usb_cam

User Guide

TekBots™
Oregon State University

Version 1.0
By Adriaan Smit
OSU EE Graduate Student

Table of Contents

Introduction

The TekBot™ usb_cam is a USB camera complete with Windows drivers and supporting MATLAB functions. The usb_cam was developed within the TekBots group at the Electrical and Computer Engineering department at Oregon State University. The usb_cam consists of two boards, the usb_io.1 board and the usb_cam.1 board. (See the USB IO User Guide for more information on the usb_io.1 board.) The usb_cam.0 board is merely an adapter board that connects an Agilent 2700-4000 camera to the usb_io.1 board.

1.1 Features

- **USB compatible device**
- **Windows 98/2000/XP drivers included**
- **MATLAB compatible**
- **60x80 pixel images**
- **1 frame per second**
- **LED status indicators**

Getting Started

Each component in the usb_cam kit is functionally tested before it is packaged. The usb_cam is completely configured before it is distributed. In order to get the usb_cam working on your PC, the Windows drivers need to be installed and the MATLAB tools placed in your MATLAB working directory.

2.1 Kit Contents

Each usb_cam Kit is shipped with the following components packaged in static sensitive bags.

- usb_jtag1.1 board
- usb_cam1_0 board
- 2700-4000 model imager
- 15ft USB extension cable

2.2 System Requirements

The drivers for the usb_cam at this time have only been developed for Windows 98, 2000 and XP. The MATLAB functions have been developed and tested under MATLAB 6.0. The usb_cam will work with any PC with the following:

- USB1.0 / USB2.0 port
- Windows 98/2000/XP
- MATLAB 6.0

2.3 Quick Start

2.3.1 Windows Drivers

Download the drivers from the TekBots Web Site and store them in a temporary folder on your PC. There are three files: a1700v1_1.inf, a1700v1_1.sys and ezusb.sys. After downloading the drivers, connect the usb_cam by plugging it into the USB port and follow the onscreen instructions. Section 3.2 gives more detailed instructions for installing the Windows drivers.

2.3.2 MATLAB Functions

Download the MATLAB functions from the TekBots web site and place them in your MATLAB working directory. There are two files: getRGB.dll and getpic.m. These files could also be placed in a different folder as long as the MATLAB path is set appropriately. To use the getpic.m function see Section 4.2

2.3.3 Power Up

The power up sequence is as follow: After the device is plugged in, Windows will initially treat it as a generic USB device. First Windows will ask it to identify itself. The usb_cam then sends Windows a Product ID and a Device ID. Windows will then match those ID's to the drivers that where installed. If the drivers where not installed, Windows will then prompt the user for driver information. The usb_cam has two drivers. The first is a firmware download driver while the second is a communications driver.

- **Firmware download driver**

The Cypress chip on the usb_jtag1.1 board is an 8051 with built-in USB protocol circuitry. The 8051 firmware can be downloaded in a number of different ways. The two most useful ways is boot loading from an EEPROM or downloading it over USB. For the usb_cam it is downloaded over USB. When the usb_cam is first connected to the PC it identifies itself as a usb_cam with no firmware. The a1700v1_1.sys driver with firmware is then downloaded after which the 8051 disconnects and reconnects to the USB port.

- **Communications driver**

After the firmware driver has configured the 8051 on the usb_cam, the 8051 will disconnect from the USB port and reconnect as a uab_cam with firmware. At this point the communications driver is loaded to specify the protocols needed to talk to the usb_cam.

- **Startup success**

The usb_cam has 8 LEDs for error report. If an error should occur during the startup process a value of 0x99 will be displayed on the LEDs. If the camera initialized correctly a value of 0x80 will be displayed on the LEDs. Allow at least eight seconds for the usb_cam to start up successfully after connecting the usb_cam to the PC.

2.3.4 Cable connections

Be sure that the cables are plugged in securely. A plug that is not connected securely could disconnect momentarily, resetting the 8051 without having Windows realize that the device has been reset. This could cause MATLAB to hang. If this happens:

- Close MATLAB
- Disconnect the usb_cam
- Wait at least 8 sec
- Reconnect usb_cam
- Start MATLAB

The reason MATLAB needs to be closed is because the *.dll will keep the USB channel active and not allow the usb_cam to reconnect correctly.

Windows Drivers

3.1 Download drivers

The drivers are available on the TekBots web site. There are three files that are needed: a1700v1_1.inf, a1700v1_1.sys and ezusb.sys. The *.inf file is a table that associates device ID's with specific system files. With the usb_cam, the a17v1_1.sys is the firmware download driver while the ezusb.sys is the USB communications driver. Place these files in a folder on your PC. For this example I assume the files are in C:/temp

3.2 Connect usb_cam to PC

After the usb_cam has been connected to the PC, Windows will start up the "add device wizard." Select the "Install from a list or specific location" option, Figure 3.1, and click on Next.

