Updating Firmware on the CEENBoT 324 Version 0.1, September 21, 2011

Below are instructions for programming the factory firmware on your CEENBoT robot using Atmel's AVR Studio 4.

Background

What is Firmware?

Firmware is a program that is written and stored in non-volatile memory on the CEENBoT microcontrollers. It does not change nor need to be reprogrammed when the microcontroller starts up. Unless you take steps to change it, firmware does not change.

CEENBoTs, Microcontrollers and Firmware

The CEENBoT has 2 microcontrollers that have updateable firmware. New versions of firmware are released in pairs for the microcontrollers. We strongly recommend that if you update firmware for one of the microcontrollers, you update the other to the same version.

The main microcontroller on your CEENBoT is an Atmel ATMega324P or for newer models, the Atmel ATMega1284. We will refer to this as the "Mega".



Figure 1 - CEENBoT ATMega324P (AKA "Mega")

The secondary microcontroller is an Atmel ATTiny48. We will refer to this as the "Tiny"



Figure 2 - CEENBoT ATTiny48 (AKA "Tiny")

Since these devices talk to each other, we recommend that they use the same firmware version to reduce the chances of odd behavior or problems due to communication problems.

Checking Firmware Versions

CEENBoTs report the installed version of software for both microcontrollers when the robot is running. Simply press the S3 button once to change to the firmware version screen.



Figure 3 - Switch S3 to Display Firmware on LCD

CEENBoT publishes the most current firmware version on the <u>www.ceenbotinc.com/tools</u> web site. Compare the version you have installed with the published version to see if your CEENBoT is up to date.

New Firmware

In September, CEENBoT engineering released a new version of firmware that significantly improves battery charging and makes the CEENBoT compatible with the battery charger included with current CEENBoT robots. This version is 1.102R for both the Mega and Tiny. We recommend updating your robot to this version of firmware.

Upgrading Firmware

If you have already programmed your CEENBoT using AVR Studio 4, the upgrade process will be familiar to you. If you have not, read the following instructions and decide if you are comfortable performing the upgrade.

If you are not comfortable with performing the upgrade process, please contact us at support@ceenbotinc.com to discuss other options for the upgrade.

Requirements for Upgrading

Upgrading your CEENBoT will require that you have a few resources handy to complete the process:

1) A computer with Windows XP, Vista or 7 installed.

2) Atmel AVR Studio 4. This is no-cost software available for download from the Atmel web site, <u>http://www.atmel.com/dyn/products/tools_card.asp?tool_id=2725</u>

Note that you will need to register to download the free software. Install AVR Studio 4 onto your computer following the instructions provided by Atmel, including support for the AVRISP mkII programmer.

Warning: AVR Studio 4 is NOT compatible with CEENBoT Commander. If you already have CEENBoT Commander on your computer, DO NOT install AVR Studio 4. Contact us at support.ceeenbotinc.com for more information.

3) Atmel AVRISP mkll programmer. This is a small device that connects between your computer and the CEENBoT, and performs the programming. On-line vendors like Digikey sell these, or they are available for purchase from CEENBoT, Inc. One programmer can be used to upgrade all the CEENBoT robots you have.



Figure 4 - Atmel's AVRISP mkII Programmer

4) New firmware. The current firmware version is available at: <u>www.ceenbotinc.com/tools</u>. Two files are needed, one for the Mega and one for the Tiny.

5) A charged battery. The CEENBoT will need to be turned on and powered by battery for the programming process.

6) A CEENBoT with an old version of firmware.

Upgrade Process

In the following steps, we will describe the actions to upgrade your firmware.

Step 1) Start AVR Studio

Step 2) Plug in your AVRISP mkII programmer and follow the prompts to install the driver for it on your computer.

Once successful, the AVRISP mkII programmer should now have a green light illuminated at the USB connector end and a red light illuminated on the robot end.



Figure 5 - AVRISP mkII Programmer with Correct Drivers

Step 3) For your safety and protection for the robot, disconnect the two motor cables from the CEENBoT controller.



Figure 6 - Disconnect Both Motor Cables

Step 4) Connect the AVRISP mkII programmer to the CEENBoT ISP programmer connector. This connector is located to the right side of the board, and is 2 pins wide by 3 pins high. Newer robot controllers have a blue plastic shroud around this connector.



