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# SUP SAT

United States Air Force Academy  
Junhyung Park

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*Integrity - Service - Excellence*

# Junhyung Park

## BS: Electrical and Computer Engineering

### Minor: Spanish



- Electronics Team Lead for Blue Horizon Rocketry Club
- Software Engineer for Weather Balloon Research
- FalconTank Contestant/SPARK
- D-III Men's Ultimate Frisbee





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# Team Members



- Junhyung Park - ECE
- Simon Gott - ECE
- Gunnar Gott - ECE
- Shepherd Kruse -  
Aeronautical Engineering
- Jack Arne - Aeronautical  
Engineering
- Matthew Sharkey -  
Aeronautical Engineering
- Ethan Lefebvre -  
Computer Science



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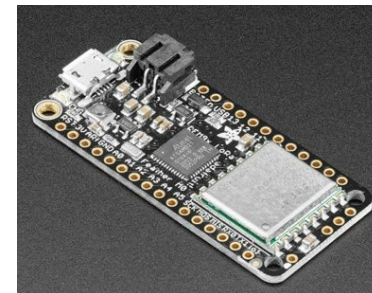
# Goals

- **Spirit Mission:** A tradition that the first-year cadets do a special activity to raise the morale of the students through tough, grueling academic and military life.
  - Send three-star general's flight cap to near-space!



- **Research**

- Long Range Wide Area Network (LoRaWAN) Radio Transmission System
- Cheaper weather balloon research!

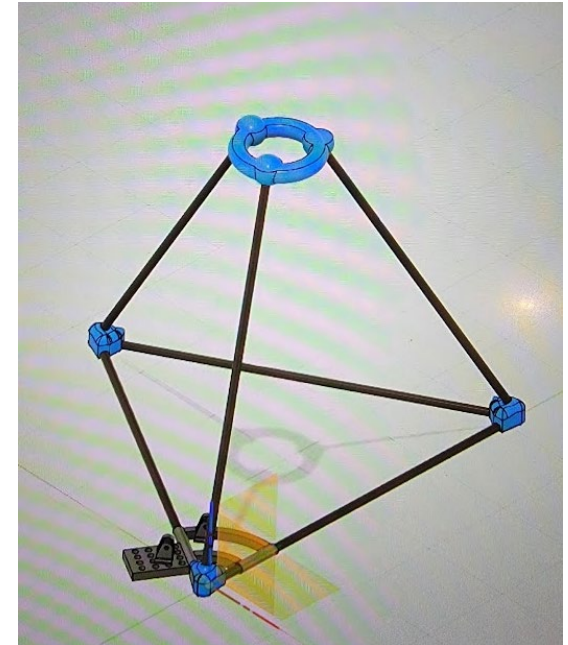
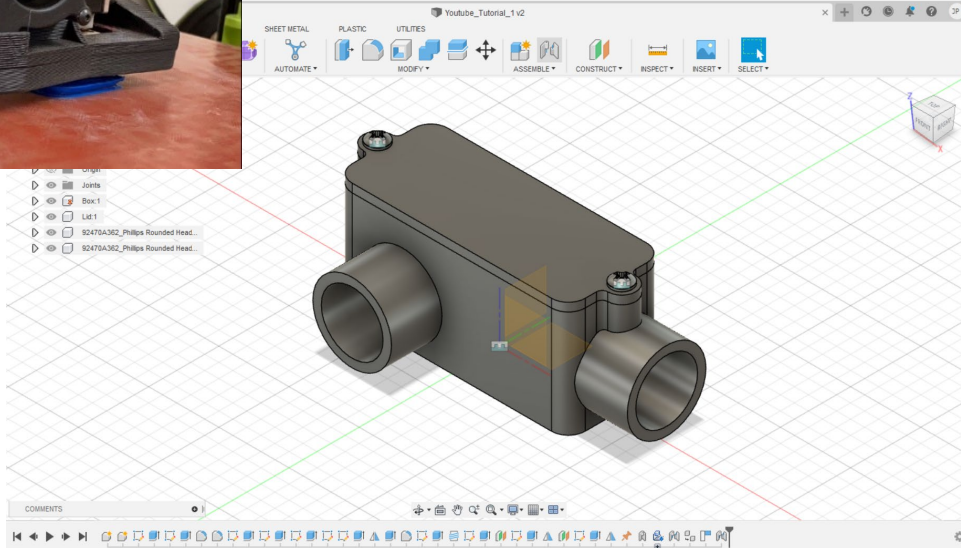
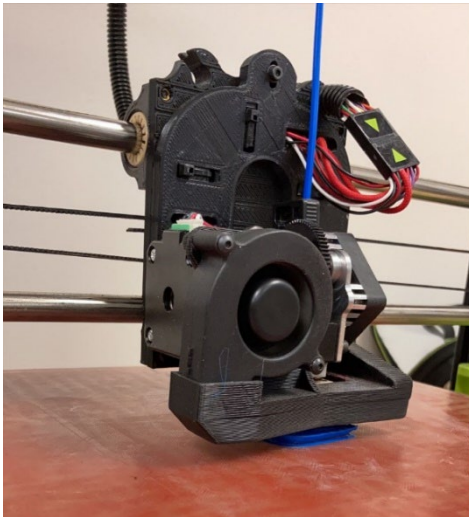


