VDR 3

Team 508: Drone Payload Sample Collection and Measurement

Department of Mechanical Engineering, FAMU-FSU College of Engineering

EML4551: Senior Design 1

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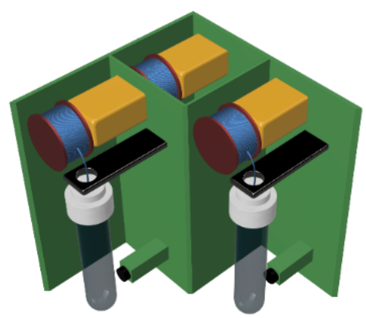
1.1 Introduction – Dominic Bellocchio

Team 508 is creating a drone payload that will collect liquid samples, prevent contamination of those samples and store them safely.

1.2 Current – Dominic Bellocchio

A final concept has been chosen and the first prototype will be constructed. The components of the prototype are designed separately and will be combined later. Getting the DC motor to reel the test tube at a desired angle and speed is the first step. Making a housing that can contain the motor, reel, line guide, and magnet, is the next step. Within our team, we intend to divide up these activities so that each sub project is completed simultaneously.

Figure 1: CAD of multi-reel design



1.3 Future – Tauben Brenner

Before the prototype is built, the workable area under the drone should be measured. The assemblies of the motors and samples must fit within the 4 separate rooms contained under the drone body. Any issues with implementing motor assemblies will be assessed and remedied. The next milestone is completing the CAD model simulation for the design to ensure there is no collision detection. The construction will commence once the models are put together.

2.1 Systems – Dylan Ma

The physical components of the payload are divided into 5 sections and the key considerations for each system's design are discussed.

- Power Supply
- Materials
- Protection
- Components/Hardware
- Integration

2.1.1. Power Supply – Dylan Ma

The power supply to the components of the apparatus will be delivered from the drone battery. For a hexa-copter, the power output is roughly 20000 mA at 14 V. The current is too high to power the DC motors and sensors normally, so the current sent to the payload will be limited. The team will implement voltage regulators and op amps to control the power.

2.1.2. Materials – Roberto Lacasa

The materials used for the sampling housing and apparatus must fit a criterion. The housing material must be able to withstand saltwater drippings or spray. The sampling bottle must not interfere/contaminate with the collected samples. UV light exposure can harm the integrity of the samples so the bottle's material should block incident solar radiation. More research is needed to determine if a change in sample temperature would affect its integrity. If so, we must consider using an insulating material in the bottle. The electronics must be protected with water-resistant material. For normal operation the drone will not be submerged, but it may experience light misting of saltwater which can lead to electrical communication errors. While our project may be used as a collection apparatus for Dow Chemical, we are focusing primarily on saltwater collection to limit scope. Some materials that are being considered are PLA, PETG, Silicon, ABS, and PVC. To maintain strength and minimize weight, we hope to use carbon fiber for bulky components wherever possible.

2.1.3. Protection – Dominic Bellocchio

The protection system encompasses the drone and the sampling apparatus. For the drone, buffers will be used in the electronics to try and limit abnormal feedback from the sampling apparatus. In the case where the sample gets entangled on an obstruction, we intend to use a sampling abortion procedure. Here, the sample line would get severed from the drone-payload body if its sensors record more than 5 Newtons of downward force to prevent the drone from getting snagged. The average maximum carrying capacity for drones in the size range we plan to design for is 2.6 kilograms. In order to prevent detriment to flight dynamics and battery life, we intend to maintain our payload at least 15% lighter than the maximum carrying capacity limit. We will also have to consider the max weight of the samples and prepare the materials accordingly.

2.1.4. Components/Hardware - Tauben Brenner

The components and hardware systems include DC motors, sensors, 3D prints, and anything related to sampling apparatus or communication between the drone and payload. The motors are currently specified to run off 6-12v at 300 mA. The miscellaneous electronic hardware used includes operational amplifiers for signal conditioning, capacitors, resistors, voltage regulators, etc. These will be tested using a breadboard and Arduino jumper wires. After ensuring the circuit works, one will be ordered from a circuit board printing website. The components will then be soldered onto the circuit board for security. The wiring will be stranded 1220 AWG, the stranding ensures that it is flexible, and it will be plenty adequate for the current supplied to our components. The collection bottle can be ordered from vendors as well as designed and 3D printed using Polyethylene terephthalate glycol (PET-G). Any food-grade plastic will work for saltwater collection.

2.1.5. Integration – Matthew Lancaster

The sequence of integration is as follows: sensors interface to the microcontroller, and the microcontroller interfaces to the flight controller. The sensors to microcontroller will be a part of the sampling apparatus. Integrating between the different components on the apparatus and between the apparatus and the drone will be done through serial communication. The flight controller being used (Pixhawk Ardupilot) comes with 5 UART serial ports that run on a baud rate of 57,600. This baud rate is not high enough to cause issues with wire length, which simplifies the hardware aspect of design. With the use of decoupling capacitors for the signal conditioning devices, transition currents that would affect sensor readings are diminished. Tying a capacitor to ground will be implemented, to allow the small drops in voltage to be ignored. The communication between the drone and apparatus and the user will be done through 900MHz with a receiver sensitivity of -121 dBm.