Application Note

Adding Custom Web Page for your Wireless Zdots® SBC

AN029801-1208

Abstract

Wireless control system is a cost-effective solution for a wide range of control applications. It has become a necessity with use in devices like remote controls, remote metering, wireless alarm, gate control, and system wireless control devices.

Zilog's Wireless Zdots® Single Board Computer (SBC) serves as a web-based control system, capable of wirelessly hosting a Web page. Wireless Zdots SBC module runs a TCP/IP stack over the wireless channel that can be used to control several applications via a wireless Internet application.

This Application Note demonstrates how you can add a custom Web page with virtual buttons which act as real buttons when connected to Wireless Zdots SBC hardware or an external link. The Wireless Zdots SBC serves as an added tool in controlling distant devices with the use of Internet.

Note: *This application is developed using ZDS II v4.11.1 and ZTP v2.2.0. The source code file associated with this Application Note,* `AN0298-SC01.zip`*, is available for download at* www.zilog.com.

Product Overview

This section provides a brief overview of Zilog's eZ80Acclaim*Plus!*™ MCU, Wireless Local Area Network (WLAN), Wireless Zdots SBC, and ZTP under the following headings:

- eZ80AcclaimPlus!™ MCU Overview
- WLAN Overview
- Wireless Zdots® SBC Overview
- Zilog TCP/IP Software Suite Overview

eZ80Acclaim*Plus!*™ MCU Overview

At the center of Wireless Zdots SBC is award winning eZ80Acclaim*Plus!* Microcontroller, featuring a powerful 50 MHz single-cycle instruction fetch eZ80® core with 24-bit ALU, 256 KB of embedded Flash, 16 KB of SRAM as well as a variety of peripherals including six 16-bit timers, 32 GPIO, 2 UARTs, 1 SPI, 1 I^2C and support for up to 16 MB of external memory. In addition, the eZ80Acclaim*Plus!* Wireless Zdots SBC boasts an additional 4 MB of NOR Flash,1 MB of SRAM, and 2 MB of serial Flash.

WLAN Overview

Wireless Local Area Network (WLAN) enables the computers and devices to send and receive the data within the range of a wireless base station. There are few WLAN standards, the newest ones being backwards compatible to older standards. These are defined by the Institute of Electrical and Electronics Engineers (IEEE): 802.11b, 802.11g and 802.11a. The WLAN standards 802.11 allow data transmission up to 2 Mbps. These extensions are recognized by the addition of a letter to the original 802.11 standard, including 802.11a and 802.11b. The 802.11b specification operates at radio frequencies in the 2.4 GHz to 2.497 GHz bandwidth of the radio spectrum.

The modulation method selected for 802.11b is known as complementary Direct Sequence Spread Spectrum (DSSS) using Complementary Code Keying (CCK) making data speeds as high as 11 Mbps. The 802.11a operates at radio frequencies between 5.15 GHz and 5.875 GHz and a modulation scheme known as Orthogonal Frequency Division Multiplexing (OFDM) makes data speeds as high as 54 Mbps possible.

The most common and widespread wireless networking products are compatible with the 802.11b standard, working in the 2.4 GHz band with a data-transfer rate of up to 11 Mbps.

Wireless Zdots® SBC Overview

Zilog's eZ80Acclaim*Plus!* Wireless Zdots SBC delivers a complete Wireless solution that can be easily and quickly embedded into various devices to enable Wireless capability. This fully integrated Wireless Zdots SBC offers a rich hardware feature set along with a full, royalty free, web-server software stack, thus, making your Wireless solution development quick, efficient, and cost-effective.

Zilog TCP/IP Software Suite Overview

The Zilog TCP/IP (ZTP) integrates a rich set of networking services with an efficient real-time operating system (RTOS). The operating system is a compact preemptive multitasking, multi-threaded kernel with inter-process communications (IPC) support and soft real-time attributes. Table 1 lists the standard network protocols implemented as part of the embedded TCP/IP protocol stack in ZTP.

Table 1. Standard Network Protocols in ZTP

HTTP	TFTP	SMTP	Telnet	IP	PPP	SSL
DHCP	DNS	TIMEP	SNMP	TCP	UDP	
ICMP	IGMP	ARP	RARP	SNTP	FTP	

Many TCP/IP application protocols are designed using the client-server model. The final stack size is link-time configurable and determined by the protocols included in the build.

Discussion

This section provides a discussion on how to build a Web page.

