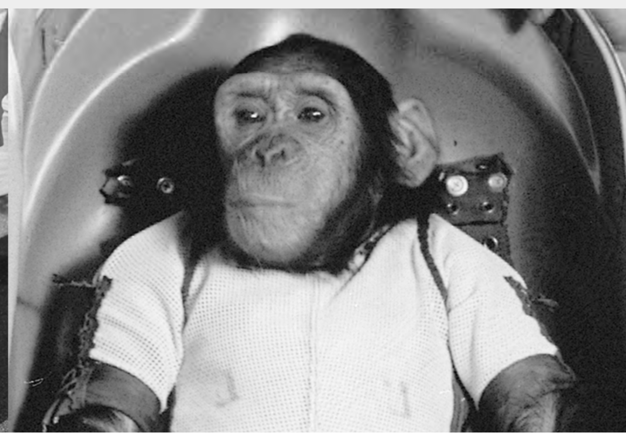



High Altitude Balloon Student Projects



Long Island Sound 90,000 ft September, 2015
UB Supported Launch, Mission Operations and Recovery

High Altitude Ballooning

EYEBALL – Engaging Young Explorers in Ballooning

High Altitude Student Payload – NASA/Louisiana Space Grant

Undergraduate Student Instrument Program

Eclipse Ballooning Project (Total Solar Eclipse)

Concept - High Altitude Robotic Puppet

A collaborative effort of the UB School of Engineering, SASD and the Discovery Museum and Planetarium to engage young students in Earth and Space Science Education.

The view from a high altitude balloon may not be “enthralling” to a K-5 student. The Museum proposed, “What if the children had a “friend” on the high altitude balloon?”

This project revolves around HAM (High Altitude Monkey), a robotic puppet that will interact with young students during high altitude balloon flights. While the robot itself is up in Near Space “collecting data”, it will actually be controlled on the ground by Museum educators.

Collaboration

School of Engineering faculty and students provided mechanical, electrical and computer engineering and software to determine if the robot's components could withstand the temperatures and near vacuum pressure at 120,000 feet and will develop the robot and its capsule.

On SASD's effort, Senior students Phillip Carroll, Joshua Hauge, and (now SASD Graduate) Irving Heredia worked on the illustration of HAM's movements, the design of HAM itself and the capsule HAM will go up into Near Space.

The Museum provided mentors in Near Space and Mission Control operations. Engineer Larry Reed mentored students in all aspects.

UNIVERSITY OF BRIDGEPORT MCM XXVII

SASD

Timeline

In January 2015, Connecticut Space Grant awarded UB a seed grant to develop a prototype of the robotic puppet. (EYEBALL)

In January 2016, Louisiana Space Grant awarded UB a seat on NASA's HASP (High Altitude Student Platform). The flight was September 1, 2016. HASP is a long duration (18 hour) balloon flight.

In July 2016, Connecticut Space Grant was awarded a $200,000 grant to complete HAM (Undergraduate Student Instrument Program). Collaboration between University of Hartford, University of Bridgeport, Wesleyan University and Vanderbilt University.

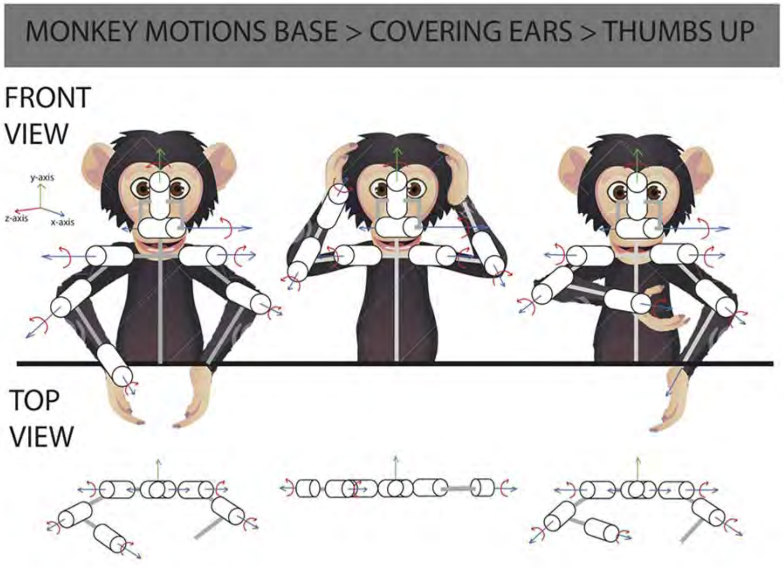
UB and the Discovery Museum will subsequently seek funding to operate the HAM balloon flights on a continuing basis.

History

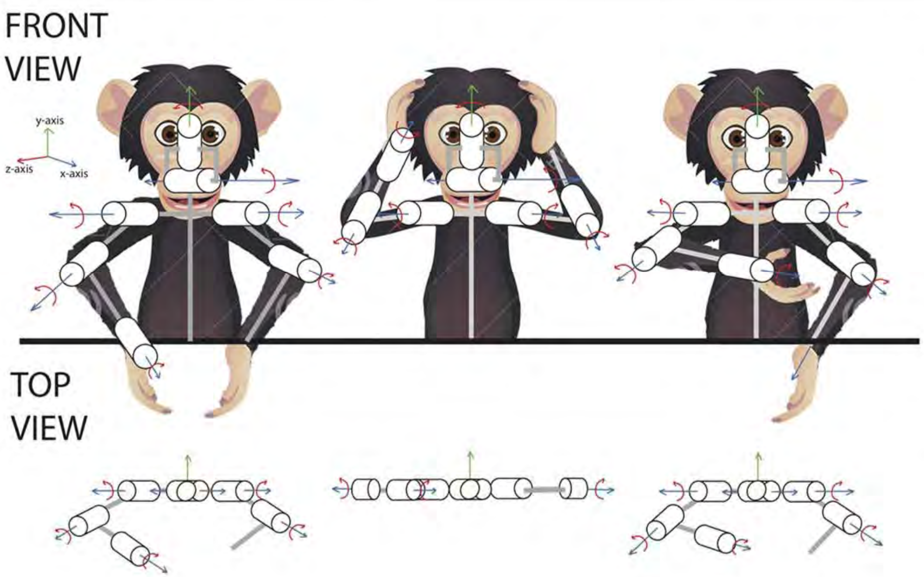
In the 1960's, NASA launched a chimpanzee into space named Ham. The results of Ham's test flight led directly to Mercury astronaut Alan Shepard's flight 3 months later. This mission is the basis of the inspiration behind this project.

