



UNIVERSITY OF IDAHO

CS 270

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# Capstone Portfolio

## Drone Mission Planning Software

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*Team:*  
Mission Control

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*Advisors:*  
Dr. Bruce BOLDEN  
Dr. Robert RINKER

*Customer:*  
Brandon ORTIZ

October 12, 2014

## Contents

<b>1</b>	<b>Team Member Contact Information</b>	<b>1</b>
<b>2</b>	<b>Introduction</b>	<b>1</b>
2.1	Target Priorities . . . . .	1
<b>3</b>	<b>Initial Client Interview Transcript 9/10/14</b>	<b>2</b>
3.1	Meetings . . . . .	2
3.2	End Goal . . . . .	2
3.3	First Steps . . . . .	2
3.4	Requirements . . . . .	2
3.5	Other Notes . . . . .	2
<b>4</b>	<b>Meeting Agendas</b>	<b>3</b>
4.1	Sept. 10, 2014 . . . . .	3
4.1.1	short . . . . .	3
4.2	Sept. 18, 2014 . . . . .	3
4.2.1	short . . . . .	4
4.3	Sept. 25, 2014 . . . . .	4
4.3.1	short . . . . .	5
4.4	Oct. 2, 2014 . . . . .	6
4.4.1	short . . . . .	6
4.5	Oct. 9, 2014 . . . . .	7
4.5.1	short . . . . .	7
	<b>Appendices</b>	<b>9</b>
<b>A</b>	<b>Miscellaneous UML Charts</b>	<b>9</b>
<b>B</b>	<b>ATMEL<sup>©</sup> Microcontrollers</b>	<b>10</b>
<b>C</b>	<b>Technical Drawings</b>	<b>12</b>

## List of Figures

1	Communication Sequence . . . . .	9
2	ATmega644 . . . . .	10
3	ATmega2560 . . . . .	11
4	Electronic speed controller part bin . . . . .	12

List of Tables

1	Team Member Contact Information . . . . .	1
2	Priorities . . . . .	1

## 1 Team Member Contact Information

Name	Phone Number	Email Address
David Klingenberg	(208) 310-9657	bigwookiee@Gmail.com
Taylor Trabun	(509) 995-0904	trab1744@vandals.uidaho.edu

Table 1: Team Member Contact Information

## 2 Introduction

Software to create and upload a flight plan to a quad copter drone. The flight plan will be uploaded using xBee radio communication.

This project will use off-the-shelf parts. ATMEL<sup>©</sup> based microcontrollers found on arduino based open source boards is the current preference.

### 2.1 Target Priorities

Number	Category	Need	Importance
1	Quadcopter	Center of Gravity Refined	5
2	Quadcopter	Reliable Flight	5
3	Quadcopter	Functioning xBee Hardware	4
4	Quadcopter	Hardware (Microcontroller) with xAPI and services to control flight	5
5	Quadcopter	Controlled with XP communications	4
6	Quadcopter	Autoland	5
7	Software	software package for flight planning	2
8	Software	API for sending commands from computer	2

Table 2: Priorities

## 3 Initial Client Interview Transcript 9/10/14

**Mentor/Client:** Brandon Ortiz

### 3.1 Meetings

We will be having weekly meetings in Brandon's office on Thursdays at 3:30 PM. These meeting will include status updates, further work on designs, troubleshooting, and assignment of tasks

### 3.2 End Goal

To have a stable and flying quadcopter that can be communicated with remotely. In addition, work done on a flight planning software (including GUI) should be underway. The project will be done in small steps, as this project requires research and development throughout.

### 3.3 First Steps

- Learn how quadcopter works
- Reconstruct quadcopter to be stable
- Learn how to fly quadcopter
- Understand flight computer documentation
- Design communications
- Be sure to use xAPI

### 3.4 Requirements

- Functional quadcopter (stable)
- Documentation of quadcopter construction
- Use of xAPI on arduino communication system
- Communication system using xBEE to communicate from computer to quadcopter
- Ability to send commands to quadcopter
- Flight planning software, including GUI

### 3.5 Other Notes

Other notes from the meeting included aviation terminology, how to pair the remote control and quadcopter receiver, quick tour of controller and motor adjustments, and a quick tour of flight computer.

## 4 Meeting Agendas

4.1 Sept. 10, 2014

### Mission Control Team Agenda

**Friday September 10, 2014.**  
**1500 — 1600 in JEB Think Tank.**

#### Type of Meeting

Initial client interview.

