Infrared Sensor Basics and Robot Autonomy Programming Using Simulink

By Jose Avendano

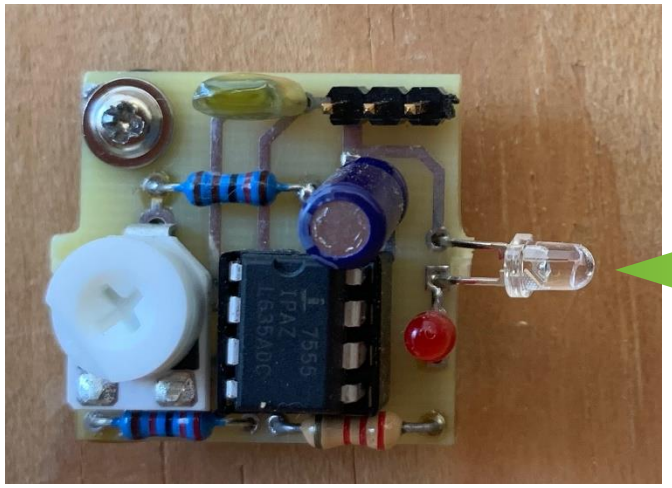
Agenda

- Introduction to the BEST IR Sensor
- Sensor Applications
  1. Object Detection
  2. Line Detection
  3. Motor Encoders
- Autonomy Integration
  1. BEST SimBot
  2. Joystick Triggering
  3. Sequences of Commands

BEST Robotics IR Sensor Kit

BEST Robotics Infrared (IR) Sensor

- 2 Sensor components



Transmitter

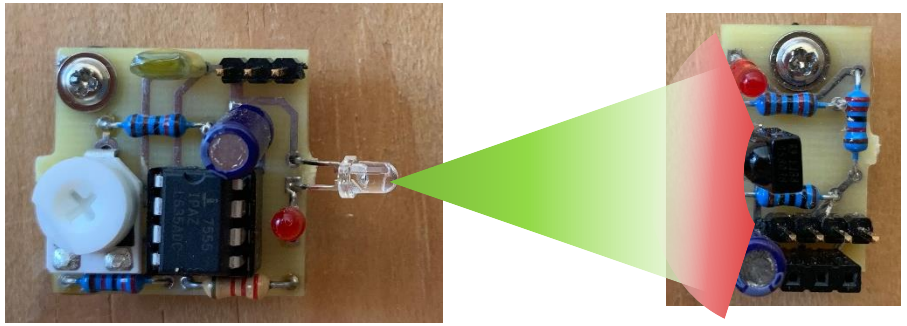
Beam
Projection Area

Receiver
Field
Of
View

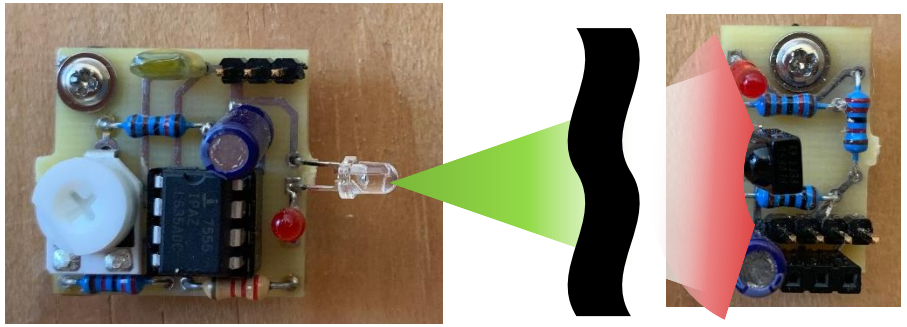
Receiver

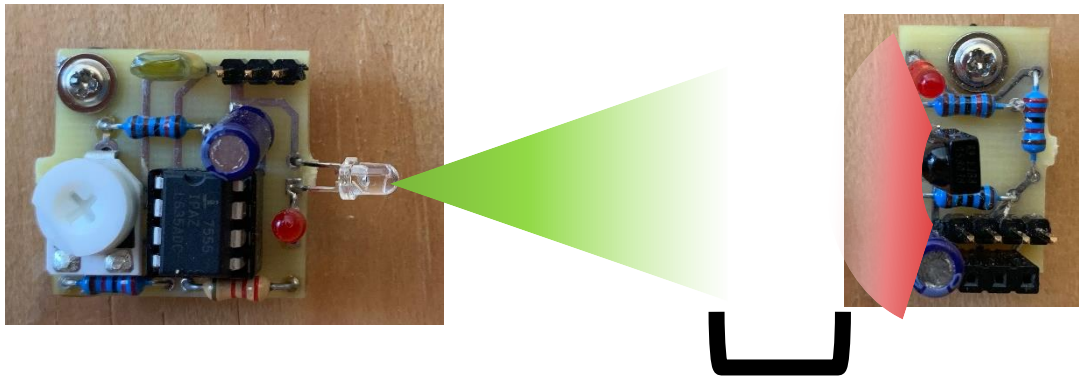
Sensor Detections

1. IR Beam cannot be obstructed



2. IR Beam must be within detection distance

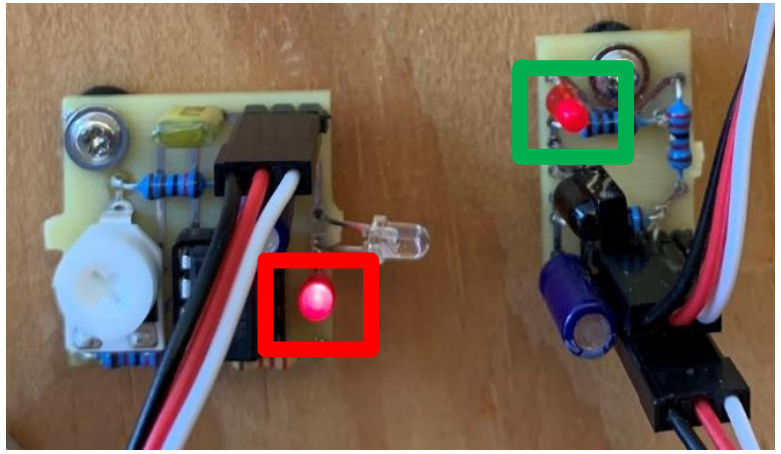




Sensor Testing

- **Transmitter LED indicates power**
- **Receiver LED indicates detection of IR beam**

IR Beam Active (LED ON)



