Remote Robot Arm Manipulation

Mechatronics Presentation

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Presentation Outline

- Applications
- Advantages
- Project Specifications
- Hardware
- Software
- Block Layout
- Economic Analysis
- Conclusion
Applications

- Hazardous Material
- Security (moving remote cameras)
- Medical Applications
- Undersea / Space Exploration
Advantages

- Works on any Local Area Network
- Can be extended globally across the internet
- Can be extended to wireless (802.11)
- Can be controlled by anyone with a PC or with a joystick and small program
Project Specifications

- **Microcontroller**
  - BS2p40
  - 32 I/O pins

- **Embedded Ethernet Controller**
  - 10baseT Ethernet connection (10Mb)
  - 16 pins

- **User Interface**
  - USB Joystick
  - Graphical Display of Joystick Values (C++ MFC program)
  - Web-based control using VBScript and Web cam
Project Specifications continued

- **Robot Arm**
  - Three Degrees of Freedom
  - DC Motors
  - Constructed using LEGO Mindstorms components

- **Motor Control**
  - Full H-Bridges Constructed using MOSFETs and BJTs
  - Inverter Circuits
  - Diodes for protection against inductive kickback
Robot Arm – Base
Robot Arm - Joint
Robot Arm – Gripper
Motor Control
Motor Control

BJT Full H-Bridge

MOSFET Full H-Bridge
Motor Control

Inverter
Embedded Ethernet Controller
Joystick

Close Gripper

Open Gripper
C++ Code Sample – Checking Values

```cpp
float x_right_threshold = 50000;
float x_left_threshold = 15000;
if (ji.dwXpos > x_right_threshold)
{
    packetize(0);
}

if (ji.dwXpos < x_left_threshold)
{
    packetize(1);
}
```
```cpp
int packetize(int action) {

    short command;
    struct sockaddr_in sin;
    WSADATA wsaData;
    SOCKET s;

    if(action == 0)  // right
        command = htons(29184);  // htons converts to big Endian

    if(action == 1)  // left
        command = htons(27648);

    sin.sin_addr.S_un.S_addr = inet_addr("192.168.0.2");  // Embedded Ethernet's IP address
    sin.sin_family = AF_INET;
    sin.sin_port = htons(1000);  // The port that the Basic Stamp program is listening on
    s = socket(AF_INET, SOCK_DGRAM, 0);

    send(s, (const char *) &command, 2, 0);  // Send the two byte (16 bit) value to the Basic Stamp
    closesocket(s);
```
PBasic Code Sample – Reading Packets

recvWord:
  addr = portRxTxData  'Receive/Transmit data (port 0)
gosub ioRead     'dataH var dataW.highbyte
dataH = value
  addr = portRxTxData+1
  gosub ioRead
  dataL = value
  return

---------------------------------------------------------------------

ioRead:
  dirh = 0            'make data bus input (pins 8-15 connected to data pins on ethernet chip)
  addrBusOut = addr   'addrBusOut var outa (pin 0-3 which are address bus)
  low    aen
  low    rd          'set to read mode
  value = dataBusIn   'save the value on the databus to variable "value"
  high   rd          'disable read mode
  high   aen        'address disable
  return
PBasic Code Sample – Checking Values and Pulsing Motors

for i = 0 to 4
  gosub recvWord
  debug HEX4 dataW, " 
  if dataW = $7200 then right
  if dataW = $6C00 then left
  if dataW = $7500 then up
  if dataW = $6400 then down
  if dataW = $6100 then grip
  if dataW = $6F00 then open
  if dataW = $6300 then close
  if dataW = $7700 then loon 'lights on
  if dataW = $7300 then loff 'lights off

right:
  debug "RIGHT"
  auxio
  high 14
  low 15
  pause 200
  low 14
  mainio
  goto checkend

left:
  debug "LEFT"
  auxio
  high 15
  low 14
  pause 200
  low 15
  mainio
  goto checkend
VBScript Code

<SCRIPT FOR="left" EVENT="onClick" LANGUAGE="VBScript">

Dim xProtocols
Dim xProtocol

Set xProtocols = CreateObject( "XceedSoftware.XceedWinsock.Protocols.1"
Set xProtocol = xProtocols.GetProtocol( 2, 0, 17 )

Dim xSocket
Dim xSocketFactory

Set xSocketFactory = CreateObject( "XceedSoftware.XceedWinsock.SocketFactory.1" )
Set xSocket = xSocketFactory.CreateConnectionlessSocket( xProtocol, 0 )

Dim xAddress

Set xAddress = CreateObject( "XceedSoftware.XceedWinsock.InetAddress.1" )
xAddress.SetAddressString( "192.168.0.2:1000" )

Call xSocket.SendBytesTo( xAddress, "left", 0 )

</SCRIPT>
## Economic Analysis

<table>
<thead>
<tr>
<th>Item</th>
<th>Retail Price (USD)</th>
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<tbody>
<tr>
<td>Embedded Ethernet Controller</td>
<td>75.00</td>
</tr>
<tr>
<td>BS2p40 Kit</td>
<td>190.00</td>
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<tr>
<td>Transistors</td>
<td>25.00</td>
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<tr>
<td>Joystick</td>
<td>30.00</td>
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<tr>
<td>Power Supplies</td>
<td>20.00</td>
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<tr>
<td>Web Camera</td>
<td>100.00</td>
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Total Cost for Prototype: $440.00
Conclusion

• Prototype was successful

• Improvements
  - Feedback on Gripper
  - Pulse Width Modulation on Motors
  - 555 Timers (move in more than one direction at the same time)