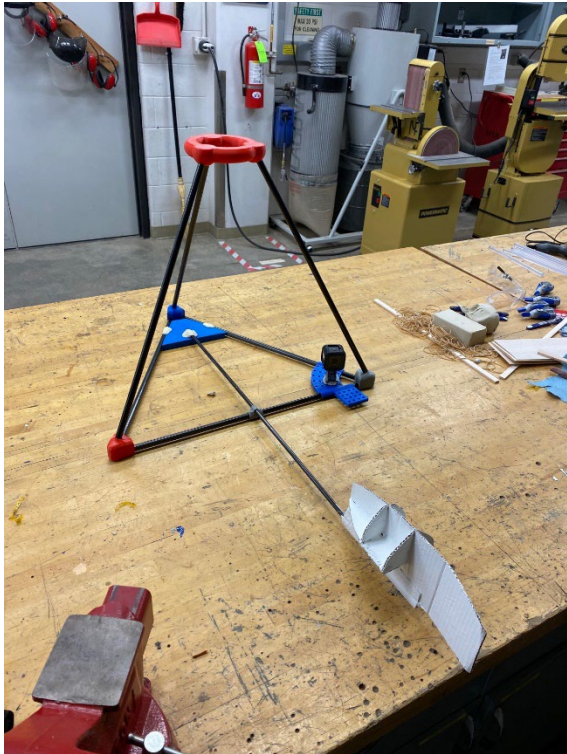


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# Structure Development

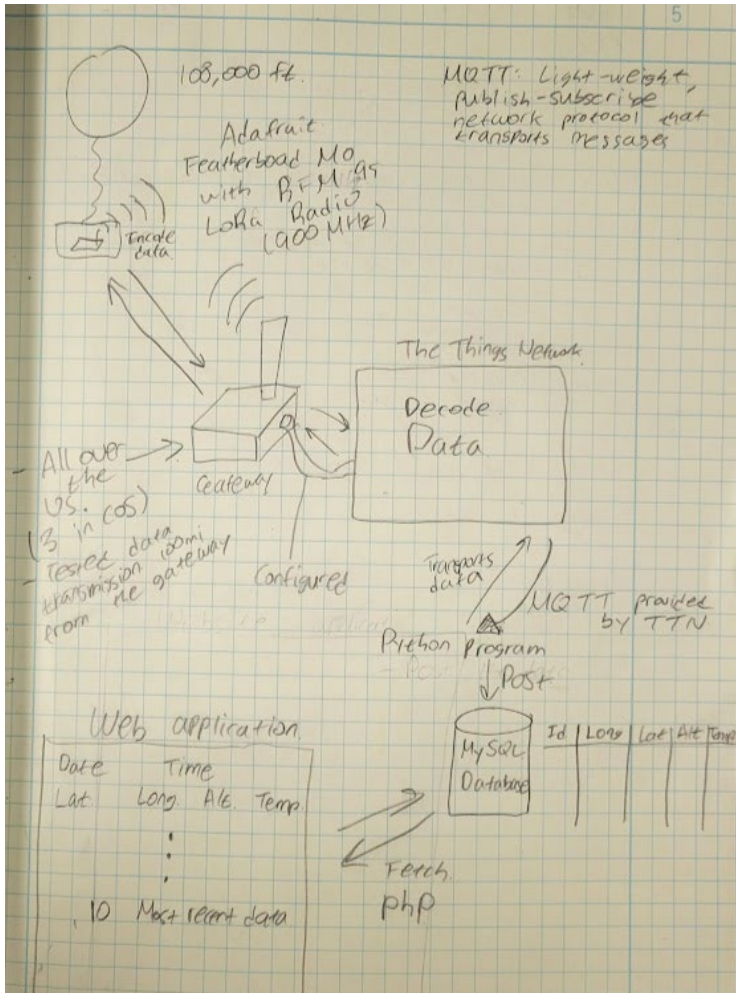
- Fusion360 CAD software
- 3D Print



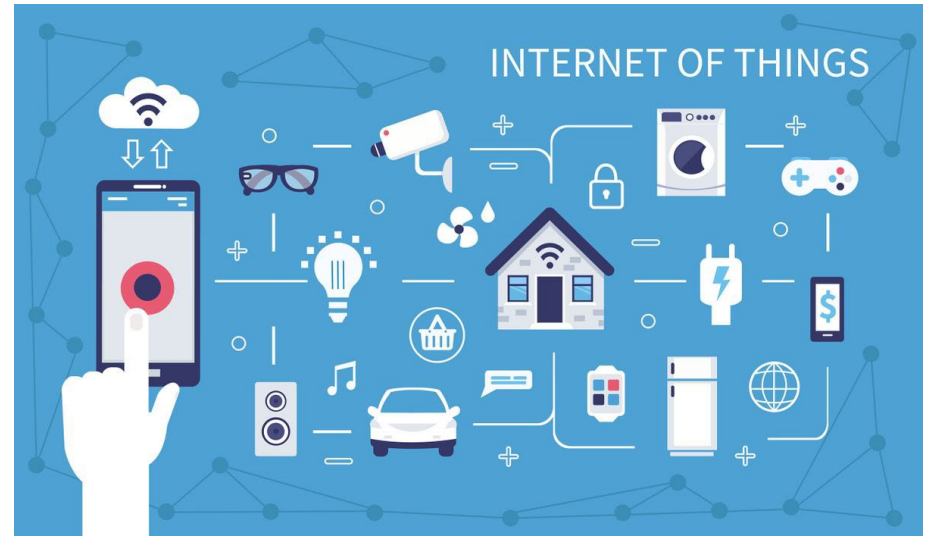




# Electronics Infrastructure



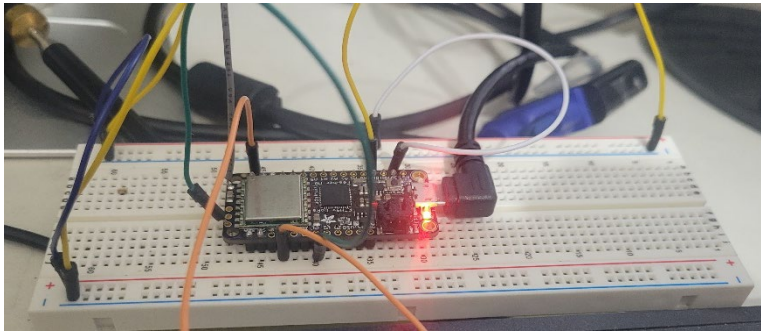
- **Components**
  - **Microcontroller**
  - **GPS**
  - **Temperature Sensor**
