The University of Texas at Austin
Cockrell School of Engineering

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USRC: Communications & Sensors

Design Review II

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INTRODUCTION

The USRC project at the University of Texas is called the Drone Estimation Lab (DEL). DEL is tasked with designing a system of generating an error ellipsoids around drones in GPS-denied environments as well as avoiding obstacles in flight. The following is a design review for the communications and sensors team.

Purpose: Flying multirotors autonomously in GPS-denied environments by generating error ellipsoid. [1]

UPDATED PARTS LIST

COMPONENTS

360 LIDAR SENSOR

(SLAMTEC)

- The RPLiDAR is a 360° LiDAR sensor that detects obstacles and provides range data within 12 m.
- According to [3], the sensor has a resolution of 0.2 cm as well as an angular resolution of 1°, allowing high resolution in close quarters.
- **Link:**

https://www.adafruit.com/product/4010?gclid=Cj0KCQjw1vSZBhDuARIsAKZlijRJGCPr-NI66sHwvrmAN_BH4kUPQlu9TdgbXvqyOP_JtgFS84REUCgaAmD5EALw_wcB

STEREO CAMERA

(ZED 2)

- Computer Vision and Obstacle Avoidance
- This is the drone’s primary computer vision sensor. It will not only improve our drone’s obstacle avoidance capabilities, but also facilitate any environment mapping.
- **Link:**

https://store.stereolabs.com/products/zed-2

FLIGHT CONTROLLER

(PIXHACK CUBE ORANGE)

- This is the drone’s low-level control brain. It shares the collected sensor data to the Jetson which then in turn tells the flight controller how to move the drone.

- **Link:**

https://www.amazon.com/dp/B0842XYLGR/ref=sspa_dk_detail_2?psc=1&pd_rd_i=B0842XYLGR&pd_rd_w=tuslL&content-id=amzn1.sym.88097cb9-5064-44ef-891b-abfacbc1c44b&pf_rd_p=88097cb9-5064-44ef-891b-abfacbc1c44b&pf_rd_r=DAQQZ3RCK6P2MHQ6ZGKK&pd_rd_wg=BT04w&pd_rd_r=00ef36c9-3282-4717-be76-5fe798eb9b71&s=toys-and-games&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWw

TRANSMITTER (updated)

- Manual drone control and general drone communications

- This is the primary drone communication sensor. It will allow us to take manual control of the drone in any emergency situations. Most importantly, it will give us the ability to receive a live feed of sensor data from the drone. The transmitter is part of the ground station.

- **Link:**

  https://www.amazon.com/FrSky-2-4GHz-Taranis-Access-Transmitter/dp/B08JCKHW6B/ref=asc_df_B08689K3BM/?hvadid=632109977210&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9028277&hvnetw=g&hvpone=&hvpos=&hvptwo=&hvqmt=&hvrand=12242071066688443238&hvtargid=pla-1571091993543&linkCode=df0&tag=hyprod-20&th=1

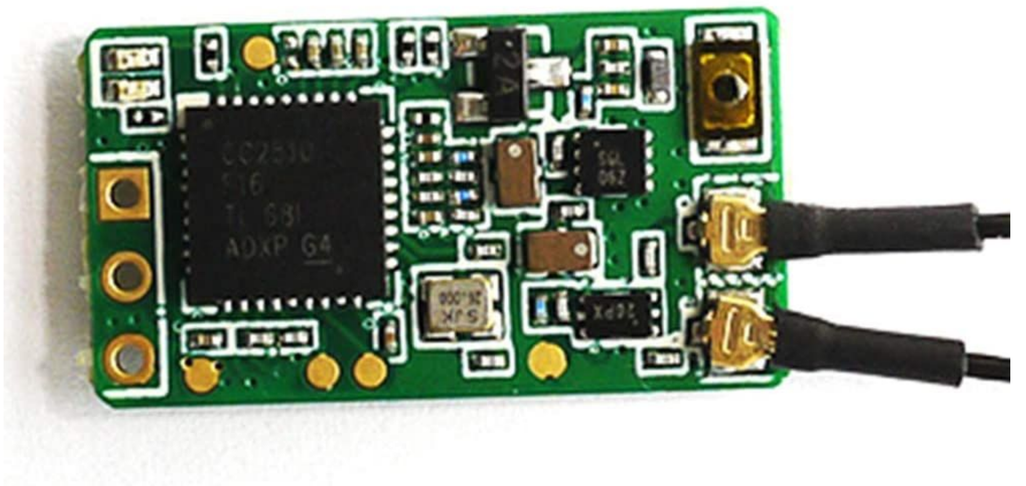
RECEIVER (updated)

- Manual drone control and general drone communications

- This is the primary drone communication sensor. It will allow us to take manual control of the drone in any emergency situations. Most importantly, it will give us the ability to receive a live feed of sensor data from the drone. The receiver will attached to the drone.

