Project Plans and Project Specifications

Underground Robotic Gopher Tortoise Scope

Team 21 (E19)

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Date: 10/10/2014

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Problem Statement

In all, there is a need for gopher scopes to have improved weather and impact durability, greater mobility, data-acquisition capability, and reduced weight and space.

Project Scope and Goal

As stated, the current scope consists of a basic infrared camera that is connected to a tube and wired to a DVD player. The design is cumbersome for several reasons. In order to use the camera, the user must physically push the camera down the tortoise burrow. Thus, the camera can easily dig into the ground and get blocked by dirt. It is difficult to navigate the camera, as there is nothing to help the camera move forward/backwards or navigate turns. Because of this lack of maneuverability, many parts of the burrows are unreachable for decent research. Often, the camera will be flipped over or rotated in an attempt to go around obstacles. Consequently, the user may no longer be able to determine which side is up or down.

The scope, which involves three large components, is heavy and bulky. By the end of the day, the sponsor related that her hands would be covered in blisters from having to physically handle the heavy equipment for eight or more hours. Furthermore, after a burdensome day of work, any results the user does find will have to be handwritten, since there are no video/picture-capturing capabilities with the current model.

When the weather is inclement problems are amplified. If it is raining, the device is at risk due to the fact that it is not waterproof, and there are open wired connections. Further, water could ruin the infrared camera itself, leading to costly repairs or replacements. Also, the scope could run into obstacles, and is not shock-proof enough to handle unexpected impacts. Finally, in the common case that the lens fogs up or is covered with dirt or mud, the user must pull out the scope, clean it, and start the process over from the beginning.

Buying a manufactured scope is typically not an option for research centers such as Tall Timbers. It is a non-profit organization, and does not have the budget for a system that can cost up to $6000. Thus, research stations like these are stuck in a financial trap, and are unable to get adequate tools for underground research.

Goal Statement:

Design a mechanism to have testing sensors, better durability, and more advanced video capabilities than the current system in order to enhance the surveying process of gopher tortoises.

Project Objectives

Objectives:

- Mechanism needs to be water and dirt resistant
- No more than 6 inches wide
- Weigh less than 50lbs
- Shock resistant

- Have a battery life for at least 8 hours
- Operate in temperatures from 0°F and 100°F
- Infrared camera that can take pictures and record live video
- Gather temperature and humidity readings of the burrow
- Move quickly with good traction down the burrow
- Be relatively quiet in order to not disturb the gopher tortoises or other animals

Overall Plan, Methodology, and Approach

- Identify key systems and functionalities
- Discuss various design ideas/methods
- Factor in constraints, limitations, possibilities, feasibility, and ergonomics
- Choose design
- Determine sectional components to design and prototype
- Outline initial CAD drawings and calculations
- Construct initial prototype and test
- Analyze need modifications and budget
- Order parts for final design
- Field testing
- Final design construction
- Final design testing
- Presentation of final product

Table 1. Summary of Desired Subsystem Features

Subsystem	**Features**
Power	8 hours of operation
Camera	Infrared
	Tilt/Pan
	Screen
Maneuverability	Cornering
	Anti-flipping
Data Acquisition	Temperature
	Humidity
	GPS
	Depth
	Recorded video
User Interface	Control Switches and Display
Tether	Durable
	Flexible
	10-15 meters in length

Constraints

The planned usage and environment of the Gopher Tortoise scope means that a great deal of constraints must be considered when designing the product. Firstly, the average size of the Gopher Tortoise burrow must be taken into consideration. The underground rover portion of the design should be no more than six inches in diameter, and ideally only four inches in diameter. The rover will also need to be attached to a tether which extends to a length of at least 10 meters.

The portability of the design must also be considered. The design of the product must allow for a single researcher to easily carry it through several miles of dense forest. To accommodate this, the design will have to fit into a standard backpack and must not weigh more than 50 pounds. The design should also be durable and shock resistant in order to withstand the stresses associated with being kept in a backpack and being loaded and unloaded from the back of a truck.

Additionally, the product will be required to operate in the field for a full work day under a variety of weather conditions. To allow for this, the batteries will need to provide enough power for eight hours of continuous operation. The design will need to be able to operate in temperatures ranging from 0^0F to 100^0F. The design will also need to be dirt and water resistant so that the electronics are not compromised while operating underground or in adverse weather.

Finally, the product should be able to be purchased and built by researchers across the country that may have limited funds and/or technical experience. To accommodate this, the product will have to be designed using only readily available parts. The assembly process will need to be carefully documented to allow other teams to duplicate the results. The final product should cost no more than $800, and ideally be only $500.