Robot Schematics

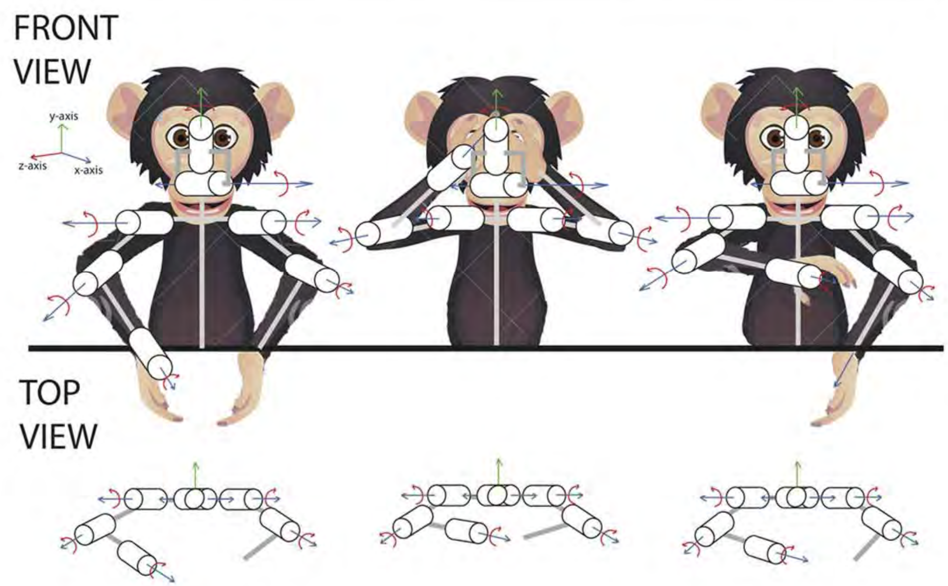
Current SASD senior student Phillip Carroll worked with Dr. Jani Pallis (UB Engineering) to create a variety of schematics for possible options of movement for HAM, including detail of the motors and the direction they turn.



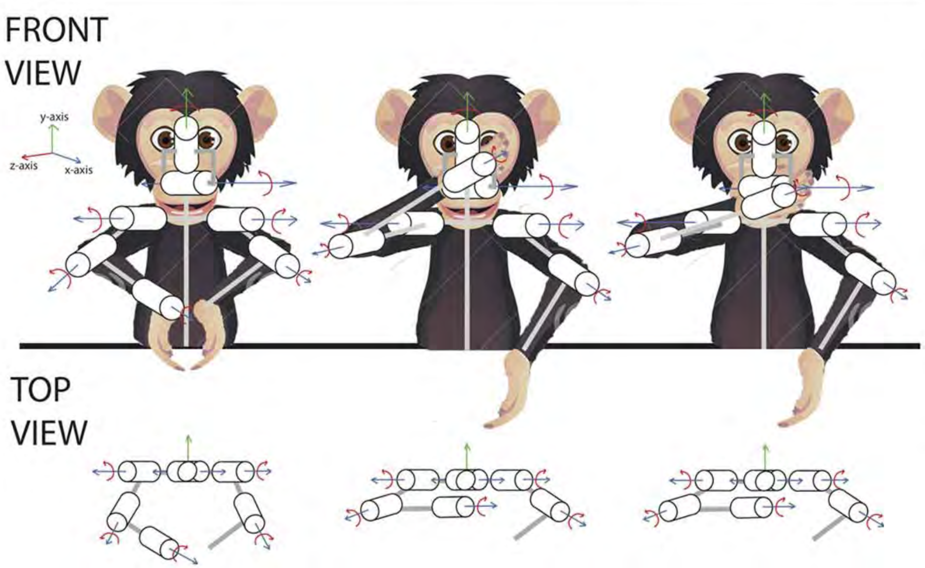
MONKEY MOTIONS BASE > COVERING EARS > THUMBS UP



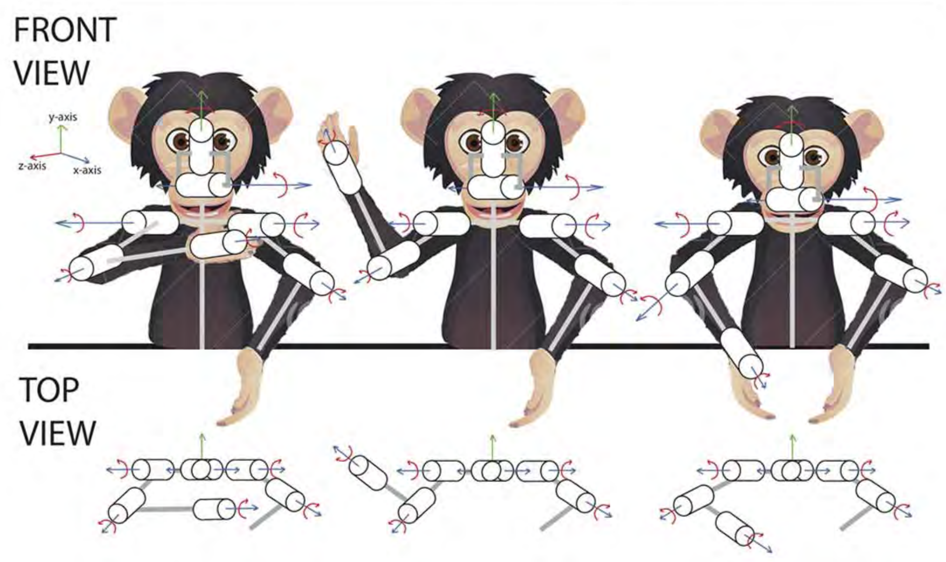
MONKEY MOTIONS BASE>COVERING EYES>THUMBS DWN



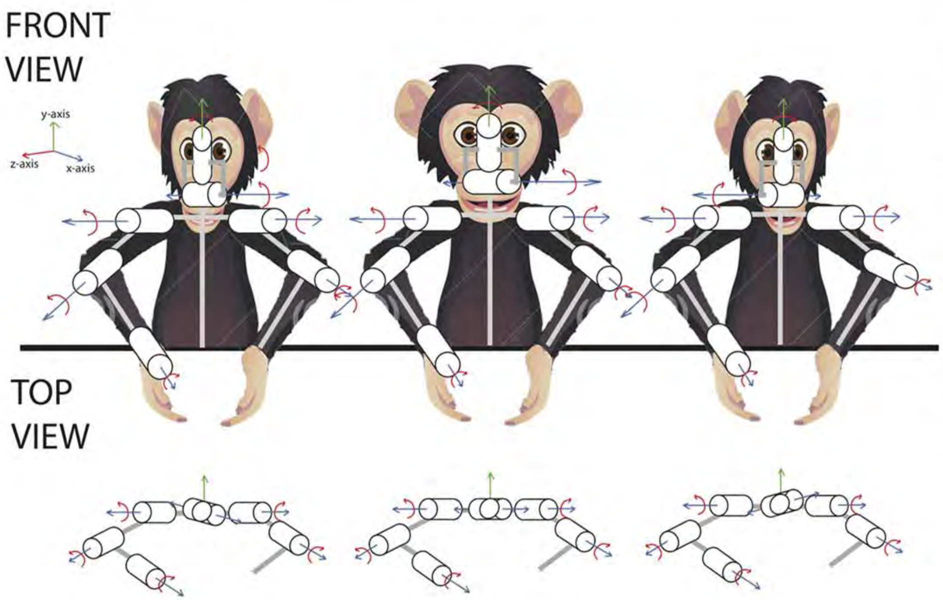
MONKEY MOTIONS>CLAPPING HNDS>CVR NSE>CVR MTH



