Final Presentation

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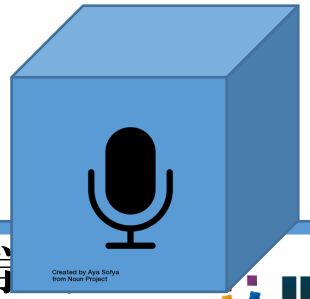
Mission - Recording sound of HEPTA during flight

- Human use many senses to sense our environment, but satellite sends only numerical data and photo.
- Numerical data is takes time for human to analyze. Photo takes time to be downlinked. Sound is easy to send and tells us more about satellite's current situation.

- MISSION: Analyze the activity of HEPTA during launch, deployment, and landing using a condenser microphone. The recorded sound will be sent at real time and stored to microSD.



Criteria

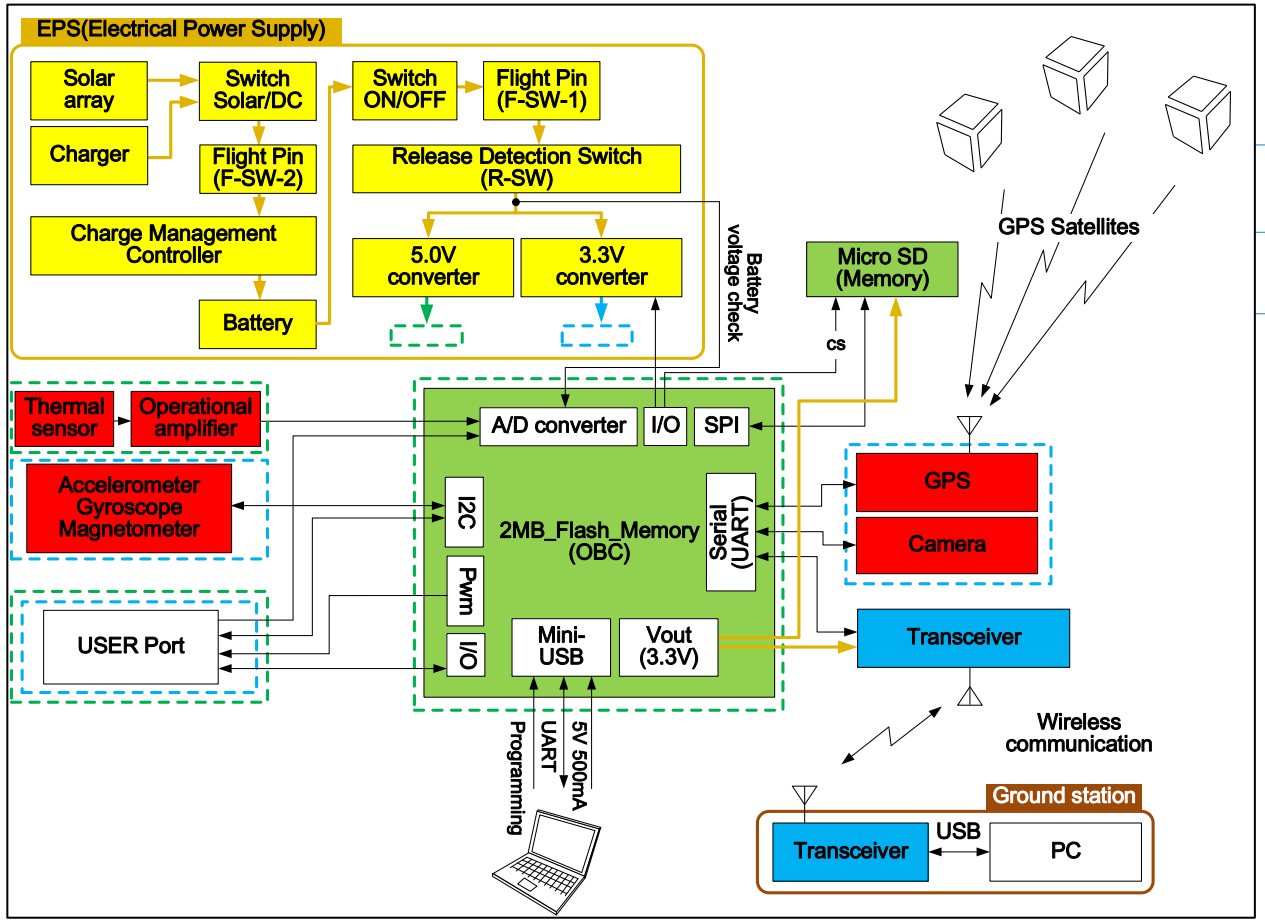
- Minimum Success
  - Record the volume of sound only (non-audible; sampling rate ～2000Hz).
- Full Success
  - Identify the point of launch, deployment, and landing from the acquired data.
- Extra Success
  - Record and send audible sound of the whole launch sequence (sampling rate 4000Hz～; c.f. phone uses sampling rate of 8000Hz).