#### Attendees

David Klingenberg

Taylor Trabun

Brandon Ortiz

#### Topics

Topic	Responsible	Time (in minutes)
Product Overview	Brandon	15
System Requirements	Brandon	15
Tasks Breakdown	Open Discussion	15
Question & Answers	Open Discussion	25

**Additional Information:** This is our initial client interview.

#### 4.1.1 Minutes from Friday September 10 Meeting

Refer to [Section 3](#) initial client transcript.

4.2 Sept. 18, 2014

### Mission Control Team Agenda

**Thursday September 18, 2014.**  
**1500 — 1600 in JEB Think Tank.**

### **Type of Meeting**

Initial Planning

### **Attendees**

David Klingenberg

Taylor Trabun

Brandon Ortiz

Bruce Bolden

### **Topics**

<b>Topic</b>	<b>Responsible</b>	<b>Time (in minutes)</b>
Progress Report	David, Tyler	5
System Overview	Brandon	10
Tasks Breakdown	Open Discussion	20
Additional Words of Wisdom	Bruce	5
Question & Answers	Open Discussion	20

### **Additional Information:**

The rerouting and reconfiguring of the drone is proceeding nicely. It progress will be shown at the meeting time.

#### **4.2.1 Minutes from Thursday September 18 Meeting**

- 1505 Meeting Started
- Discussed drone rebuild progress.
- Evaluated ESC bin for the drone.
  - Refer to [figur 4](#) in Appendix [C](#)
- Discussed, evaluated, and illustrated the communication sequence.
  - Refer to [figur 1](#) in Appendix [A](#)
- 1610 Meeting

#### **4.3 Sept. 25, 2014**

## **Mission Control Team Agenda**

**Thrusday September 25, 2014.  
1530 — 1630 in JEB 37**

### **Type of Meeting**

Status Report and Next Week Planning

### **Attendees**

David Klingenberg

Taylor Trabun

Brandon Ortiz

### **Topics**

<b>Topic</b>	<b>Responsible</b>	<b>Time (in minutes)</b>
Progress Report	David & Tyler	10
Demonstrations	David & Tyler	10
New Tasks	Open Discussion	20
Question & Answers	Open Discussion	20

### **Additional Information:**

#### **4.3.1 Minutes from Thursday September 25 Meeting**

- 1530 Meeting Start
- Discussed LCD use on Arduinos.
- Reviewed TUN packets.
- Status updates
  - Things moving along.
  - Getting closer to flying possibly next Thursday.
- xBee discussion on how to connect.
- Evaluated future problems.
  - Gyros and accelerometers need to be implemented separately from the flight computer.
- 1630 Meeting Ended



4.4 Oct. 2, 2014

## Mission Control Team Agenda

**Thursday October 2, 2014.  
1530 — 1630 in JEB 37**

### **Type of Meeting**

Status Report and Next Week Planning

### **Attendees**

David Klingenberg

Taylor Trabun

Brandon Ortiz

### **Topics**

<b>Topic</b>	<b>Responsible</b>	<b>Time (in minutes)</b>
Progress Report	David & Tyler	10
Demonstrations	David & Tyler	10
New Tasks	Open Discussion	20
Question & Answers	Open Discussion	20

### **Additional Information:**

#### **4.4.1 Minutes from Thursday October 2 Meeting**

- 1530 Meeting Start
- Status updates.
  - Taylor has one-way communications working.
  - David finished a prototype for the ECS bin.
    - \* Bin needs its weight reduced.
    - \* ECS cables need to be lengthened.
- To
  - Taylor will attempt to get XP comm working.
  - David will finish quadcopter.
  - Get a new adrenal for running a second xBee radio.
  - Solder new LCD board.

- xBee Configuration notes.
  - Use XCTU tool for configuration.
  - Need FID drivers installed for XCTU tool.
- 1630 Meeting Ended

4.5 Oct. 9, 2014

## Mission Control Team Agenda

**Thursday October 9, 2014.**  
**1530 — 1630 in JEB 37**

### Type of Meeting

Status Report and Next Week Planning

### Attendees

David Klingenberg  
 Taylor Trabun  
 Brandon Ortiz

### Topics

Topic	Responsible	Time (in minutes)
Progress Report	David & Tyler	10
Demonstrations	David & Tyler	10
New Tasks	Open Discussion	20
Question & Answers	Open Discussion	20

### Additional Information:

#### 4.5.1 Minutes from Thursday October 9 Meeting

- 1530 Meeting Start
- Update
  - Taylor is preparing for snapshot day.
  - David
    - \* Quadcopter rebuilt.
    - \* Simple xBee terminals working between two computers.

