Mini Book Robot White Paper

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- **The design described in this presentation is currently at the level of a prototype. As such, it hasn't been extensively tested. Some techniques described in this paper are non-standard uses of off- the-shelf components. This means there is a potential that the components you use may be damaged. Evolution Robotics cannot be held responsible for the damage or destruction of any off-the-shelf or ER1 component modified using this White Paper. By using the instructions in this White Paper you assume all responsibility for any product damage and/or injury to persons resulting from the instructions.**

- **The project described in this paper is intended for advanced users with a solid grounding in the fundamentals of electronics and computers. Details on every single step are not provided. The goal is to give the user some pointers and tips on projects that other people have successfully completed. Read through the entire presentation and make sure that this is an appropriate project for your skill set prior to attempting this project.**

- **Cost estimates were as of Dec 2002 and are subject to change. Part numbers were determined as of Dec 2002 and may be obsolete. Evolution Robotics has no control over pricing, availability, or quality of third-party components.**
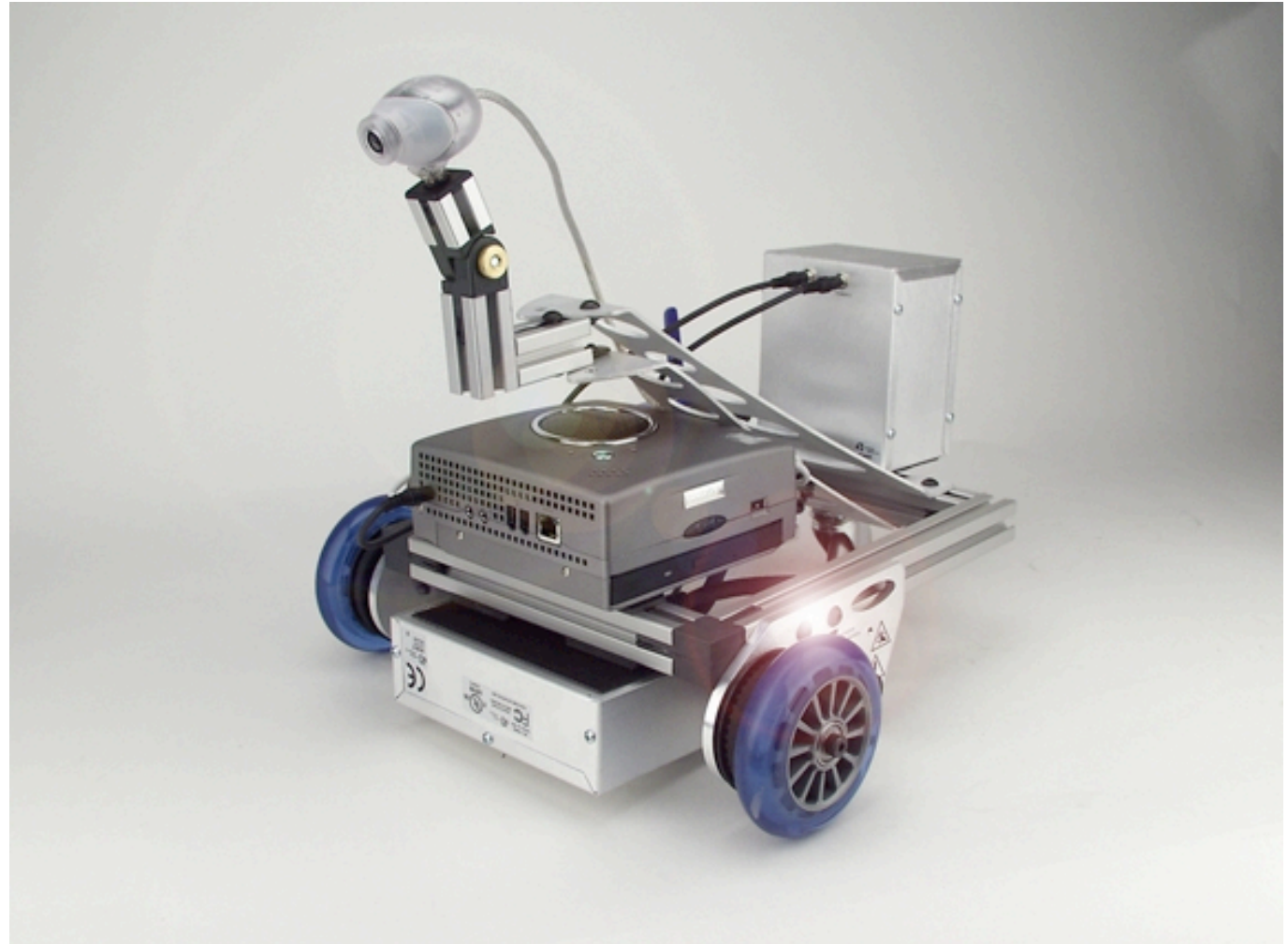
Overview