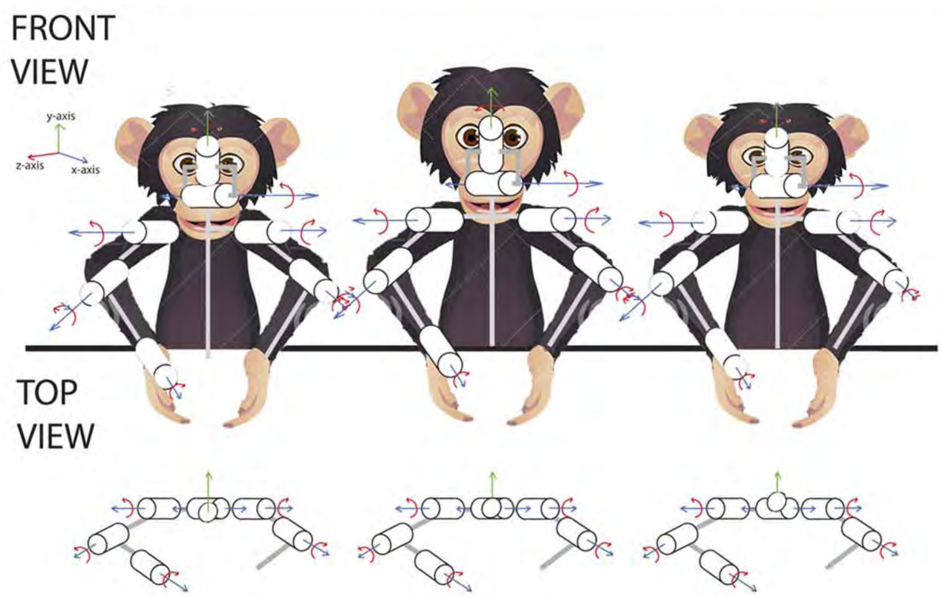
MONKEY MOTIONS>CVR HEART>WAVING>LOOK @CNSL



MONKEY MOTIONS_"NO" HEAD MOTIONS_RIGHT>B>LEFT

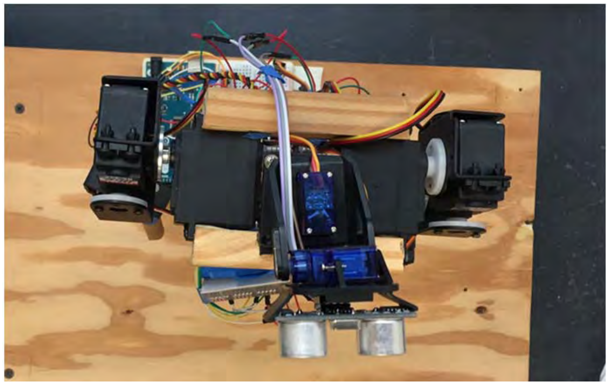


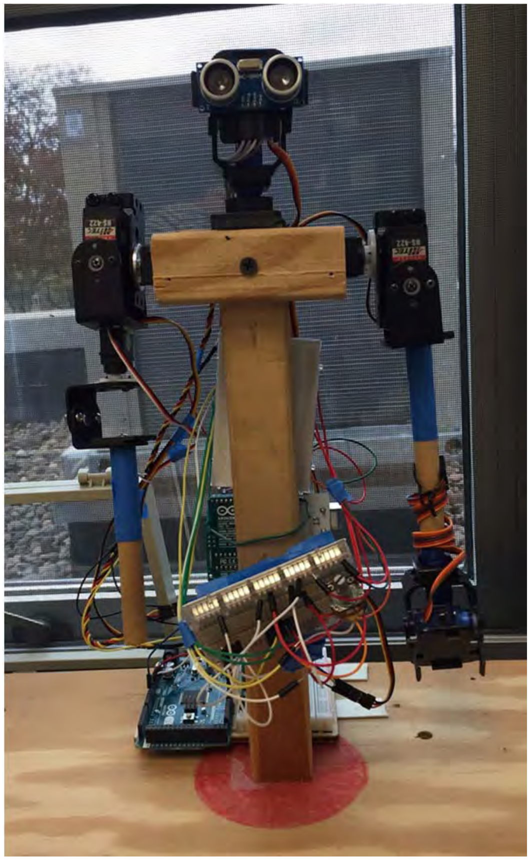
MONKEY MOTIONS_"YES" HEAD MOTIONS_DOWN_B_UP

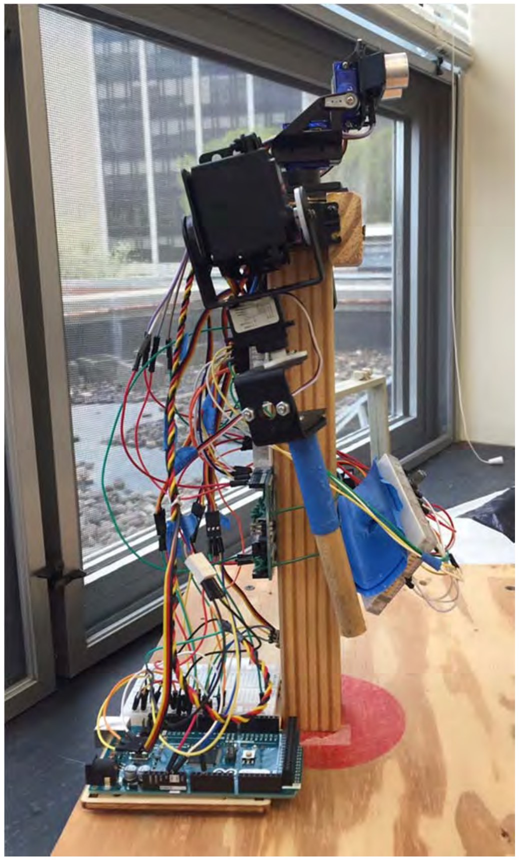


Robot Model

UB Engineering students worked off of the schematics of the robot and were able to create a functioning model that would act as the skeleton for HAM with rotating motors for joints.







