

Ant Robot Mk.2 Software Documentation

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List of things that need to be done in the future:

Improvement on capacitive sensor:

When the robot accelerates, it often stays tilted at an angle, since the back is heavier than the front. This often causes the ant robot unable to detect other ant robots, because the copper foil may not touch each other. Possible solutions are extending the copper foil upward to cover more surface (this should not affect capacitive sensor value much, but probably needs to be recalibrated) and lowering the front caster wheel by a few millimeters to shift center of weight forward.

Improvement on turning in/after turn_reversal mode:

The robot often does not complete turning in turn_reversal mode, and it often decides to turn again and again. It doesn't seem like the turn_reversal mode is the cause, as it seems to turn after completing the turn_reversal mode. Rather, it is likely due to the PD controller not calibrated correctly, thus overshooting the pheromone trail by a lot, or Pixy camera not having enough field of vision.

Checking turn_reversal mode:

I already checked to see if turn_reversal mode works correctly in a normal run (i.e. the robot goes back and forth from digging), but it still needs to be checked in other runs, such as Lorentz run, when it decides to go back to charging due to low battery, or when it comes out of rest mode. Please check to see that this mode correctly puts the robot into the next mode correctly.

Robot Direction in Digging Mode:

The robot sometimes stays at a wrong angle when digging, thus failing to dig anything. This should be easy to correct; it probably needs TurnHeading function called right before digging attempt (maybe disable contact response, set preferGyro=false; and make sure that the robot doesn't change its mode afterwards).

Cohesive material stuck inside robot gripper:

Sometimes the cohesive material stays stuck inside the robot, prompting the robot to attempt dumping mode repeatedly. Consider suppressing this behavior after certain number of trials. To do this, you need to look at both DumpingMode and GoingInMode. There is a function that triggers it to go back to dumping when it detects something inside its gripper. However, beware that this also enables the robot to immediately go back to dumping after a reset. Reset often happens after it successfully dug something, so I added this function to not lose progress after reset.)

Reset Problem:

After successful excavation, the robot often resets itself in exitTunnel mode. This problem was solved by adding a check function in GoingInMode. When it detects something inside its gripper in GoingInMode, it prompts the robot to immediately go back to dumping. This solution may conflict with the problem above. Note that this problem has no impact on robot's functionality; it doesn't reset memory, but only loses a few seconds while resetting.

Robot Echo Problem:

The robot Echo has issues with its two wheel motors. It accelerates to much faster speed compared to other robots, and this doesn't seem like software issue. Consider replacing the whole wheel motor assembly. Make sure that the capacitor on the wheel motors are correct ones. Also make sure that the wiring is correct.

Robot Charlie Problem:

The robot has issues with its IMU sensor. The heading values from the IMU sensor seems to stick to wrong values. I already replaced the IMU several times, but it didn't make any change. Consider replacing the wiring and the Arduino Due.

Common Problems of the Robot and Solutions

Problem: Ant robot goes into digging mode even though there's no cohesive material in front.

Solution: Magnetometer MAG3110 sensor is either damaged or not functioning. Check the sensor. The magnetometer is prone to physical damage as well, so consider replacing it with a new one.

Problem: The robot goes into turn_reversal mode even though there's nothing inside its gripper.

Solution: Force sensitive resistor is either damaged or not functioning. Check the sensor.

Problem: The robot keeps resetting itself.

Solution: The voltage regulator may be overheating. Separate the battery power completely from the robot and let the voltage regulator cool down for a few minutes.

Problem: The robot doesn't move at all or doesn't track the pheromone trail.

Solution: The Pixy Camera may have lost focus or its color designation. Reprogram or refocus the camera accordingly. You can also check whether the camera is functioning properly by visually checking for its blinking light.

Added Sensors/Systems

Hall Effect Sensors

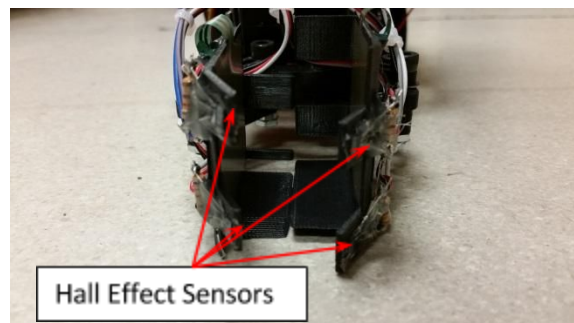


Figure: Hall Effect Sensors

Please look at GripperSensor.cpp and GripperSensor.h for the code. There is no specific test function for these sensors, but you can use `RUSensor.IsDetected()` for testing (this tests the hall effect sensor located on Right Up). Change RU to LU, RD, or LD to test other hall effect sensors.