Building Your Web Page

The Project Viewer in ZDS II contains the directories of all the source files, dependencies, and web files in the project. The web files are added to the appropriate folder in the `AN0298-SC01.zip` directory. For this Application Note, the webserver demonstration project used is the `website.zdsproj`. To include Web page files in the project, or to change a set of Web pages in the project, the current `Acclaim_Website.lib` file must be removed or updated from the project.

All the files are placed and linked to a Web page, including java applets and CGI functions in the `AN0298-SC01.zip` directory. Table 2 provides the samples of these filename extensions. The web files in the `AN0298-SC01.zip` directory must follow the correct directory format as displayed in Figure 1 on page 3.

Table 2. Web Page Filename Extensions

File Name	Extension
Web Pages	.htm, .html
CGI Functions	.c
Applet Classes	.class
Image Files	.jpg, .gif

After rebuilding the project, the resulting executable file contains web pages appropriate to the project. Files in the Web files directory are removed during the build, and a new `Acclaim_Website.lib` file is generated in the source file directory. This library includes structures of the type static page for each Web page, and these structures are identified with a name that is derived from the name of each web file.

HTTP is interfaced with the Zilog File System. As a result, web pages can be uploaded to the eZ80® CPU at run-time using either TFTP or FTP. All the web files to be uploaded to the directory must be specified by using the following statement in the `ZTPConfig_Wlan.c` file:

```
INT8 httppath[] = "/"
```

HTTP first searches for the requested Web page in the static website array. If this Web page is not found in the static array, it searches in the directory specified by the `INT8 httppath[]` variable. For web files added to the Zilog File System, the **Content type** field in the HTTP reply is filled based on the file extension used. A standard mapping of a file extension to its content type is maintained in a structure that is defined in `website.c` file, located in the following path:

```
\ZTP\SamplePrograms\website
```

The `website.c` file is listed in the following code fragment, which includes a definition for the `mimetypes[]` structure.

```
struct mimetype
{/* file extensions */
INT8 * fileExtns;
/* Associated mime types for the file
extensions */
INT8 * type;
};
struct mimetype mimetypes[] =
{
{".htm","text/html"},
{".html","text/html"},
{".jpg","image/jpg"},
{".class","application/octet-stream"},
{".gif","image/gif"},
// If the file extensions does not match
any then
// unknown will be used.
// This should always be at the end.
{"unknown","unknown"}
};
```

The last statement of the `website.c` file should always be `{"unknown","unknown"}`. The structure of this file can be updated with additional file extensions and their MIME types. If this structure is updated, then the website library must be rebuilt to reflect the updated elements.

Developing Application with Wireless Zdots® SBC

This section discusses the implementation of the Wireless Zdots SBC as a web-based control system using Wireless Zdots SBC module.

Adding Web Page Demo

The Demo described in this Application Note requires the Wireless Zdots SBC (with the eZ80F91 eZ80Acclaim*Plus!*™ MCU) and the ZTP. For the Demo execution, some of the files specific to the Demo must be added and integrated to the ZTP stack before it is downloaded onto the Wireless Zdots SBC.

The Demo files that must be added to the ZTP project files are in the `AN0298-SC01.zip` file, available for download at www.zilog.com. Figure 1 displays the directory structure of the sample Web page.

Figure 1. Directory structure of a Sample Web Page

The ZTP v2.2.0 stack (available for download at www.zilog.com) can be downloaded with a user registration key. ZTP can be installed in any location as specified by you. By default, ZTP is installed in below path:

```
C:\Program Files\ZiLOG
```

To add and integrate the Web page Demo files to the ZTP stack, perform the following steps:

1. Download and install ZTP v2.2.0. Browse to the location where ZTP is installed, and open the below folder:

   ```
   ..\Program Files\ZiLOG\
   ZTP_2.2.0_Lib_ZDS\ZTP\
   SamplePrograms
   ```

2. Download the `AN0298-SC01.zip` file. Extract and copy `website.WLAN` folder and its contents to the below folder:

   ```
   ..\ZTP_2.2.0_Lib_ZDS\ZTP\SamplePr
   ograms
   ```

3. Launch **ZDS II—eZ80Acclaim! v4.11.1**, and open the `website.zdsproj` project file available in the below path:

   ```
   ..\ZTP\SamplePrograms\website.WLA
   N
   ```

4. Add the `*.png` and `*.swf` files to ZDS II by selecting **Tools** → **Options** → **File Types** tab. In the **Associated File Types** field, type the file extensions to store in the new directory. Use a comma to separate the file types. Click **OK**.

