

UNITED SENSORS

Winter Update



Engineering Team



Edison Chen	Team Captain/Firmware and Sensor Integration
Ethan Nguyen	Ardupilot/EKF Support
Tim Qin	PCB Design
Hector Moreno	RC Control
Shabeeb Reza	Telemetric Comm

Mission

Drones help gather information, their versatility enable us to:

Explore Frontiers



Respond to Disasters






Mobilize Surveillance



Deliver Goods


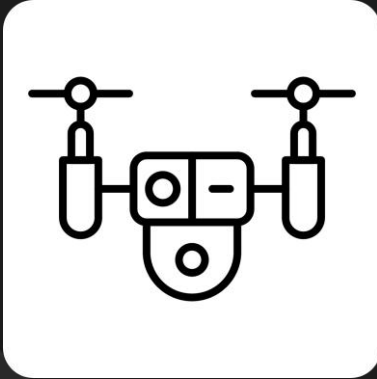



Problem

Inaccuracy	Compromise	Repair
Single Sensor Systems	Ripple Effect	Expensive Service
		

Solution

Sensor Redundancy - Multiple Sensors for the Same Operation

Precision	Tolerance	Robust
Multi Sensor System	Versatile Function	Built-In Backup
		

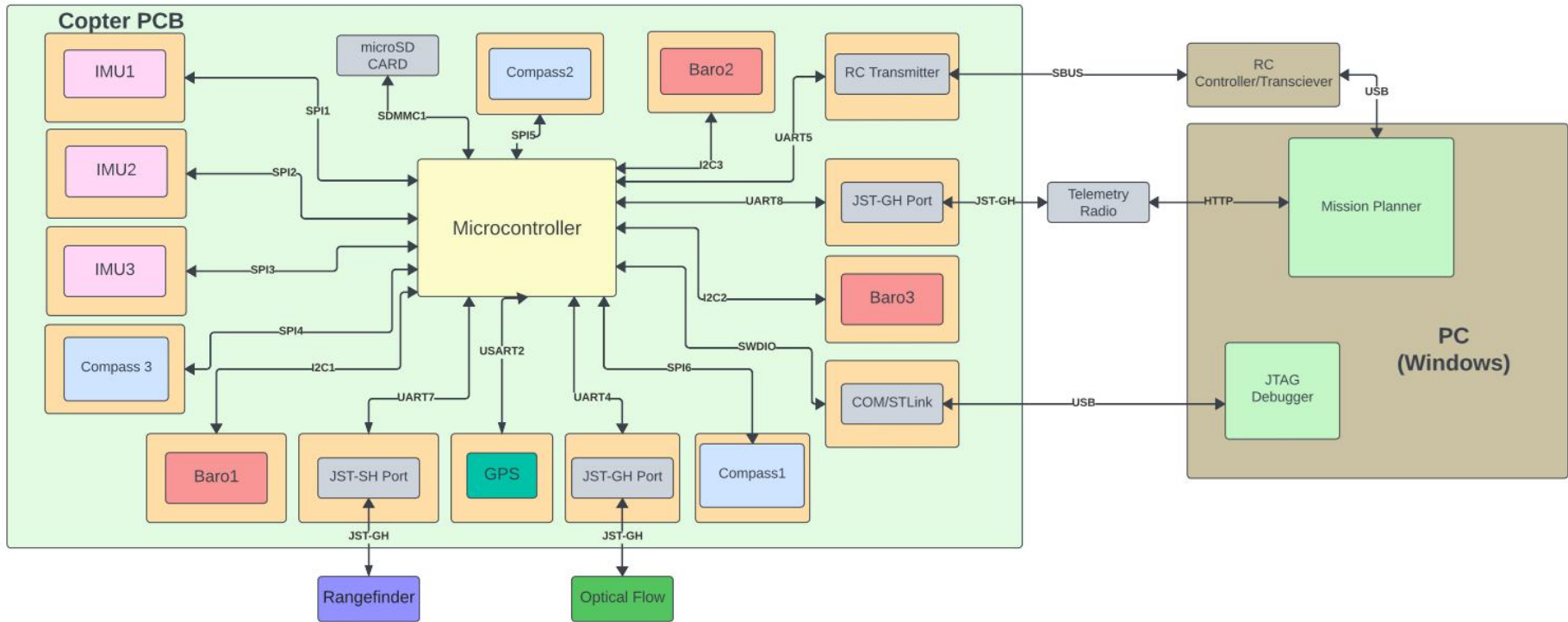
Description

Goal: Prove sensor redundancy in quadcopter flight

- **Design custom PCB with various redundant sensors types**
- **Develop new drivers for open-source codebase, including a new EKF (Extended Kalman Filter)**
- **Build new firmware to be used during test flights**

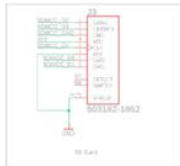
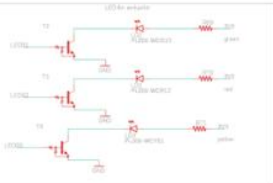
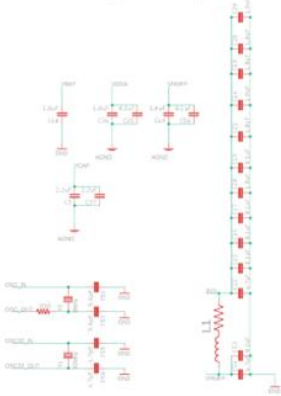
ARDU **COP** **TER**