Concept Suit

The design of the robot itself has gone through a few different variations over time due to multiple factors.

To match the hair of Ham, a stuffed animal of a monkey will be used for the exposed arm and head parts.

For HAM’s suit, SASD senior Phillip Carroll chose for the initial concept to harken back to Ham’s original suit design from the 1960’s.

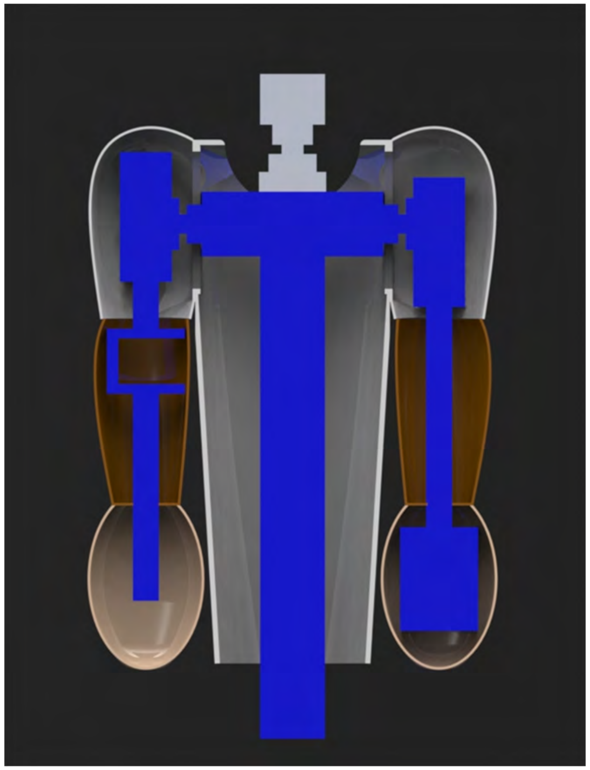
Concept Suit

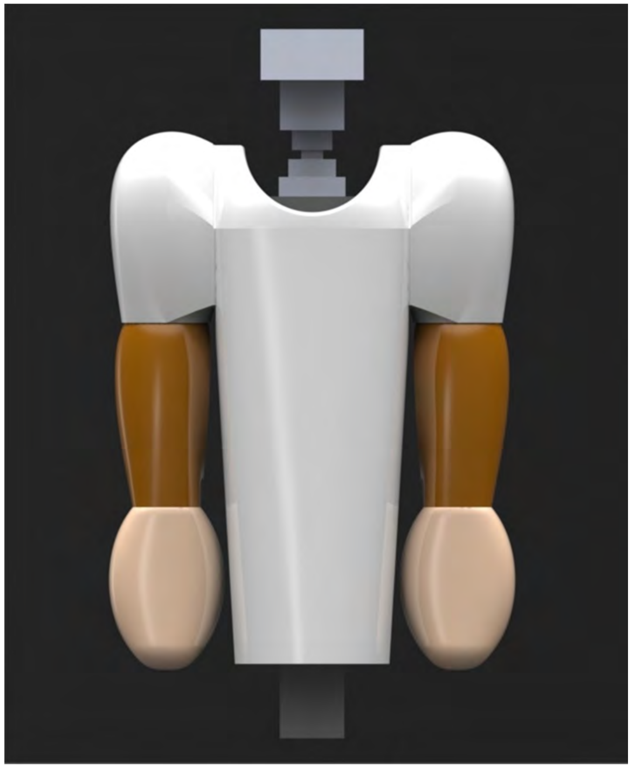
The suit is made up of four parts: two sleeves that slide up the arm and allow a freer range of motion for the robot and a two-part vest to cover the robotic insides.

The vest comes in two parts and is connected by velcro strips for easy access removal in case the motors/robot needs to be checked on.

Concept Suit

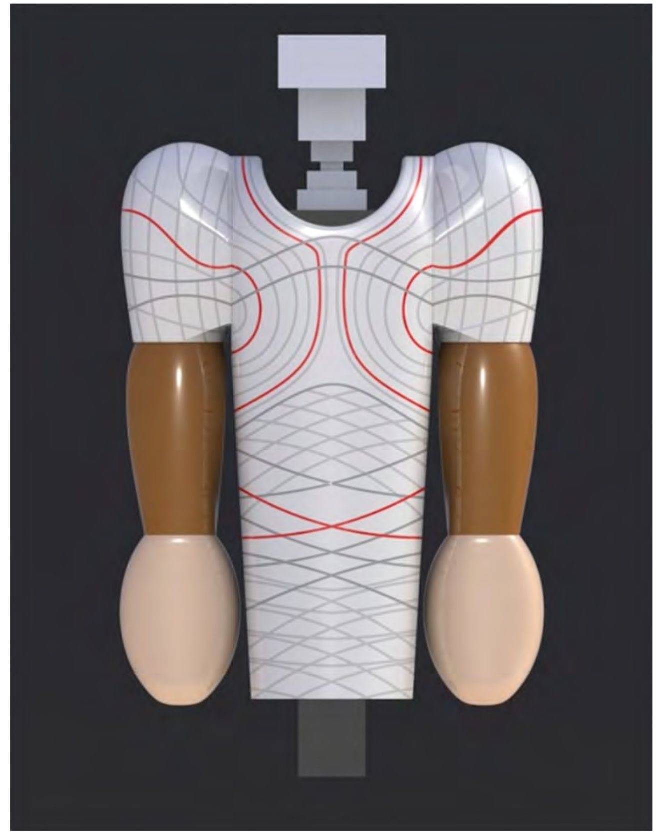
The suit shown here, scaled correctly to the robot model.





Concept Suit

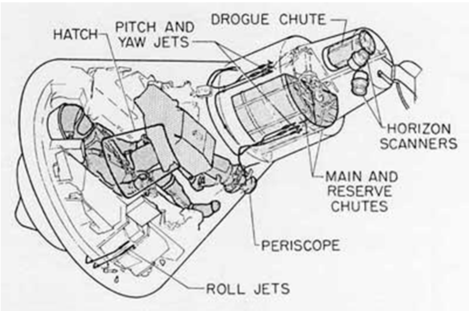
After scaling the suit to the proper dimensions of the robot, Dr. Pallis suggested looking at the space suit designs of colleague Dr. Dava Newman; a radical, new kind of space suit that is more form-fitting and stitched together, giving HAM a taste of modern space aeronautics.



