Chapter 14: Next Steps

# Mini Abstract

1-2 paragraph chapter description. Should generally go over contents, expectations, and results. Abstracts are usually the last part of something to be written out since it is a summary of the article, but we can use them hear to help flesh out our ideas a bit for how to structure. Final abstract should be overhauled at the end of the chapter though, the chapter dictates the abstract, not the other way around.

# Chapter 14 Outline

Develop the chapter outline here. Should become very detailed and broken down to paragraph level. Remember, if we invest time and effort into making a detailed outline, the actual writing will be far easier since we understand the flow and structure before we lay out the details. Before even writing a subsection, take the time to outline that subsection in the chapter outline. A lot of writing is in the layout. Remember to update this chapter in the Master Outline file so we can all keep track of the full outline of the report, its large so breaking it up this way should help everyone keep track of each other's ideas and work.

Section 1 What to keep

* Simulation
* Power Budget
* RC Control System
* Systems Programming Code

Section 2 Points of failure that can be improved

* Envelope Fabrication
* PCB Design/Sensor Array

Section 3 Considerations of different solutions/tech to incorporate

* Autonomous Design

Section 4 Recommendations to future teams, or to ourselves if we moved forward

## Section 1: Next Steps for the Simulation

### Subsection 1: RC Control(If it wasn’t completed)

Get remote API functions in V-rep to work. Complete RC testing using the block diagram. Analyze the data and iterate code done in

### Subsection 2: Autonomous Control

## Section 2: Next Steps for the Hardware Implementation

### Subsection 1: PCB and Sensor Array

* PCB needs to be iteratively verified before sending off to the boardhouse
* Soldering with small components such as 0805 SMD footprint should be done with reflow solder

### Subsection 2: Design Improvements

* Redo the fabrication of the envelope to fix errors

### Subsection 3: Physical Testing

* Hover test done in a controlled environment

# Chapter 14

This chapter details the next steps of the project, areas of improvement, future considerations to incorporate, and general recommendations for the continuation of the project.

## 14.1 What to keep

One of the successes of the project was the creation of a simulation environment for testing the dimensions and movement of the drone. This simulation can take a variable wind speed, motor throttle, and motor angle. RC control was implemented into the simulation, but work needs to be done with integrating autonomous control.

The power budget of the system consists of estimated and verified power requirements of each part used, the voltage each part requires, and estimated heat losses. The power required is also variable depending on a performance factor for the motors and servos across a pre-set flight time on the power budget, allowing fast simulation of flight time.

## 14.2 Points of failure that can be improved

Extra considerations need to be taken into account when fabricating the next iteration of the envelope. The envelope shape was not only fabricated to the incorrect shape, but the lift bag was punctured repeatedly showing that the design is fragile and not structurally stable.

Future PCB design needs to be iteratively verified to ensure signal bus as far away from power traces as possible. Increasing PCB footprint from 4 by 4 inches to a larger size can help improve signal and power trace separation and a ground plane bridge needs to be implemented for the GPS module and the antenna.

Soldering components to the PCB should be done with reflow solder because the resistors and some of the IC’s had only have solder pads on the bottom of them, using reflow solder would make it much easier.

## 14.3 Considerations of New Technologies

Zerone

ZeRONE’s blade-free propulsion drone uses ultrasonic vibrations of piezoelectric elements as propulsion. Each propulsion system is called a microblower, and each of the microblower’s piezoelectric elements operate at ultrasonic frequency ranges which generate less noise than conventional quadcopter drones. The microblower flaps a diaphragm at ultrasonic speeds instead of using conventional spinning propellers, removing the risk of injury by propeller blades[4]. The ZeRONE drone uses a 24- inch aluminum-metallized film balloon filled with helium gas making it a neutrally buoyant drone. The total weight without helium uplift of the ZeRONE drone is 106.4g including the balloon, microblower, carbon rods, drive circuit, receiver, battery, joint, screws, etc. The drone can be used as advertisement billboards in indoor crowds or halls. The drone also has been tested with a camera for crowd monitoring, human flow analysis and security. However, the microblowers cannot provide enough thrust beyond 1 meter per 7.5 second upwards and downwards. ZeRONE is prone to drift caused by slight winds, either by people walking past it or areas with air conditioning. [3]

Although the drone uses low noise microblowers to provide lift, it cannot counteract external forces such as slight breeze which makes it not ideal for precise sensor data collection. ZeRONE cannot add IMU and GPS sensors for autonomous flight control without increasing the balloon diameter and adding more microblowers. The technology is not advanced enough yet to be used to solve researchers problems with data collection, but can be useful with further development and should be watched.

## 14.4 Recommendations for Further Development

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# Chapter Bibliography

We do have a full bibliography that should absolutely be updated with all content here. The point of the chapter bibliography is to help keep track of citations in the chapter since the numbering may change in the full bibliography with changes and additions. This way will isolate the sources in this section so you can cite here without having to worry about it, and can use a simple find and replace on your citations to update the new numbering when we combine everything in the final report.