Mission Requirements

- In addition to bus requirements :
  - SD can be opened
  - Sound data can is observed

No.	Event	Requirment	Required Function	verification way
R-1	Preparation pahse	・・・	・・・	・・・
R-2		・・・	・・・	・・・
R-3		・・・	・・・	・・・
R-4	Stanby time pahse	Battery voltage is 4.0 V or more	Function to charge from the External source	Confirm battery is charged
R-5		・・・	・・・	・・・
R-6		・・・	・・・	・・・
R-7	Launch phase	Send the sensing start command	Function to send commands	・・・
R-8		Receive command, wait for sensing	・・・	・・・
・		Save latitude, longitude, altitude, barometric pressure	・・・	・・・
・		・・・	・・・	・・・
R-18	Mission phase	・・・	・・・	・・・
R-19		・・・	・・・	・・・
・		・・・	・・・	・・・
・		・・・	・・・	・・・
R-25	Analysis phase	・・・	・・・	・・・
R-26		・・・	・・・	・・・
R-13		・・・	・・・	・・・

Bus System Architecture



P19

3.3V

GND

Created by Aya Sofya from Noun Project

SD Subsystem

- fprintf(fp, "%c", ain.read_u16()>>8);

1. Data was read from AD Converter in HEX (0 – FFFF)
2. Data was bit-shifted by 8 bit for compression (same as dividing by 256)
3. Data was converted to ASCII and was written on SD

- Example

1. 486C
2. 48
3. H

SD Subsystem - Data Analysis Method

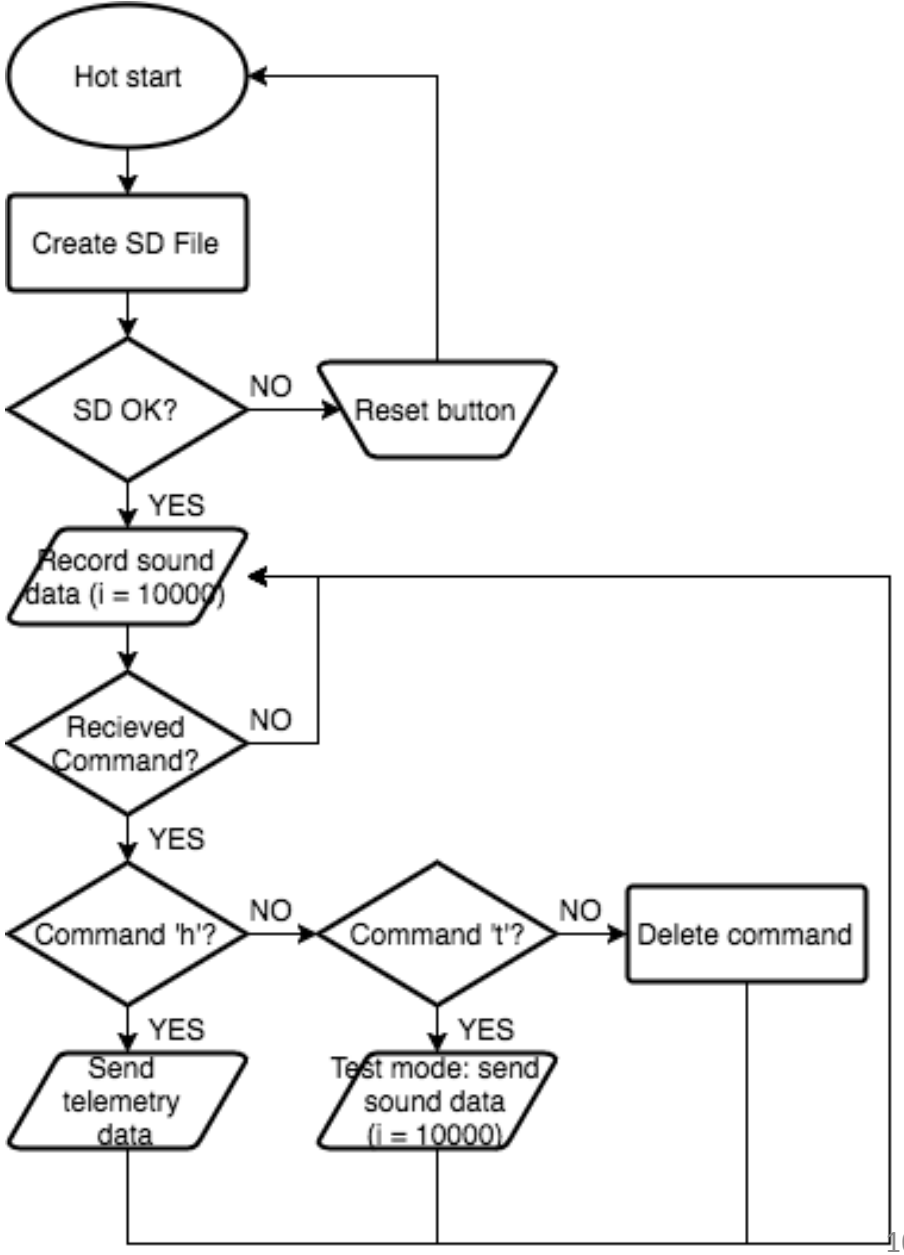
- Data was recorded to SD in ASCII.
  - One sampling data was recorded as single letter in ascii
- Data was changed to wav using Python package SciPy
  - wav_array = np.fromfile(csv_name+'.txt', dtype=np.uint8, count=-1)
    scipy.io.wavfile.write(csv_name+'.wav', sampling_rate, wav_array)