5. Add the Web page files (listed in Table 3) to the project by selecting **Add Files** from **Project** menu. When **Add files to Project** dialog box is displayed, navigate to the directory containing the web pages `*.htm`, `*.jpeg`, `*.class`, `*.png` and `*.swf` file types.

Table 3. Web Page Files

/website.WLAN	/website.WLAN/image Folder
cgi.htm	acclaimheading.jpg
contactus.htm	logo.jpg
demos.htm	leadfree.jpg
ez80f91.htm	devkit.jpg
ez80f92.htm	/website.WLAN/swf Folder
ez80.htm	ez80.swf

Table 3. Web Page Files (Continued)

javaapplets.htm	/website.WLAN/buttons Folder
javascripts.htm	button1over.png
lake.class	button1up.png
main.htm	button2over.png
overview.htm	button2up.png
products.htm	button3over.png
siteinfo.htm	button3up.png
siteinfopage.htm	button4over.png
tcpip.htm	button4up.png
webpagedemo.htm	button5over.png
	button5up.png

6. Open the `website.c` file of the website project and add the following structure definition for the included web files with the **filename.extension → filename_extension** format.

```
//website.WLAN
extern const struct staticpage cgi_htm;
extern const struct staticpage contactus_htm;
extern const struct staticpage demos_htm;
extern const struct staticpage ez80f91_htm;
extern const struct staticpage ez80f92_htm;
extern const struct staticpage ez80_htm;
extern const struct staticpage javaapplets_htm;
extern const struct staticpage javascripts_htm;
extern const struct staticpage Lake_class;
extern const struct staticpage main_htm;
extern const struct staticpage overview_htm;
extern const struct staticpage products_htm;
extern const struct staticpage siteinfo_htm;
extern const struct staticpage siteinfopage_htm;
extern const struct staticpage tcpip_htm;
extern const struct staticpage webpagedemo_htm;
//website.WLAN/image
extern const struct staticpage acclaimheading_jpg;
extern const struct staticpage logo_jpg;
extern const struct staticpage leadfree_jpg;
extern const struct staticpage devkit_jpg;
//website.WLAN/swf
extern const struct staticpage ez80_swf;
//website.WLAN/buttons
extern const struct staticpage button1over_png;
extern const struct staticpage button1up_png;
extern const struct staticpage button2over_png;
extern const struct staticpage button2up_png;
extern const struct staticpage button3over_png;
extern const struct staticpage button3up_png;
extern const struct staticpage button4over_png;
extern const struct staticpage button4up_png;
extern const struct staticpage button5over_png;
extern const struct staticpage button5up_png;
```

Note: *The Object Librarian for ZDS II IDE will generate a C file equivalent to the added web pages in the* **file.extension → file_extension.c** *format.*

