Remote Robot Arm Manipulation

Mechatronics Presentation

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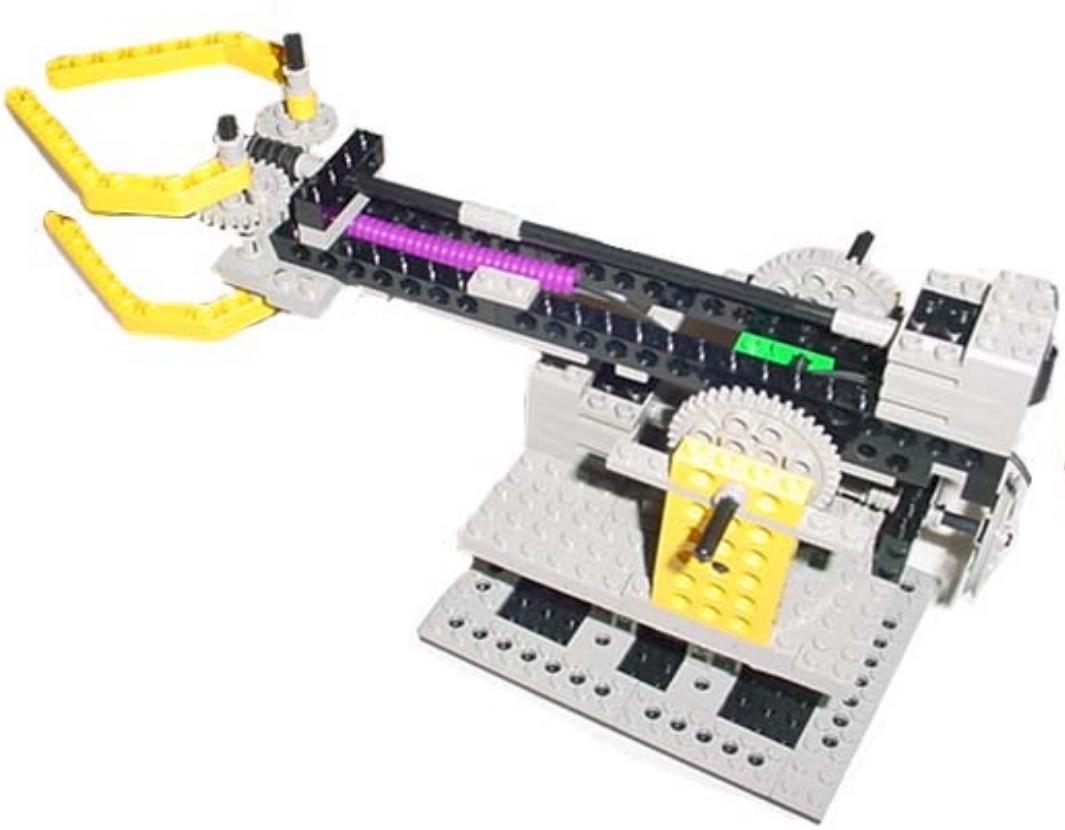
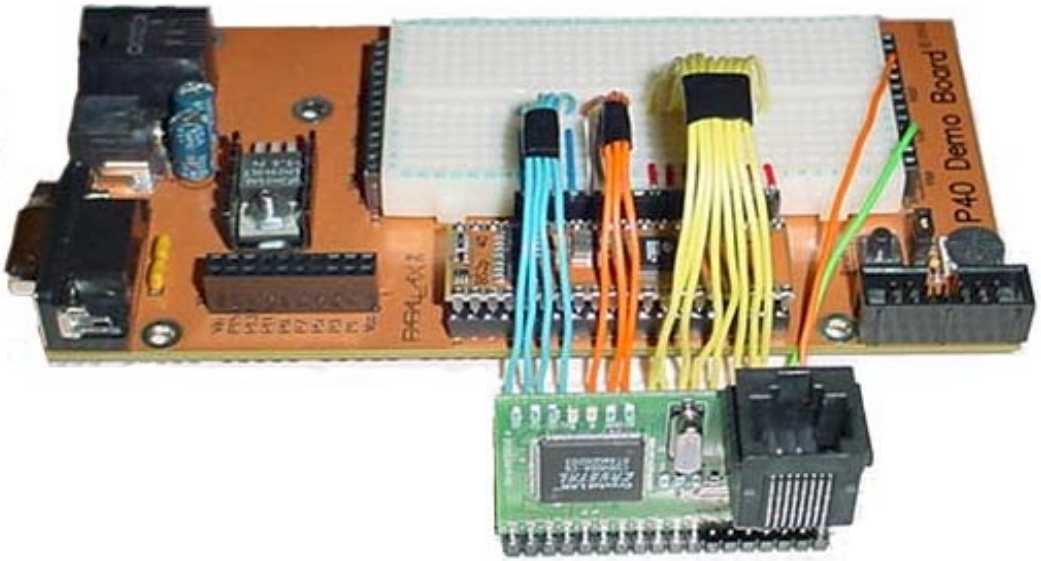




