Tiny VRSE
(Virtual Reality Space Experience)

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COSGC Projects:
- DemoSat Fall 2019 & Spring 2020: Team-lead
- RockSat-X 2019-2020 Biology: Team-lead, Programming, Electrical
Overview:

Part of a larger project sponsored by NASA Goddard Spaceflight Center to design a payload for RockSat-X 2020 to collect 360° footage in space.

The team is comprised of students from both the Red Rocks and Arapahoe Community Colleges.

This year-long mission was broken down into researchable segments where the team could test its proposed designs and hypotheses using different COSGC (Colorado Space Grant Consortium) projects.

Tiny VRSE is the second DemoSat project used by Red Rocks Community College as a testing ground for the CCofCO RockSat-X 2019-2020 team.
Project Objectives:

Challenging the Design:
• Recreating a smaller version of the team’s RockSat-X payload for the High-Altitude Balloon platform.

Training and Setting Standards:
• Testing viability for RockSat and proving accessibility for small affordable student projects.

Shocasing New Techniques:
• Creating a VIVE VR experience with the RockSat-X 2020, DemoSat Spring 2020, and DemoSat Fall 2019 mission footage through iteration and collaboration.
RockSat-X Design Overview

Major Components:
- Electrical Box
- Stepper Motor and Linear Actuator System
- Reel and Scissor Arm
- 360° Camera Housing
- 200° Pi Camera
Tiny Challenge Objectives:
- Compact
- Portable
- Lightweight
- Cost Effective

Big Idea:
Since miniaturized electronics are market available students can create payloads that are smaller while maintaining mechanical effectiveness.

Same Theory, New Hypothesis:

RockSat-X 2019-2020:
- Machined Aluminum
- 14-lbs, 13x4.95x13-inch
- Budget: High

DemoSat Spring 2020:
- 3D Printed PLA
- 400-gram, 8x8x4-inch
- Budget $300.00
DemoSat Design Overview

Major Differences:

- MADV Mini
- UV and Altitude Sensors
- Android Application Compatibility
- Lineage OS and Raspbian
DemoSat Design Overview

Major Components:
- Sensors
- 360° Camera
- Housing and Pi Camera
- Stepper Motor and Linear Actuator System
- Scissor Arm
- Microcontroller Compartment
- Power Components
Methods:

• Extend MADV Mini 360° into the environment at approximately 1,000 ft.

• Cameras and sensors record when powered on.

• Arm is programmed to retract when the balloon reaches a set lower altitude than flight.

• Ensures retraction will occur prior to touch down.

• 360° Footage and 3D Models will be compiled into a VIVE VR experience.
Partnerships:

Advisors and Staff at COSGC
- Director: Chris Koehler
- Deputy Director: Bernadette Garcia
- Advisor: Corey Huffman

Sponsors:
- NASA Goddard Spaceflight Center
- NASA Wallops Flight Facility

Advisors:
- Barbra Sobhani, RRCC Trefny Honors Program Director
- Jennifer Jones, ACC Astronomy Program Chair.

Student Collaboration:
- Stacey Barbarick, RRCC RockSat-X 2018-2019
- Graham Kersey, Community College of Denver, DemoSat 2019 with Dr. Joel Thompson
- Bri Trefner Colorado School of Mines Rocksat-X 2019-2020 Team-lead.

Image Credit: Graham Kersey – DemoSat Fall 2019 – 360° Footage
Materials:

Main Components
• PLA printed scissor arm system
• Raspberry Pi Zero
• CMX219 Raspberry Pi Camera V.2
• Raspberry Pi 4 Model B or Arduino Uno R3
• MADV Mini System
• Raspbian - Lite - Pi Zero
• Lineage OS - Pi 4.
• Step Motor Controller
• Pre-built Miniature Linear Actuator Rail System

Power:
• Power Switch
• LM2596 DC-DC Buck/Step Down converter

Sensors:
• Adafruit TB6612FNG Stepper Motor BOB.
• VL53L0X Adafruit Time-of-Flight Sensor
• BME680 Barometric Pressure and Humidity Sensor
• ML8511 UV Sensor
• HTU21DF Temperature Sensor
• ADXL335 Tri-Axis Accelerometer
• Energizer Lithium Ion Battery Pack
Procedures:

Program Basics:
- Begin recording before lift-off.
- Extend through aluminum flap just at lift-off completion.
- At low enough altitude trip condition and retract the arm.
- Store sensor data on the high-speed micro SD of each Pi.

Cut-Offs:
- Humidity issues in electrical enclosure.
- Power surges or voltage irregularity.
Analysis of Design:

Tiny Parts, Major Testing:
Completed:
• Main electronics assembled
• Power calibration
• Pi camera data storage

Needed:
• CAD parts to be printed and assembled.
• Whip, Drop, and Tumble.
• Data accuracy tweaks.
• Camera recording enhancements.
• Long term power efficiency.
• Lineage OS and app processing.
• Field of view tweaks.
Tiny VRSE Now:

The Good:
• The internal pi camera is working at a pre-set interval and will readily capture footage of the arm functioning.
• This will be useful if failure is experienced and help figure out what goes wrong.

The Difficult:
• Different OS were attempted using the MADV mini and Android compatible applications. The pi-zero simply doesn’t have enough processing power to function in this way.
• Only an android compatible microcontroller can be used unless the hardware is to be further modified.
Conclusion:

Benefits:
• Encourage new thinking in developing camera-arm systems.
• Spur and encourage student and public participation in atmospheric and space sciences.
• Prove the portability and cost efficacy of video and virtual experience creation.
• Decrease costs while increasing capabilities.

Tiny VRSE Now:

The parts are ready to be printed and constructed. The electronics are assembled and being tested for general operations. The housing is awaiting full assembly with printed parts. The system is scheduled to be launched in Summer 2020.
Thank you!

COSGC Deputy Director, Bernadette Garcia

RRCC Mathematics Professor Adam Forland
Engineering Professor Jeremy Beard
Advisor Barb Sobhani

ACC RockSat-X Advisor Jennifer Jones, and the entire

The entire CCofCO RockSat-X team, its dear friends, and collaborators!

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