

# Ant Robot Mk.2 Hardware Documentation

Jungsoo Park

CRAB Laboratory

Georgia Institute of Technology

626-720-3140

ryanryan0906@hotmail.com

## Added Sensors/Systems

- [Magnetometer](#):

The ant robot has one magnetometer sensor located in the front lower section of the robot, as shown in figure 1, to detect any magnetic cohesive material in the front. This sensor is used to inform when the robot has reached the digging site, and trigger the excavation behavior.

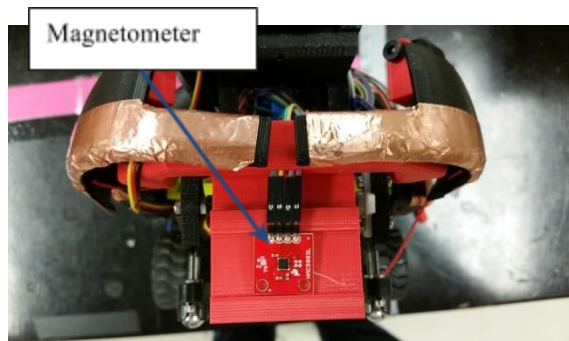


Figure 1: Magnetometer

The gripper system on the previous design featured a small gripper and servo, with an IR sensor to detect material in front, as shown in figure 2. In contrast, the new ant robot features more advanced gripper system, as shown in figure 3. It has much bigger gripper and stronger servo. In addition, it features more intelligent sensing capabilities, with the addition of Hall Effect sensors and force sensitive resistors. As a result, it is capable of excavating several times more material than that of the previous design. Furthermore, to ensure that the gripper system does not interfere with the robot's capacitive sensors, it is designed to retract itself when it is not being used, but extend only when it is digging or depositing the material. Figure 3a shows the gripper in extended position, and figure 3b shows the gripper in retracted position. Figure 3c and figure 3d shows the gripper in open position and closed position, respectively.

- Gripper System:

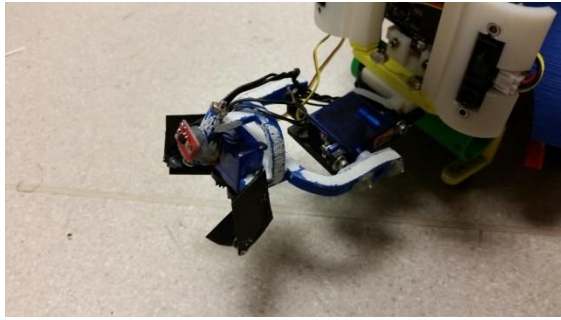


Figure 2: Gripper, Previous Design

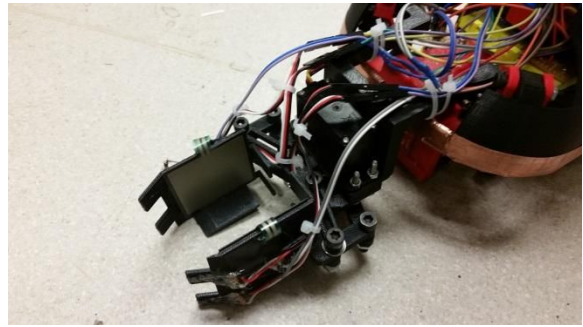


Figure 3c: Gripper, Open Position

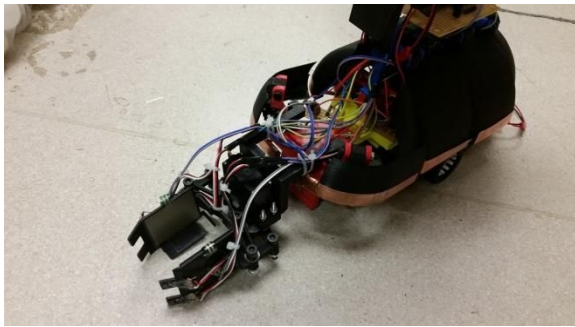


Figure 3a: Gripper, Extended Position

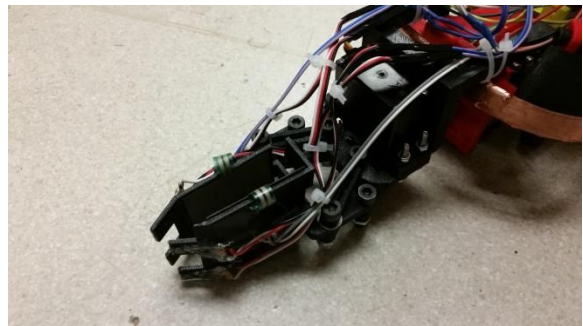


Figure 3d: Gripper, Closed Position

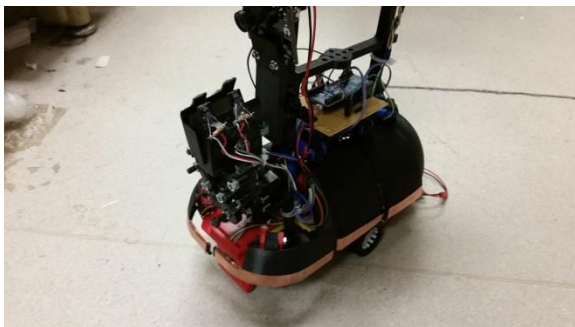


Figure 3b: Gripper, Retracted Position

- Hall Effect Sensor:

Four Hall Effect sensors are located at the front tip of the gripper, as shown in figure 4. It is used as an alternative way to detect any magnetic cohesive material in front, as when the gripper is in extended position, it blocks the magnetometer and prevents it from detecting the magnetic cohesive material. In addition, these Hall Effect sensors can detect the accurate position of magnetic cohesive materials. This enables the robot to accurately position the gripper for optimal digging.

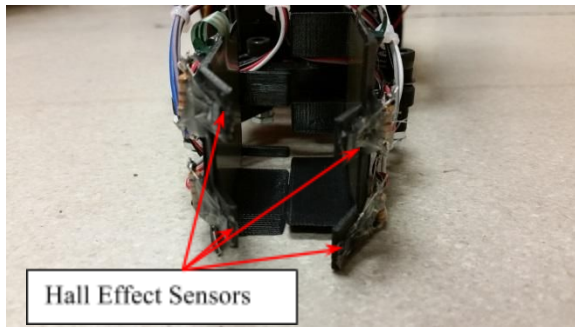


Figure 4: Hall Effect Sensors

- Capacitive Sensor:

The capacitive sensor is designed to detect and distinguish the tunnel wall and other ant robots. It is connected to eight copper foils surrounding the robot, as shown in figure 8. In addition, the tunnel walls have aluminum foils, as shown in figure 5. By monitoring the capacitance difference in the two different kinds of foils, it can distinguish the tunnel wall from other ant robots.

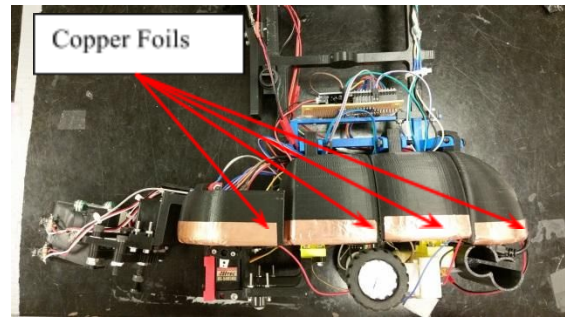
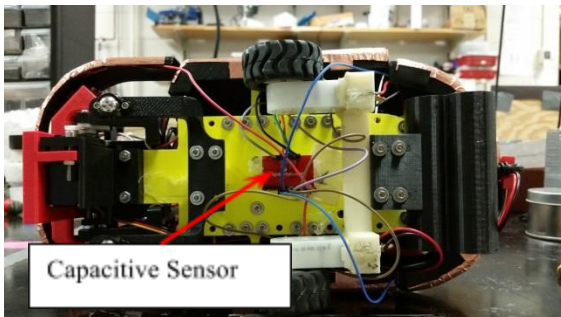


Figure 5: Capacitive Sensor

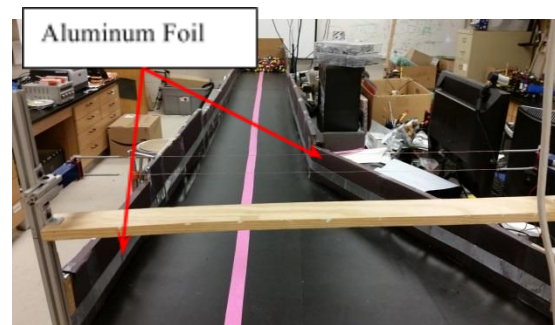


Figure 6: Tunnel

- Force Sensitive Resistor:

The force sensitive resistors are located inside the gripper to detect any material grasped by the gripper, as shown in figure 7. Depending on the pressure applied to the sensor pads, it gives different resistance, and by measuring the voltage difference, it can tell whether there's any material inside the gripper.

