Web-Controlled Boe-Bot

Installation Instructions

VERSION 1.0

PARALLAX

2

Web-Controlled Boe-Bot

This document shows how to set up a web-controlled Boe-Bot. This document is specific to the hardware and software used at Parallax to set up this system, and is not a complete discussion of internet control or wireless control in general.

The Boe-Bot can be controlled over the Internet. It is a standard Parallax Boe-Bot with a wireless video camera and a wireless RF receiver mounted on it. The Boe-Bot can be driven around from a web browser, and video of its surroundings seen in the web browser. A screen shot of the web browser, with command entry and video output, is shown below. In this shot, it seems the Boe-Bot has encountered a dog.
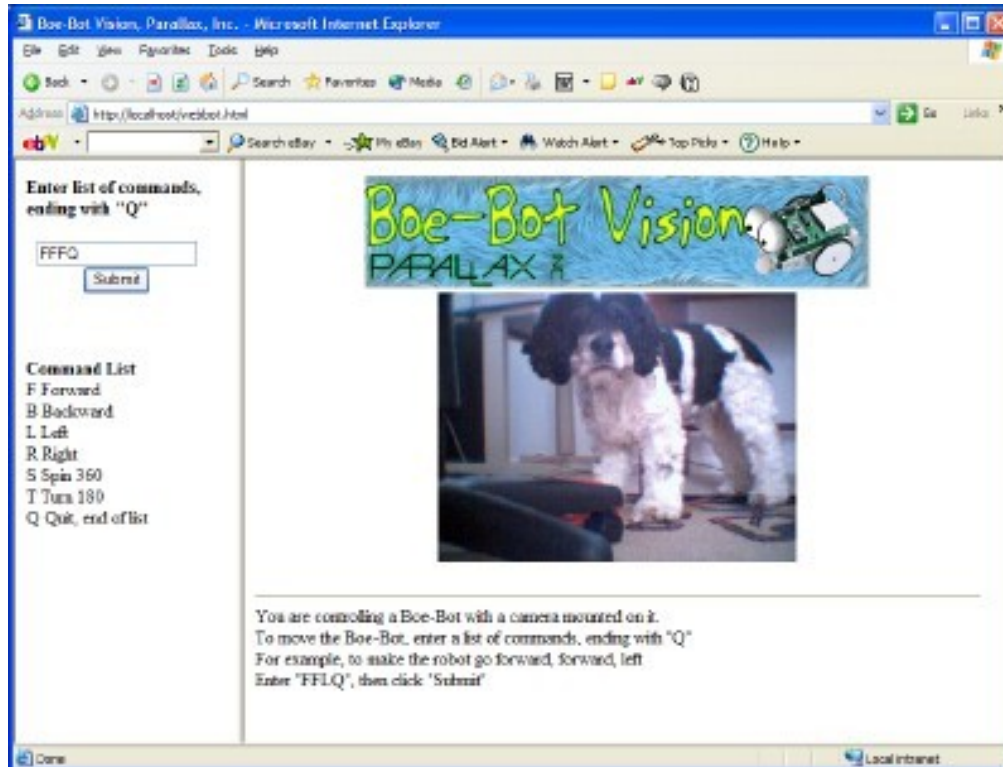

