The Gopher Tortoise Scope

Sponsored by

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The Tall Timbers Research Station and Land Conservancy

In partnership with

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TALL TIMBERS
Research Station & Land Conservancy

Team 21

FLORIDA A&M UNIVERSITY 1982 FLORIDA STATE UNIVERSITY
COLLEGE OF ENGINEERING

Overview

- Background and objectives
- Subsystem breakdown
  - Electrical
  - Mechanical
- Prototype
- Project management
  - Budget overview
  - Work to be completed

Background

- Tall Timbers research focuses on fire dependent ecosystems
- One species they study is the gopher tortoise
  - They are a keystone species
  - Burrows are a maximum of 50 ft long
  - Function of the scope is to take population surveys

Figure 1. Gopher tortoise emerging from his burrow. [1]

Objectives and Goals

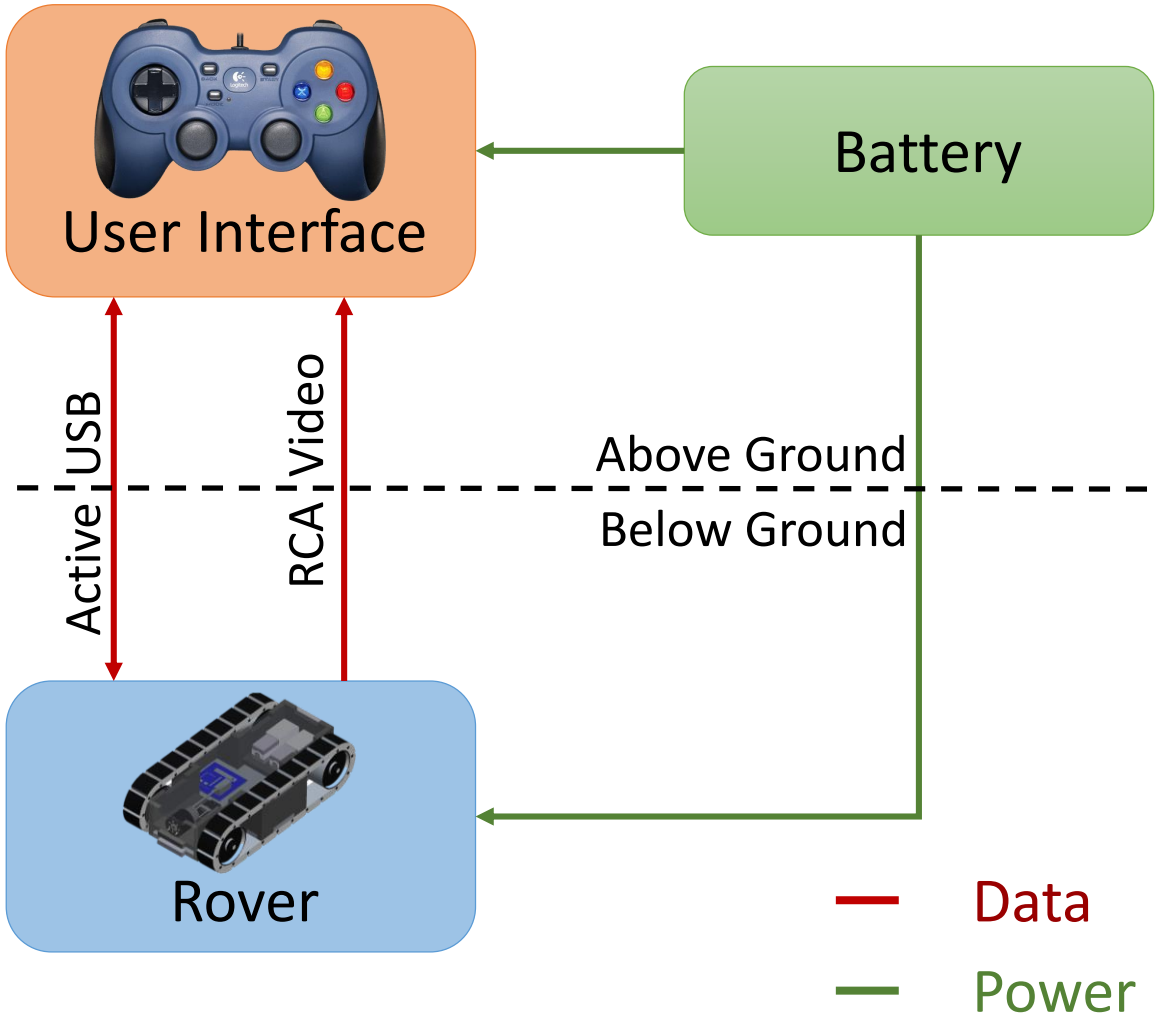
Our objective is to create a design that is:

- Durable
- Capable
- Portable
- Affordable

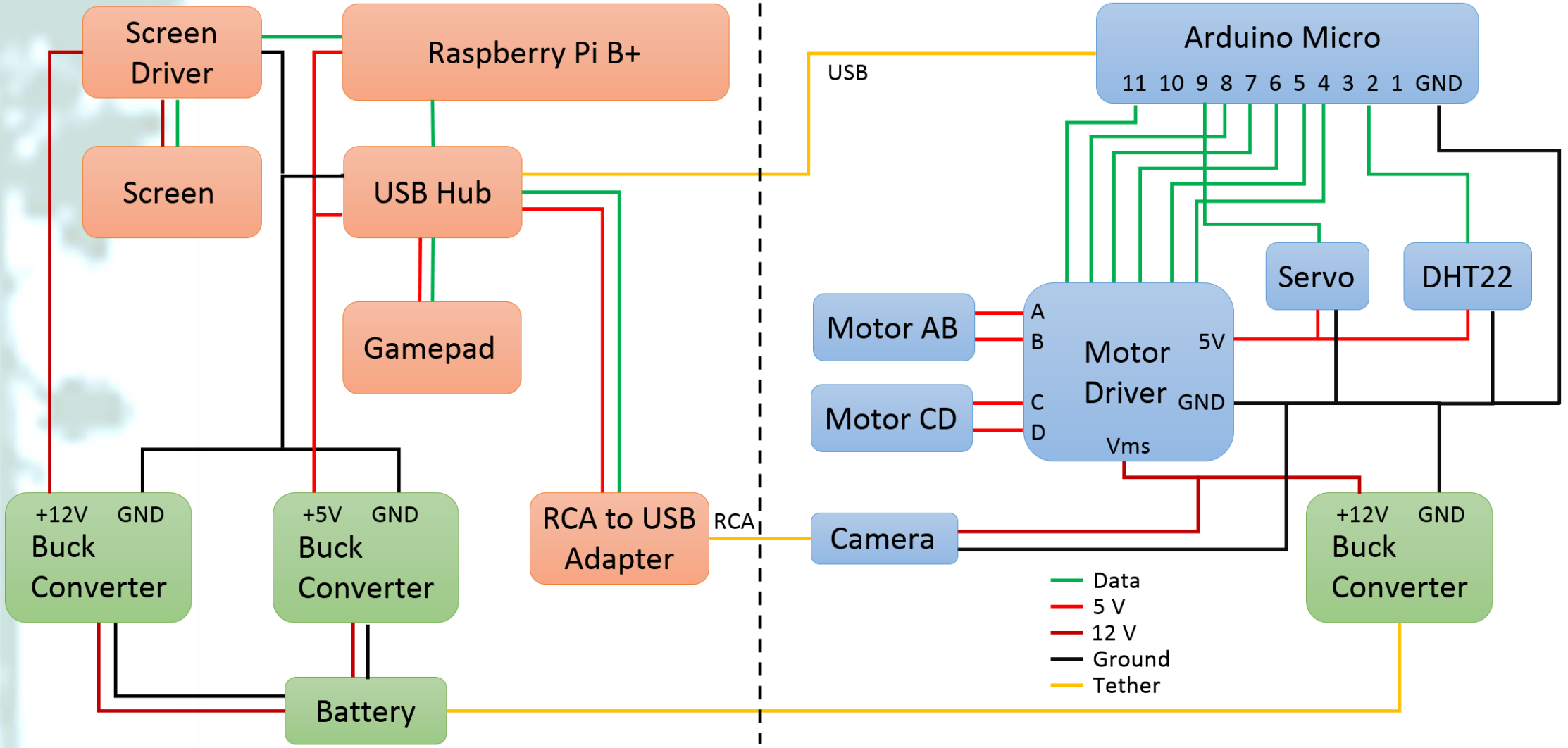
"The main goal is to design a mechanism that has testing sensors, better durability, and more advanced video capabilities than the current system in order to enhance the surveying process of gopher tortoises."

