FIRE SUPPRESSION MISSION

A. James Clark School of Engineering

Team Fuego

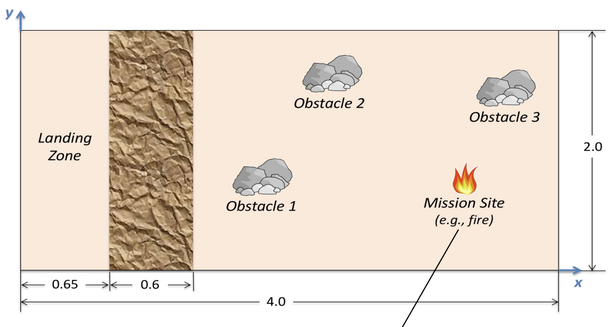
Shruti Das, Robert Calkins, Chester Ting, Ryan Utz, Brendan Ziegler, Chris Chen, Irene Huang, Andrew Setiawan

ENES100 (0401)
López-Roshwalb

MISSION

To engineer an autonomous OSV capable of navigating to a random destination and avoiding any obstacles in order to measure the number of active flames and extinguish them

DESIGN CRITERIA



FIRE SITE WITH RANDOMIZED ORIENTATION

→ maximum weight of 3 kilograms

→ 350 x 350 millimeter footprint

→ run all systems at full power for at least 10 minutes

→ receive & transmit RF communications with APC 220

→ extinguisher may not leave behind residue

→ total built-in cost max of $350

PROJECT MANAGEMENT

OUR DESIGN PROCESS

IDEAS PROPOSED

PRACTICAL TESTING

ASSESSING DESIGN

REPEAT PROCESS

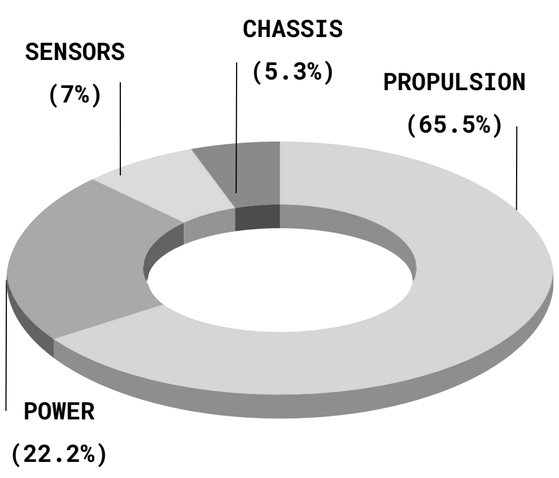
→ heavily relied on Gantt processing & dividing work up into subteams:

→ CHASSIS TEAM

→ ELECTRICAL TEAM

→ PROGRAMMING TEAM

→ MISSION SPECIFIC TEAM



PURCHASED PARTS: $194.05

PRINTED PARTS: $29.59

TOTAL COSTS INCURRED: $223.64

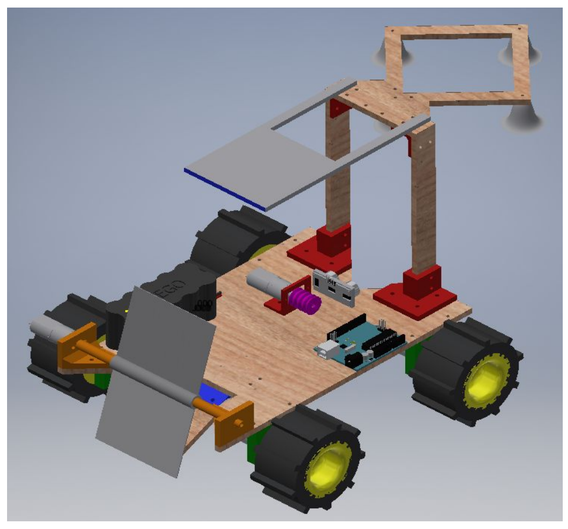
FINAL DESIGN DETAILS

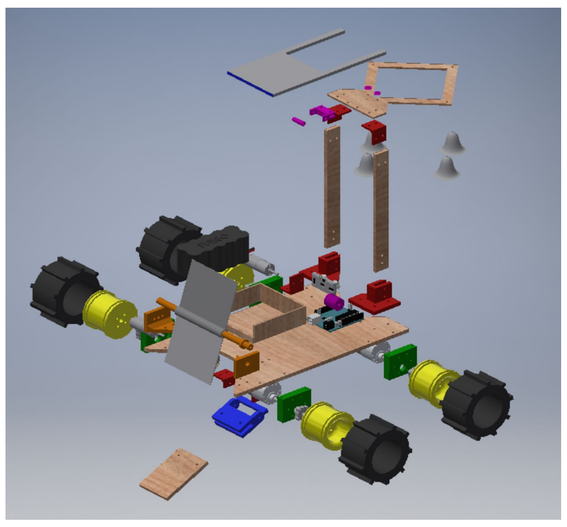
→ four wheel drive with metal gear motors, 3D PLA printed wheels, & four paddle tires

→ powered by Nickel Metal Hydride battery

→ wooden chassis holding hardware (breadboard, motor controller, battery, servo motor, ultrasonic sensor, & arduino microcontroller) with triangular cutout in front

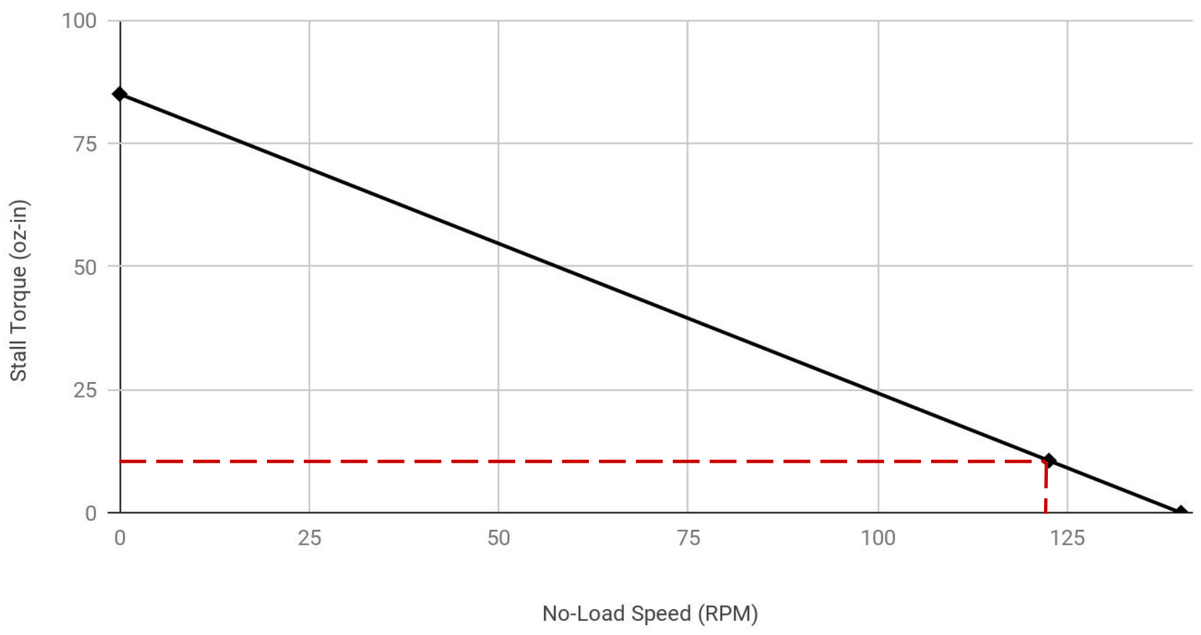
→ mission specific implemented dowel & pulley system





MASS (kg)	1.7		X-VALUE	Y-VALUE
STALL TORQUE (oz-in)	85	STALL POINT	0	85
NO-LOAD SPEED (RPM)	140	NO-LOAD POINT	140	0
NO-LOAD CURRENT (A)	0.09	OPERATING POINT	123	11