Magnetometer MAG3110

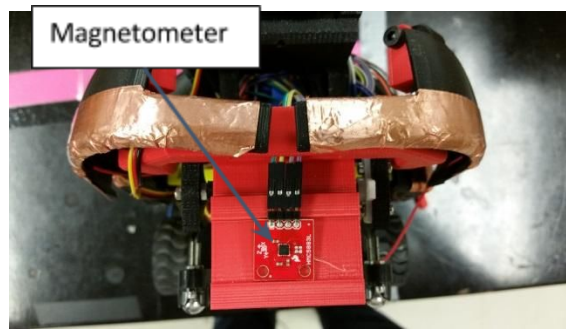


Figure: Magnetometer

Please look at `MAG3110.cpp` and `MAG3110.h` for the code. To test the sensor, search “for magnetometer MAG3110 sensor test and calibration” in the setup in the main code, and enable that section.

Capacitive Sensor MPR121

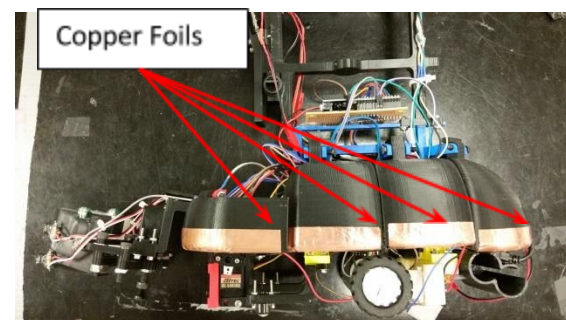
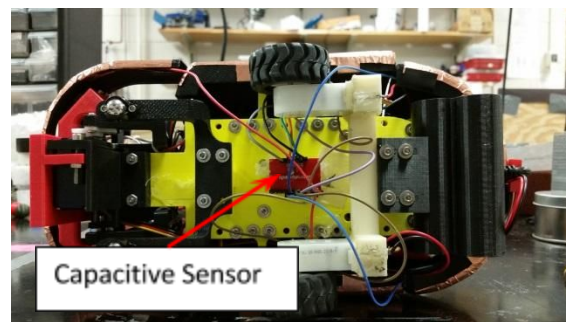


Figure: Capacitive Sensor

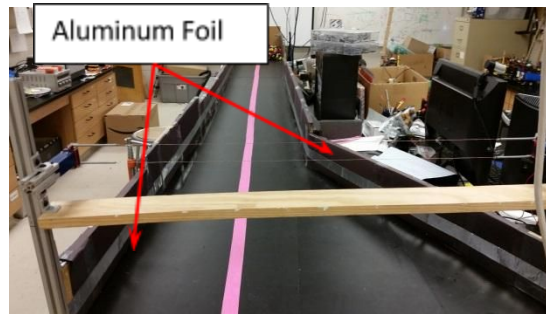


Figure: Tunnel

Please look at `CapacitiveSensor.cpp`, `CapacitiveSensor.h`, and `mpr121.h` for the code. To test this sensor, search to “for capacitive sensor test and calibration” in the setup in the main code, and enable that section. In addition, go to `FioWirelessV4.ino` file, and then enable “enable this part when calibrating/testing the capacitive sensor” section, and then disable “disable this part when calibrating/testing the capacitive sensor” section. This should display the capacitive sensor reading from one pin to the LCD screen.

Force Sensitive Resistor

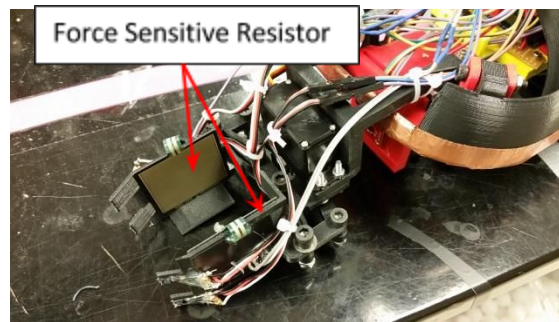


Figure: Force Sensitive Resistor

Please look at `CheckPayload()` function in the main code. There is no dedicated function for testing this sensor, but `CheckPayload()` function can be used to test this sensor.