Moving Target System

On-Point Engineering

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MECH 477
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Special Thanks

Mr. Neil Haney
Dr. Lucas Craig
Mr. Cullen Haskins
Jim Dahl and John Feneck

Introduction

Our Capstone is to design a moveable target system for Mr. Neil. He has a hunting camp and wants to have a moving target system that can be remote controlled and posited between two random trees for operation (Fig. 1) for target practice.

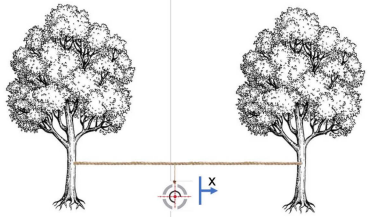


Fig. 1: Moveable Target Schematic.

Design Requirements

Basic Features

- Must fit in hard shell case
- Must be remote control
- Must be adjustable in length (8ft–20ft)
- Light weight (10 lbs)
- End stops
- Run time (45 min)

Performance Features

- Variable speed (1ft/s-10ft/s)
- Interchangeable targets
- Quick install time (10 min)

Excitement Features

- Y-axis movement (3ft)
- Programmed exercises (3)
- Multiple Firearms

Background

Two Methods:

~~Gantry:~~	Tree Mounted:
• Moves entire system **along the line**	• Moves the line **through the system**
• Target is **attached to the System**	• Target is **attached to the line**
• Electric DC Motor	• Electric DC Motor

Key Elements throughout the Design:

- Small
- Compact
- Lightweight
- Remote Control
- Portable
- Durable
- Easy to set up
- Interchangeable Parts
- 3D Printed Prototype

Fig 2. DIY Setup

Fig 3. Military grade target system

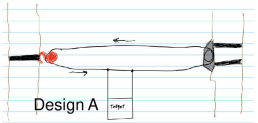
Capstone Objectives

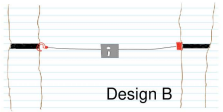
- Design a moveable target system
- Implement 3D modeling using Autodesk Inventor/ Solid Works
- Design and construct the radio control system
- Construct and experimental test the moveable target system
- Search for potential patents – future work is to patent this device
- Provide detailed design analysis and provide an engineering poster and design report

Weighted Objectives Table

ON-POINT ENGINEERING	WEIGHTED OBJECTIVES TABLE							
		FULL TROLLY		TWO PULLEY TROLLY		SINGLE PULLEY DRIVE	
CRITERIA	WEIGHT	SCORE	WEIGHTED	SCORE	WEIGHTED	SCORE	WEIGHTED
MUST FIT IN (18x13x7) in. HARD SHELL CASE	12%	2	0.24	3	0.36	4	0.48
SMALL REMOTE CONTROL (HAND SIZE)	9%	~~5~~	~~0.45~~	~~5~~	~~0.45~~	~~5~~	~~0.45~~
ADJUSTABLE IN LENGTH (8-12) ft.	8%	2	0.16	5	0.4	5	0.4
LIGHT WEIGHT (10lbs)	10%	1	0.1	3	0.3	4	0.4
HAS END STOPS	5%	3	0.15	2	0.1	3	0.15
VARIABLE SPEED (1-10) ft/s	8%	3	0.24	4	0.32	4	0.32
INTERCHANGABLE TARGETS	10%	~~5~~	~~0.5~~	~~5~~	~~0.5~~	~~5~~	~~0.5~~
QUICK ASSEMBLY (10min)	18%	3	0.54	3	0.54	4	0.72
Y-AXIS MOVEMENT (3ft)	2%	~~1~~	~~0.02~~	~~1~~	~~0.02~~	~~1~~	~~0.02~~
PROGRAMMED EXERCISE (3)	4%	4	0.16	2	0.08	4	0.16
MULTIPLE FIREARMS	3%	~~5~~	~~0.15~~	~~5~~	~~0.15~~	~~5~~	~~0.15~~
FULLY 3D PRINTED	11%	3	0.33	3	0.33	4	0.44
TOTAL	100%		2.4		2.99		3.44

Initial Designs





Design A)
Single Pulley Drive.
Pros:
- Supports all Basic Design requirements.
- Different length of string for adjustable length.
- Follows customer's vision.

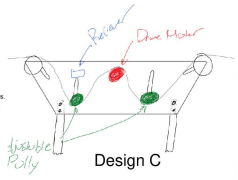
Cons:
- New sling necessary for relocation.

Design B)
Two Pulley Trolly.
Pros:
- Trolly runs from side to side.
- Target is attached to trolly.
- Simple design

Cons:
- Risk of shooting mechanism.
- Harder to retain tension of string.
- Friction difficulties for left to right travel.
- Limited space for components

Design C)
Gantry System.
Pros:
- Strong system.
- Easy to setup.
- Room for all electrical and power components.
- Target is attached to trolly.

Cons:
- Heavy.
- Large.
- System already used in other applications.
- Risk of shooting mechanism.



