Drag Racing

JOSEPH COGNATO[1], JONATHAN GLYNN[1], MATTHEW HARTMAN[1], LEONARDO OLIVEIRA[2]

[1]. *Department of Mechanical Engineering, Florida State University, Tallahassee, FL*
[2]. *Department of Mechanical Engineering, Universidade Federal de Itajubá, Itajubá, MG*

4/12/2012

Overview

- Introduction
- Scope
- Concepts
- Final Concept and Design
- Budget
- Results
- Conclusion

Introduction

- Design a Museum display that will demonstrate properties of aerodynamics to young minds (K-12)
- User friendly educational display

Initial Plans

- Mary Brogan Museum
- Business School
- For kids

Objectives

- Low maintenance
- Interactive
- Robust and simple for repeated demonstrations
- Easy to operate

Initial Concepts

- Decision between housings of a traditional display or alternative flow tank (water)
- Possible visualizations using water, or air
- Display the wake off of the shapes using a piezoelectric sensor
- Allowing the users hand to act as an airfoil

Initial Concepts Cont'd

- Large airfoil with adjustable pitch to find the critical lift angle
- Different shapes placed on the carts to minimize drag

Selection Matrix

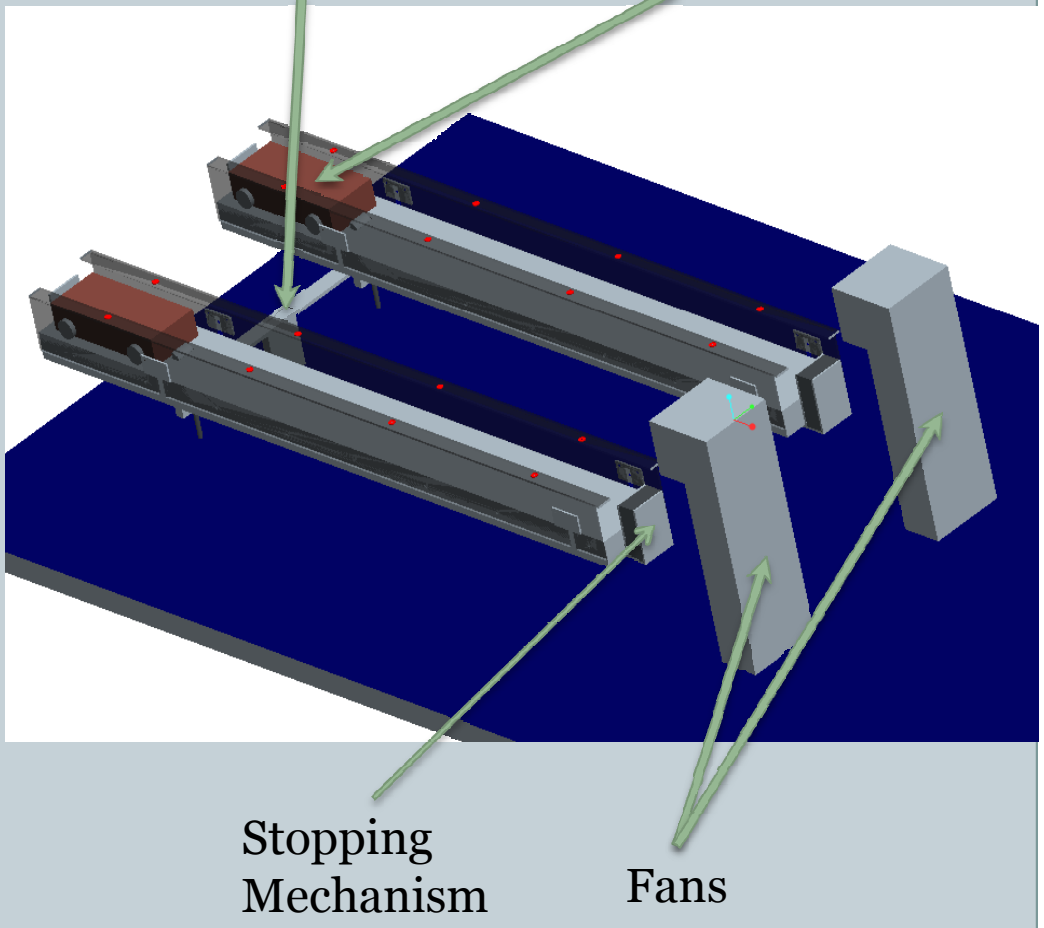
	Cost	Maintenance	Space	Robust	Educational	Simple	Safety	Total
Weight	0.1	0.25	0.1	0.1	0.25	0.15	0.05	10
Air Box	10	9	10	10	7	10	8	8.9
Water Tank	1	7	2	8	10	8	5	6.8
Smoke	3	1	4	9	10	9	7	6.1
Cart	8	8	8	7	7	9	9	7.9
Hand	10	10	8	10	6	10	2	8.4
Airfoil	6	9	6	8	9	7	8	8
Actuator	8	9	7	8	5	5	8	7
Drag Racing	6	10	10	9	8	7	4	8.25
10=good	1=bad							

Final Design Selection

- Drag Racing was selected due to the low maintenance and easy to convey ideas
- The interactivity can keep the user engaged and get them to learn more
- The multiple shape options allows for continued use

