System Team:
Land Vehicle For Education

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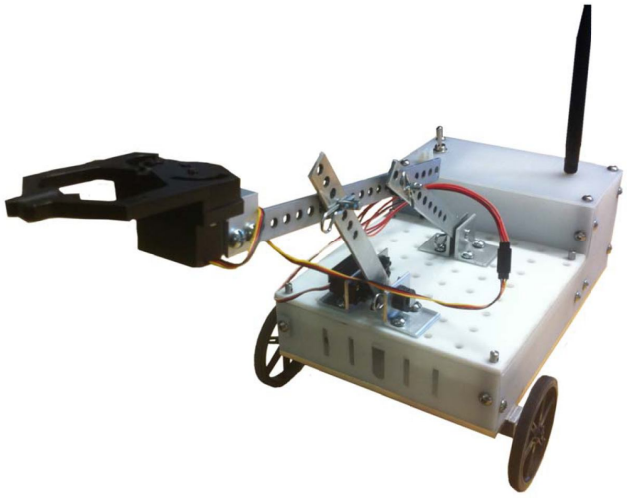
Contents

Project Summary

- To work with the various other engineering teams to develop, design, build, and test a robotic platform that has an educational component known as the MSA
- The MSA needs to teach the 2013 ME Freshman basic design concepts and to captivate their interest

Final Product

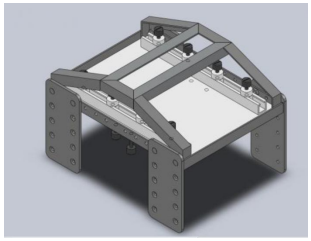


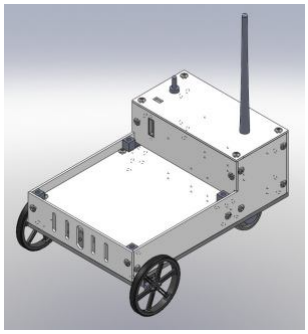
The Customer, ME Department

- $500 Prototype Budget, $5000 Mass Production
- Other departments and schools want to emulate
- Has educational value
- Robust, can last repeated years of abuse
- Be designed in house, and incorporate WOCCS

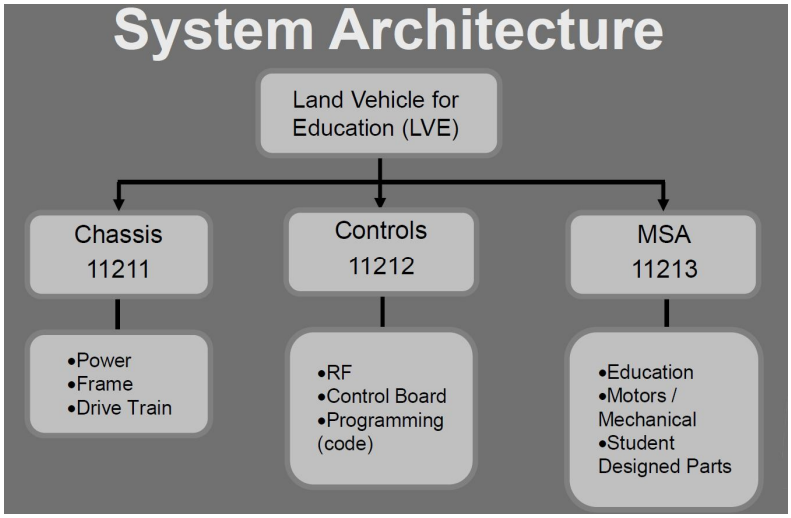
Engineering Decisions Driven by Specifications

- Need less LVEs to MSAs
- Four bar linkage for the MSA
- Smaller motors and battery size
- Paneling for appearance
- Protected electronics to enhance robustness



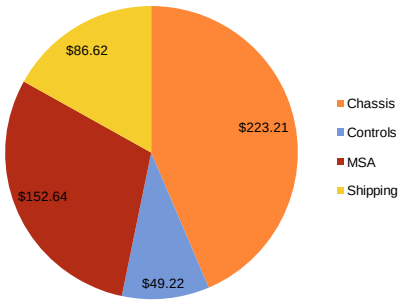


System Architecture



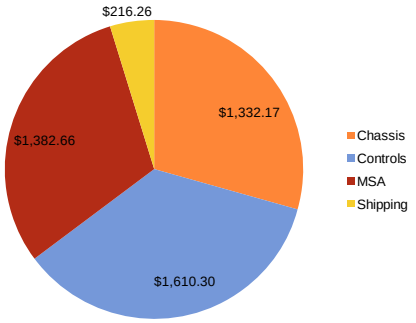
Prototype

- $511.69
- Shipping was 10%
- 2 Emergency Order
  - Aluminum plate
  - Defective motor
- Gripper, Servos, Motors, Battery, and Boards dominated cost
- Changing suppliers



