

Rbe 3001 Development board guide

The RBE Development board is designed to use an AVR644P to control a robotics system. The Board has multiple functions and features.

<u>Wiki</u>

3001 Wiki: http://wiki.wpi.edu/robotics/RBE_3001

Processors

AVR 644P Main Processor

http://wiki.wpi.edu/images//images/b/be/Atmel-8011-8-bit-avr-microcontroller-atmega164p-324p-644p_datasheet_%281%29.pdf

AVR 328P Co Processor

http://wiki.wpi.edu/images/images/9/9b/328p.pdf

Programmer

ISP Programming ports for both processors

http://wiki.wpi.edu/images//images/5/5a/Pololu_usb_avr_programmer.pdf

USB Communication

FTDI 232 USART to USB serial interface

http://wiki.wpi.edu/images//images/a/a4/DS_FT232R.pdf

SPI Devices

1 -12 bit 4 channel SPI Digital to Analog Converter (DAC)

http://wiki.wpi.edu/images//images/3/3e/10_Bit_DAC_3001.pdf

2- SPI Quadrature encoder counters

http://wiki.wpi.edu/images//images/f/f1/LS7366R.pdf

MOSFETS

4 -High Power linear Op Amps (Linear Drivers)

http://wiki.wpi.edu/images//images/5/59/Opa548.pdf

2-High Power Sinking MOSFETS

http://wiki.wpi.edu/images//images/9/99/ZXMN4A06G.pdf

Analog Sensing

2-Analog Current Sense circuits

http://wiki.wpi.edu/images//images/5/51/Lmp8601.pdf

Other

8-LED's

8-Switches

1-Sensor Interface for WPI Sensor Boards

8-Coprocessor Controlled Servo Ports

4-Analog Input ports

1-H-bridge with 2 motor outputs

AVR 644P

The 644P is a high performance, low power, low cost 8 bit microcontroller. The microcontroller has 64 Kbytes of Flash memory, JTAG and ISP programming ports, 2-8bit Timers/Counters, 1-16bit Timer/Counter, 8 channel 10-bit Analog-To-Digital-Converter (ADC), 2-Serial USARTs, Master/Slave SPI. The microcontroller is a 5V, 40 Pin Wide DIP package with an 18.432 MHz External Crystal. It also has an internal oscillator that is not used in RBE 3001.

We are Using the Eclipse C/C++ IDE with WINAVR and the Eclipse-AVR Plug-in to program the AVR 644P, Along with Git to access the Fusion forge Project.

Eclipse Install

1. Download Eclipse IDE for C/C++ Developers

http://www.eclipse.org/downloads/

a. How to tell if you are running 32-bit or 64-bit

http://support.microsoft.com/kb/827218

- 2. Extract the Eclipse folder from the downloaded zip file to a desired location and run Eclipse from the extracted folder.
- 3. Choose a workspace (where your code will be stored) and press OK.

WinAVR

- 1. Download WinAVR at <u>http://sourceforge.net/projects/winavr/files/</u>.
- 2. Open the WinAVR folder and open 20100110 (the most recent version).
- 3. Download and install WinAVR-20100110-install.exe with the default settings.

Or if you are using mac

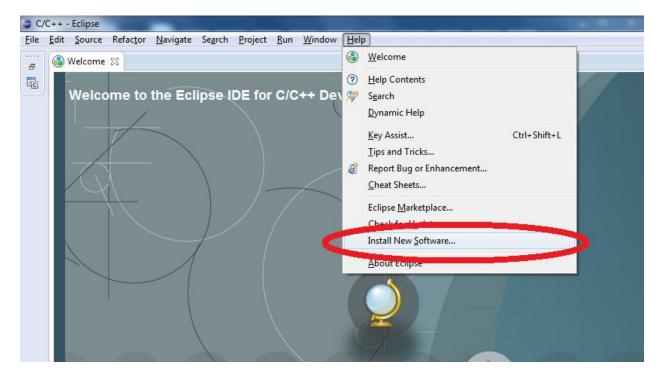
- 1. Download <u>https://www.obdev.at/products/crosspack/index.html</u>
- 2. Follow the instructions on the crosspack website.

JDK

- Download the Java Development kit at <u>http://www.oracle.com/technetwork/java/javase/downloads/index.html</u> by clicking on the Download button under JDK. If you do not have it already.
- 2. Accept the license agreement and download the 32-bit (x86) or 64-bit (x64) depending on your version of Windows.
- 3. Install it with the default options.

AVR Install

1. Use Eclipse to install the AVR plugin (Help > Install new software)



2. In the Work with field, input <u>http://avr-eclipse.sourceforge.net/updatesite</u> and click add.

Install		
Available Software Select a site or enter the location of a site.		
Work with: http://avr-eclipse.sourceforge.net/updatesite	Find more software by working with the <u>Available Software</u>	<u>A</u> dd
type filter text		
Name	Version	
① There is no site selected. Select All Deselect All		
Show only the latest versions of available software	\overline{I} <u>H</u> ide items that are already installed	
	What is <u>already installed</u> ?	
Show only software applicable to target environment		
Contact all update sites during install to find required software		
(V)	< <u>Back</u> <u>N</u> ext > <u>Finish</u>	Cancel

- 3. In the next prompt in the name field put AVR and click OK.
- 4. Make sure AVR Eclipse Plugin is selected and click Next.

Install	
Available Software Check the items that you wish to install.	
Work with: http://avr-eclipse.sourceforge.net/updatesite	▼ <u>A</u> dd
type filter text	Find more software by working with the <u>"Available Software Sites"</u> preferences.
Name	Version
a 👿 💷 AVR Eclipse Plugin	
AVR Eclipse Plugin	2.4.0.201203041437
Select All Deselect All 1 item selected	
A plugin to support development for the Atmel AVR series of embedded micro	processors, including support for the avr-gcc toolchain.
Show only the latest versions of available software	✓ <u>H</u> ide items that are already installed
<u> G</u> roup items by category	What is <u>already installed</u> ?
Show only software applicable to target environment	
<u> C</u> ontact all update sites during install to find required software	
?	< <u>Back</u> <u>Next ></u> <u>Finish</u> Cancel

- 5. Click Next again on the Install Details screen and then accept the terms of the license agreement and click Finish to start the installation.
- 6. When a Security Warning comes up saying the software contains unsigned content, click OK to continue with the installation.
- 7. When asked to restart Eclipse, click Yes.