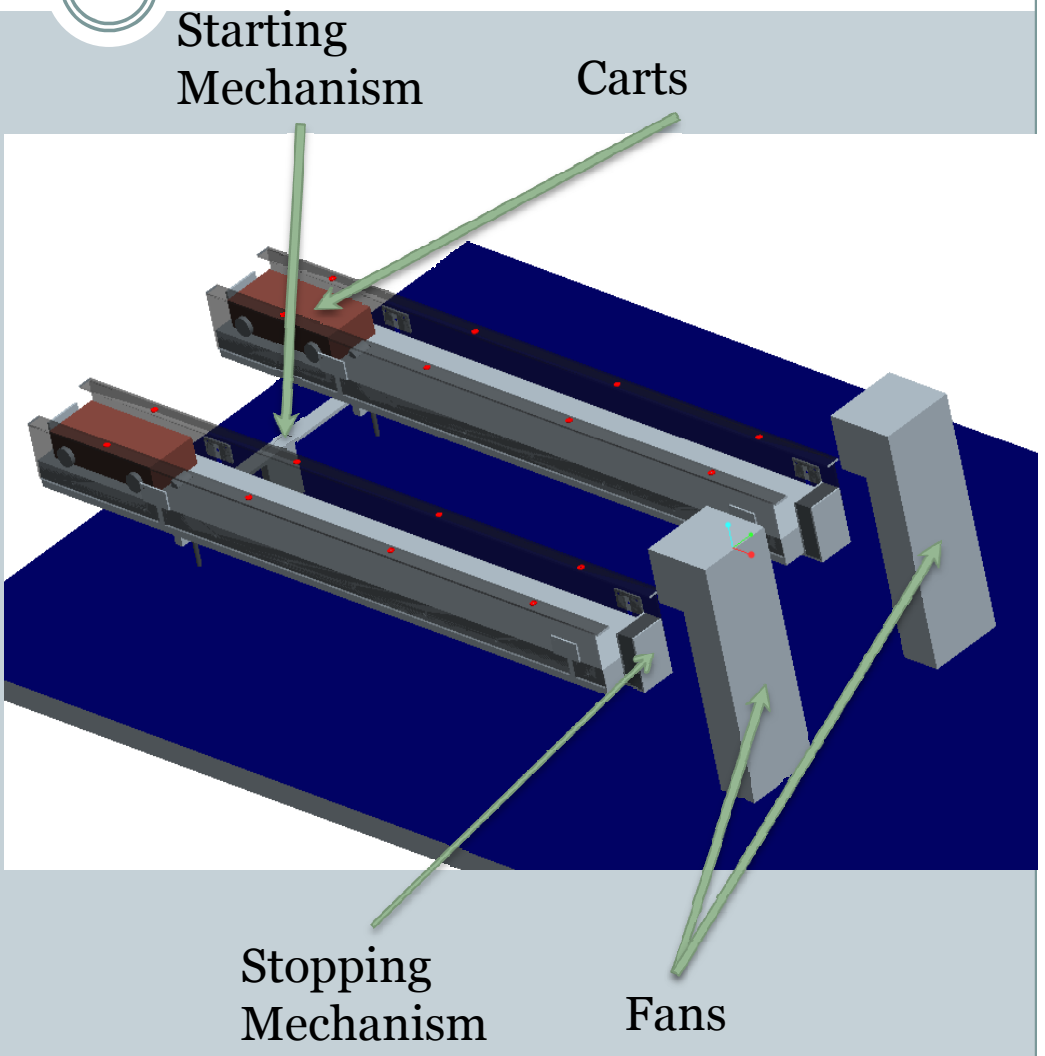
System Overview

- One shape per cart
- Held in the starting mechanism
- Fans are activated by the user
- Carts are released



System Overview

- Cart that reaches the end
- Attaches to stopping mechanism
- Sets off LED
- Reset manually



Shapes

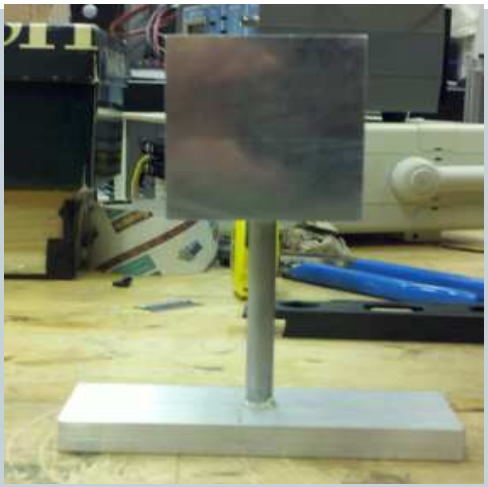
- Each shape was chosen due to the differences in the coefficients of drag
- User will be able to visually see difference in shapes
- The coefficients of drag range from 0.04-2.3
- The main stopping force is the drag

Shapes Cont'd

- Coefficient of drag determines stopping order
- Shapes were machined using CNC at the FAMU-FSU College of Engineering
- The shapes are used to demonstrate the need for more streamlined bodies instead of blunt bodies

