iPhone Controlled Robots

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Acknowledgements:

NYU·poly

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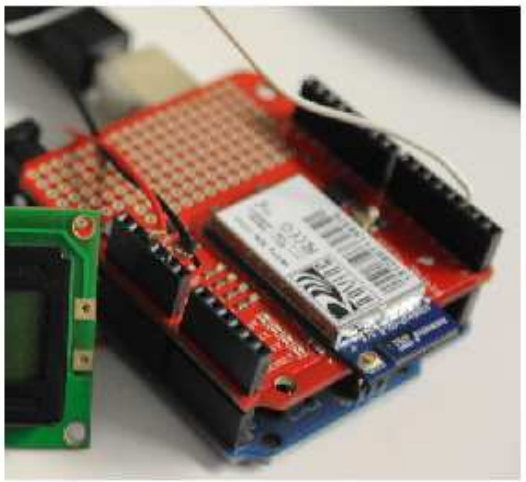
Robot Projects

- Robotic Fish
- iRobot
- Photo Resistor Send/Receive
- CRS Robot
- DC Motor Web Lab Experiment
- QBot

Robotic Fish

iPhone



Arduino

Robotic Fish

-Control the motion of the Robotic Fish with a custom iPhone app.

Original Fish App GUI

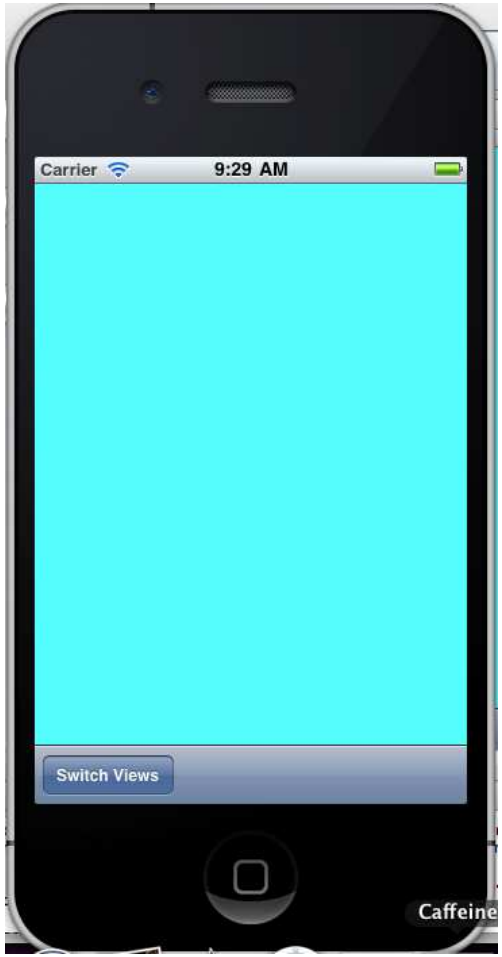
The original Fish App used three sliders to control:

- Frequency
- Amplitude
- Offset

Drawbacks

- Lack of auto-centering
- Hard to see while being used

First Attempt at Multi-view Apps



One button was used to toggle between two views

This design was abandoned in favor of Tab Bar Apps

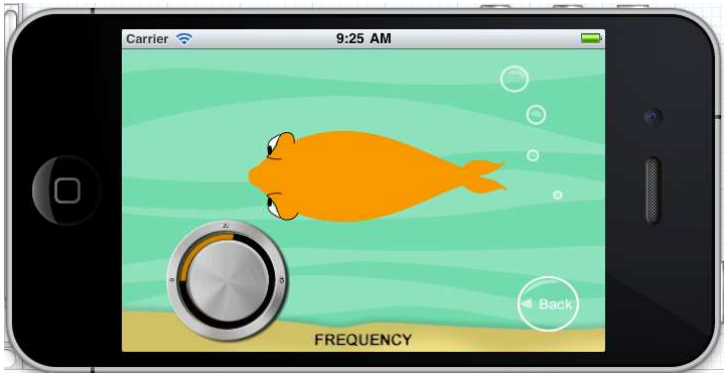
New Fish App GUI

The main navigation is handled by a Tab Bar

The main view is just a splash image

Tutorials Home Page

The tutorials use a sub navigation with modal windows
The sub views use back buttons



The New Fish App GUI

Control Design:

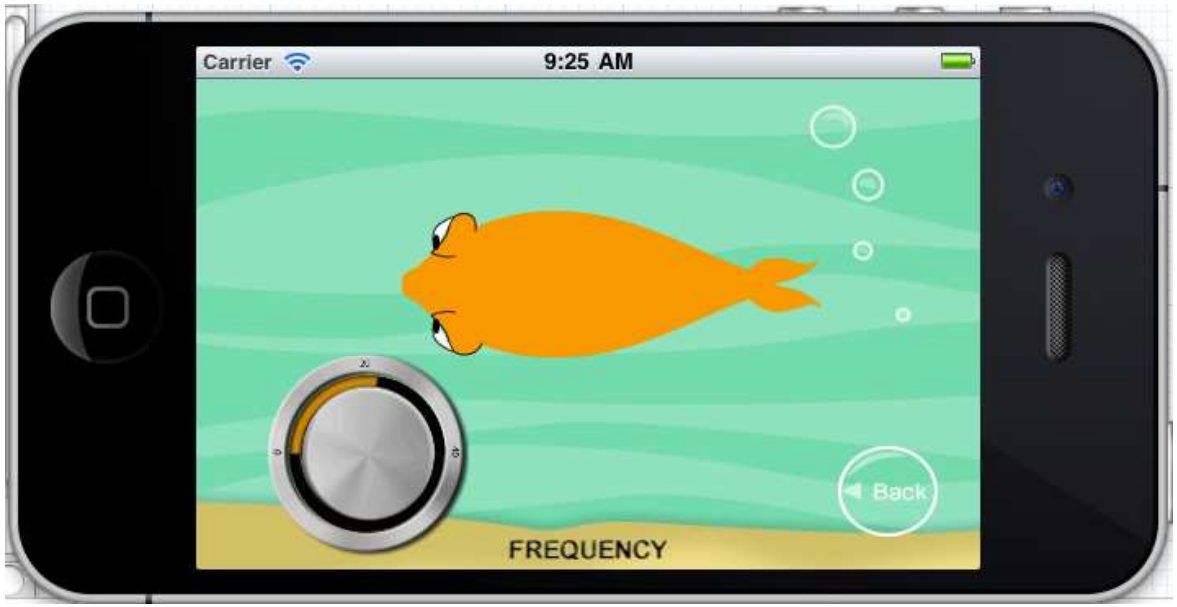
- 2 Dials
- 1 Slider
- All graphics were custom made in Adobe Photoshop and Fireworks

