Electrical Overview

Year: \_2019\_ Semester: \_Spring\_ Team: \_\_17\_\_ Project: \_Face Tracking Drone\_\_\_\_\_\_

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Assignment Evaluation:

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| **Item** | **Score (0-5)** | **Weight** | **Points** | **Notes** |
| **Assignment-Specific Items** | | | | |
| **Electrical Overview** |  | x3 |  |  |
| **Electrical Considerations** |  | x3 |  |  |
| **Interface Considerations** |  | x3 |  |  |
| **System Block Diagram** |  | x3 |  |  |
| **Writing-Specific Items** | | | | |
| **Spelling and Grammar** |  | x2 |  |  |
| **Formatting and Citations** |  | x1 |  |  |
| **Figures and Graphs** |  | x2 |  |  |
| **Technical Writing Style** |  | x3 |  |  |
| **Total Score** |  | | |  |

5: Excellent 4: Good 3: Acceptable 2: Poor 1: Very Poor 0: Not attempted

General Comments:

*Relevant overall comments about the paper will be included here*

1.0 Electrical Overview

The microcontroller for this project will be a 32-bit microcontroller. It will not perform any computation directly. Instead, it will be the interface between other devices including flight controller, RF transceiver and gimbal controller. The inputs will be control signals received from local computer, pedal controllers, and statuses of te gimbal motors. The output will be control signals sent to flight controller and gimbal controller.

There will be another 32-bit microcontroller taking charge of sending control signals from a local computer to the drone. The input is control signals from local computer. The output is control signals sent to a RF transceiver.

2.0 Electrical Considerations

2.1 Operating Voltage

This project consists of two operating parts: flight part and ground part. The flight part is powered by HRB 11.1V 5000mAh 3S 50C-100C LiPo Battery with Traxxas TRX Plug[1], whose output voltage is 11.1V. There are four devices belonging to the flight part: STM32F4 microcontroller[2], 4x SIMONK 30A ESC For DJI Phantom[3], Pixhawk flight control[4] and STorM 32 gimbal[5]. The operating voltage range of the ESC is 8V to 12V and that of gimbal is 11.1V to 16.8 V. 11.1V falls in both of these two ranges. But the operating voltages of microcontroller and flight control are both 5v. Therefore, a voltage regulator is needed, which convertes the 11.1V to 5V.

For the ground part, there are two devices need to be powered: STM32F4 microcontroller and Dunlop GCB95 Cry Baby Wah Pedal[6]. For this microcontroller, it is powered by the laptop using USB. And there is a battery to power the pedal which provides 9V output matching the operating voltage of the pedal.

2.2 Operating Frequency

While our project is targeting tracking human face in real time, such task requires heavy computing power. With a reasonable setup (a laptop/ desktop computer), our target operating frequency will be around 30-50 Hz (30-50 fps). Since the microcontroller and the flight controller both run at a much higher frequency, the face pose estimation algorithm will be the bottleneck in our use case due to heavy computational load. In order to keep track of the target face and not lose track easily, 30-50 Hz would be reasonable.

On the RF side, the NRF24L01+ module can handle data transfer at 2000kbps[7]. Since we want our latency as low as possible to reach the best face tracking accuracy, we will use the maximum transfer speed. While doing so may increase the power consumption, neither the RF module nor the microcontroller consumes significant power compare to the motors. The large battery and relative trivial power cost will allow us to use a more aggressive RF setting.

2.3 Power Supply

The power for the drone’s ESCs is supplied by a ‘HRB 11.1V 5000mAh 3S 50C-100C Lipo Battery’, and the flight controller will be powered by this battery as well but the voltage has been transformed to 5V. VTX transmitter and micro-controller will be power through this battery as well.

The power for the ground station is supplied by usual laptop power outlet, however, the RF transmitter[8] will be powered by a usb-uart bridge which is connected with laptop.

Our battery is a 5000mAh 3S 50C Lipo battery, which can support upto 5000mA \* 50 = 250Amp and operate at 11.1V.

The breakdown for this usage is:

* Battery[1] Burst Rating 50C-100C \* 5000mA = 250A-500A(maximum current draw for a few seconds)
* STM32F4[2] = 215 uA
* 4 \* ESCs[3] \* 3A = 12A
* Pixhawk[4] = 215 uA
* Storm32 gimbal[5] = 1.5A
* Dunlop GCB95 Cry Baby Wah Pedal[6] = DC 10mA
* 4 \* motors \* 9.5A = 38A(Tested with 11.1V power)
* VTX receiver = 200 mA

3.0 Interface Considerations

3.1 Serial Interface

SPI will be used for communication between most microcontroller and all the devices on the drone. SPI is selected against I2C mainly because of it’s high speed data transfer rate. A high data rate is important to make sure the drone reaction fast enough to the control signals. The trade off that the distance of SPI transfer must be short is not a concern because the distance between on-flight devices is short enough. It is also verified that SPI works with other devices on the drone. SPI data tranfer rate need to be the same as RF data transfer rate, which is 2000kpbs[6].

