Wayward Navigation Rover

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Introduction

-GT Engineering group tasked to create a mobile robot platform to navigate through a garden

-Goal is to navigate robot remotely via cloud and mobile device

-Design will be open source when completed

-Possible issues: sustainable power, space for GNC module and space for additional components, robot tracking from remote location

-Possible Solution: solar panel charger, ensure robot is large enough for components

Customer Requirements/Design Goals

Customer: Modern Radio/ Hip-Sci, perspective customers

Customer Requirements:

- Rechargeable battery*
- Long battery life*
- Traverse obstacles*
- Space for Future accessories
- Ability to view various size plant rows and beds
- Operate entirely outdoors

Customer Requirements continued...

- Integrate GNC (Guidance, Navigation, Control) modem*
- Rover control with cell phone
- Wireless connectivity to rover and cloud
- Software system able to integrate additional sensors*
- Simplistic design for easy repairs and operation

Technical Specifications & HOQ

Electrical:

1. **12 hr + battery life***
2. **Solar Panel charger(2A charge rate)***
3. **Brushed motor for rover movement(target 3mph)**

Mechanical:

1. **Ability to traverse difficult terrain***
2. **Weatherproof(Heat, Cold, Rain, Acts of God)**
3. **Simple design and construction(repairable by user)**

Technical Specifications & HOQ

Software:

1. **Integration of GNC modem***
2. **Communication with cloud service for position, remote viewing and control**
3. **UI and control with mobile app***

General:

1. **Integrate future accessories after release***
2. **User friendly controls and easy operation**
3. **Weight: target of 150 lbs(includes payload)**

HOQ Weight Chart

Target	Charge rate of 2A	Battery life of 12 hours of extended	traverse obstacles, "offroad	fit support electronics, GNC	overall height 18"	weather proof	Include GNC modem	phone app to control robot	communication w/ cloud	aftermarket/user upgrades	Inexpensive components
Max Relationship	9	9	9	9	9	9	9	9	9	9	9
Technical Importance Rating	171	270	207	165	63	90	243	153	153	279	117
Relative Weight	9%	14%	11%	9%	3%	5%	13%	8%	8%	15%	6%
Weight Chart	≡	≡	≡	≡	—	—	≡	≡	≡	≡	=

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Design Concept Ideation

System controller:

- Raspberry Pi

UI and Control with mobile app:

- Modern Radio GNC-Modem
- High-resolution Wi-Fi camera

Robot Analytic features:

- Modern Radio IOT stick
- Modern Radio Sensors

Robot Build major factors:

- Durability
- Size
- Water-resistant

Preliminary Concept Selection

- There are seven finalized design aspects: modular robot chassis, raspberry pi, JPL open API, controlled over cellular, recharged to solar panels, wifi enabled camera, modern radio sensor.
- We are responsible for :
  - The rechargeable battery pack : Panasonic 18650
  - The motors: DC brushed motors
  - The motor controllers: Generic DC motor controller
  - Software and hardware that controls and operates the robot.
- Potential Risks:
  - Low output motors.
  - Short battery life.