Presentation Outline

- 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

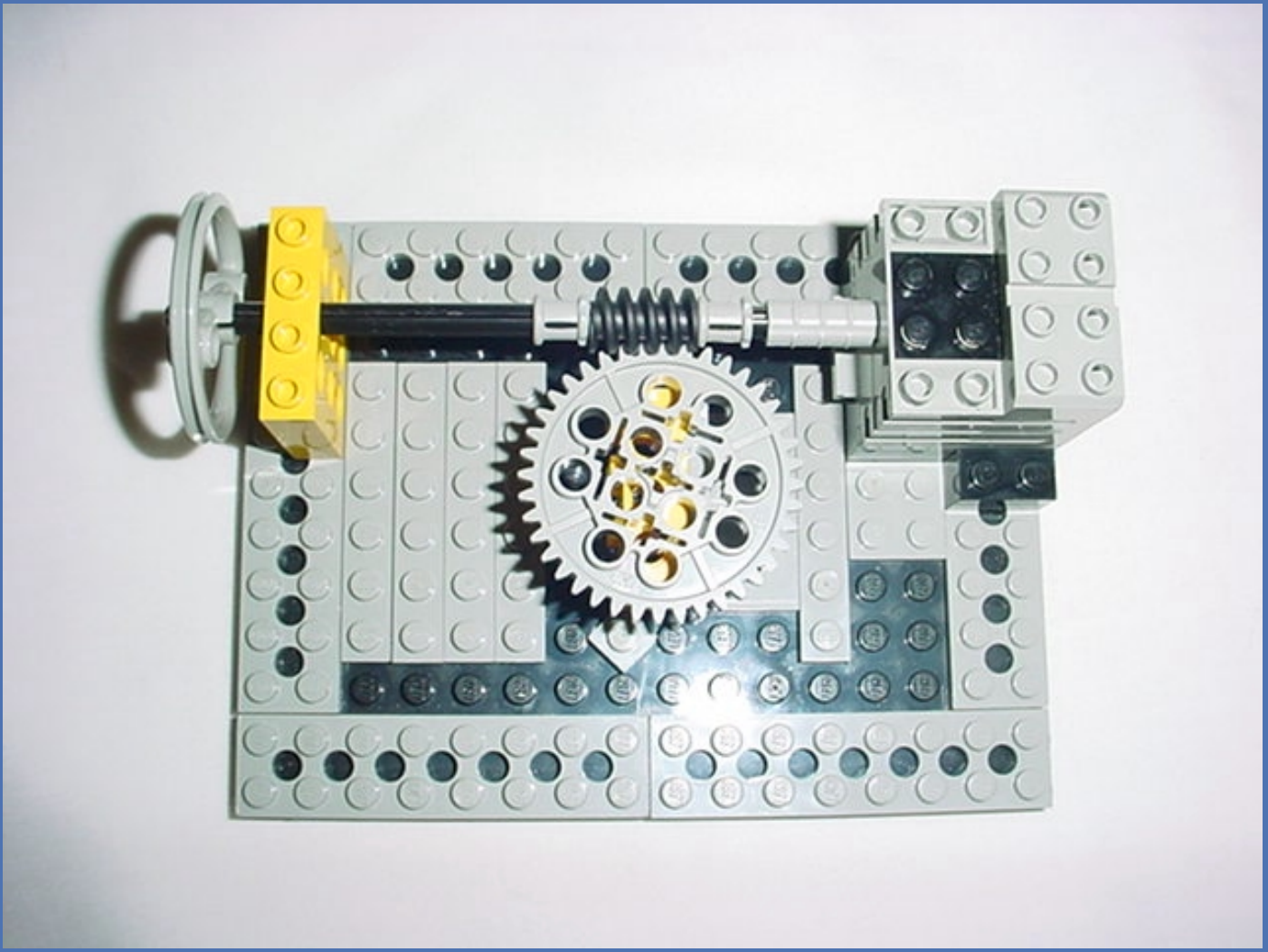
Project Specifications

- **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

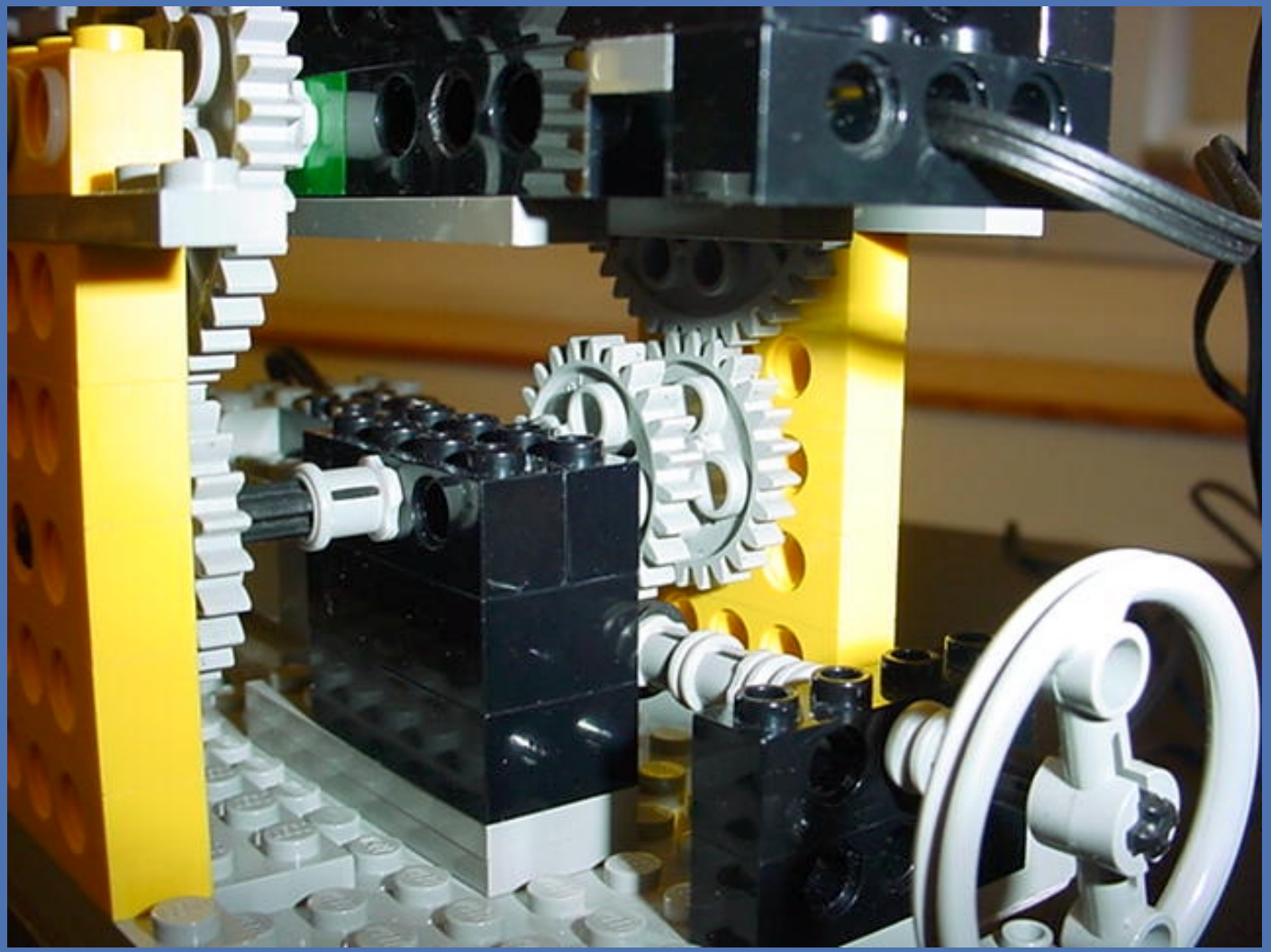