Concept Capsule

SASD senior Joshua Hauge has been focused on the design of the capsule HAM would go up in for the exhibit.

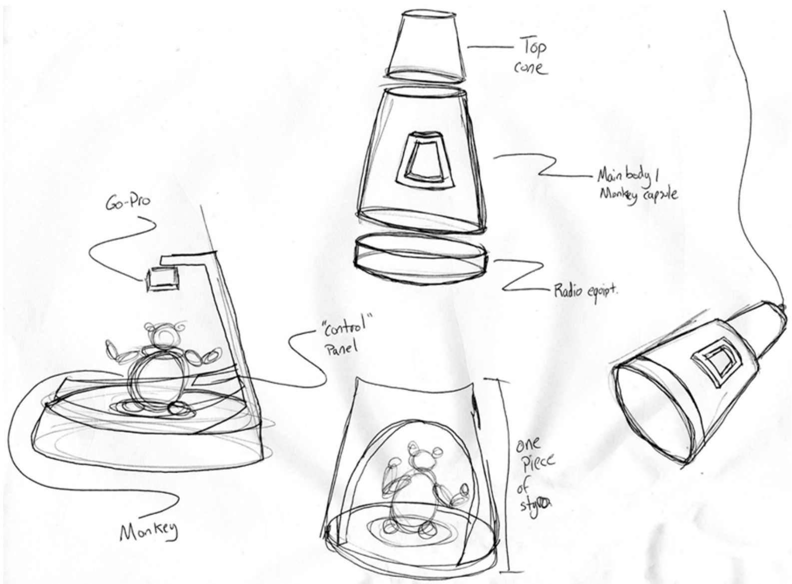
The design has mainly drawn influence from the Mercury space capsule from the 1960's, which was part of the first spaceflight program for humans for the US.

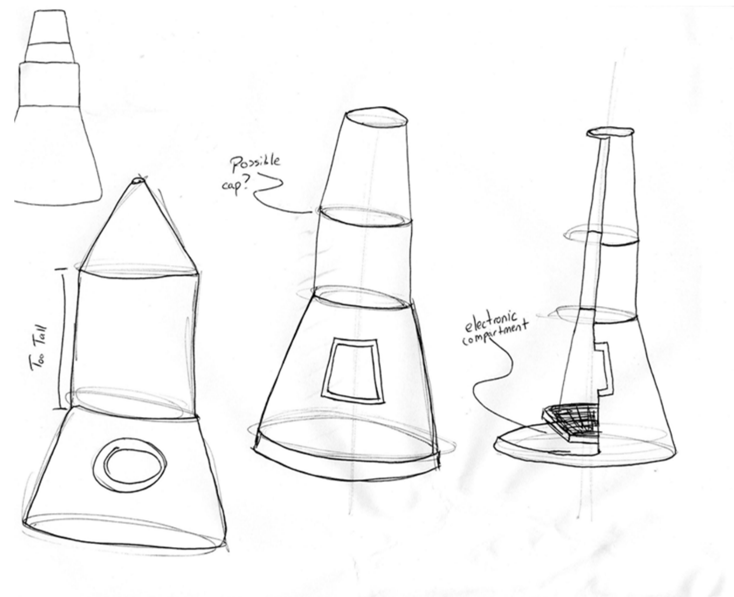


Render and diagram of the original Mercury capsule

Concept Capsule

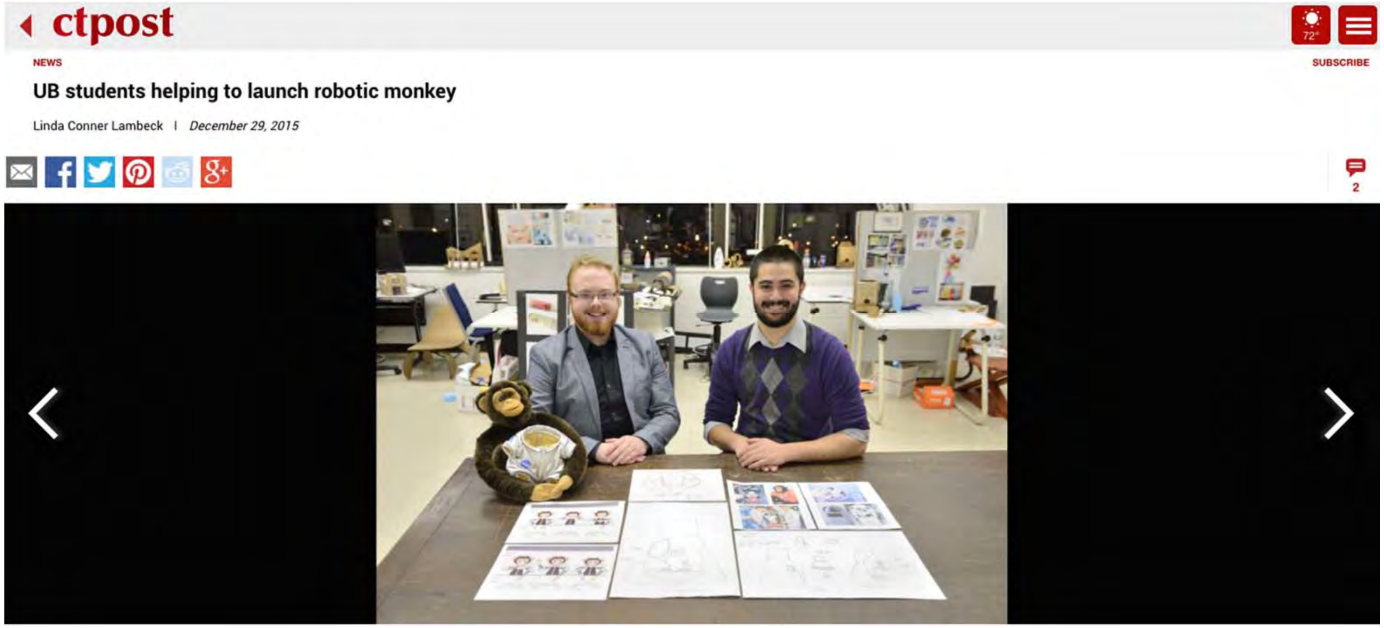
The capsule would be stationed upright for HAM and would have a small control panel that the robot would interact with on command.





Headlines

With this project, Phillip Carroll and Joshua Hauge (respectively pictured in the image below) received $5,000 Undergraduate Scholarships each from the Connecticut Space Grant and garnered some headlines from various news outlets.