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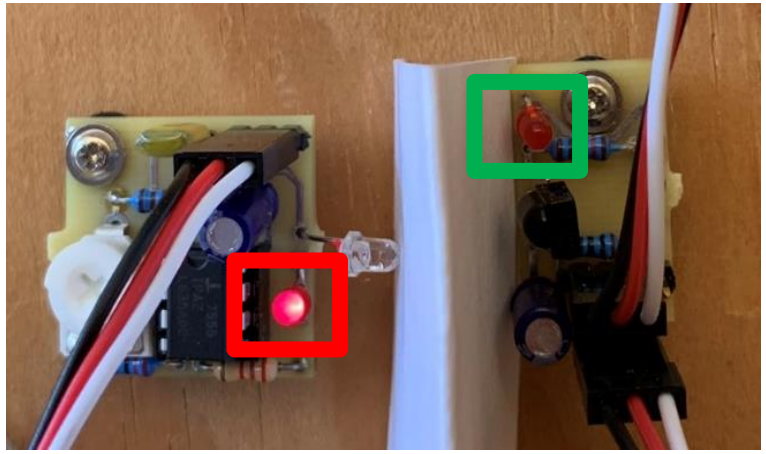
IR Beam Broken (LED OFF)



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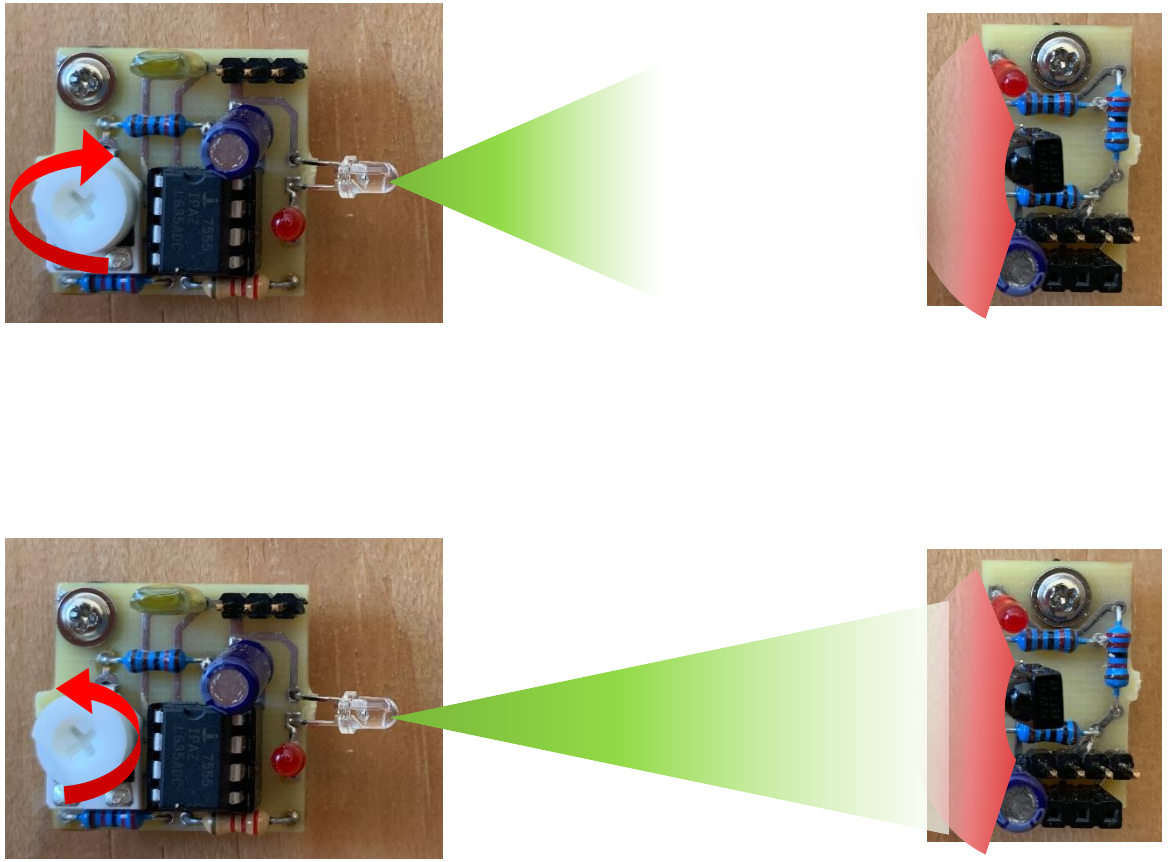
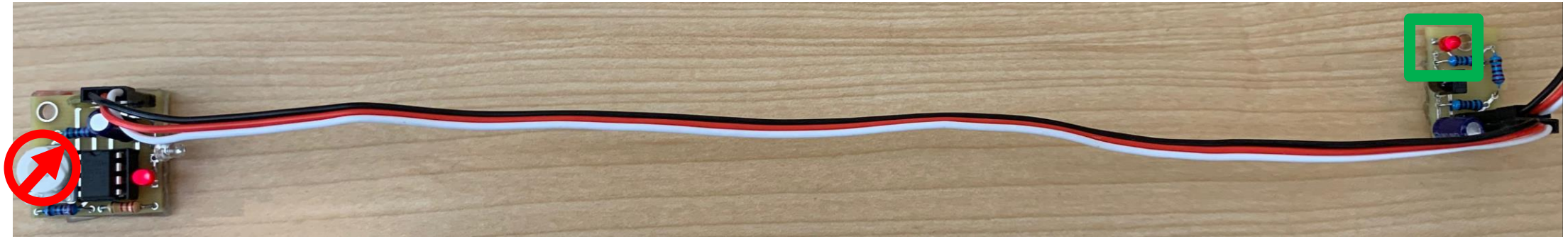
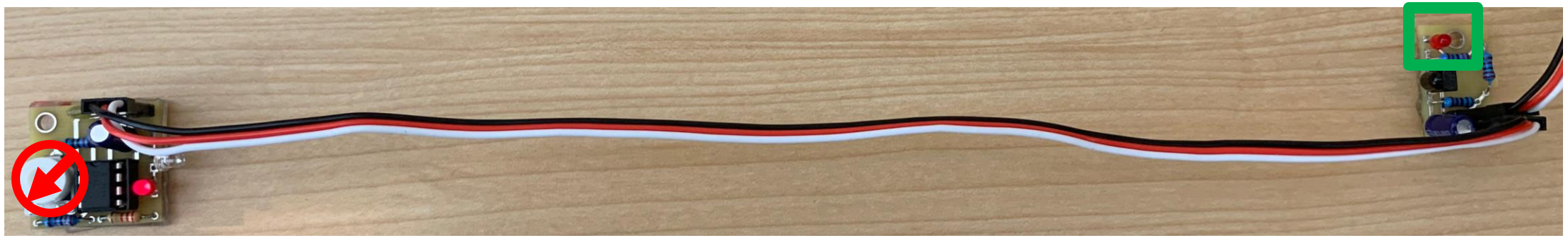
Sensor Sensitivity