Fusion Forge Setup

- 1. Each member needs to create an account at https://fusion.wpi.edu
- 2. One person in the group needs to create the project on Fusion Forge by click the My Page button near the top of the page.



3. Next, click on Register Project

Fusion Storge	Project 💌 Search		Log Out (Eric Willcox) My Account Get Help WPI fusion user guide Quick Jump To
Home	My Page	Projects	Code Snippets
Personal Page For Eric Willcox My Personal Page Trackers dashboard Diary & N Add widgets Customize layout	iotes Account Maintenance Register Project		
My Projects	rss 🖻 🗙	My Artifacts	Preferences 🖃 🗙
3733 Software Engineering b12 Team 2 [Admin] (Admin)	(*)	You have no artifacts.	
RBE3001-C13-Team2 [Admin] (Admin) (*)		None	
RBE_3001_C_term_2013 (Student) (*)	8		
(*) Private project			

4. Read the descriptions and fill out the form appropriately. Make sure for Source Code you choose Git and for Project Template you choose WPI Git Template Project.

Register Project My Personal Page Trackers dashboard Diary & Notes Account Maintenance Register Project
To apply for project registration, you should fill in basic information about it. Please read descriptions below carefully and provide complete and comprehensive data. All fields below are mandatory.
1. Project full name
You should start with specifying the name of your project. The "Full Name" is descriptive, and has no arbitrary restrictions (except a 40 character limit).
Full Name:
2. Project Purpose And Summarization
Please provide detailed, accurate description of your project and what FusionForge resources and in which way you plan to use. This description will be the basis for the approval or rejection of your your project. It must be written in English.
2. Desirat Bublis Description
3. Project Public Description
This is the description of your project which will be shown on the Project Summary page, in search results, etc.
4. Project Unix Name
In addition to full project name, you will need to choose short, "Unix" name for your project.
The "Unix Name" has several restrictions because it is used in so many places around the site. They are:
cannot match the unix name of any other project;
 must be between 3 and 15 characters in length; must be in lower case (upper case letters will be converted to lower case);
can only contain characters, numbers, and dashes; must be a valid Unix username;
cannot match one of our reserved domains; Unix name will never change for this project;
Your unix name is important, however, because it will be used for many things, including:
 a web site at unixname.fusion.spi.edu, the URL of your source code repository, search engines throughout the site.
Unix Name:
5. Source Code
You can choose among different SCM for your project, but just one (or none at all). Please select the SCM system you want to use.
SCM Repository: ONo SCM OSubversion GGI
6. Project template
Please pick a project that will act as a template for yours. Your project will initially have the same configuration as the template (same roles and permissions, same trackers, same set of enabled plu
WPIGIT Project Template

- 5. Click submit and wait up to 72 hours for an Admin to approve your project.
- 6. Once approved, go back to the My Page section of Fusion and select your project.
- 7. To add members to your group, click on the Admin page on the top.
- 8. Click on Users and Permissions.

Fusion Forge		Search the entire project	Search Advanced search	
Home		My Page	Projects	Code Snippet
Summary	Admin	Tracker	Docs	Surveys
Project Information Project Informatio () Users and permissions) cools P	Project History Stats Qu	ota		
Misc. Project Information				
Descriptive Project Name				
RBE 3001 Team Pretend E 13				
Short Description				
Maximum 255 characters, HTML will be stripped from	this description			
Robotics 3001 E 13 Test				
	/			
Project tags				

9. Under Add Member, type in the Usernames of those you wish to add and press Add Member.

OR

Select Add Users From List to see all members registered on Fusion and select who you want to add and press Finish.

Fusion SForge		Search the entire project	Search Adv	vanced search					Log Out (f
Home		My Page	1	Projects Code Sni		Code Snip	pets		
Summary	Admin	Tracker		Docs			Surveys	New	is
Members of RBE 3001 Team Pretend E 13 Project Information Users and permissions Tools Project History Stats Quota									
Add Member					Edit Roles				
			Ad	min 💌 Add Member	Role name				
Add Users From List			_		Admin				
User name Role				Action	Anonymous/not logg	ged in (g	global role)		
Adm				Remove	Any user logged in (g	global n	ole)		
Eric Willcox	nin 💌			Grant extra role					
7.00				(oran crub rong					
					Edit Observer				
					Currently used ext	ternal	roles		
					Role name				
					Anonymous/not logg	ged in (g	global role)		
					Any user logged in (global n	ole)		
					Available external				
					Role name	i roles			
					User (in project Disco)				

10. You can create a different Role besides Admin to prevent users from editing your files if you want to only give them permission to view you file. To do so, under Edit Roles, type a name into the empty field and press Create Role

Search the entire project	Search				Log Out (Eric Willcox) My Account Get Help WPI fusion user gu Quict Jump To
My Page	Pro	jects	Code Snippets		RBE 3001 Team Pretend E 13
Tracker		Docs	Surveys New		SCM
/ Stats Quota					
		Edit Roles			
	Admin 💌 Add Member	Role name			Action
		Admin			Delete role Edit Permissions
	Action	Anonymous/not logged in (global role)		Edit Permissions
	Remove	Any user logged in (global	role)		Edit Permissions
	Grant extra role				Create Role
		Edit Observer			
		Currently used external	roles		
		Role name			Action
		Anonymous/not logged in (global role)		Unlink Role
		Any user logged in (global	role)		Unlink Role
		Available external roles	•		
		Role name			Action
		User (in project Disco)	•		Link external role

11. On the next screen, select what permissions the new role has. To give allow them to only view your project without editing, make sure the fields match the following then press Submit.

Fusion Sorge		Search the entire project	Search Advanced search
Home		My Page	Projects
Summary	Admin	Tracker	Docs
Edit Role Project Information Users and permissions	Tools Project History Stats Quot	a	
Use this page to edit the permissions attached	to each role. Note that each role has	at least as much access as the A	nonymous and LoggedIn roles. For example, if the Anonymo
Role Name staff Shared role (can be referenced by other proj	ects)		
Section	Subsection		Setting
Project visibility			Visible 💌
Project administration			No administrative access
SCM			Read only
Documentation manager			Read only
Trackers administration			No administrative access
Default for new trackers			Read only
Submit			

- 12. Go back to Users and Permissions to assign the new role to a user.
- 13. Click on the drop-down arrow for the user whose role you want to change and select the newly created role, then click Grant extra role.