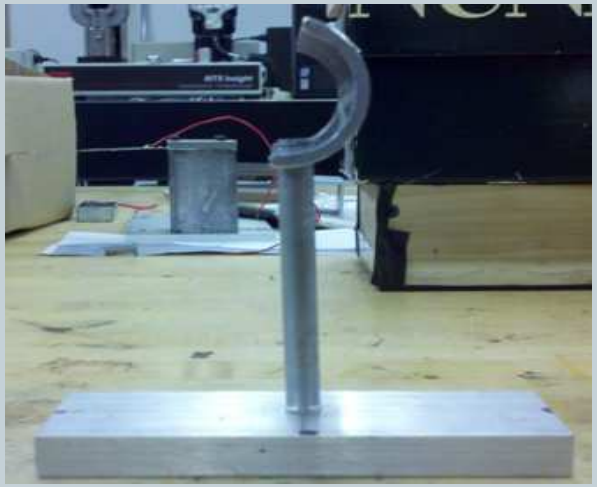
Shapes

Cube

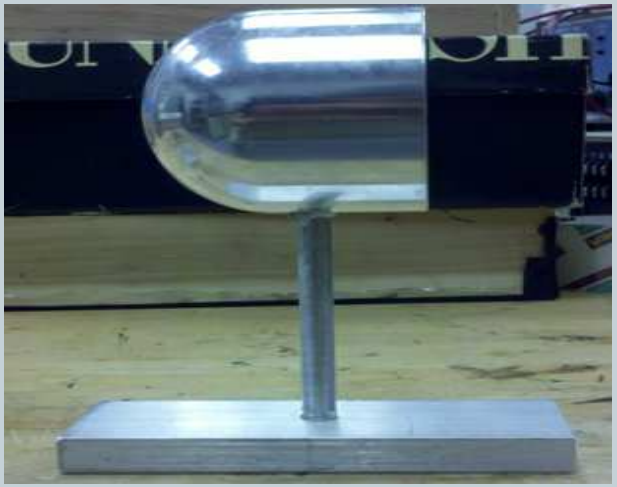


Airfoil

Shell
Rod



Bullet



Results: Shapes

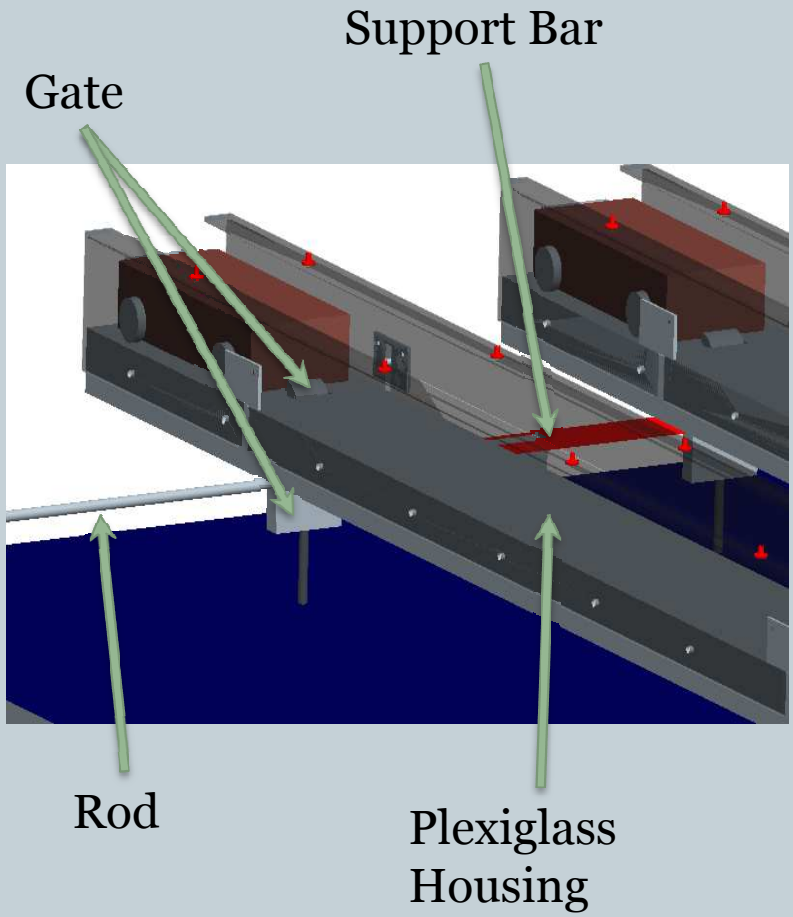
- Theoretical vs. the actual stopping distance
- Turbulent flow
- Friction
- Finished in expected order

