MnSGC Quadcopter Project “Year 1” Competition/Challenge Goals

Announced Oct. 13, 2014

Here are the graded aspects of the competition (learning to solder, learning to program microcontrollers, learning CAD and 3D printing, building the ELEV-8 kit, learning to fly quadcopters, and doing the required reports and outreach events):

1. 10% **Video**: Make a 1-2 minute video (that we might post to YouTube) about your team’s work on this project – the video should include at least some coverage of the kit build, some flying, and some coverage of your solutions to the competition goals. (Note: this is to be completed before the competition date so it won’t include footage from the competition itself – videos will be peer-rated during the competition day.)
2. 10% **Rotor protection**: Design (using CAD) and build (possibly, though not necessarily, using 3D printing and/or laser cutting) something to protect the rotors of the ELEV-8 from striking other objects (like walls or vertical posts). This must be light, of course, but also strong enough to withstand a low-speed collision. Rotor protection is required while learning to fly the ELEV-8 (so get this built early!) but requiring rotor protection might be relaxed later in the year.
3. 10% **Multi-pilot**: At the competition have at least 3 different team members fly a very-basic pattern, just to show they can do it. Start from a 1 meter square landing pad on the ground, fly to and land on an elevated 1 meter square landing pad (on a table), then return to the original landing pad. No time limit (i.e this is not a race), but deductions if any pilot misses the landing marks or crashes. This may be done with either the ELEV-8 quadcopter or with a toy quadcopter. Cudos (but no additional points) to any teams in which all team members can accomplish this task.
4. 10% **Camera mount**: Design (using CAD) and build (this must use 3D printing and/or laser cutting) mount(s) to hold a video camera pointing down and pointing horizontally. (You will need both views for challenge #5 below.) You may build two mounts or one mount that is able to hold the camera in two different orientations or else a mount with a tilt servomotor so the camera can swing between pointing down and pointing out. You may select your own video camera but you may only fly one imaging camera (at a time). (Exception – you are allowed to fly two cameras simultaneously as a “Unique capability” (see #7 below) if one camera is used only for live transmissions to help pilot the quadcopter – AKA First Person View – but not for taking the images used in Goal #5 (Close-up imaging) and Goal #6 (Exploration/Mapping).)
5. 10% **Close-up imaging**: Take photos of specific targets (could be frames from a video; use the camera and mount from #4) on horizontal surfaces (i.e. on the floor or perhaps the top of a “tower” (too small to land on) and on vertical surface(s) (i.e on a vertical wall – don’t hit the wall with your rotors as you approach!). The targets will have features of a variety of sizes so the most points will be awarded for the photos in which the smallest features can be seen. Thus aim for high-resolution and in-focus photos.
6. 40% **Exploration/Mapping**: Generically “explore” a region (probably about 5 meters x 5 meters in size). Collect images of the whole region, generate a 3-D map (i.e. include sizes of features (with real units!) and changes in elevation) of the whole region, sense (and use an Arduino-based microcontroller to log to an SD card) basic environmental conditions such as air pressure, air temperature, surface temperature (of specific target spots on the ground), relative humidity, magnetic field, etc.) as well as anomalies to those values (i.e. locations of elevated magnetic field, surface hot spots, etc.), plus collect and return surface samples from fluid target(s) (i.e. water) and/or granular material targets (i.e. sand/soil). Note: This will be a timed event – you will have about 10 minutes to explore the region. You may spend the whole time in flight or else choose to fly out, fly back to deliver data to help inform additional exploration, then fly out again. You may swap out “exploration hardware” during the time period, if desired. You may elect to pick and choose from the possible types of exploration – teams will get more points for doing more things (as long as you do them well) but you do not have to implement them all. Indeed, you might not be able to implement them all at the same time without exceeding the weight capacity of the ELEV-8.
7. 10% **Unique capability**: Implement and demonstrate at least one unique capability of your team’s choosing besides those required for this competition – either something that will help you complete competition tasks more effectively or just something that interests your team. Possibilities include, but are not limited to, live video transmission while in flight (AKA First Person View), two-way radio communication while in flight (possibly using XBEE radios), the ability to drop off and pick up stationary payloads (either with or without landing), the ability to land and take off from a (calm) water surface, the ability to do infrared or ultraviolet imaging (e.g. of vegetation), mounting a camera that can both tilt and swivel (controlled by servo(s)), implement GPS so that sensor data can be location-tagged,etc. Your unique capability must involve flying, but does not have to be flown with all the “exploration hardware” still in place.