Original Tutorials

Drawback:

•Lack of feedback

Frequency Tutorials



As the dial is turned the fish's tail oscillates faster

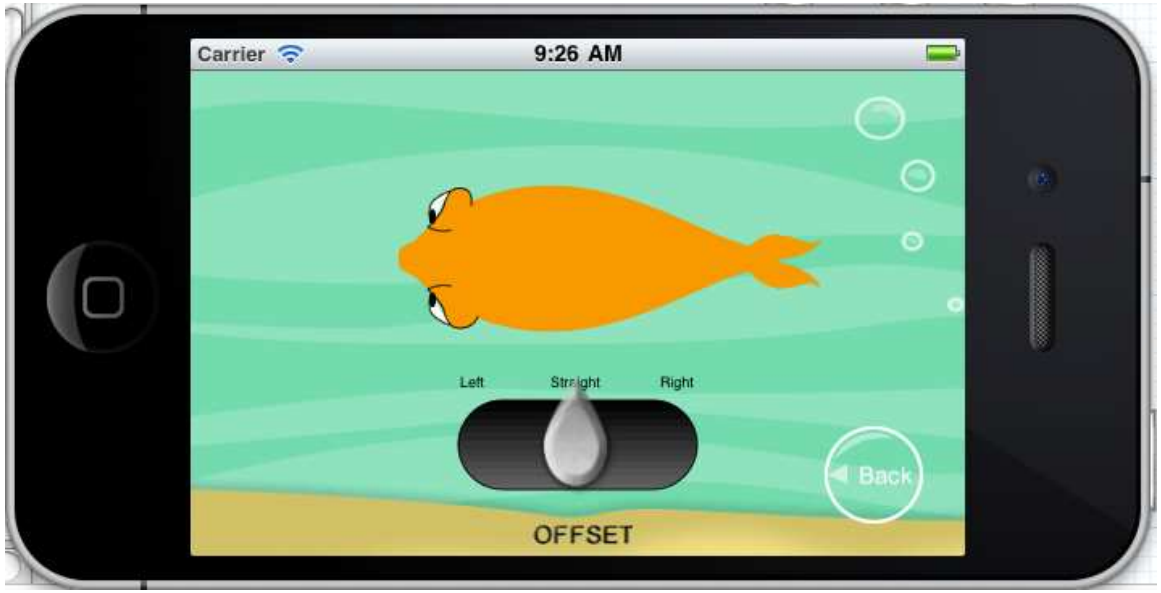
```
-(void)processSwipeRight:(NSSet*)touches withEvent:event {
        distRad = distDeg * 3.14157 / 180;
        [UIView beginAnimations:nil context:NULL];
        [UIView setAnimationDuration:myDur];
        viewTail.transform = CGAffineTransformMakeRotation(-distRad);
       [UIView commitAnimations];
}
```

Amplitude Tutorials

As the dial is turned to the right the distance of the oscillation increases

```
-(void)processSwipeRight:(NSSet*)touches withEvent:event {
        distRad = distDeg * 3.14157 / 180;
        [UIView beginAnimations:nil context:NULL];
        [UIView setAnimationDuration:myDur];
        viewTail.transform = CGAffineTransformMakeRotation(-distRad);
       [UIView commitAnimations];
}
```