This white paper describes how to replace the ER1 laptop with a Mini Book PC and reconfigure the robot into an exciting new miniature robot.1' 2" long by 1' 2" wide by 1' 5" tall.

This paper is organized in five parts:

• Parts Lists

• Build Instructions

• Software configuration

• Operation

• Further Development

Prerequisites for this project:

• You must have an ER1. This will need to be reconfigured to create the robot outlined in this presentation.

•In order to use the robot in the manner described in this white paper, you'll need to have an 802.11b wireless network.

•You will need a desktop PC. Initially you will use the monitor, keyboard, and mouse to configure the Mini Book PC. Afterwards you will use the desktop to remotely control the Mini Book robot.

Parts -- Overview

You'll need an ER1 and the parts listed below for this project. Details on the parts and how they can be ordered are listed on the following pages.

Some general notes on the parts used:

•The Mini Book PC is a full featured but very small Pentium PC. It is especially convenient for use on the robot because unlike your average PC motherboard, it takes a single unregulated DC voltage as an input. Even more convenient is that the Mini Book will run off of 12 V, enabling you to use your existing ER1 battery. (Although our investigation of the regulator used internally on the Mini Book motherboard indicates that this should work fine and preliminary testing has validated this, it should be pointed out that this is not standard manufacturer suggested operation of this product and may invalidate the manufacturer's warranty)

•The Mini Book PC part suggested in this presentation is a bare bones system that does not come with Windows installed. You can purchase Mini Book PCs that come pre-configured, but these are more expensive.

•The suggested Mini Book PC is a 1.2 GHz Celeron. This is the only system that we have currently done preliminary testing on. Other less powerful computers may or may not be sufficient.

•Other wireless USB 802.11b adapters should work fine, however, we have currently only tested with the Linksys unit. Another nice feature about the Linksys product is that it comes with holding case and Velcro, so it's very convenient to mount onto the robot.

Part	Estimated Cost
ER1	N/A
Mini Book PC	$449.97
Windows XP	$99.99
Linksys WUSB11 802.11b Wireless USB Adapter	$56.29
Evolution Robotics Power Cable	$13.68
Total	**$619.93**

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Overview

Distributor: Tiger Direct (TigerDirect.com)

Distributor Part Number: **N52-1042**

Approximate Cost: $449.97

Notes: Price does not include Windows

Required for configurations: Base, Recommended, Fully Loaded

Specifications

- **Case**: Intraplex Mini Book PC Case

- **Processor:** Intel Celeron 1.2GHz CPU (Retail Box w/3 Year Warranty)

- **Memory**: 128mb PC-133 SODIMM (upgradeable to 512MB, only 1 slot)
- **Hard Drive:** 10gb Slimline Notebook Drive

- **Drives:** CD Drive: Notebook 24x

- **Modem:** PCTEL V.90 Modem on board

- **Chipset:** Intel 815E Chipset

- **Onboard video:** 11MB video on board

- **LAN:** 10/100 Realtek NIC on board

- **Motherboard**
  - Intel 815E Chipset Motherboard
  - Socket 370 (Supports up to P3 1.4GHz, Celeron 1.3GHz)