Fusion Forge		Search the entire project	Search Advanced search	
Home		My Page	Proj	jects
Summary	Admin	Tracker		Docs
Members of RBE 3001 Team Prete Project Information Users and permissions 1		ota		
Add Member				Edit Roles
Add Users From List			Admin 🗶 Add Member	Role name
Current Project Members				Admin
User name	Role		Action	staff
	Admin		Remove	Anonymous/not lo
Eric Willcox	Admin 💌		Grant extra role	Any user logged in
Joseph St. Germain	Admin		Remove	
Joseph St. Germain	staff 💌		Grant extra role	Edit Observer
	Admin staff			Currently used e
				Role name
				Anonymous/not lo
				Any user logged in
				Available extern

14. Once added, take away the old Admin role if you created them with it by click Remove on the Admin line.

Fusion Sorge		Search the entire project	Search Advanced search	
Home		My Page	Projects	
Summary	Admin	Tracker		Docs
			Member Add	ed Successfully
Members of RBE 3001 Team Pr Project Information Users and permissio		ta		
Add Member				Edit Roles
Add Users From List			Admin 💌 Add Member	Role name
Current Project Members				Admin
User name	Role		Action	staff
	Admin		Remove	Anonymous/not logged in
Eric Willcox	Admin 🚽		Grant extra role	Any user logged in (globa
	Admin		Remove	
Joseph St. Germain	starr		Remove	Edit Observer
	staff 💌		Grant extra role	Currently used extern
				Role name
				Anonymous/not logged in
				Any user logged in (globa

15. If you ever need to check the URL of the location of the Git repository for your team, go to the SCM team tab at fusion.wpi.edu and look at the URL here (in the form:

https://****@fusion.wpi.edu/git/rbelib16-17/rbelib16-17.git where *** is your UNIX
name).

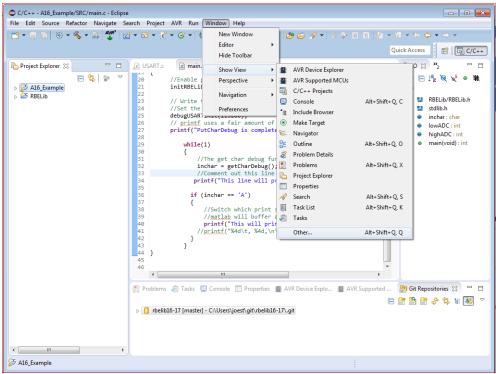
Home		My Page Projects		Co		
Summary	Admin	Tracker	Docs	Surveys		
Source Code Repository for RBE 3001 Team Pretend E 13 View Source Code Reporting Administration Documentation for Subversion (sometimes referred to as "SVN") is available here. Developer Subversion Access via DAV Only project developers can access the SVN tree win this method. Enter your site password when prompted.						
	svn checkoutusername evit -th. https://fusion.epi.edu/svn/rbe-pretend/truit					
wn checkoutusername ewit for https://fusion	n.wpi.wdd/wwn/How-precend/crank					

Joining RBELib

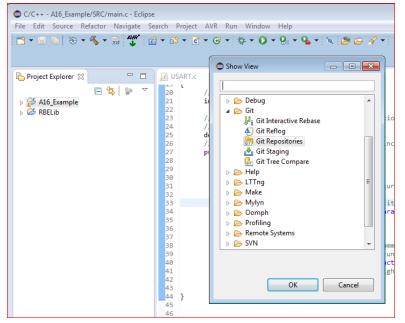
- 1. To join RBELib, you need to request permission on Fusion Forge to the project. Open up <u>fusion.wpi.edu</u> in your web browser and log in to your account.
- Go to Joe St. Germain's profile and find your class's project and request permission to join it. Joe's profile can be found at: <u>fusion.wpi.edu/users/joest/</u>. The name of the project will be given out on Blackboard. For A16 and D17 RBE 3001 RBELib 2016/17 Class code. The fusion forge search does not work unfortunately. Feel free to complain to the CCC, we have for a few years.
- 3. Wait for the Course staff to approve your request.

Using Git to clone RBELib and the example project.

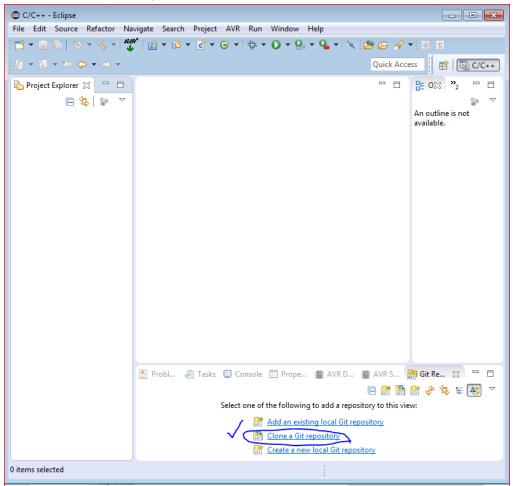
1. First select Windows > Show View > Other



2. Then Select Git > Git Repositories



3. Now select Clone repository from the Git Repository Tab (sometimes opens on the right hand side of the screen) and open it.



4. Add the address of the repository for RBELib. This address can be found under the SCM tab on the RBELib project page on fusion.

🖨 C/C++ - Eclipse		
File Edit Source F	Clone Git Repository	
11 + 11 12 3 + 21 + 72 + 4+ 4+	Source Git Repository Enter the location of the source repository.	▼
Project Explorer 🔀	Location UR: https://joest@fusion.wpi.edu/git/rbelib16-17/rbelib16- Host: fusion.wpi.edu Repository path: /git/rbelib16-17/rbelib16-17.git Connection Protocol: https: Port: Authentication User: joest Password: Store in Secure Store	O☆ [≫] 2 □ □ outline is not ailable.
	October Sector Secto	
	Probl Tasks Console Prope AVR D AVR D AVR S AVR C AVR S Select one of the following to add a repository to this view: Add an existing local Git repository Clone a Git repository Create a new local Git repository	5it Re ☆ 😑 🗖
0 items selected		

5. Login to the repository using your CCC password

🖨 Login	x
Repository	https://joest@fusion.wpi.edu/git/rbelib16-17/rbelib16-17.git
User	joest
Password	••••••
Store in Secure St	tore
	OK Cancel

6. Make sure the master branch is selected and then press Next.

7. Check the box for "Import all existing Eclipse projects after the clone finishes" and then set the destination directory to your workspace. to select "finish"

Clone Git Repository
Local Destination Configure the local storage location for rbelib16-17.
Destination
Directory: C:\Users\joest\git\rbelib16-17 Browse
Initial branch: master 🔹
Clone submodules
Configuration
Remote name: origin
Projects
Import all existing Eclipse projects after clone finishes Working sets
Add project to working sets
Working sets: Select
(?) < Back Next > Finish Cancel

It is possible that the Import all existing projects option will not be available. If that is the case simply click finish and follow the following step.