  - **Internet of Things (IoT)**





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# Payload Development



```

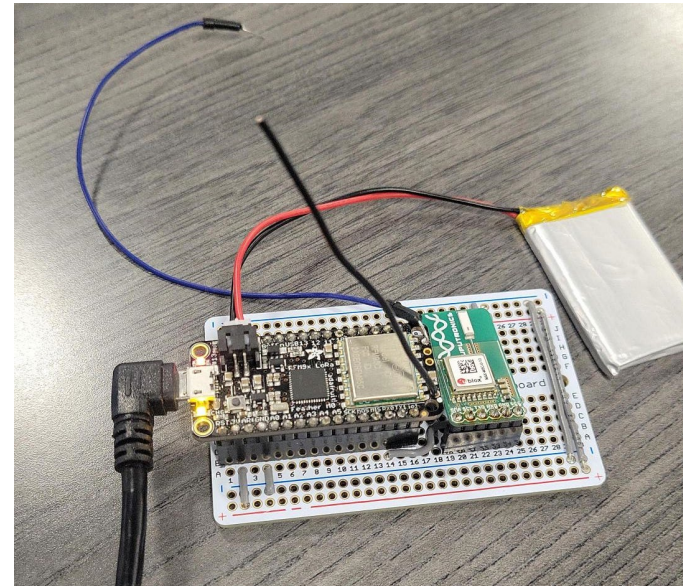
- Rx1 Delay: b
- MAC payload: 7F 9A 4C 14 16 90 97 F7 ... <> FPort: 1 Data rate: SF8BW500 SNR: 10.5 RSSI: -36
Payload: { altitude: "0 ft", latitude: "0.0000 N", longitude: "0.00000 W", temperature: "22.75 C" }

