E2.09 - Project M.A.R.U

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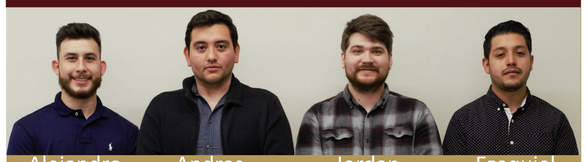
Mr. Jeffrey Stevens, Mr. Lee Hinkle

M.A.R.U is an autonomous Robo-Car that is designed to detect objects and boundaries and navigate accordingly.

Meet the Team



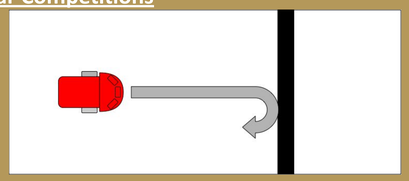
Alejandro Longoria | Andres Saldivar | Jordan Severinson (PM) | Ezequiel Gardea

Project Requirements

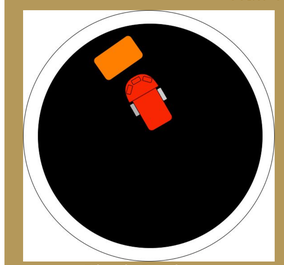
Robo-Car size
- Height: Unlimited
- Weight: ≤ 1200 g • Width: ≤ 17 cm • Length: ≤ 17 cm

Robo-Car features:
- Non-offensive, non-destructive, and non-harmful
- Battery powered lasting all of senior design day
- Autonomous
- Start button to make Robo-Car move after 5 seconds
- Object detecting without use of cameras

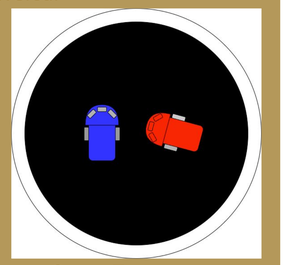
Robo-Car Competitions



- Hall Traversal



- Block Push



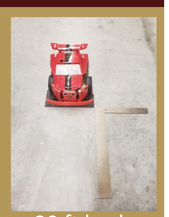
- Sumo Tournament

BOM Cost

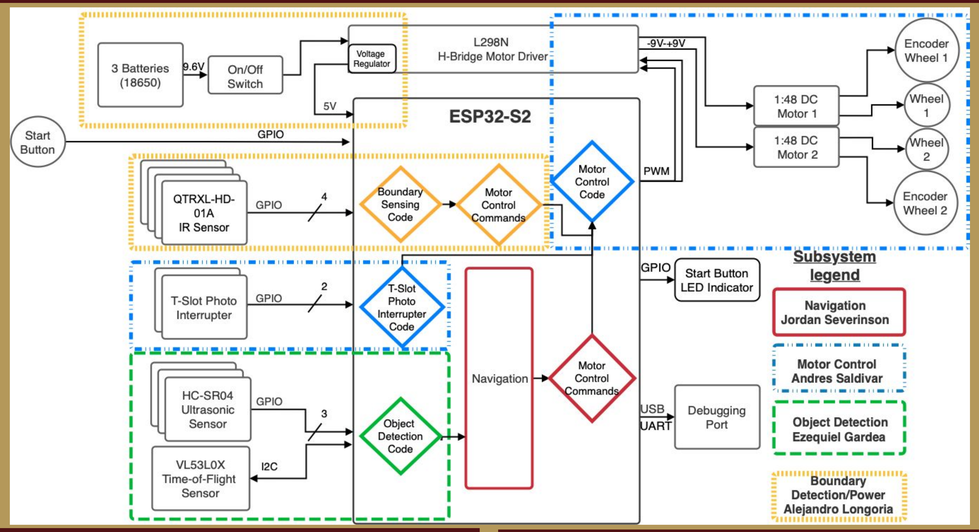
Budget: $50.00	Actual Cost: $49.54

Motor Control

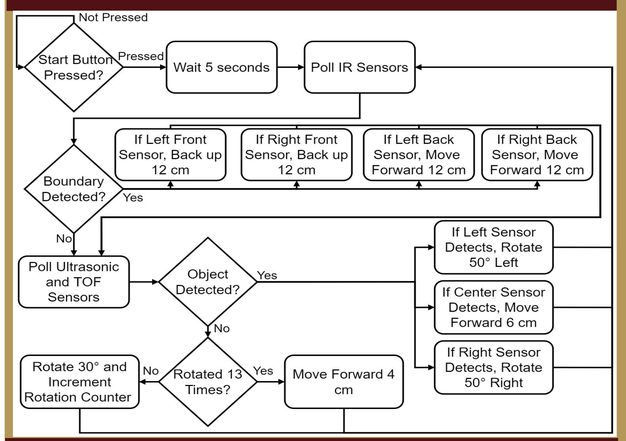
Requirements:
- Must be able to push a 1200g object
  - 442.2g wooden block
  - 841.1g wooden block
  - 947.3g wooden block
- Handles speed/distance/angle
  - Travel 30 ft going straight then another 30 ft back
  - Speed = Distance/ Time
  - Circumference of wheel = 6.7π