Electrical Designs

Fig 4. RC

Fig 5. plug in Motor Shield

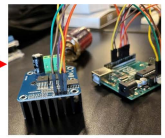


Fig 6. External Motor Shield

Experimental Setup

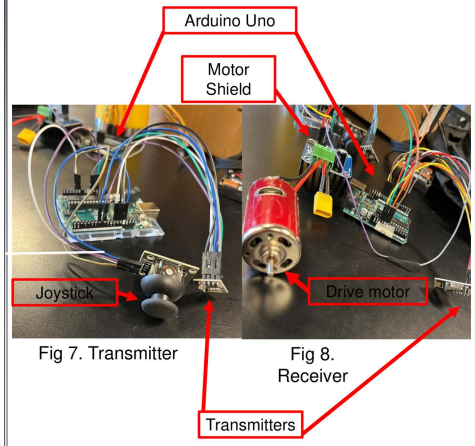


Fig 7. Transmitter

Fig 8. Receiver

Testing

- RPM Testing with NEIKO digital tachometer.
- Tensile testing on string.
- Radial load till stall, varied based on RPM.

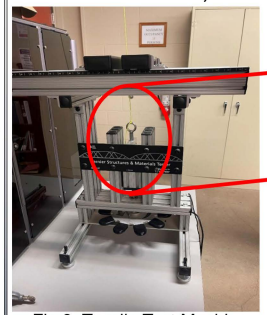


Fig 9. Tensile Test Machine

Fig 10. Tensile Test

Design Phase

Design 1:

- Gantry System
- 2 Plates – Front & Back
- Line runs through 2 pullies
- Target Hangs below system

Fig 11. Design 1

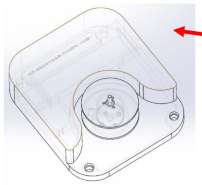


Fig 12. Design 2

Design 2:

- Same electronics
- Entire system was rotated 90 Degrees
- Enclosed tree side
- Pully would help vent the ESC and motor

Final Design

- Design revolves around motor assembly and electronics
- Fully enclosed
- Waterproof
- Significantly more durable
- Potential for Future improvement

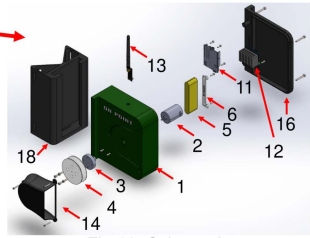


Fig 13. Schematic

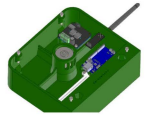


Fig 14. Internal Design

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	6674668-01	Mounting Plate	1
2	6674668-02	65T Motor	1
3	6674668-03	Motor Coupling	1
4	6674668-04	Drive Pully	1
5	6674668-05	2S Lipo Battery	1
6	6674668-06	Battery Bracket	1
7	B1B.3.1M - 3 x 0.5 x 10 Hex SHCS – 10MHX	M3x10 SHCS	8
8	B1B.3.1M - 4 x 0.7 x 12 Hex SHCS – 12MHX	M4x12 SHCS	4
9	DPM 0.125x1	1/8' Dowel Pin	1
10	B1B.3.1M - 3 x 0.5 x 12 Hex SHCS – 12MHX	M3x12 SHCS	2
11	6674668-07	Arduino Uno	1
12	6674668-08	DC Motor Shield	1
13	6674668-09	Transmitter	1
14	6674668-10	Pully Cover	1
15	B1B.3.1M - 3 x 0.5 x 20 Hex SHCS – 20MHX	M3x20 SHCS	3
16	6674668-11	Cover Plate	1
17	B1B.3.1M - 4 x 0.7 x 30 Hex SHCS – 30MHX	M4x30 SHCS	4
18	6674668-12	Tree Bracket	1

Fig 15. Bill of Materials

Future Work

- Patent Search
- Add longer range Transmitters
- Design changes for ease of use
- Making component out of all aluminum

Project Contributions

Name:	Forest Hall
Contribution:	
Draft Poster	
Draft Report	
3D printing Design Prototypes	
Made Purchase List for Mr. Haney regarding all Electronics	
All wiring and coding for Arduino, motor, and remote Control	
Communicated design ideas	
One on One communication with Mr. Haney on Wiring Updates	

Name:	Steve Dahl
Contribution:	
Modified Gantry Design	
Initial Tree Mounted Design	
Modified tree mounted design w/ new components	
3D Printed test parts for fits/bolt patterns	
outsourced coupling to be professionally made	
Helped run initial tests with RC setup	
Created multiple design configurations (pulley)	

Name:	Eric Roach
Contribution:	
Safety Manual creation	
Machined a coupler, later was outsourced	
Helped with purchase lists	
Tensile Testing and Recording of Data	

Name:	Nathaniel Klinger
Contribution:	
Compiled notes from presentation video	
Assisted in the design by consultation	
Made multiple purchase lists	
All wiring and testing of RC setup	
RPM testing	
Designed coupler for pulley	
Gone to purchase material for project	
3D printed several test pieces for model	