Figure 7 - Programmer Connected to Robot Controller

To correctly orient the programmer connector, the cable should go to the right, and all 6 pins should be connected. Double check this, as damage can be caused to the programmer if this is not correct.

Step 5) Confirm or move the microcontroller program select jumper is ready for the Tiny . The jumper is located immediately to the right of the CEENBoT controller's red LED, straight above the programmer connector. If the jumper is on the top two pins, it will select the Mega. If it is on the bottom two jumpers, it will select the Tiny. Make sure it is located on the bottom two pins for the Tiny.



Figure 8 - Microcontroller Programming Select Jumper , Tiny At Bottom

Step 6) Turn on your CEENBoT. In a short time, the red light on the AVRISP mkII programmer will turn green so that both lights are now green.



Figure 9 - AVRISP mkII Programmer Correctly Connected to Controller

Step 7) Select the "Display Connect Dialog" icon on the AVR Studio 4 toolbar



Figure 10 - AVR Studio 4 Programmer Connect Icon

Step 8) Identify your programmer as the AVRISP mkII, connected by USB.

Select AVR Program	nmer				
Platform: AVR ONE! STK600 QT600 AVRISP mkll STK500 JTAGICE mkll AVR Dragon AVRISP Tip: To auto-connect t button on the toolbar. Note that a tool canno a debugging session. I	o the programm t be used for p n that case, se	Port: USB ner used last time, (rogramming as long lect 'Stop Debuggi	press the 'Programmer' g as it is connected in ng' first.	Connect Cancel Baud rate: 115200 Baud rate chang active immediate	ges are
F	igure 11 - Se	election for the (Correct Programm	er	

Step 9) In AVR Studio 4, on the Main screen, select 125KHZ as the programming speed, and click <write>

Main [Program Fuses LockBits Advanced HW Settings HW Info Auto	
Devi	e and Signature Bytes	1
ATn	ega324P Since Device	
0x18	0x92 0x09 Read Signature	
WAF	NING: Signature does not match selected device!	
Prog	amming Mode and Target Settings	
ISP	node 💽 🖌 Settings	
	ISP Frequency: 125.0 kHz	2
	Taxaat Sattinas	
	ISP Clock	
	Pead	
	ISP Freq: #25.0 kHz V Attainable:	
	Write	
	Close	
	Nate: The TCD frequency much be less than 1/4 of the target	
	Note: The top frequency must be less than 1/4 of the target	
ottina in	parameter SD-0405 OK	3
etting is	parameter. 30-0x00 OK	

Figure 12 - In AVR Studio 4, Setting the Programmer Speed

Step 10) In AVR Studio 4, on the Main screen, select the ATTiny48 microcontroller from the drop-down menu. It will be near the bottom of the list.

ain Program Fuses LockBits	Advanced HW	Settings HW Info Auto
Device and Signature Bytes		
ATmega32	~	Erase Device
AT tiny44 AT tiny44A AT tiny45 AT tiny461 AT tiny461A	^	Read Signature
ATtiny48		
AT tiny5 AT tiny84 AT tiny85 AT tiny861 AT tiny861A AT tiny87 AT tiny88		Settings ISP Frequency: 125.0 kHz
ATtiny9 ATxmega128A1 ATxmega128A3 ATxmega128D3		
ATxmega16A4 ATxmega16D4 ATxmega192A3 ATxmega192D3		
ATxmega256A3 ATxmega256A3B ATxmega256D3 ATxmega3264		
ATxmega32D4 ATxmega64A1 ATxmega64A3		
ATxmega64D3 No device selected	~	

Figure 13 - Selecting the ATTiny48 Microcontroller in AVR Studio 4

Step 11) Check the processor ID by clicking the button. You should see the message" processor matches.

RISP mkll in ISP mode with ATtiny48	
ain Program Fuses LockBits Advanced HW S	Settings HW Info Auto
ATtinu48	Frase Device
0x1E 0x92 0x09	Read Signature
Signature matches selected device	
Programming Mode and Target Settings	
ISP mode	Settings.
	ISP Frequency: 125.0 kHz
ting mode and device parameters., DK!	
ering programming mode OK!	