Figure 1-1: Web browser view of web-controlled Boe-Bot

OVERVIEW

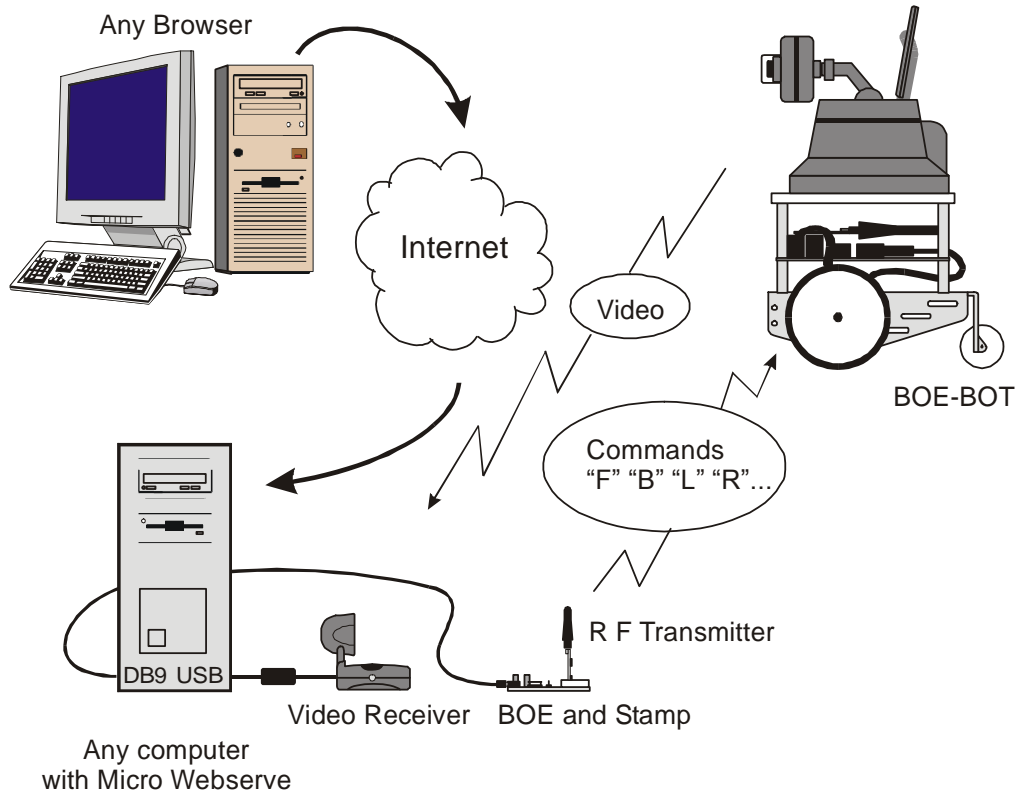An overview of the system is shown below.

Figure 1-2: Overview of web-controlled Boe-Bot.

Internet control is achieved by installing Micro Webserv on a computer. Micro Webserv is a web server program specifically designed to interface with the BASIC stamp. Micro Webserv receives the commands typed in any browser, and communicates them to a BASIC Stamp. This Stamp then re-transmits the commands out to the Boe-Bot via a RF transmitter. The Boe-Bot receives the commands with its matching RF receiver, and

executes the commands. The Boe-Bot is completely wireless, not tethered to the computer, for maximum mobility.

To transmit images, a wireless video camera, transmitter, and receiver are set up as a wireless web cam. Web cam software is used to transmit the image back to any web browser.

PARTS LIST

Table 1-1: Parts List		
Parallax Part #	**Description**	**Qty**
27995	RF Receiver	1
27996	RF Transmitter	1
28102	BOE and BS2	1
28132	Complete Boe-Bot including BOE and BS2	1
N/A	X-10 Wireless Video Camera, Transmitter, and Receiver	1
N/A	X-10 Camera Battery Pack	1
N/A	X-10 VA110A Video to USB Adapter	1
N/A	WebCam 32 web cam Software, Surveryor Corp	1
27907	Micro WebServ software, CSMicro Systems	1
	Mounting plate, standoffs, etc.	

FILES NEEDED

Table 1-2: Files Needed		
Filename	**Location/Loaded into**	**Description**
Boe-Bot Mult Command.bs2	Boe-Bot	Stamp Program
Control via Web.bs2	BOE with RF Transmitter	Stamp Program
webbot.html	C:\MicroWebServ\www\http	Main Web Page
camera.html	C:\MicroWebServ\www\http	Camera Image frame
mws_command6.html	C:\MicroWebServ\www\http	Command entry frame
boe_bot_vision.gif	C:\MicroWebServ\www\http	graphic

ACTIVITY #1: IDENTIFY COM PORT

√ Run the BASIC Stamp Editor
√ From the menu, select Run | Identify
√ Note the COM port that the BASIC Stamp is using
For example, in Figure 1-3, the Stamp is using COM1

√   Make a note of it. It will be needed when configuring Micro WebServ software
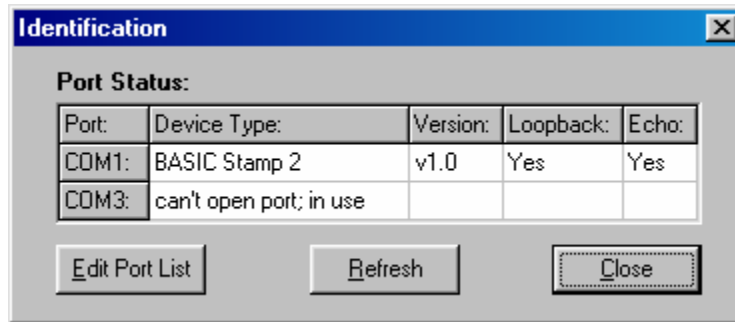