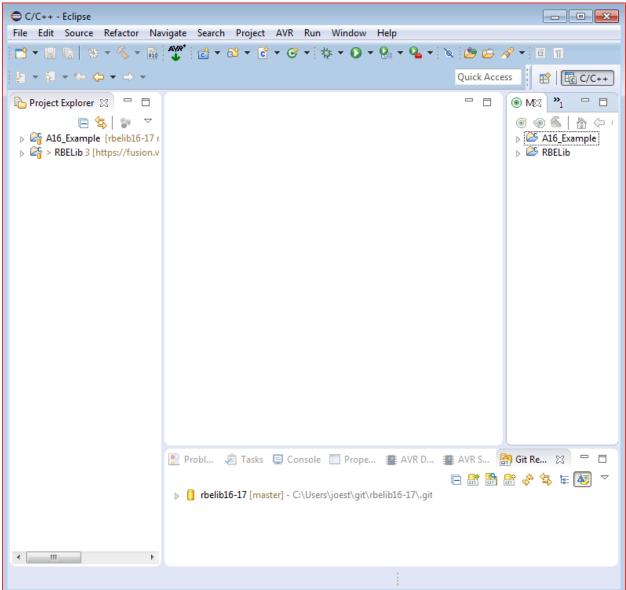
1.1 Right click on the repository and select import projects.

 Problems Z Tasks E Console D Properties T sks rbelib16-17 - C:\Users\joe\git\rbelib16-17\.git [ma Branches Tags References Remotes 	ter]	·
 Working directory - C:\Users\joe\git\rbelib16-' @git @metadata @A16_Example @Matlab script data collection example @RBELib @RemoteSystemsTempFiles 	Add Import Projects Copy Path to Clipboard Paste Repository Path or URI Ctrl+V	

1.2 Then select "import existing projects" and click next.

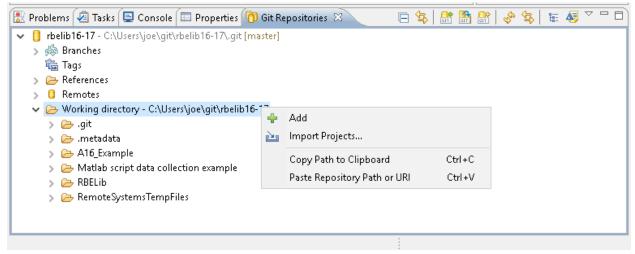
1.3 Select the Example project and the RBElib project only, and click finish. Now you have 2 projects in the project explorer window.





- Be sure to disconnect the projects from the course page and reconnect to your team's repository. This can be done by right clicking on each project in the project explorer tab and selecting "team > Disconnect"
- 10. Now follow the previous steps to add your team's repository location to eclipse.

11. Then right click on each project and select "Team >



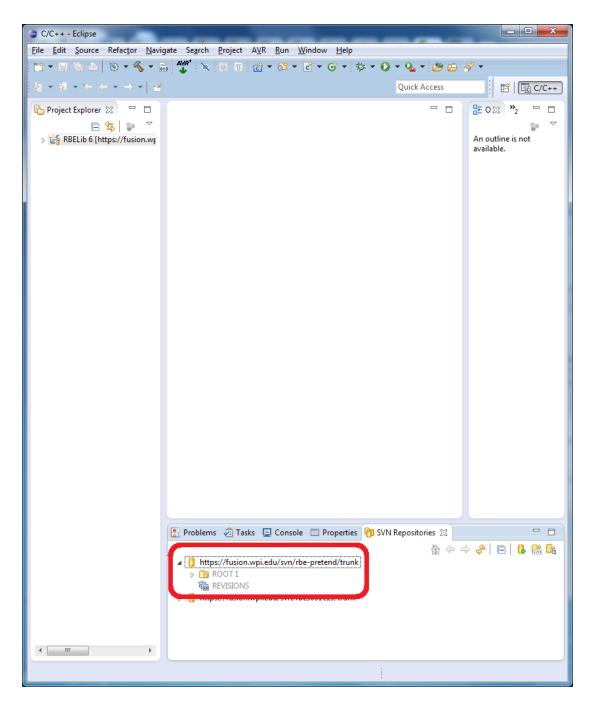
share project" and selecting your teams repository.

- 12. At this point you can use any Git program or command line tool that your team chooses to share your project amongst yourselves. Although you must use the Fusion server as the remote location.
- 13. Make sure to build RBELib once before using or building the example project.

Creating a New Project

These steps have been completed for you in the example project but are left in this document for your reference.

1. Make sure you have your Git project setup properly.



- 2. Select File > New > C Project
- 3. Name your Project and Select AVR Cross target Application > empty project > AVR-GCC Tool chain and press Next.

C Project	
C Project Create C project of selected type	
Project name: robot_stuff	
✓ Use <u>d</u> efault location	
Location: C:\Users\joest\Desktop\Robot\robot_stuff	B <u>r</u> owse
Choose file system: default 💌	
Project type: Toolchains:	
 GNU Autotools AVR Cross Target Application Empty Project AVR Cross Target Static Library Executable Shared Library Static Library Makefile project 	atform
? < <u>Back</u> <u>Next</u> > Finish	Cancel

