Barone2 Report Week of 1/17/21

Sprint 1,

Prepared by Chin Ming Ryan Wong

**Executive Summary of Progress:**

Sprint 1 focused on the functional design stage of the project. For the sprint, we undertook updates to the system block diagram and technical requirements, performed a force analysis, decided on a general sensor array, drew a sketch of the drone, and defined basic mechanical functionality of the drone. This phase was meant to lay the foundation for the detailed design. In addition, the time was taken in this period to prepare for the more detailed design phase by downloading CAD models for available components, beginning the specific microcontroller, sensors, and materials selection, keeping an updated budget, and finding or starting simulations for power usage and drone flight simulation.

The functional design was completed at the end of the sprint, and preparation has started for the next phase, but we are slightly behind on the microcontroller selection and CAD model, but by only a few days, so that can be caught up in Sprint 2. The flight simulation selection and download was delayed due to technical problems, but these issues have been resolved.

**List of Project Backlog Items Undertaken:**

BoM has been moved to the To Do list, we are providing constant updates to balloon size, propeller diameter, and motor specifications for the propeller. As we begin using V-rep for more advanced drone simulation, parts specification will change in order to maximise flight time.

We have decided to use a microcontroller for the input/output of our drone, and a microprocessor for the image processing, but we have not decided on the exact kinds of microcontroller and microprocessor yet. We think an Arduino and Raspberry Pi would suffice, but are not sure about the exact models yet since we do not know exactly how much processing power or how many pins we need, and also the maximum allowable size. Leonid is working on this. Expected to take about 4 hours.

PCB design is incomplete because some sensor kits already provide PCB designs with the IC sensors and have issues with sourcing individual IC sensors instead of buying breakout sensors.

CAD modeling is incomplete, collecting CAD model libraries for every sensor in BoM. Had to do some troubleshooting to get access to UCSC licenced Solidworks.

**Progress made toward acceptance criteria:**

| Task Deliverable/  Acceptance Criteria | Status | Responsible Party | Anticipated Hours | Details |
| --- | --- | --- | --- | --- |

**Functional Design:**

| Update Block Diagram | Finished | Dylan, Ryan, George, Jeremy, Leonid, Isaac | 3 | Updated the block diagram from the project proposal with sensors and new propulsion setup to reflect changes |
| --- | --- | --- | --- | --- |
| System Technical Requirements | Finished | Ryan, Dylan, George, Isaac, Jeremy, Leon | 3 | Define what shall, should, and may be done for the drone |
| Microcontroller selection | In progress | Leonid | 2 | Started creating chart with various microcontrollers comparing processing power, number of pins, and price, and choose based on desirability and compatibility |
| Finalize Sensors | Finished | Leonid | 3 | Decided on what sensors to use, now just have to order them |
| Force Analysis | Finished | George & Dylan | 5 | Performed force analysis of the drone, including the effects of the propeller forces on net force and moments, drag forces, and lift forces, to aid in further design work |
| Finalize Dimensions of drone (schematic) | Finished | Dylan | 1 | Sketched out a simple sketch of the drone with updated dimensions.  A Lot of this time was spent on deciding propeller size and formation. |

**Order Initial Parts:**

| Update BoM | In progress | Ryan, Dylan, George, Isaac, Jeremy, Leon | 3 | Changing materials in the BOM to fit current specifications of the drone |
| --- | --- | --- | --- | --- |

**CAD Design:**

| CAD Model | In progress | Dylan | 10 | Found pre-existing models for many sensors, microcontrollers, etc…. After making sure they were the correct dimensions.  Downloaded Solidworks |
| --- | --- | --- | --- | --- |

**Drone Simulation:**

| Flight simulation | In progress | Isaac | 10 | Downloading a flight simulation program and finding tutorials on how to simulate models in the simulator. |
| --- | --- | --- | --- | --- |

**PCB Design:**

| PCB Design | In progress | Ryan | 5 | Create a PCB for all electronic sensors and microcontrollers to mount to |
| --- | --- | --- | --- | --- |

**Power Management:**

| Find Battery Drain Simulation | Finished | Jeremy | 1 | Found an omni-calculator to estimate drone flight time, other circuit simulations will be done with Eagle CAD |
| --- | --- | --- | --- | --- |