Project Specifications continued

- **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

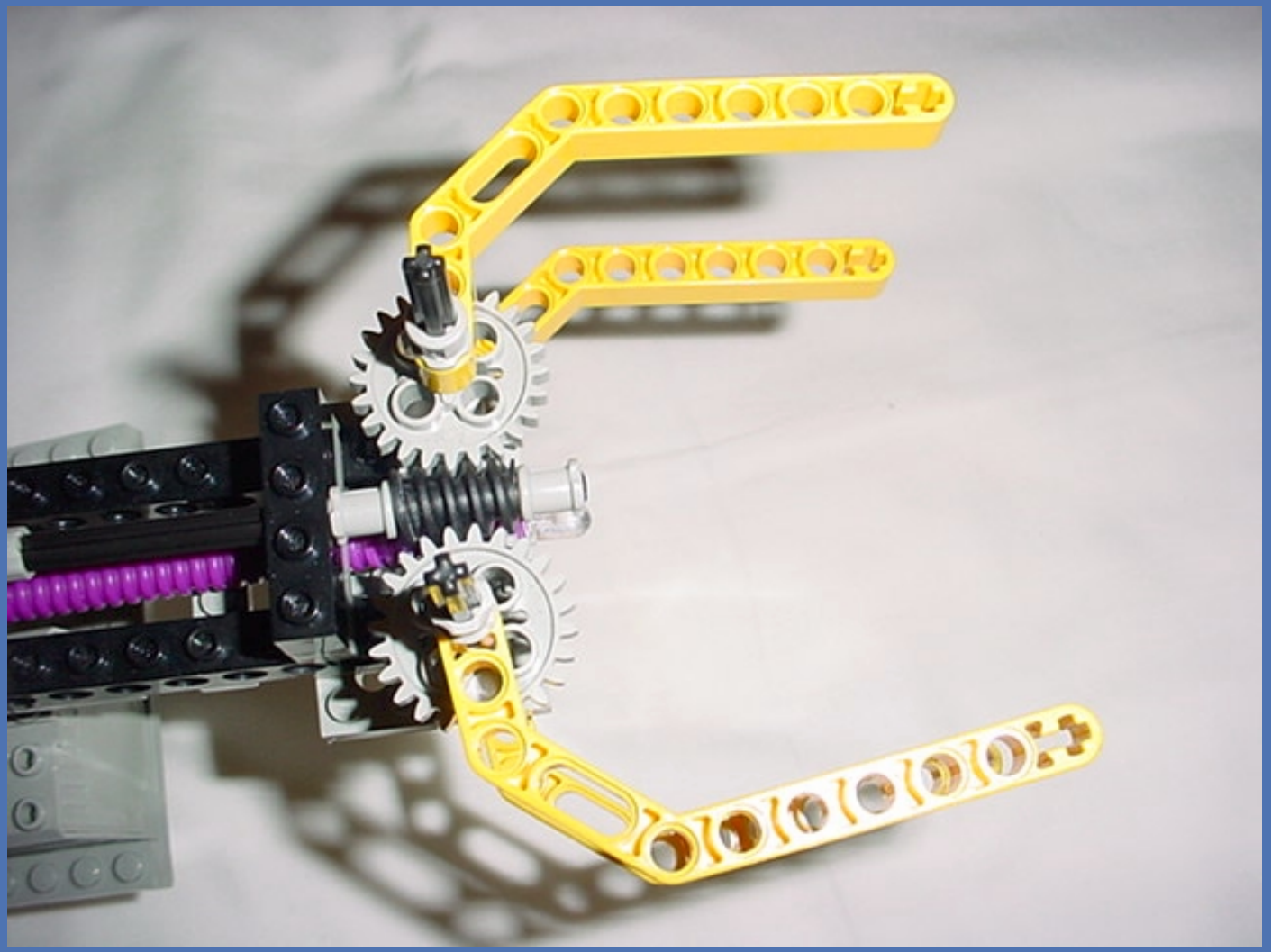
Robot Arm – Base



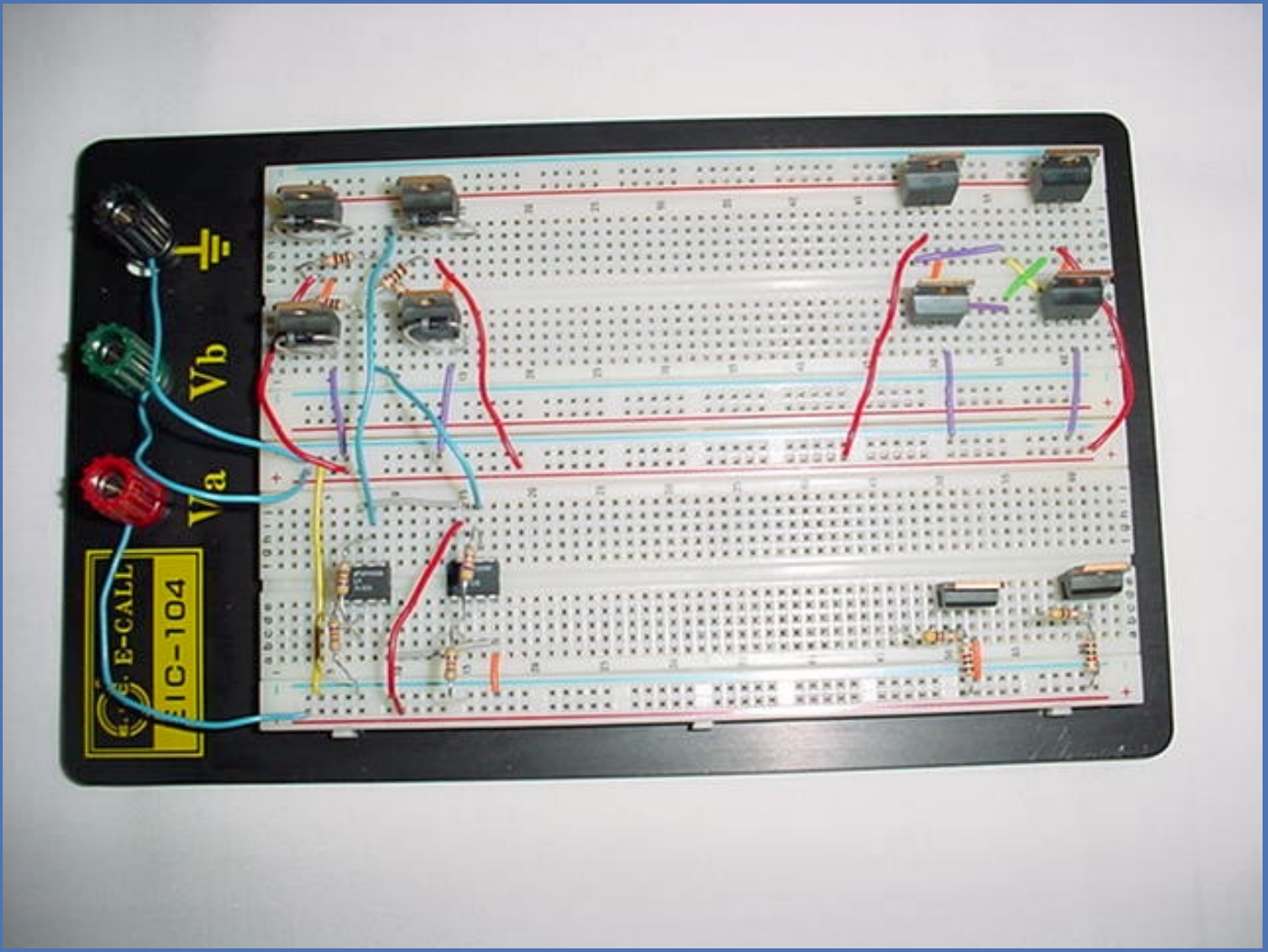
Robot Arm - Joint



Robot Arm – Gripper