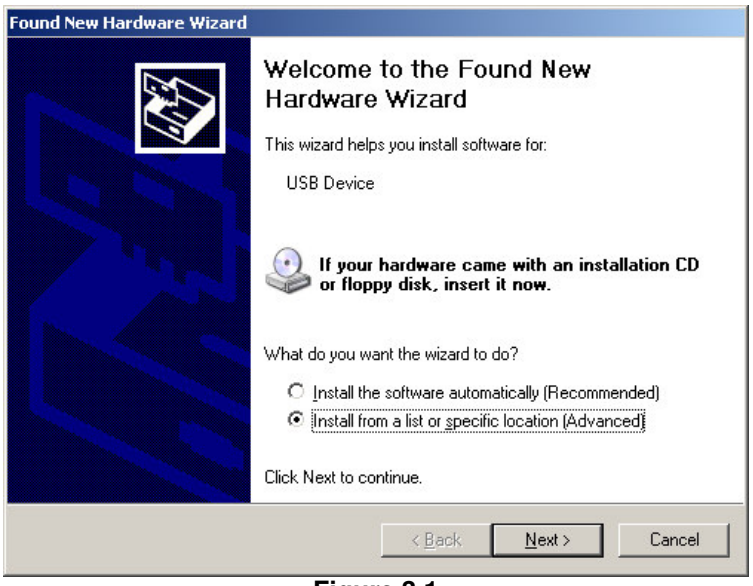

Figure 3.1

In the next window, Figure 3.2, select the first option to search for the driver. Also check the second box in order to specify the location of the drivers. Then Browse to the folder where you saved the three files that where downloaded from the TekBots web site. In this example it is the C:/temp folder. Click Next. Windows will now display a warning screen stating that the driver you are installing is not Microsoft certified, Figure 3.3. Click Continuo Anyway. You will now see Windows transferring the driver files and completing the settings. After the files have been set up, click finish. If all went well the first driver is now installed and you should see the LEDs on the usb_cam displaying the value 0x80.

Windows will now go through to same process to install the second driver. Because you have already specified where the files are located you should only have to click next all the way through. Figure 3.4

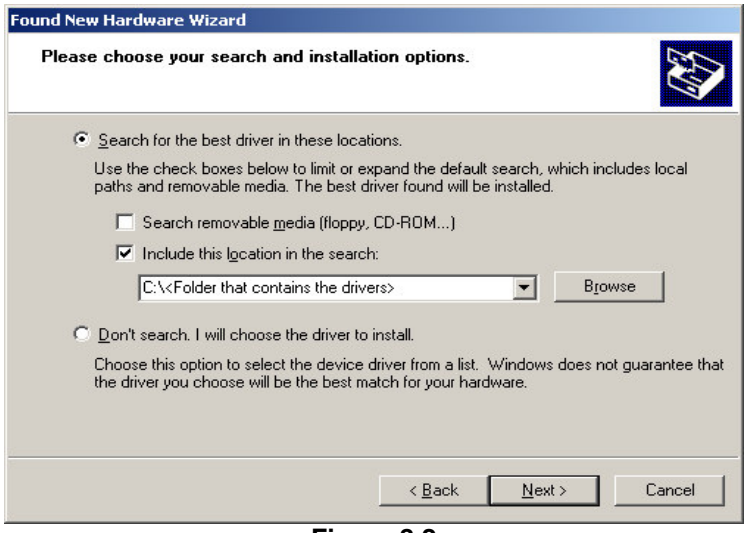

Figure 3.2

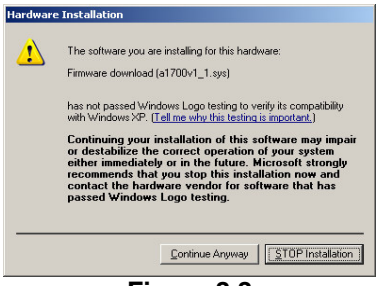

Figure 3.3

Figure 3.4

If the wizard found the EZUSB (ezusb.sys) you can click next. If not, you will need to specify the location as done for the first driver.

MATLAB Functions

Once the Windows drivers have been installed it is easy to start using the MATLAB functions. Simply download them from the TekBots web site and place them in your MATLAB working directory. You can now start using the usb_cam in MATLAB.