- Adjust potentiometer to change sensitivity
- Somewhere in the middle (not either extreme) is the highest sensitivity



Sensor Sensitivity

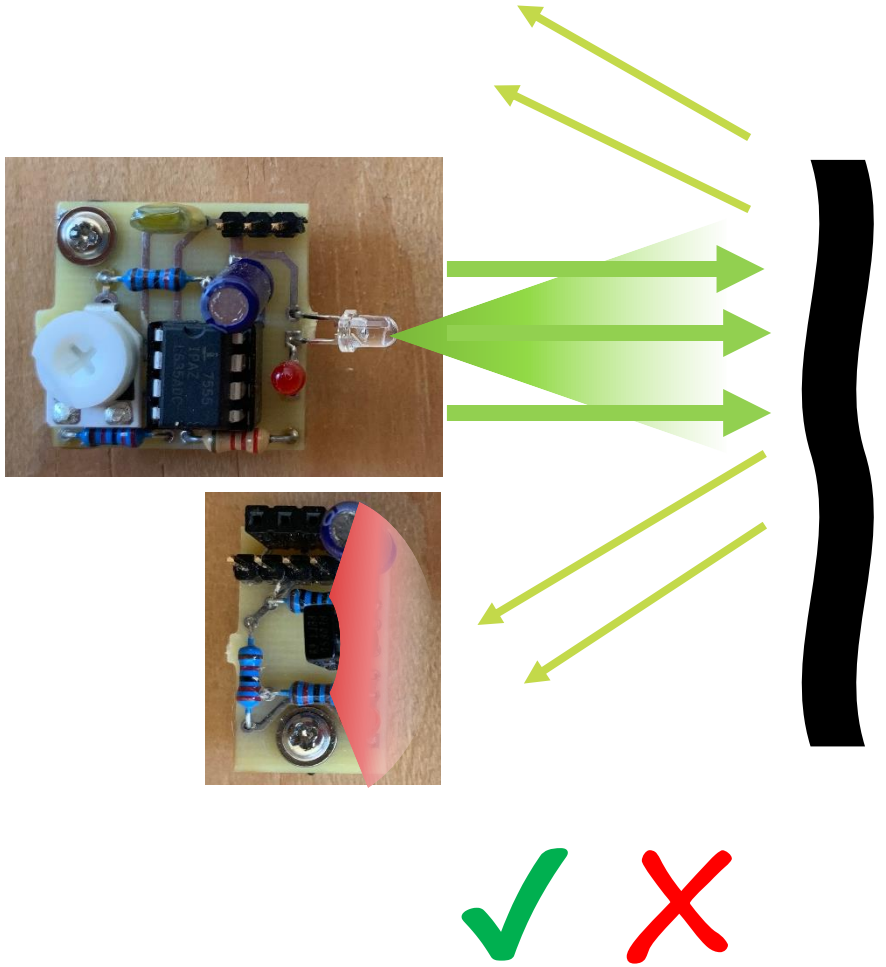




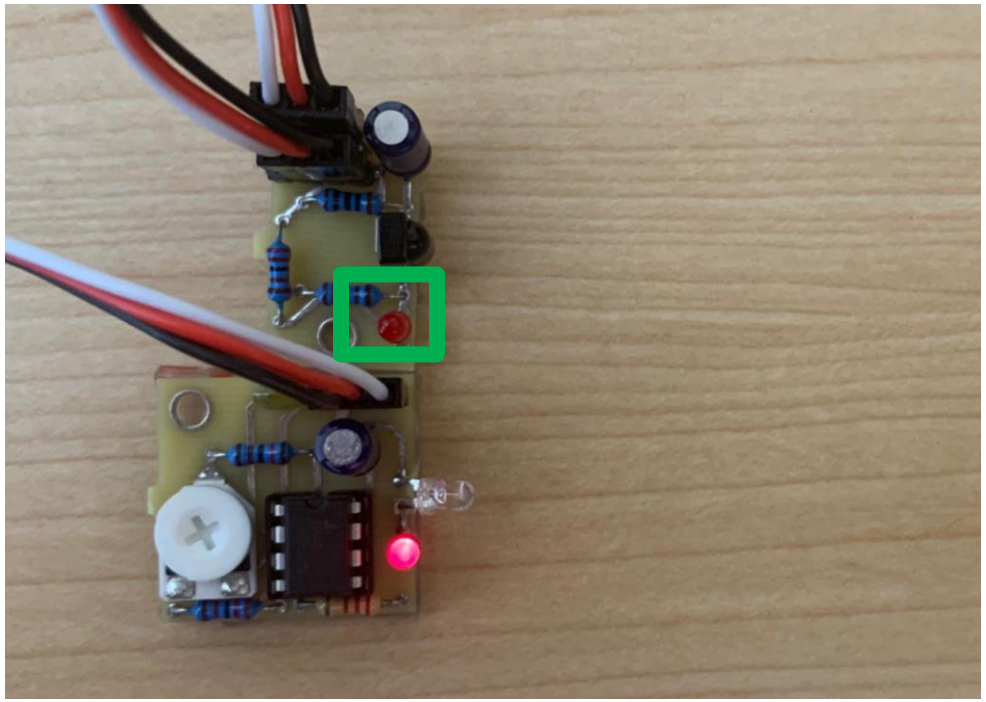
Sensor Application 1
Object Detection

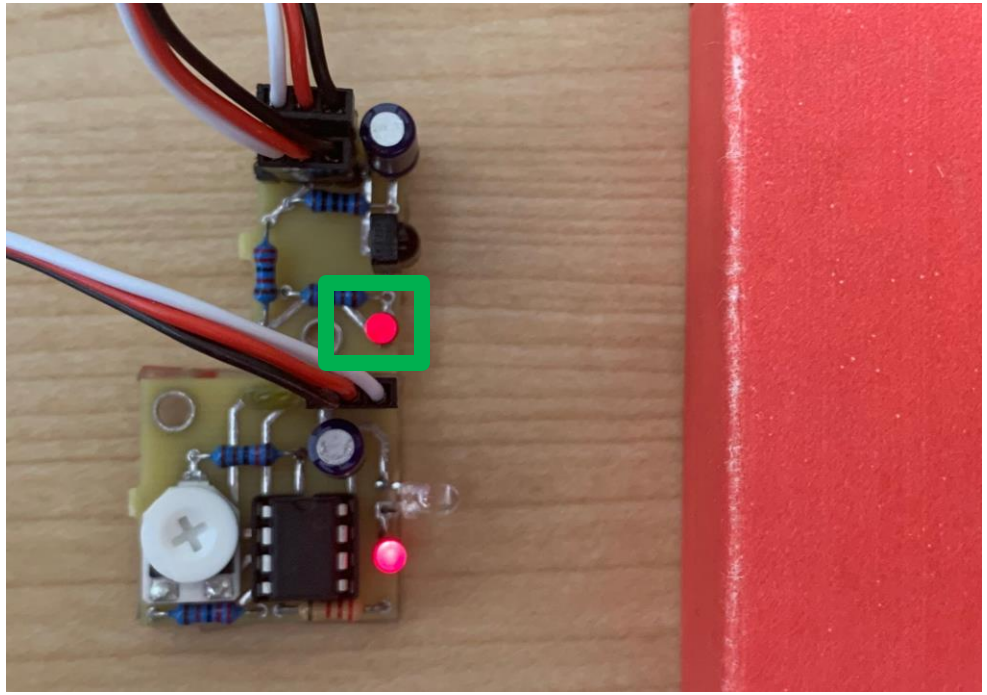
Object Detection

- Bouncing light from an object
- Place transmitter and receiver facing in the same direction
- Reflected light will be detected and indicate an object