Figure 1-3: Identifying the COM Port

ACTIVITY #2: BUILD THE BOE-BOT RF RECEIVER CIRCUIT

Parts Required

 (1) RF Receiver, Parallax part number 27995
 (1) Boe-Bot

Building the RF Receiver Circuit

Plug the RF receiver into the breadboard on the Boe-Bot, as shown in Figure 1-3. One side of the RF receiver is labeled. Place the RF receiver module into the breadboard so the labeling is facing the BASIC Stamp.
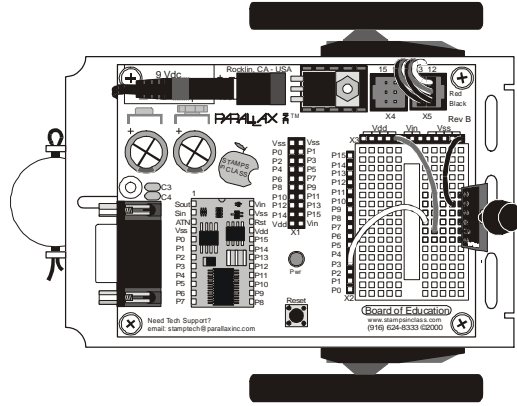
6

Figure 1-4
The RF Receiver
mounted on the Boe-
Bot

*Wiring diagram follows
in next figure.*

Wire the circuit as shown in **Table 1-3** and Figure 1-5.

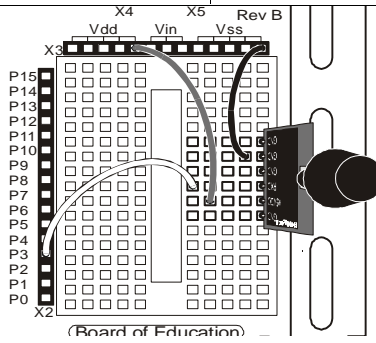| Table 1-3: Wiring the RF Receiver		
RF Receiver	**BASIC Stamp**	
GND	No connection	
GND	Vss	
GND	No connection	
RXD	P3	
+5VDC	Vdd	
GND	No connection	

Figure 1-5
Wiring Diagram for RF
Receiver

*It is sufficient to wire
just one of the GND
pins.*

ACTIVITY #3: PROGRAM THE BOE-BOT

- √ Load the program named Boe-Bot Mult Command.bs2 into the BASIC Stamp editor
- √ Connect the serial cable to the Boe-Bot
- √ Download the program into the Boe-Bot by selecting File | Run from the menu
- √ Disconnect the serial cable
- √ Place the Boe-Bot on the floor or somewhere where it can't fall

Program: Boe-Bot Mult Command.bs2

```
' Boe-Bot Mult Command.bs2
' This program controls a Boe-Bot equipped with an RF receiver.

' This program waits for a string of commands to be sent to the RF
' receiver.  The commands tell the Boe-Bot which direction to move.
' Once received, the commands are carried out.
'
' Expected format of command string is:
'     "XXXXXQ",
' where X is a command, and Q for Quit
' Maximum length of command list is 20 commands, including the "Q"
' String must end with a "Q"
' Supported commands:
'   "F" - Forward
'   "B" - Backward
'   "R" - Right
'   "L" - Left
'   "S" - Spin_360
'   "T" - Turn_180
'   "Q" - Quit

' Hardware Setup:
' Parallax RF Receiver Module, Part Number 27995

' Revision History:
' Kris Magri    27 Nov 2002                  Created
' Kris Magri    21 Jan 2003                  Added spin and turn command
'                                            Formatted to new standards
'                                            Cleaned up comments
'{$STAMP BS2}

' -----[ Declarations ]-------------------------------------------------

MaxCommands     CON     20                   ' Maximum commands in list
RxModule        CON     3                    ' RF Receiver to pin P3
N2400           CON     17197                ' 2400 Baud for RF Receiver
RServo          CON     12                   ' Right servo motor pin P12
```