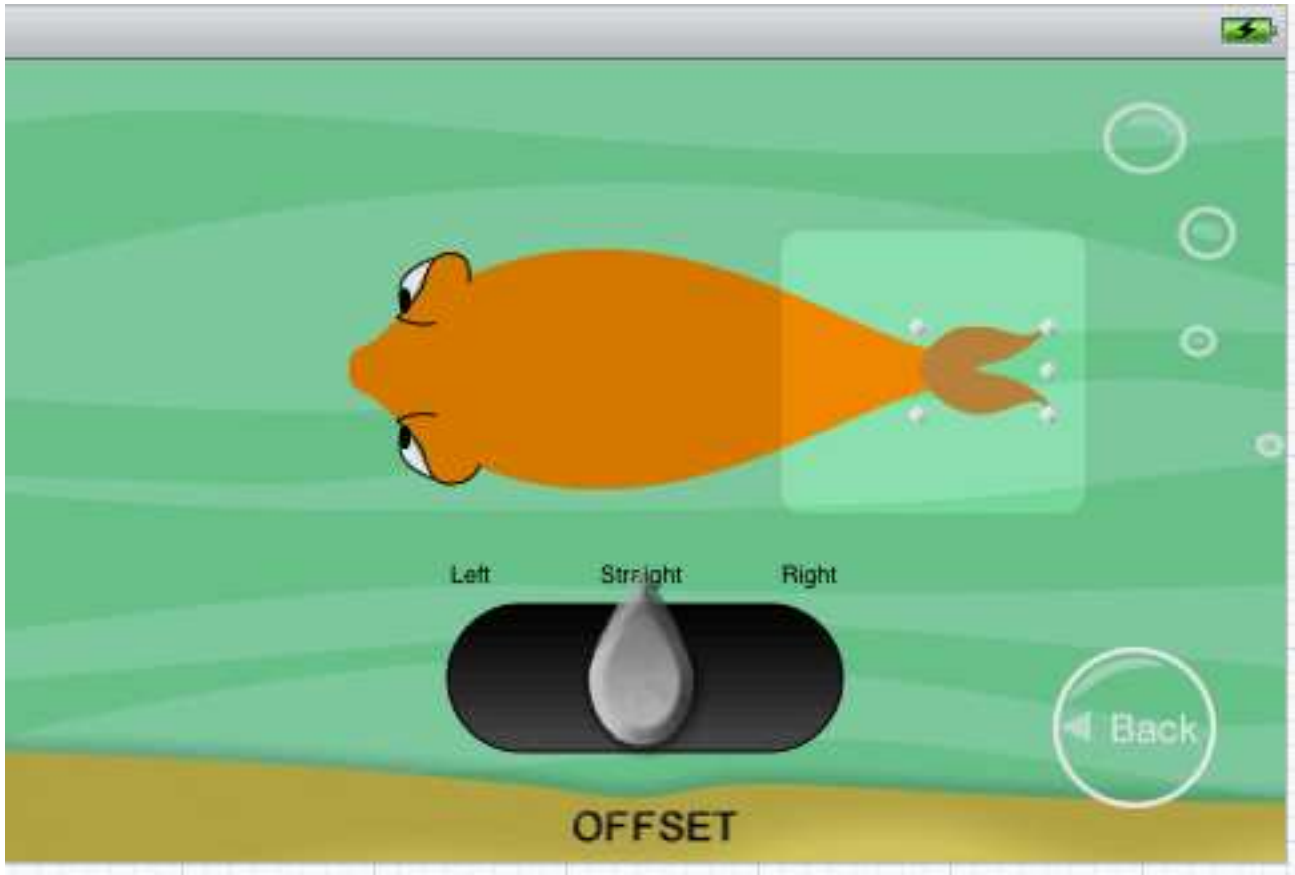
Offset Tutorials



As the Slider is moved the angle of the is changed.

```
-(void)processSwipeRight:(NSSet*)touches withEvent:event {
        distRad = 15 * 3.14157 / 180;
        [UIView beginAnimations:nil context:NULL];
        [UIView setAnimationDuration:.5];
        viewTail.transform = CGAffineTransformMakeRotation(-distRad);
       [UIView commitAnimations];
}
```

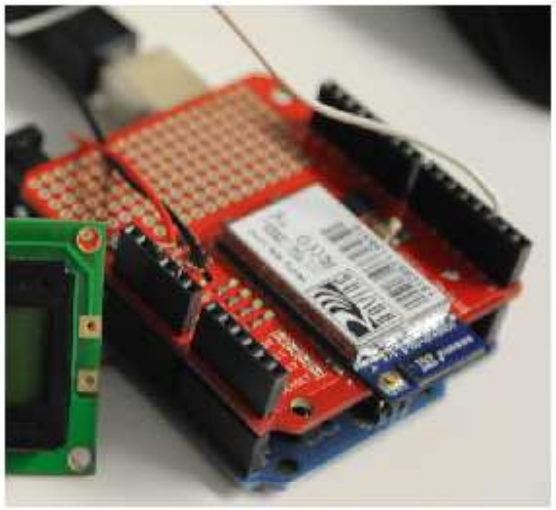
Dual Animation for Offset



Inner Rectangle: UIImageView
Outer Rectangle: UIView

iRobot

iPhone



Arduino

iRobot

-Control the motion of the iRobot with the accelerometer of the iPhone.

-Control the motion of the arm on the iRobot with the pushbuttons on the iPhone app.

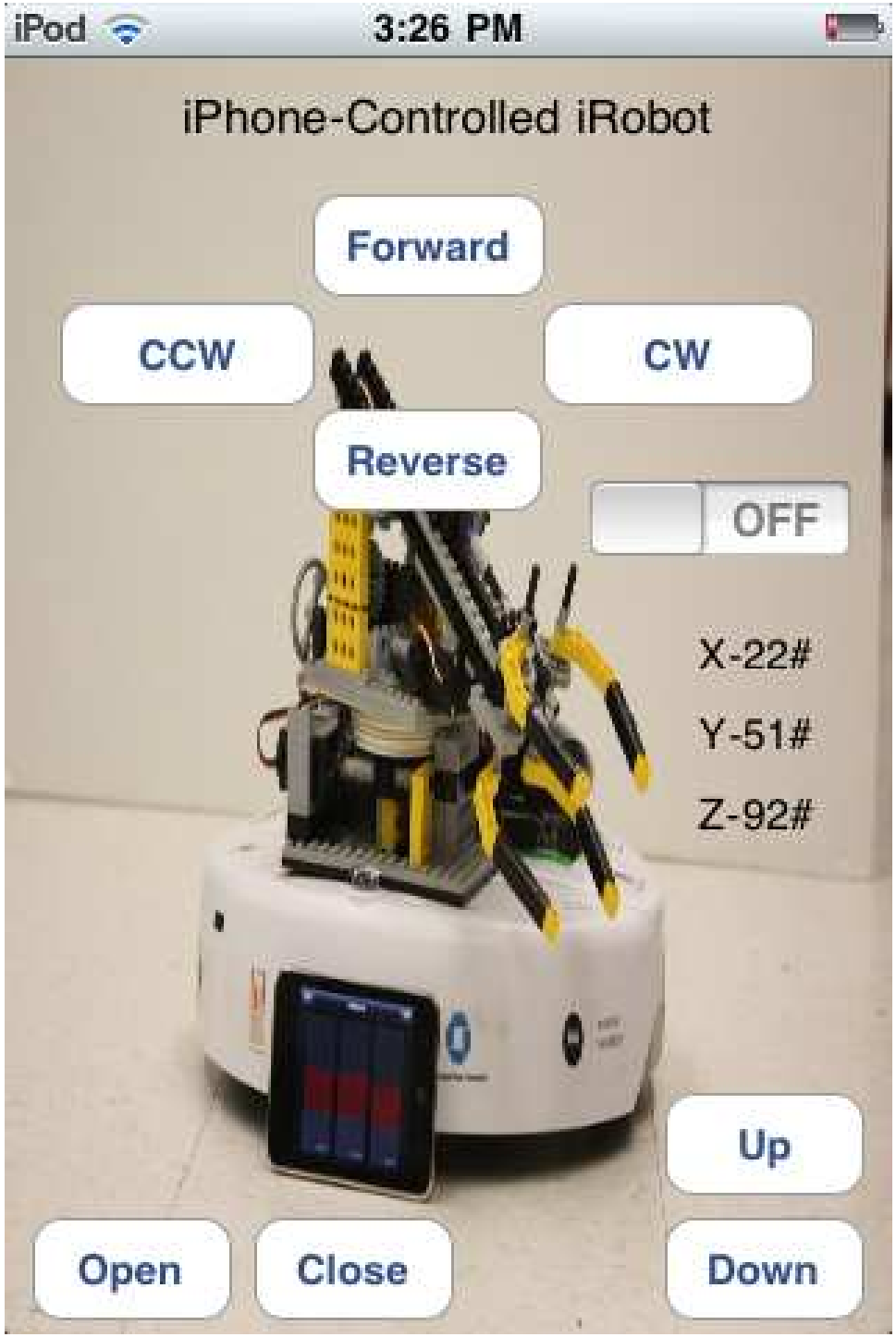
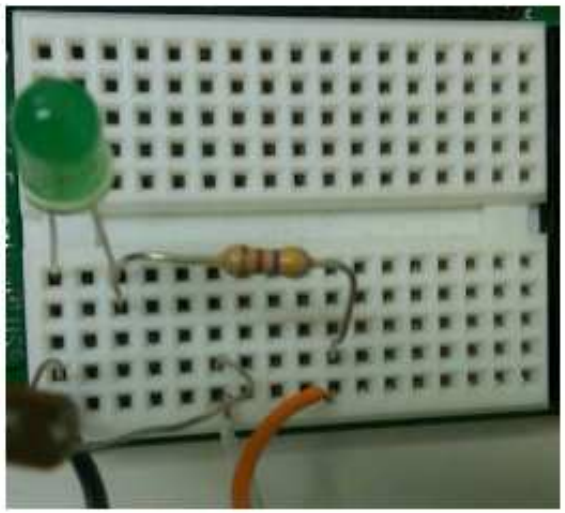
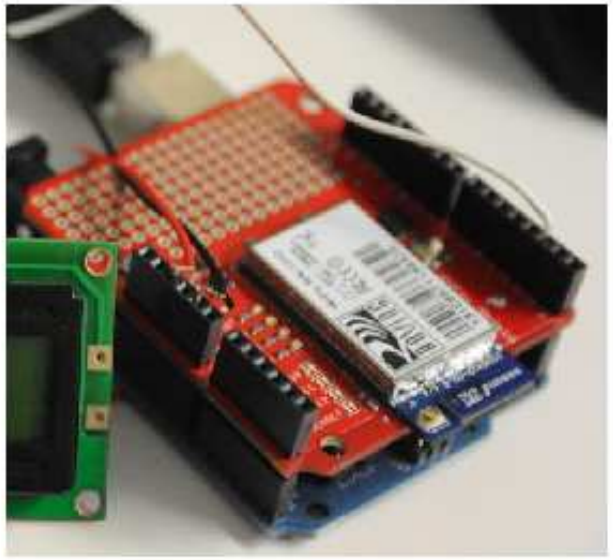

