and lowering the cost barrier. It will require a high degree of planning in order to ensure the weight and power limitations are met. It includes a high degree of electrical engineering content, and allows our team to put to use the skills we have acquired during our time as undergraduate students. Because of these things, we believe this will be an excellent capstone design project.