8

```
LServo           CON      13                        ' Left servo motor pin P13

' Explanation for size of commandList VAR Byte(MaxCommands+1):
'   Last element in array will be 0 (zero) to denote end of string.
'   This is neccessary when using PBASIC's STR type formatter.
'   Commands are stored in commandList(0) thru commandList(MaxCommands-1),
'   and end-of-string marker is stored in commandList(MaxCommands)

commandList      VAR      Byte(MaxCommands+1)      ' Array, holds command list
pulses           VAR      Word
index            VAR      Byte

' -----[ Initialization ]-------------------------------------------------
Initialize:
  commandList(MaxCommands) =  0                    ' place 0 as end-of-string
                                                   ' marker

' -----[ Main Routine ]---------------------------------------------------

Receive_Commands:
  '/*
  ' * First, clear out the list of commands
  ' * This is necessary so the second, third, etc list of commands
  ' * is read cleanly
  ' */
  FOR index = 0 to MaxCommands - 1
    commandList(index) = " "             ' Set all to "space" character
  NEXT

  '/*
  ' * Read in list of commands from RF reciever
  ' * Stop reading after MaxCommands bytes or stop at the "Q" character
  ' */
  SERIN RxModule, N2400, [STR commandList\MaxCommands\"Q"]

'/*
' * This subroutine is here because of the need to come back into the
' * FOR-NEXT Loop after jumping out to a subroutine.
' * A trick to GOSUB when PBASIC forces to GOTO
' */

Process_Commands:
  FOR index = 0 TO MaxCommands
    GOSUB Move_Accordingly                ' Trick to GOSUB when must GOTO
  NEXT
  GOTO Receive_Commands                   ' When done processing, read more

Move_Accordingly:
    IF commandList(index) = "F" THEN Forward    ' PBASIC must GOTO after IF
    IF commandList(index) = "B" THEN Backward
    IF commandList(index) = "R" THEN Right
```

```
    IF commandList(index) = "L" THEN Left
    IF commandList(index) = "S" THEN Spin_360
    IF commandList(index) = "T" THEN Turn_180
    IF commandList(index) = "Q" THEN Quit        ' Will jump out of FOR-NEXT
    '/*
    ' * If command is other than the above, return to FOR-NEXT loop
    ' *
    GOTO Exit_Navigate


' -----[ Subroutines ]-----------------------------------------------------
Forward:
  FOR pulses = 1 to 20
    PULSOUT RServo, 500
    PULSOUT LServo, 1000
    PAUSE 20
  NEXT
GOTO Exit_Navigate

Backward:
  FOR pulses = 1 to 20
    PULSOUT RServo, 1000
    PULSOUT LServo, 500
    PAUSE 20
  NEXT
GOTO Exit_Navigate

Right:
  FOR pulses = 1 to 10
    PULSOUT LServo, 1000
    PULSOUT RServo, 1000
    PAUSE 20
  NEXT
GOTO Exit_Navigate

Left:
  FOR pulses = 1 to 10
    PULSOUT LServo, 500
    PULSOUT RServo, 500
    PAUSE 20
  NEXT
GOTO Exit_Navigate

Spin_360:
  FOR pulses = 1 to 400
    PULSOUT LServo, 600
    PULSOUT RServo, 600
    PAUSE 20
  NEXT
GOTO Exit_Navigate
```

```
Turn_180:
  FOR pulses = 1 to 200
    PULSOUT LServo, 600
    PULSOUT RServo, 600
    PAUSE 20
  NEXT
GOTO Exit_Navigate

Exit_Navigate:
  RETURN

Quit:
  GOTO Receive_Commands
```

ACTIVITY #4: BUILD THE RF TRANSMITTER CIRCUIT

Parts Required

(1) RF Transmitter, Parallax part number 27996
(1) Board of Education with BS2

Building the RF Transmitter Circuit

Use a separate Board of Education for the RF transmitter. Plug the RF transmitter into the breadboard on the BOE. One side of the RF transmitter is labeled. Place the RF transmitter module into the breadboard so the labeling faces the BASIC Stamp.
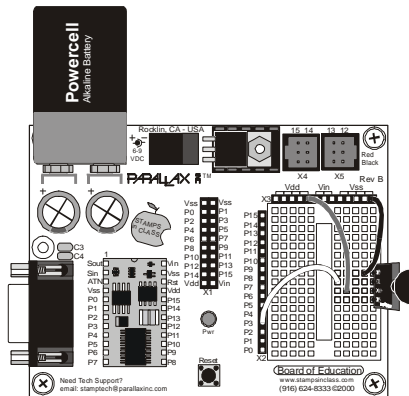

Figure 1-6

The RF Transmitter mounted on a Board of Education.