- 16.21 [seconds]/30 [loop]
- 1 [loop] = 10,000 [record]
- Sampling rate = $\frac{30}{16.21} * 10000 = 18507\ [\mathrm{Hz}]$

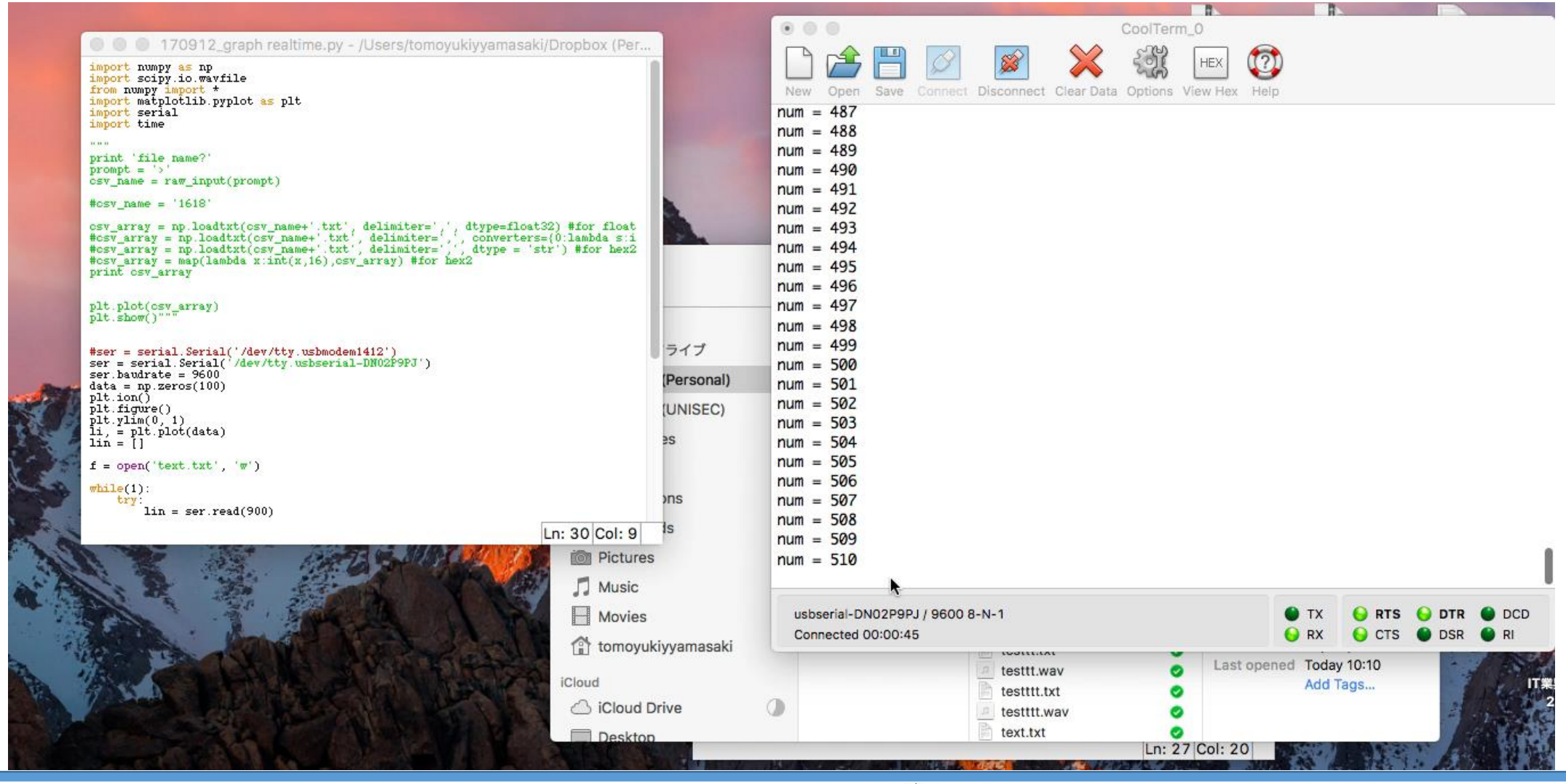
Microphone subsystem

Mission Sequence

- Continuously records sound while waiting for a command
- When it receives command from ground station, it goes into test mode or sends telemetry data



Validation and Verification Testing



Flight Result: First Attempt

- No result

- Reason:
  - The code was written in a bad manner; Mbed deleted and rewrote the file ’text.txt’ every time it was reset.
  - Reset button functioned and data was deleted upon impact of landing

Flight Result: Second Attempt

- Changed code: checked if file ‘text%d.txt’, i existed or not, and created the first file that did not exist.
  - It doesn’t delete file when it is reset!

- Got audible sound data at sampling rate of 18507 Hz
- Point of launch, deployment, and landing could be analyzed

