Phase Report 1 - CAD Design and System Layout

07.11.25
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v0.2

1.) Objectives

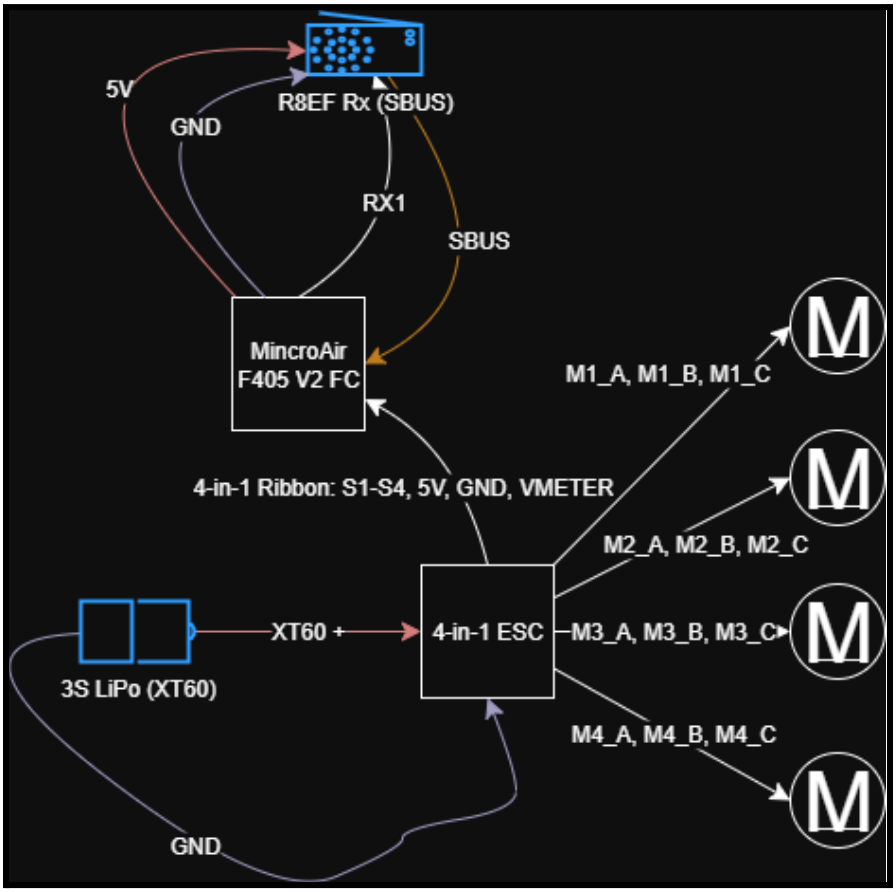
- **Component Research & Selection:** Evaluate motors, ESC, propellers, flight controller, and radio link for compatibility and performance.
- **Procurement:** Order all necessary hardware within budget and timeline constraints.
- **CAD Design:** Develop a 250 mm X-frame in Siemens NX, including baseplates, arms, and skids.
- **Wiring Diagram:** Create a clear block-diagram of electrical connections between battery, ESC, FC, receiver, and motors.
- **Print Preparation:** Export print-ready STL files for frame components; plan 3D printing logistics.

2.) Research Summary & Design Decisions

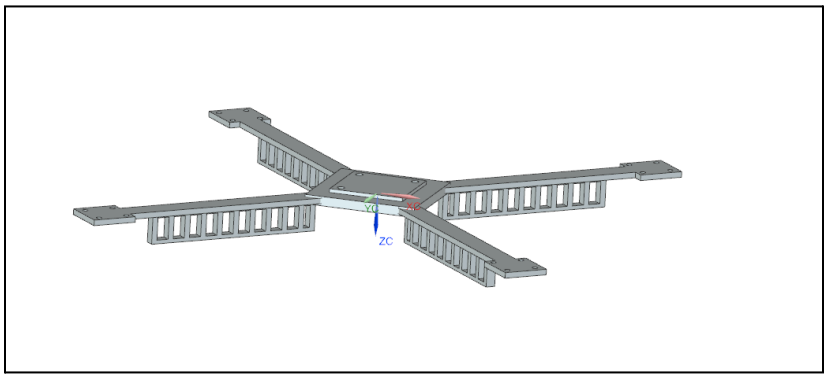
- **Frame & Structural Geometry:**
    - **X-Frame vs. H-Frame**
        - X-frame chosen for optimal torsional rigidity, symmetric motor placement, and weight distribution.
        - Siemens NX used to parametrize arm length (125 mm) and plate dimensions (60 x 60 x 3 mm bottom, 40 x 40 x 2 mm top).
- **Propulsion System**
    - **Motors:** FEICHAO 2204 2300 KV brushless DC motors offer ~400 g thrust per motor on 3 S with 5″ props.
    - **Propellers:** HQProp DP 5×4.3×3 PC V1S tri-blades selected for balance of hover stability and durability.