Wiring diagram follows in next figure.

Wire the circuit as shown in **Table 1-4** and Figure 1-7.

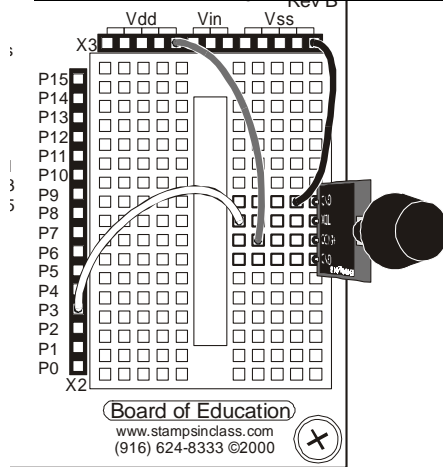| **Table 1-4:** Wiring the RF Transmitter		
RF Transmitter	**BASIC Stamp**	
GND	Vss	
TXD	P3	
+5VDC	Vdd	
GND	No connection	

Figure 1-7
Wiring Diagram for RF Transmitter

It is sufficient to wire just one of the GND pins.

ACTIVITY #5: PROGRAM THE BOE

√   Load the program named Control via Web.bs2 into the BASIC Stamp editor
√   Connect the serial cable to the BOE
√   Download the program into the Boe-Bot by selecting File | Run from the menu
√   Leave the serial cable connected. It must be connected to communicate with Micro WebServ.

Program: Control via Web.bs2

```
' Control via Web.bs2
' This program accepts commands from a web page and sends the commands out
' via an RF transmitter.
```

```
' Uses Micro WebServ (MWS).
' Web Page Setup:
' There is a web page with a text input box.
' Users type a list of commands in the text input box.
' MWS sends the list of commands out the serial port, to this program.
' This program sends the entire list of commands out via an RF transmitter.

' Commands are expected in the following format:
'    "XXXXXXQ!"
' Where "X" is a character representing a Boe-Bot motion,
'       "Q" marks the end of the command list,
'       "!" is generated by MWS,
' Max length of list is MaxCommands + 1 chars,
' including the "!"

' Hardware Setup:
' Parallax RF Transmitter Module, Part Number 27996

' Revision History
' Ken Gracey    April 2002                  Created
' Kris Magri    21 Jan 2003                 Changed for multiple cmds
'                                           Removed hard-coded PageID
'                                           Formatted to new standards
'{$STAMP BS2}

TxModule             CON     3            ' RF transmitter module
                                          ' wired to Stamp pin P3
serialPin            CON     16           ' Serial port receive pin
MaxCommands          CON     21           ' Maximum commands in list
                                          ' 20 + "!"

N2400       CON     17197                 ' 2400 Baud for Tx Module
N9600       CON     16468                 ' 9600 Baud for serialPin

commandList  VAR     Byte(MaxCommands+1)  ' list of commands

RequestID    VAR     BYTE                 ' MicroWebServ Request ID
PageID       VAR     BYTE                 ' MicroWebServ Page ID

' -----[ Initialization ]--------------------------------------------
Initialize:
  LOW TxModule                            ' Initialize transmitter
  commandList(MaxCommands) =  0           ' Set last char to 0, reqd
                                          ' for PBASIC STR formatter

' -----[ Main Routine ]----------------------------------------------
Main:
  ' MWS will send RequestID and PageID of the web page requested
  SERIN serialPin, N9600, [DEC RequestID, DEC PageID]
  PAUSE 20
```

```
  ' MWS then sends the command, terminated by an exclamation mark
  SERIN serialPin, N9600, 2000, TimeOut, [STR commandList\MaxCommands\"!"]

  ' put 0 as end-of-string marker
  commandList(MaxCommands) =  0

  PAUSE 100

  ' Send the command out the RF Transmitter module
  SEROUT TxModule, N2400, [STR commandList]

  ' Confirm receipt to MWS.  MWS expects to receive PageID.
  SEROUT 16, N9600, ["mws_fileID=", DEC PageID, CR]

GOTO Main

' -----[ Subroutines ]---------------------------------------------------
' If command not received, send message to MWS
TimeOut:
  SEROUT serialPin, N9600, ["mws_status=No Command Sent", CR]
GOTO Main
```

ACTIVITY #6: INSTALL MICRO WEBSERV

When you install Micro WebServ on your computer, your computer has the capability to act as a web server. Hereafter, when this document refers to "the web server", it is referring to your computer, running the Micro WebServ program. Micro Webserv is specifically designed to work with the BASIC Stamp.

