Why this study

Gather the opinion from people who really use Ground Control Stations software to propose some user experience improvements based on that.
DIY Drones Community

DIY Drones is the largest community (71,055 members) for amateur Unmanned Aerial Vehicles. They are focused on recreational projects by amateurs. They are primarily interested in just have fun technical challenge.

“DIY Drones is explicitly built as a social network, which means that the community is as important as the content. We’re also focused on the most accessible end of the amateur UAV world, with the aim of potentially including high school students.”

Chris Anderson
Methodology

Skype conversations with some of the main developers of most used GCS and members of DIY Drones community

Open questions in the DIY Drones forum
What is your drones’ usage?
Which GCS do you use and why?
What are the main features you use?
What are the best and the worst experience using the Ground Control you had?
Online survey posted in DIY Drones Blog

Users profiles

15 respondents
All male
Profession
Around 20-30 years-old
Country

Blog post: Ground Control Stations - Studying a redesign
Setup, Planning and Flight Monitoring are the most used features.

Massive set of controls are difficult to understand and use.

Performance is a big concern.

Lack of explanation for new users.
Get the **vehicle recognized by the GCS and customize the UI** according to that.

**Mission planning is hard** once the UI doesn’t work properly to edit waypoints.

**GCS for mobile are growing**, but the lack of hardware requisites is a concern.
Survey results

Regular drone usage

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photography</td>
<td>10</td>
<td>74%</td>
</tr>
<tr>
<td>Video</td>
<td>8</td>
<td>57%</td>
</tr>
<tr>
<td>Agriculture (NDVI maps, crop scouting)</td>
<td>6</td>
<td>43%</td>
</tr>
<tr>
<td>Surveillance / inspections</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Humanitarian (Eyes/ ears for physically disabled persons)</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Recreation (Flying for fun/ doing acrobatics)</td>
<td>5</td>
<td>35%</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>42%</td>
</tr>
</tbody>
</table>
Survey results

Regular drone usage
Other usages brought by the community

- Survey
- Scientific research
- Ecology and geoscience research
- Environmental survey
- Lidar surveying
Survey results

Owned drones

<table>
<thead>
<tr>
<th>Drones</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR Drone 2.0</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Phantom 2 Vision+</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Phantom 3 Professional</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Inspire</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>F450</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Iris+</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>Solo</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>X8+</td>
<td>3</td>
<td>21%</td>
</tr>
<tr>
<td>DIY Quad Kit</td>
<td>5</td>
<td>36%</td>
</tr>
<tr>
<td>DIY Y6 Kit</td>
<td>1</td>
<td>7%</td>
</tr>
<tr>
<td>Phantom 3 Professional</td>
<td>2</td>
<td>14%</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>50%</td>
</tr>
</tbody>
</table>
Survey results

Owned drones

Other usages brought by the community

- Custom built
- Planes and multirotors
- Custom made hexcpter
- DJI S1000
- Gaui 1300
- Sky Hero Spyder X8 w/ Pixhawk
- XA4000
Survey results

Flight journey

- Preflight checks
  - Authority compliance
  - Camera setup

- Program mission
  - Guided missions
    - Monitor position and altitude

- Monitor mission
  - Auto missions
    - Monitor to guarantee all the data are in range

- Post Flight inspections
  - Auto landing or in stabilize and loiter mode
  - Retrieve camera

Regular
Optional
Survey results

Majority of flights

<table>
<thead>
<tr>
<th></th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous</td>
<td>8</td>
<td>57.1%</td>
</tr>
<tr>
<td>Guided</td>
<td>6</td>
<td>42.9%</td>
</tr>
</tbody>
</table>

42.9%  
57.1%
### Most used ground control stations

<table>
<thead>
<tr>
<th>Ground Control Station</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mission Planner</td>
<td>12</td>
<td>92%</td>
</tr>
<tr>
<td>APM Planner</td>
<td>7</td>
<td>54%</td>
</tr>
<tr>
<td>QGroundControl</td>
<td>4</td>
<td>31%</td>
</tr>
<tr>
<td>Tower</td>
<td>7</td>
<td>54%</td>
</tr>
<tr>
<td>Droid Planner</td>
<td>4</td>
<td>31%</td>
</tr>
<tr>
<td>DJI Go</td>
<td>3</td>
<td>23%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>23%</td>
</tr>
</tbody>
</table>
Survey results

