UCD-UAV: Remote Sensor data collecting over autonomous UAV for Agriculture

UC DAVIS ELECTRICAL AND COMPUTER ENGINEERING

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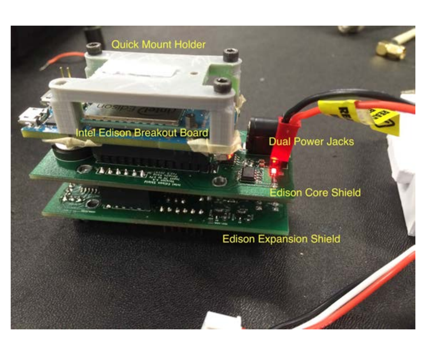
Summary

An autonomous UAV system designed for replacing people from massive workforce tasks in the agriculture fields. One application implemented in our project is collecting data from data loggers in the field. This system will increase the data collecting efficiency, and extent the remote data logger battery life by using low power BLE instead of Xbee or cellular network. Not being designed only for remote data collecting job, the special Task Control System (TCS) software enables the capability of collaborating with various payload devices and executing more jobs including agriculture spectroscopy, animal tracking and etc.

Hardware

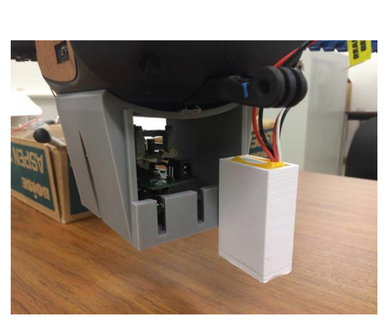
Pixhawk flight controller, running on PX4 flight control firmware, is produced by 3DR company.

Intel Edison microcontroller, working as companion computer, runs ROS and all the task scripts.



Customized Intel Edison Shield, provide protected level shifters with advanced power management features.

We have three UAV platforms in our project. Two of them are built from scratch parts, and one of them is Iris+ UAV from 3DR company.



3D printed Quick Release Rack for holding the companion computer and payloads, designed by Solidworks

System Structure

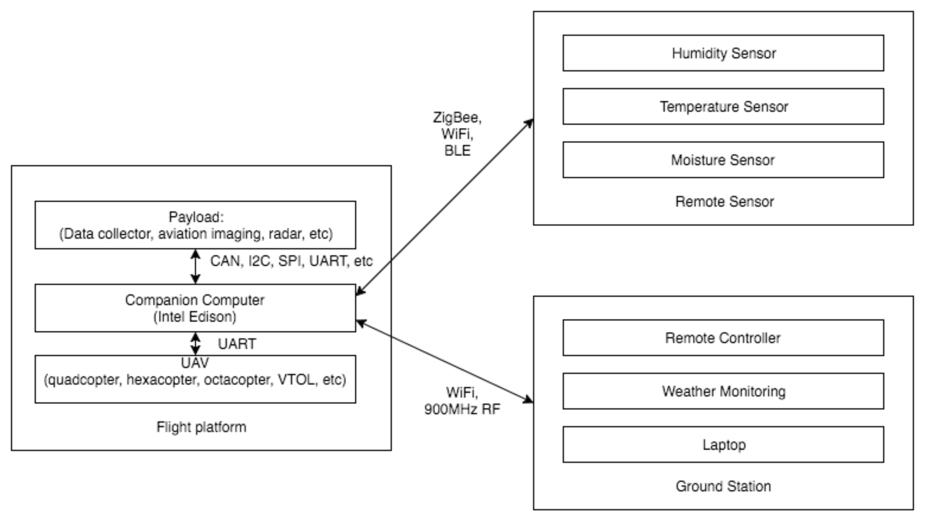


Figure 1. Hardware Structure

Flight platform is UAV with companion computer and payload mounted. Ground station is used to start the flight job and monitor the flight status, and remote sensor in our project is data loggers that waiting for UAV to download the data logs.