Downloading the Software

The software can be downloaded from either the Parallax or CSMicro Sytems company websites. On the Parallax website, Micro WebServ can be found under Products, RF and Communication. The direct link is below:

http://www.parallax.com/detail.asp?product_id=27907

At CSMicro Systems, Micro WebServ can be downloaded from:

http://www.csmicrosystems.com/microwebserv/index.html

14

Installing Micro WebServ

Accept the defaults for program installation.

Registering Micro WebServ

Start the Micro WebServ program. If you have not registered the software, the splash screen has a button labeled "Evaluation Copy". Click on "Evaluation Copy". The program will start, and a small icon will appear in the Windows taskbar, down where the clock usually appears. Right click on this icon, and a menu will appear. Select Registration Code from the menu, and a window will pop up. Enter your serial number and registration code.

Figure 1-8: Micro WebServ Registration Window

Configuring Micro WebServ

√ Enter the COM Port
Under the Configuration tab, enter the COM port that the Stamp is using. This was identified in Activity #1.

√   Note your IP address
    Make a note of the IP address shown. This is the IP address of your web server.
    Others will need this IP to connect to your web server. The IP address will be in
    the form of four numbers separated by periods. In the screen shot below, the IP
    address is 10.10.10.104.

Figure 1-9: Micro WebServ Configuration Tab

Place Files into Micro WebServ Directory

Copy four files into the following folder:

        MicroWebServ\www\http

The root directory for Micro Webserv is either C:\Microwebserv or C:\Program
Files\Microwebserv, depending on where Micro WebServ was installed, so the full
path will be one of the following:

```
C:\Program Files\MicroWebServ\www\http

C:\MicroWebServ\www\http
```

Table 1-5: Files for Micro Webserv		
Filename	**Description**	
webbot.html	Main Web Page	
camera.html	Camera Image frame	
mws_command6.html	Command entry frame	
boe_bot_vision.gif	graphic	

Edit camera.html

The camera.html program must be edited and the IP address inside it changed.
- √ Open the camera.html program using an editor such as Notepad
- √ Change the IP address to be the IP address of the web server.
- √ The IP address appears in two places – be sure to change both of them.

Figure 1-10: Editing the camera.html file

ACTIVITY #7: HOOK UP X-10 EQUIPMENT

Hook up the X-10 equipment as shown in the X-10 documentation. The main points are:
- √   Plug the battery pack into the camera
- √   Plug the power supply into the video transmitter
- √   Plug the VA-110A video to USB adapter into the video transmitter
- √   DO NOT plug the VA-110A into the USB port yet!

ACTIVITY #8: INSTALL X-RAY VISION SOFTWARE

Download the X-Ray vision software from www.x10.com.

Installing the X-Ray Vision software will load the necessary drivers for the X-10 camera.
Follow the instructions and good luck! The most important thing is:

Don't plug the equipment into the USB port until instructed to do so by the installation
program.

ACTIVITY #9: INSTALL WEBCAM32

Downloading WebCam32

A   10-day   evaluation   version   of   WebCam32   can   be   downloaded   from
www.webcam32.com
Accept the defaults for installation.

Configuring WebCam32

- √   From the WebCam32 menu, select File | Preferences
- √   Double Click on TCP/IP
- √   TCP/IP Features
    - o   Check Applet Enabled
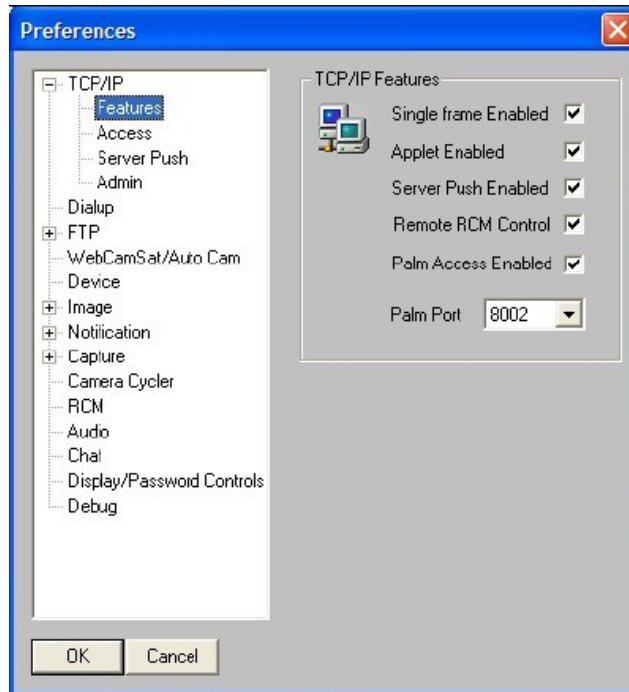   - o   Check Server Push Enabled