iPod
3:26 PM
iPhone-Controlled iRobot
Forward
CCW
CW
Reverse
OFF
X-22#
Y-51#
Z-92#
Up
Open
Close
Down

Photo Resistor Send/Receive



PhotoResistor / LED Circuit



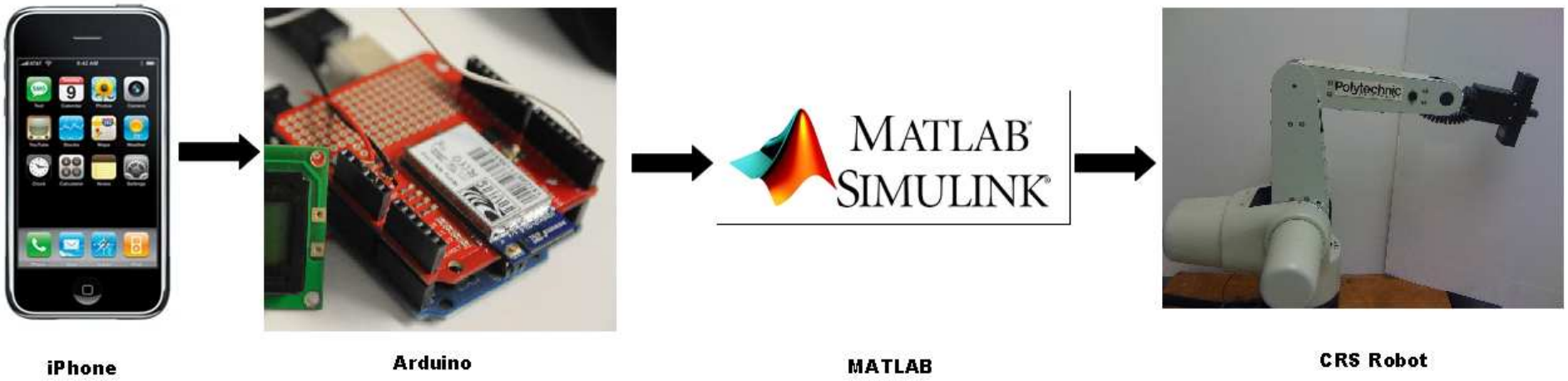
Arduino

iPhone

-Arduino reads and sends photo resistor values to the iPhone.

-iPhone decides whether or not to turn on/off an LED based on the resistance values and sends the decision back to the Arduino, which controls the LED.

