MSc Project Thesis

Topic – Biomimetic Micro-glider for Autonomous Thermal Soaring

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Keywords – Embedded wing; Dragonfly; Thermal Soaring; ArduSOAR

This project was split into 3 parts – wing design, embedded sensor design, and thermal soaring algorithm testing. I worked on the wing design and the thermal soaring algorithm.

Summary –

Designed and built a lightweight, portable glider inspired by the structure of dragonfly wings to explore autonomous thermal soaring mimicking the flight of soaring birds.

Onboard System and Experiment Details –

Custom onboard sensing: temperature, pressure, GPS, pitot, thermal camera. Onboard computer: Raspberry Pi Zero 2W. Flight Controller: Pixracer with ArduPilot (ArduSOAR from ArduPlane).

Conducted six bungee-launched test flights to study energy exchange, glide ratio, and flight dynamics. Flights with better energy management had higher glide efficiency. Despite sensor issues limiting thermal data collection, the project laid the foundation for future autonomous soaring research using biomimetic principles.

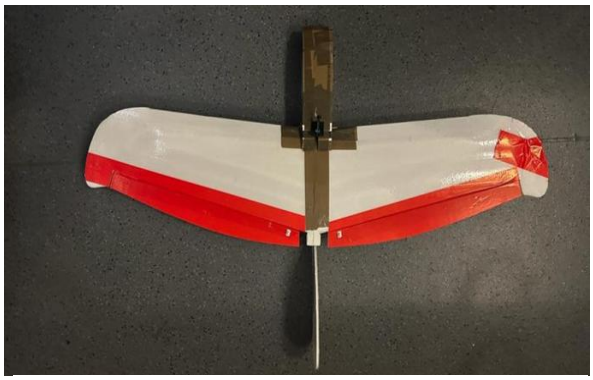

Figure 10: Micro glider with Embedded Wing Sensory Suite. Wingspan = 90 cm.

Figure 11: CAD model of wing with corrugations inspired by the internal structure of a dragonfly's wing.

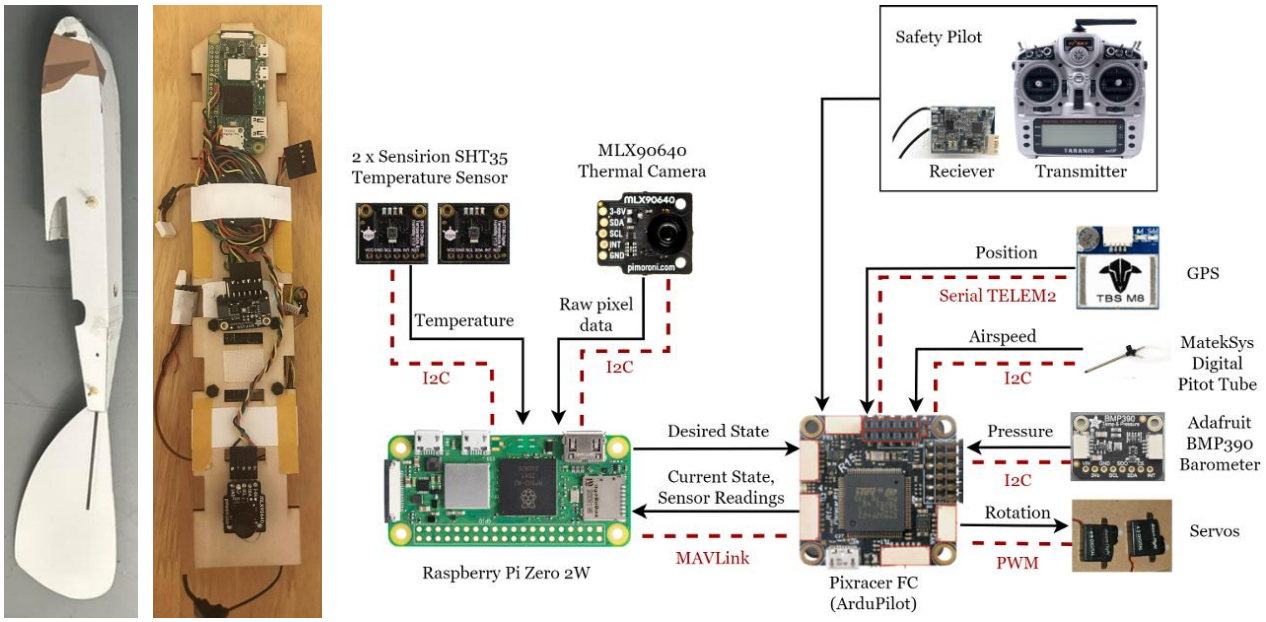

Figure 12: (Left) Glider fuselage, (Middle) Sensor plate with Pixracer and Raspberry Pi, (Right) Systems flowchart to show the connections between the different onboard devices and ground station. Dashed lines represent the communication protocol.