System

- Starting Mechanism
- Housing
- Stopping Mechanism
- Electrical System

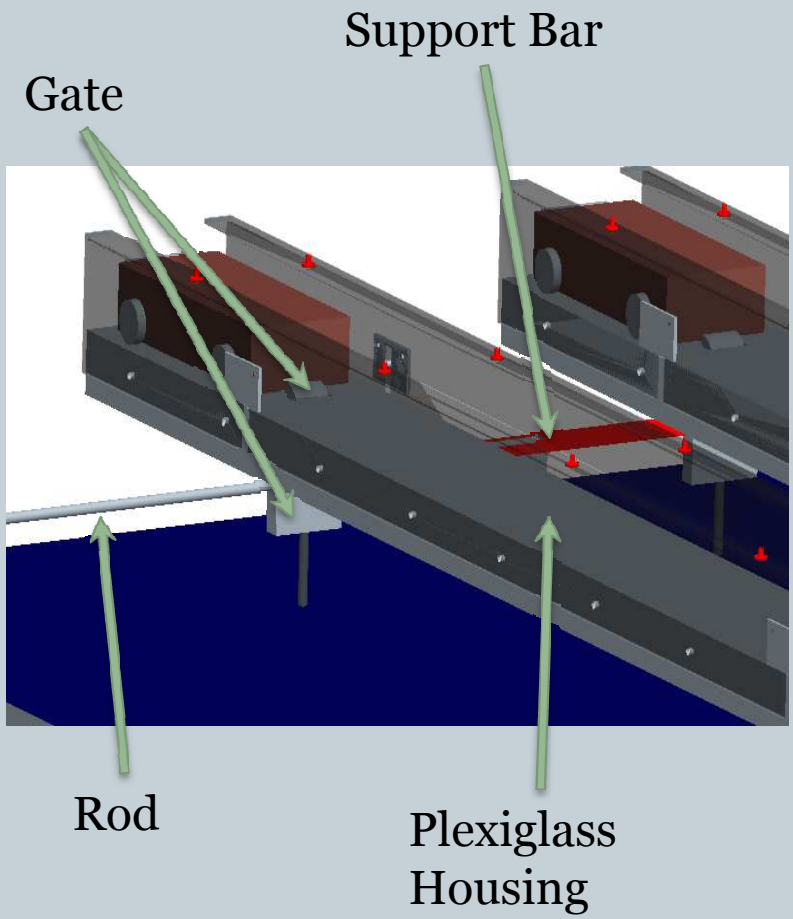
Starting Mechanism

- Reliable and simultaneous start
- Independent loading of each cart



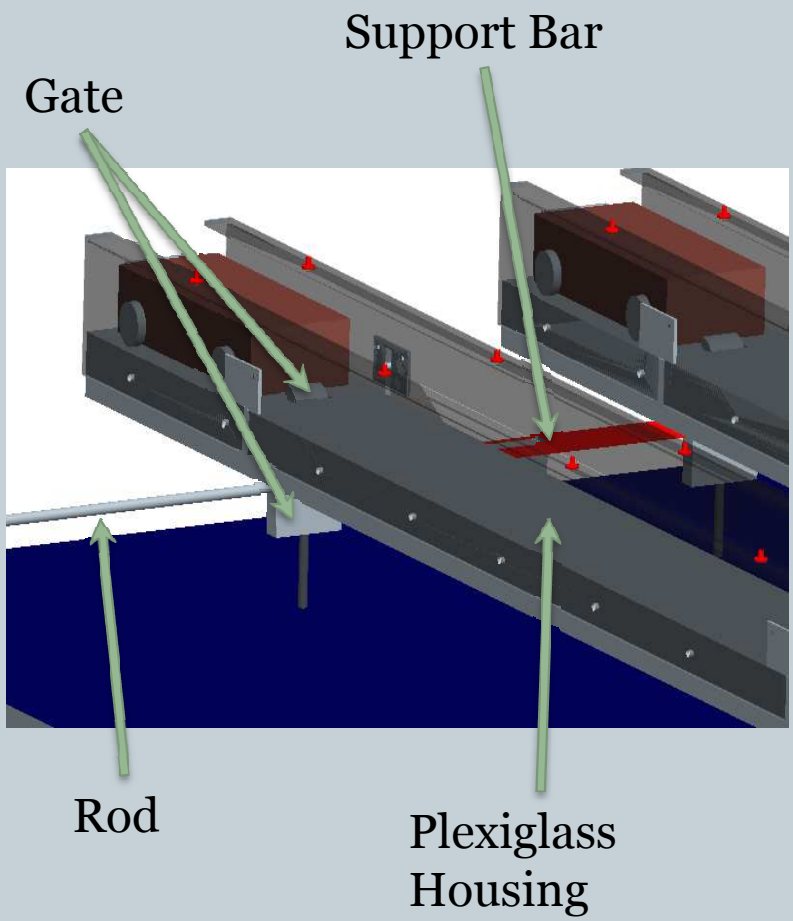
Starting Mechanism

- Intuitive method of propulsion
- Will not alter views of outcome