	Task Name	Duration	Start	Finish
1	Project Assignment	6 days	Mon 9/1/14	Mon 9/8/14
2	Ice Breaker	6 days	Mon 9/1/14	Mon 9/8/14
3	Meet with Project Sponsor	11 days	Mon 9/1/14	Mon 9/15/14
4	Code of Conduct	5 days	Mon 9/1/14	Fri 9/5/14
5	Meet with Academic Advisor	11 days	Mon 9/1/14	Mon 9/15/14
6	Needs Assessment	10 days	Mon 9/15/14	Fri 9/26/14
7	Initial Web Page Design	20 days	Mon 9/22/14	Fri 10/17/14
8	Initial Prototype	18 days	Mon 9/22/14	Wed 10/15/14
9	Midterm Presentation 1	2 days	Thu 10/16/14	Fri 10/17/14
10	Midterm Report 1	15 days	Mon 10/6/14	Fri 10/24/14
11	Midterm Presentation 2	7 days	Mon 11/3/14	Tue 11/11/14
12	Final Web Page Design	47 days	Mon 9/22/14	Tue 11/25/14
13	Final Design Presentation	7 days	Mon 11/24/14	Tue 12/2/14
14	Final Report	10 days	Mon 11/24/14	Fri 12/5/14
15	Begin Testing	10 days	Mon 12/1/14	Fri 12/12/14

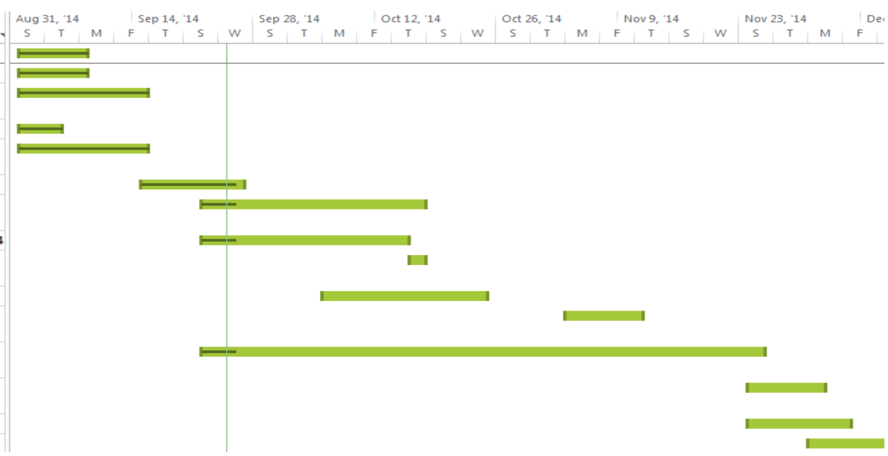

Figure 2. Gantt Chart for Team 21

Deliverables

- Component Breakdown
  - Week 6-8

    - Layout individual components of tortoise scope functionality
    - Decide overall initial design
- Decide CAM/Design Tilt and Pan
    - Week 6-9
    - Perform research on available options
    - Design camera housing
- Purchase Prototype Material
    - Week 7-8
    - Purchase chassis
    - Allow enough time for materials to be shipped
- Presentation 1: Conceptual Design
    - Week 8-9
    - Initial CAD model
    - Prepare for presentation
- First Functioning Prototype
    - Week 10-12
    - Assembly of prototype
    - Begin testing of first prototype
- Presentation 2: Interim Design Review
    - Week 13
    - Prepare for presentation
- Finalize Refined Design
    - Week 13-15
    - Develop a workable prototype
- Presentation 3: Final Design Presentation
    - Week 15

Product Specifications

A. Design Specifications

- Rover
    - Size
        - 4" track
        - 6" in long
        - 4" high
    - Weight
        - 1-5lbs
    - Maneuverability
        - Treads
        - Anti-flipping device
- Camera
    - Size
        - Diameter – 1.2"

    - Temperature and humidity sensors
    - Infrared
    - Tilt and Pan
- Tether
    - Length- 10-15 meters
    - Diameter – 5mm
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B. Performance Specifications

- Rover
    - Power
        - Battery system
            - Wired
            - Motors
                - Treads
                - Tilt/Pan
    - Durability
        - Waterproof
        - Shockproof
        - Dirt resistant
    - Sound
        - Decibel level (10 Db)
- Camera
    - Durability
        - Waterproof
        - Shockproof
        - Dirt resistant
    - Power
        - 1.5 Watts
    - Video and imaging capability
- Tether
    - Durability
        - Waterproof
        - Shockproof
        - Dirt resistant
    - Flexibility
        - Ability to wrap around self retracting spool

References