- New Resources
  - UAV control paper with GUI design example.
  - Survey of UAV papers.
- Action Items
  - David will experiment with PWM and the quadcopter and portfolio.
  - Taylor will work on poster for snapshot day and continue working on communications.
- Test Flight
  - Quadcopter has severe drift forward. David will work on solution.
- 1630 Meeting Ended

# Appendices

## A Miscellaneous UML Charts

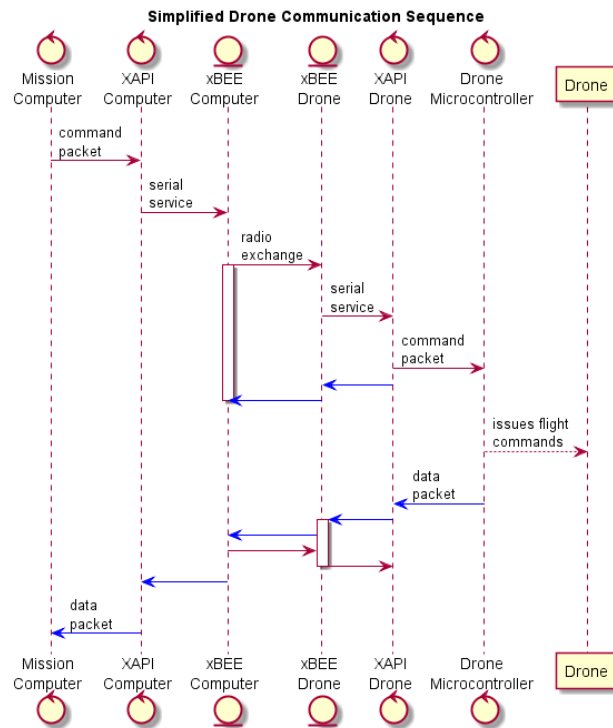


Figure 1: Communication Sequence

## B ATMEL<sup>®</sup> Microcontrollers

### Features

- High-performance, Low-power Atmel<sup>®</sup> AVR<sup>®</sup> 8-bit Microcontroller
- Advanced RISC Architecture
  - 131 Powerful Instructions – Most Single-clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 20 MIPS Throughput at 20MHz
- High Endurance Non-volatile Memory segments
  - 64 Kbytes of In-System Self-programmable Flash program memory
  - 2 Kbytes EEPROM
  - 4 Kbytes Internal SRAM
  - Write/Erase cycles: 10,000 Flash/100,000 EEPROM<sup>(1)(3)</sup>
  - Data retention: 20 years at 85°C/100 years at 25°C<sup>(2)(3)</sup>
  - Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by On-chip Boot Program
    - True Read-While-Write Operation
  - Programming Lock for Software Security
- JTAG (IEEE std. 1149.1 Compliant) Interface
  - Boundary-scan Capabilities According to the JTAG Standard
  - Extensive On-chip Debug Support
  - Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescalers and Compare Modes
  - One 16-bit Timer/Counter with Separate Prescaler, Compare Mode, and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Six PWM Channels
  - 8-channel, 10-bit ADC
    - Differential mode with selectable gain at 1x, 10x or 200x
  - Byte-oriented Two-wire Serial Interface
  - One Programmable Serial USART
  - Master/Slave SPI Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated RC Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby and Extended Standby
- I/O and Packages
  - 32 Programmable I/O Lines
  - 40-pin PDIP, 44-lead TQFP, and 44-pad QFN/MLF
- Speed Grades
  - ATmega644V: 0 - 4MHz @ 1.8V - 5.5V, 0 - 10MHz @ 2.7V - 5.5V
  - ATmega644: 0 - 10MHz @ 2.7V - 5.5V, 0 - 20MHz @ 4.5V - 5.5V
- Power Consumption at 1MHz, 3V, 25°C
  - Active: 240µA @ 1.8V, 1MHz
  - Power-down Mode: 0.1µA @ 1.8V

Notes: 1. Worst case temperature. Guaranteed after last write cycle.  
2. Failure rate less than 1 ppm.  
3. Characterized through accelerated tests.