Top Level Design

- Rover
  - Navigates into burrows
  - Carries camera, temp and humidity sensor
- User Interface
  - 7 inch screen
  - Gamepad for controls
  - Linux based OS
- Battery
- Tether



Electrical Schematic



Controls

*Pan range: 0°≤N≤120°; 1.4° minimum resolution; 8-bit PWM

Controls

- Joystick commands
  - 24 zones
  - Convert rectangular coordinates to polar coordinates
    - Magnitude for speed
    - Angle for direction
- Watchdog timer
  - New command every 2 seconds from User Interface
  - Rover applies brakes if no command received within 3 seconds

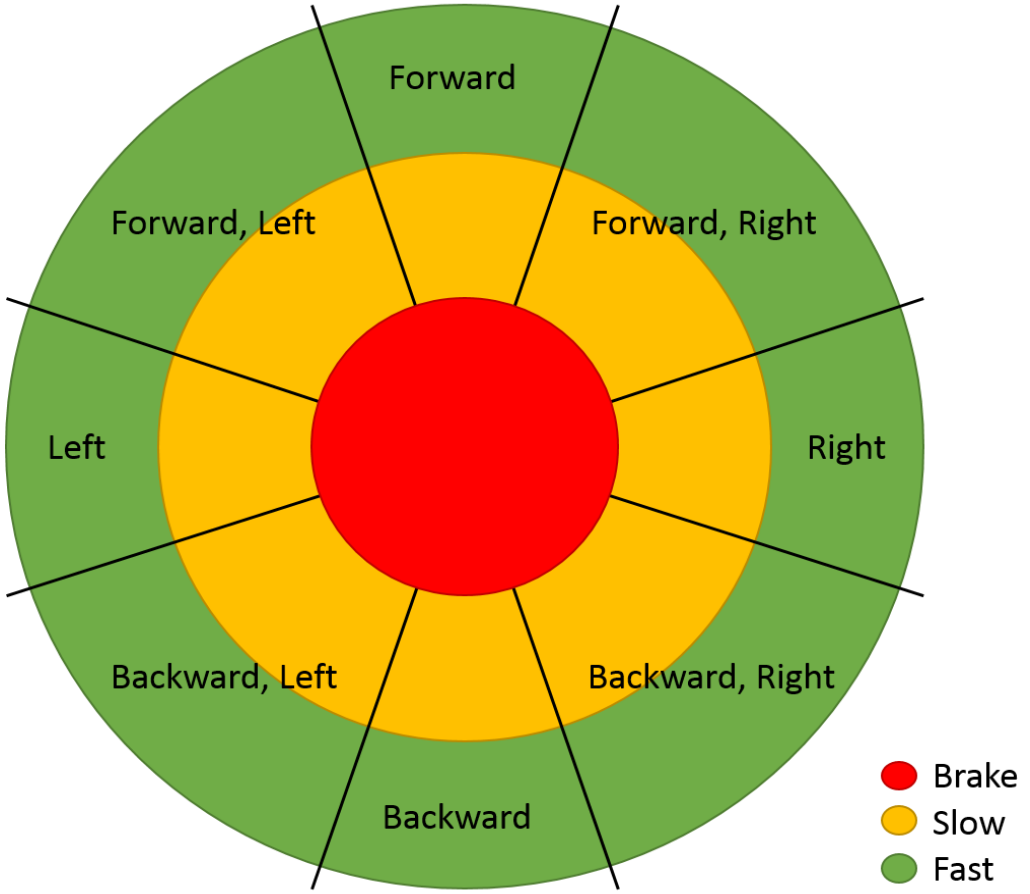


Figure 2. Joystick rover control layout

Sensor

- DHT22 sensor measures both temperature and humidity
- One wire communication
- The DHT22 measures:
  - Relative Humidity from 0% to 100% with ±0.05% accuracy
  - Temperatures from -45°C to 125°C with ±0.5°C accuracy
- Refresh rate of 2 seconds
- Located outside of rover body

