

# Jade Robot™ Introduction & User Guide



**mimetics**  
digital education

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## License and Warranty

This document and code was written for the Mimetics Jade Robot™ and follow on products.

This document and code is considered Mimetics Proprietary and may not be released outside of Mimetics except by permission of Mimetics, Inc.

## Software Compatibility

The script language described in this document was written to be supported by:

Jade Support 0.9.9.24 or later

Robot Software Release 42 or later

Robot Tokenizer Version 0.11.17 or later

XML Processor 0.1.5 or later

\_start.s defined as \_main\_10.script or later

## Conventions, Options and Selections

Example code will be put in monospace font like:

```
A = B + C
```

In the language definition, there are a number of instances where there are optional parameters or multiple parameters for the same task. To make these situations more obvious, the following convention is used:

[] – Optional parameter

| - One parameter or another

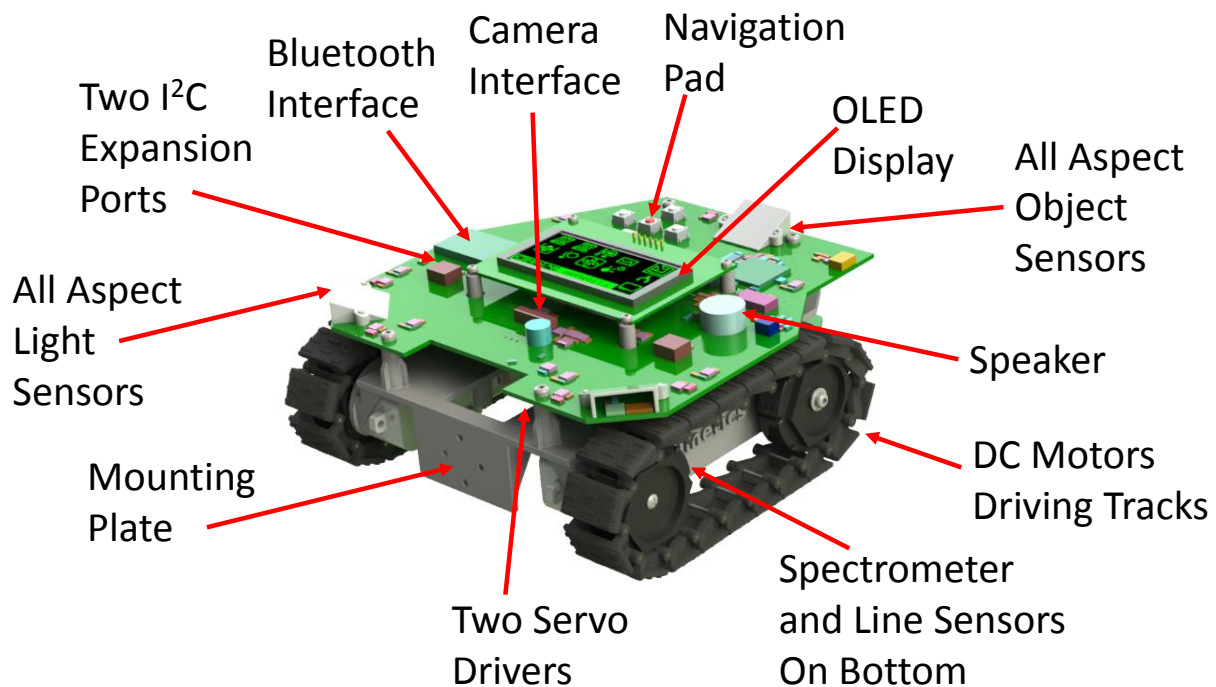
... – Previous parameter can be repeated

<none> - indicates that nothing is a possible option

## Welcome

When we started working on the Jade Robot™ we had a vision for it to be easy to use anywhere and provide users with a platform that would provide more sophisticated capabilities as the user's abilities grew. A corner piece of this is the built in OLED based user interface which provides access into the robot as well as a way to program and command its operation. From the programming perspective, we have created an easy to use Integrated Development Environment (IDE) that provides the ability to create and learn starting with "Scratch" programming and moving on to the "C" language. Finally, we knew the robot had to be expandable, having the ability to add features and capabilities for specific missions and experiments. We're very pleased with the final product and think it has accomplished the requirements set out for it and we are proud to present it to you.

Like many products which strive to be simple and easy to use, Jade Robot probably appears very complex – a diagram of the robot outlining all its features probably is overwhelming:



This document, will present the different features of the Jade Robot as well as an introduction to connecting the Jade Robot to a PC via Bluetooth and using the Jade Support IDE.

As good as the Jade Robot is, it's not perfect. Mimetics was founded on a philosophy of constant improvement and this is designed in to the Jade Robot with the ability to update its software. To improve the Jade Robot, we need your feedback and comments.