Mass Production

- $6070.21 before changes
- $4541.39 after changes
- 10 LVEs, 30 MSAs
- WOCCS dominated costs



	Original Budget	Revised Budget	Savings
Chassis	$1,571.22	$1,332.17	$239.05
Controls	$1,720.23	$1,610.30	$109.93
MSA	$2,489.70	$1,382.66	$1,107.04
Shipping	$289.06	$216.26	$72.80

Test

Test #	Test	Pass/Fail Criteria	Status	Actual Performance
2.1	Drop Height	Can be dropped from 3 feet and still function as intended	Fail	Motor gears broke upon a 1 ft drop
2.2	Educational	At least 75% approval from faculty survey	Pass	Average faculty approval is 80.43%
2.3	System Weight	Weighs at most 15 lbs	Pass	LVE and MSA assembly weighs 9.9 lbs
2.4	LVE Speed	Maximum speed is greater than 0.5 mph	Pass	Average system speed after 3 trials was 0.86 mph
2.5	Turning Radius	Less than 12 inches	Pass	Turning radius is 2.3 in
2.6	Battery Life	At least 90 minutes	Pass	After 90 minutes of continuous operation, 7.2V remained
2.7	Recharge Time	Less than 4 hours	Pass	Battery was fully charged in 70 minutes
2.8	Surface Temperature	Never exceeds 130 deg F	Pass	The highest Temperature (89 deg F) was measured at the drive motors
2.9	Sharp Edges	No edges or corners tear through more than 3 sheets of tissue	Pass	No more than 2 sheets were torn by any corner or edge

ANALYSIS

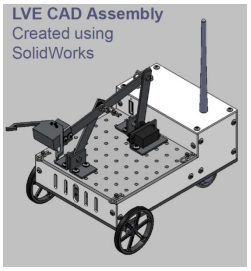
Test #	Test	Pass/Fail Criteria	Status	Actual Performance
3.1	Quantity of LVEs	At least 10 mass produced LVEs	Pass	Mass production budget accounts for 10 LVEs
3.2	Quantity of MSAs	At least 30 mass produced MSAs	Pass	Mass production budget accounts for 30 MSAs
3.3	Mass Production Cost	Less than $5,000 deployment cost	Pass	Final Mass production budget estimates a cost of $4,541.39
3.4	Prototype Cost	Less than $500	Fail	Final cost is $511.69 (over budget due to shipping costs for the replacement motor)
3.5	Chassis Height	Less than 8 inches	Pass	Chassis height measures 7 in
3.6	Chassis Base Area	Less than 144 square inches	Pass	Chassis base area measures 125 square inches
3.7	Time to Construct	Less than 60 man hours	Pass	Entire Assembly took approximately 30 hours

DEMONSTRATION/OBSERVATION

Test #	Test	Pass/Fail Criteria	Status	Actual Performance
4.1	Student Machined Parts	At least 3 student machined parts	Pass	There are 8 parts that can be made by the students
4.2	Hand Tools Required by Students	No more than 5 hand tools required	Pass	A maximum of 2 handtools were required
4.3	Material Waste	Less than 1 lb of material waste	Fail	1.7 lbs of material waste was produced
4.4	OTS Part Lead Time	Less than 2 weeks for parts to arrive	Fail	All parts arrived within 2 weeks except for the PBCs
4.5	Machined Parts per LVE	No more than 20 custom machined parts per LVE	Pass	The LVE contains 17 custom machined parts
4.6	Custom Order Components	No custom ordered mechanical parts	Pass	No mechanical components were custom ordered

Conclusion

- A successful project for the time and budget
  - Functions as intended
- Went over on budget due to last minute purchases and to follow up on design changes
- Numerous opportunities for future MSAs
- Room for improvements in terms of cost and production value
  - Combine control boards
  - Reduce the weight and related components
  - Commercial WOCCS



Questions