MOTOR CHARACTERISTIC GRAPH



DOWEL INTAKE SYSTEM

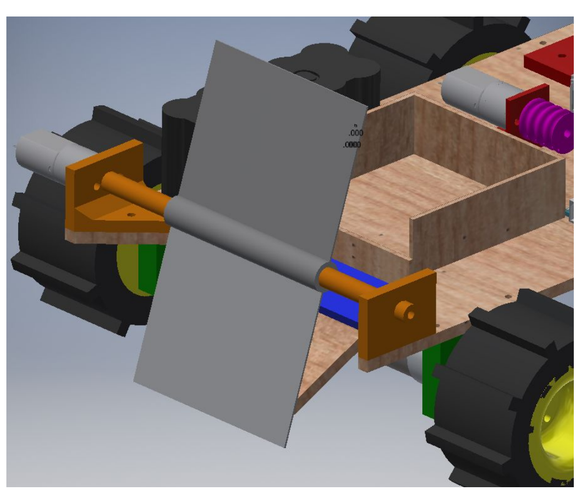
→ rotating system on back of OSV to passively collect dowel while moving around fire site

→ 3D printed axle mounted onto D-shaft held in place by custom 3D printed brackets

→ fabricated flap out of zip-ties & duct tape attached to axle

→ a custom ramp fabricated out of wood & 3D printed components

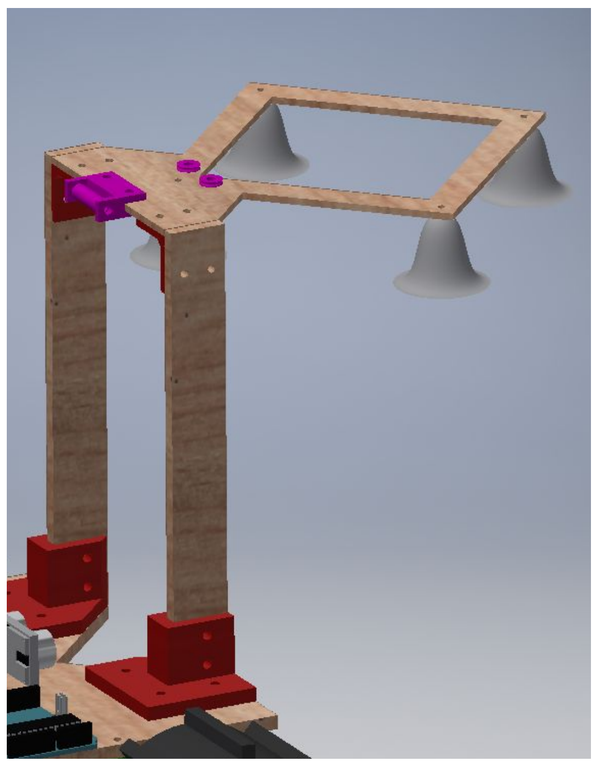
→ 51 RPM Mini Econ Gear Motor with stall current of 1.5A at 12V and stall torque of 333.4 oz-in at 12V



DOWEL FLAP CONNECTED TO RAMP

FOUR CAP PULLEY SYSTEM

FIREPROOFED CAPS WITH FIRE SENSORS



→ all-in-one extinguishing device

→ four 3D printed hemispherical caps attached to pulley system run by a 360 degree servo motor

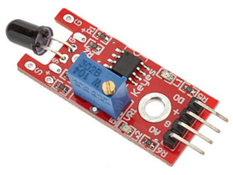
→ utilize ultrasonic & fire sensor capabilities to reposition caps

→ rotating pulley to lower all four caps to smother corner flames

OSV PERFORMANCE

→ successfully crossed the rocky terrain area

→ successfully detected flames with four fire sensors



FIRE SENSOR

→ accurately reported the number of active flames

→ failed to reach the destination with precise position

→ failed to implement ultrasonic sensor's obstacle avoidance capabilities

ULTRASONIC SENSOR

→ four cap pulley system poorly implemented with fishing wire

→ dowel intake system was not fully executed

CONCLUSIONS

→ failed to complete all mission requirements due to imprecisions with navigation

→ ultrasonic sensor was ineffective due to poor placement on chassis

→ learned importance of testing and debugging code for obstacle avoidance

→ "cleverly designed" cutout in chassis led to downfall as it got stuck on the obstacle

Although we had not performed as well as we hoped, we learned a lot about programming, electrical systems, and teamwork.

As a whole, we explored the design process and how to apply engineering concepts.

This project challenged us to complete a seemingly impossible task and dive into the world of engineering.

Special thanks to Professor López-Roshwalb and our UTF, Lauren Drumm for their support throughout the semester.