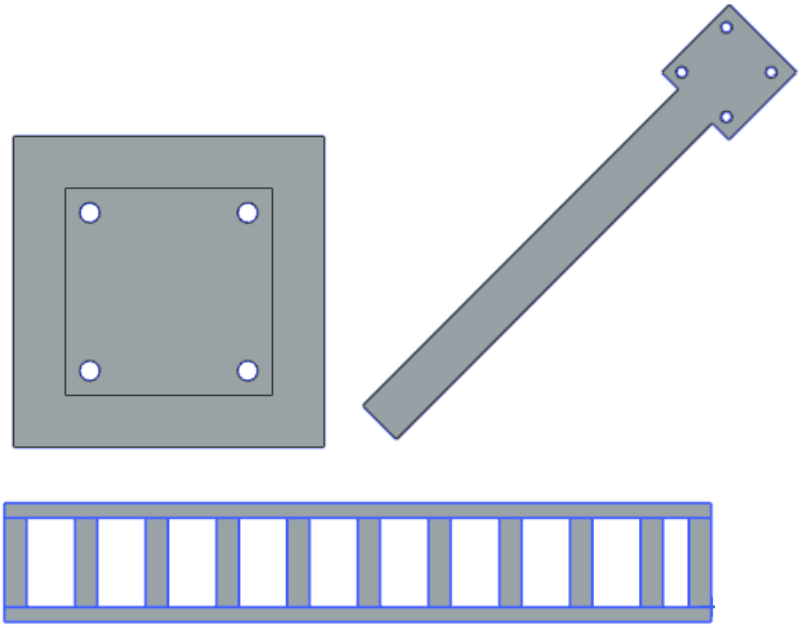
    - **ESC:** AERO SELFIE 45 A 4-in-1 ESC chosen for integrated 30.5 × 30.5 mm mount, DShot/PWM support, and 6 S capability.
- Signal Processing
    - **Flight Controller:** MicoAir F405 V2 (STM32H743 MCU, BMI088 IMU) for SBUS, BEC, and Blackbox logging.
    - **Radio Link:** Radiolink T8FB transmitter + R8EF receiver with SBUS output ensures adequate 8-channel control.
- Power Electronics
    - **Battery:** Tattu 1300 mAh 45C 3 S LiPo provides sufficient headroom for hover current (~48A).

3.) Wiring Diagram



4.) CAD Deliverables & Screenshots





5.) Bill of Materials

Item	Qty	Total Cost (USD)	Notes
Micro Air F405 V2 Flight Controller	1	37.90	STM32H743
HQ DP 5x4.3x3 PC V1S Propellers	4	9.69	May need spares
Radiolink T8FB TX + R8EF RX	1 (ea.)	53.11	SBUS, 8-channel
Tattu 11.1 V LiPo 1300 mAh (XT60)	1	17.49	45 C continuous

LiPo Balance Charger (2-3 S)	1	12.46	May need adapter
FEICHAO 2300 KV Brushless Motor	4	31.86	M3 mount
AERO SELFIE 45A 4-in-1 ESC	1	33.89	DShot compatible
Soldering Iron Kit (80 W)	1	10.08	Solder, stand, paste
Total		206.48	Currently under budget

6.) Challenges

- **Extruding a single region in NX:** Resolved by following a video tutorial on the Siemens NX Tutorials channel, which explains that the Extrude setting must be changed to "Region Boundary Curves" (the non-default option).
- **Part availability:** Sourced cost-effective alternatives when items were out of stock or, more commonly, when delivery would take longer than a week.

7.) Next Steps

- FEA drop-test on frame
- Simulink hover model for altitude hold dynamics.
- Print frame parts at UMass Amherst library