4.1 Before starting MATLAB

Make sure that the usb_cam is plugged in and that the drivers have loaded successfully before starting MATLAB. If the usb_cam makes MATLAB hang, refer to section 2.3.4

4.2 Usage information

The getRGB.dll is a MATLAB mex file that communicates with the usb_cam Windows drivers. The getpic.m function uses the gerRGB.dll to talk to the usb_cam and get an image.

```
>>    RGB = getpic;
```

This command will return to the RGB variable an image matrix. RGB will have dimensions 60x80x3 and will be of type uint8 (unsigned integer, 8 bits). The image is a 2x2 matrix of pixels where each pixel has one byte one data for each of the three primary colors (red, green and blue). A bitmap version of the image will also be stored straight to your current folder as p60x80.bmp.

usb_cam Board Specifications

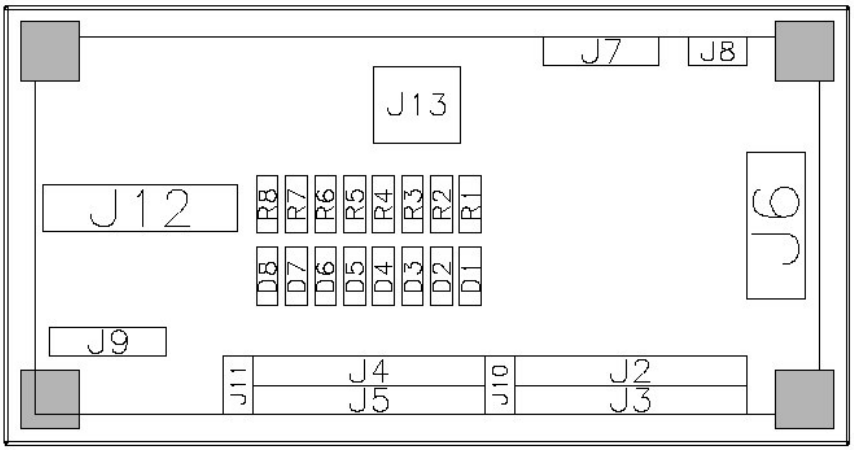

Figure 5.1 – Component Outline

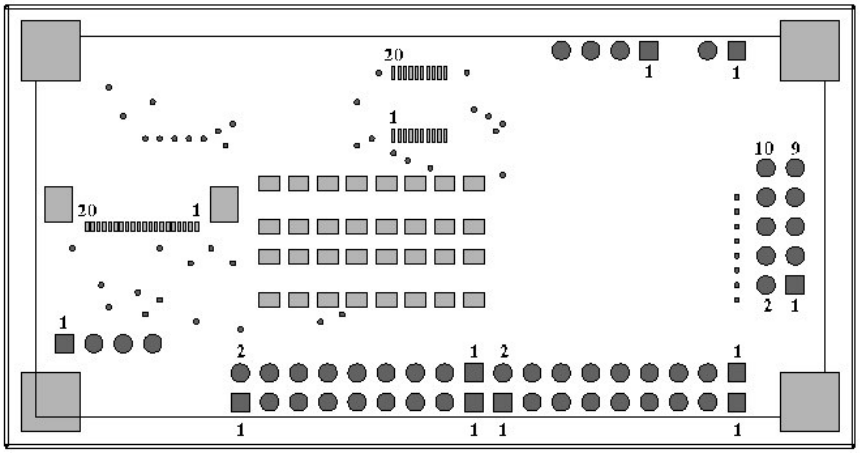

Figure 5.2 – Pin Numbers

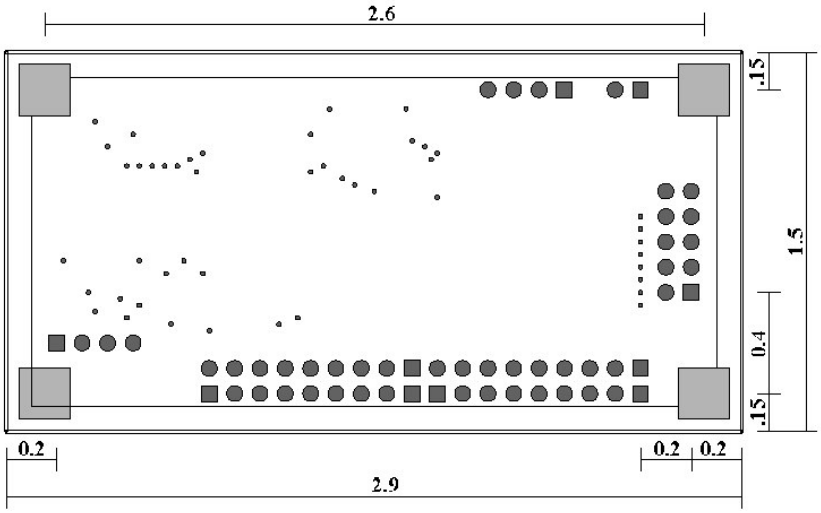

Figure 5.3 – Board Dimensions (in)