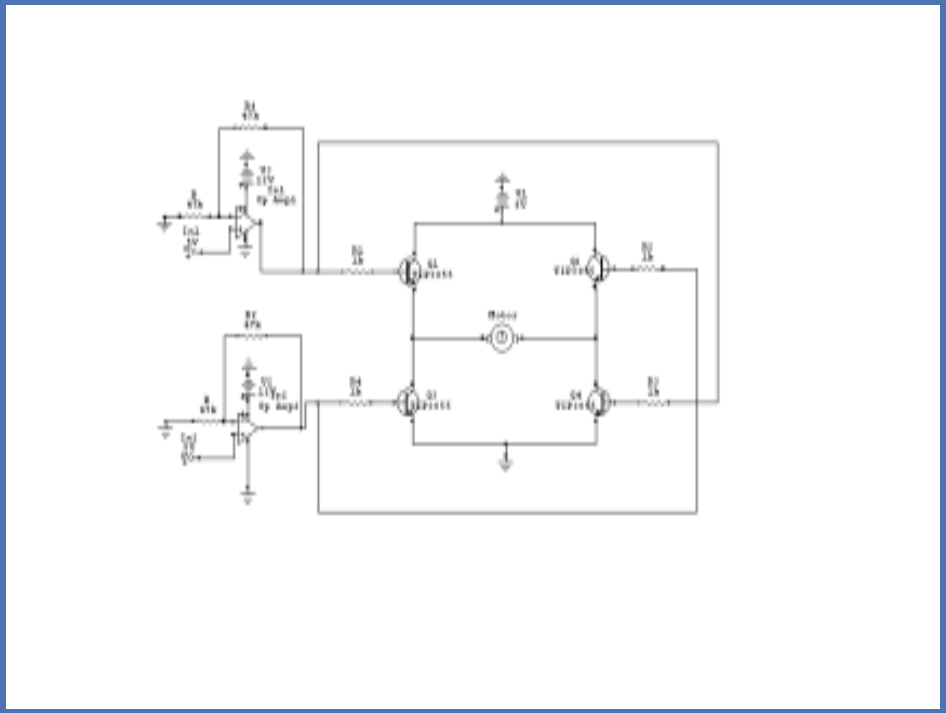


Motor Control

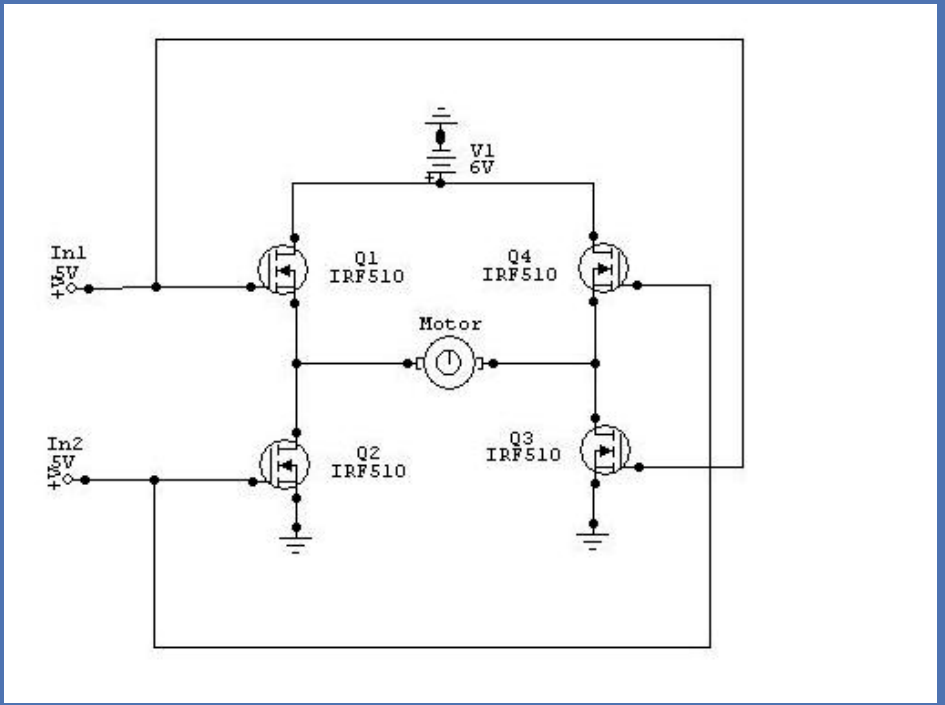


Motor Control

BJT Full H-Bridge

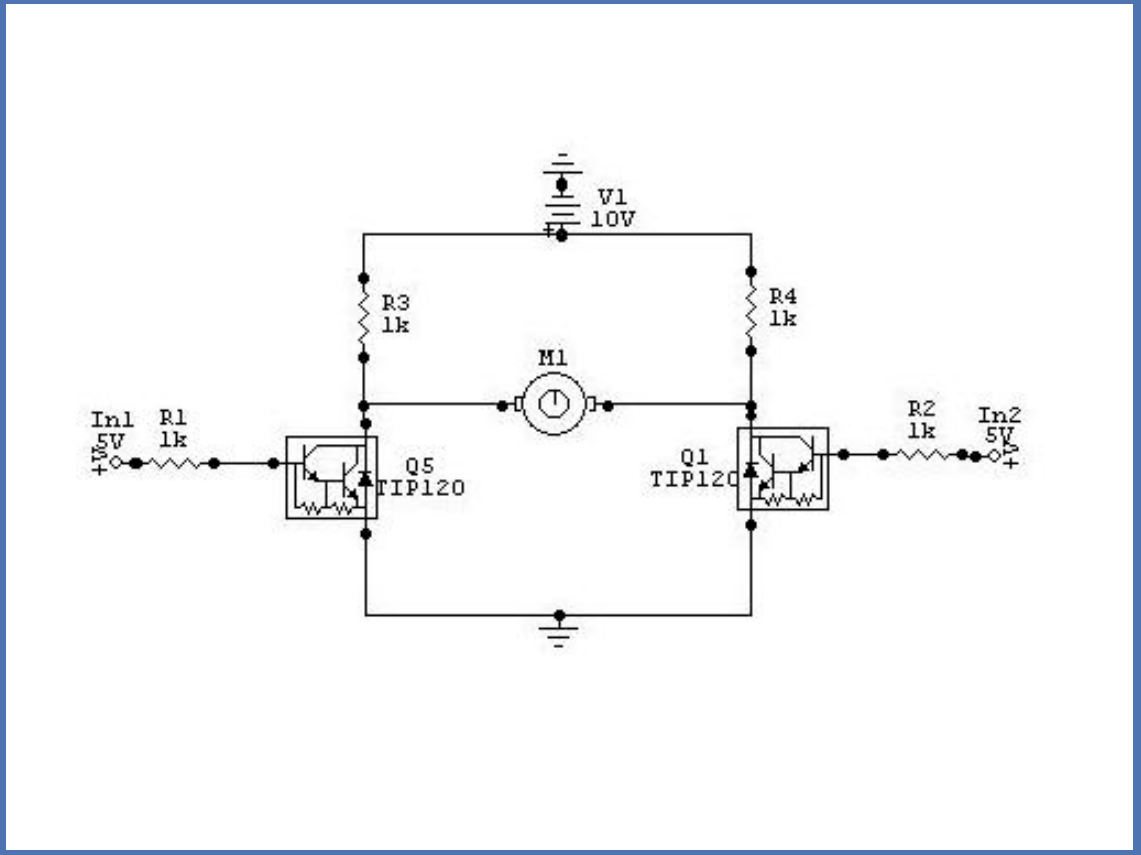


MOSFET Full H-Bridge

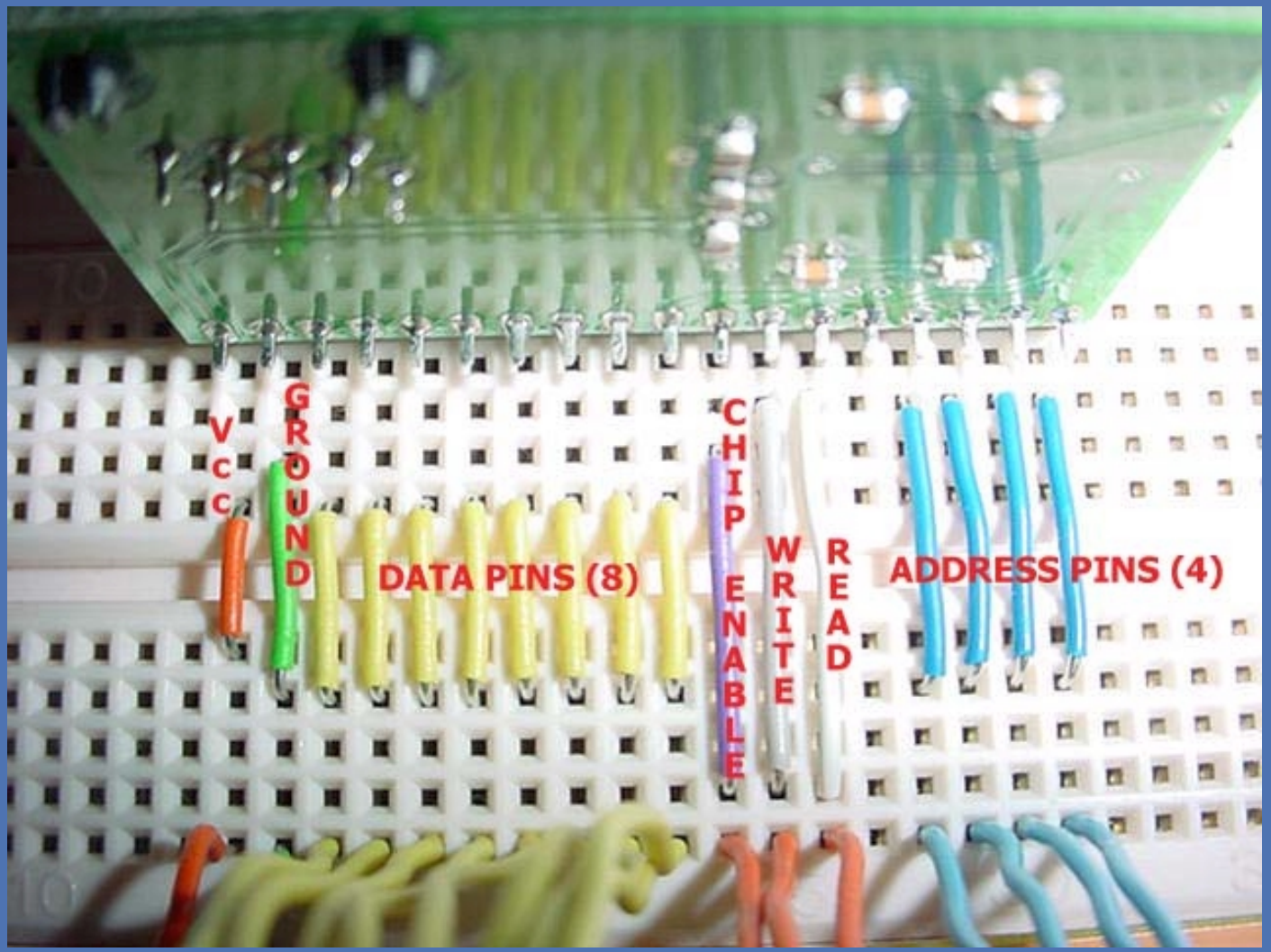


Motor Control