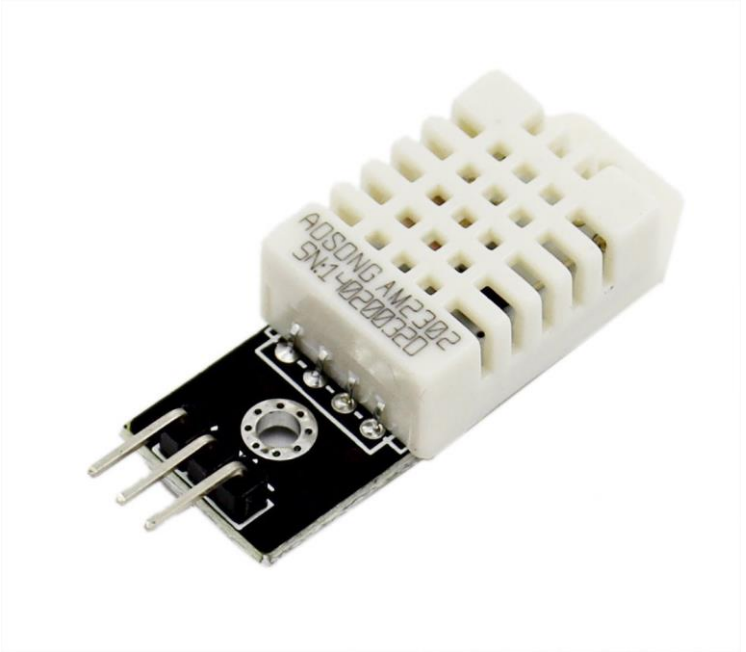


Figure 6. The DHT22 temperature & humidity sensors. [4]

Rover Body

- Planar Chassis
- Casing
  - 0.125 inch IR transmitting Plexiglas
  - Angled front shield
  - Construction
    - Laser cut
    - Adhere with silicone sealant
- Treads
  - Lynxmotion Tracks - Polypropylene/rubber
  - Cut width of 2 inch treads in half