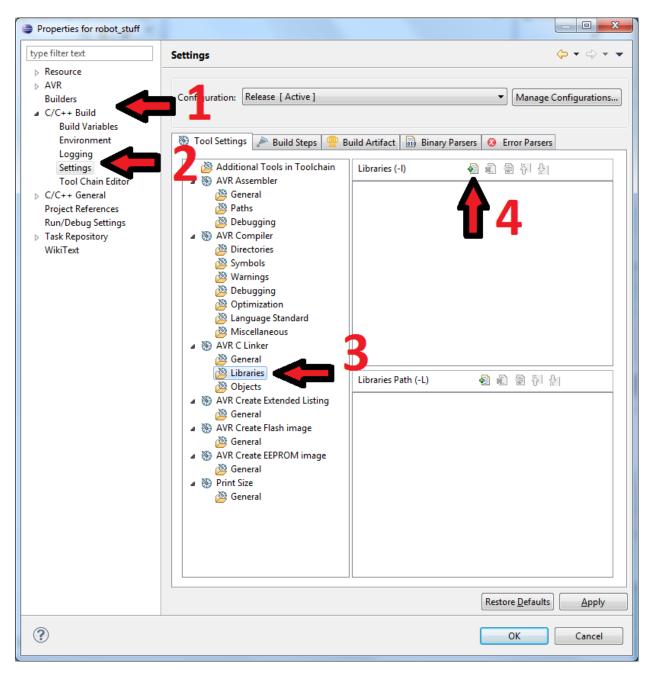
4. Deselect Debug and press next

C Project	
Select Configurations Select platforms and configurations you wish to deploy on	
Project type: AVR Cross Target Application Toolchains: AVR-GCC Toolchain Configurations:	
Debug Release	Select all Deselect all
Use "Advanced settings" button to edit project's properties. Additional configurations can be added after project creation. Use "Manage configurations" buttons either on toolbar or on prop	Advanced settings
? < <u>Back</u> <u>Next</u> > <u>Finis</u>	h Cancel

5. Select the Atmega 644P and Enter the MCU Frequency (18,432,000) and press Finish

C Project		
AVR Target Hardwa Define the AVR target		
MCU Type:	ATmega644P	~
MCU Frequency (Hz):	18432000	
?	< <u>B</u> ack <u>N</u> ext > <u>Finish</u>	Cancel

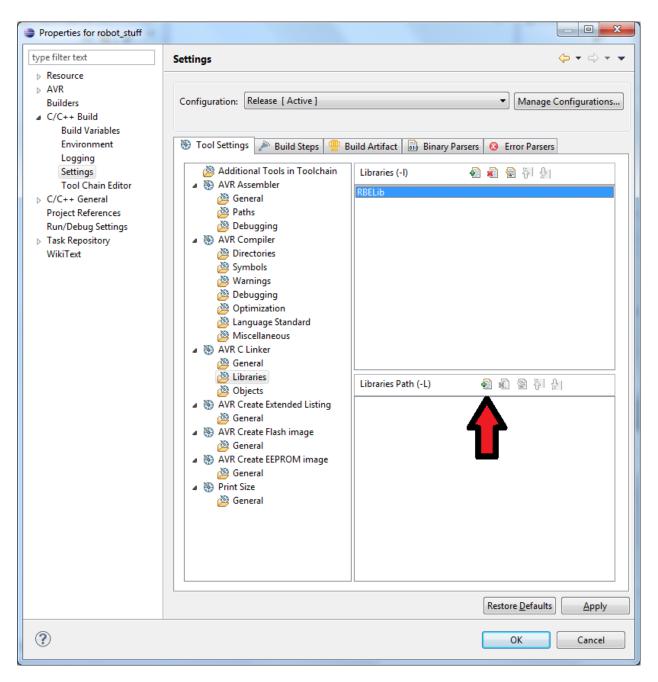
- 6. Now That we have the project created we need to link the RBELib to the project. Right Click on the Project in the Project Explorer and select properties
- 7. Expand C/C++ Build > settings
- 8. Select AVR C Linker > Libraries
- 9. In the Libraries Section hit the + Button



10. Enter 'RBELib', then do it again but this time enter 'm' which will include the math library library.

Enter Value	x
Libraries (-I)	
RBELib	
	OK Cancel

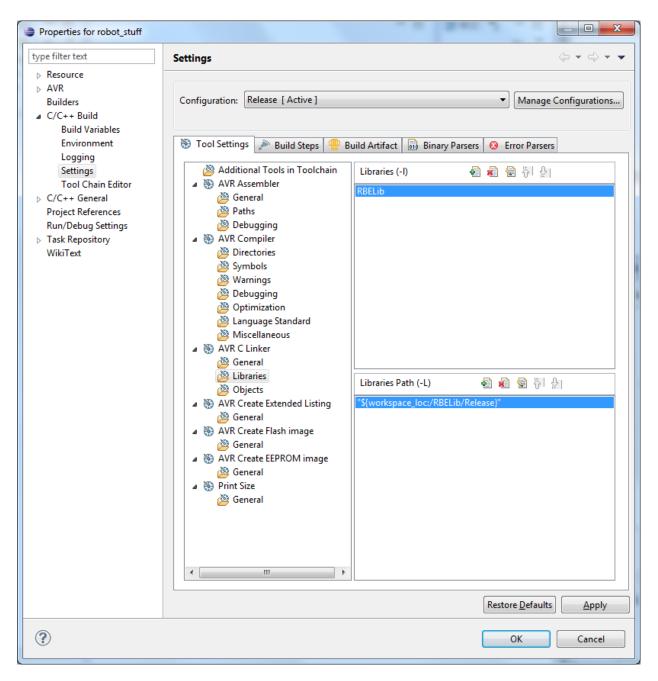
11. In the Library Path Section hit the + Button



12. Click on Workspace, Expand RBELib and choose Release. Select OK on this window and OK again on the next.

Folder selection		J
Select one or more Workspace Folders		
🔺 😂 RBELib		
b 🗁 .settings		
⊳ 🗁 bin		
include		
Ca lib		
🕞 🗁 Release		
 E src E RemoteSystemsTempFiles 		
 b G robot_stuff 		
ОК	Cancel	
	Cancer	

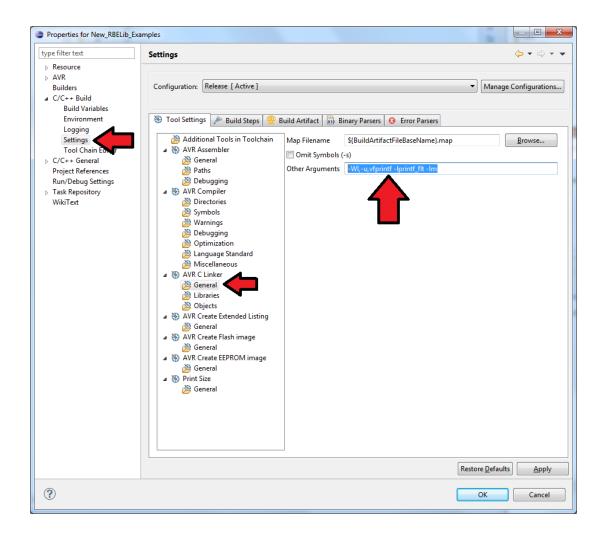
13. Your window should now look like this.



