Outline

• Motivation
• Rat Research
• Sensors/Robot Design
  • Circuitry
• Results/Demonstration
Motivation

• NYC rat population matches City’s human population.
• Coastal flooding of NYC by Hurricane Sandy displaced rat to new inland areas.
• Public Health Issue: Rats are carriers for zoonotic viruses such as Hantavirus.
• An understanding of rat behavior is needed for educational/research purposes
Rat Research I

Normal Human Vision

Color-blind Human Vision

Normally-pigmented Rat Vision

- Visual acuity or angular resolution often measured in cycles per degree (cpd)
- A human typically has an acuity in the range of 30-50 cpd while a rat has an acuity of 1 cpd.
Rat Research II

• Warmth-seeking behavior

• Tactile sensing
  • At short-range distances, rats rely on whiskers for “visual” acuity depth perception.
  • Piloerectile muscle permit whiskers to sweep back and forth at rates of 4-12 sweeps per second
## Arduino Leonardo Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microcontroller</td>
<td>ATmega32u4</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Input Voltage (recommended)</td>
<td>7-12V</td>
</tr>
<tr>
<td>Input Voltage (limits)</td>
<td>6-20V</td>
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<tr>
<td>Digital I/O Pins</td>
<td>20</td>
</tr>
<tr>
<td>PWM Channels</td>
<td>7</td>
</tr>
<tr>
<td>Analog Input Channels</td>
<td>12</td>
</tr>
<tr>
<td>DC Current per I/O Pin</td>
<td>40 mA</td>
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<tr>
<td>DC Current for 3.3V Pin</td>
<td>50 mA</td>
</tr>
<tr>
<td>Flash Memory</td>
<td>32 KB (ATmega32u4) 4 KB used by bootloader</td>
</tr>
<tr>
<td>SRAM</td>
<td>2.5 KB (ATmega32u4)</td>
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<tr>
<td>EEPROM</td>
<td>1 KB (ATmega32u4)</td>
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<tr>
<td>Clock Speed</td>
<td>16 MHz</td>
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</tbody>
</table>
Sensors/Robot Design II

UV Circuit

Photo Resistor Circuit

5V

10 kΩ

10
Sensors/Robot Design III

Emergency Stop

10 kΩ

5V

4

LED Circuit

5, 6, 7

Servos

S

5V

10

9

Limit Switch Circuit

10 kΩ

5V

1
Sensor/Robot Design IV

Digital sensor: Tactile “Whiskers”

“Tail”

UV Diode: Warmth-seeking sensory systems

Photoresistor: Light evading “eye”
References

- Hanson, A. "What Do Rats See?“ Rat behavior and biology. 7 Dec. 2006. [18 Nov. 2013]. [http://www.ratbehavior.org/history.htm](http://www.ratbehavior.org/history.htm)
Thank You

Questions

Comments

Concerns