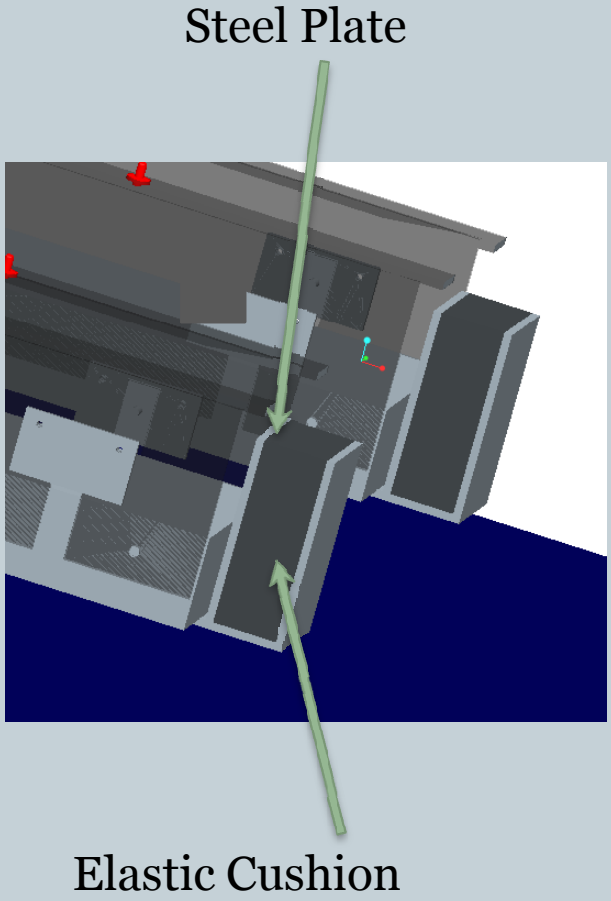
Housing

- Two Plexiglass sections supported by corner brackets
- Electronics support
- Observer separate
- Secure main components of the display



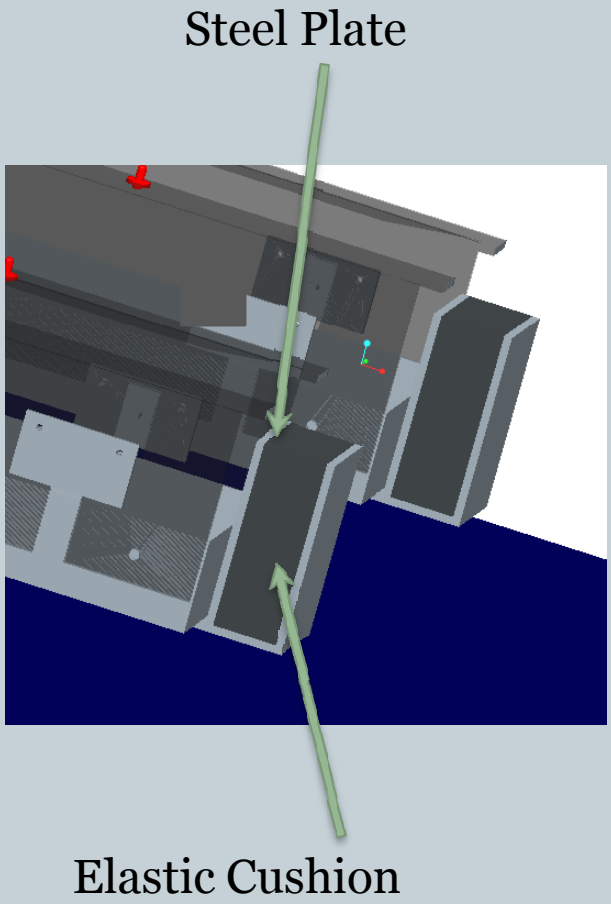
Stopping Mechanism

- Light weight, simple, and reliable
- Impact force is a factor
- Cushion need to soften impact