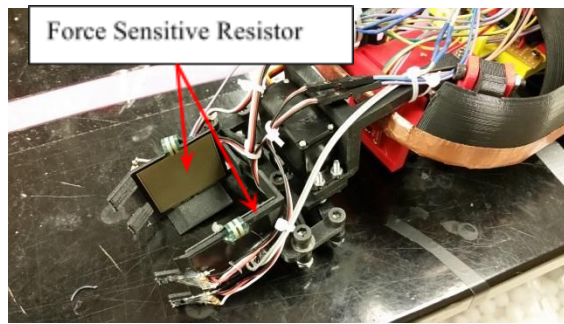
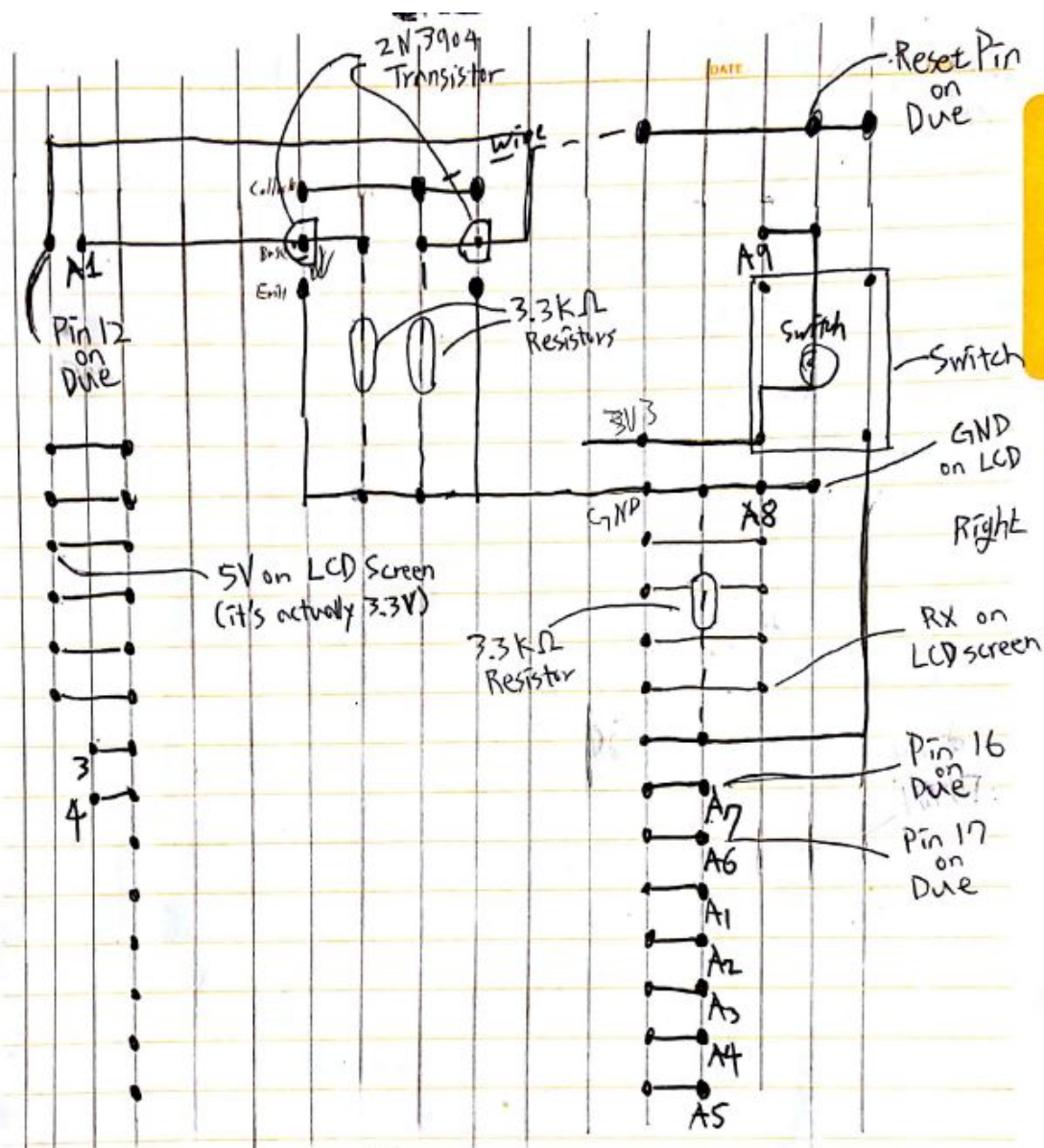