CRS Robot

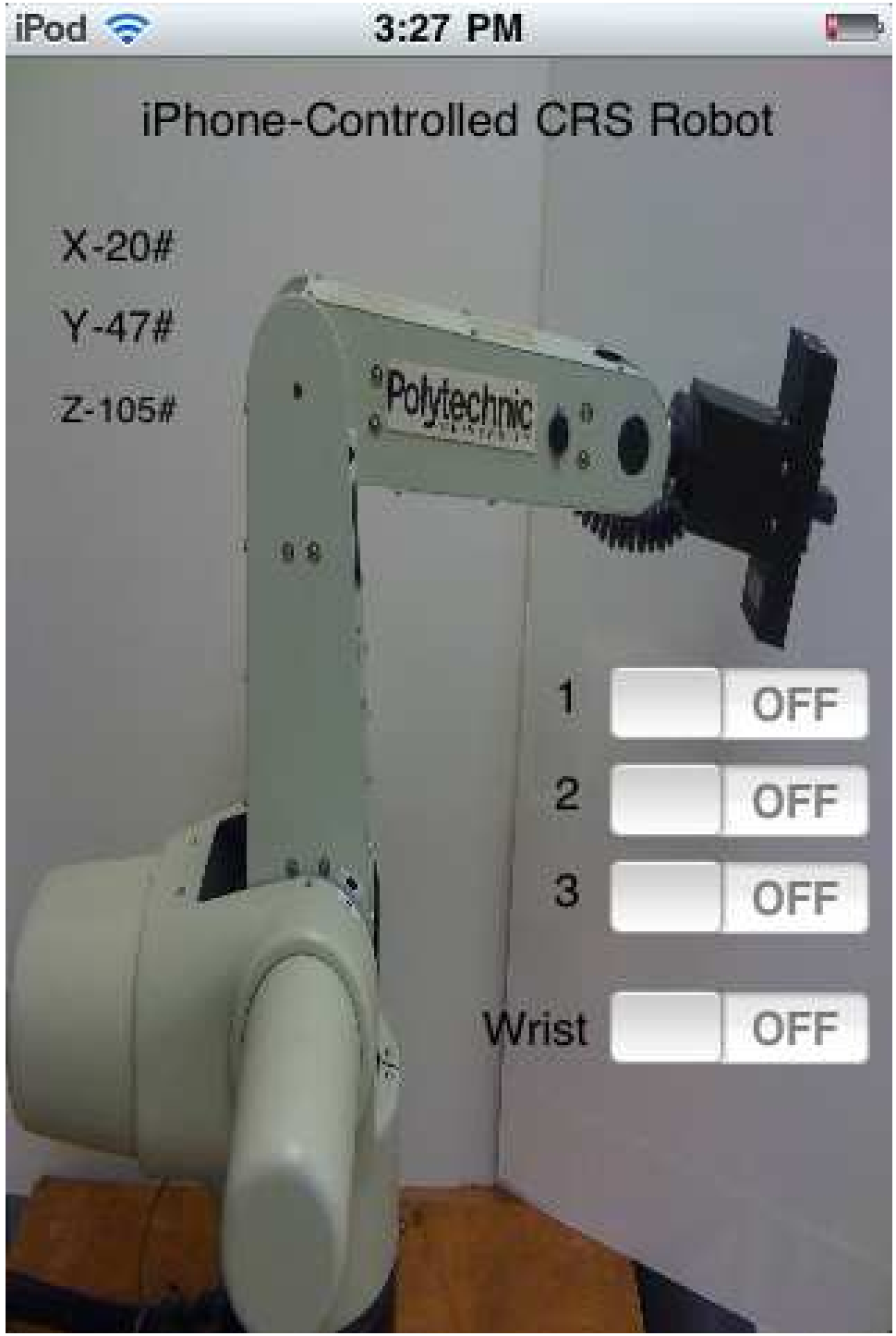


iPhone | Arduino | MATLAB | CRS Robot

-Control the two joints of the wrist at once with the accelerometer on the iPhone.

-Control the gripper of the robot by pinching on the iPhone.

CRS Robot Video


iPod
3:27 PM
iPhone-Controlled CRS Robot
X-20#
Y-47#
Z-105#
Polytechnic
1
OFF
2
OFF
3
OFF
Wrist
OFF

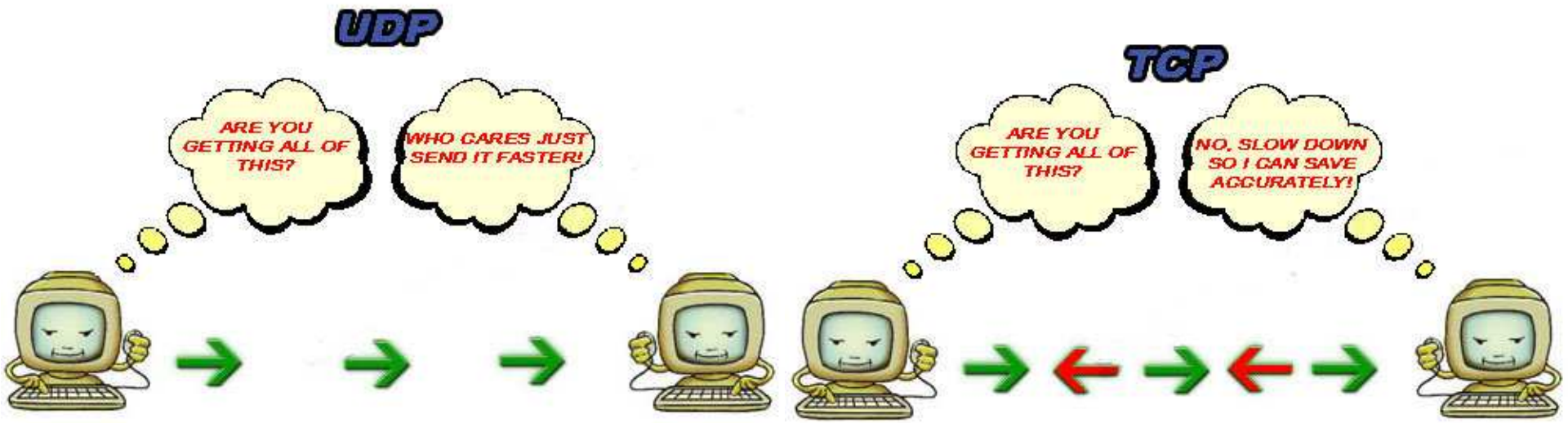
DC Motor Web Lab Experiment

-Control the DC Motor using the iPhone.

-Receiving and graphing voltage readings of Tachometer and Potentiometer on the iPhone.