Stopping Mechanism

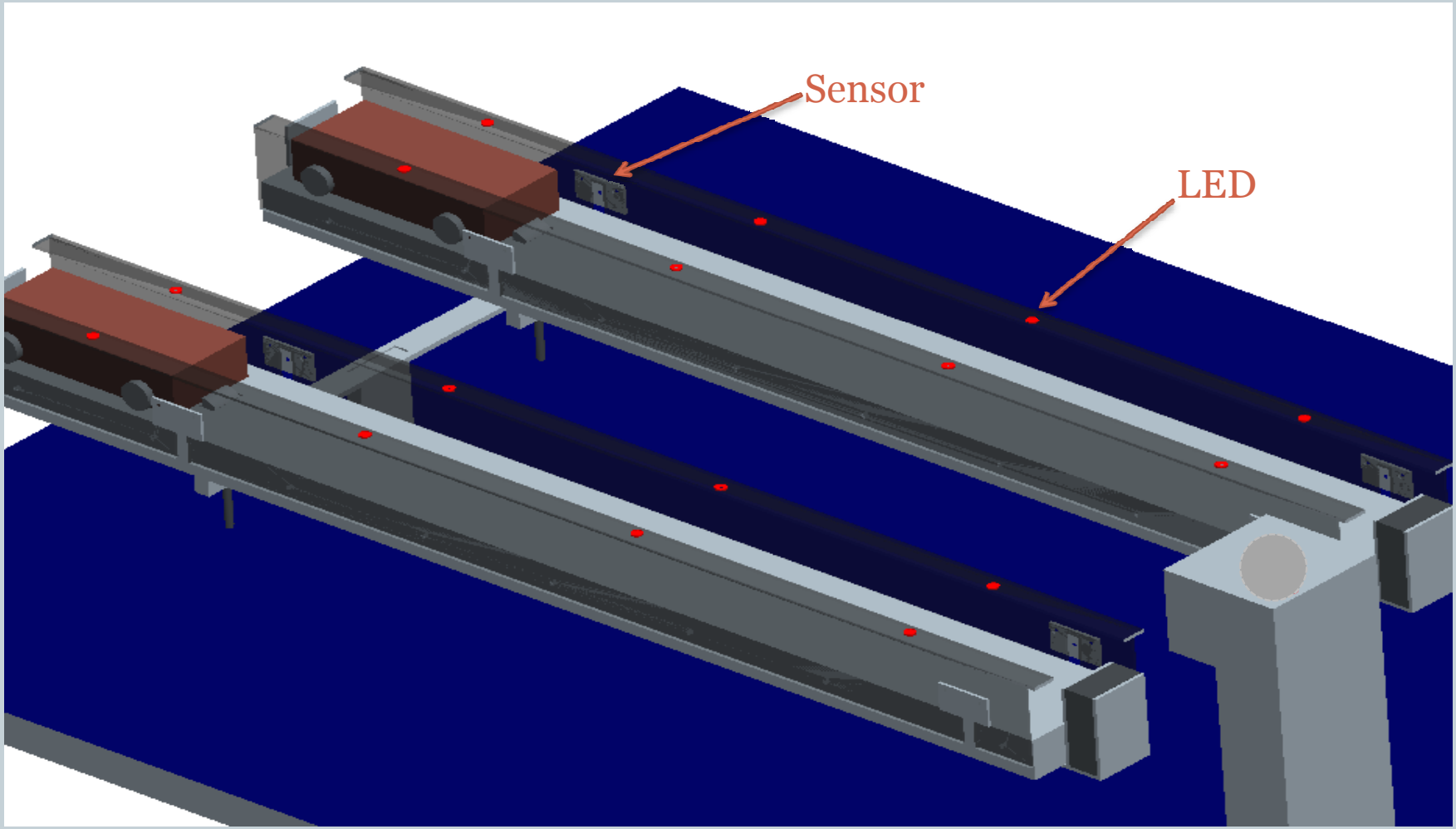
- Magnetic force
- Use of a ferrous metal



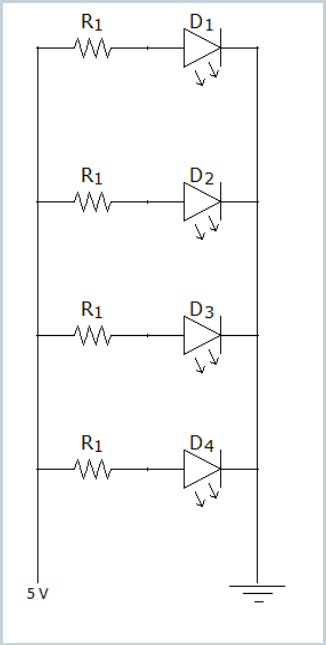
Fan

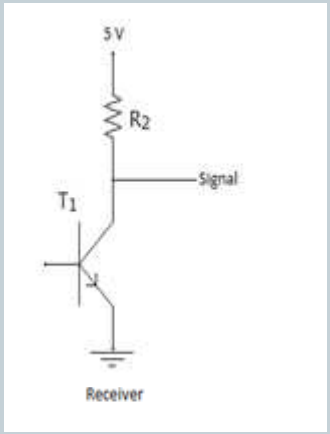
- High mass flow fan required
- Measured using a pitot static probe
- Provides a wind speed varying from 7-16 m/s
- The fan was chosen due to the relatively controlled airflow