18

Figure 1-11: WebCam32 TCP/IP Features

√   TCP/IP Server Push
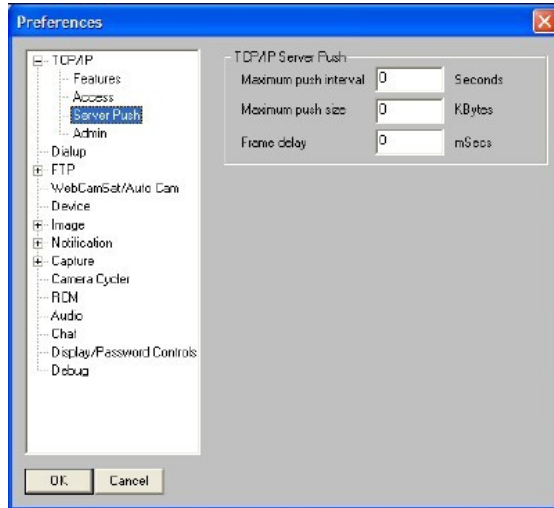- o   Enter zero for all three parameters

Figure 1-12: WebCam32 TCP/IP Server Push

Testing the camera with WebCam 32

- √ From the WebCam32 menu, select Window | Preview
- √ The camera image will be shown in a window
- √ Close the window after verifying the camera is working

ACTIVITY #10: START MICRO WEBSERV

- √ Launch the MicroWebServ program
- √ Turn on the BOE with the transmitter and check it is plugged into the serial port.
- √ Click on the "Start Server" button.
- √ Micro WebServ is now running

ACTIVITY #11: START WEBCAM32

- √ Launch WebCam32. It may take a while to load.
- √ WebCam32 is now ready

20

ACTIVITY #12: CONTROL BOE-BOT FROM WEBSERVER MACHINE

This will serve to test the system locally, from the computer running Micro WebServ.

- √ On the computer running Micro WebServ, open an Internet Browser such as Microsoft Explorer or Netscape Navigator
- √ Enter http://localhost/webbot.html
- √ The page will show in the browser and you can send commands to the Boe-Bot
- √ If you receive a "Device not ready" error, the BOE is not connected to the serial cable, or is not turned on

ACTIVITY #13: CONTROL BOE-BOT FROM OTHER BROWSERS

The final result is to control the Boe-Bot from any browser. It is much harder to control the Boe-Bot when it cannot be seen in person.

- √ Obtain the IP address of the computer running Micro WebServ
- √ Open an Internet Browser such as Microsoft Explorer or Netscape Navigator
- √ Enter http://*IPAddress*/webbot.html, substituting the correct IP address
- √ The page will show in the browser and you can send commands to the Boe-Bot
- √ If you receive a "Device not ready" error, the BOE is not connected to the serial cable, is not turned on, or another browser is accessing the Boe-Bot at the same time.

ACTIVITY #14: REACHING YOUR BOE-BOT

There can be various problem which prevent others from accessing your web-controlled Boe-Bot. Problems involve IP address resolution, firewalls, routers, LANS, WANS, and other networking issues. While most of these problems are beyond the scope of this document, here is a quick note about IP addresses.

Which IP? LAN vs Internet IP Addresses

In general, all IP addresses on the Internet are unique. However, certain blocks of addresses are set aside for use in Local Area Networks (LANs). These IP addresses are meaningful only on the local LAN, and are meaningless on the Internet, outside the LAN. If people inside your LAN can see your Boe-Bot, but people outside cannot, you are probably using the local LAN IP. Overcoming this problem may require the services of your network administrator.

Table 1-6: LAN-only IP addresses		
	From	**To**
Range 1	10.0.0.0	10.255.255.255
Range 2	172.16.0.0	172.31.255.255
Range 3	192.168.0.0	192.168.255.255