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College students helping to launch robotic monkey to space

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By LINDA CONNER LAMBECK - *Associated Press - Sunday, January 10, 2016*

ASEE | FIRST BELL in affiliation with Bulletin MEDIA

TODAY'S ENGINEERING AND TECHNOLOGY NEWS PREPARED EXCLUSIVELY FOR THE ENGINEERING AND TECHNOLOGY EDUCATION COMMUNITY

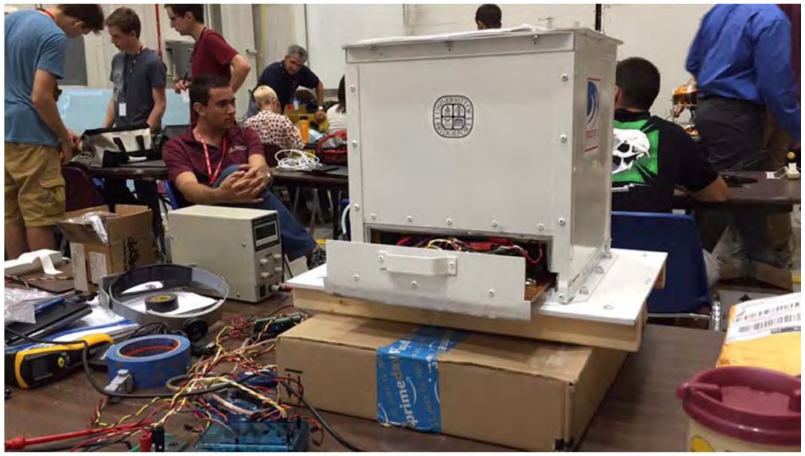
Good morning Dr. Angela Colman Des Jardins — January 11, 2016

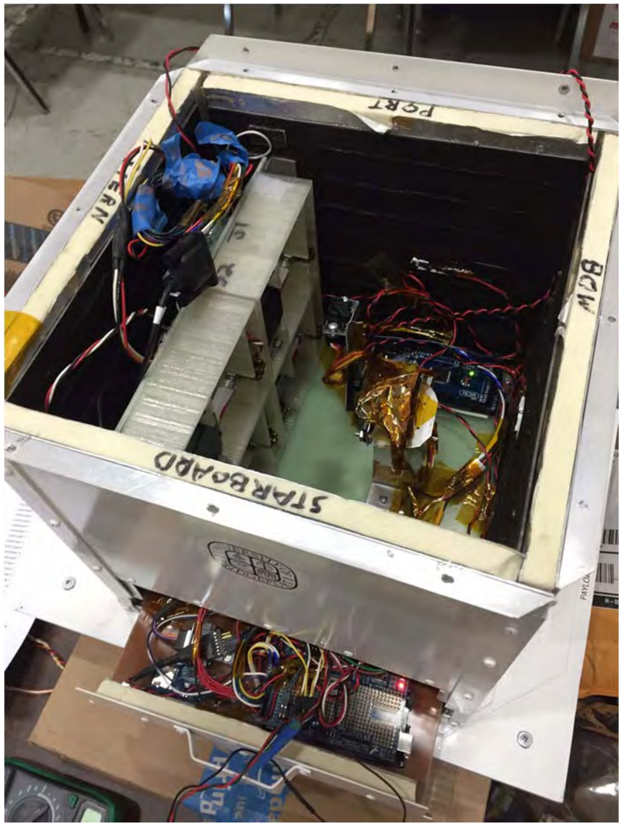
Two College Students In Connecticut Plan To Launch Robotic Monkey Into Space.

The AP (1/11, Lambeck) reports Phillip Carroll and Joshua Hauge, students at the University of Bridgeport in Connecticut studying industrial design, are working to launch a robotic money, known as High Altitude Monkey ("HAM") 100,000 feet above the surface of the Earth in a balloon later this year. After being launched, HAM is designed to fly the balloon and come back to Earth in the Atlantic Ocean off the coast of Massachusetts. The students want to reignite interest in space exploration with their project.

HASP - Testing the Capsule (Texas)

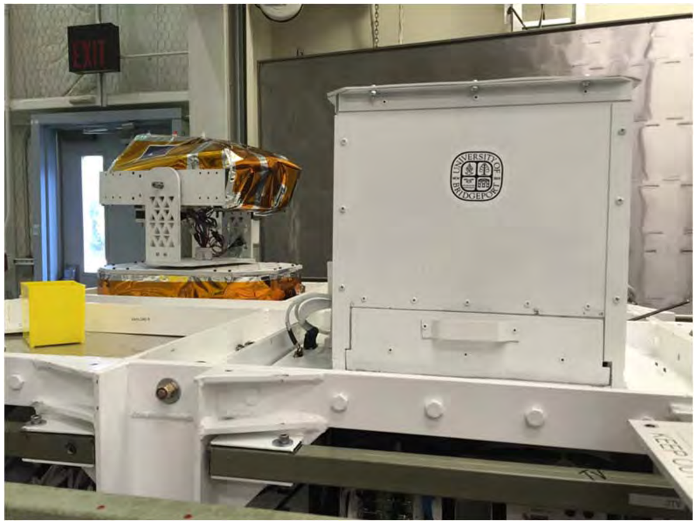
In August, Phillip Carroll, Dr. Jani Pallis, and Engineer Larry Reed traveled to NASA’s Columbia Scientific Balloon Facility in Palestine, TX to test a capsule containing HAM’s motors and electronics in a vacuum. The vacuum simulates space environments and tests to see if the servo-motors will work in the extreme environment.





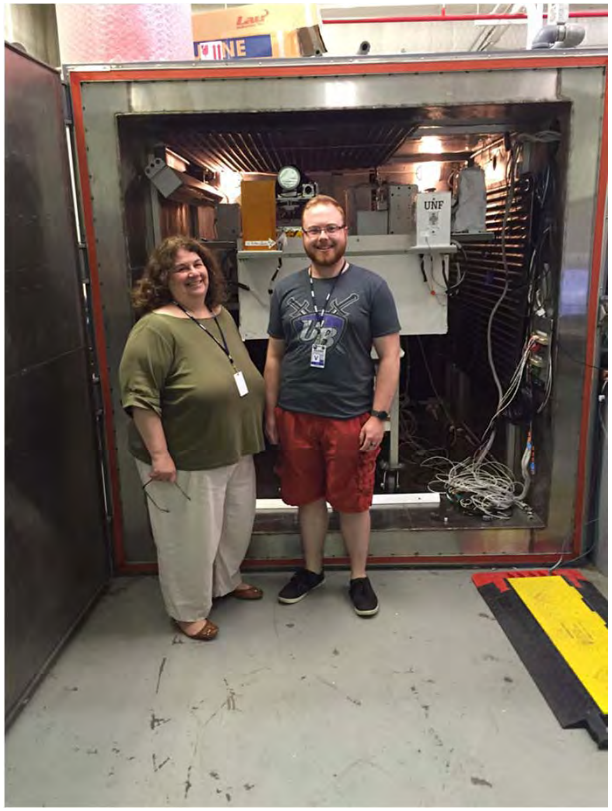
Testing the Capsule (Texas)

The capsule being loaded into the vacuum that will test it at temperatures of -50°C to 50°C.