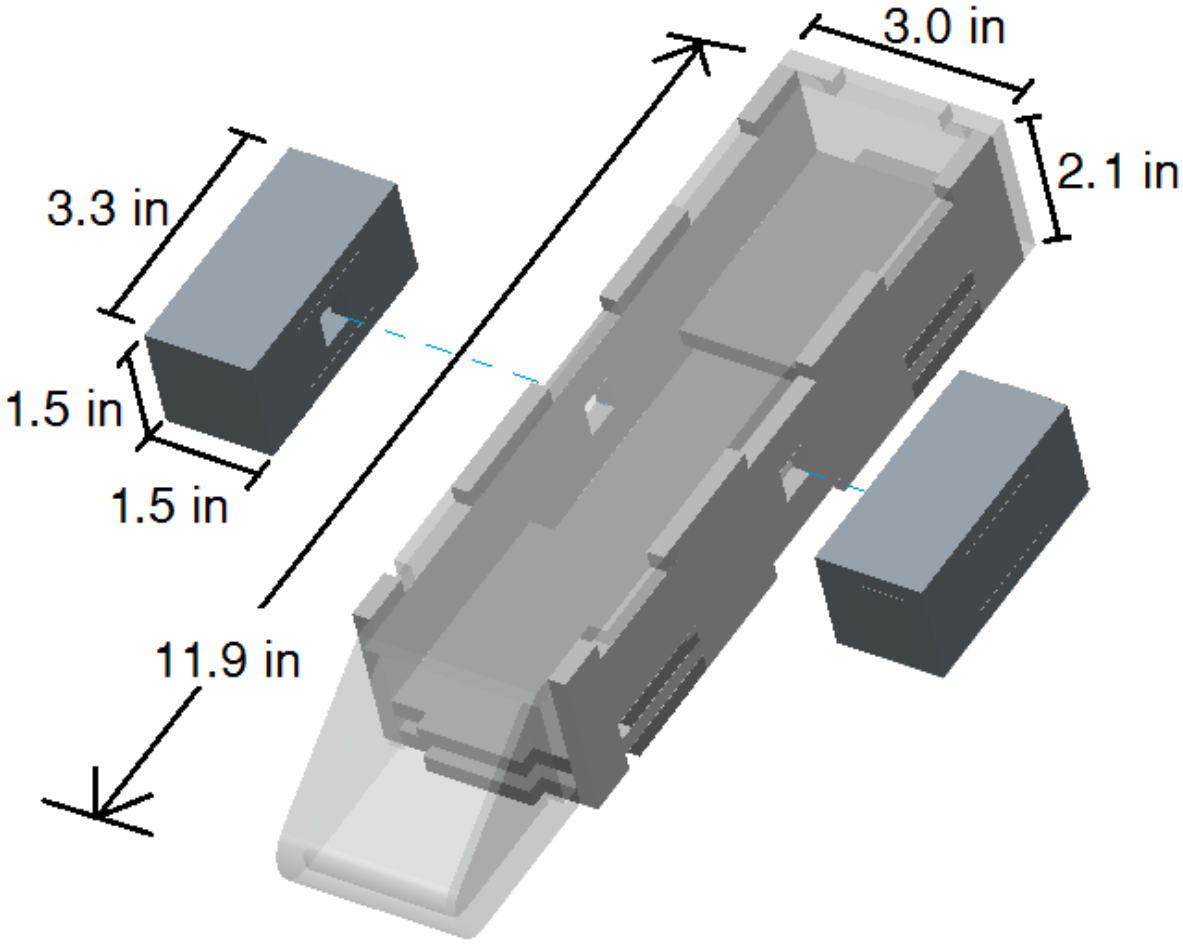


Figure 3. CAD drawing of chassis body.

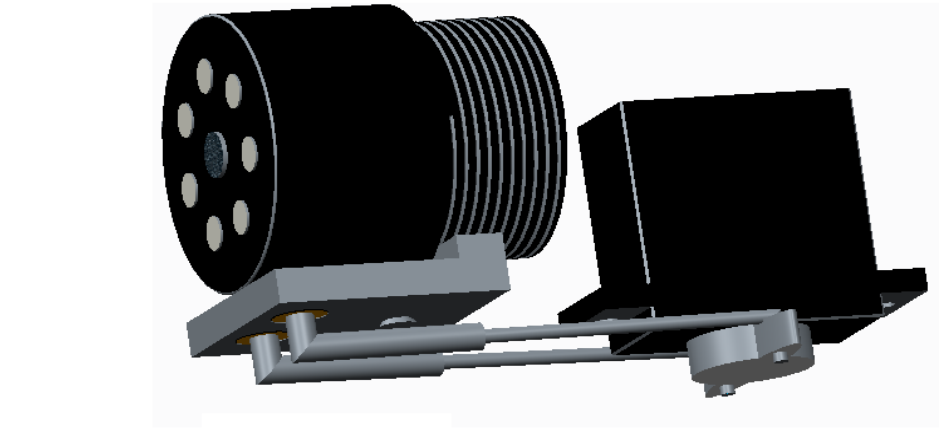
Tether

- Features:
  - Kevlar
  - 50 ft
  - 0.75 in diameter
  - Tensile strength- 440 ksi
- 8-pin waterproof connection
  - PVC external
  - Weight 0.21 lbs
  - Mounted to back of rover

Figure 4. Kevlar expandable braided sheathing and 8-pin connector. [3]

Pan Servo

- Aileron system design
  - Panning only
  - Simpler and more compact
- Aileron rods close together and toward the front of the camera
- Placement in rover such that the camera is in front of tracks