Block Diagram

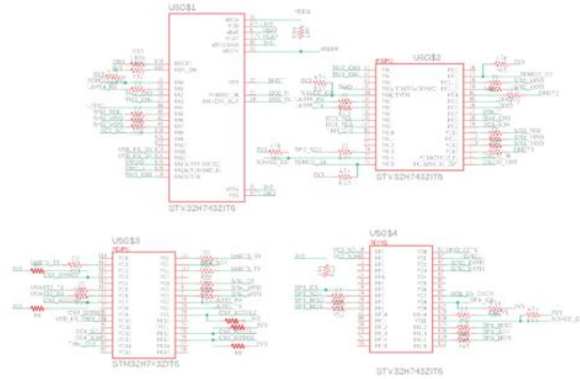


PCB Schematic

Bypass Capacitors



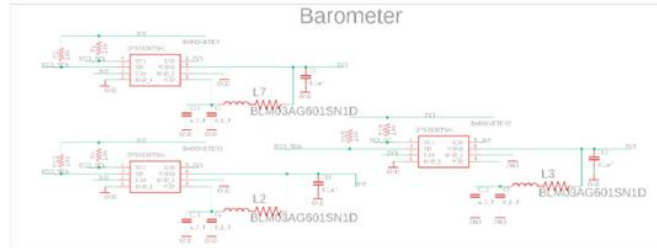
STM32H743



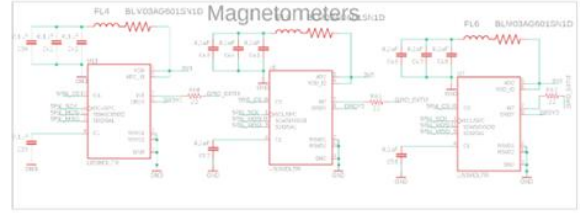
Off-board components



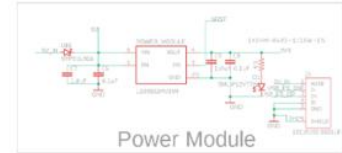
Barometer



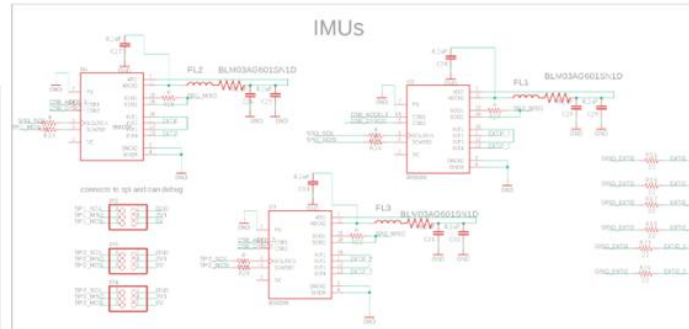
Magnetometers



Power Module

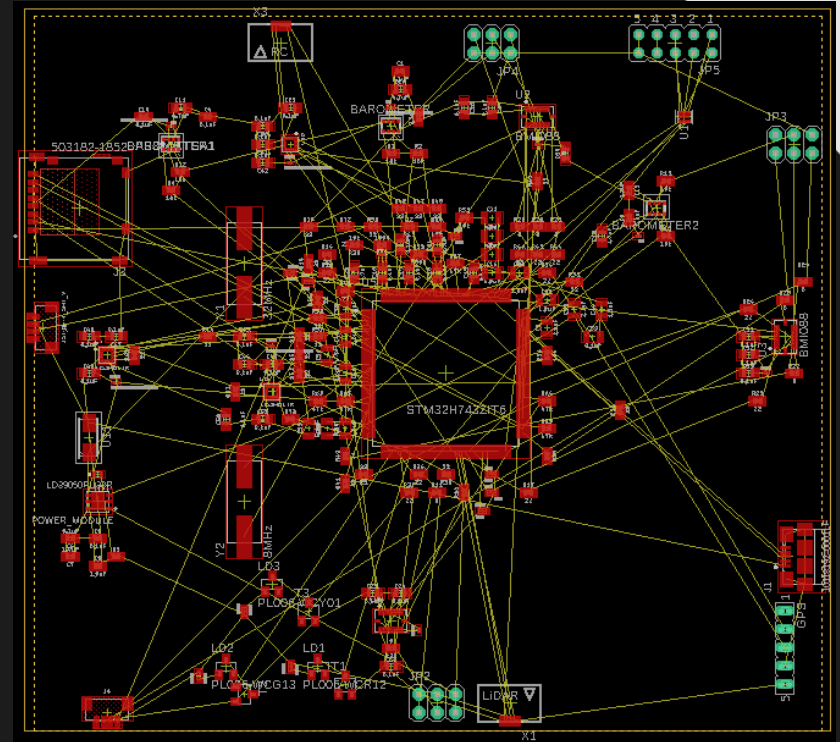


IMUs



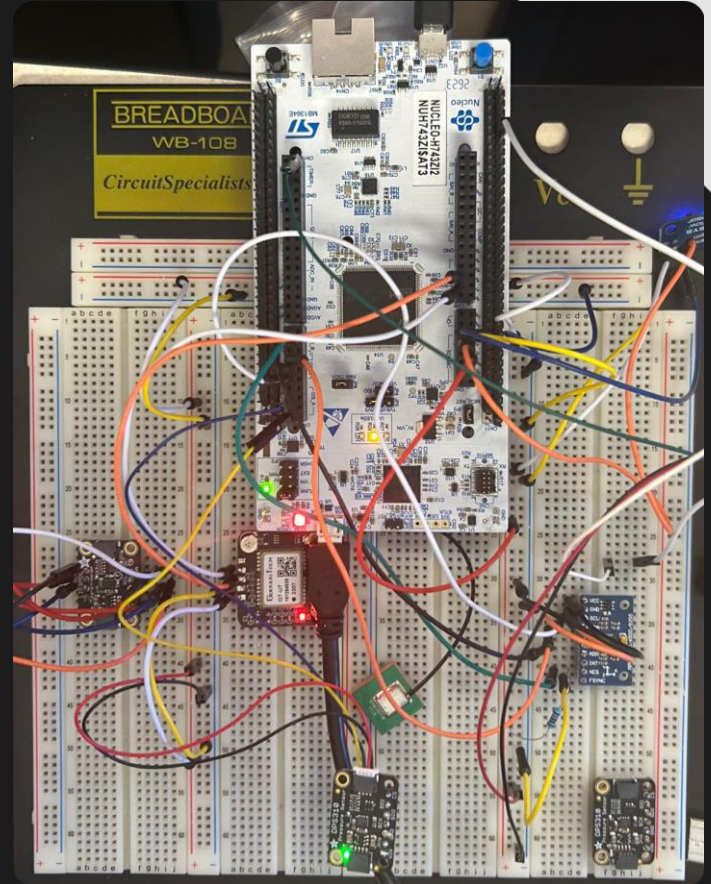
PCB Preliminary Layout

- Larger size than last years due to 3x sensors
- Still a work in progress



Current Progress

- Finalized Sensor Drivers
- First PCB design
- Debugging custom firmware
- Adding memory/radio components



Demo

- Ran an instance of ArduCopter
- Focused on three namesake backup sensors:
 - Compiled demo programs for each of the sensors
 - United work into team breadboard as a display prototype

