Introduction to BIObot Robot

By Abraham Howell

BINGHAMTON UNIVERSITY
State University of New York

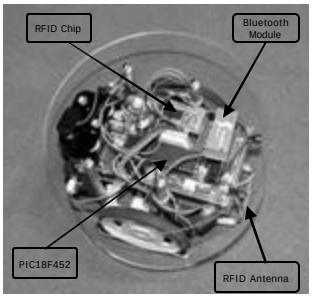
Outline

- Introduce BIObot
- Discuss How to Program & Control BIObot
- Demonstrate How to Bluetooth Pair with BIObot and Control Using HyperTerminal
- Introduce & Demo Manual Control GUI
- Examine Manual Control GUI Source Code

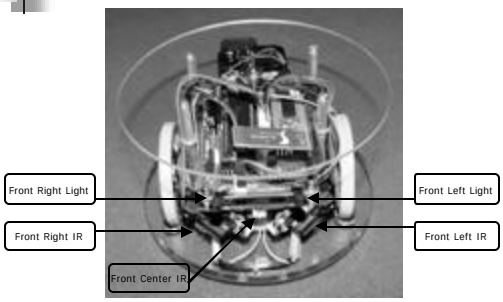
BIObot's Specifications

- **A**utonomous ro**B**ot controll**E**r, A.B.E., is the "heart and brains" of BIObot. A specially designed firmware resides in the PIC18F452 so that BIObot can be controlled using simple asynchronous serial commands (ASCII Chars).
- (5)–Infrared (IR) Sensors, (2)–Light Sensors, and (2)–Low cost quadrature wheel encoders.
- Read/write passive Radio Frequency Identification (RFID) tags.
- Extended digital I/O and I_2C is available for the connection of additional sensors.

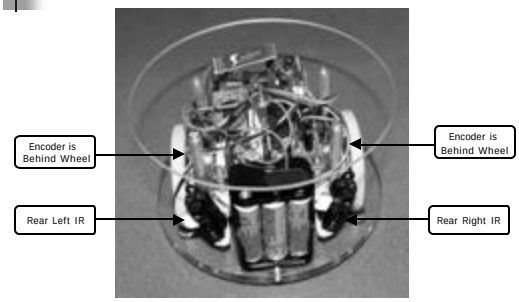
BIObot Robot



BIObot Front View

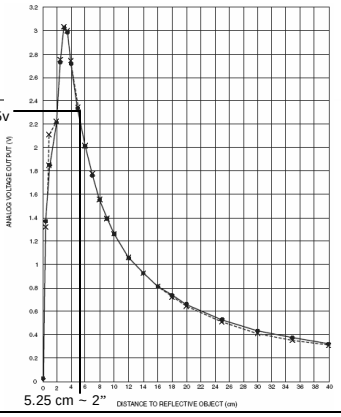


BIObot Rear View



Sharp GP2D120 IR Sensor

- Capable of sensing objects 1.5"-12" away.
- Returns a varying output voltage 0-5 volts.
- PIC's analog to digital (A/D) hardware converts output voltage to an 8-bit number.
- This 8-bit number can be correlated to a detection distance in inches, feet, cm, m, etc…



- A/D Value = 120
- V_{out} = 120*5v/255
- V_{out} = 2.35v

Light Sensors

- Consist of a cadmium sulfide (CDS) cell placed into a voltage divider with an appropriately sized second resistor.
- Output of voltage divider returns 0-5 volts and is converted to an 8-bit number using PIC's A/D hardware.
- A larger 8-bit value corresponds to bright light, while smaller values indicate dark conditions.
- Can be used for light tracking or avoidance behaviors.

Battery Voltage Circuit

- Output from battery pack is connected to a voltage divider with approriately sized resistors so that the battery voltage is mapped to the range of 0-5 volts.
- PIC's A/D hardware converts this to an 8-bit value.

- V_{in} = (8-bit A/D value)*(7.4k*5v) / (2.7k*255)
- Recharge batteries if voltage falls below 6.90 volts (128).