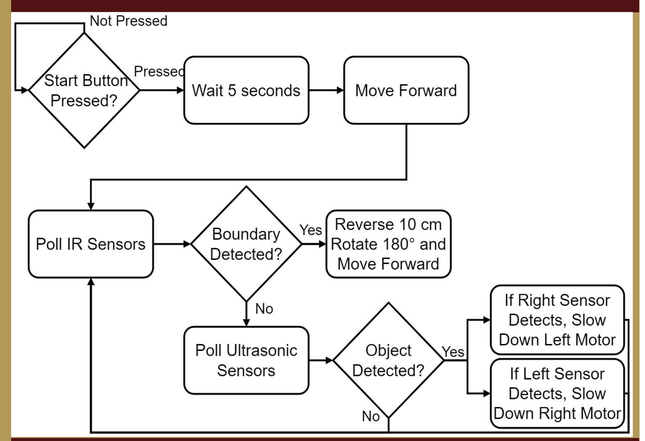
Functional Block Diagram



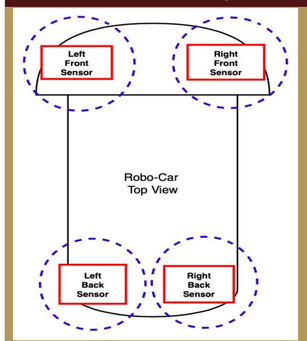
Block Push and Sumo Flowchart

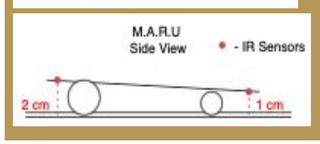


Traversal Flowchart



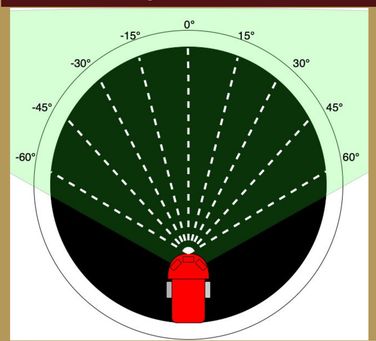
Boundary Detection Design

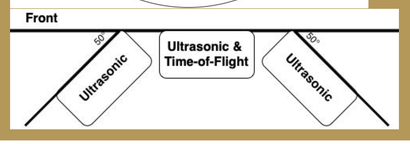




- 4 IR sensors
- Placed 2 cm and 1 cm from ground
- The closer the IR Sensor are to the ring, the higher the contrast is between the light and dark readings

Object Detection Design





- 4 front facing sensors
- Placed 2 cm behind chassis edge on Robo-Car
- Angle of 50° relative to center sensor
- 140° field of view

Test Cases

Requirement	Criteria
3 Hour Minimum Battery Life	Pass: The Robo-Car stops functioning after 118 minutes of continuous use, so it will last 3 hours of non continuous usage
Block Push	Pass: 100% success rate with 0° - 15°, at 30°, the success rate is 80% for the medium and large blocks, 70% for the small block
Sumo Tournament	Pass: 100% success rate with 0° - 15° at all distances, 90% success rate at 30° and 30 cm, and 80% success rate at 30° and 60cm
Traversal competition	Pass: 100% success rate at 20 ft, 85% success rate at 30 ft, and 75% success rate at 40 ft

Power Dissipation

Energy Source	Voltage (V)	Power (W-h)
18650 Lithium-Phosphate Battery (3)	9.8	14.4
Energy Drain	**Voltage (V)**	**Power (W-h)**
ESP32-S2	5.00	1.13
L298N Motor Driver	9.00	2.43
DC TT Motor(left)	7.80	1.29
DC TT Motor(right)	7.70	1.26
QTRXL-HD-01A (VCC) (4)	4.95	0.63
T-Slot Photo Interrupter (2)	4.97	0.29
HC-SR04(3)	4.95	0.22
VL53L0X	4.83	0.09
	Total	7.36

Acknowledgements

Thank You:
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