```

```

32 .....
33
34 #include <mic.h>
35 #include <hal/hal.h>
36 #include <GPS.h>
37 #include <Onewire.h>
38 #include <DallasTemperature.h>
39
40 #define ONE_WIRE_BUS 12
41 #define GPS_Serial 1
42 #define VBATPIN A7
43
44
45 // Setup a onewire instance to communicate with any OneWire devices
46 OneWire onewire(ONE_WIRE_BUS);
47
48 // Pass our onewire reference to Dallas Temperature.
49 DallasTemperature sensors(&onewire);
50
51 char radiodata[1000] = {};
52
53
54 // This EUI must be in little-endian format, so least-significant-byte
55 // first. When copying an EUI from stm32l output, this means to reverse
56 // the bytes. For TTN issued EUIs the last bytes should be 0x05, 0xd3,
57 // 0x70.
58 static const u1_t PROGEM_APPEUI[] = { 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00, 0x00 };
59 void os_getAppEui(u1_t* buf) { memcpy_P(buf, APPEUI, 8); }
60
61 // This should also be in little endian format, see above.
62 static const u1_t PROGEM_DEVEUI[] = { 0x0A, 0xCf, 0x34, 0x00, 0x7E, 0x05, 0x83, 0x70 };
63 void os_getDevEui(u1_t* buf) { memcpy_P(buf, DEVEUI, 8); }
64
65 // This key should be in big endian format (or, since it is not really a
66 // number but a block of memory, endianness does not really apply). In
67 // practice, a key taken from ttnctl can be copied as-is.
68 static const u1_t PROGEM_APPKEY[] = { 0xCA, 0x00, 0x00, 0x00, 0x07, 0xCA, 0x00, 0xCD, 0x21, 0x02, 0xF9, 0x0E, 0x14, 0x00, 0x06, 0x7A };
69 void os_getAppKey(u1_t* buf) { memcpy_P(buf, APPKEY, 16); }
70
71 static uint8_t mydata[10];
72 uint32_t LatitudeBinary, LongitudeBinary;
73
74 static void t_send();

```







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# User Interface Development



April 23 2022

Most Recent Data ( 00:06:51 )

Altitude	Latitude	Longitude	Temperature (Deg C)
100	100	100	100

Previous Data

Time : 00:06:51  
Altitude: 100 Latitude: 100 longitude: 100 Temperature (Deg. C): 100