-Data sent via TCP

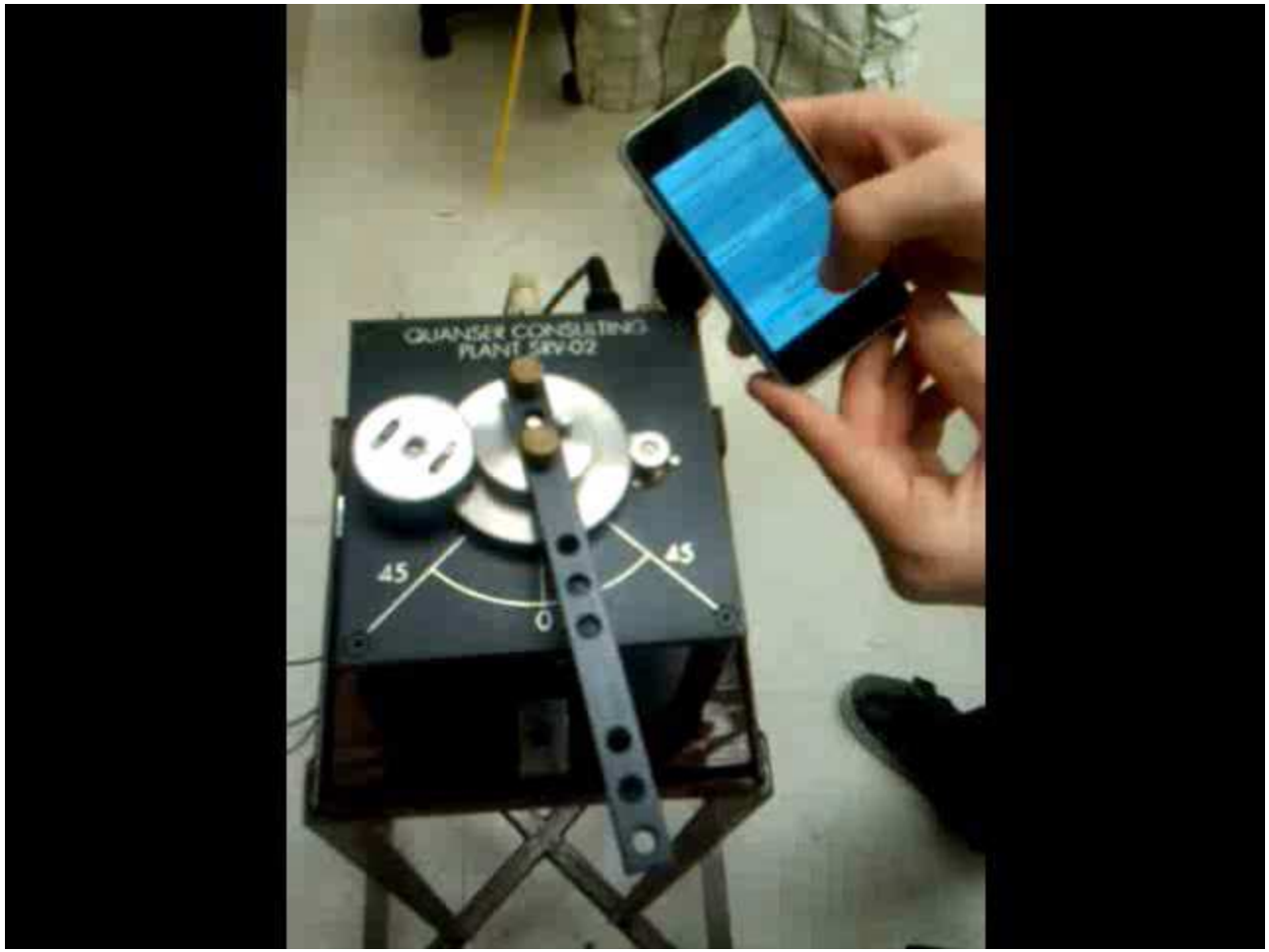
UDP vs. TCP

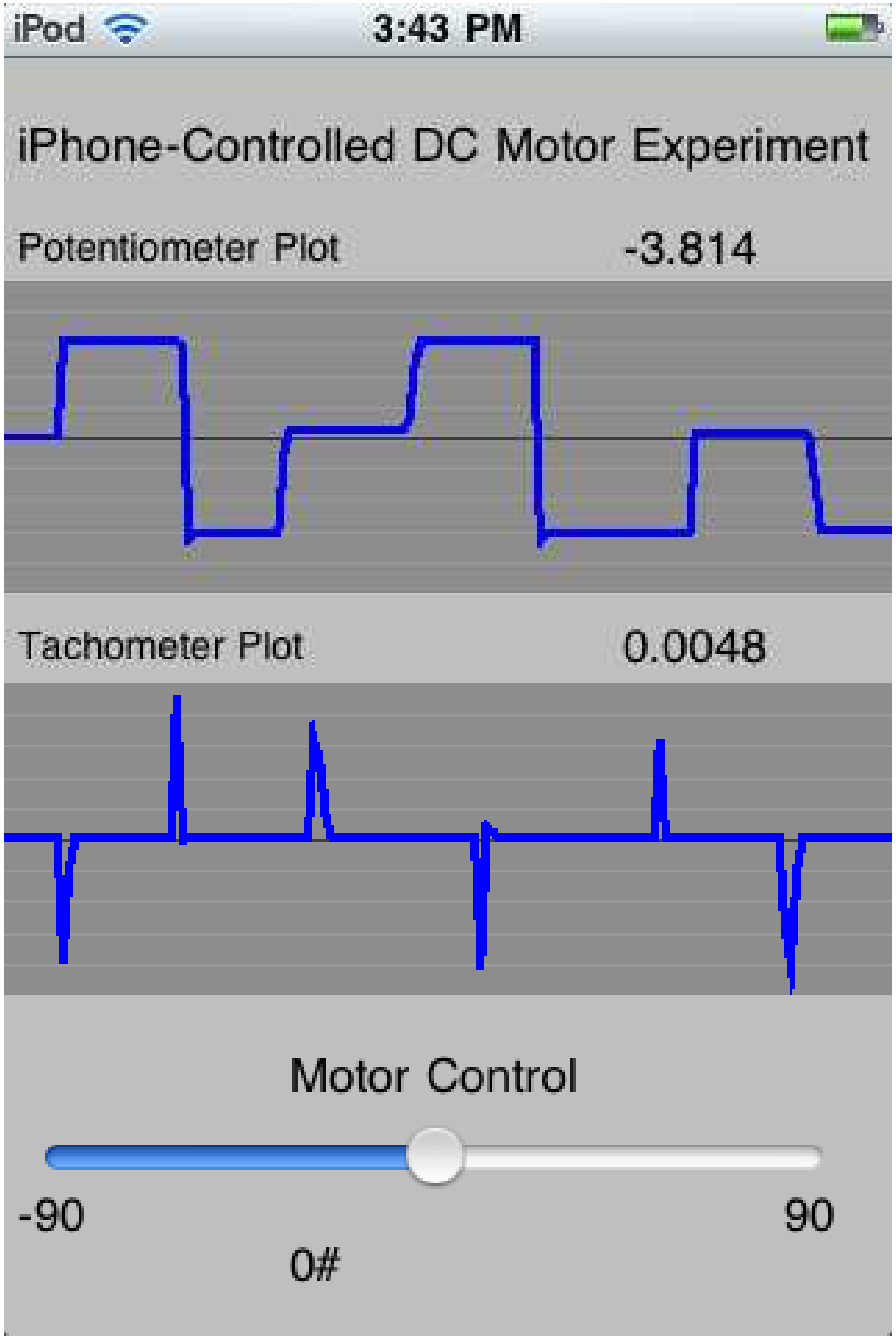


-Tradeoff between speed and reliability.

-TCP has guaranteed delivery due to flow control.