7. Add the following mimetype to the website structure array that will define the content type of the added files:

```
Webpage website[] = {
//website.WLAN/root
{HTTP_PAGE_STATIC, "/", "text/html", &main_htm },
{HTTP_PAGE_STATIC, "/cgi.htm", "text/html", &cgi_htm },
{HTTP_PAGE_STATIC, "/contactus.htm", "text/html", &contactus_htm },
{HTTP_PAGE_STATIC, "/demos.htm", "text/html", &demos_htm },
```

```
{HTTP_PAGE_STATIC, "/ez80f91.htm", "text/html", &ez80f91_htm },
{HTTP_PAGE_STATIC, "/ez80f92.htm", "text/html", &ez80f92_htm },
{HTTP_PAGE_STATIC, "/ez80.htm", "text/html", &ez80_htm },
{HTTP_PAGE_STATIC, "/javaapplets.htm", "text/html", &javaapplets_htm },
{HTTP_PAGE_STATIC, "/javascripts.htm", "text/html", &javascripts_htm },
{HTTP_PAGE_STATIC, "/Lake.class", "application/octect-stream", &Lake_class
},
{HTTP_PAGE_STATIC, "/main.htm", "text/html", &main_htm },
{HTTP_PAGE_STATIC, "/overview.htm", "text/html", &overview_htm },
{HTTP_PAGE_STATIC, "/products.htm", "text/html", &products_htm },
{HTTP_PAGE_STATIC, "/siteinfo.htm", "text/html", &siteinfo_htm },
{HTTP_PAGE_STATIC, "/siteinfopage.htm", "text/html", &siteinfopage_htm },
{HTTP_PAGE_STATIC, "/tcpip.htm", "text/html", &tcpip_htm },
{HTTP_PAGE_STATIC, "/webpagedemo.htm", "text/html", &webpagedemo_htm },
{HTTP_PAGE_DYNAMIC, "/cgi-bin/increment", "text/html", (struct staticpage
*)increment_cgi },
//website.WLAN/image
{HTTP_PAGE_STATIC, "/image/acclaimheading.jpg", "image/jpg",
&acclaimheading_jpg },
{HTTP_PAGE_STATIC, "/image/logo.jpg", "image/jpg", &logo_jpg },
{HTTP_PAGE_STATIC, "/image/leadfree.jpg", "image/jpg", &leadfree_jpg },
{HTTP_PAGE_STATIC, "/image/devkit.jpg", "image/jpg", &devkit_jpg },
//website.WLAN/swf
{HTTP_PAGE_STATIC, "/swf/ez80.swf", "unknown", &ez80_swf },
//website.WLAN/buttons
{HTTP_PAGE_STATIC, "/buttons/button1over.png", "unknown", &button1over_png
},
{HTTP_PAGE_STATIC, "/buttons/button1up.png", "unknown", &button1up_png },
{HTTP_PAGE_STATIC, "/buttons/button2over.png", "unknown", &button2over_png
},
{HTTP_PAGE_STATIC, "/buttons/button2up.png", "unknown", &button2up_png },
{HTTP_PAGE_STATIC, "/buttons/button3over.png", "unknown", &button3over_png
},
{HTTP_PAGE_STATIC, "/buttons/button3up.png", "unknown", &button3up_png },
{HTTP_PAGE_STATIC, "/buttons/button4over.png", "unknown", &button4over_png
},
{HTTP_PAGE_STATIC, "/buttons/button4up.png", "unknown", &button4up_png },
{HTTP_PAGE_STATIC, "/buttons/button5over.png", "unknown", &button5over_png
},
{HTTP_PAGE_STATIC, "/buttons/button5up.png", "unknown", &button5up_png },
{0, NULL, NULL, NULL } };
```

8. Build the project. The `Acclaim_Website.lib` gets generated in the same directory as the project. Copy and overwrite the existing library file to the following location:

   `..\ZiLOG\ZTP_2.2.0_Lib_ZDS\ZTP\Lib`

9. Close the `website.zdsproj` project.

Demonstrating the Application

This section describes the equipment used, setup, and procedure followed to host a Web page through Wireless Zdots® SBC module.

Equipments Used

The equipment used for demonstrating the Web page demo application include:

Hardware

- eZ80acclaim*Plus!*™ Wireless Zdots SBC Development Kit (eZ80F91WF01ZCOG). This development kit contains Wireless Zdots SBC Module and eZ80® Wireless Zdots SBC Board
- Wireless Access Point (WAP)

Software

- Zilog Developer Studio II (ZDS II) IDE v4.11.1 for eZ80Acclaim!® devices
- Zilog's TCP/IP stack (ZTP) v2.2.0
- Windows-based PC with the HyperTerminal application

System Configuration

The HyperTerminal application settings are provided below:

- Serial Port: COM1 or COM2
- Baud Rate: 57600 bps
- Parity: None
- Data Bits: 8
- Stop bit: 1
- Flow Control: None

Setup

Install eZ80F91 eZ80Acclaim! development kit as indicated in the *eZ80F91 Development Kit User Manual (UM0142)*. Unplug the power supply and remove the eZ80F91 module.

Figure 2 displays the hardware setup for the WLAN application that is used to demonstrate Wireless Web page demo application.