- **Onboard Sound**: AC97 Codec 16 channel Sound on board

- **I/O:**
  - 2- Rear USB
  - 2- Front USB
  - 1-IRDA port
  - 2- Rear 1394 Firewire
  - 1-PS/2 Keyboard
  - 1-PS/2 Mouse
  - 1- TV Out
  - 1- S-Video Out
  - 1-Audio In
  - 1- Audio Out
  - 1-Microphone

Parts – Windows XP OEM Version

Purchasing

Distributor: Tiger Direct (TigerDirect.com)

Distributor Part Number: **M17-7500**

Approximate Cost: $99.99

Notes:

Required for configurations: Base, Recommended, Fully Loaded

Specifications

Package Contents:
- Microsoft Windows XP Home Edition OEM Version

- ARX Rear Case Fan (60mm)

Purchasing

Distributor: Amazon.com

Distributor Part Number: **Linksys WUSB11 802.11b Wireless USB Adapter**

Approximate Cost: $56.29

Notes:

Specifications

- **Model:** WUSB11
- **Interface:** USB, plug and play
- **Standards:** IEEE 802.11b, USB 1.0 and 1.1
- **Channels:** 11 (US, Canada), 13 (Europe), 4 (Japan)
- **Speeds (Mbps):** 11, 5.5, 2, 1, auto fallback
- **Operating range:** Indoors: up to 100 feet at 11 Mbps, 165 feet at 5.5 Mbps, 230 feet at 2 Mbps, 300 feet at 1 Mbps; outdoors: up to 500 feet at 11 Mbps, 885 feet at 5.5 Mbps, 1,300 feet at 2 Mbps, 1,500 feet at 1 Mbps
- **LEDs:** Power, link
- **Frequency:** 2.4 GHz, direct-sequence spread spectrum (DSSS)
- **Compatibility:** PC
- **System requirements:** PC with USB port; Windows 98, Me, or 2000; Pentium 90 MHz or faster processor; 32 MB RAM (minimum), CD-ROM drive
- **Software included:** Driver utility on CD-ROM
- **In the box:** Wireless USB network adapter, USB cable, CD-ROM, user guide, registration card
- **Dimensions:** 4.84 by 3.38 by 1.10 inches (W by D by H)

Parts – Evolution Robotics Power Cable

Purchasing

Distributor: Evolution Robotics (www.evolution.com)

Distributor Part Number: MC5001

Approximate Cost: $13.68

Notes:

Specifications

- 2.5 mm DC Power Jacks
- 1.5 foot long

Build Instructions -- Overview

The frame of this robot can be built using the standard parts that came with your ER1. You may want to organize each of the beam lengths by size prior to starting the project.

2 x 10" beam, 2x 2D2

1 x 8" beam, 2 x 1x2 Velcro, 1 x U-clip

1 x 7" beam on U-clip, 2 x Gussets.