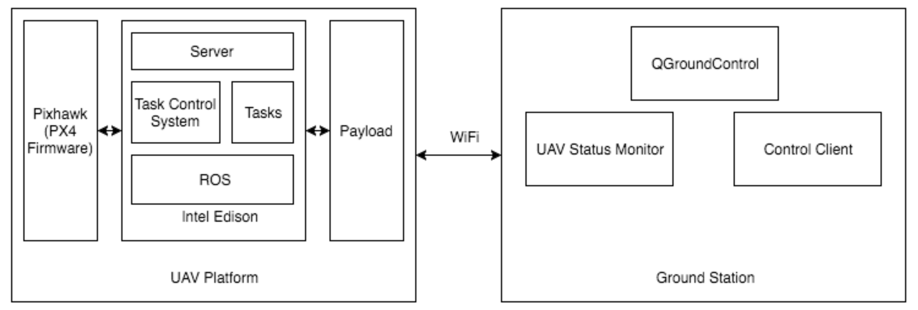


Figure 2. Software Stucture

Intel Edison as center of the UAV platform, controls the Pixhawk flight controller via Mavlink, and interface with Payload to handle the data collecting process. Ground station in our project is a laptop that connected to Intel Edison via WiFi and used to start the flight task.

Methodologies

Two important components in this project are the use of **Companion Computer** and the software platform **Task Control System (TCS).** They convert the role of UAV from a simple toy to the critical flight platform as sub-module in the whole system.

Intel Edison, or the companion computer runs Robot Operating System (ROS), continually send commands to UAV via Mavlink, planning the waypoints, and Intel Edison is also connecting to the payloads, conducting the tasks. Because Intel Edison runs normal Linux system, so it is able to collaborate with various payload devices including data collector, Li-Dar, Camera, Radar and more. It is also able to run node.js and java as webserver, make it possible for user to check the UAV system status in real-time.

On the other hand, Task Control System is a carefully designed schedular software that executs the task scripts in order, and maintains the safety checks all the time. For example, Task Control System divides the remote data collecting job into multiple tasks:

Taking off -> Goto first desitination -> Collect data -> Goto second desitination -> Collect data -> ... -> Goto home position -> Landing

Each task is written in a generalized task script that receive user defined parameters that can be re-used in different situations, and during the whole flight procedure, UAV platform will follow the task_list shown below, and users do not need to interact with UAV with RC, QgroundControl or any other methods.

```
TASK_LOCAL_GOTO 10 0 10 20    // Goto (10,0) position at altitude as 10 meters
TASK_GRAB_DATA 1 20           // Collect data from beacon #1
TASK_LOCAL_GOTO 0 10 10 20    // Goto (0,10) position at altitude as 10 meters
TASK_GRAB_DATA 2 20           // Collect data from beacon #2
TASK_LOCAL_GOTO -10 1 10 20   // Goto (-10,1) position at altitude as 10 meters
TASK_GRAB_DATA 3 20           // Collect data from beacon #3
TASK_LOCAL_GOTO 0 0 3 20      // Goto home.
```

Figure 3. Sample Task list for data collecting demo

Results

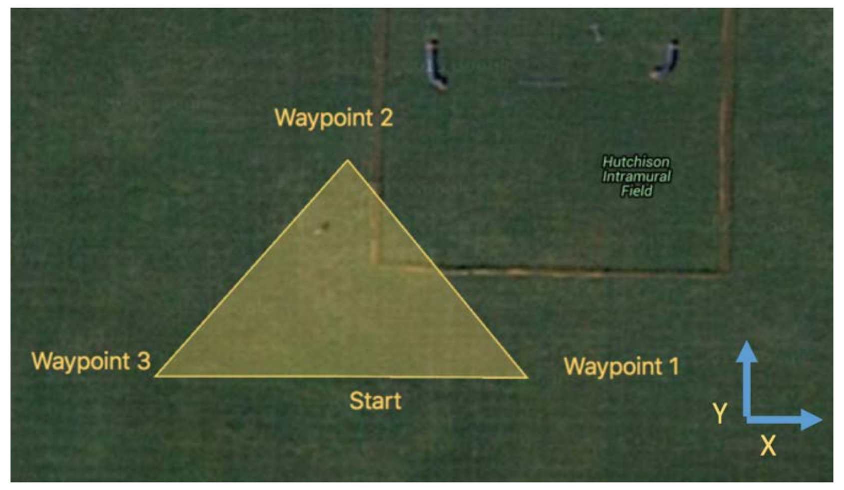


Figure 4. Data collecting DEMO route

Our test was conducted on Hutchison Intramural Field in southern UCDavis campus. UAV will take off at the Start point, flying over the remote data loggers on the waypoint 1 to 3 and collect the log files from them.