**Calculate sprint velocities:**

| Velocities | Estimated Hours | Total Hours | Velocity ( Total hr./Estimated hr.) | Description (Reasoning for velocities < 1 |
| --- | --- | --- | --- | --- |
| **Team** | 103 | 94 | .913 | Overall, good team velocity, but difference can be improved by balancing the current workload better in accordance with roles |
| Dylan | 25 | 20 | 0.8 | some CAD models for the sensors were not available so there was less work to be done on checking if model dimensions where correct |
| Ryan | 16 | 12 | 0.75 () | Focused design course lab this week so didn’t do as much in PCB .Some sensors and Microcontrollers already have PCB. |
| Jeremy | 12 | 12 | 1 |  |
| Isaac | 18 | 18 | 1 |  |
| George | 16 | 16 | 1 |  |
| Leonid | 16 | 16 | 1 |  |

**Product Owner, Teaching Team, Client Feedback:**

| Functionality Demonstrated | Owner Feedback | Team Response |
| --- | --- | --- |
| Sensor array would theoretically cover all control system requirements | It seems the team has put a lot of thought into what sensors they will be using for what in this project. The team made good use of time in the sprint getting rid of nonessential sensors and replacing them with sensors that would be more beneficial to the project. | The sensor array initially fell short when deciding the bag was adequately filled, so it was decided we would add a pressure sensor. Additionally, we did originally consider using a laser sensor for object avoidance due to the increased range, but decided on ultrasonic due to the wider angle and the fact that the drone would be operating at low heights. |
| PCB design shows physical connections between every sensor to its respective microcontrollers. | There seems to be not much PCB work to do other than assisting power management with how the different parts will interact | The PCB design done so far are only diagrams of electronic connections between every sensor/microcontroller. Board design has yet to be started. Physical locations of soldering are yet to be determined on the PCB board itself. |
| Power management able to be simulated with Amps and Volts of Battery versus weight, estimating total flight time. More in-depth power analysis will be possible with CAD design | Although some work has been done here in order to estimate the size of the battery that would be needed, it would be nice to see more work done to see how power could be optimized in order to make battery life more efficient | The internal power requirements of the systems and sensors can only be found through the PCB and CAD designs. Once those are completed, software can be implemented to control any optimizations that deal with the power input of systems |
| CAD models where downloaded, and placed into project files in Fusion, Some files did not open in solidworks which was not available until later on | It was good to see these models downloaded, but it would have been good to see this student spend the time making the files compatible with solidworks during the sprint if that is what he plans on using | Solidworks was not available to the team until the last day or two of the sprint, to which this student was working on other class work and did not have the time to learn how to convert the already downloaded files to solidworks format. |
| Simulation capabilities were found and demonstrated to simulate a working drone model. | The student in charge of this spent a lot of time weighing all his options on different software. It was initially worrying that Gazebo was thrown out after deciding it would be the best to use. However the team seems confident that Vrep the new software to be used will be more than sufficient. | Gazebo on a Windows platform was very difficult to build and many errors were encountered during installation due to incompatibility. Therefore, choosing V-rep was a much easier decision to make, given that the system had less issues downloading the program and setting up models. |
| A sketch of the drone was made with rough dimensions in order for the initial force analysis and CAD model to be based off of. This involved deciding on how large the propellers could be, as well as deciding on how far apart they will be and where they will be located on the body | This schematic although it covered the basics could have been a lot more detailed in its sizing. It would have been nice to see more specifics on how different parts would be connected and the vertical locations of the propellers on the lift bag | The sketch was only a rough design based off of current knowledge of what would be put on the drone in this project. More specifics should be added to the schematic and will be in the future to base the CAD design off of. |
| The force analysis document provides a basic summary of the forces and moments the drone can expect to experience from the propellers, as well as the forces and moments due to buoyancy, gravity, and drag, assuming a spherical model. There is also a quick summary of calculating the propulsion force for different rotors as speeds in the static range of flight, and that can be used for motor/rotor selection. | This force analysis is well done, with many factors considered. Although it could have been more percisce it would be hard to give more specific data points for how early in the project it is, since many specifics have not been finalized namly the weight of many of the parts. | The model captures the physical functionality of the drone as sketched in the drone design sketch. The drag model currently only works for a spherical model, assuming a spherical lift bag, and will need to be updated with simulation results in bag geometry changes. The document should also be updated throughout the project with concrete calculations of drone features. |

**Possible Sprint Improvements:**

The primary area that needs improvement is a more balanced division of work. Certain roles were lighter due to the stage of the design process, however, we should take the time to better allocate our personal resources to support members who currently have heavier workloads.

