College of Engineering
Department of Mechanical & Industrial Engineering

College of Engineering
School of Electrical Engineering & Computer Science

To Predict ▶ To Design ▶ To Perform

ME, ECE Capstone Design Programs

Jack Rettig

Team #47: Chem-E-Car

ExxonMobil

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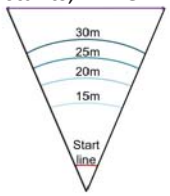
Project Objective

To win the 2018 AIChE Chem-E-Car Competition by designing and building a chemically propelled car that travels a prescribed distance, quantifiable by a controlled change in a concentration of chemical reactants, while carrying a load.



Chem-E-Car Competition:

- Judges give a distance and load
- Closest to the target line wins
- Sponsored by AIChE

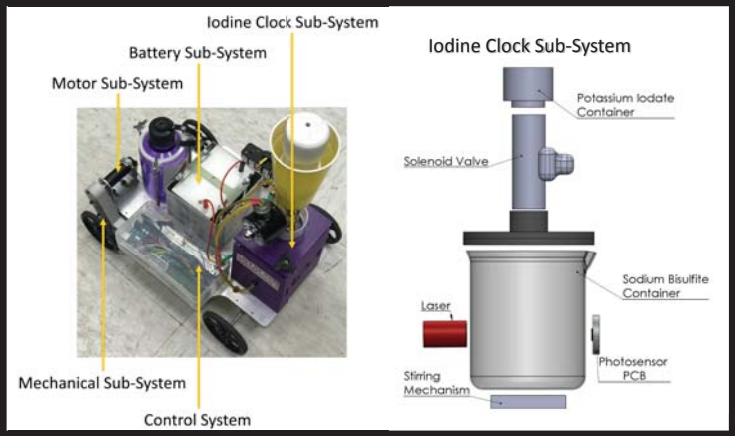
Engineering Specifications

Type	Threshold/Detail	Specification Met
Time	< 2 minutes	✓
Distance	15-30 meters	✓
Size	< (40 x 30 x 20) cm^3	✓
Load	0-500 mL water	✓
Speed	> 0.25 m/s	✓
Alignment	± 26 degrees from center	✓

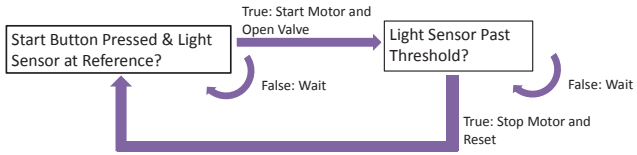
Design Overview

Mike XII Volt is powered by a lead-acid battery and stopped by an iodine clock reaction. When the start switch is pressed an Arduino controller starts the motor and the iodine reaction is mixed via a valve and magnetic stirrer. After the color change has transpired a photocell coupled with a laser detects this change and the controller stops the motor. Safety is prioritized in our design features.

Labeled Assembly



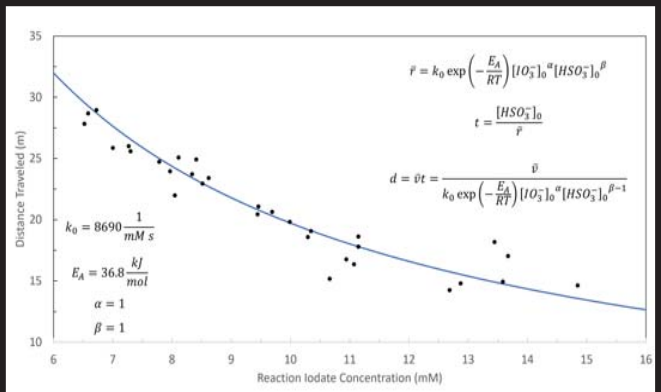
Control Logic Flow



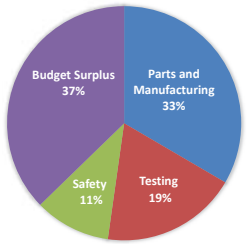
Safety Features

Consideration	Precautionary Measures
PPE	• Goggles, lab coats, long pants, closed shoes, safety glasses, gloves
Shock Proof	• Housing for electronics and control system • Heat shrink tubing / Insulated wires
Burn Proof	• Maximum operating temperature is 53°C • Wires sized appropriately to prevent melting
Pinch Proof	• Guard for drive belt
Spill Proof	• All containers covered securely and have secondary containment • All containers mounted securely to chassis • Proper ventilation for battery and iodine clock • Containers chosen to grant large tolerance of free capacity

Analysis & Testing Results



Budget



Category	Amount
Total	$3,137
Parts and Manufacturing	$1,671
Testing	$940
Safety	$525
Budget Surplus	$1,863

Conclusions

- All engineering specifications were met
- Placed 4th in the Southern Regional Competition
- Placed 2nd in the Poster Presentation Competition
- The team had the most consistent performance
- Earned a spot in the 2018 National Chem-E-Car Competition
- With more testing, a better model can be created to win the National Chem-E-Car Competition

September Define Objective, Functions, Constraints → **October** Concept Selection → **November** Detailed Analysis → **Nov - Dec** Plan Manufacturing, Testing, Safety → **January** Manufacture and Test → **February** Assemble Car → **March** Finalize Equation → **April** Competition

Sponsors: ExxonMobil, Dr. John Flake, Dr. Dimitris Nikitopoulos

Adviser: Dr. John Flake