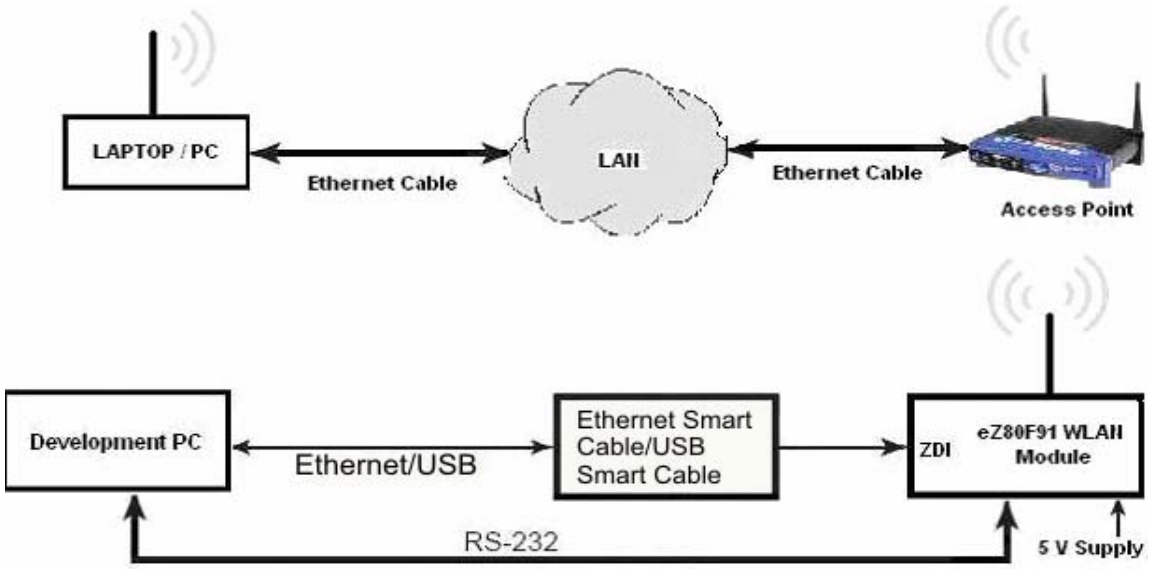

Figure 2. Hardware Setup for WLAN Application

To set up the Hardware, perform the following steps:

1. Connect Zdots® SBC to J1 of the Wireless base board. The SBC must be connected before applying the power.
2. Connect the RS-232 adapter (99C1067-001G) to the WLAN Zdots SBC J3 header.
3. Connect the USB Smart cable (or any Zilog Debug tool) to the 6-pins ZDI interface on the Wireless Base Board on your development PC.
4. Connect the RS-232 cable to the RS-232 adapter P1 connector and the other end to the communication port (COM1) of the PC.
5. Connect the power supply (5 V DC) cable to the Wireless Base board J4 connector.
6. Set up an Access Point (AP) in the test area and power it ON.

Procedure

Configuring the HyperTerminal Application

You must first configure the HyperTerminal application before starting the demo application.

To configure the HyperTerminal application, perform the following steps:

1. Launch the HyperTerminal application by navigating to **Start → Programs → Accessories → Communications → HyperTerminal**. The **Connection Description** dialog box is displayed.
2. Enter a name for a new connection in the **Connection Description** dialog box, and click **OK**. The **Connect To dialog** box is displayed.
3. In the **Connect using** text field, select the port (COM1 or COM2) to which the serial cable is connected and click **OK**. The **Port Settings** dialog box appears for the selected port.
4. In the **Port Settings** dialog box, select the values in the respective text fields (see System Configuration on page 7).
5. Click **OK**. The connection to the eZ80® development platform via the serial port is established.

Running the Web Page Demo Project

The Web page demo initializes the appropriate device drivers of the WLAN interface. It sends the probe request to the configured Service Set Identifier (SSID), receives response from the specified SSID only, and also joins the same Basic Service Set Identifier (BSSID). Using the ZTP WLAN demo, you can browse the web pages on the resident HTTP server, and use Telnet server/client.

To execute the Web page demo project in the ZDS II development environment, perform the following steps:

1. Set up the hardware as displayed in Figure 2 on page 7.
2. Launch ZDS II by navigating to **Start → Programs → ZiLOG ZDS II - eZ80_<Version>_ZDS II-eZ80_<Version>**.
3. Select **Open Project** from the **File** menu and open the sample ZTP demo project located in the below path:

   ```
   <ZTP Installed Dir>\ZTP_2.2.0_Lib_ZDS\ZTP\Sample Programs\WLANDemo\WLANDemo.zdsproj>
   ```

4. Select **Set Active Configuration** from the **Build** menu. The **Select Configuration** dialog box is displayed. Select the RAM configuration as shown below and applicable for this Application Note:

   RAM Configuration:

   ```
   RANGE ROM: 0-8FFFF
   RANGE RAM: 90000-FFFFE
   ```

   FLASH Configuration:

   ```
   RANGE ROM: 0-3FFFF, 100000-4FFFFF
   RANGE RAM: C00000-CFFFFF
   ```

   COPY_TO_RAM Configuration:

   ```
   RANGE ROM: 0-3FFFF, 100000-1FFFFF
   RANGE RAM: C00000-CFFFFF
   ```

5. Select **Settings** from the **Project** menu. The **Project Settings** dialog box is displayed. In the **Project Settings** dialog box, select the **Debugger** tab. In the **Debugger** tab, ensure that `eZ80F91_WiFi_RAM` option is checked.
6. Click **OK** to close the **Project Settings** dialog box.