Assembly from step1 added

Wheel assembly slides on 10" beam

Locate screws as shown

Slide the Sideplate and Caster onto 8" beam, Caster in the middle of the Sideplate…
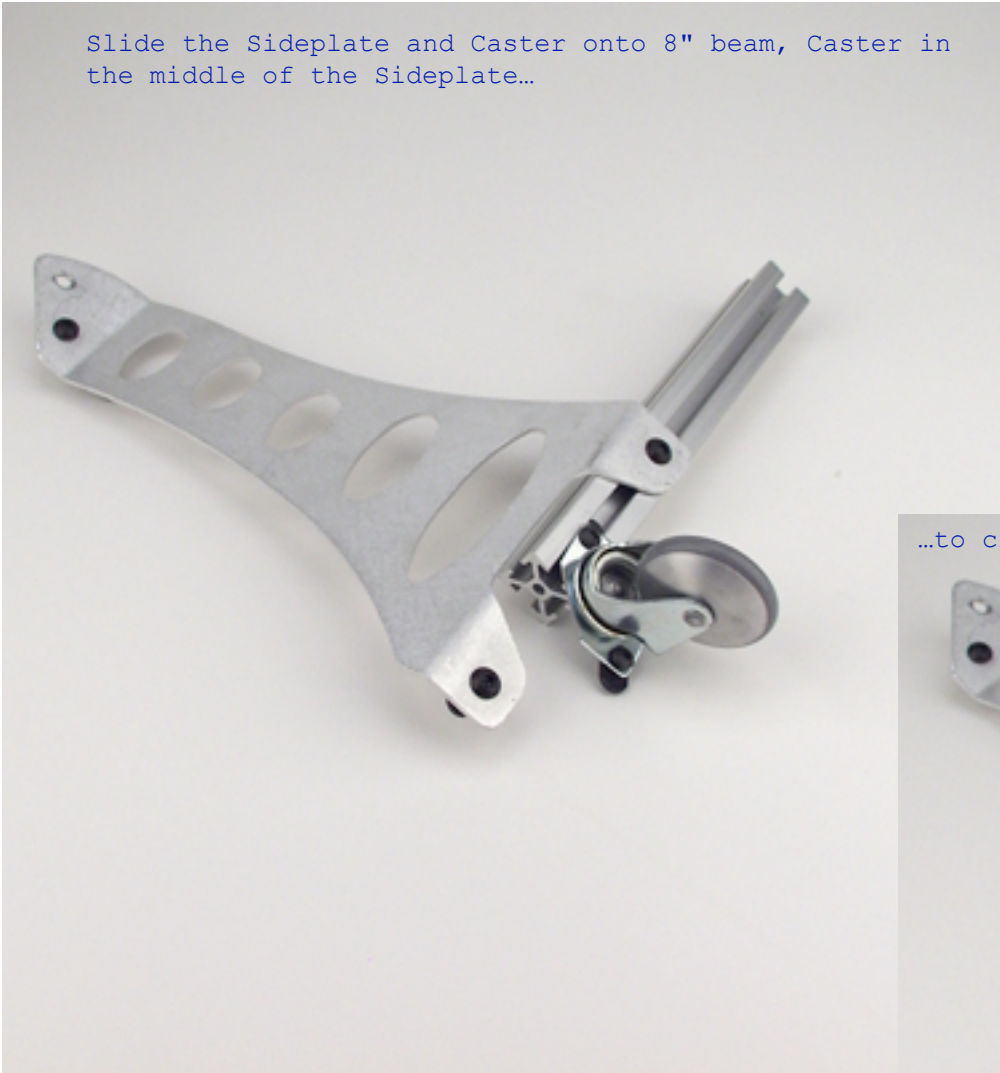
…to create the assembly shown here