Figure 5. IRIS+ UAV on the fly

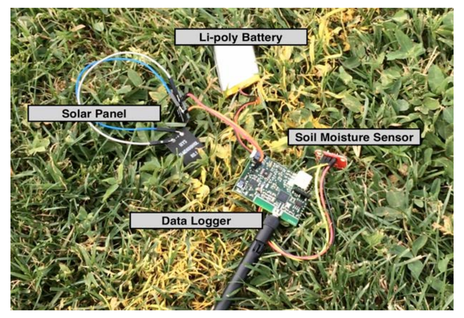


Figure 6. Ground Data logger

Figure 7. Data collecot is taped under the UAV platform

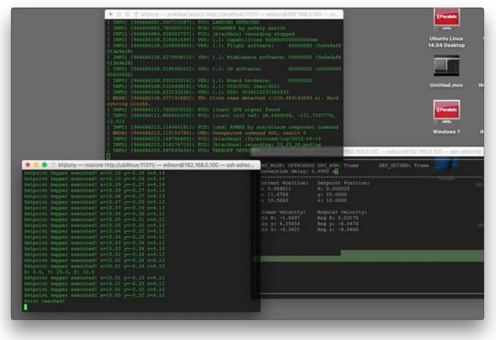
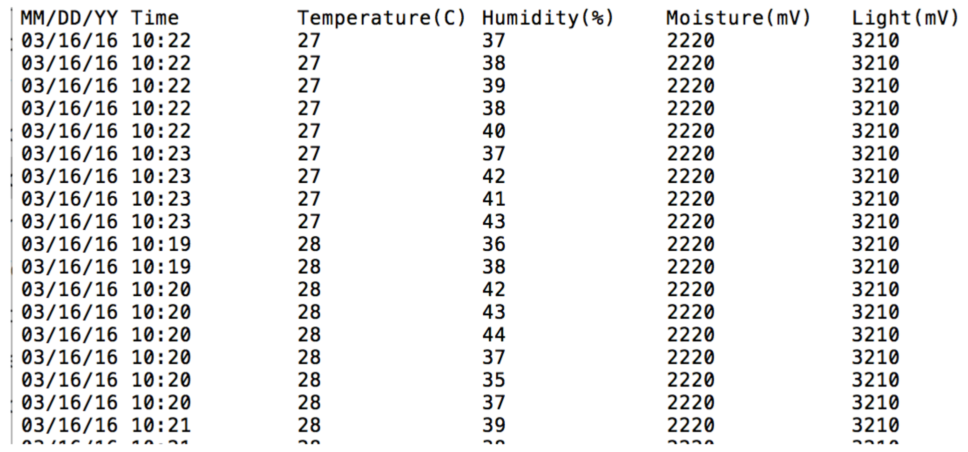


Figure 8. Screen shot of Ground station



MM/DD/YY Time	Temperature(C)	Humidity(%)	Moisture(mV)	Light(mV)
03/16/16 10:22	27	37	2220	3210
03/16/16 10:22	27	38	2220	3210
03/16/16 10:22	27	39	2220	3210
03/16/16 10:22	27	38	2220	3210
03/16/16 10:22	27	40	2220	3210
03/16/16 10:23	27	37	2220	3210
03/16/16 10:23	27	42	2220	3210
03/16/16 10:23	27	41	2220	3210
03/16/16 10:23	27	43	2220	3210
03/16/16 10:19	28	36	2220	3210
03/16/16 10:19	28	38	2220	3210
03/16/16 10:20	28	42	2220	3210
03/16/16 10:20	28	43	2220	3210
03/16/16 10:20	28	44	2220	3210
03/16/16 10:20	28	37	2220	3210
03/16/16 10:20	28	35	2220	3210
03/16/16 10:20	28	37	2220	3210
03/16/16 10:21	28	39	2220	3210

Figure 9. Screen shot of Logged data

Acknowledgements

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