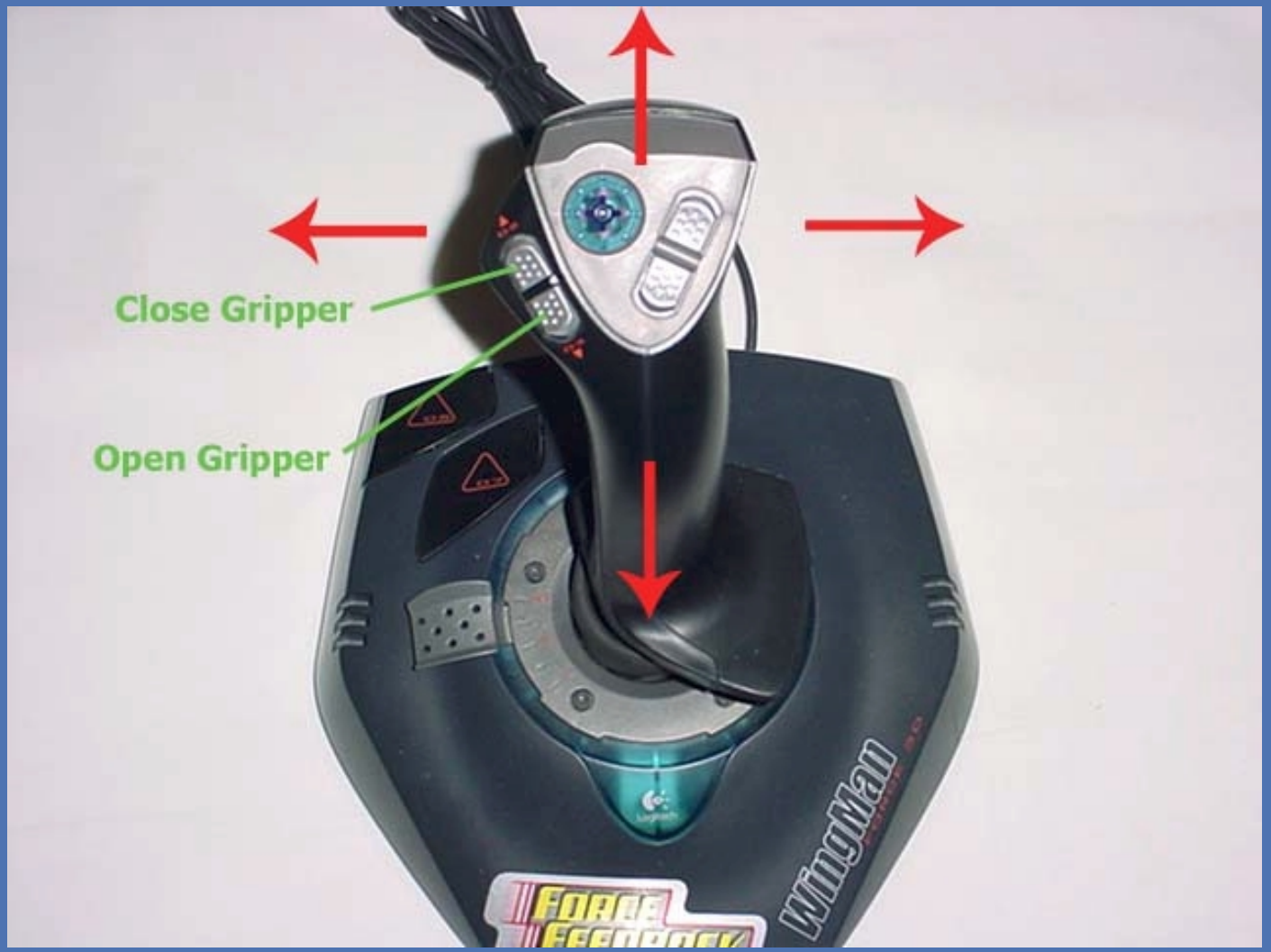
Inverter



Embedded Ethernet Controller



Joystick



C++ Code Sample – Checking Values

```
float x_right_threshhold = 50000;
float x_left_threshhold = 15000;
if (ji.dwXpos > x_right_threshhold)