Figure 14 - Confirming the Correct Microcontroller is Selected in Software and With Jumper

If you get the message that the processor does not match, troubleshoot the problem by checking the microcontroller program select jumper and the microcontroller type on the programmer screen.

DID	Discourse	Euro	LashDas	(Advanced	LINK COM			
airi	Program	Fuses	LOCKBICS	Advanced	HW Settin	gs HW In	ro Auto	
De	vice and Si	gnature E	lytes					
A	Tmega324F	8		*		Erase [evice	
08	(1E 0x92 0x	09				Read Si	gnature	
W	ARNING: SI	ignature (does not ma	atch selected	device!			
-		-			-			
Pro	ogramming N	lode and	I larget Set	tings				
IS	iP mode			~		Settir	ngs	
						ISP Frequ	ency: 125.0 kH	łz
tting	mode and d	device pa	arameters (ок!				

Figure 15 - Error if Incorrect Microcontroller Settings are Selected

If you get the message no power, make sure the robot is turned on, that both programmer lights are green, that the connector is on right and that the program select jumper is on right.

Step 12) In AVR Studio 4, on the programmer screen, select the firmware for the ATTiny48 microcontroller from the location where you put it when downloaded.

Open					? 🛛
Look jn:	CEENBoT Fi	rmware	00	• 🛄 💙	
My Recent Documents Desktop	ATMega324_v	/1_102R.hex 102R.hex			
My Documents					
My Computer					
	File <u>n</u> ame:	ATTiny48_V1_102R.hex		· (<u>O</u> pen
My Network	Files of type:	Flash Intel Hex Files (*.hex;*.a90))	• (Cancel

Figure 16 - Selecting the Right Firmware File for Tiny Upgrade

Step 13) Make sure the erase before programming check box is selected (checked).

AVRISP mkll in ISP mode	e with ATmega324P
Main Program Fuses	LockBits Advanced HW Settings HW Info Auto
Device	
Frandovice	
Erase device befo	re flash programming 🕖 🛛 🗹 Verify device after programming
Flash	
O Use Current Simula	ator/Emulator FLASH Memory
Input HEX File	wnloads\CEENBoT Firmware\ATMega324_V1_102R.hex
Program	Verify Read
EEPROM	
O Use Current Simula	ator/Emulator EEPROM Memory
💿 Input HEX File	
Program	Verify Read
ELF Production File Form	at
Input ELF File:	
Save From: 🔽 FLASH	EEPROM FUSES LOCKBITS Fuses and lockbits settings
Program) must be specified before saving to ELF
Erosing device OKI	
Programming FLASH OK	1
FLASH contents is equal to fil	e OK
Leaving programming mode	OK!

Figure 17 - Setting AVR Studio 4 to Erase the Microcontroller Before Reprogramming

Step 14) Press the program button and wait for the process to complete. AVR Studio 4 shows a progress bar at the bottom left of the screen. Note that programming is a two-step process that first writes the firmware and the reads it back to make sure no errors occurred.

WRISP mkll in ISP mode with ATmega324P
Main Program Fuses LockBits Advanced HW Settings HW Info Auto
Device
Erase Device
Erase device before flash programming
Flash
Use Current Simulator/Emulator FLASH Memory
Input HEX File wnloads\CEENBoT Firmware\ATMega324_V1_102R.hex
Program Verify Read
EEPROM
Program Verify Read
ELF Production File Format
Input ELF File:
must be specified before
Program Save saving to ELF
Erasing device OK!
Reading FLASH OK!
FLASH contents is equal to file OK Leaving programming mode OK!

Figure 18 - The "Program" Button in AVR Studio 4 Starts Programming Process

Note the results of the programming process in the window at the bottom. You are looking for "OK!" for erasing, programming, reading and contents are equal.

Step 15) Prepare to program the Mega microcontroller. Move the microcontroller program select jumper to the top two pins to select the Mega



Figure 19 - Microcontroller Programming Select Jumper, Mega at Top

Step 16) In AVR Studio 4, on the programmer screen, select the ATMega324P microcontroller from the drop-down menu. It will be near the middle of the list. There are several microcontrollers listed that start with the name ATMega324P. Be sure to use the ATMega324P setting.