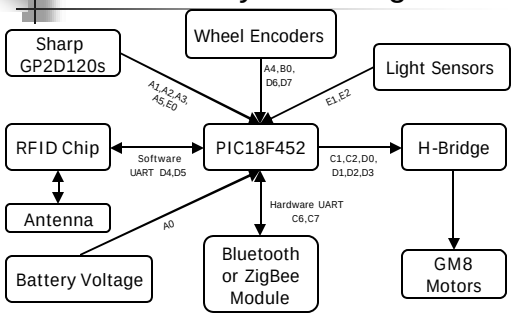
WW02 Encoders

- Provide two 0-5 volt signals; a 25us clock and direction signal which are captured by the PIC.
- There are a total of 128 encoder transitions per wheel rotation and the wheel diameter is 2.621".
- PIC uses this information to perform Proportional, Integral, and Derivative (PID) position and velocity control.

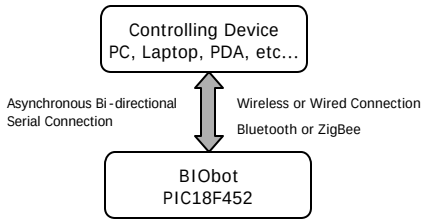
RFID Module

- PIC communicates with RFID module using a software UART.
- Read/Write 125 KHz Passive Tags. Read range is about 0 - 4".
- Tag contains a total of eight 4-byte storage blocks.
- Only block# 's 3, 4, 5, 6, and 7 can be used to store data.
- Currently, BIObot only reads/writes block#3.
- Example: Write –> "abcd" then Read –> "61626364"

Controller System Diagram



Communication



Programming/Control

- BIObot's PIC18F452 can be programmed directly using any compatible PIC compiler: PICBasic, MPASM, CCS C, CH Flash Basic, HI-TECH C, etc…
- Or can be controlled wirelessly using any programming tool that supports asynchronous serial communication: Visual Basic & C#.NET 2.0, Java, MatLab, C, C++, Mathematica, Python, etc…
- I've created several libraries that encapsulate all the robot's functionality and these can be leveraged in user created programs.

ASCII Firmware Commands

- Get AD Readings: "A"
- Get Encoder Readings: "E"
- Get Reflex Levels: "F"
- Get Position PID Gains: "GP"
- Get RFID Reading: "T"
- Get Velocity PID Gains: "GV"
- Get Wheel Velocities: "V"
- Get Digital Pin Reading: "L"+PIN#
- Is Sensor Reflex Triggered: "B"
- Is Move Complete: "D"
- Move To Position: "MP"+LW+RW
- Reset Triggered Sensor Reflex: "R"
- Save Parameters to EEPROM: "Y"
- Set Baud Rate: "O"+8-Bit#
- Set Closed Loop Velocity: "MV"+LW+RW
- Set AD Reflex Level: "N"+8-Bit#
- Set Digital Pin High: "K"+PIN#
- Set Digital Pin Low: "J"+PIN#
- Set Light Reflex Level: "N"+8-Bit#
- Set Sensor Reflexes: "I"+8-Bit#
- Set Open Loop Velocity: "MO"+LW+RW
- Set Position PID Gains: "P"+Kp+Ki+Kd
- Set Velocity PID Gains: "Q"+ Kp+Ki+Kd
- Stop Agent: "H"
- Write RFID Data: "W"+DATA

***All Commands must be followed by a line-feed "\r"**

Configure HyperTerminal

Configure HyperTerminal

Give connection a name

Select appropriate COM Port

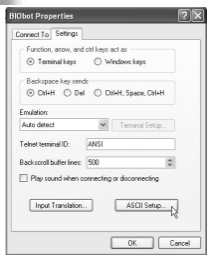
(Machine Specific)

Configure HyperTerminal

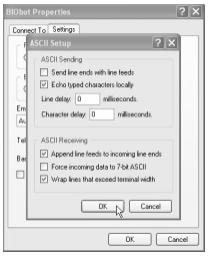
Configure COM Port

Select Properties

Configure HyperTerminal



Select Settings Tab



Configure connection settings

Configure HyperTerminal

Exit Settings

Open connection

Demo HyperTerminal and Manual Control Center Software

Questions?