Also, our stand up meetings are also lengthy, so we should be more succinct in our personal updates.

Lastly, although there was not as much of a need yet, we should prepare to have more frequent contact with our mentors to ensure the drone design goes smoothly with the detailed design; more frequent contact would especially be beneficial for George since he is doing the Control System Design, and does not have extensive experience in the area.

**Next Week’s Goals and Objectives:**

Our goals for the next week are to decide on our microcontroller and microprocessor. After making the chart comparing different models, this should show us which ones are the best choice.

From there, Ryan can continue PCB design connecting sensors to microcontrollers, which will also allow a more in-depth analysis of the power management requirements. Additional help will be provided by Jeremy to find libraries for sensors listed in BoM.

V-rep drone simulation will begin next week by Isaac. Using a working drone model or Basic CAD model built by Dylan, the goal is to have a model close to the finished model flying with basic controlled movement. Then we will begin building a simulation environment in V-rep including wind, buoyant forces, and terrain gradients.

Make sure to download CAD files that are in a format that is compatible with Solidworks and finish moving the project to Solidworks. Start CADing the main project in solidworks, including making parts that did not have online CAD models and creating assembly files for all parts that are connected. A simplified design will be completed and submitted to Isaac so he can begin working on the simulation.

A remote controller needs to be decided that meets the needs of the drone. Additionally, the system response to user inputs needs to be designed, and this should be programmed and prepared for simulation.

**Meeting Minutes for Sprint 1 Week:**

**1/17/21 5 - 6:30pm**

* Organized Trello App Scrumboard
  + Ryan is Scrummaster for sprint1
  + Turned in to Sprint0 assignment
* Completed System Concept Flow chart

**1/19/21 7:30 - 8:00pm**

* Spring Planning Meeting
* Short Meeting
* Stay on top of Trello assignments
* Vrep vs Gazebo
  + Gazebo is better for beginners
* Thursday meeting:
  + Update system block diagram

**1/21/21 7:30 - 9:30pm**

* Sprint Meeting
* Updated System block diagram
  + Arduino microprocessor added with microcontroller in drone
    - Arduino is better at sampling and controlling input/output
    - Raspberry Pi has own operating system
  + Added ultrasonic sensor for detecting nearby objects and ground
  + Servos for motor positioning
  + Added Camera for video streaming
  + Sensor: Sparkfun IMU MPU-9250
* Sprint Review/Planning Meeting
  + Merge Jeremy’s and Ryan’s Roles to get them more work in the beginning of the project as most of their work is later, what else can they work on?
  + What do we turn in for the sprint?

**1/22/21 4:30 - 5:15pm**

* Sprint review meeting with TA
  + Slides for tasks that are completed for design reviews
    - Design review in 2 weeks
    - Presentation on progress of project
  + Sprint report
    - Fill out template, include meeting minutes
  + If some members have less work early on, have them assist other team members, and they will have more hours to report on.
  + Put each of the microcontrollers on excel, add features and weighting factors for each
    - Future assignment to compare microcontrollers
  + Jan 25th
    - Intro to Pspice
    - Review of team scrum processes
    - (Possibly) Microcontroller workshop
  + CSE13E microcontroller is similar to the arduino

**5:15 - 6:00pm**

* Sprint debrief meeting
  + PCB schematics
    - Gotta download more libraries to connect modules
  + Force analysis is almost complete
  + For batteries, need higher voltage, lower current to minimize magnetic interference

**1/23/21 7:30 - 8:30pm**

* Worked on Sprint 1 Report
  + Inputted the tasks and hours divided by gantt chart categories

**1/24/21 7:30 - 9:30pm**

* Finished sprint 1 report