DC Motor Web Lab Experiment Video




iPod
3:43 PM
iPhone-Controlled DC Motor Experiment
Potentiometer Plot
-3.814
Tachometer Plot
0.0048
Motor Control
-90
90
0#

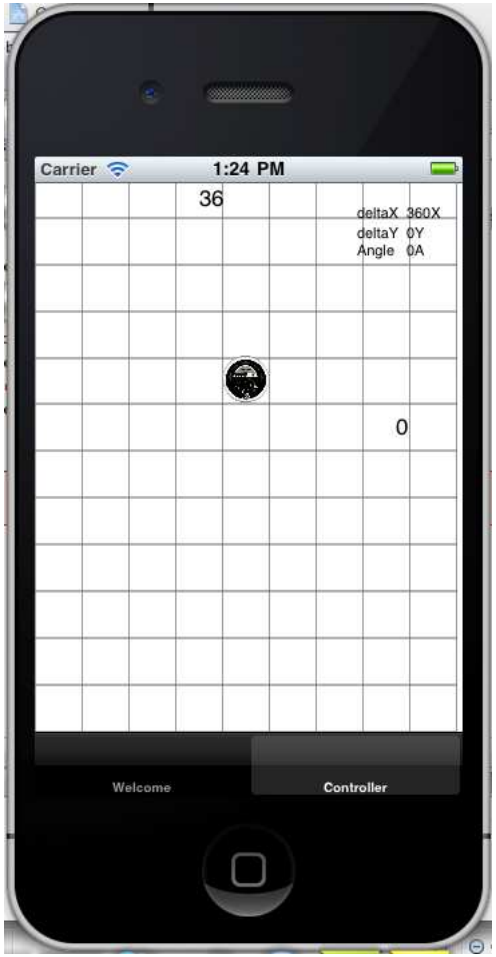
QBots

iPhone MATLAB QBot

-iPhone animation allows you to choose where on the grid you want the QBot to go.

-QBot goes to designated spot.

QBot GUI



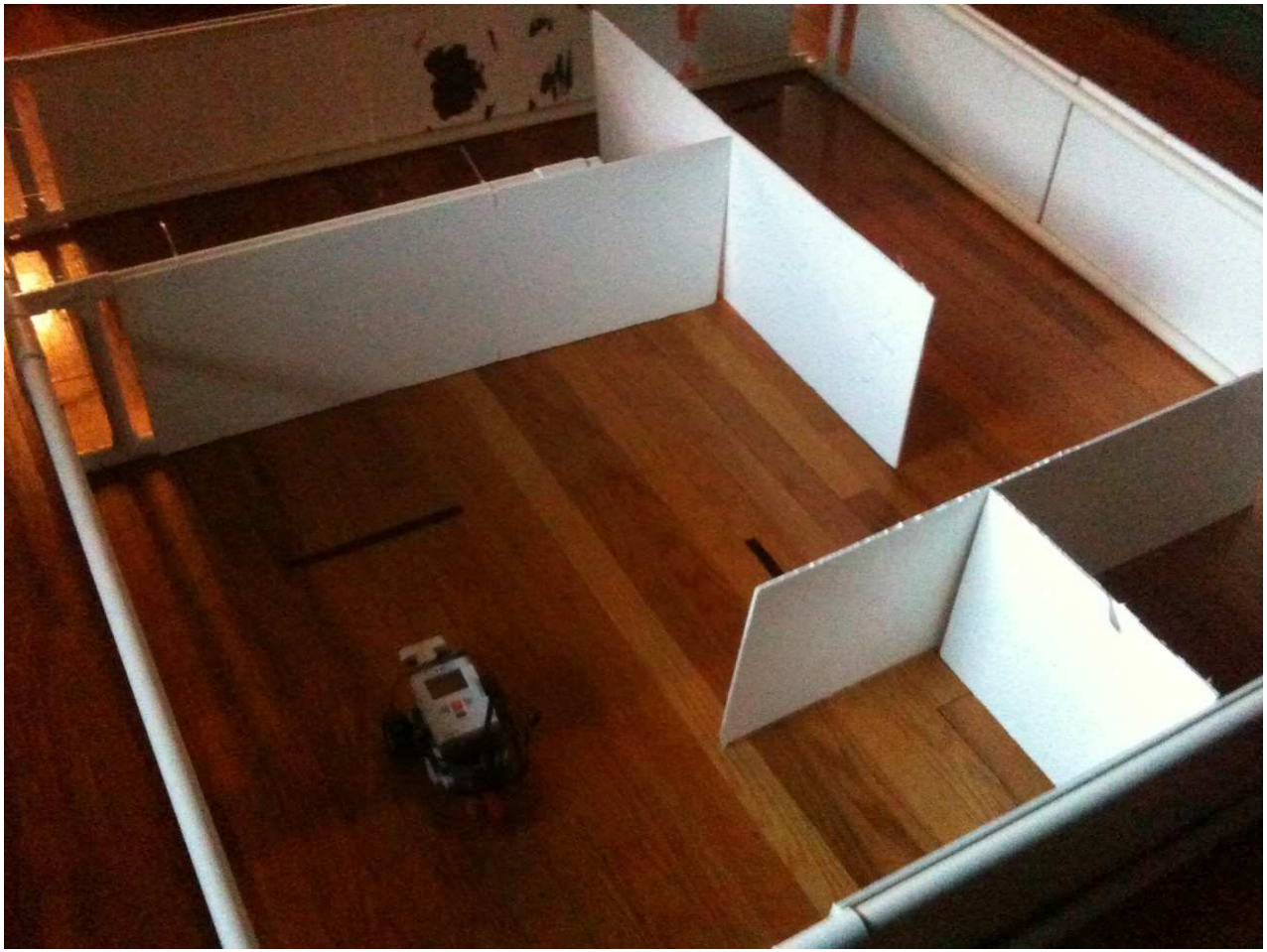
- Touch Screen Animation to control the QBot
- Calculates in which square the user touches and moves the graphic to that location
- Sends the delta x and delta y values to the robot
- Uses similar programming concepts to the Fish App
    - Rotation
    - Location translation
    - UIImage View inside an UIView

Qbots Video

“A-maze-ing Robotics”

