Target & Tracking Vehicles

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Project Background

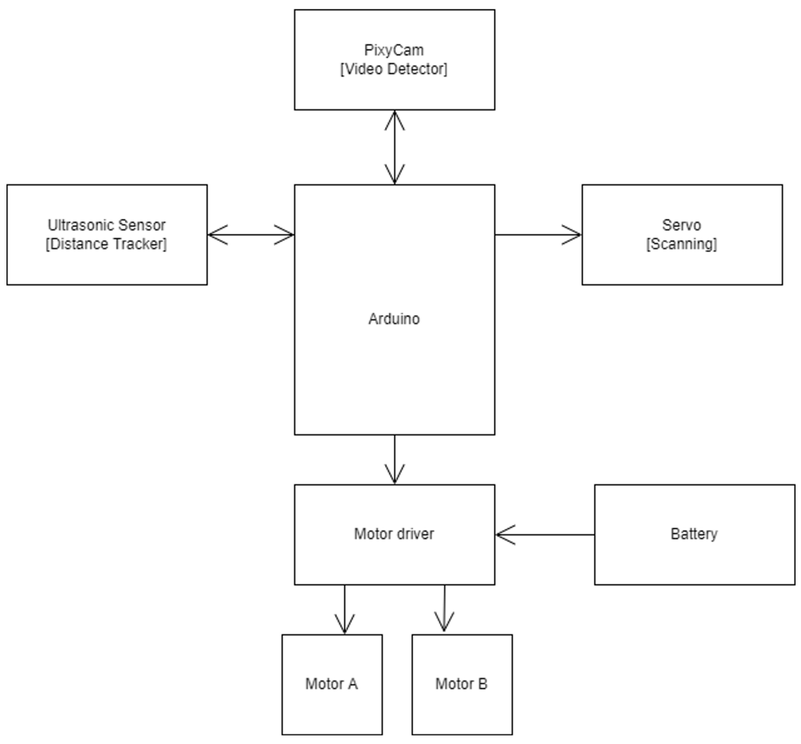
Raytheon Target and Tracking Vehicles are based on the topic of search and identification, acquisition lock, and continuous navigation capabilities. This Project's objective is to build two robots, one which is Remote Controlled (RC) the lead Robot #1 and a following autonomous Robot #2 that shall follow the lead Robot #1 using sensing capabilities. Once Robot #1 is identified, the tracking robot must autonomously follow Robot #1 as it executes complicated maneuvers, while maintaining a fixed distance.

Requirements

No.	Requirement	Verification
1	Robot #2 Shall Track and Follow Robot #1 Autonomously	Observation
2	Robot #1 and Robot #2 Shall Run For 15 Minutes	Observation
3	Robot #1 and Robot #2 Shall Maneuver In a Figure 8	Observation
4	Robot #2 Shall Maintain a Fixed Distance from Robot #1	Observation

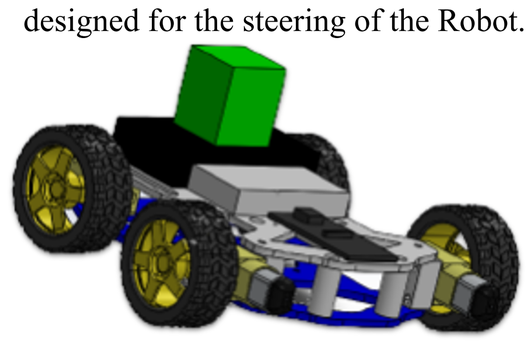
Overall Design Approach

Functional Block Diagram

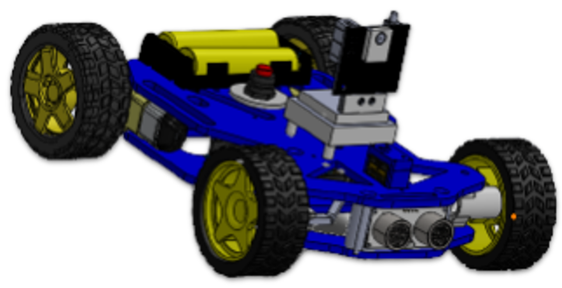


Mechanical Design

The Design for both Target & Tracking vehicles include the necessary mounting component holes for all on board electronics. Robot #1 includes a 4 DC-Motor drive design, while Robot #2 includes 2 DC-Motors in the rear that drive the vehicle and a front wheel servo steering system designed for the steering of the Robot.

