An Autopilot Experience

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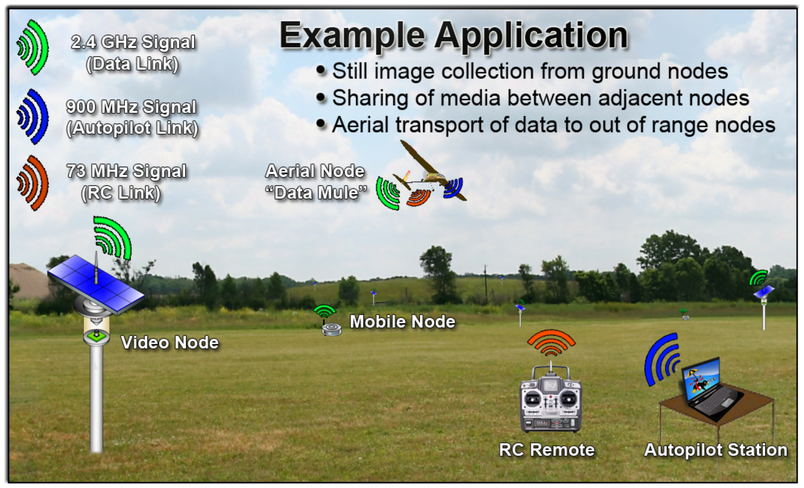
Progress Timeline

- [x] Compilation and installation of Paparazzi linux software
- [x] Configuration of RealFlight for real-time flight simulation
- [x] Mechanical installation of IR sensors and processor board
- [x] "Hardware in the loop" testing: generation of sensor inputs in order to view autopilot outputs
- [~] Radio frequency selection and interference management
- [x] Weight ballancing and mechanical trimming of control surfaces
- [~] IR sensor calibration: finding neutral values
- [~] Angle calibration between software and actual value
- [~] Range testing of telemetry link compared to RC reliability
- [x] Manual flight testing with controller
- [x] Auto1 flight: autopilot control over aircraft balance
- [~] Inflight pitch and roll software configuration and tuning
- [ ] Auto2 flight: full autopilot control with GPS coordination

Introduction

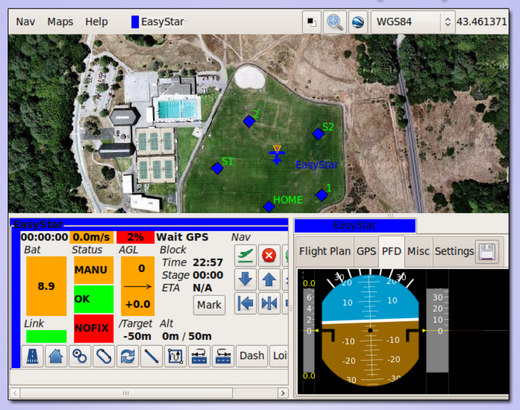
As the complexity of sensor networks increases, range and connectivity become a prevalent issue. The future aim of this project is to provide existing sensor networks with an aerial node which can receive, transmit, and transport data to surrounding nodes. To accomplish this an open source autopilot software, Paparazzi, will be implemented on a RC plane to provide aerial coverage for sensor networks.

Example Application



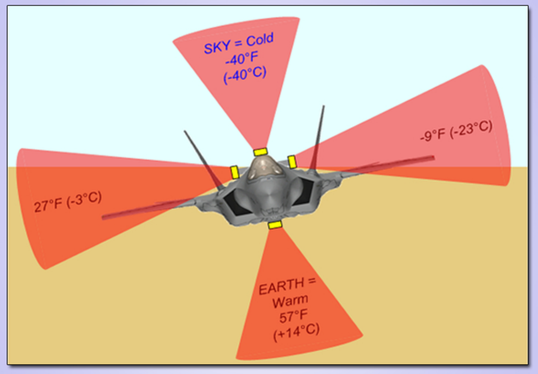
- Still image collection from ground nodes
- Sharing of media between adjacent nodes
- Aerial transport of data to out of range nodes

Ground Control Station (GCS)



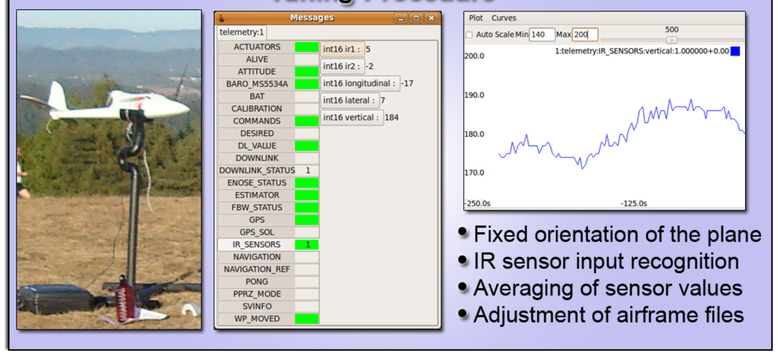
- Complete GUI aircraft control
- Displays speed, altitude, heading, and battery info
- Controls GPS and waypoint navigation
- Allows for realtime airframe tuning

Infrared Sensor Principle



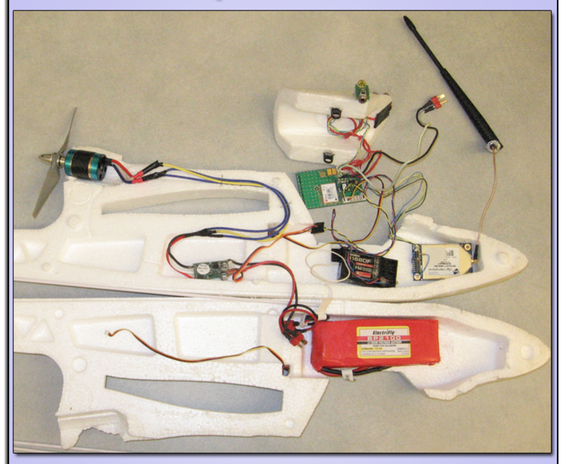
- Assumes that the ground is warmer than the sky
- IR sensors use heat to measure pitch and roll
- At zero pitch angle temperature difference is zero
- Three pairs of sensors increases accuracy

Tuning Procedure



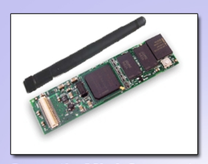
- Fixed orientation of the plane
- IR sensor input recognition
- Averaging of sensor values
- Adjustment of airframe files

Exploded View



- Insertion of TinyOS processor board
- Servo controls routed through the autopilot
- Orientation of the autopilot link
- Placement of the gumstix link (not shown)

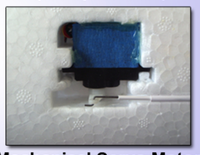
Onboard Hardware



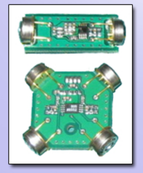
Gumstix Mini Computer (Data Link)

900 MHz Radio (Autopilot Link)

RC Reciever



Mechanical Servo Motor



IR Single/Dual Sensor

Tiny v1.2 Autopilot Board

Legend

- [x] Success
- [~] Improvement Needed
- [ ] Incomplete

Inter-Networking Research Group

PAPARAZZI The Free Autopilot