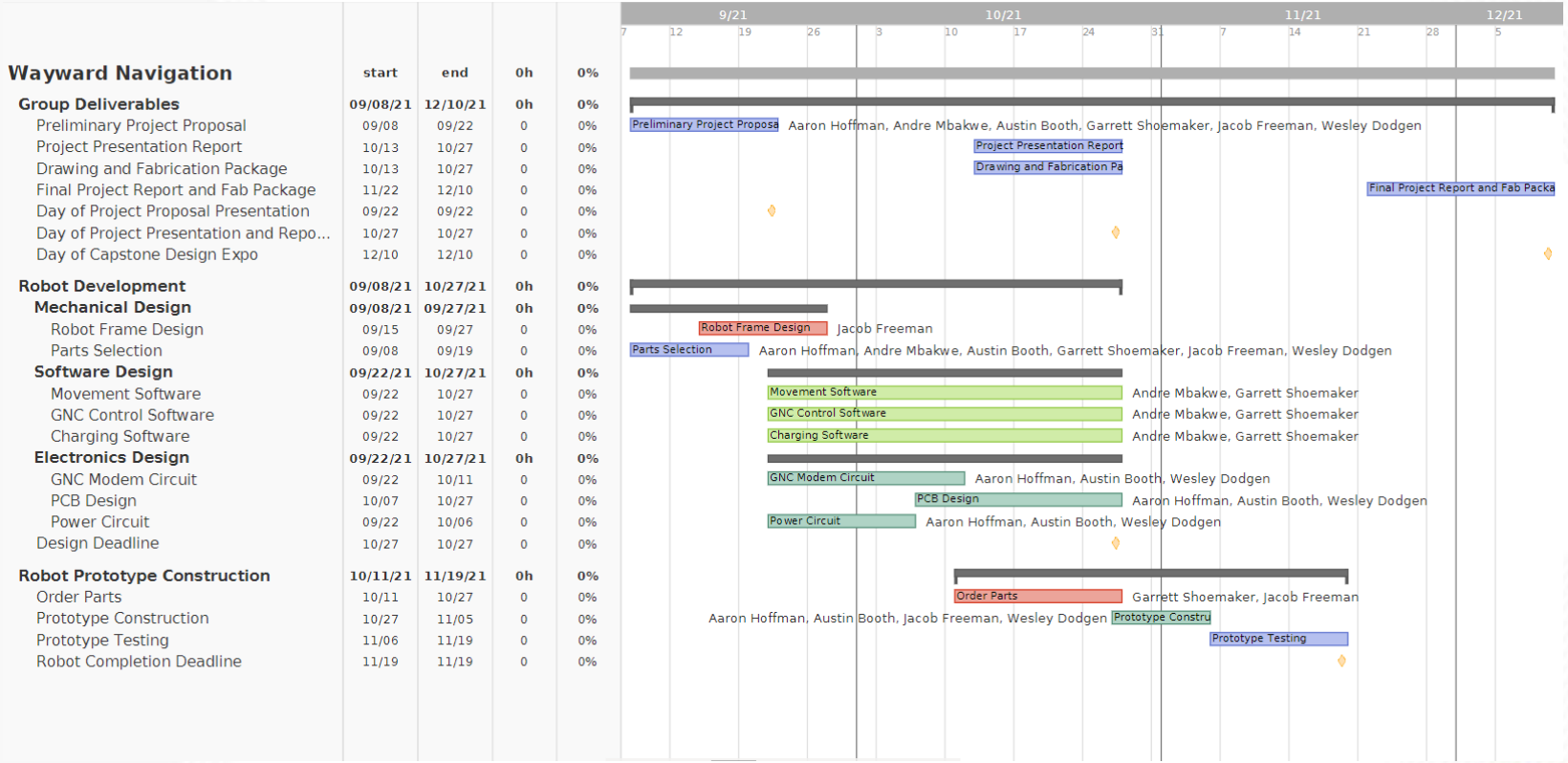
Engineering Analyses

- There will be many amounts of inspection tests and evaluations once specification requirements have been defined.
- **Prototype testing stages**:
  - Manual Control of the Robot with HW Interface
  - Cellular Device Control of the Robot
- **Manual Control of the Robot with HW Interface**:
  - Movement testing using a gaming controller.
  - Movement on various terrain types
- **Cellular Device Control of the Robot**:
  - Movement testing using cellular device.
  - Data translation from several sensor inputs.

Codes and Standards

- A list of several standards that will affect the design decisions of this project include:
  - UL 1642 – Standard for Safety for Lithium Batteries
  - ANSI/NEMA C18 – Safety Standards for Primary, Secondary and Lithium Batteries
  - UL 2054 – Standard for Household and Commercial Batteries
  - UL1004: Establishes general requirements for all types of electrical motors
  - 1641 - IEEE Standard for Signal and Test Definition