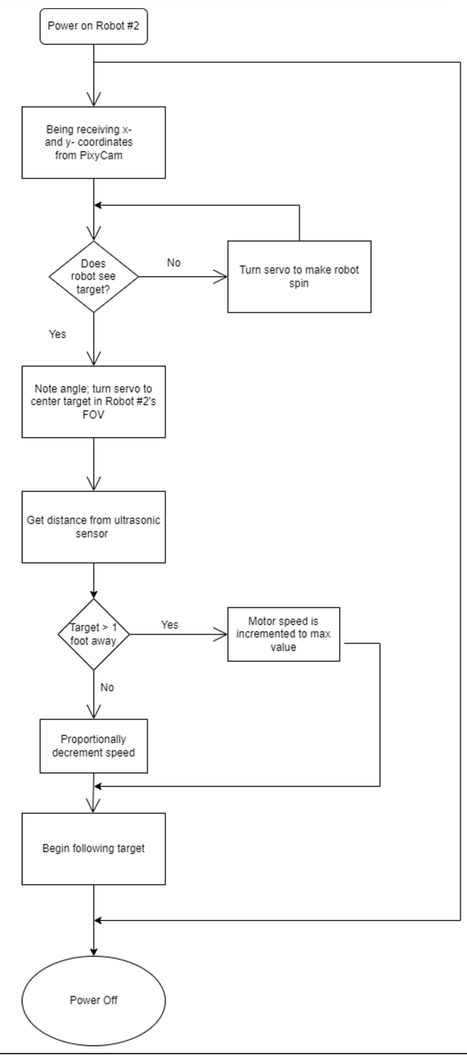


Target: ***Remote Controlled (RC) Vehicle Robot #1***



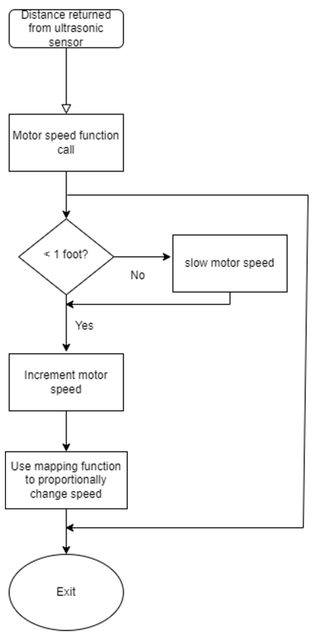
Tracking: ***Autonomous Vehicle Robot #2***

Software Flowchart



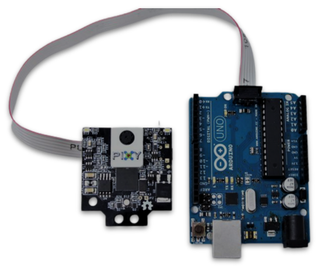
Fixed Distance

This process controls the speed of Robot #2's motors to keep it a fixed distance from Robot #1. An ultrasonic sensor on Robot #2 measures the distance between the two robots which is then used to adjust the speed of Robot #2. The determined distance is then sent to another function which has two possible cases: if the distance is more than a foot, the motor speed will be incremented, or if the distance falls within a foot, the motor speed will be decremented as the distance becomes smaller.



Object Detection

Robot #2 used a Pixy2 camera sensor to track an object's position on Robot #1. The position is used by the processor to calculate the steering function of Robot #2. The Pixy2 has a color searching algorithm that is used for tracking. The Pixy2 delivers the x and y coordinates of the object. This allows the processor to control the steering of Robot #2 to follow Robot#1.



Pixycam2 (Left), Arduino UNO (Right)

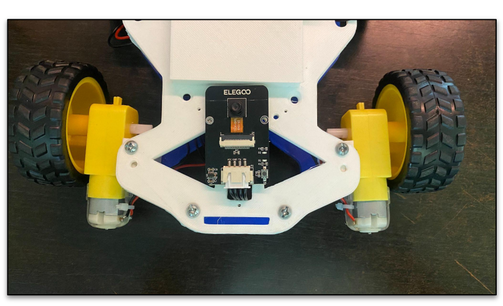
Steering Design

In the Direction function of our main code, the direction of the wheels are determined by the angle between Robot #1 and Robot #2. However, there is a limitation in our front wheel linkage system that only allows the servo motors to rotate in a 70 deg range (+/-35 deg). In the code, the angle of the servo motor is set proportionally to the angle of the object. The location variables of Robot #1 are continuously being updated. Therefore Robot #2 is always adjusting its steering servo motor to accurately follow Robot #1.



Robot #1 Controlling Method

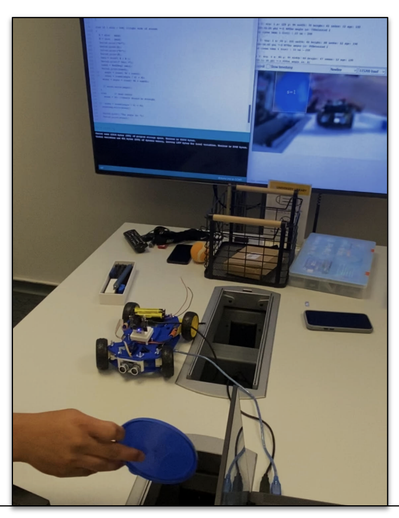
Robot #1 is controlled using a smartphone via Wi-Fi. The Wi-Fi module, located at the front of Robot #1, transmits a Wi-Fi connection that a smartphone can connect to. The smartphone then acts as a joystick and uses control software supplied with the Robot kit.



Remote Control (RC)Vehicle & Wi-Fi Transmitter

Testing

The main code was tested multiple times to build a robot that could accurately detect and follow another moving robot. The Pixy2 was tested various times through its own software, Pixymon. Pixymon allows users to watch the Pixy2 live video feed at 60 FPS. This was crucial to the development of the Direction function. Tests were also run to assure that the speed of the DC motors adjust to the values received from the ultrasonic sensor.



Results

Through a collective team effort, Robot #2 was successfully able to identify and follow Robot #1. Each member had a key role in the development of Robot #2. These roles include selecting the components needed, the physical design of the robot, and the source code to make it operational. Because of these efforts, Robot #2 also can meet all requirements set for this Project.



Robot #1 & Robot #2 final Product