{
    packetize(0);
}

if (ji.dwXpos < x_left_threshhold)
{
    packetize(1);
}
```

C++ Code Sample - Packetize

```
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             'address enable
                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
```

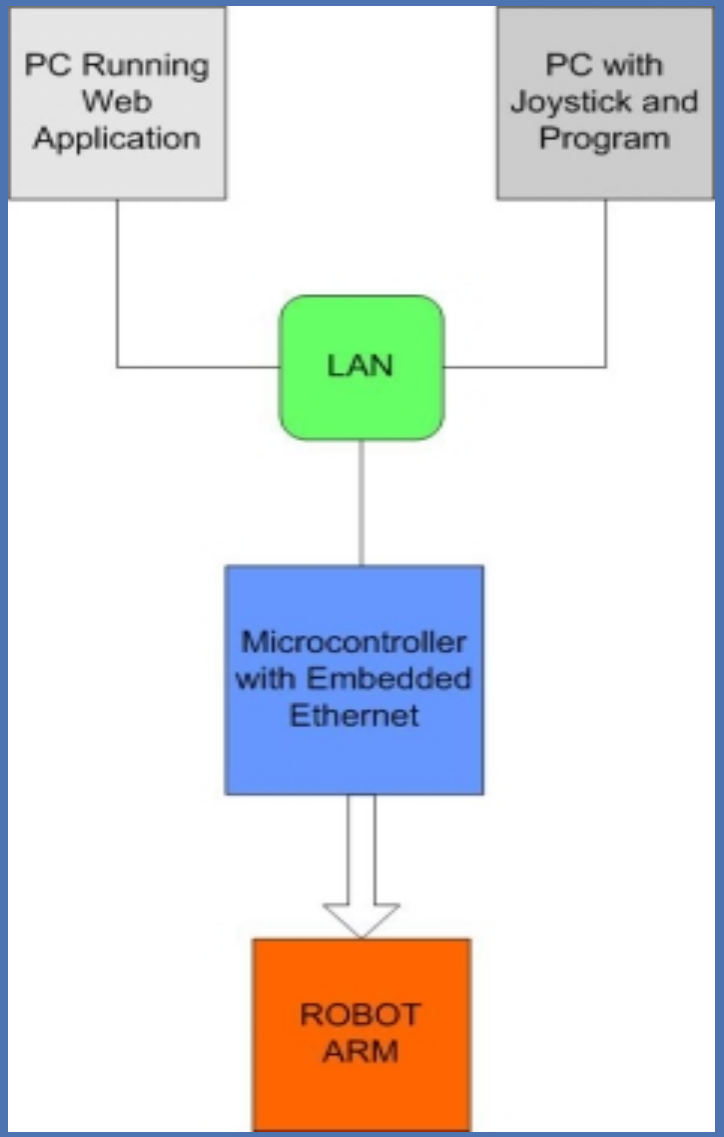
PBasic Code Sample – Checking Values and Pulsing Motors

```
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 lon   '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>
```

Block Layout



Economic Analysis

	Retail Price (USD)
Embedded Ethernet Controller	75.00
BS2p40 Kit	190.00
Transistors	25.00
Joystick	30.00
Power Supplies	20.00
Web Camera	100.00

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)