**High-Altitude Ballooning Workshop (final agenda)**

**August 6, 2013 (build/skills) and August 8, 2013 (primary flight date)**

**Akerman Hall – “Hangar Lobby” U of MN – Minneapolis campus**

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**Tuesday, August 6, 2013**

9 to 9:15 a.m. **Introductions, overview of agenda, divide into payload teams (X, Y, and Z)**

9:15 to 9:40 **First look at payload boxes and components**

* **Payload box construction options** (including “flat-sat” configuration) **and rigging** (will practice cutting pieces for payload boxes later)
* **Cameras**
* Still: Canon PowerShot A570 IS (programmed with CHDK)
* Video: Flip, GoPro, Contour helmet cam with GPS, HackHD, etc.
* **Snap-together resistive heater with switch and (optional) indicator LED**
* **Off-the-shelf, user-friendly, HOBO data loggers**
* Standard 2-channel HOBO with sensors (internal temperature and relative humidity; external temperature, pressure, or solar panel)
* Pendant loggers (3-axis “accelerometer” (really a 3-axis force sensor) and light intensity + temperature)
* **Telemetry of experiment data during flight (deal with GPS data later)**
* Zigbee (an Xbee radio that telemeters analog and digital data through the StratoSAT main radio) with a StratoStar “advanced sensor suite” (temperature, pressure, relative humidity)
* RTrak-HAB (an aprs ham radio GPS with analog channels for data) with a Verhage “weather station” (temperature, pressure, relative humidity)
* **Arduino microcontroller to log sensor data (variety) and control servos**

9:40 to 10:25 **Plan interior layout** **then begin integration (use Velcro; also see “mock box”)**

* Practice cutting box pieces (then use pre-cut ones)
* Decide which way to point camera – cut a hole for it to look out
* Make sure components don’t interfere when box is folded up!
* Practice running the components as they are installed

10:25 to 10:30 **Break**

10:30 to 11:50 **Arduino build/program lesson**

* Uno vs Mega; shields; pins; Arduino programming environment
* SD card and real-time clock
* Analog vs digital sensors: temperature, pressure, relative humidity,

3-axis “accelerometer” (force sensor), 3-axis magnetometer

* GPS and LEDs indicator cable

11:50 to noon **Presentation of Arduino capabilities (oral – brief!)**

Noon to 12:30 **Continue payload integration and assembly**

* Add (working-and-tested!) Arduino package into payload
* Strap down components with zip ties
* Fold up payload box and hold it with strapping tape (might have also used epoxy if we weren’t so rushed) – beware: nothing sticks well to Styrofoam
* Add rigging (if you have time – otherwise we’ll do it for you later)

12:30 to 1:00 **Lunch** (provided)

1:00 to 1:10 **Overview of what else there is to ballooning** (besides payload-building)

* Include comments about FAA regulations

1:10 to 1:25 **Practice doing flight predictions for a Thursday 10 a.m. (15:00 UTC) flight**

1:25 to 1:45 **Introduction to tracking hardware** (will only discuss off-the-shelf solutions)

* 144.39 MHz aprs systems (flight and ground equipment – need to have a ham radio license to purchase and operate this equipment)
* StratoSAT system (flight and ground equipment – the most capable system, but also most expensive option by far)
* Other tracking options:
  + Ham radio – 440 MHz aprs (not on internet) and 440 MHz MMT
  + Non-ham-radio – PocketFinder, SPOT tracker – need subscription

1:45 to 2:45 **Mock launch and tracking** (so tomorrow’s activities make more sense)

* Practice inflation (indoors), calculate/measure excess lift, seal the balloon
* Finalizing the stack – verify tracking, turn on experiments, seal payloads
* Practice tracking the stack (walk it around; monitor it from the hangar)
  + “In-car” aprs operations (hardware and software required)
  + “In-car” StratoSAT operations (hardware and software required)
  + On-line tracking options (aprs.fi and PocketFinder)

2:45 to 2:50 **Break**

2:50 to 3:10 **Considerations, techniques, and equipment for recovering payloads**

* **What to aspire to for a chase and landing zone**
* Sun angle, road access, water/woods coverage, flying short/long
* **Top 10 recovery mottos**
* Have redundant trackers and monitor them all before and during the flight
* Be able to get transmissions after it lands (don’t depend just on internet)
* Watch it land (be there when it comes down if at all possible)
* Use a siren – warns people of landing, helps in poor-visibility situations
* Get permission before going on private land (if at all possible)
* Dress for terrain – long pants, enclosed shoes or boots, long sleeves, etc.
* Stay safe, stay together – water, hats, sunscreen, bug spray, first aid kit
* Required recovery equipment – hand-held GPS (watch units!) & batteries
* Useful recovery equipment – string & ropes, sling shot, extendible pole, ladder, hand saw, boots/waders, chain saw, walkie talkies, etc.
* Observe payloads carefully before picking them up / opening them up

3:10 to 3:45 **Overview of data analysis**

* What photos and video look like from a balloon flight, with examples.
* What aprs tracking data looks like; screenshots and 3-D plot examples.
* What HOBO sensor data looks like and graphed examples.
* What StratoSAT sensor data looks like and graphed examples.
* What Arduino sensor data looks like and graphed examples.

3:45 to 4:00 **Discuss logistics for Thursday’s flight**

**Thursday, August 8, 2013**

7 a.m. – **Equipment van departs** campus and begins set-up

8 a.m. – **Passenger vans depart campus** (launch site TBA, probably southern MN – weather dependent)

9:30 a.m. (approx.) – **Arrive on launch site, set up tracking in cars, organize stacks**

10:30 a.m. to 11 a.m. (approx.) – **Fill balloons and release them**

11 a.m. to 1 p.m. (approx.) – **Track balloons during flight** (bring lunch/snacks to eat while we drive)

1 p.m. to 3 p.m. (approx.) – **Recovery operations**

3 p.m. to 5 p.m. (approx.) – **Return to campus, first look at data** (some analysis while driving)

Later (dates TBA): **Distribution of data** (raw and analyzed) and **opportunities to discuss it** (in person and/or by phone)