Robotic Buoy

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Discipline: Mechatronics
Acknowledgments

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The Gowanus Canal Time Line

1860’s built
1906
1911 flushing tunnel system
1960s
1987 Red Hook WPCP
1999
2010 Superfund
Combined Sewage Overflow

- Older cities use one pipe for all their sewage and runoff
- When it rains there is an overflow
- There are 14 CSO entry points into the Gowanus Canal
Gowanus Canal Water

- Dissolved Oxygen (DO)
- pH level
- Temperature
# Gowanus Canal Sediment

## TABLE 1

New York State Guidelines for Effects of Metals on Marine Organisms and the Concentration of Metals in the Sediments of Four Waterways in the Port of New York/New Jersey

<table>
<thead>
<tr>
<th>Metal</th>
<th>Lowest Effect Level</th>
<th>Severe Effect Level</th>
<th>Gowanus Canal</th>
<th>Newark Bay</th>
<th>Arthur Kill</th>
<th>Newtown Creek</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antimony</td>
<td>2.0</td>
<td>25.0</td>
<td>&lt;21</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Arsenic</td>
<td>6.0</td>
<td>33.0</td>
<td>10</td>
<td>9-17</td>
<td>17-25</td>
<td>5-33</td>
</tr>
<tr>
<td>Beryllium</td>
<td>NA</td>
<td>NA</td>
<td>1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Cadmium</td>
<td>0.6</td>
<td>9.0</td>
<td>11</td>
<td>1-2</td>
<td>1.5-3</td>
<td>1-20</td>
</tr>
<tr>
<td>Chromium</td>
<td>26.0</td>
<td>110.0</td>
<td>151</td>
<td>175</td>
<td>161</td>
<td>305</td>
</tr>
<tr>
<td>Copper</td>
<td>16.0</td>
<td>110.0</td>
<td>630</td>
<td>105-131</td>
<td>178-304</td>
<td>61-770</td>
</tr>
<tr>
<td>Lead</td>
<td>31.0</td>
<td>110.0</td>
<td>1343</td>
<td>109-136</td>
<td>111-261</td>
<td>68-554</td>
</tr>
<tr>
<td>Mercury (total)</td>
<td>0.15</td>
<td>1.3</td>
<td>3</td>
<td>2-3</td>
<td>2-4</td>
<td>1-3</td>
</tr>
<tr>
<td>Nickel</td>
<td>16.0</td>
<td>50.0</td>
<td>88</td>
<td>33-40</td>
<td>20-60</td>
<td>12-140</td>
</tr>
<tr>
<td>Selenium</td>
<td>NA</td>
<td>NA</td>
<td>2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Silver</td>
<td>1.0</td>
<td>2.2</td>
<td>21</td>
<td>2-4</td>
<td>2-5</td>
<td>2-3</td>
</tr>
<tr>
<td>Thallium</td>
<td>NA</td>
<td>NA</td>
<td>&lt;42</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Zinc</td>
<td>120.0</td>
<td>270.0</td>
<td>1130</td>
<td>188-244</td>
<td>230-403</td>
<td>104-1260</td>
</tr>
</tbody>
</table>

**Sources:**
- Audrey Massa — metal concentrations for Newark Bay, Arthur Kill, and Newtown Creek
- Robert Smith — metal concentrations for the Gowanus Canal
- N.Y.S. Department of Environmental Conservation — effect levels

NA = Not available
The Gowanus Bot

✧ Robotic Buoy
✧ Collect
✧ Send
✧ Graphic User Interface
✧ Public education
Similar Projects

✧ Emily Robot
✧ ARGO
✧ Seaperch
✧ Globe.org
Robot Frame

✧ PVC piping for floatation
✧ 4 inch diameter
✧ ½ inch diameter
✧ Plexiglas mount
Microcontroller

- Arduino UNO
- open source wiring platform
- shield design
- Inexpensive
-(void) moveLeft
{
    NSString * motorMove = [NSString stringWithFormat:@"HELLO#"];
    if (leftYN == YES)
    {
        motorMove = [NSString stringWithFormat:@"2#"];//send move left until send stop command
    }
    else
    {
        motorMove = [NSString stringWithFormat:@"2#"];//send move left while touched
    }
    NSString * address = @"192.168.1.172";
    UInt16 port = 9000;

    NSData * moveData = [motorMove dataUsingEncoding: NSUTF8StringEncoding];
    [socket sendData:moveData toHost:address port:port withTimeout:-1 tag:1];
}
Programming: Arduino

```cpp
SpiSerial.print("set ip gateway 192.168.1.152");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set ip netmask 255.255.255.0");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set ip address 192.168.1.152");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set ip local 9000");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set ip host 192.168.1.151");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set ip protocol 1");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set wlan channel 1");
SpiSerial.print(byte(13));
delay(500);
SpiSerial.print("set wlan ssid GowanusBot");
SpiSerial.print(byte(13));
delay(500);
```

```cpp
Serial.println(message);
if (message == "1#") { digitalWrite(8, HIGH); }
else if (message == "2#") { digitalWrite(3, HIGH); }
else if (message == "5#") { digitalWrite(8, LOW); }
else { digitalWrite(3, LOW); }
```
Wireless Communication

- WiFly Shield
- Cellular Shield
- UBD Protocol
- GUI sends commands
- Arduino makes decisions
Motor Design

✧ Device Controller
✧ H-Bridge
✧ SN754410
H Bridge

L293NE or SN754410

Connect to POWER to enable motor
Connect to GROUND to disable motor

Motor Logic Pin 1: 1A, 1Y
Motor Terminal 1: 2A
HEAT SINK AND GROUND
Motor Terminal 2: 3Y, 3A
Motor Logic Pin 2: 4A, 4Y
Motor Power Supply: VCC2

FUNCTION

<table>
<thead>
<tr>
<th>EN</th>
<th>1A</th>
<th>2A</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>L</td>
<td>H</td>
<td>Turn right</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>L</td>
<td>Turn left</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
<td>L</td>
<td>Fast motor stop</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>H</td>
<td>Fast motor stop</td>
</tr>
<tr>
<td>L</td>
<td>X</td>
<td>X</td>
<td>Fast motor stop</td>
</tr>
</tbody>
</table>

L = low, H = high, X = don't care
H Bridge
Graphic User Interface
Sensors

✧ Camera
✧ Temperature Sensor
✧ Dissolved Oxygen
✧ ph sensor
✧ sediment sensor (anchor)
Check List

✧ I-Device App
✧ Robot Frame
✧ Moving Robot
✧ Sensors
✧ Sending Video
Beyond Six Weeks

✧ Education App
✧ kits that students build (seaperch)
✧ database
Lesson

✧ Physics Modeling
✧ NXT Robot
Lesson

✧ Graph
✧ Share
Lesson

✧ Students Program

- velocity vs. time graph with lines labeled A, B, C, D