3.2 UART Interface

A UART interface will be used between the local computer and the microcontroller on the base. Since RF modules is used instead of wifi modules for control signal transfer between the local computer and the drone, a seperate microcontroller is needed at the local computer. It will also use SPI to perform on-board communication. UART is used for communication with local computer. Since UART data rate cam reach.

4.0 Sources Cited:

[1] “HRB 11.1V 5000mAh 3S 50C-100C LiPo Battery with Traxxas TRX Plug for RC DJI F450 Quadcopter RC Helicopter Airplane Hobby Drone and FPV (6.10 x 1.89 x 0.91 Inch),” Amazon. [Online]. Available: https://www.amazon.com/gp/product/B06XNTHQRZ/ref=ppx\_yo\_dt\_b\_asin\_title\_o02\_\_o00\_s00?ie=UTF8&psc=1. [Accessed: 31-Jan-2019].

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Appendix 1: System Block Diagram

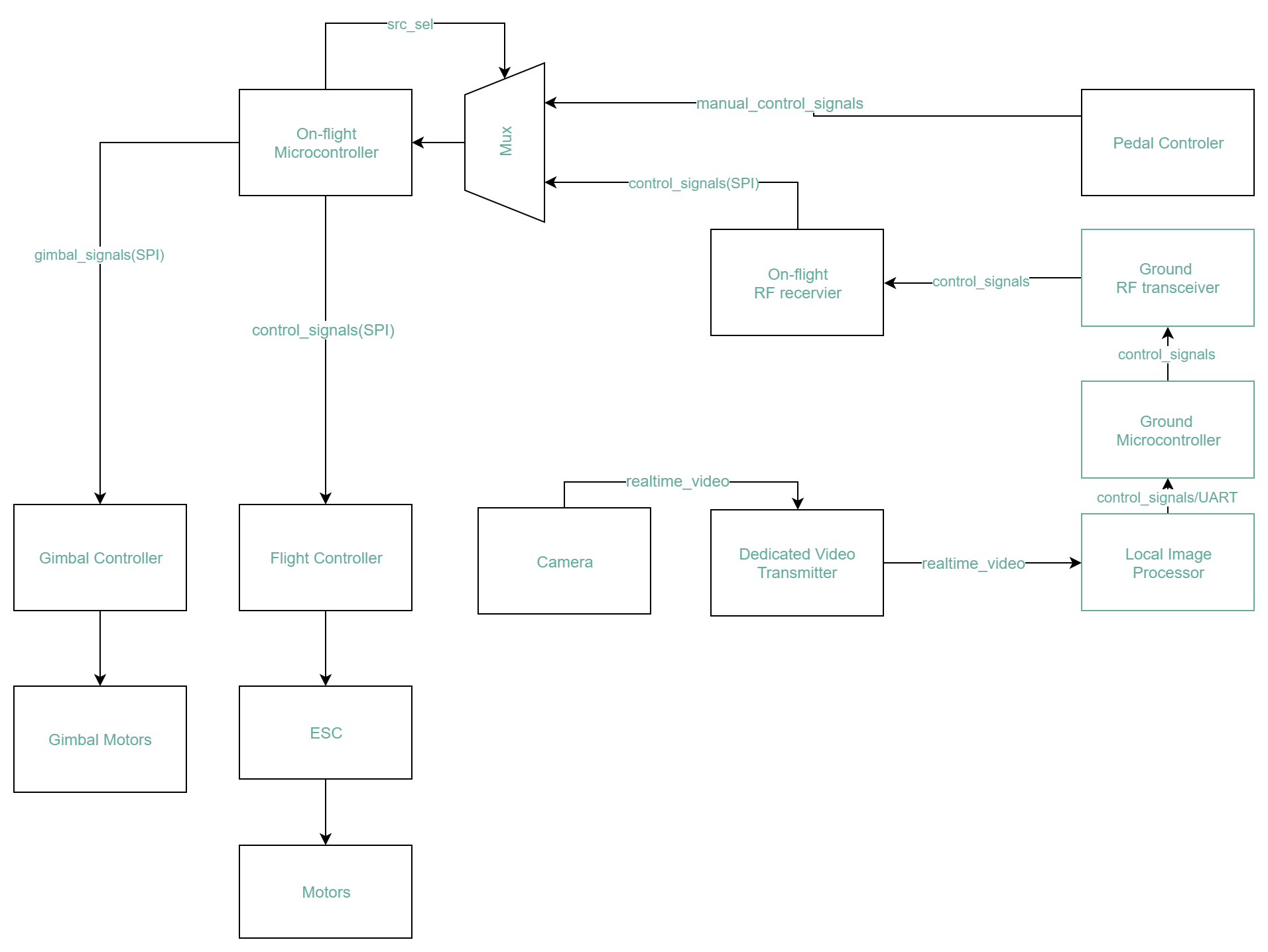
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Figure 1. System block diagram