1ain	Program	Fuses	LockBits	Advanced	HW Setti	ngs HW Info Au	ito
De	vice and Si	gnature B	lytes			22	
A	[mega324P	0		~		Erase Device	1
AT AT AT AT AT AT AT AT AT	mega32 mega324A mega324P mega325 mega3250 mega3250 mega325A mega325P mega328 mega328P mega328P mega328P	A P			device!	Read Signature Settings ISP Frequency:) 125.0 kHz
AT AT AT AT AT AT AT AT AT AT AT AT	mega3290 mega3290 mega329A mega329A mega329P mega329P mega32A mega32C1 mega32L1 mega32L2 mega32L4 mega32L4 mega32L6 mega48 mega48A	Р А (В					
AT AT	mega48PA mega64 mega640	63		~			
ttihg	isp paramet	ei 5D=0	NOP OK				

Figure 20 - Selecting the ATMega324P Microcontroller in AVR Studio 4

Step 17) Check the processor ID by clicking the button. You should see the message" processor matches.

If you get the message that the processor does not match, troubleshoot the problem by checking the microcontroller program select jumper and the microcontroller type on the programmer screen.

If you get the message no power, make sure the robot is turned on, that both programmer lights are green, that the connector is on right and that the program select jumper is on right.

AVRISP mkll in ISP mode with ATmega324P	
Main Program Fuses LockBits Advanced HW Se	ttings HW Info Auto
Device and Signature Bytes	
ATmega324P	Erase Device
0x1E 0x95 0x08	Read Signature
Signature matches selected device	
Programming Mode and Target Settings	
ISP mode	Settings
	ISP Frequency: 125.0 kHz
Setting mode and device parameters: OKI	
Entering programming mode. OK!	
Leaving programming mode OK!	~

Figure 21 - Checking That the Correct Microcontroller is Selected on Controller and in Software

Note: a small number of robots built for University and College Engineering departments have the ATMega1284 processor installed instead of the ATMega324P. If your robot has the ATMega1284 installed, AVR Studio 4 will report a mismatch. This is acceptable and you may continue without changes to settings.

Step 18) In AVR Studio 4, on the programmer screen, select the firmware for the ATMega324 microcontroller from the location where you put it when downloaded.

Open					? 🛛
Look jn:	🚞 CEENBoT Fir	mware 😪	00	🖻 🛄 -	
My Recent Documents Desktop	ATMega324_V	1_102R.hex 102R.hex			
My Documents					
My Computer					
	File <u>n</u> ame:	ATMega324_V1_102R.hex		· (<u>O</u> pen
My Network	Files of type:	Flash Intel Hex Files (*,hex;*,a90)		~ (Cancel

Figure 22 - Selecting the Correct Firmware File for the Mega

Step 19) Press the program button and wait for the process to complete. AVR Studio 4 shows a progress bar at the bottom left of the screen. Note that programming is a two-step process that first writes the firmware and the reads it back to make sure no errors occurred.

AVRISP mkll in ISP mode with ATmega324P
Main Program Fuses LockBits Advanced HW Settings HW Info Auto
Device
Erase Device
Erase device before flash programming Verify device after programming
Flash
Use Current Simulator/Emulator FLASH Memory
Verify Read
EEPROM
Use Current Simulator/Emulator EEPROM Memory
Program Verify Read
ELF Production File Format
Input ELF File:
Save From: FLASH EEPROM FUSES LOCKBITS Fuses and lockbits settings
Program Save saving to ELF
Erasing device OK!
Reading FLASH UK!
LASH contents is equal to file UK Leaving programming mode OK!

Figure 23 - The "Program" Button in AVR Studio 4 Starts Programming Process

Note the results of the programming process in the window at the bottom. You are looking for "**OK!**" for erasing, programming, reading and contents are equal.

Step 20) Disconnect the AVRISP mkII programmer from your CEENBoT, and turn off the CEENBoT for a few seconds.

Step 21) Turn your CEENBoT on and once it has fully started, check the firmware version it reports by pressing S3 until the correct screen is displayed. If the firmware version is the one you installed, your upgrade is successful. If it is not the expected version, check the steps and firmware file names and try again. If you are unable to get the expected version to display, contact us at support@ceenbotinc.com.



Figure 24 - Using Switch S3 to Check New Firmware on LCD

Step 22) Turn off the CEENBoT, reconnect the motor cables, close AVR Studio 4.

Congratulations, you are done!