14. Now select the AVR C Linker > General and on the Other Arguments line enter:

-Wl,-u,vfprintf -lprintf_flt -lm

Which enables printf() to be used with all of the options typically disabled. Your window should now look like the below image.



15. Now Select C/C++ General > Paths and Symbols and select Add

Properties for robot_stuff			
type filter text	Paths and Symbols		⇔ • ⇔ • •
 ▷ Resource ▷ AVR Builders ▲ C/C++ Build Build Variables Environment 		se [Active]	Manage Configurations
Logging	归 Includes # Sym	nbols 🛋 Libraries 😕 Source Location 🔂 References	
Settings Tool Chain Editor C/C++ General Code Analysis Documentation File Types Formatter Indexer Language Mappings Paths and Symbols Preprocessor Include Pa Profiling Categories Project References Run/Debug Settings Task Repository WikiText	Languages GNU C s,S,asm	Include directories	Add Edit Delete Export Move Up Move Down
	 "Preprocessor Inco ✓ Show built-in value ✓ Import Settings. 		al entries
<		Restor	re <u>D</u> efaults <u>A</u> pply
?			OK Cancel

- 16. Choose the Workspace button
- 17. Go to RBELib > include

older selection
ect a folder from workspace:
😤 RBELib
> 🧁 .settings
> 🤁 Release
> 🤁 src
🔁 RemoteSystemsTempFiles
😤 robot_stuff
OK Cancel
 Src .cproject .project RemoteSystemsTempFiles robot_stuff

- 18. Click OK and OK again on the next screen.
- 19. You should now have something like the following.

Properties for robot_stuff			
type filter text	Paths and Symbols		
 ▷ Resource ▷ AVR Builders ▲ C/C++ Build 	Configuration: Relea	sse [Active]	Manage Configurations
Build Variables Environment Logging	🕒 Includes # Syr	mbols 🛋 Libraries 🤔 Source Location 🖹 References	
Settings Tool Chain Editor C/C++ General Code Analysis Documentation File Types Formatter Indexer Language Mappings Paths and Symbols Preprocessor Include Pa Profiling Categories Project References Run/Debug Settings Task Repository WikiText	Languages GNU C s,S,asm	Include directories	Add Edit Delete Export Move Up Move Down al entries
	import Settings] 👘 Export Settings	
۰ III ا		Restor	re <u>D</u> efaults <u>A</u> pply
?			OK Cancel

Setting up your programmer

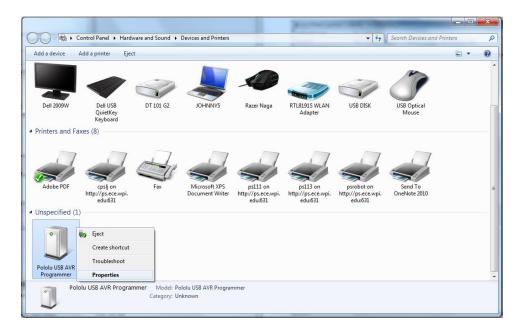
- 1. Set your programmer to AVR > AVRDude. If you get an Error about invalid values, press OK, and Press OK again to save your settings and restart Eclipse. Then re-open the project properties and try again. *This is a common error in Eclipse and could happen multiple times*.
- 2. Select the Programmer Tab and select New

Properties for robot_stuff	
type filter text	AVRDude 🔶 👻 🔿
 Resource AVR AVRDude Target Hardware Builders 	Configuration: Release [Active]
 ▷ C/C++ Build ▷ C/C++ General Project References 	Programmer Flash / EEPROM Fuses Lockbits Advanced Other Programmer configuration Edit. New
Run/Debug Settings ▶ Task Repository WikiText	Please select a Programmer Configuration to enable avrdude functions JTAG ICE BitClock Specify the bit clock period in microseconds for the JTAG interface or the ISP clock (JTAG ICE only). Set this to > 1.0 for target MCUs running with less than 4MHz on a JTAG ICE. Leave the field empty to use the preset bit clock period of the selected Programmer. JTAG ICE bitclock BitBang Programmer Bit State Change Delay
	Specify the delay in microseconds for each bit change on bitbang-type programmers. Set this when the the host system is very fast, or the target runs off a slow clock Leave the field empty to run the ISP connection at max speed. Bit state change delay Image state st
	AVRDude command line preview
	Copy <u>P</u> roject Settings Restore <u>D</u> efaults <u>Apply</u>
?	OK Cancel

3. Type an identifying name for this configuration, select Atmel AVR ISP V2 and type in the COM port that the programmer is connected to and press OK. See the sub-steps if you don't what your COM port is or how to find it, otherwise skip them.

Edit AVRDude Programmer Configuration New Configuration	
Configuration name rbe3001 com8	
Description Default AVRDude Programmer Configuration. Modify	as required for your setup.
Programmer Hardware (-c)	
ABCmini Board, aka Dick Smith HOTCHIP Altera ByteBlaster Arduino AT-ISP V1.1 programming cable for AVR-SDK1 from <http: micro-research.co.th=""></http:> Atmel AppNote AVR109 Boot Loader Atmel AppNote AVR109 Boot Loader Atmel AppNote AVR109 Boot Loader Atmel APR Dragon in HVSP mode Atmel AVR Dragon in HVSP mode Atmel AVR Dragon in JSP mode Atmel AVR Dragon in JSP mode Atmel AVR Dragon in JPD mode Atmel AVR Dragon in PD mode Atmel AVR ISP V2 Atmel JTAG ICE mkII in AVR32 mode Atmel JTAG ICE mkII in AVR32 mode Atmel JTAG ICE mkII in SP mode Atmel JTAG ICE mkII in ISP mode Atmel JTAG ICE mkII in ISP mode Atmel JTAG ICE mkII programmer Atmel STK500 V2 in high-voltage serial programming mode Atmel STK500 V2 in high-voltage serial programming mode Atmel STK500 V2 in high-voltage serial programming mode Atmel STK500 V2 in in parallel programming mode Atmel STK500 V2 in in parallel programming mode Atmel STK500 v2 in in parallel programming mode Bascom SAMPLE programming cable Brian Dean's Programming cable Brian Dean's Programming cable Brian Dean's Programming cable Brian Dean's Programming board design ponyprog serial, reset=itxd sck=rts mosi=dtr miso=cts Direct AVR Parallel Access cable Dontronics DT006	Programmer details from [C:\WinAVR-20100110\bin\avrdude.conf:329] id = "avrispv2"; desc = "Atmel AVR ISP V2"; type = stk500v2;
Override default port (-P) COM8	
Override default baudrate (-b)	
/Reset Line ● restore to previous state ○ activated (-E reset) ○ deactivated (-E noreset) Delay between avrdude invocations milliseconds	Vcc Lines extore to previous state cativated (-E vcc) deactivated (-E novcc)
Command line preview avrdude -cavrispv2 -PCOM8 [part specific options	1
Image: Second and the preview avidude -cavitspv2 -P COMB [part specific options	OK Cancel