Figure 7: Force Sensitive Resistor

### Arduino Fio Board Diagram

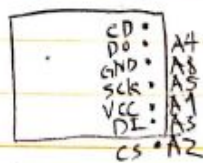




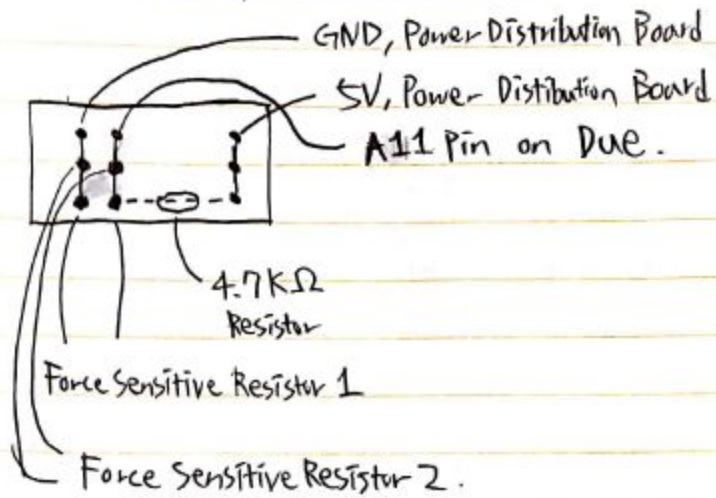
Back

Fio Board.