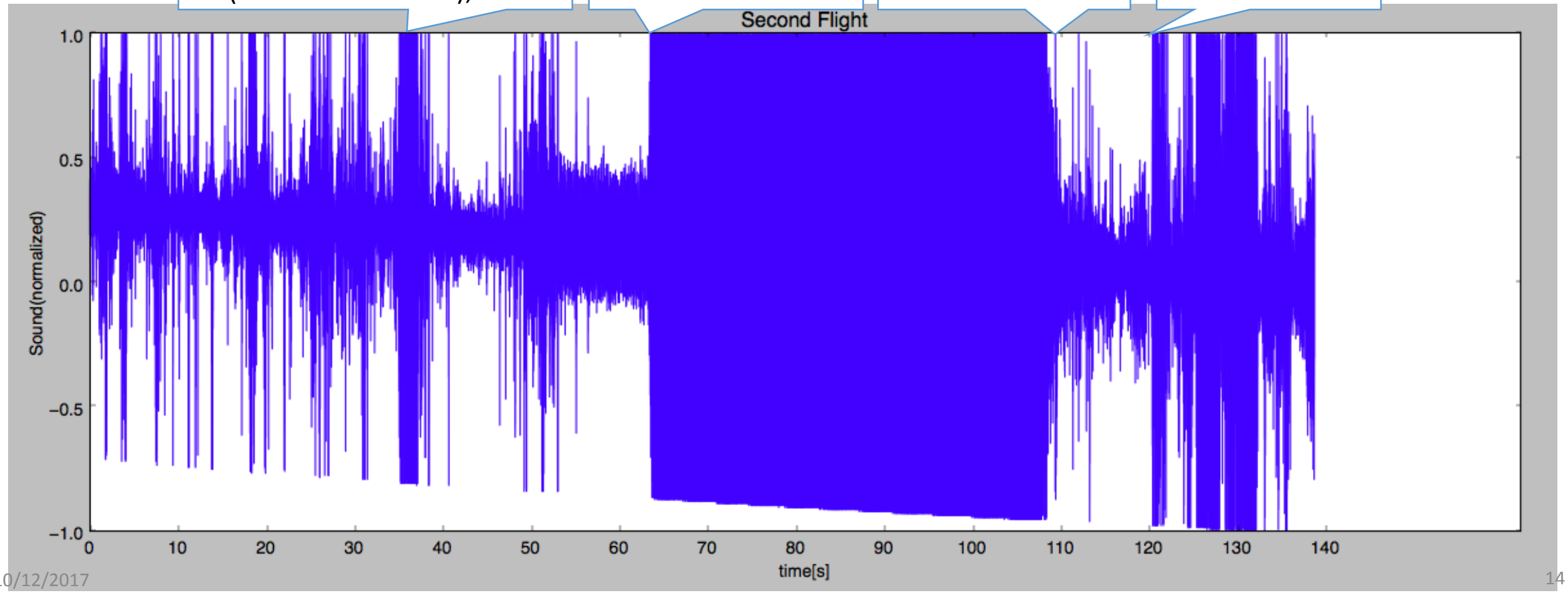
Flight Result: Second Attempt

今から試験始めます
(I will start the test); 35s

Point of Launch; 63s

Deployment; 108s

Landing; 122s



Flight Result: Second Attempt

- Launch; 63s (From Launch: 0s)
- Deployment; 108s (From Launch: 45s)
- Landing; 122s (From Launch: 59s)

- Matches well with the data from video
- Launch – Deployment; 46s Launch – Landing; 60s

CLTP-8 Drop test			2nd Drop					
Family Name	First Name	Middle Name	knot check	Binding check	Weight[g]	wind velocity [m/s]	altitude[m]	TIme[sec]
Yamasaki	Tomoyuki		o	o	360	2.4	50	13

Conclusions

- Minimum Success SUCCESS!!
  - Record the volume of sound only (non-audible; sampling rate ～2000Hz).
- Full Success SUCCESS!!
  - Identify the point of launch, deployment, and landing from the acquired data.
- Extra Success Partial SUCCESS!!
  - Record and send audible sound of the whole launch sequence (sampling rate 4000Hz～; c.f. phone uses sampling rate of 8000Hz).
- Unsuccessful Test was done in SD saving mode; data was not sent wireless
- Successful Sampling rate was much higher than Extra Success criterion.

Recommendation and Future Work (Mission)

- Downlink recorded sound from HEPTA sd via Xbee.
  - Should be easy
- Decrease the gain of the circuit
  - Some sound data was going off limit
- Use a mbed with faster, higher impedance AD converter
  - Faster AD converter will increase accuracy, higher impedance will decrease noise
- Send the live audio data to ground station and play real time sound
  - Xbee communication? – Sampling rate may not be enough(xbee send command will slow down the loop); converting to audio file may be difficult.
  - FM transmitter? – Seems like a good way!

Thank you!!

Feedback and Recommendation (CLTP)