a. If you need to find your COM port, go to Start > Devices and Printers and right click your device and go to properties



4. Go the hardware tab, and hover over the Programming Port to see what port the ISP uses.

Pololu USB AVR Programmer Properties	x
General Hardware	
Pololu USB AVR Programmer	
Device Functions:	
Name Type	
Pololu USB AVR Programmer Programming Port (COM8) M	
USB Composite Device Universal Se	
Device Function Summary	
Manufacturer: Pololu Corporation	
Location: 0000.001d.0000.001.006.004.000.000.000	
Device status: This device is working properly.	
Properties	
OK Cancel A	oply

5. Make sure your configuration is selected in the dropdown, then press OK to close this window and accept your settings.

Accessing the Fuses from eclipse

The Fuses control which hardware features you would like enabled. The Fuses can control a number of features such as Crystal selection, brownout detection, or to enable JTAG. For our Purposes we need to set the Fuses to

(Low: CF), (High: D1), (Extended: FF).

1 Right click on your project and select properties.

2 Select AVR > AVRDude

3 Open the Fuses Tab, choose direct hex values and enter CF D1 FF into the appropriate fields.

Properties for robot_stuff										
type filter text	AVRDude	↓ ↓ ↓								
 Resource AVR AVRDude Target Hardware Builders 	Configuration: Release [Active]	Manage Configurations								
 ▷ C/C++ Build ▷ C/C++ General Project References Run/Debug Settings ▷ Task Repository WikiText 	 Programmer Flash / EEPROM Fuses Lockbits Advanced Other 									
	 HIGH On-Chip Debug Enabled JTAG Interface Enabled Serial program download Watchdog timer always of Preserve EEPROM throug Select Boot Size Boot Reset vector Enable A EXTENDED 	No Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms 0xD1 Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms No Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms No Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms No Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms No Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms Ves Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms Ves Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms Ves Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms Soot Flash size=4096 words Boot address=\$7000 Image: Crystal Osc. 8.0- MHz; Start-up time: 1K CK + 65 ms								
	AVRDude command line preview	Copy <u>P</u> roject Settings Restore <u>D</u>efaults <u>Apply</u>								
?		OK Cancel								

Creating a Source File, Building, and Downloading

Now That the Project is created, the RBELib is checked out and linked, and the fuses and programmer are set we are ready to begin our source file.

- 1. Right click on your project and select "New" >" Source File"
- 2. Name your Source File something.c (do not forget the .c)

New Source	File	
Source File Create a new s	ource file.	C
Source fol <u>d</u> er: Source fil <u>e</u> :	robot_stuff main.c	<u>B</u> rowse
<u>T</u> emplate:	Default C source template 🗸 🗸	Configure
?	Finish	Cancel

- 3. Include RBELib and the AVRIO header files, see the below examples for reference.
- 4. Build RBElib using the hammer button.
- 5. Once your done coding build your project by selecting your project in the project explorer and either press the hammer or by Project > Build Project.
- 6. Then Upload the hex file that was created by selecting your project and pressing the "AVR" button. If the build was not successful then refer to the Console window to see the error info. If the build was not successful then there is no .hex file to upload and you need to fix your errors first.

PuTTY

- 1. Download PuTTY from http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html and choose the Intel x86 putty.exe.
- 2. Run the exe file to open PuTTY, there is no install process.
- 3. In the Session category, choose serial, input your baud rate and your serial line.

8	PuTTY Configuration	? ×
Category: Session Logging Terminal Keyboard Bell Features Window Features Window Features Window Features Vindow Selection Selection Selection Colours Colours Connection Data Proxy Telnet Rlogin Serial	Basic options for your PuTTY ses Specify the destination you want to connect to Serial line COM3 Connection type: Raw Ielnet Raw Ielnet Save or delete a stored session Saved Sessions Default Settings Close window on exit Always Never Only on clear	sion Speed 115200 Serial Load Save Delete
<u>A</u> bout <u>H</u> elp	<u>O</u> pen	<u>C</u> ancel

4. To log data, click on Logging and choose All Session Output and click browse for where to put your file. To save it for Excel or Matlab, make sure to make the extension *.csv.

8	PuTTY Configuration ? ×
Category: Session Logging Terminal Keyboard Bell Features Window Preatures Window Selection 	Puttry Configuration ? × Options controlling session logging: Options controlling session logging: Printable output None Printable output SSH packets All session output SSH packets SSH packets and raw data Log file name: C:\Users\Eric\Desktop\putty.csv Browse (Log file name can contain &Y, &M, &D for date, &T for time, and &H for host name) What to do if the log file already exists: Always overwrite it Always append to the end of it Ask the user every time Flush log file frequently Options specific to SSH packet logging Omit known password fields Omit session data Omit session data
<u>A</u> bout <u>H</u> elp	<u>O</u> pen <u>C</u> ancel

5. If your code is formatted properly, your output will be logged into a file that can easily be opened by Excel/MATLAB to parse.