Team Schedule Gantt Chart



Wayward Navigation	start	end	0h	0%
Group Deliverables	09/08/21	12/10/21	0h	0%
Preliminary Project Proposal	09/08	09/22	0	0%
Project Presentation Report	10/13	10/27	0	0%
Drawing and Fabrication Package	10/13	10/27	0	0%
Final Project Report and Fab Package	11/22	12/10	0	0%
Day of Project Proposal Presentation	09/22	09/22	0	0%
Day of Project Presentation and Repo...	10/27	10/27	0	0%
Day of Capstone Design Expo	12/10	12/10	0	0%
Robot Development	09/08/21	10/27/21	0h	0%
Mechanical Design	09/08/21	09/27/21	0h	0%
Robot Frame Design	09/15	09/27	0	0%
Parts Selection	09/08	09/19	0	0%
Software Design	09/22/21	10/27/21	0h	0%
Movement Software	09/22	10/27	0	0%
GNC Control Software	09/22	10/27	0	0%
Charging Software	09/22	10/27	0	0%
Electronics Design	09/22/21	10/27/21	0h	0%
GNC Modem Circuit	09/22	10/11	0	0%
PCB Design	10/07	10/27	0	0%
Power Circuit	09/22	10/06	0	0%
Design Deadline	10/27	10/27	0	0%
Robot Prototype Construction	10/11/21	11/19/21	0h	0%
Order Parts	10/11	10/27	0	0%
Prototype Construction	10/27	11/05	0	0%
Prototype Testing	11/06	11/19	0	0%
Robot Completion Deadline	11/19	11/19	0	0%

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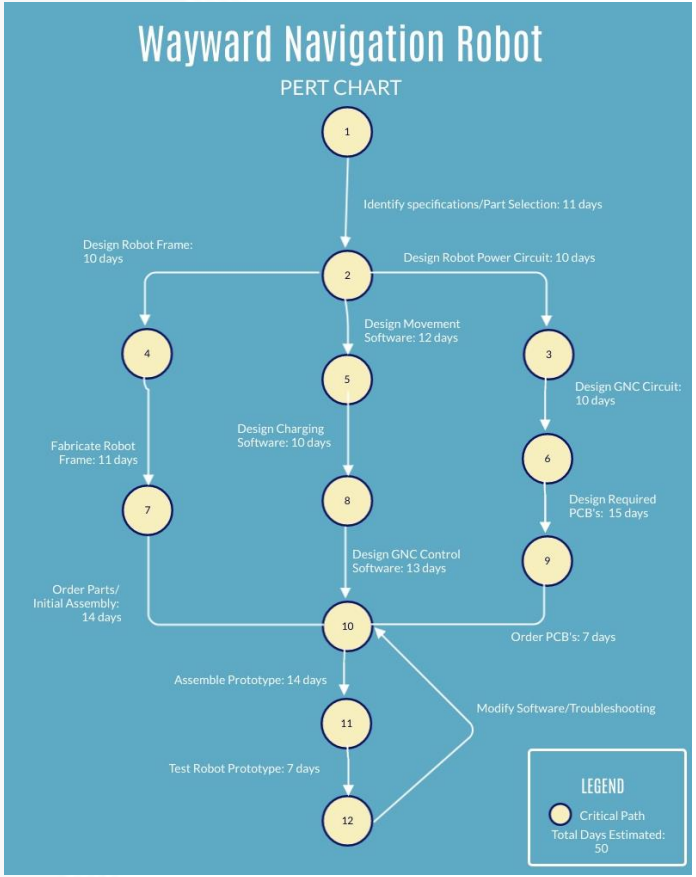
Critical Path PERT Chart



- Estimated chance of success: 95%
- Minimum days for completion: 50
  - Margin of 10 days
- Error margin attributed to issues that may be encountered during robot assembly, testing, and troubleshooting

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Marketing Analysis

Competitor

- Features
  - Collision Sensor
  - Real-Time Video Transmission
  - Control Via Mobile Application
- Price
  - $72.24 - $138.99

GT Robot

- Features
  - Weather Resistant
  - Near Limitless Range (GNC-Modem)
  - Self-Charging Via Solar Panel
- Price
  - $0.00

Cost Analysis

Cost Analysis			
	Hourly Rate	Days	Total
Labor	$19	50	$950
	Cost	QTY	Total
Frame	$30	1	$30
Motors	$15	4	$60
Motor Hat	$23	1	$23
PCB	$18	1	$18
Solar Panel	$10	1	$10
Battery	$7	4	$28
GNC Module	$20	1	$20
Wiring	$15	1	$15
Light Sensor	$8	1	$8
Servo	$10	2	$20
Wheels	$19	3	$57
Materials			$289
Final Cost			$1,239
Product Price			$0

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