Testing the Capsule (Texas)

By the end of the trip, the capsule passed the thermo-vacuum test in Texas and was sent out to New Mexico for further integration into NASA's high altitude balloon gondola..



Testing the Capsule (New Mexico)

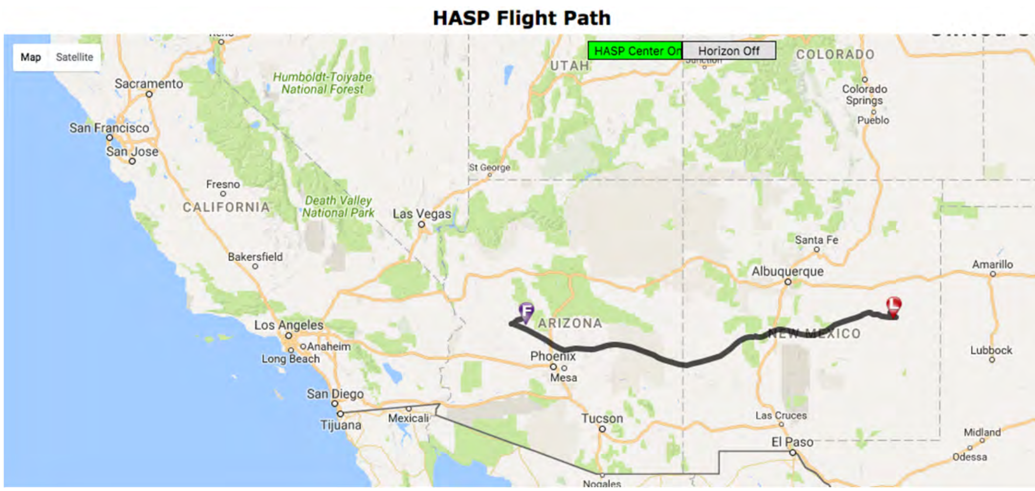
At the end of August, Joshua Hauge and Larry Reed traveled to Fort Sumner, New Mexico to the Columbia Scientific Balloon Facility to prepare HAM for flight operations and integration on HASP.

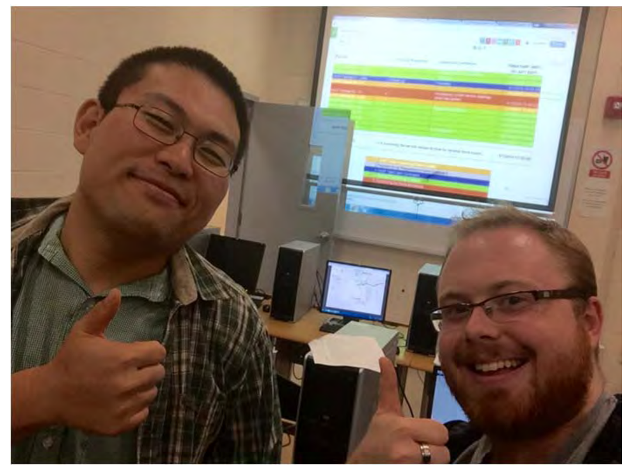
Testing the Capsule (New Mexico)

Below are two short clips of the balloon. The first preparing the balloon for flight, the second the balloon ascending and lifting the payloads into the air.

Launch

Once the balloon had launched into Near Space, with payloads in tow, the UB HASP team took turns monitoring the status of the capsule and operating controls, checking transmitted data and ensuring that the servo-motors inside operated throughout the flight. The flight itself lasted from 12:08 PM on September 1st to 6:27 AM on September 2nd. Mission Control was operated in a computer room in Engineering. The test was a success!





Future

In July 2016, Connecticut Space Grant was awarded a $200,000 NASA grant to complete HAM (Undergraduate Student Instrument Program). UB will provide project management and engineering support over 18-months.

Now that testing is completed, we can proceed with making a finalized capsule for HAM, as well as his completed model.

Timeline - Extreme Environment Projects

2014 - Connecticut Space Grant provides funding for a UB Satellite Design course

2014 - 2016 - CanSat - UB students have participated in an annual satellite competition for 3 years.

2015-2017 - HAM Related Projects (USIP - approximately $200,000)

2016 - Discovery NASA Project - UB designs payloads as subaward to a NASA grant from the the Discovery Museum. $50,000

2016 - SSEP - Student Spaceflight Experiments Program - UB Mentors and participates in a K-12 program where a Bridgeport school student experiment will be operated on the International Space Station in Spring 2017.

Timeline - Extreme Environment Projects

Photo courtesy of Alan Winick

2016 - 2018 - Explorer 1-person submersible on loan to UB through 2018 - Multiple engineering projects planned.

2017 - Total Solar Eclipse - Connecticut's high altitude balloon to video and broadcast the August 21, 2017 total solar eclipse from 80,000 feet in Kentucky. CT Space Grant joins 40 other teams on the eclipse line. $50,000 funding.

2018 - CubeSat - UB designed satellite expected to launch on a NASA vehicle in early 2018. Planned orbit 3-12 months. Collaboration with the Discovery Museum.

Eclipse Ballooning – August 21, 2017

Supported through CT Space Grant: Collaborators University of Bridgeport, University of Hartford, Discovery Museum and Planetarium, Fairchild Wheeler Interdistrict Magnet High School.

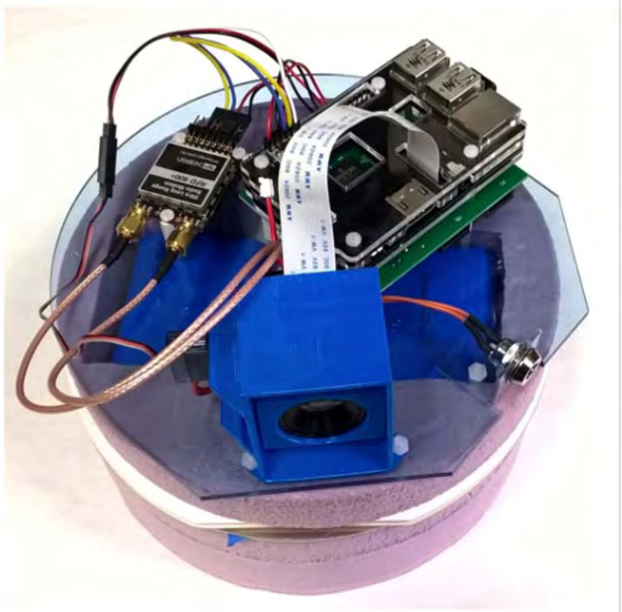
Eclipse Ballooning – August 21, 2017

The Eclipse Ballooning Project to date has distributed over 50 system kits to 52 teams.