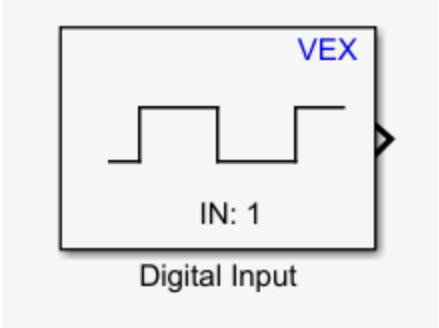
Object Detection

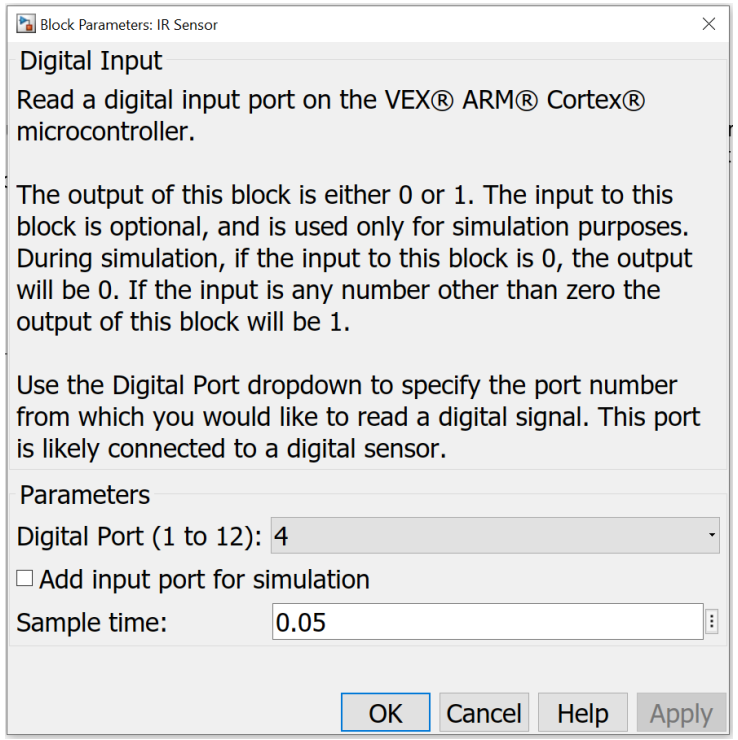


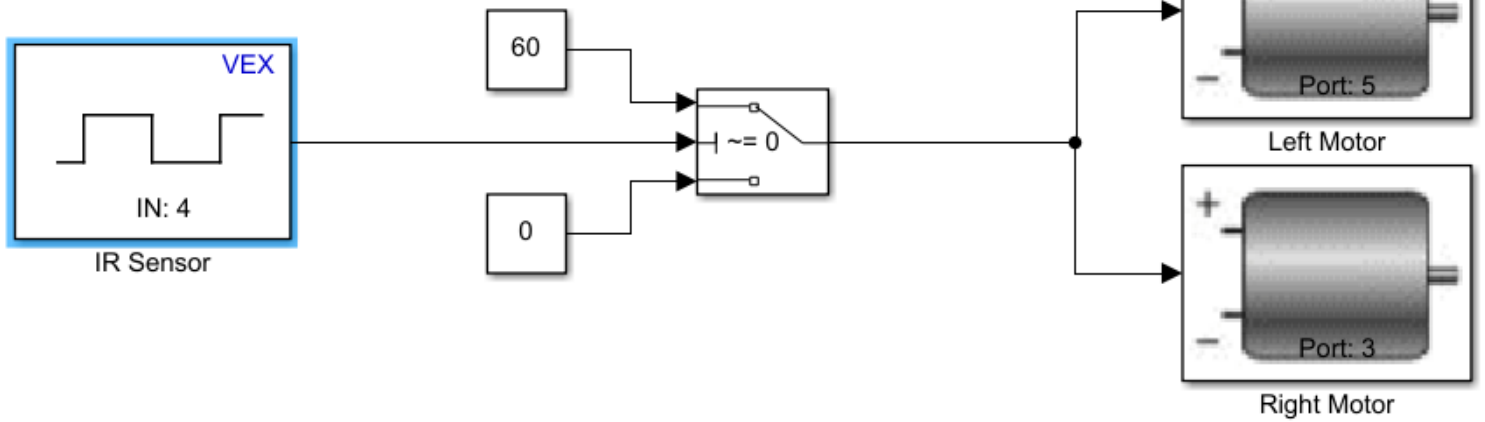


Simulink Example 1
Object Detection

Simulink Example: Move Until Object is Detected



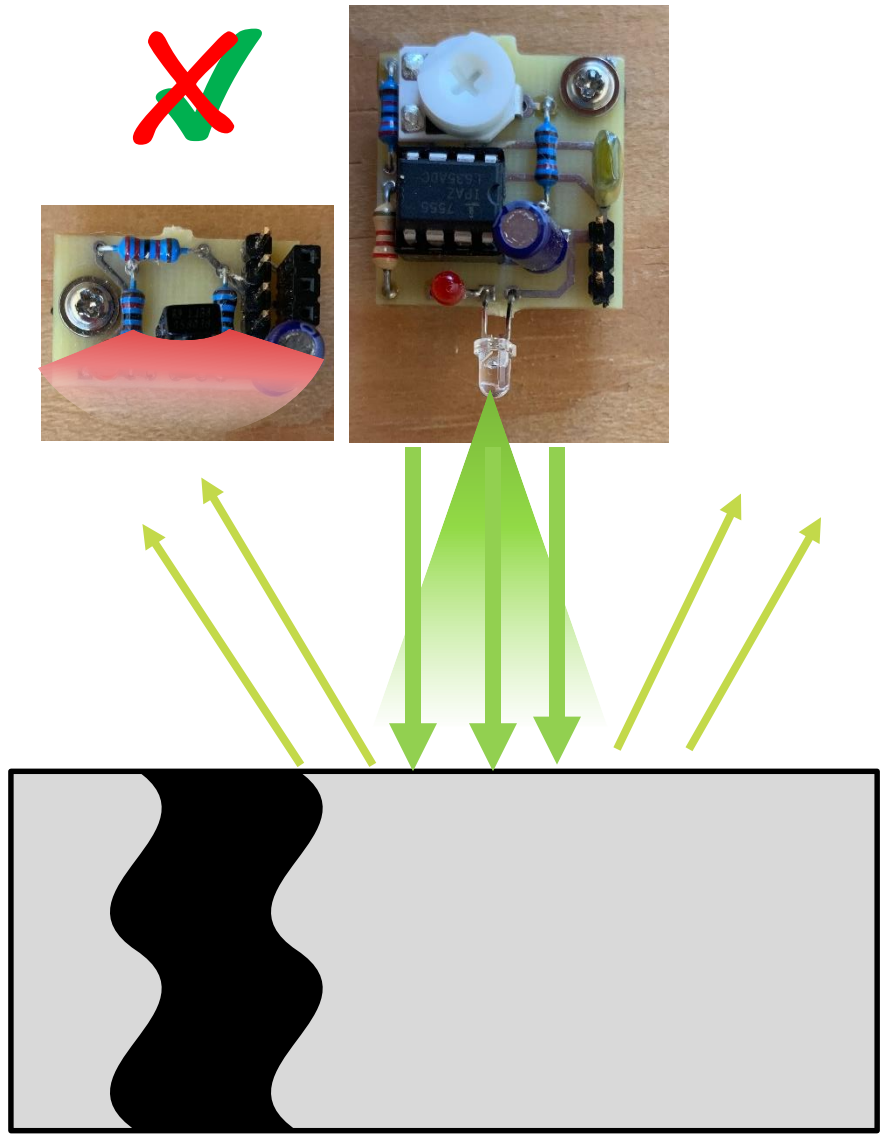




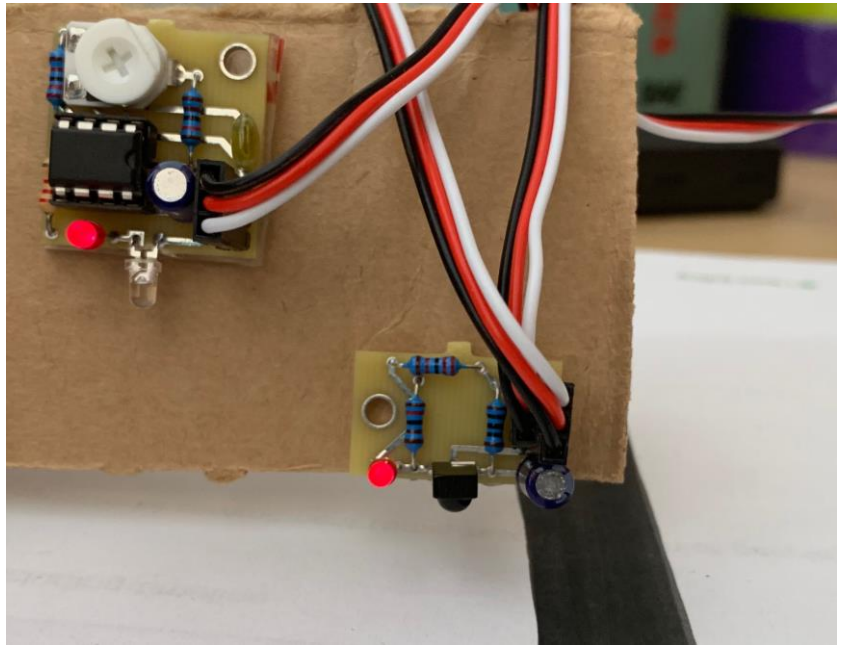
Sensor Application 2
Line Following