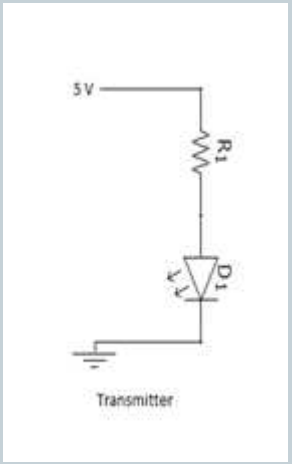
Electrical System

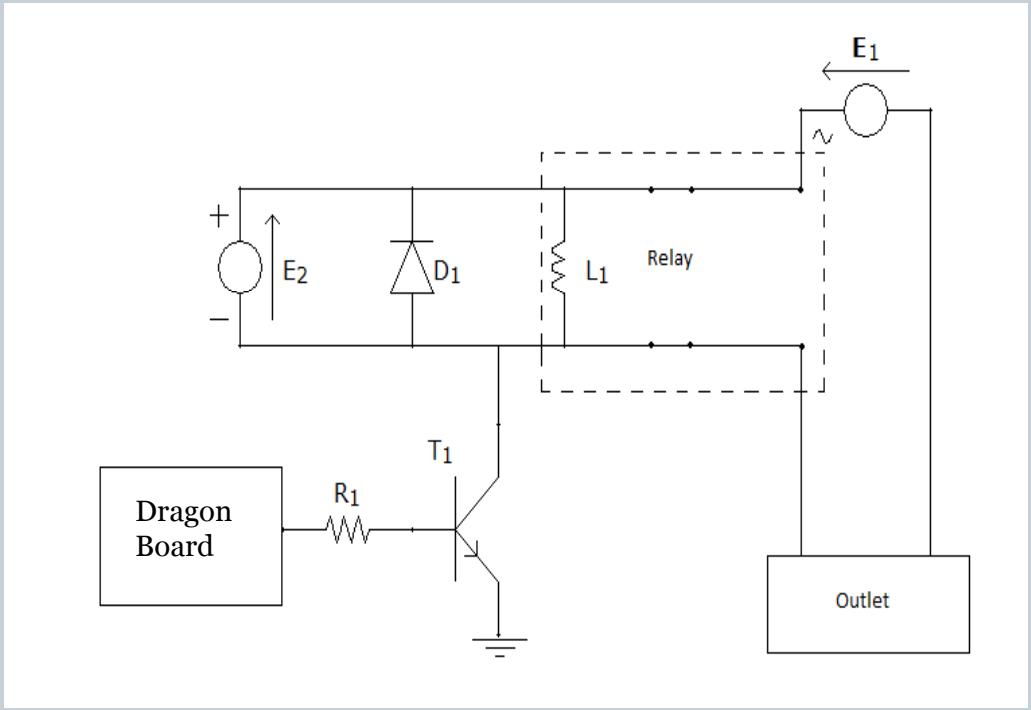


LED, Relay, and IR Sensors









Results: Electrical System

- Sensors
  - Connected to Dragon Board
  - Light signal = 0V; no signal = 5V
- Relays
  - Tested with 12V supply
- LED
  - Connected to Dragon Board

Engineering Economics

Initial Budget: 2000$

Item	Quality	Cost per unit($)
Aluminum bars	5	39.31-88.24
Paint	1	21.97
Paint Supplies	1	9.97
Gorilla Glue	2	10.97
Wall Outlet	1	2.99
Light Switch	1	8.97
Washers	24	0.11
Screws	2	0.98
Plexiglass	1	50.00
Aluminum rod	1	50.00
Steel Bar	1	50.00
Springs	3	50.00
Electric system	1	76.00