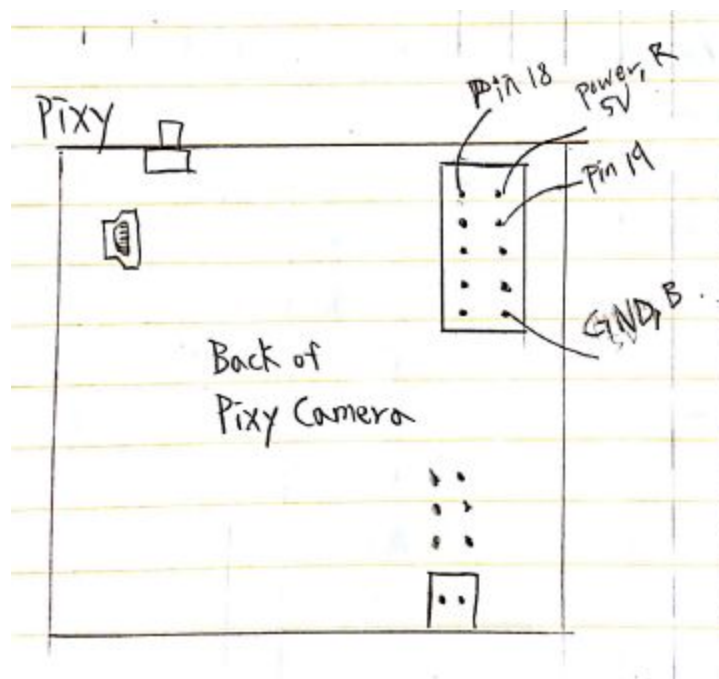
SD Card



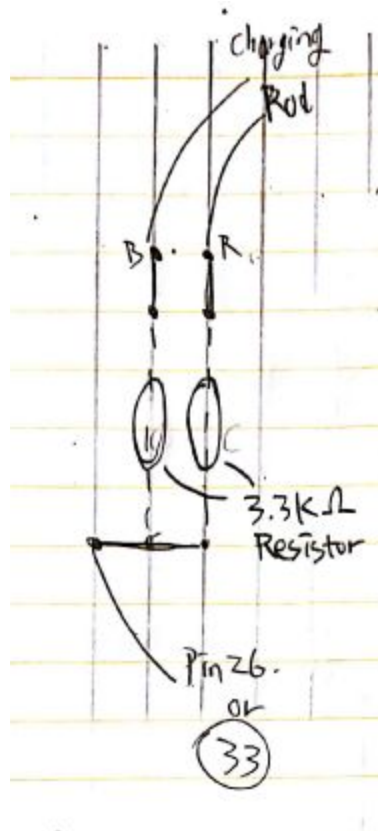
## Force Sensitive Resistor Board



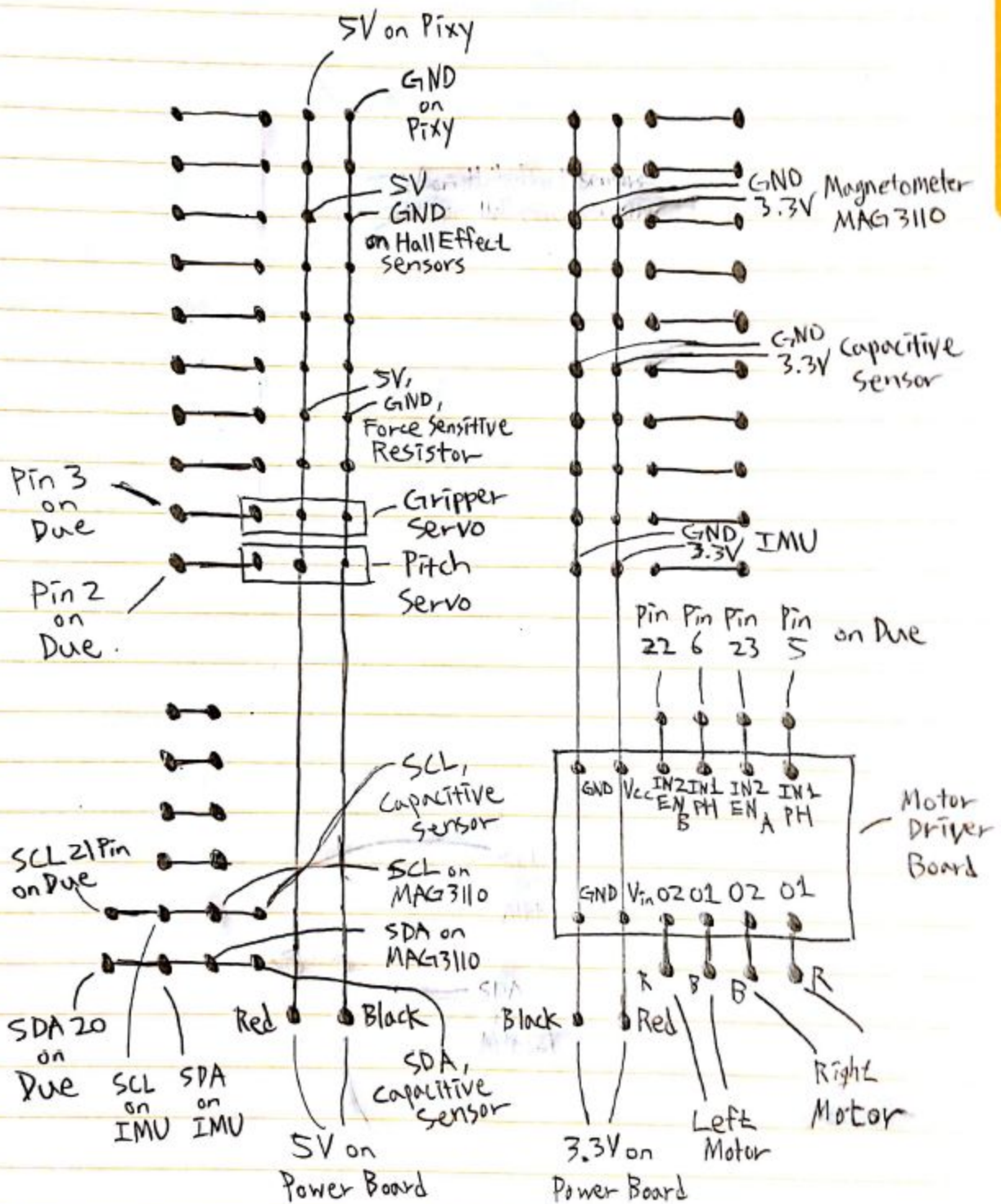
## Pixy Camera



## Charging Rod Board



# Power Distribution Board





# Power Board

DATE

NO