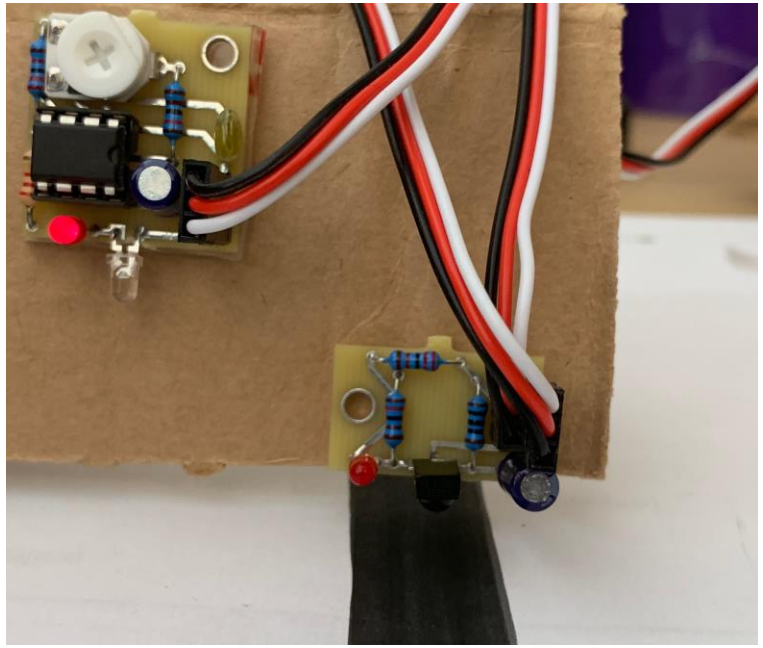
Line Detection

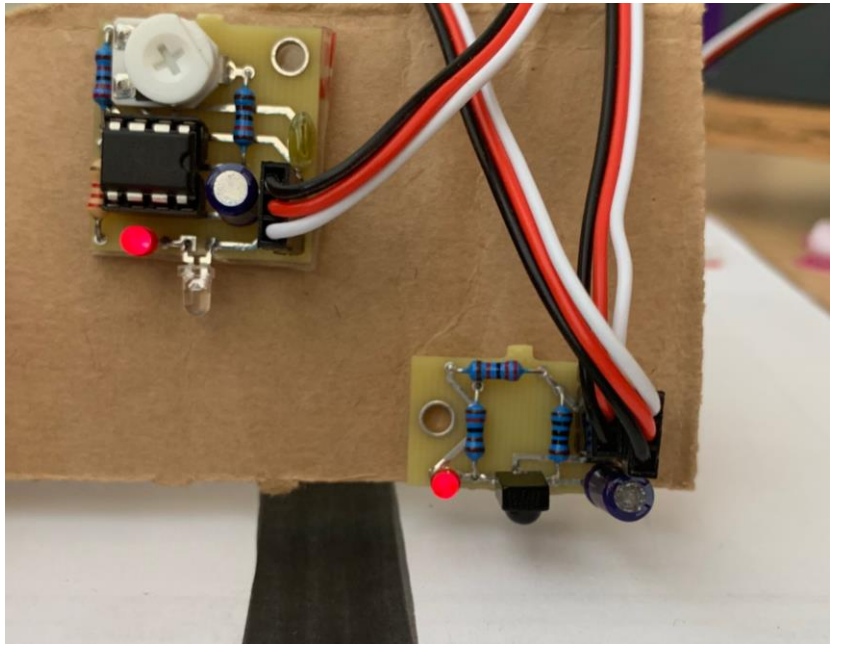
- Same as object detection, place transmitter and receiver facing the same direction
- Light will be reflected by bright colored surfaces and absorbed by dark surfaces
- Place the transmitter and receiver strategically
- Make sure to calibrate the sensor sensitivity