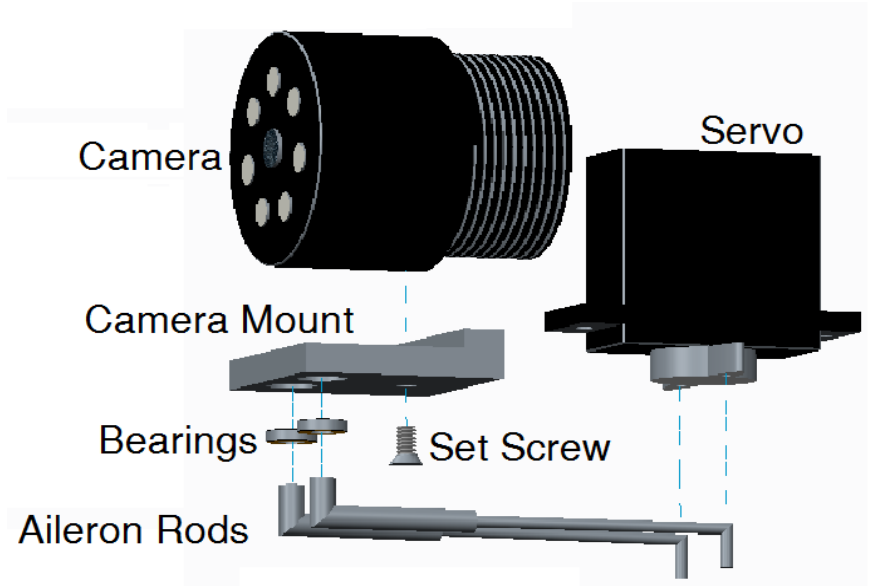


Figure 3. Prototype aileron system.

Prototypes

- Recent progress
  - Laser-cut ABS chassis body and casing
  - Custom treads
  - Simultaneously controlled motor driver, servo and temp/humidity sensor
  - Compartmentalized body
    - More room without major body modification
    - Isolates sensitive hardware
    - Internal tunnel for any wiring

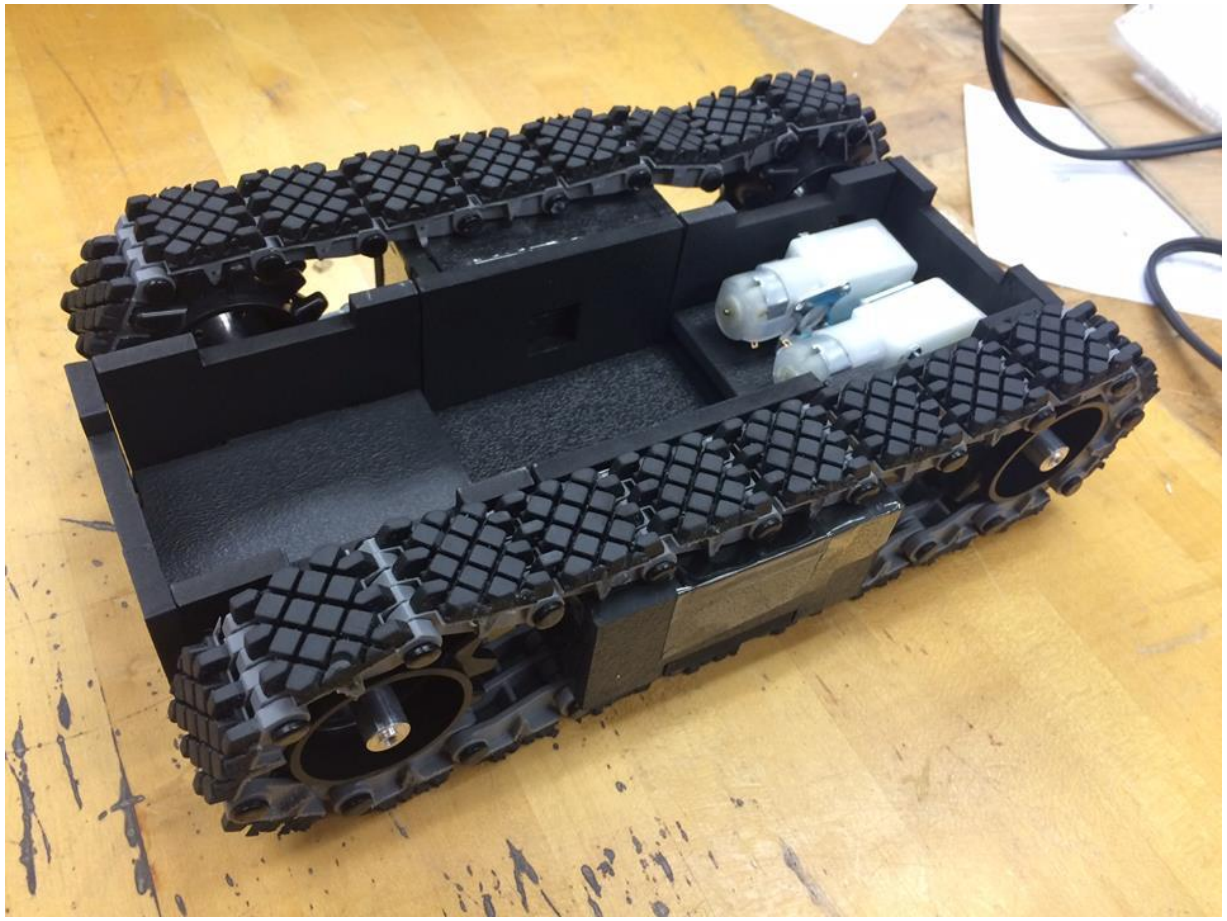


Figure 7. Initial prototype (top) and recent prototype (bottom).