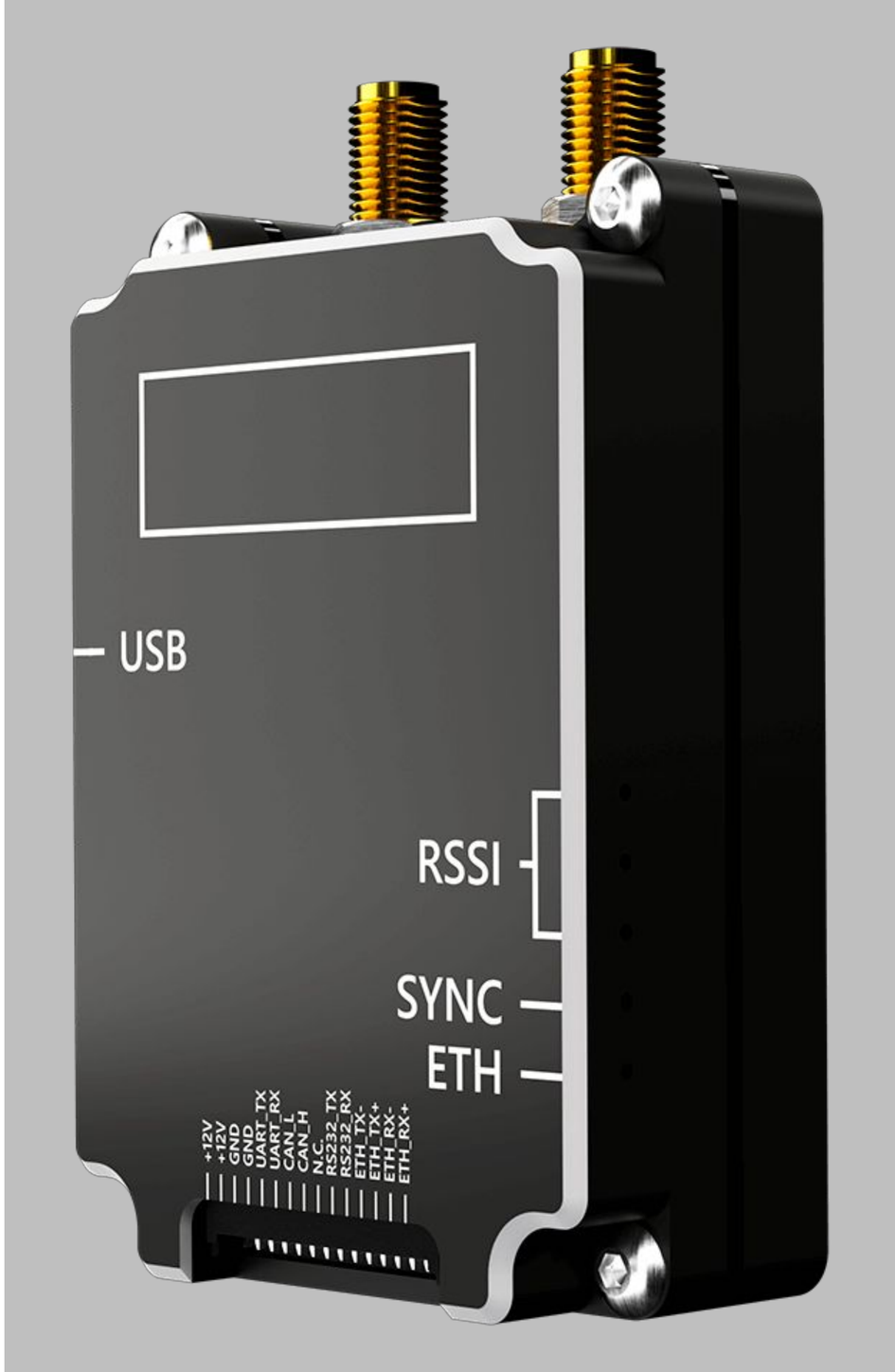
- **Link:**

  https://www.amazon.com/gp/product/B01N5INCBH/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&psc=1