Most used ground control stations

Other usages brought by the community

UGCS
Mikrokopter
Mavproxy
Survey results

Most used features (GCS)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log</td>
<td>11</td>
<td>78.6%</td>
</tr>
<tr>
<td>Setup/ Calibration</td>
<td>13</td>
<td>92.9%</td>
</tr>
<tr>
<td>Mission Planning</td>
<td>12</td>
<td>85.7%</td>
</tr>
<tr>
<td>Mission Monitoring</td>
<td>13</td>
<td>92.9%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>21.4%</td>
</tr>
</tbody>
</table>
Survey results

Most used features (GCS)

Other usages brought by the community

- Re-flight checklist
- Guided flights
- Executing Python scripts
Contingency actions
What do you do if the drone has some problem during a flight? How is this problem analysed afterwards? (if applicable)

- Take manual control
- Run an auto analyst on GCS then manually check but graphing each parameter
- Check the sensors accuracy
Best experiences using GCS

“Haven't had an experience that I could call it the best, it’s just that if the software is doing what it’s supposed to do, everything should be Ok.”

“Old DJI GS very simple and good, so is Tower.”

“Tower, when it comes to flying. Mission Planner when it comes to anything else. Mostly for the sheer volume functionally.”

“I would love a tower like ground station which featured full functionally.”

“Another thing I find useful is video overlay in mission planner. In mission planner you can have a video input, and then put your his over the video. There is nothing like this for android.”
Worst experiences using GCS

“Problems not related to the software itself like losing telemetry signal or running out of power with the PC.”

“Often I experience crashes with mission planner. Another time I connected my UAV and there was a problem refreshing the parameters, so it reset the UAV. I didn’t know, so I went to take off with reversed accelerometers. Caused a nasty crash. It would be good if there was some kind of check list for this.”

“Software don’t make what you think.”

“Proprietary software from now defunct company.”

“Poor camera planning, does not estimate the number of pictures needed for required overlap very well, especially side to side.”

“Hit auto by accident, causing quad to fly away, used RTL to recover.”
How analyse the collected data

“It would be good in the future to be able to download images taken from the drone and have integrated functionality in the ground station.”

“I generally compare each flight with a baseline flight (a flight in which there were no identified anomalies) and check to see the differences between the two log outputs.”

**Most analysed parameters:**
Geotagged images  
post processing  
LIDAR  
Hyperspectral  
Photos with RTK GPS gcp's  
sensors accuracy and health.
More

What we need is a Ground station that focus on Planes and Heli's where automated flight is a must as missions can be 1-4 hours long covering 50-500 hectares

Recommendations for a new GCS:
1. More customizable, to be able to present additional information about the drone, i.e. remaining fuel, multiple battr monitor, camera trigger info, external sensors like temp and humidity.

2. More visible notifications of important information like flight modes.

Mission planner is ok, I am looking for something more robust to replace, I am only getting started in survey flying. Key issues I see is a weak setting on Home, could result in a fly away because it does not understand that home should be where it took off, not my house.

Very poor presentation of flight data, units are unreliable need to show units in all displays, we work in ft, ( I know we need to change) but data can be presented in ft on one display and M on the next, with no units shown to make sure are correct.

Flight planning is weak, gps coordinates from google maps are close but not really close, it would be nice to set a survey/know point and have the program adjust the flight gps coordinates to match.
"I've been flying quadcopters for just under a year, have crashed many and several months ago **built myself a** $2500 dollars quadcopter, for the sake of learning, experimenting and developing my skills."

"Too many ways of doing the same thing, difficult to explain to new people (especially with regards to flight modes and state)."

"We **must** always be able to **command** the UAV."
The biggest mistake with the current GCS software is that they are monolithic in nature. I think they can be split into three areas, Configuration (which is drone specific), Mission Monitoring and Control (MAVLink makes this more generic for all MAVLink autopilots) Mission Planning.

Set-up can be complicated, but it’s more an indication of the complexity of the flight controller (Pixhawk) than the software.

Overall mission planner works quite well once you get used to it.
Information flow is also key, especially for a GSC. Make sure the vital stuff you need is always visible, and at the same time make sure you don't stress the user by showing too much information. Placement is also a big factor. The vital information should be logically grouped and placed, so that the eyes does not have to move around hunting for the information when you do a quick glance at the screen.

Certain screens/lists will cause the entire GCS to become unresponsive (Full Parameter List, Survey Grid are the worst offenders).
Thank you

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