Budget

- Spent about 62% of total budget
  - Two prototypes
  - Testing
  - New components
- Still need:
  - Raw materials
  - Sealant
  - Couplers
  - Accessories

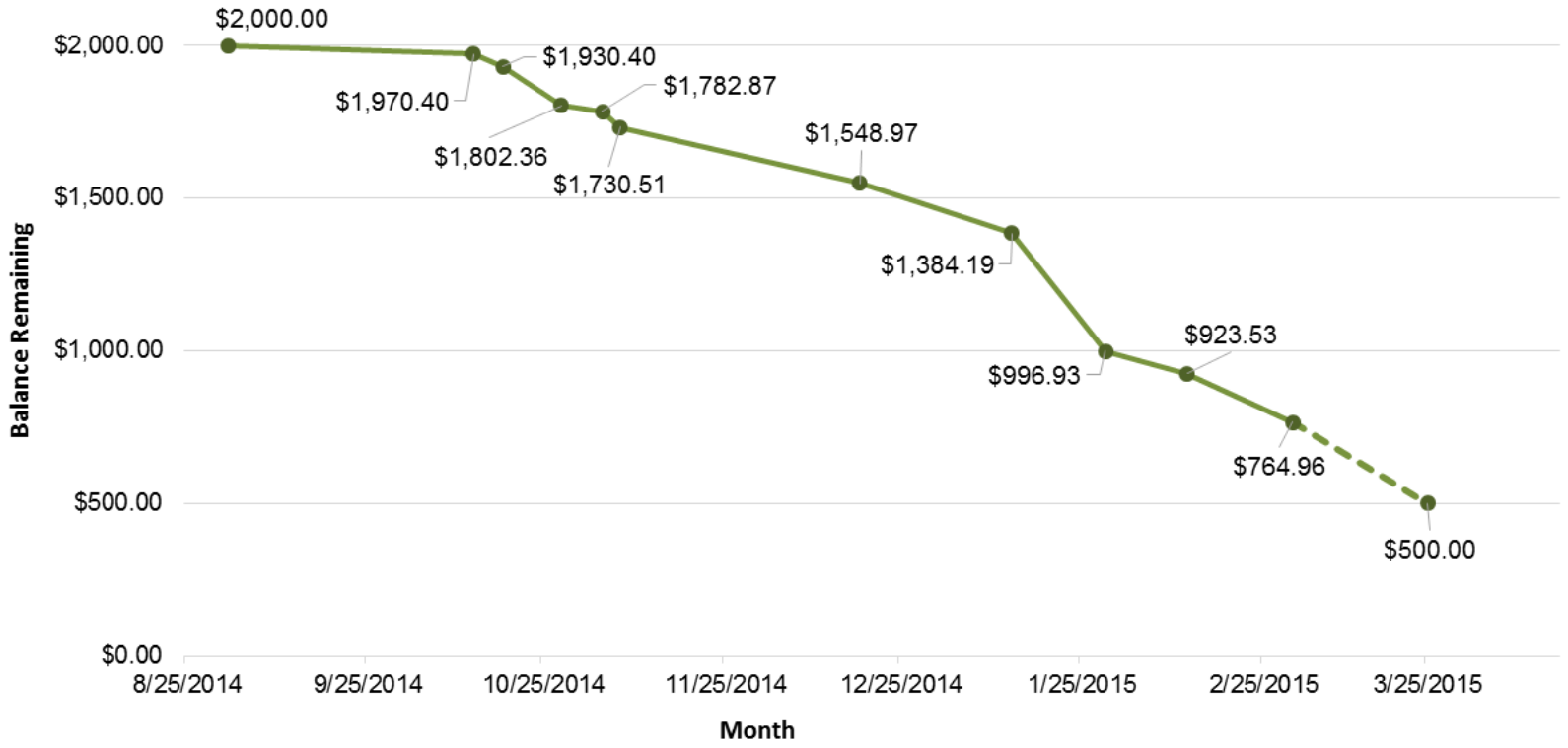


Figure 8. Budget burn chart.