Α		C							J	K	L	M	N	0	Р	Q	R	S	T	U	V	W
	~:~=~=~=~	=~=~= Pu	TTY log 201	3.08.23 16:	:51:58 =~=^	*=~=~=~=~	-~=~=~=~=	~=														
me	Value																					
	0 423																					
	1 753																					
	1 217																					
	2 42																					
	3 898																					
	4 712																					
	4 728																					
	5 510																					
	6 835																					
	6 77																					
	7 152																					
	8 85																					
	8 652																					
	9 994																					
1	10 179																					
1	11 839																					
1	11 279																					
1	12 273																					
1	13 920																					
1	14 340																					
1	15 559																					
	15 785																					
1	16 557																					
	17 773																					
1	18 600																					
	19 757																					
	20 363																					
	20 470																					
	21 904																					
	22 263																					
	10 450	-																				
Þ	putty	\oplus												4						. . .		

The structure that your print statements should be in is the following (note, the commas are REQUIRED for comma separated value file format *.csv):

Print Column Title 1, Print Column Title n \n (or new line)

<Loop to sample values>

Print Value 1, Print Value n \n (or new line)

<end loop>

This format will give you proper output for parsing.

Example blink port program

Blinks all pins on port B

*Note in order to connect a pin or port to an LED or switch a connection must be made between the pin or port to either the LED or Switch breakout port. To use printing statements, you must first write debugUsartInit()and putCharDebug().

```
/*
* main.c
 *
 * Created on: Aug 6, 2014
 *
       Author: ewillcox
 */
#include "RBELib/RBELib.h" //RBELib
int main(void) {
     initRBELib(); //Setup printf() and setServo()
     debugUSARTInit(115200); //Initialize UART
     DDRB = 0xFF; //Set Port as output
     while (1) {
           PORTB = 0xFF; //Turn port on
            delay ms(500); //Delay .5 sec
           PORTB = 0 \times 00; //Turn port off
           _delay_ms(500); //Delay .5 sec
           printf("Hello\n\r"); //Print "Hello"
      }
     return 0;
}
```

Example Blink Pin program

Register Structures

"Reg Structs" is built into RBELib and allows you to address individual bits instead of whole registers.

```
/*
 * main.c
 * Created on: Aug 6, 2014
 *
      Author: ewillcox
 */
#include "RBELib/RBELib.h" //RBELib
int main(void){
     DDRBbits. P4 = OUTPUT; //Set Port B Pin 4 to output
     while(1) {
           PINBbits. P4 = 0; //Sets Port B Pin 4 to low
            delay ms(100); //Delay .1 sec
           PINBbits. P4 = 1; //Sets Port B Pin 4 to high
           _delay_ms(100); //Delay .1 sec
     }
     return 0;
}
```

Now that we have some code, we can upload it to our Git repository. To add a project the first time to the repository, right click your folder in the project explorer and click on Team > Share Project. Select Git as the repository type and click next, then make sure Use existing repository location is selected and pick your groups repository and click Finish. You may be asked to type in a comment for your commit, you can put in anything and press OK.

Once you've committed the project at least once, in the future you only need to click on your project and go to Team > Commit and then put in a comment and it will upload whatever files have been updated.

Splitting Files

You should split your code into multiple files by using header files with corresponding C files, each file would contain code relevant to the file it's in. Ex, you put your initialization code into a file called init.c, your motor driving code into motors.c, etc.

You can also include global variables in a header file and share them amongst all your files.

General layout of a header file:

```
/*
 * ex_header.h
 *
 * Created on: Aug 6, 2014
 * Author: ewillcox
 */
#ifndef EX_HEADER_H_
#define EX_HEADER_H_
//Declarations / constants / includes / etc.
//Actual code (logic) does NOT go here!
#endif /* EX HEADER H */
```

If we wanted to separate the blink program into multiple files, we could create another file for controlling port B which does the LEDs. The first will be a header file which will have all of our includes in it so we only have to include this one file after it's setup.

```
/*
 * main.h
 *
 * Created on: Aug 6, 2014
 * Author: ewillcox
 */
#ifndef MAIN_H_
#define MAIN_H_
#include "RBELib/RBELib.h" //RBELib
#include "portB.h"
#endif /* MAIN H */
```

The next file is the header file for port B.

```
/*
 * portB.h
 *
 * Created on: Aug 6, 2014
 * Author: ewillcox
 */
#ifndef PORTB_H_
#define PORTB_H_
#include "main.h"
#define PORT_OUTPUT 0xFF
void initPB();
void blinkAll(double timeDelay);
#endif /* PORTB_H_ */
```

Now we need the .c file that has all of the code to control the port.

```
/*
 * portB.c
 * Created on: Aug 6, 2014
 *
       Author: ewillcox
 */
#include "main.h"
void initPB() {
     DDRB = PORT_OUTPUT;
}
void blinkAll(double timeDelay) {
     PORTB = 0xFF;
     _delay_ms(timeDelay);
     PORTB = 0 \times 00;
     delay ms(timeDelay);
}
```

And finally our main code.

```
* main.c
 *
 * Created on: Aug 6, 2014
 * Author: ewillcox
*/
#include "main.h"
void initializations() {
     initPB();
}
int main() {
     initializations();
     while(1) {
          blinkAll(100);
     }
     return 0;
}
```

If you wanted to share your globals from one file, you can create a header file to declare them all, and initialize them (if desired) in a c file by doing the following.

```
/*
 * globals.h
 *
 * Created on: Feb 6, 2013
 * Author: joest
 */
#ifndef GLOBALS_H_
#define GLOBALS_H_
typedef struct {
    double timeCount;
} Globals;
extern Globals globals; // declaration
void initGlobals();
#endif /* GLOBALS H */
```

```
/*
* globals.c
```

```
*
 * Created on: Feb 6, 2013
 * Author: joest
 */
#include "globals.h"
Globals globals;
void initGlobals() {
    globals.timeCount = 0;
}
```

You can now call timeCount by adding in globals.h into our previous main.h and then calling globals.timeCount where you want to get the value.

Common Problems

A lot of problems in Eclipse can be solved by either restarting the program or by making a new project and copying your code over. Please try this first if nothing below works for you before asking for help.

Error 1 / a lot of code not being recognized

Make sure you included all of your header files (#include), especially RBELib. If you do have all of your necessary headers included (in each .c file!) make sure you setup the project correctly, re-check all the steps from above. If both of these are correct restart Eclipse, and if the error still persists try to make a new project and copy your code over.

Component X is not working

If you DAC/Current Sensor/FTDI/etc isn't working, check that all jumpers are properly set on the board. Also make sure that you didn't leave switches connected from Lab 1 if you are not using them!

Current sensor is outputting a waveform

See Joe, it's broken.