RangeFinder



None

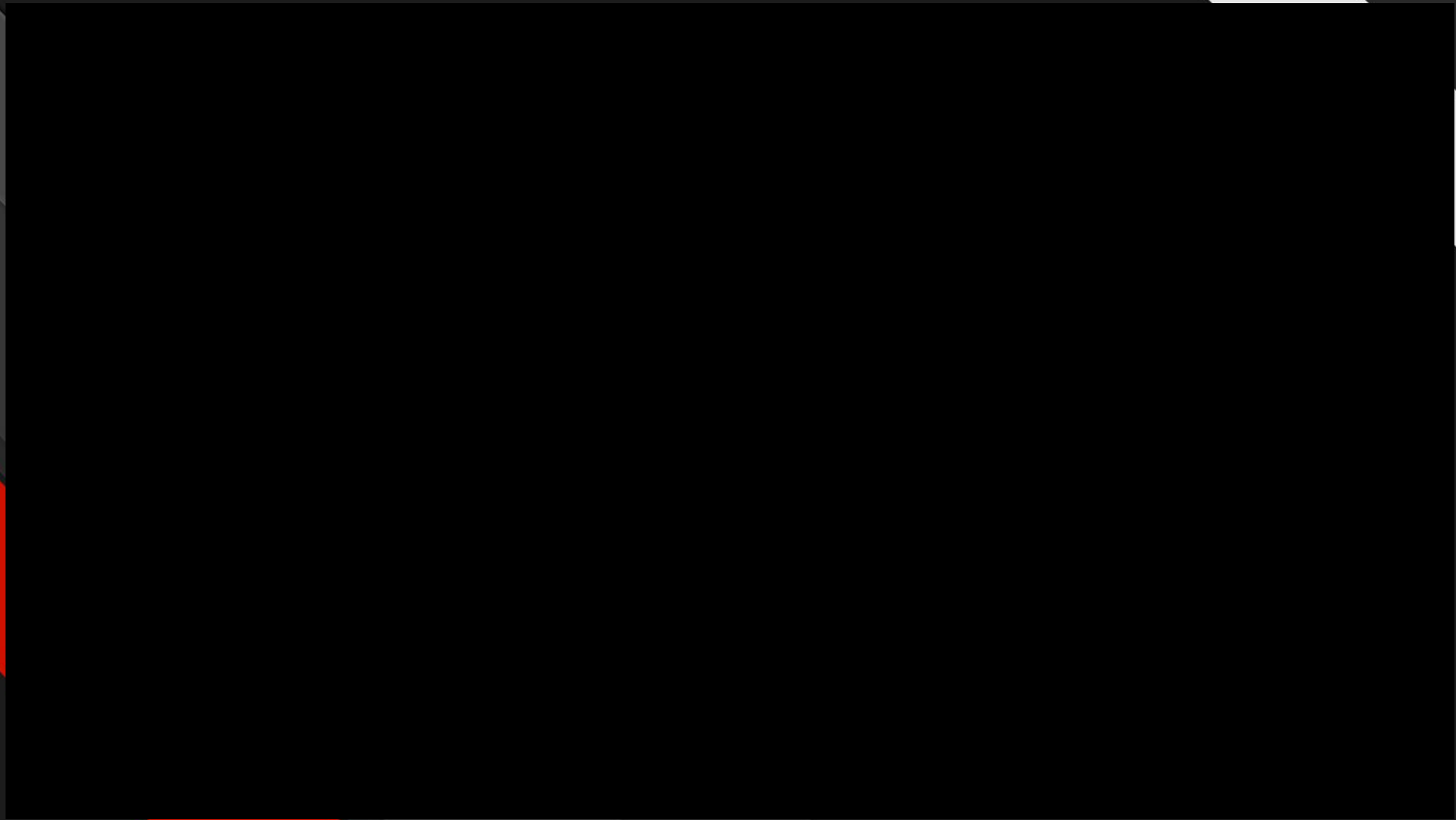
Distance: 1.87

Voltage: 0

	ParamName	DevID	Bus Type	Bus	Address	Dev Type
D>	BARO1_DEVID	65590	SITL	0	0	BARO_SITL
	BARO2_DEVID	65796	SITL	0	1	BARO_SITL
	BARO3_DEVID	0	UNKNOWN	0	0	0
	COMPASS_DEV_ID	97539	UAVCAN	0	125	SENSOR_ID#1
	COMPASS_DEV_ID2	131874	SPI	4	3	LSM3030
	COMPASS_DEV_ID4	263178	SPI	1	4	AK8963
	COMPASS_DEV_ID5	97283	UAVCAN	0	124	SENSOR_ID#1
	COMPASS_DEV_ID6	97785	UAVCAN	0	126	SENSOR_ID#1
	COMPASS_DEV_ID7	98051	UAVCAN	0	127	SENSOR_ID#1
	COMPASS_DEV_ID8	0	UNKNOWN	0	0	0
	COMPASS_PRI01_ID	97539	UAVCAN	0	125	SENSOR_ID#1
	COMPASS_PRI02_ID	131874	SPI	4	3	LSM3030
	INS_ACC_ID	2759028	SITL	0	2	SITL
	INS_GYF_ID	2752772	SITL	0	1	SITL
	SIM_MAG_SAVE_ID5	1	I2C	0	0	0
	SIM_MAG1_DEVID	97539	UAVCAN	0	125	SENSOR_ID#1
	SIM_MAG2_DEVID	131874	SPI	4	3	2
	SIM_MAG3_DEVID	263178	SPI	1	4	4
	SIM_MAG4_DEVID	97283	UAVCAN	0	124	SENSOR_ID#1
	SIM_MAG5_DEVID	97795	UAVCAN	0	126	SENSOR_ID#1
	SIM_MAG6_DEVID	98051	UAVCAN	0	127	SENSOR_ID#1
	SIM_MAG7_DEVID	0	UNKNOWN	0	0	0

ArduCopter

- **Working on fork of open-source codebase**
- **Testing EKF and sensor drivers on SITL tool**
- **Building custom firmware to initialize all sensors required for testing**



SiK Telemetry Radio V3

- **Wireless Communication**
- **Small, Light, and Inexpensive**
 - **Range: 300m ->1000 Feet (7.5 Football Fields)**
- **Compatible with Mission Planner <-> PCB thru HTTP**



Receiver - FrSky RX6R

- Operating range of over 2km
- 16 Channel Communication
- 100mA Operating Range



RC Controller - Taranis X9D Plus

- OpenTX Operating System
- 16 Channel Configuration
- Built-in Failsafe



Proposed Plan

Winter 2024

Create Custom PCB Firmware

- Compact to accommodate the size of the drone
- Perform SWAP reduction as much as possible
- Document progress at UnitedSensors.US

Spring 2024

Attach PCB to drone and demo flight scenarios

- Expecting to go through several iterations
- Alter EKF as needed to ensure most reliable data

Acknowledgements

AeroVironment

- Phil Tokumaru
- Ryan Friedman
- Matthew Fehl



UCSB ECE

- Professor Isukapalli
- Eric Hsieh

THANK YOU!
Questions?