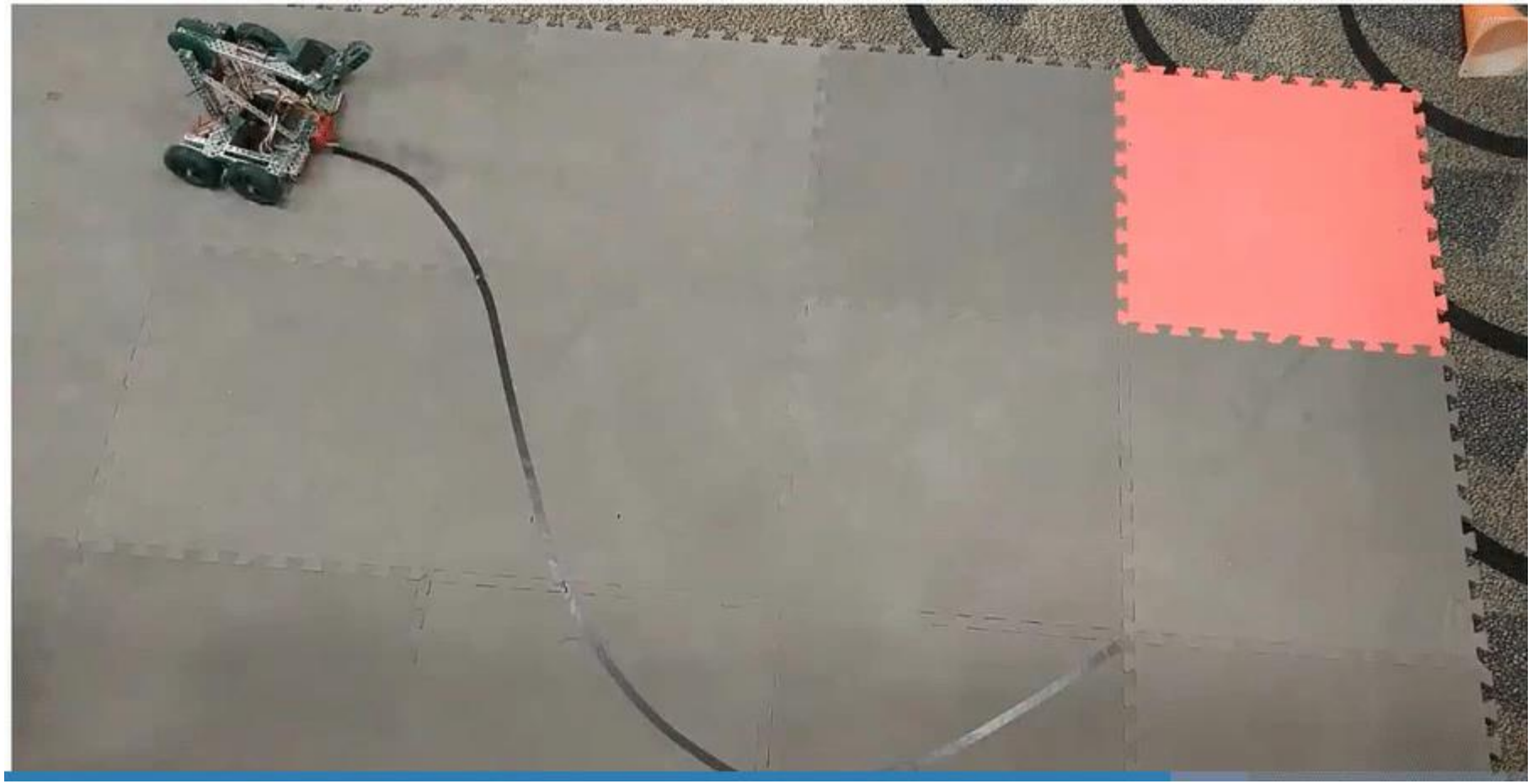
Line Detection







Line Following

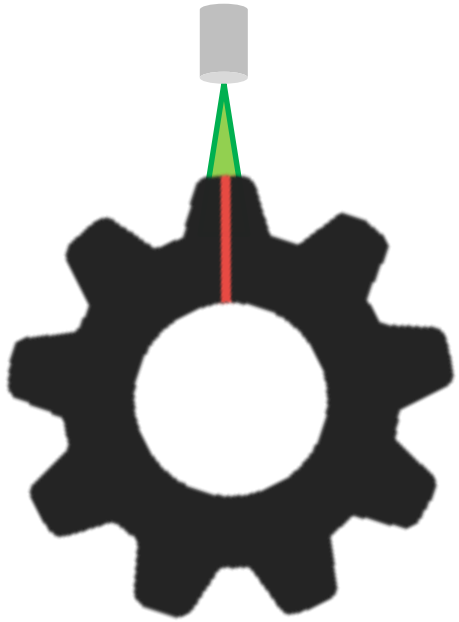


Simulink Example 2
Line Following

Sensor Application 3
Wheel Encoders

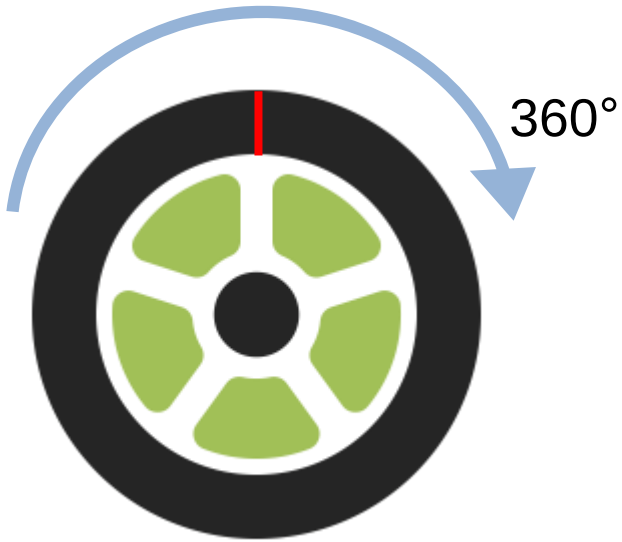
Motor/Wheel Encoders

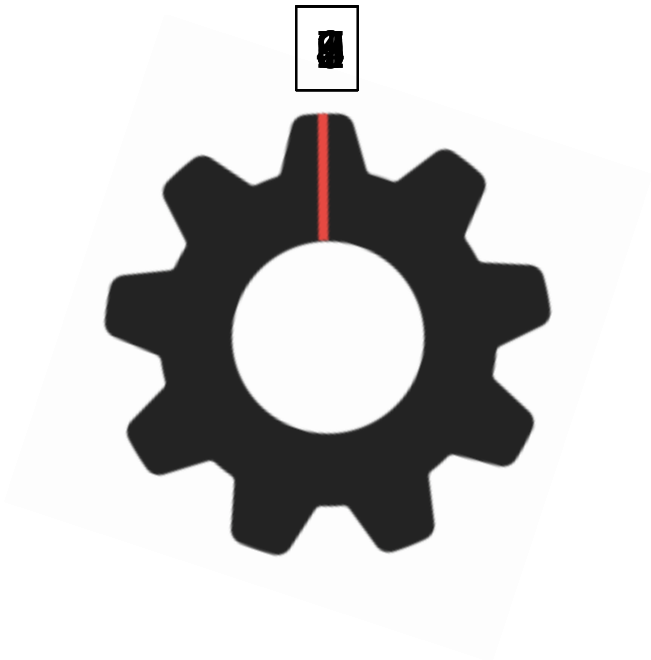
- Place the transmitter and receiver so the detection is interrupted by a rotating wheel
- Resolution of encoder depends on number of detections per rotation
- Use black paint and adjust sensitivity to help reduce false detections



Motor/Wheel Encoders

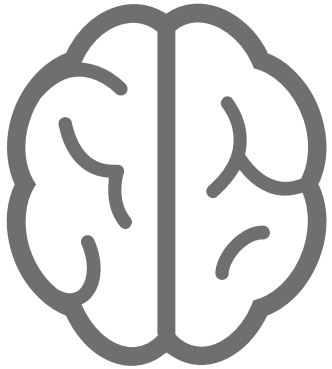
- Derive distance traveled with robot geometry