Lesson Unit for Teach Engineering

The A-maze-ing Challenge

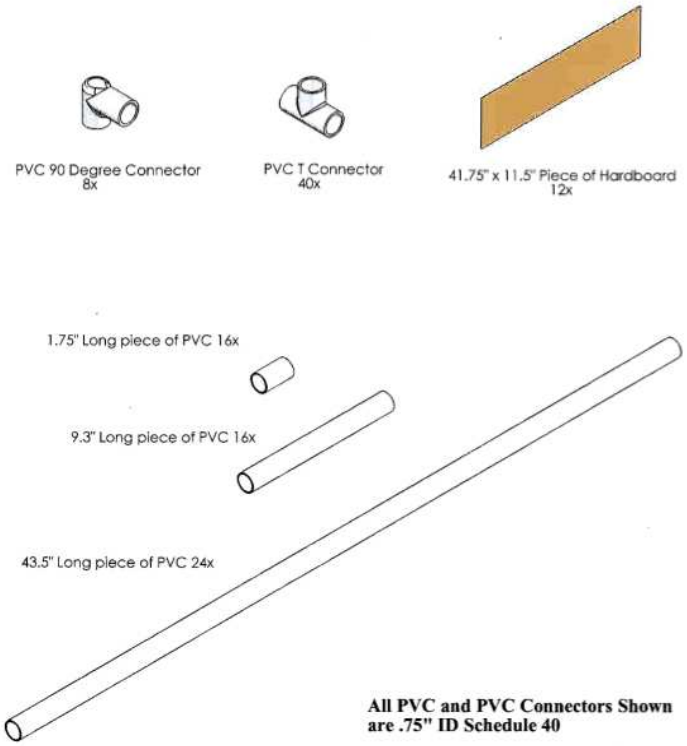


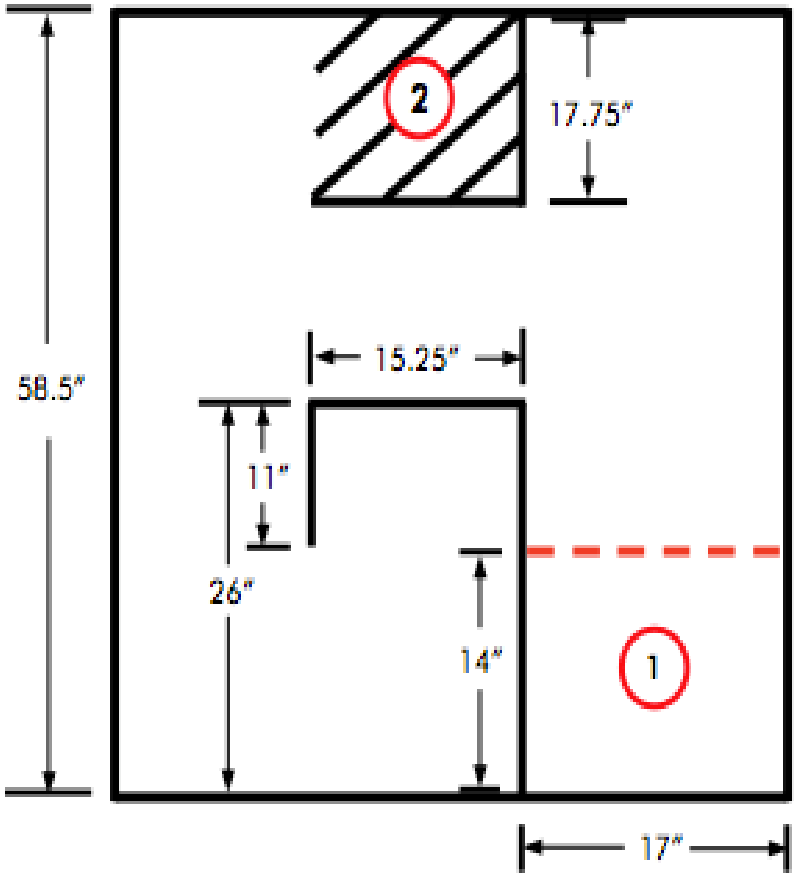
Materials

- Black electrical tape
- Ruler
- PVC piping
- 90 deg PVC
- Tee PVC
- PVC Cutter
- Foam Board
- #8 Wood Screws

- NXT Mindstorms Kit #9797

Maze Design


PVC 90 Degree Connector
8x
PVC T Connector
40x
41.75" x 11.5" Piece of Hardboard
12x
1.75" Long piece of PVC 16x
9.3" Long piece of PVC 16x
43.5" Long piece of PVC 24x
All PVC and PVC Connectors Shown
are .75" ID Schedule 40


2
17.75"
58.5"
15.25"
11"
26"
14"
1
17"

Goal

- Students learn the roles of engineers and how they use the engineering design process.
- Through the use of math and science, students demonstrate the understanding of how sensors work and its application to problem solving.

Learning Objectives

- Understand what engineers do and the process they use to solve problems
- Apply math and science skills to solve problems
- Build a robot to navigate through a maze through the use of sensor information
- Explain the advantages and limitations of different types of sensors (e.g. touch, rotation, ultrasonic, and light)

Vocabulary/Definitions

Word	Definition
Robot	A programmed machine that senses it environment, makes a decision and performs an action.
Engineering	The application of math and science to create a product or process to solve a problem amidst constraints.
Ultrasound	A sound wave with a frequency that extends the range of the human ear. (above 20 Khz)
Circumference	The distance (perimeter) around a circle. $C = 2\pi r$
Diameter	The distance of a line through the center of a circle
Radius	The distance of a line from the center of the circle to the perimeter

Unit Outline

- Introduction to Engineering
- Engineering Design Process
- iPhone Robotic Fish Research: incorporates controls, sensors, programming
- Students work in teams to build a robot
- Working in Teams (3-4): Students complete activities with various sensors: rotation, light, ultrasonic, touch
- Final Challenge: Navigate a maze using a combination of sensors. (Time Trials, Wall Avoidance)

Math/Science Application of Activities

- Activity 1: Exploring the Rotation Sensor.
  - Math concept: Distance travelled = # of wheel rotations x circumference of the wheel. $C = 2\pi r$
- Activity 2: Exploring the Light Sensor
  - Math/Engineering concept: Threshold determination. To find a threshold, compute the average of the lowest sensor value (black tape) and the highest sensor value (light colored floor).
- Activity 3: Exploring the Ultrasonic Sensor.
  - Science/Math concepts: Speed of sound (340 m/s). Ultrasound (44 Khz). Distance =The speed of sound X half the length of time it takes the wave to return.

Assessment Summary

- Robotic Design & Presentation
- Each team will present their design to the class with a PowerPoint presentation that considers the following:
- Why did you consider this particular design?
- What was the function or expertise of each member in the group?
- What type of sensors did you use and why?
- Did the robot perform as intended?
- What could you do to improve your design?