Future Work

- Rover
  - Outdoor testing and casing durability
  - Fashion couplers and camera frame
  - Test water resistance of body shell
- User Interface
  - Build permanent casing
  - Control testing
  - Video control
  - Program graphic User Interface
- Potential Challenges
  - Sprocket and camera mounting
  - Shock durability

Summary

- Identified needs and objectives
- Expanded construction of above and below ground subsystems
  - User Interface development
  - Improved hardware modularity
  - Body redesign
- Modified third prototype
- Prepared for outdoor testing in the future

References

1) "Gopher Tortoise." *Wildlife*. Meryman Environmental, n.d. Web. 20 Jan. 2015. <http://merymanenvironmental.com/gopher-tortoise/>.
2) "Pololu - 200:1 Plastic Gearmotor, 90° Output." *Pololu - 200:1 Plastic Gearmotor, 90° Output*. Pololu, 2015. Web. 16 Feb. 2015. <https://www.pololu.com/product/1120>.
3) "Kevlar Expandable Braided Sleeving." *Kevlar Expandable Braided Sleeving*. Cable Organizer, 2015. Web. 16 Feb. 2015. <http://www.cableorganizer.com/kevlar/#features>.
4) "DHTxx Sensors." *Overview*. Adafruit, 29 July 2012. Web. 16 Feb. 2015. <https://learn.adafruit.com/dht/overview>.

Questions?

For more information go to:
eng.fsu.edu/me/senior_design/2015/team21

Appendix: Gantt Chart

TALL TIMBERS
Research Station & Land Conservancy

Task Name	Start	Finish
Motor control	**Thu 1/15/15**	**Fri 1/30/15**
Programming	Thu 1/15/15	Tue 1/20/15
Building	Mon 1/19/15	Fri 1/30/15
Testing	Mon 1/19/15	Fri 1/30/15
Glare Mitigation	**Tue 1/27/15**	**Thu 2/12/15**
Material Bonding	Tue 1/27/15	Mon 2/2/15
Weatherproofing	Tue 1/27/15	Thu 2/5/15
Testing	Wed 1/28/15	Thu 2/12/15
Casing	**Mon 1/12/15**	**Fri 1/30/15**
Assembly	Mon 1/12/15	Mon 1/19/15
Installation	Thu 1/22/15	Fri 1/30/15
Dimensioning and cutting	Mon 1/12/15	Thu 1/22/15
Baseplate Assembly	**Tue 1/20/15**	**Mon 2/16/15**
Installation	Tue 1/20/15	Wed 1/21/15
Complete Acquisition	Tue 1/20/15	Thu 1/29/15
Assembly	Tue 1/20/15	Mon 2/16/15
Mock Burrow Testing	**Fri 2/27/15**	**Thu 3/26/15**
Burrow Construction	Fri 2/27/15	Fri 3/6/15
Testing	Fri 3/6/15	Thu 3/26/15
Camera Mount	**Wed 12/31/14**	**Fri 1/30/15**
Installation	Wed 1/21/15	Fri 1/30/15
Material Acquisition	Wed 12/31/14	Wed 1/21/15
Interfacing	**Mon 12/1/14**	**Thu 2/5/15**
Screen to Raspberry Pi	Mon 1/12/15	Wed 1/14/15
Camera to Raspberry Pi	Mon 12/1/14	Thu 12/4/14
Arduino to Temp/Humidity sensc	Fri 1/30/15	Thu 2/5/15
Gamepad to Raspberry Pi	Mon 12/1/14	Fri 12/5/14
Raspberry Pi to Arduino	Fri 1/9/15	Thu 1/15/15
Tether	**Sat 1/3/15**	**Fri 3/27/15**
Final	Mon 3/23/15	Fri 3/27/15
Testing	Thu 1/29/15	Fri 2/6/15
Prototype	Mon 1/5/15	Thu 3/19/15
User Interface	**Tue 3/10/15**	**Mon 3/23/15**
Screen Casing	Tue 3/10/15	Mon 3/16/15
Weatherproofing	Thu 3/12/15	Fri 3/20/15
Testing	Thu 3/19/15	Mon 3/23/15