- Derive robot orientation using multiple encoders





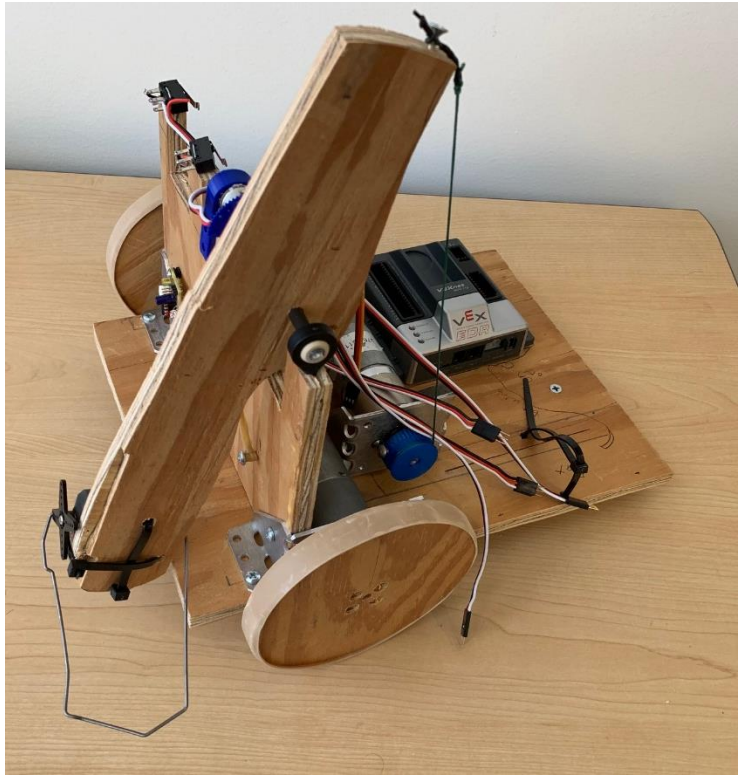
Simulink Example 3
Wheel Encoders

Autonomy Integration



Intro to SimBot

- Robot designed for teaching BEST workshops
- Built with BEST components
- Robot controller is a VEX Arm-Cortex Microcontroller

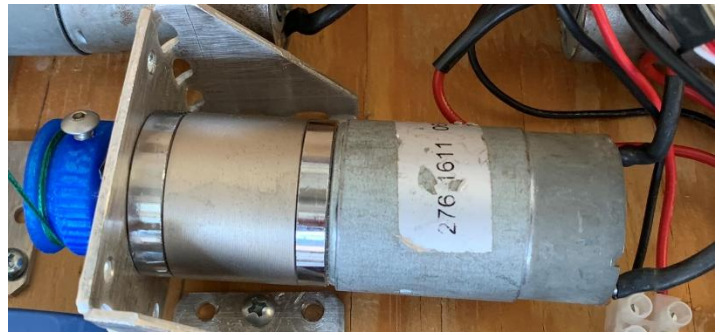


SimBot Components

A. 1 Servo Motor
B. 3 DC Motors
   - Left Wheel
   - Right Wheel
   - Arm
C. 2 Contact switches
D. 2 Potentiometers
E. 1 InfraRed (IR) Sensor

A

B



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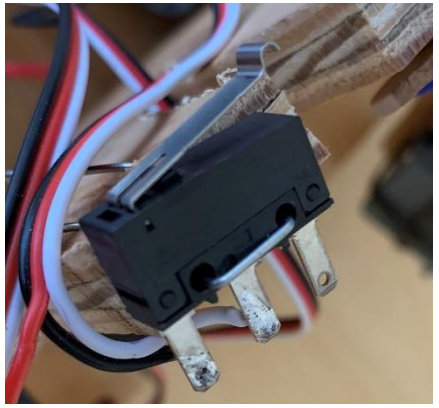