These systems give teams, both novice and experts, a starting platform to build upon in preparation for the 2017 total solar eclipse.

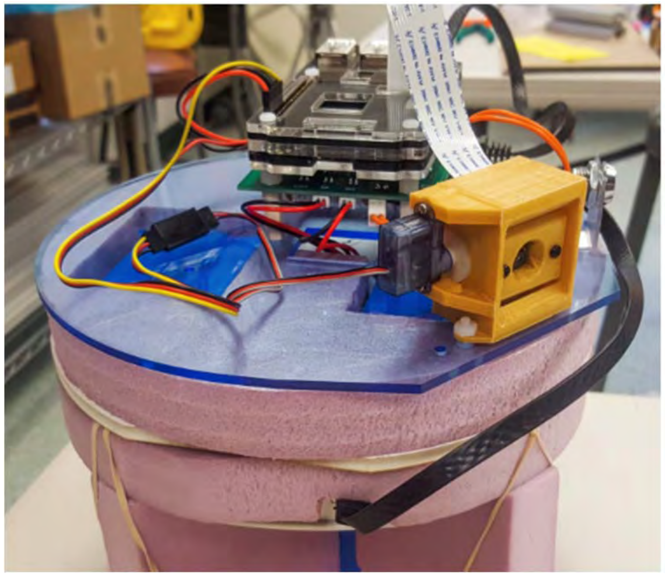
Still Image Camera

The still image payload uses a Raspberry Pi and Pi Camera to take, store and transmit images. Transmitting images to the ground station is accomplished using a 900Mhz modem which also allows the user to indirectly send commands to the Pi such as changing camera settings, selecting images to be transmitted and tilting the camera vertically.



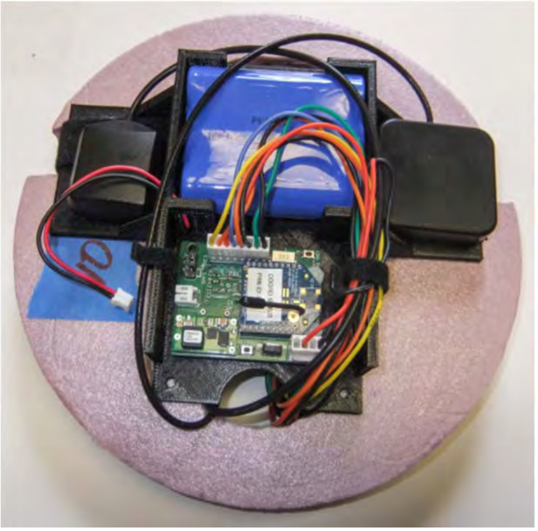
Video Payload

The video payload uses a Raspberry Pi and Pi Camera to record HD video while transmitting the feed (which is uploaded onto the internet for public viewing) to the ground station using a 5.8Ghz Ubiquiti modem. The Ubiquiti modem also allows for user commands to be sent to the on-board Pi to, for example, tilt the video camera or adjust camera settings.



Tracking Payload

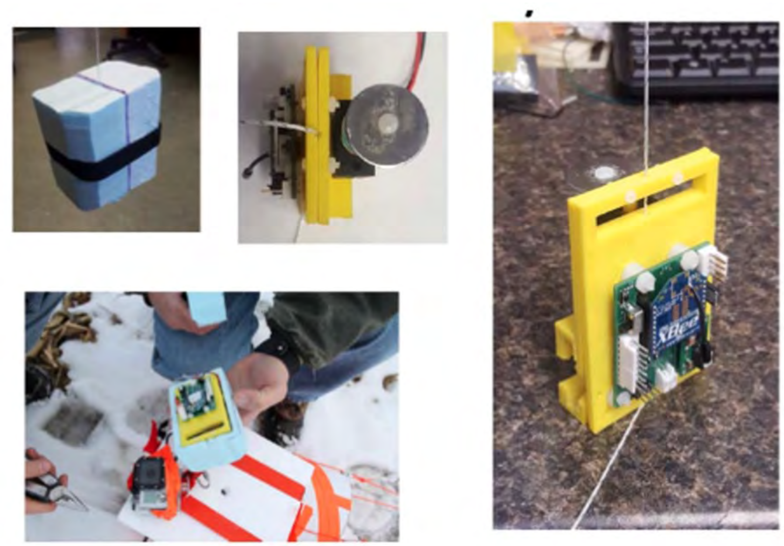
The tracking payload houses an NAL Iridium satellite modem which allows for near real time tracking of the balloon for both FAA and public viewing. The ground station collects these GPS data points and uses them to automatically adjust the antennas accordingly towards the balloon. The Iridium modem also works as the line of communication for users to send the cutdown command to the balloon should the flight need to be terminated for any reason.



Cutdown

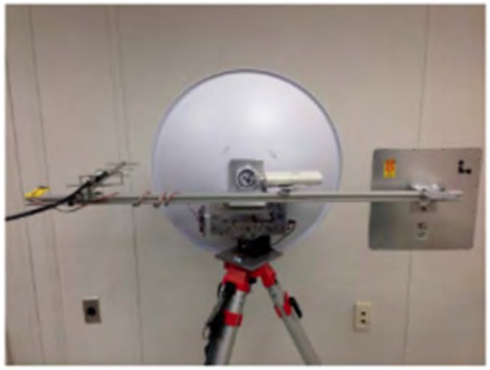
The cutdown system mechanically severs the line connecting the payload string to the balloon. Should the flight need to be terminated, the user simply sends a “termination email” to the balloon.

The email is received by the Iridium modem, the cutdown command is sent to the cutdown system initiating a motor and a cutting blade severs the line between the payload string and balloon. The payload string then parachutes down to Earth for recovery.



Ground Station

The ground station tracks the balloon during flight while gathering the video stream being transmitted at 5.8 Ghz with the dish antenna and communicating with the still image payload at 900 Mhz using patch (flat square) and Yagi (short metal rods protruding perpendicularly out of a metal support) antennas. The video feed is then uploaded onto the internet for near real time viewing.





Thank you