Mini-proposal Document

Authors: Jordy A. Larrea Rodriguez, Cody Argyle, and Nicole Sundberg

Base Requirements: UART, GPIO, interrupts, timer, PID

Components: 3x HC-SR04 ultrasonic sensors, 2x motors, 2x 20 mm bearing wheel, 4x 65mm diameter wheel, 1x breadboard, 2x custom H-bridge motor controller, 1x GP2Y0A21YK0FIR distance sensor

Bill of Materials

Component	Quantity	Price	Documentation/link
Purple Aluminum Chassis for TT Motors - 2WD	2	$14.95	https://www.adafruit.com/product/3796
20mm Height metal caster bearing wheel	2	$3.90 ($1.95 per)	https://www.adafruit.com/product/3948
Thin white wheel for TT DC gearbox Motors - 65 mm Diameter	4	$6.00 ($1.50 per)	https://www.adafruit.com/product/3763
Ultrasonic Ranging Module HC - SR04	3	$0 (already have)	https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf
breadboard	1	$0 (already have)	NA
Lipo battery	1	$0 (already have)	NA
Custom H-bridge motor controller	2	$0 (already have)	NA
IR distance sensor (10-80cm, 4-32”)	1	$14.95	https://www.adafruit.com/product/164#technical-details https://www.mouser.com/datasheet/2/737/gp2y0a21yk_e-1915144.pdf
(SHIPPING)		~$14.00	
Total Cost per person		$24.34	

Power, Sensing, Control, Motion

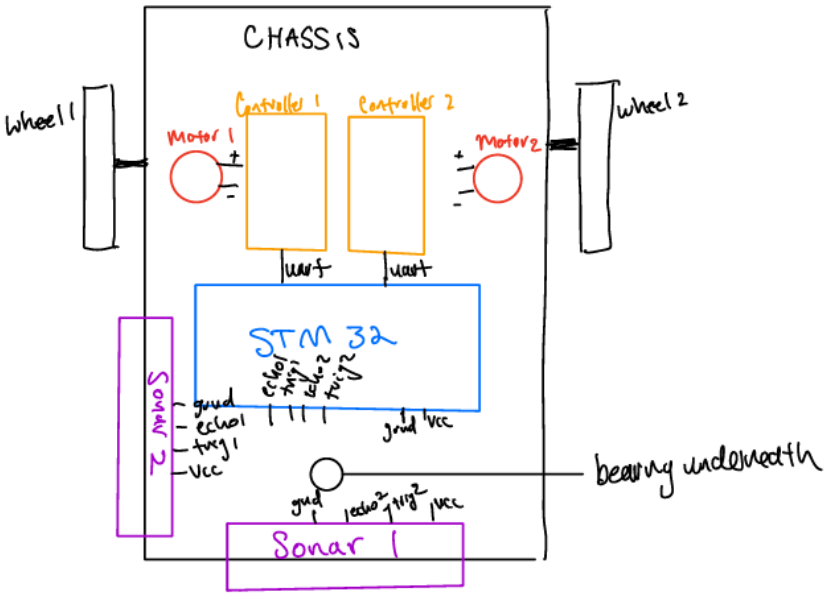
Power: 6.4 V lipo batteries for motors and board.

Sensing: The rover will use ultrasonic sensors in order to determine how close it is to obstacles or walls. These sensors will be placed facing forward and to the side of our rover, allowing for sensing obstacles in front of the rover as well as allowing the rover to maintain a threshold from a wall while traveling alongside it.

Control: Our rover will have autonomous capabilities, relying on the ultrasonic sensors to move around the course. We will also implement UART connections to interact with the rover, allowing for data to be sent back and forth and for intervention in movement/direction if needed.

Motion: We will be using two motors attached to 65mm diameter wheels for putting our rover in motion, we will also have a trailing bearing wheel in the back for stability. Our two motors and main wheels will be responsible for driving motion, allowing for forwards, backwards, and turning capabilities.

System Design



- Have the navigator find a wall by polling ultrasonic sensors at the front of the robot (**Meets Base Requirement 2)**, then align the robot parallel with the wall using PID and ultrasonic sensors. The robot will then enter a state where it will follow the wall at a certain distance employing an ultrasonic sensor mounted on the right side of the chassis and PID to maintain that specific distance (adjust motor speeds for turning) (**Meets Base Requirement 5**). If our navigator detects looping of the relative position then stop following the wall, turn 90 degrees and find the next wall and repeat. Assume End state when the robot can no longer detect a wall on its right side (implement solution for sharp corners).
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    - The solution communicates state space with operators or serverfor manual control (terminate search or send commands) (Meets Base Requirement 1).
    - The solution uses GPIO to interface sensors (Meets Base Requirement 2).
    - The solution implements timers and interrupts for scheduled communication or state checking (Meets Base Requirement 3 and 4).
    - The solution implements PID for motor speed adjustment depending on the state of our Navigator (Meets Base Requirement 5)

Milestones / Plans

Milestone	Date	Details
Milestone 1	3/17/23	Have full design finalized, order relevant parts
Milestone 2	3/24/23	All components must be on hand and ideally assembled.
Milestone 3	3/31/23	Mount wheels and motors, have motors control wheels - forwards, backwards, turning. GPIO implemented. Power system finalized
Milestone 4	4/7/23	Read data from ultrasonic sensors, mount to our frame Have UART connection working, be able to send and receive data
Milestone 5	4/14/23	Link data read from ultrasonic sensors to motor controls, maintain a distance away from a wall. PID implemented.
Milestone 6	4/21/23	Extended Testing and Fine Tuning

we plan to work on testing and future milestones if we finish our current work earlier

Risks, Unknowns, Potential Problems

We aren't sure how having multiple sonar sensors mounted perpendicular to each other will behave. We assume they won't leak into each other but with some tuning we'll figure it out. In the case that they do cause interference, we can switch out one of the ultrasonic sensors for another type of distance sensor (a backup IR sensor is listed in our components/bill of materials).

Not knowing what kind of layout the maze will be including how the obstacles will be placed can provide some problems. We don't know if there will be obstacles in the middle of the path causing unique readings with our sonar sensors.

References

- https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf
- https://www.adafruit.com/product/3796
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- https://www.adafruit.com/product/164#technical-details
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