Locate screws as shown

Slide into beam as shown
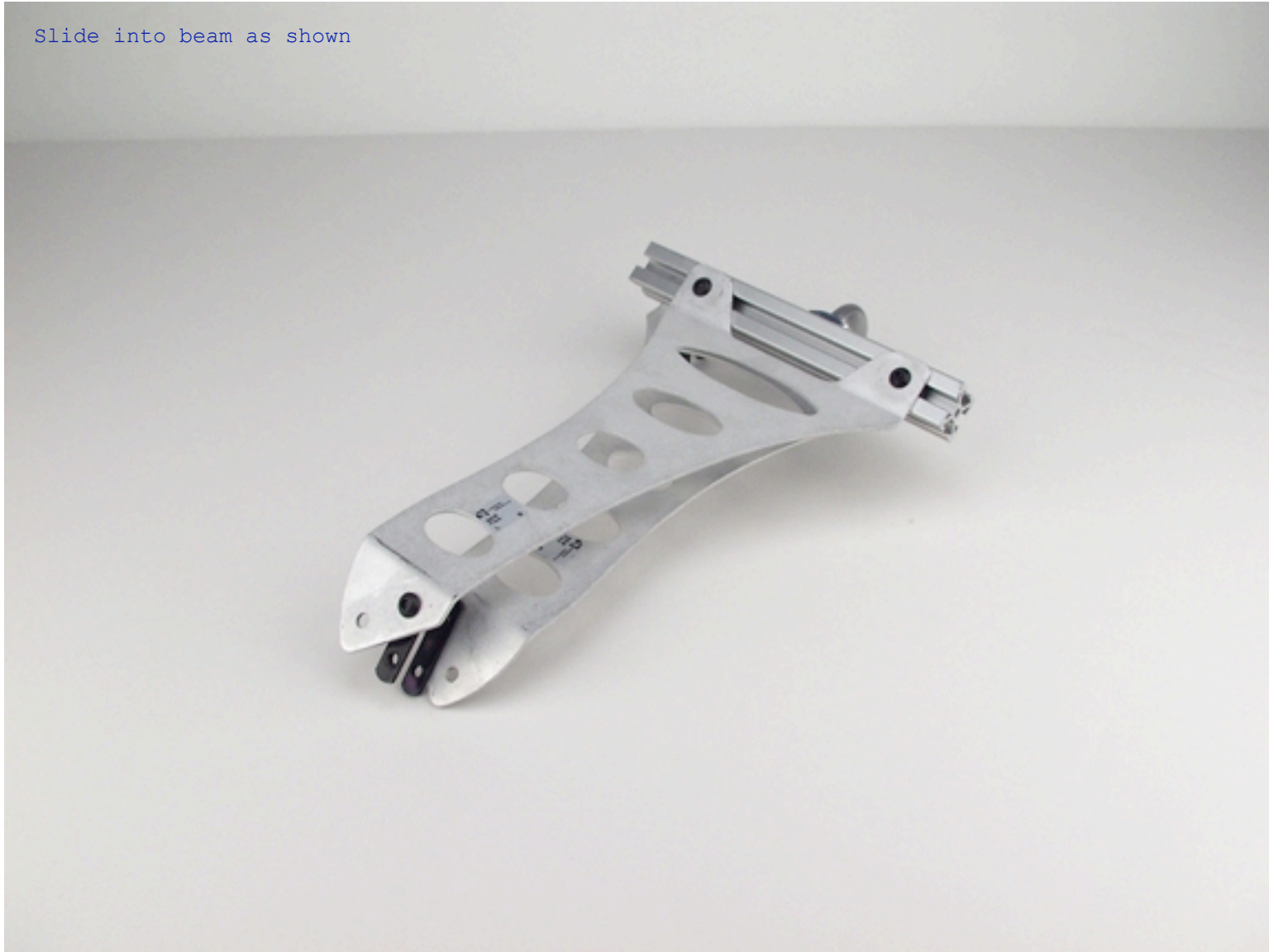
Add 2 x U-clip

Slide assembly into 10" beams

1 x 2" beam, 1 x U-clip

1 x 2" beam, 1 x Hinge
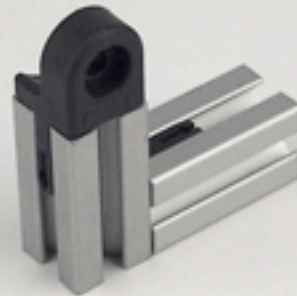
Mount the assembly in the Sideplates use 2 x screws to
attach 2"beam. Add camera assembly