**8-bit Atmel  
Microcontroller  
with 64K Bytes  
In-System  
Programmable  
Flash**

**ATmega644/V**

2593O-AVR-02/12



Figure 2: ATmega644



## Atmel ATmega640/V-1280/V-1281/V-2560/V-2561/V

8-bit Atmel Microcontroller with 16/32/64KB In-System Programmable Flash

### DATASHEET

#### Features

- High Performance, Low Power Atmel® AVR® 8-Bit Microcontroller
- Advanced RISC Architecture
  - 135 Powerful Instructions – Most Single Clock Cycle Execution
  - 32 x 8 General Purpose Working Registers
  - Fully Static Operation
  - Up to 16 MIPS Throughput at 16MHz
  - On-Chip 2-cycle Multiplier
- High Endurance Non-volatile Memory Segments
  - 64K/128K/256KBytes of In-System Self-Programmable Flash
  - 4Kbytes EEPROM
  - 8Kbytes Internal SRAM
  - Write/Erase Cycles:10,000 Flash/100,000 EEPROM
  - Data retention: 20 years at 85°C/ 100 years at 25°C
  - Optional Boot Code Section with Independent Lock Bits
    - In-System Programming by On-chip Boot Program
    - True Read-While-Write Operation
  - Programming Lock for Software Security
- Atmel® QTouch® library support
  - Capacitive touch buttons, sliders and wheels
  - QTouch and QMatrix acquisition
  - Up to 64 sense channels
- JTAG (IEEE® std. 1149.1 compliant) Interface
  - Boundary-scan Capabilities According to the JTAG Standard
  - Extensive On-chip Debug Support
  - Programming of Flash, EEPROM, Fuses, and Lock Bits through the JTAG Interface
- Peripheral Features
  - Two 8-bit Timer/Counters with Separate Prescaler and Compare Mode
  - Four 16-bit Timer/Counter with Separate Prescaler, Compare- and Capture Mode
  - Real Time Counter with Separate Oscillator
  - Four 8-bit PWM Channels
  - Six/Twelve PWM Channels with Programmable Resolution from 2 to 16 Bits (ATmega1281/2561, ATmega640/1280/2560)
  - Output Compare Modulator
  - 8/16-channel, 10-bit ADC (ATmega1281/2561, ATmega640/1280/2560)
  - Two/Four Programmable Serial USART (ATmega1281/2561, ATmega640/1280/2560)
  - Master/Slave SPI Serial Interface
  - Byte Oriented 2-wire Serial Interface
  - Programmable Watchdog Timer with Separate On-chip Oscillator
  - On-chip Analog Comparator
  - Interrupt and Wake-up on Pin Change
- Special Microcontroller Features
  - Power-on Reset and Programmable Brown-out Detection
  - Internal Calibrated Oscillator
  - External and Internal Interrupt Sources
  - Six Sleep Modes: Idle, ADC Noise Reduction, Power-save, Power-down, Standby, and Extended Standby
- I/O and Packages
  - 54/86 Programmable I/O Lines (ATmega1281/2561, ATmega640/1280/2560)
  - 64-pad QFN/MLF, 64-lead TQFP (ATmega1281/2561)
  - 100-lead TQFP, 100-ball CBGA (ATmega640/1280/2560)
  - RoHS/Fully Green
- Temperature Range:
  - -40°C to 85°C Industrial
- Ultra-Low Power Consumption
  - Active Mode: 1MHz, 1.8V: 500µA
  - Power-down Mode: 0.1µA at 1.8V
- Speed Grade:
  - ATmega640V/ATmega1280V/ATmega1281V:
    - 0 - 4MHz @ 1.8V - 5.5V, 0 - 8MHz @ 2.7V - 5.5V
  - ATmega2560V/ATmega2561V:
    - 0 - 2MHz @ 1.8V - 5.5V, 0 - 8MHz @ 2.7V - 5.5V
  - ATmega640/ATmega1280/ATmega1281:
    - 0 - 8MHz @ 2.7V - 5.5V, 0 - 16MHz @ 4.5V - 5.5V
  - ATmega2560/ATmega2561:
    - 0 - 16MHz @ 4.5V - 5.5V

2549Q-AVR-02/2014

Figure 3: ATmega2560

## C Technical Drawings

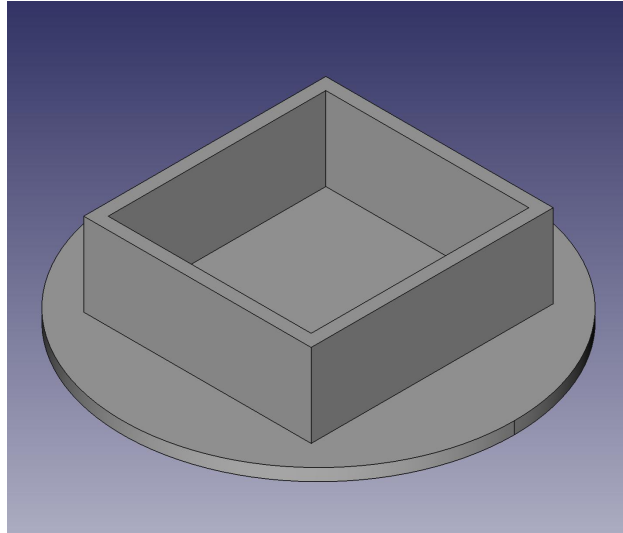


Figure 4: Electronic speed controller part bin