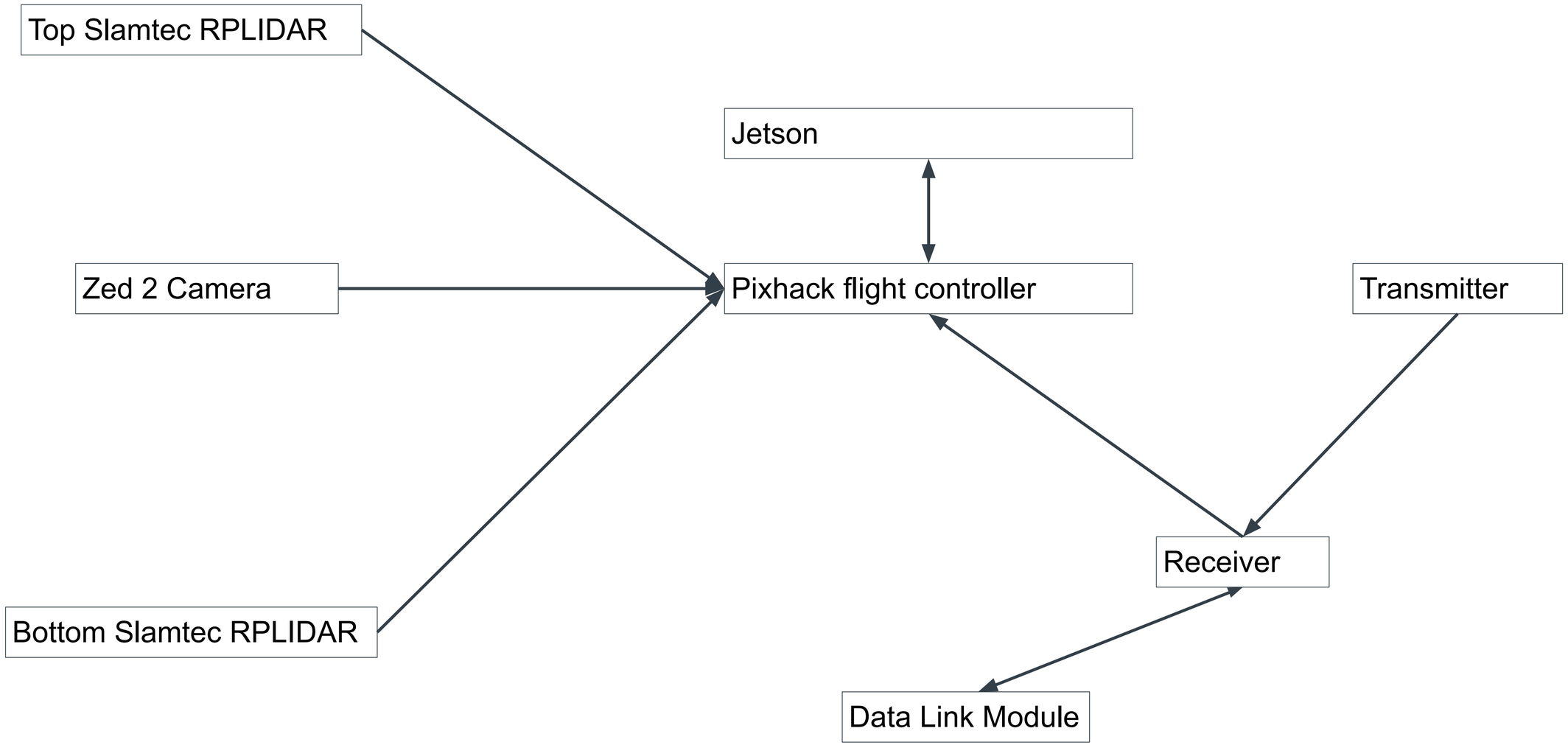


DATA LINK MODULE (added)

- Acts as ground station to manage video, control, and telemetry channels.
- Supports data relay of multiple drones for 47+ miles
- Purpose: Adds extra functionality that we lose from not getting the herelink system → live data feedback
- **Link:** https://uavradio.com/



CAMERA AND SENSOR BLOCK DIAGRAM



NEXT STEPS

IMMEDIATE NEXT STEPS

- Manual flying system
  - Set up flight controller
  - Pair receiver and transmitter
  - Connect flight controller and communication system
- Confirm procurement of parts for next phase of building drone with autonomous flight capabilities
  - Ensure correct orders placed and arrival within next semester or before end of this semester

NEXT STEPS FOR AUTONOMOUS SYSTEM

- Set up flight controller with Lidar Sensor
  - Conduct lidar sensor tests to ensure visibility is sufficient
- Test the ZED camera’s object detection capabilities while stationary
- Mount the ZED and test in air
- Set up jetson with ZED Camera
- Test total sensor visual coverage

FUTURE WORK (from last design review)

- Visualizing an ellipsoid with collected sensor data
  - Types of sensors needed and optimal configurations
- Potential implementation of sensors that take into account and adjust for the effects of wind on the drone flight
  - Types of sensors needed and optimal configurations
  - Connection(s) with pixhawk and jetson needed to adjust flight

REFERENCES

[1] M. Roberts, The University of Texas at Austin, “Essential Information for USRC”., 2022.

[2] H. Yang, Y. Lee, S.-Y. Jeon, and D. Lee, “Multi-rotor drone tutorial: Systems, Mechanics, control and state estimation - intelligent service robotics,” SpringerLink, 16-Mar-2017. [Online]. Available: https://link.springer.com/article/10.1007/s11370-017-0224-y. [Accessed: 10-Sep-2022].

[3] “RPLIDAR A1 Los Cost 360 Degree Laser Range Scanner.” SLAMTEC, 04-Jul-2016.

[4] “Zed 2i Camera and SDK Overview.” Stereo Labs.

[5] “UAV guidance model,” MATLAB & Simulink. [Online]. Available: https://www.mathworks.com/help/uav/ug/approximate-high-fidelity-uav-model-with-guidance-model.html. [Accessed: 01-Nov-2022].

[6] “UAV Guidance Model,” Environmental inputs for UAV - MATLAB. [Online]. Available: https://www.mathworks.com/help/uav/ref/fixedwing.environment.html. [Accessed: 01-Nov-2022].

THANK YOU.

QUESTIONS?

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Innovation starts here