Introduction to BIObot Robot

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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
- **Autonomous robot controller, 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 Chrs).
- (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 I2C 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...

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 appropriately 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.

\[ V_{in} = \frac{(8\text{-bit } A/D \text{ value})*(7.4k\Omega*5\text{v})}{(2.7k\Omega*255)} \]
- 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# 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**

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Controller System Diagram

Sharp GP2D120s

RFID Chip
Software UART D4,D5

PIC18F452

Light Sensors

Wheel Encoders

H-Bridge

Antenna

Battery Voltage

Bluetooth or ZigBee Module

GM8 Motors
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**Communication**

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Communication

Controlling Device
PC, Laptop, PDA, etc

Asynchronous Bi-directional Serial Connection

Wireless or Wired Connection

Bluetooth or ZigBee

BIObot PIC18F452
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**Programming/Control**

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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.
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**ASCII Firmware Commands**

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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”
- Set Baud Rate: “O”+8-Bit#
- Set Closed Loop Velocity: “MV”+LW+RW
- Set AD Reflex Level: “A”+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”+PIN#
- 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”*
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**Configure HyperTerminal**

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Configure HyperTerminal

Give connection a name

Select appropriate COM Port
(Machine Specific)
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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?