Add 3 x Foam 1x2 and 1 Velcro 1x2

Attach the motor connectors and mount the RCM under the front 8" beam

1 x Battery

1 x MiniBook, attach the camera USB

Attach the wireless network bridge using Velcro, connect to MiniBook
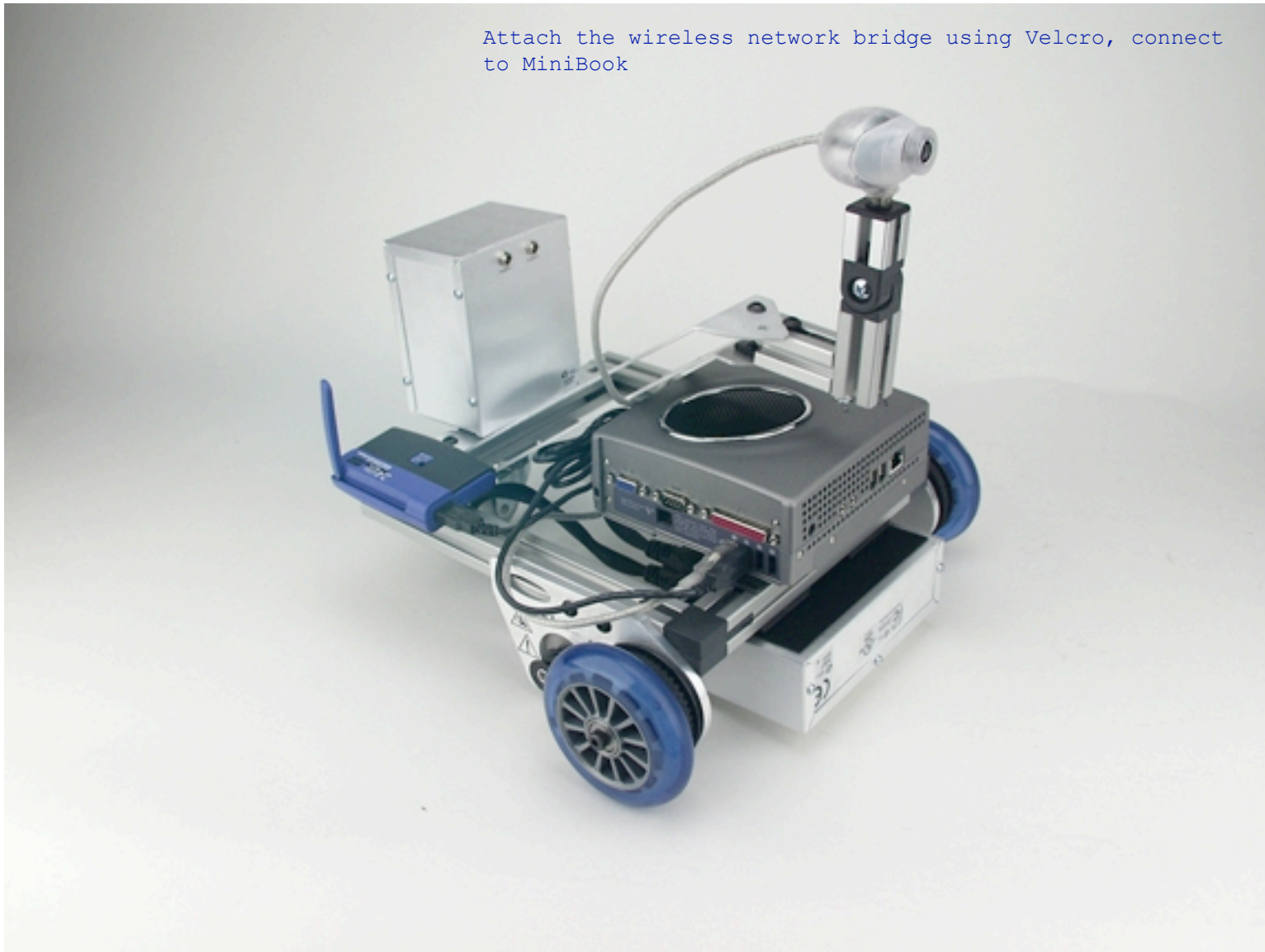
Connect RCM to the USB port on the Mini Book PC

Add 2 x power cables.

Congratulations! You've completed the build portion of this project.

There are three steps required to configure the Mini Book PC for use with the ER1 software:

• Installation of Windows

• Installation of the wireless bridge

• Installation of ER1 software

• Installation of VNC

The Mini Book PC part number recommended in this white paper is a bare bones system that does not come with Windows installed. Also, until VNC is up and running, you'll need to connect up to a keyboard, mouse and monitor in order to configure the Mini Book PC.

• Connect a keyboard, mouse, and monitor to the Mini Book PC. Also it is probably at this point more convenient to power the Mini Book PC using the power supply that comes with the Mini Book PC, rather that running it off the ER1 battery.

• Configure the Mini Book PC to boot first off the CD ROM. On the unit tested for this white paper, this was done by pressing DEL while the PC was booting through the BIOS screen.

• Insert the Windows installation CD and reboot the system.

• Follow the on screen directions and install Windows. MAKE SURE YOU DON"T LOSE THE MICROSOFT CERTIFICATE OF AUTHENTICITY STICKER THAT IS ATTACHED TO THE WRAPPER OF THE WINDOWS INSTALLATION CD. You need the numbers on this sticker to be able to complete the installation of Windows.