✎	✂	🗑	176	38.988	104.413	658924	18.05	2022-03-03 06:52:11
✎	✂	🗑	177	38.9883	104.41	755709	16.25	2022-03-03 06:53:15
✎	✂	🗑	178	38.9887	104.407	901867	14.61	2022-03-03 06:55:05
✎	✂	🗑	179	38.9888	104.407	921907	14.5	2022-03-03 06:55:20
✎	✂	🗑	180	38.9888	104.404	962968	14.18	2022-03-03 06:55:57
✎	✂	🗑	181	38.9885	104.403	987899	13.93	2022-03-03 06:56:19
✎	✂	🗑	182	38.9875	104.406	558718	13.18	2022-03-03 06:58:01
✎	✂	🗑	183	38.9871	104.401	609554	12.05	2022-03-03 06:59:15
✎	✂	🗑	184	38.9867	104.386	661368	11.05	2022-03-03 07:00:35
✎	✂	🗑	185	38.9861	104.385	677501	10.5	2022-03-03 07:01:05
✎	✂	🗑	186	38.9858	104.383	698030	10.05	2022-03-03 07:01:41
✎	✂	🗑	187	38.9855	104.383	704873	9.75	2022-03-03 07:01:54

```

43 jsonData = json.loads(message)
44
45 # You can access the data by using brackets
46 # Use a website like https://jsonformatter.curiousconcept.com to see
47 # how the data is structured
48
49 try:
50     altitude = jsonData["uplink_message"][["decoded_payload"]]["altitude"]
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# Launch Day



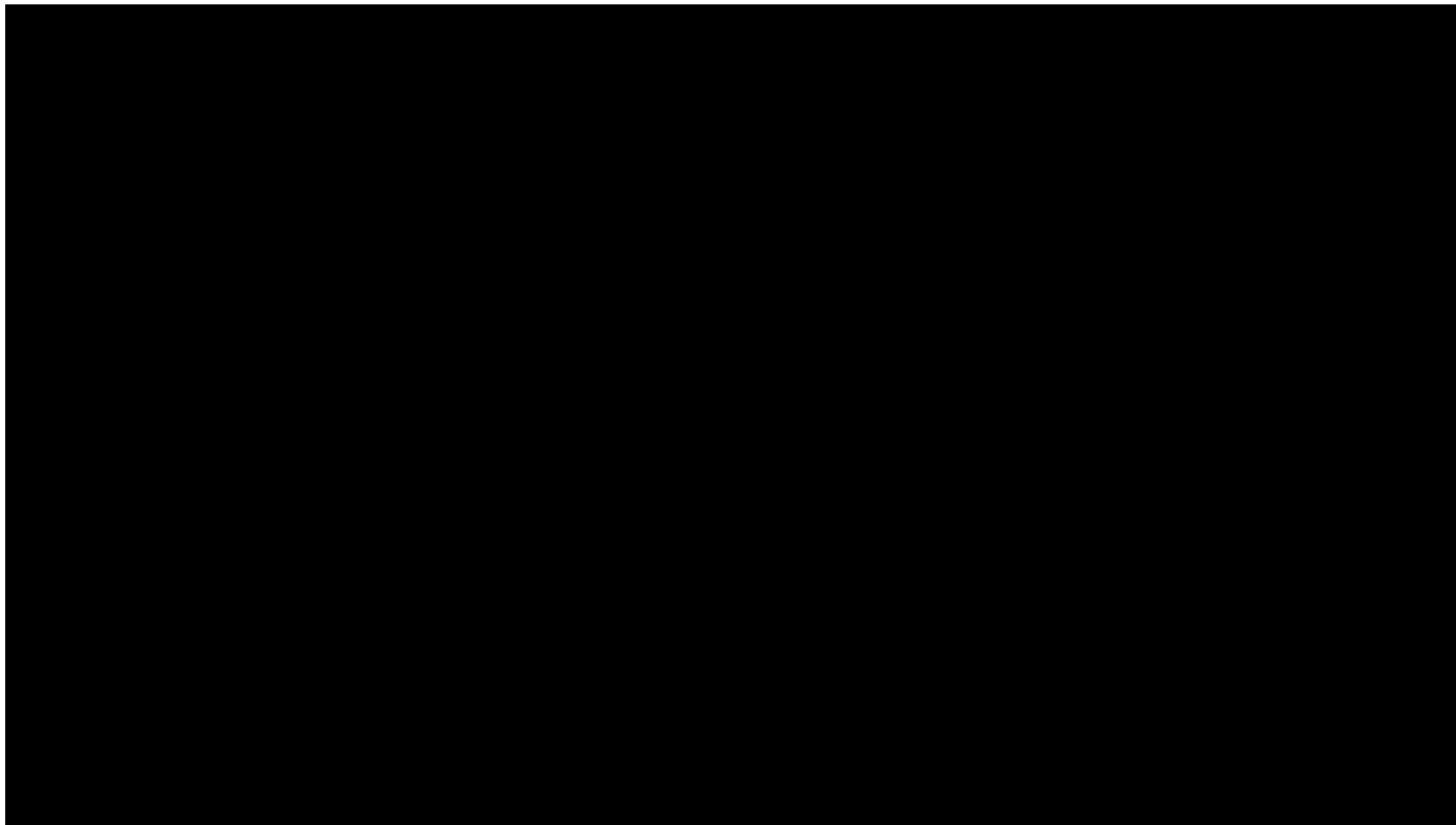
- 137 ft<sup>3</sup> of helium
- 4.29 kg of lift
- 1000 g balloon
- 900g of free lift
- Liftoff at 0650





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Video



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# Result

- Apogee 108,000 ft
- Total flight time 2h 8mins 14sec
- Descent time 20mins



Research Data	
<b>Current Location</b>	
Latitude	38°38'44.6"N
Longitude	104°03'03.4"W
Altitude (mean sea level)	100110ft
Altitude (above ground)	92950ft
Geopotential	92482ft
North Offset	-40.426km
East Offset	72.342km
Azimuth bearing	119.2°
Elevation	18.9°
Slant Range	87.580km
Ground Range	82.871km
Ascent Rate	1165ft/min
<b>Data</b>	
Wind Direction	13.8°
Wind Speed	27.6kts





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# Impacts

