Building an Agricultural UAV System for Aerial Field Surveys

AGCO
Your Agriculture Company

The Problem

Currently, farmers with large farms tend to spray the entire field when problems arise. Blanket spraying of chemicals (including pesticides and fertilizers) is expensive, increases pesticide resistance, and harms the environment through run-off.

An Opportunity—Commercial UAVs

The FAA has indicated plans to allow commercial use of UAVs beginning September 30, 2015. Agriculture is a prime potential application, and AGCO would like to be prepared to take advantage of such an opportunity.

Our Goals

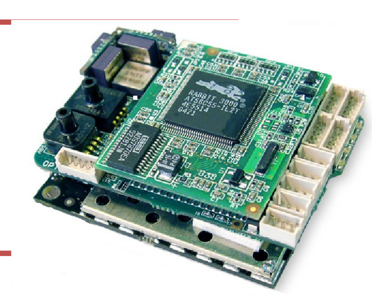
As a part of the AGCO R&D team, the AGCO SCOPE team had 5 main goals:

- Explore potential uses for an agricultural UAV and develop a compelling use model
- Design a preliminary system architecture
- Create a demonstration prototype, documenting the process for AGCO's future use
- Evaluate the potential financial benefits to farmers to determine whether a commercial agricultural UAV is a worthwhile pursuit for AGCO
- Identify problems that must be solved in order to create a fully functional, commercial product

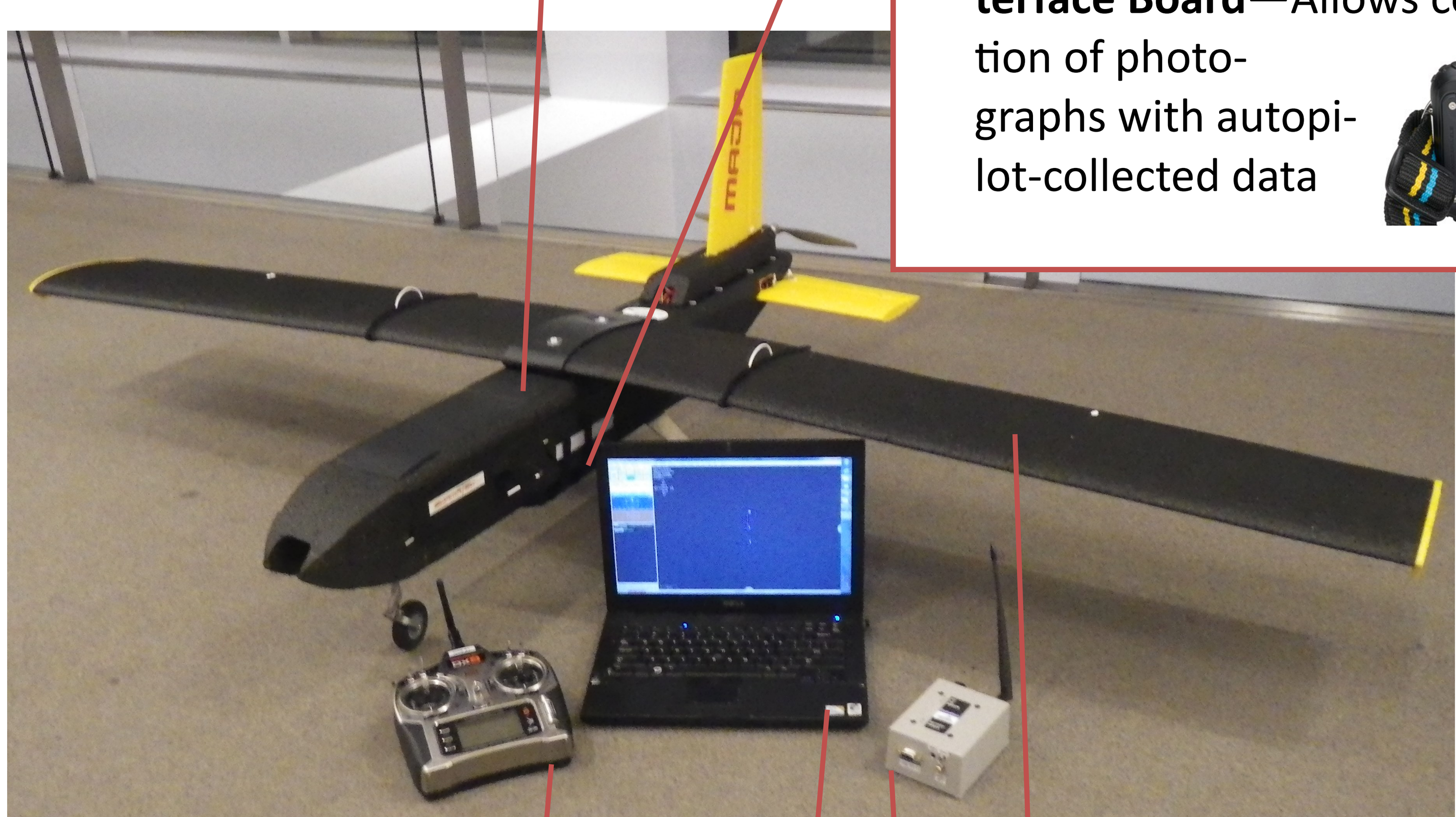
System Overview

Hardware

Kestrel Autopilot—Navigates autonomously to waypoints and capable of autonomous takeoff and landing