- Following the instructions that come with your wireless bridge, install all necessary drivers and connect bridge to the Mini Book PC.

- Configure the bridge and confirm that it is operation by for example connecting to a well known website.

- Although not absolutely necessary, for operation to be practical, you should configure the Mini Book PC to have a static IP address.

Installation of ER1 software on remote Mini Book PC

• Install the ER1 software following the instructions in the ER1 manual

• Connect the RCM and camera to the system. Follow the instructions in the ER1 manual and install the drivers for these items.

• Power the RCM from the ER1 battery and then start the ER1 software. Confirm that you can drive the robot using the joystick control and confirm that the camera comes up fine.

• Configure the RCC to allow remote operation.

Installation of ER1 software on main desktop system

Since you will be controlling the Mini Book robot from a main desktop system, you will also need the ER1 software installed on that system.

• Install the ER1 software following the instructions in the ER1 manual

• Test configuration by connecting to the IP address of the Mini Book PC system. Ideally for optimal troubleshooting purposes you would have two sets of monitors and keyboards for both the Mini Book PC and the main desktop system. If you don't you can try removing the keyboard, mouse and monitor from the Mini Book system and returning it to the desktop system.

VNC stands for Virtual Network Computing. It is remote control software which allows you to view and interact with one computer (the "server") using a simple program (the "viewer") on another computer anywhere on the Internet. The two computers don't even have to be the same type, so for example you can use VNC to view an office Linux machine on your Windows PC at home. VNC is freely and publicly available and is in widespread active use by millions throughout industry, academia and privately. You can download VNC from realvnc.com.

Since you don't want to always have to connect a monitor and keyboard to your Mini Book robot, VNC is essential. It allows you to log into the remote Mini Book and control it as if you were directly connected to it using a monitor, mouse, and keyboard.

• Install VNC server on the Mini Book PC

• Install VNC viewer on your main desktop system

• Test the setup by logging into the remote Mini Book PC.

Once you've configured the software on your Mini Book PC as described earlier, you will no longer need to connect a keyboard, mouse, and monitor to your robot. Instead simply program the Mini Book PC robot using your ER1 RCC software on your main controlling desktop PC. If you need to adjust other settings on the Mini Book PC, log in using VNC and make the adjustments as if you were sitting at the machine with a keyboard and mouse directly connected to the robot.

Main Controlling PC
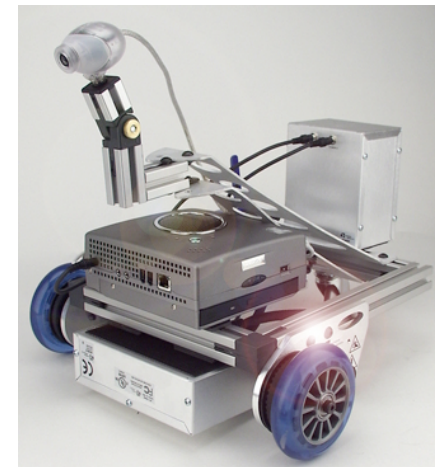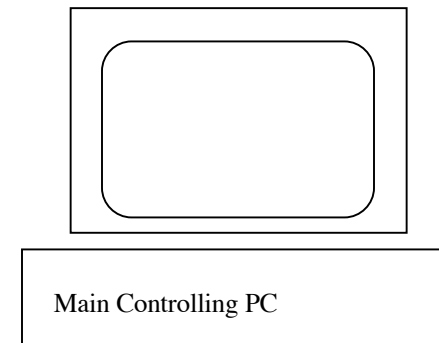
Remote MiniBook Robot

We'd love to hear feedback from those who attempt this project. What are the pros and cons of this configuration?

Depending on the level of interest in this project, there may be additional white papers describing additional features which can be added to this robot including:

• LCDs (we're looking at a 5" screen from Xenarc and a 7" touch screen version)

• Additional power modules. (Preliminary tests show that the robot can drive continuously for about 45 minutes on a single fully charged battery.)