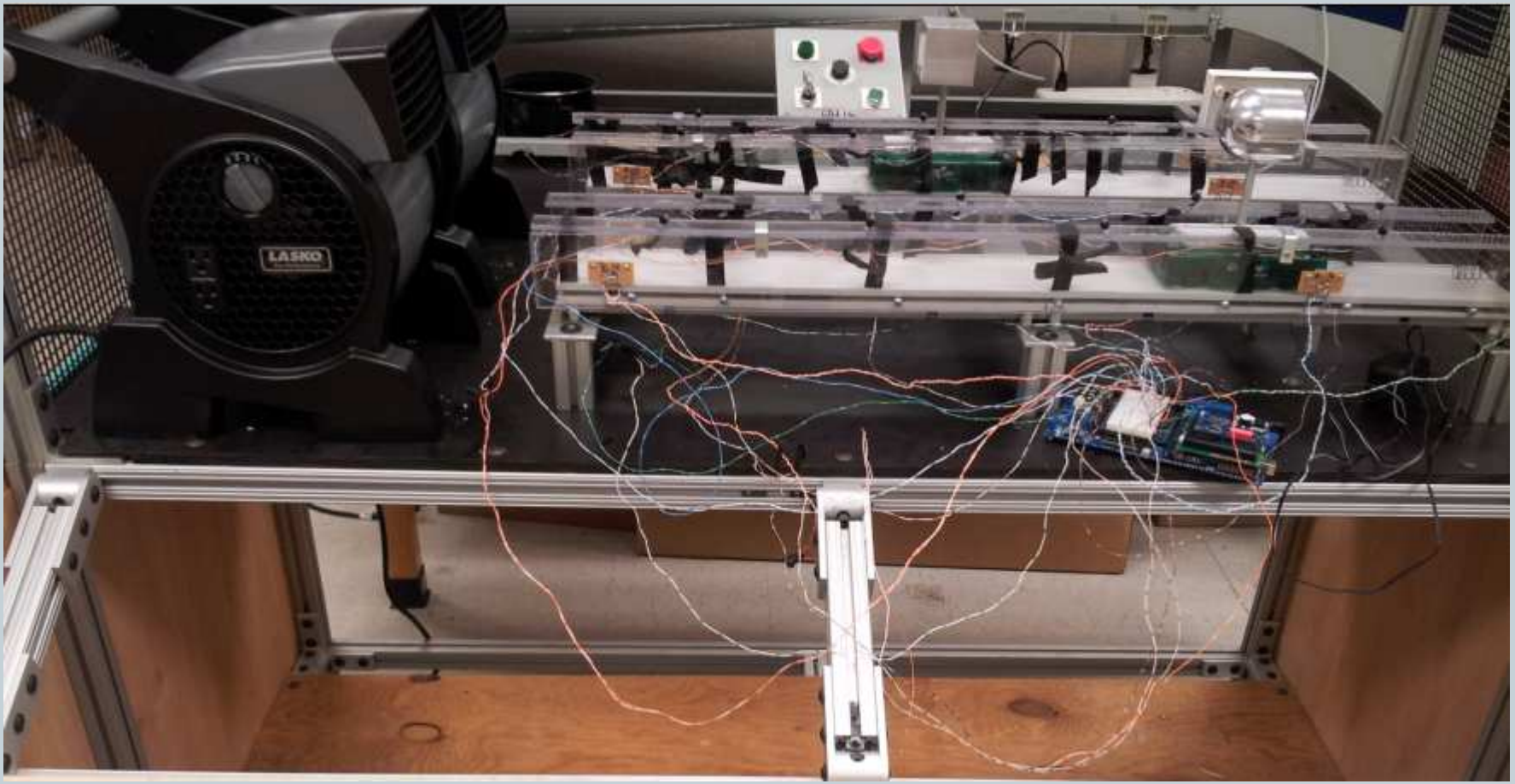
Total Cost	$559.04

Shapes:345.74$ Electrical system:76.00 Housing:103.34$

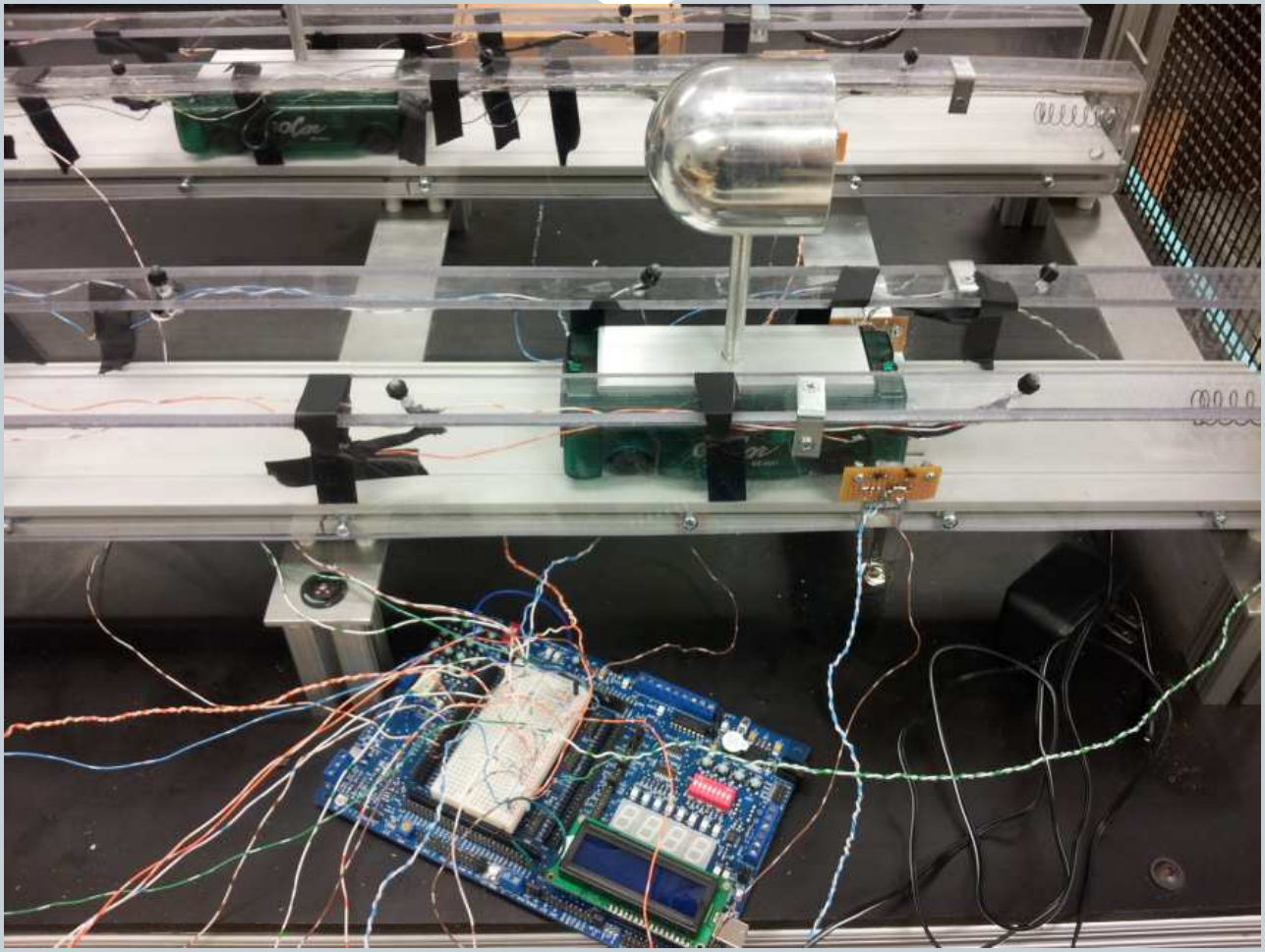
Conclusion

- Display shows drag differences among shapes
- Display is robust and low maintenance
- Display shows the property intuitively
- Display results are obvious
- Electronic systems implemented to aid in information communication
- Not successful in attaching relays to fans
- Electronics not as secure as desired
- System is not as stable as desired

Working System



Working System



Future Plans

- Addition of more shapes
- Streamline flow
- More visuals
- Other demonstrations
- Added functionality
- Simplify construction to mass produce

Acknowledgements

- Dr. Shih
- Dr. Oats
- Dr. Kosaraju
- Dr. Dalban-Casnassy

Questions