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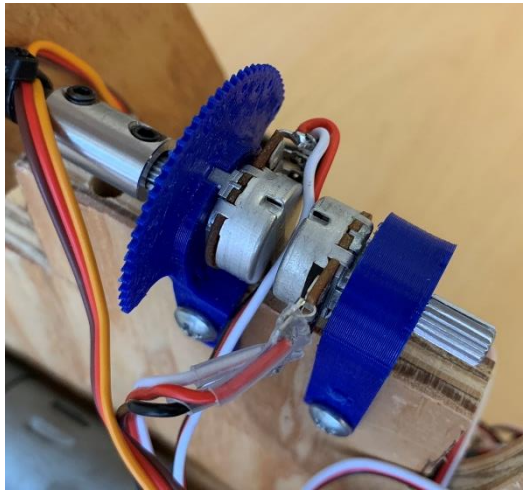

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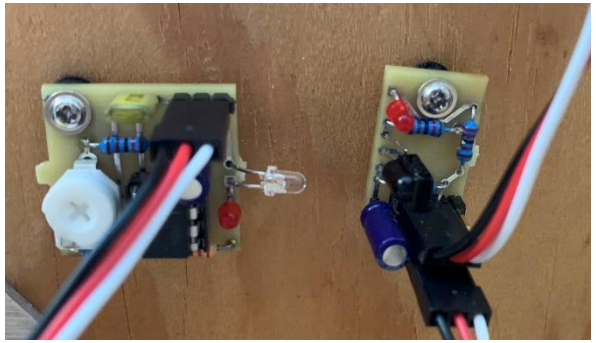
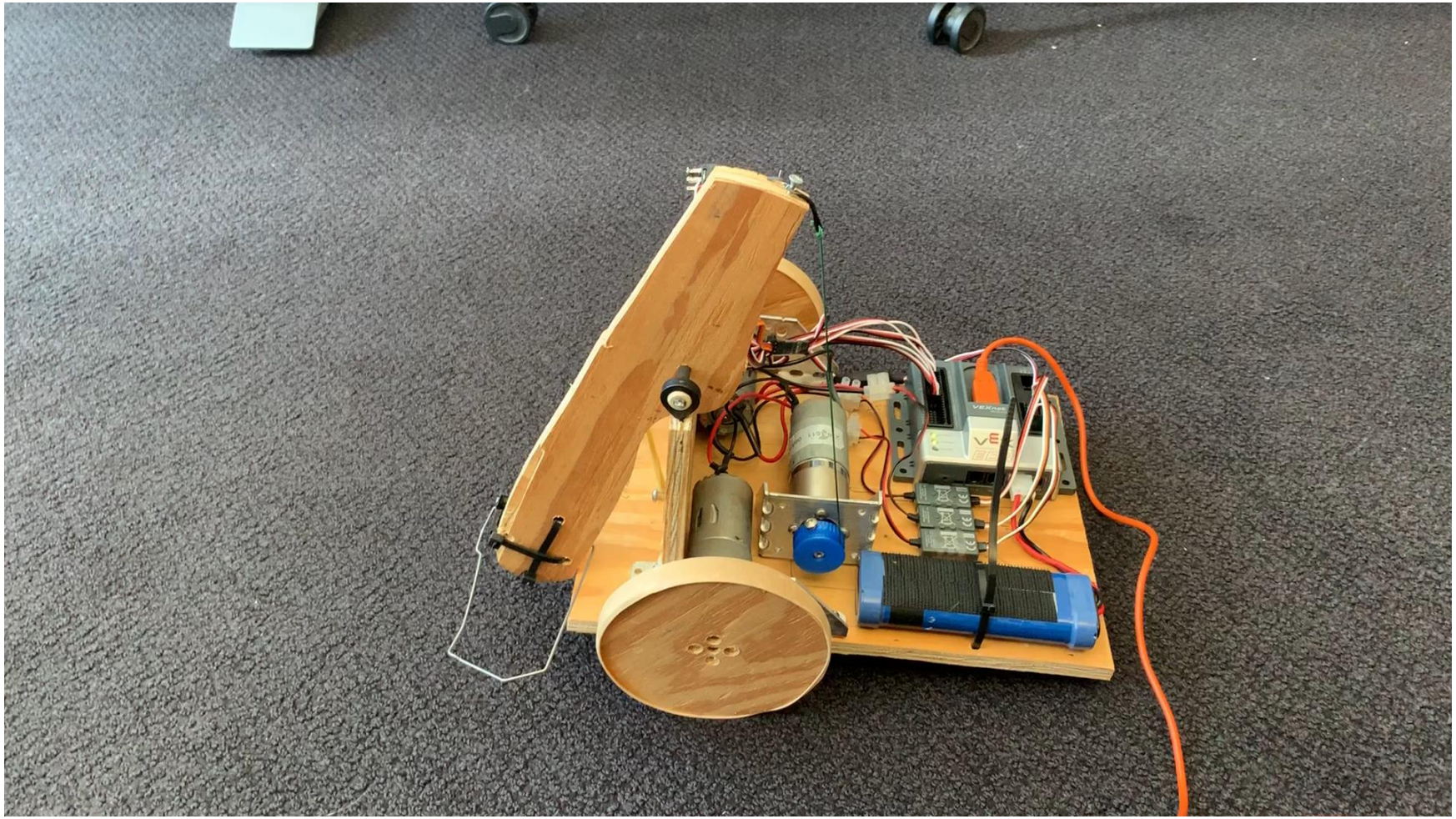


Fetching an object Autonomously

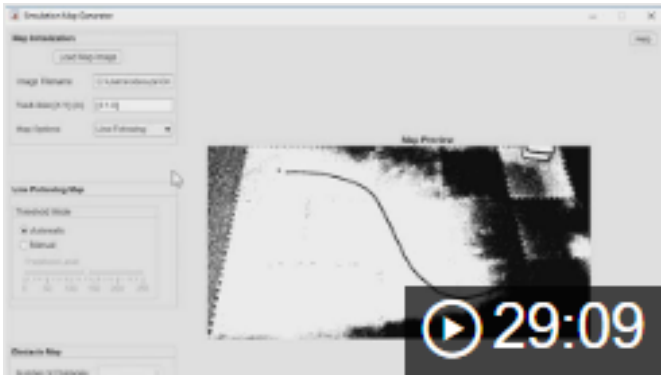


Simulink Example 4
Trigger Autonomous Behavior

Simulink Example 5
Sequencing Commands

MathWorks Student Competitions
Mobile Robotics Tutorials

- Control of robot motion
- PID Controllers
- Line Following
- Obstacle Detection
- Path Navigation



Robot Autonomy and Control Webinar

- Intro to Robot Autonomy
- Motion Control
- Using VEX Sensors
- Control Algorithms
- Navigation Logic/State-Machines
- PID Control implementations