- Thank you very much for this intensive course!

- More time to design mission
  - Let participant know of HEPTA's interface, they may be able to bring their own sensor
- CDR should be more critical
  - Some mission may have low possibility of success. Earlier feedback is desired.
  - May be take individual consulting time to improve each participants' mission.
- Launch can be much more efficient
  - Have each participant prepare a concrete launch sequence (what program to bring from home, what verification must be done before launch etc…）

Feedback and Recommendation (CLTP)

- Example of functions
  - Some example (sample program) along with the function list would have been helpful.
  - void vol(float* bt); …. What happens to bt?
- Making action item and notice discrete
  - It was hard for me to understand if a slide was something that I had to do or something that I should just read and understand.
- Offline IDE might have been better
  - Sometimes online IDE server fails
  - Can be used at launch site too
- Taking picture function should be changed to not to overwrite
  - Add a line like if(fp_jpeg = fopen(fname, ”r")) break;

Feedback and Recommendation (CLTP)

- Diagram of circuit
  - In paper. I want to get the big picture of how HEPTA works.
- Parts list
  - Parts list should include type number
  - Parts' bags could be labeled with Number so it is easier to find.
- Slides
  - Slide number
  - Subtitles are sometimes ambiguous (see next two slides)
- How can we go further?
  - Where to find launch, radio module that can be used from space, how to do thermal design etc.

Slide Title

- Content A
- Content B
- Content C
- Content D

Slide Title

- Content A
- Content E
- Content F
- Content G

Am I reading the same slide??

Oh, it’s a different slide!!