Note: *If the ZDS II prompts to* **Rebuild the Project**, *click* **YES** *to enable the configuration on* **Project → Settings**.

7. After the successful build, run the Demo application using **Debug → Go**.
8. Once the `shell` prompt appears, use the `scan` command on the **Hyper Terminal** window and press **Enter** to search the access points (AP) available in the range. Then use the `join <SSID> <WEPKEY>` shell command and press **Enter** to connect to a specified AP.

   For more details on shell commands, refer to *Zilog TCP/IP Software Suite Programmer's Guide (RM0041)*.
9. After successful connection to the BSS (AP) the network stack will be initialized and Zdots® SBC behaves as a complete wireless station.

Notes:

1. *To support FLASH and COPY_TO_RAM configuration on Wireless Zdots SBC (due to new external SPANSION Flash) ZDS II Flash driver configuration file must be modified. Replace the* `FlashDevice.xml` *file in the* `...\ZDSII_eZ80Acclaim!_4.x.x\config` *folder with the file given in the* **WLAN-Demo** *folder. In the* **Project → Settings → Debugger**; `eZ80F91_WiFi_Flash` *must be selected for FLASH and COPY_TO_RAM configurations. After replacing the* `FlashDevice.xml` *file close all ZDS II instances and reopen again.*
2. *By default the* `wlan_conf.c` *file contains WLAN parameters set to zero. In this case, you can configure these parameters through shell and connect to a BSS (AP).*
3. *If the WLAN parameters in* `wlan_conf.c` *are valid (that is, not initialized to NULL), the Demo connects to the specified BSS (AP) without the user interaction.*
4. *In FLASH and COPY_TO_RAM configurations the SSID and WEP key can be set through the* `configwlan` *shell command. For more details, refer to Zilog TCP/IP Software Suite Programmer's Guide (RM0041).*
5. *The Zdots® WLAN solution cannot be configured to work as an Access Point.*

Demonstration

When you run the Web page demo application, Zdots SBC joins the BSS with the specified SSID and displays the network parameters and a login prompt on the HyperTerminal application. You can type `help` on the command prompt to know other command line applications.

To browse the Web page embedded on Wireless Zdots SBC, perform the following steps:

1. Use `PING` command from any PC present in the same BSS or ESS to eZ80® Wireless Zdots SBC Board running ZTP. You can also ping from Zdots SBC shell to other PC as well.
2. Open Internet Explorer from PC or a laptop and browse to the eZ80® Wireless Zdots SBC with the IP specified on the console output (see Figure 3 on page 10).
3. You can access the eZ80® Wireless Zdots SBC Board through Telnet by a PC or a laptop and its shell prompt through a wireless connection.

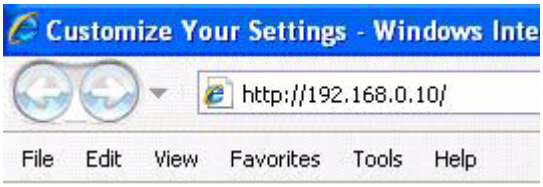

Figure 3. IP Address Example

Figure 4. Static Web Page Demo with Link Buttons to External Websites

Summary

This Application Note (using Wireless Zdots® SBC) demonstrates a wireless web-based control, which directs the users to an external link (Internet). This embedded application can be configured to the style, look, and interface you wish to use depending on your application. It also allows you to control several wireless applications when configured to interface from a hardware that is connected to the Wireless Zdots SBC module. They can turn ON and OFF to a certain device, log, and capture the data. This module can also replace the existing wired control applications.

References

The documents associated with ZTP, eZ80Acclaim*Plus!*™ Wireless Module, and Wireless Zdots SBC available on www.zilog.com are provided below:

- Zilog TCP/IP Software Suite Programmer's Guide (RM0041)
- Wireless Zdots® Single Board Computer Development Kit Quick Start Guide (QS0075)
- eZ80Acclaim*Plus!*™ Wireless Zdots® Single Board Computer Product Specification (PS0280)
- Wireless Zdots® Single Board Computer Development Kit User Manual (UM0224)

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