KAUIDA
Individual Subsystem Testing Report (ISTR)

Northwest Nazarene University (NNU)
Kauai Community College (KCC)
Saturday March 21, 2020
4PM MST (12 PM HST)
Mission Overview: Mission Statement

• Team KAUIDA’s mission is for students from NNU and KCC to construct a payload using RF communication and V.R. technologies to develop students’ engineering skills and provide opportunity to share the results with a broader community.
Mission Overview: Mission Objectives

- **Objective 1**: Test short-range RF communication in space.

- **Objective 2**: Create a high quality 360-degree VR experience of the Earth, space, and the RockSat-X launch vehicle.
Mission Overview: Expected Results

- To obtain VR footage of the boom extending from and towards the rocket.
  - This is to be used to create content to inspire current and future stem students about space.

- To obtain RSSI (Relative Signal Strength Indicator) data and onboard sensor data: temperature, humidity, pressure, and gas.
  - This data will be used to better understand and solidify the feasibility of using RF technology in space.
Functional Block Diagrams
Power Subsystem
Control Subsystem

Raspberry Pi

- TE-1 Signal In
- 5V Power In
- Motor On/Off
- Signal Out

- IMU
- RF Transceiver
- Go Pro
- VR Camera
Motor Subsystem

Diablo Motor Controller
12V Motor
Power In

12V Power
and Ground

SS Relay

Scissor
Boom Motor
Changes from STR

• Batteries: Latching circuit works for 5.9 - 6.4 volt DC

TE changes:
• GSE 1: Turns on Control Power Board to power the Raspberry Pi, which starts GoPro, IMU, etc.
• TE-1: Turns on Motor Power Board, signals the Raspberry Pi to enable the battery backup and extend the motor boom
• TE-2: Recent changes have been made to no longer require TE-2, but we would like to reserve it in the event of other changes being made in the near future
Program Management and Team Updates

• Did anyone switch roles?
  – Aaron Borger, new software/electrical member
  – Benny, KAUIDA spacecraft
Schedule Update

• Corona Craziness
  – KCC had to cancel spring trip to NNU
  – Access to lab space and equipment has been limited due to school closures
  – Group working around corona-associated issues as they come

• KCC having CNC equip problems and board can not be sent out for fab due to Chinese manufacturing closures.
Subsystem Overview

• Power and Electrical
• Mechanical
• RF/Bluetooth
• Software
Ricoh-Theta V Subsystem Update

- **Status** - Functionally complete and integrated to system
  - Software control script complete
  - Backup time to RPi characterized
  - Multiple mission simulations completed from start of applying power
Motor and Electrical Subsystem Update

- Using JST wire-to-board connectors
- Using adhesive to fasten connectors in place
- All functions of power boards have been tested and verified
- Verified the motor works and can be controlled via Raspberry Pi
Motor Power Board Update

- Motor Power board complete and tested under load

Test:
28V input
4 ohm load
12V output, 3A

Will ship to NNU
3/23
Power and Control Board Update

1st prototype fully tested:
- Verified latch functionality
- Verified 3.3 volt output
- Verified Python programs using GPIO control for the Theta V camera and the GoPro camera
- Board has wrong footprint
  - Remade board but CNC machine having issues
Control and Power Board Status Update

Working board with mods and wrong footprint

Correct footprint board with RPi. This board has poorly milled traces and some functional issues.
Motor and Electrical Subsystem Update

- Boom deployment/retraction successful using automated script and manual control
Mechanical Subsystem Update

• **Status**
  – Full 3D printed prototype in development for full fit testing prior to aluminum machining
  – Aluminum component manufacturing to be continued
Mechanical Subsystem Update
Mechanical Subsystem Update
Mechanical Subsystem Update
Mechanical Subsystem Update
Scissor Arm Update

• **Status**
  – Full 3D prototype has been constructed
  – Need to machine prototype aluminium arms

![Image of scissor arm prototype]
Scissor Arm Update
Mechanical Subsystem Update

- Horizontal deployment testing
Mechanical Subsystem Update

• Vertical deployment testing
Mechanical Subsystem Update

• Results
  – 3D printed plastic assembly has been operational
  – Scissor boom tends to lean/bend while in use (mostly because this prototype is made out of plastic), but still moves outward as needed
  – Prototype plastic assembly has been helpful in helping determine an appropriate assembly/connection scheme
RF/Bluetooth Subsystem Update

• Status
  – RSSI can be transmitted from Arduino on scissor boom to RPi
  – Other sensor data cannot be transmitted yet
RF/Bluetooth Subsystem Update

• RSSI transmission test was completed successfully
• Transmitting sensor data was not successful due to error in Adafruit library
  – Adafruit has been reached out to
RF/Bluetooth Subsystem Update

• What were the results
  – RSSI data was successfully read and printed to file.

$ nano rssi.py
$ python rssi.py
Connecting to Arduino...
Discovering services...
Reading RSSI:
-50
-43
-41
-43
-47
-44
-46
-50
-40
-45
-48
-45
-47
-50
-40
-47
-46
-43
-50
-41
Disconnecting...
Software Subsystem Update

• Status
  – GoPro control script and Ricoh Theta V control script have been completed
  – Motor control script has been completed
  – Overall mission script has been outlined
  – Subsystem scripts are not yet integrated into mission control script
  – Code for timed event detection has not yet been written
Software Subsystem Update

• Completed Tests and Results
  – File transfer between Ricoh Theta V and Raspberry Pi takes roughly 2.5 minutes for a 4-minute video
    • This transfer time has been reduced from 6 minutes, a significant improvement
  – Motor control script automatically extends and retracts boom
Software Subsystem Update

• All software is now managed in a GitHub repository
  – Allows for quick software recovery and version control
  – Software developed by KCC can be merged with NNU software
  – Includes ReadMe files and other essential documentation
Command/Data Handling Subsystem Update

• Status
  – Verification testing for battery backup: COMPLETE
    • Rising edge of TE-1 will set latch
    • Connected battery has no current draw until after latch is set
    • Repeated GSE cycling does not set latch
  – Application of 28 V powers RPi, starts service, and calls script to control cameras: COMPLETE
  – What has not yet been checked out
    • GoPro script timing and interrupt implementation not complete
    • Finally merging of all scripts not complete
Plan for Subsystem Integration

• Pieces are being shipped from KCC to be assembled 3/23

• COVID-19 makes travel between schools impossible.
Lessons Learned

● Circuit board milling lessons learned:
  ○ CNC can randomly break
  ○ Traces need to be wide as copper will peel
  ○ Board updates must stop
  ○ Document control must be enforced

● Coding is time consuming
  ○ GitHub makes code management much more effective
Conclusion

- **Effects of COVID-19**

- We look forward to our continued partnership with the RockSat program, and hope to be able to continue this project without any more major hiccups caused by the current pandemic