Air Mail

Project Number: 234
Semester: Spring 2015

- **Advisor:** Bryan Jones - bjones@ece.msstate.edu
- **Team Leader:** James Tate - jct322@msstate.edu
- **Team Members:**
  - Boddrick Hudson - bh392@msstate.edu
  - Tyler Hannis - tjh153@msstate.edu
  - Josh Dowdy - jld563@msstate.edu

Project Keywords:

UAV

The purpose of the following worksheet is to document the EE/CPE Design project, design team, and faculty mentor, prior to beginning the course.

1. High-level project description (problem solved by design and functionality).

This Project will consist of a UAV multicopter that will have the ability to deliver a 450 gram package up to one mile from its home base.

2. A brief discussion of relevant technical background material on which the project is based (identify at least 3 published references).

[1] "Microelectronic Circuits" Sedra/Smith. New York, NY: Oxford Press. 2010
--Some of the electronics will need a specific voltage and amperage to operate correctly. A PCB will need to be designed for power distribution.

[2] "Microcontrollers From Assembly Language to C using the PIC24 Family" Reese/Bruce/Jones Cengage. 2014
--The flight controller we will use is has a microcontroller capable of communication via I2C, SPI, and Serial interfaces to peripherals. This reference will be used when programming peripherals to communicate with the flight controller.

[3] "Embedded Linux" 2014.
Available: http://elinux.org/Main_Page
--The UAV will have an on board image processing unit. This will be used to to aid in programming the unit.

[4] "AruduCopter wiki" 2014
Available: http://copter.ardupilot.com/wiki/table-of-contents/
--The Flight controller has an open source community. This reference will aid in setting up and programming the flight controller.

3. Projects are evaluated, in part, on the inclusion of a number of the following "real-world" concerns. Provide preliminary comments on how these issues relate to your

design.

Economic:

The control systems will can be adapted to different UAV systems for customer specific needs. This can increase weight the UAV can carry and the distance and speed at which the UAV can travel.

Preliminary build budget: $1200
Parts will include everything needed to implement the UAV, video processing system, and payload delivery system.

Environmental:

The LiPo battery('s) that will be used the power the UAV will need to be disposed of correctly once its life has ended.

Sustainability:

Since the system will be electrical powered, the battery will need to be recharged before flight missions can begin. Also, a preflight check will need to be performed before each flight to reduce the chances of failure of the mission.

Manufacturability:

The UAV design will be adaptable. The implementation of this model will be a small scale version. The design itself could be adapted to a larger(or smaller) UAV in order to carry out similar missions.

A majority of the parts will be off the shelf parts which will be assembled by hand.

Ethical:

Recent events have some people paranoid about UAV surveillance. This UAV "though equipped with a camera" will not perform any type of surveillance.

The IEEE code of Ethics will also need to be followed.

Health and Safety:

The UAV is a flying object, which has the potential to fail in flight. Precautions will need to be taken before each flight to ensure it cannot harm anyone in case of failure.

Due to current FAA regulations two pilots will need to be one-half the distance between the home base and the delivery point, and will need to maintain a constant line of sight with the UAV. Either of the pilots will be able to take full control of the UAV's predetermined flight if the UAV does not perform the correct actions. Private land that meets FAA regulations has been secured for testing.

Social:

A delivery UAV could potentially replace the need for a delivery person for tasks such as food delivery. However, building the UAV and maintaining it will need to be done someone who is trained to do so which could create more jobs. It could give bushiness's an opportunity to deliver products to customers homes. An example would be a local Pharmacy would be able to offer a delivery service to a customers home.

Political:

Currently the FAA has restrictions on commercial UAV operations. If a company wanted to use an automated UAV delivery system it would require them to request a waiver from the FAA. With the advancement in UAV technology over recent years many believe in the near future commercial UAV operations will become more prevalent, this forcing the FAA to allow more commercial operations.

4. More detailed description of hardware and software design components (both hardware and software design are required for CPE students and both are strongly encouraged for EE students).

Specifications:
Software - The software that operates the UAV will be designed in two sections. An off the shelf autopilot system will be used and programmed so a user can enter GPS coordinates from a computer that will guide the UAV in flight. The system will also need to have a function for manual takeover and piloting of the UAV if needed. The second section will consist of image processing. Once the UAV is in close proximity of the entered coordinates it needs to be able to make a decision to find a suitable landing location. If a location is found it should land and deliver the payload. If a location is not found it should return to the home base.

Hardware - The UAV will need to be able to make a 15 minute flight time to give sufficient time to fly to the location, land, deliver, and return home. A Linux board will communicate with a server and be used for the image processing. This will be accomplished by using a camera connected to the Linux board. The Linux board will make use of an wireless link to communicate with the server. The delivery system will be custom fabricated by using a servo motor connected to the Linux board.

Constraints:
-A redundancy takeover system with the ability either one of two pilots to take full control of the UAV during flight. One will be over a 915 MHz telemetry link, the other through a 2.4 Ghz transmitter/receiver.
-15 minute flight time.
-The UAV must be able to perform a stable flight with less than 60% throttle when a 450 gram payload is attached, in addition to the onboard systems.
-Ability to make a decision to land and deliver the payload.
-Ability to deliver the payload up to one mile from home base.

"Due to FAA regulations maximum delivery distance will need to be lab tested by calculating 80% flight speed and maximum battery life. Field tests will be conducted on private land at a 500 meter range so the pilot will have constant eye contact with the UAV."

5. Vision for participation in project by team members.

Research: ALL
Website: James, Josh
PCB Design: ALL
Hardware Design: ALL
Hardware Assemble: Boddrick, Tyler
Flight Programming: Boddrick, Josh
Delivery Programming: Josh, James
Documentation: ALL

All team members will have some level of input on every aspect of the design. A group discussion will take place before and after ever step in the build process.

6. Preliminary schedule of what you are planning to do and discussion of feasibility.

January: Research, order parts, start programming.
Some research has been done to find out the feasibility of the project. Research into which parts will be best to accomplish the goal will need to be done. Once parts are ordered programming can begin while waiting on the parts.

February: Assemble UAV, finish programming.
As the parts arrive assembling them to ensure they fit correctly in the case that anything will need to be replaced will be essential. Programming the basic functions just to get the UAV off the ground is projected to take approximately two weeks. Once the UAV is flying in manual mode, programming on the image processing system can begin.

March: Begin system testing, perform maiden flight.
After all programming has been done lab test to confirm all the systems are communicating correctly can begin. Once this has been done a field test can be done.

April: Continue testing and debugging.
Depending on test that will be done up to this point, the team can look at correcting anything that is not behaving properly during the test, or improving how the system works.

May: Deliver Prototype.
Delivering the prototype will give the team a chance to get outside opinions on how we can improve the UAV.

Everyone on the team is enthusiastic about the project. The team members all have interest in UAV's and are looking forward to getting to work. The team has a good amount of experience in programming so getting the UAV to do what we need should be very feasible. The biggest challenge of the project will be making sure the onboard systems are light enough so the UAV can fly with the weight of the package.