Pentax Camera + Autopilot Interface Board—Allows correlation of photographs with autopilot-collected data



RC Controller—For manual flight control

Laptop—Virtual Cockpit software for mission planning and monitoring

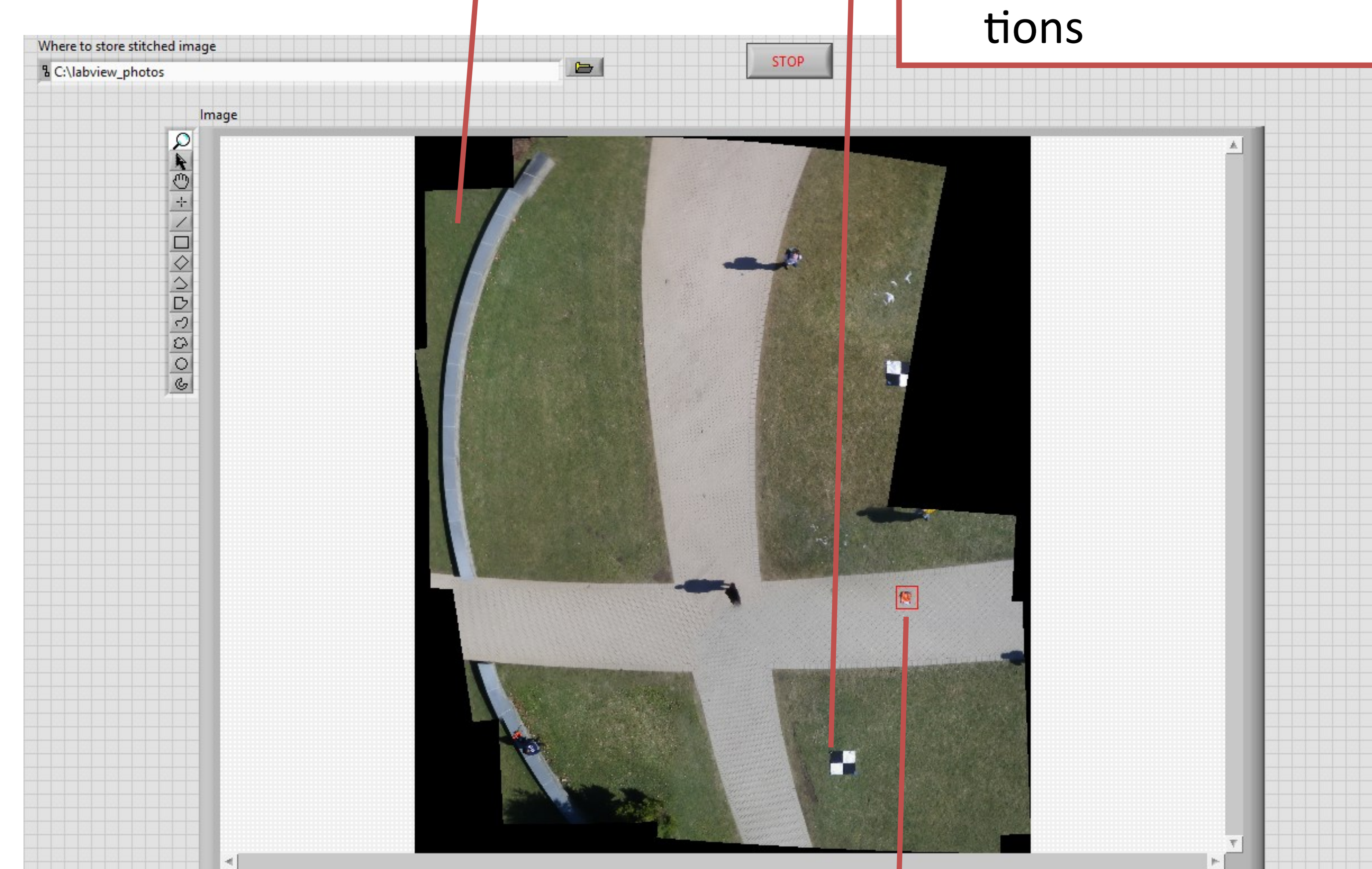
Commbox—On-the-ground hardware for communication with the autopilot

MAJA Fixed-Wing Plane—Chosen for durability, payload space, and long battery life

Software

Image Stitching—Creates a single map of the aerial images taken by the UAV

User Placed Fiducials—Creates a coordinate system for the field based on known locations



Feature Detection—Outlines and returns contour coordinates for markers representing problem spots

Demo

The user interaction with the system in described below:

1. The flyover area is defined in advance.
2. The user launches Virtual Cockpit software, arms the plane's motor, and manually takes off.
3. Plane takes overlapping images of the field, time-stamps them, and stores them on the SD card in the camera. The autopilot also sends time-stamped altitude, orientation, and GPS data back to the ground station.
4. Vital indicators (battery life and signal strength) are displayed to the user during flight.
5. At the end of the mission, the plane returns to a "home" point.
6. The user inserts the SD card into the laptop and launches the post-flight application.
7. The application stitches the collected images into a map and displays GPS coordinates of problem areas (markers).

Future Work

- Sensors and software to identify problems with crops
- Increased automation (i.e. takeoff and landing)
- More rigorous software testing with a multitude of data collected from a plane
- Integration of this system with a sprayer

SCOPE
Senior Capstone Program in Engineering

SCOPE 2012—2013
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