Please contact us via email at:

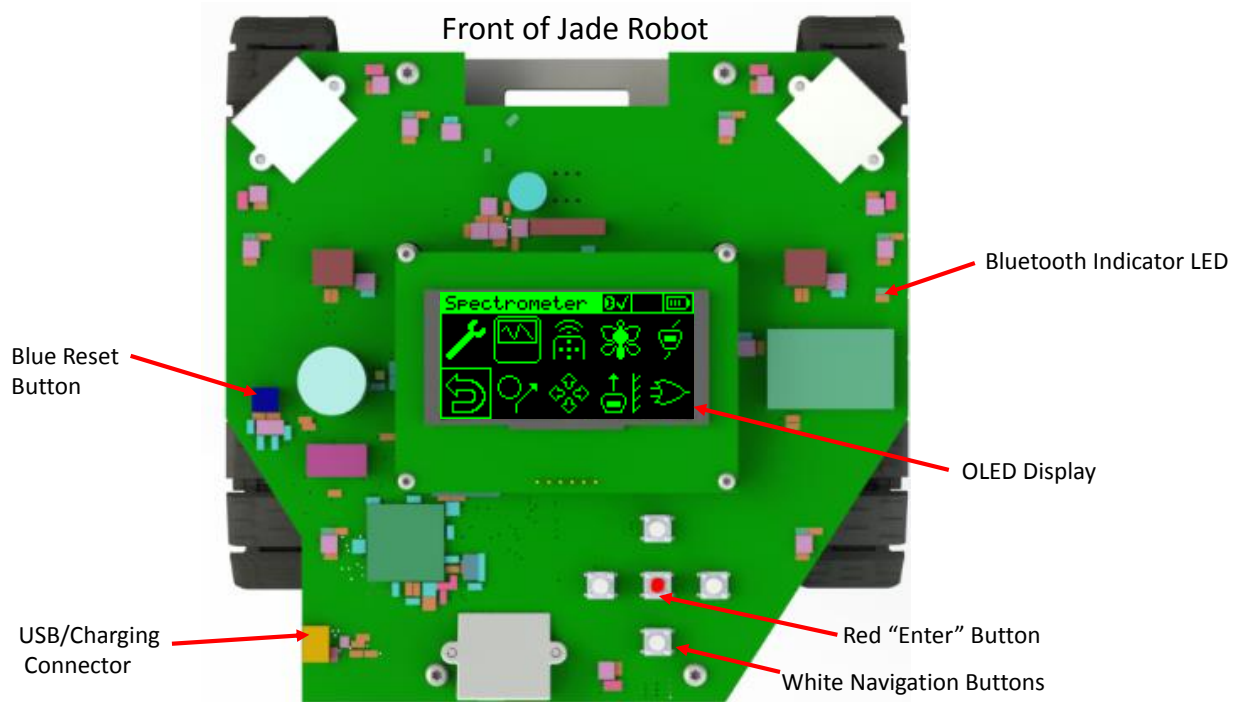
[info@mimetics.ca](mailto:info@mimetics.ca)

Thank you for your interest and we look forward to hearing from you and making the Jade Robot even better!

## Out of the Box

Hopefully you have noticed that the packaging the Jade Robot is saved in is rugged and has a handle; its purpose is to be used to store and transport the Jade Robot – Please Don't Throw The Box Away!

The important features of the Jade Robot that you will need to be familiar with can be seen in this image:



## Power

The Jade Robot has a built in 2200mAh Lithium Polymer battery. This will provide seven hours of operation in a typical setting. When the Jade Robot is not being used, it will go into a low power "Sleep Mode" which it is awakened from by pressing the "Down" white navigation button. When the robot is in Sleep Mode, it will flash one of the six green LEDs on the top of the robot once every five seconds. If the green LEDs are not flashing, then the Jade Robot's battery requires recharging.

## Charging the Jade Robot

Inside the box, you'll find the Jade Robot along with an AC/DC USB power adapter and a USB "A" to "micro" cable. The USB Power Adapter and cable is used for charging the Jade Robot. To charge the Jade Robot, plug the AC/DC USB power adapter into a 110V AC socket with the USB cable plugged in to the USB socket at the top and the cable plugged into the USB/Charging connector indicated in the image above.

During charging a green and blue LED located on the bottom of the Jade Robot will turn on. When the Jade Robot is fully charged, the blue LED will turn off and another green LED will turn on. It takes five hours or so to charge the robot.

## The Reset Button

While there is a reset button on the Jade Robot, it should not be required for normal usage. Later versions of the Jade Robot will either not have a reset button or have it in a location where it cannot be easily accessed.

**NOTE:** The reset button should never be used as a “fast disconnect” of the Jade Robot Bluetooth connection to a PC or Mac. This will cause problems with the PC link software resulting in the possible need for removing and then repairing the Jade Robot and/or restarting the PC or Mac.

If there is a situation where the use of the reset button is required (this includes “Run Time Errors” mentioned below), please contact Mimetics as noted above to report the circumstances.

## The File System

One feature that truly sets the Jade Robot apart from other educational robots is the inclusion of a file system which is used to store applications, “panel” files (which provide simplified user interface menus”, function files, bitmap images, wav sound files and text files. These files can be updated at any time in terms of deleting or storing new files in the system (“renaming” a file would consist of reading the contents of the file, deleting it and then storing the contents under a new name). The File System does not have any provisions for folders which means that users must strive to avoid applications which have files that are of the same name as existing files in the robot (basic system files cannot be accessed which prevents them from being inadvertently overwritten).

The File System used in the Jade Robot is known as a “Journaling File System”. This means that when a file is deleted, the space it is used is marked as “deleted” and ignored. Obviously there will be a point when all the file memory is used up and, at this point, there needs to be a “garbage collection” operation which overwrites the “deleted” areas of the file system. It is possible to explicitly command garbage collection from the Jade Robot’s user interface.

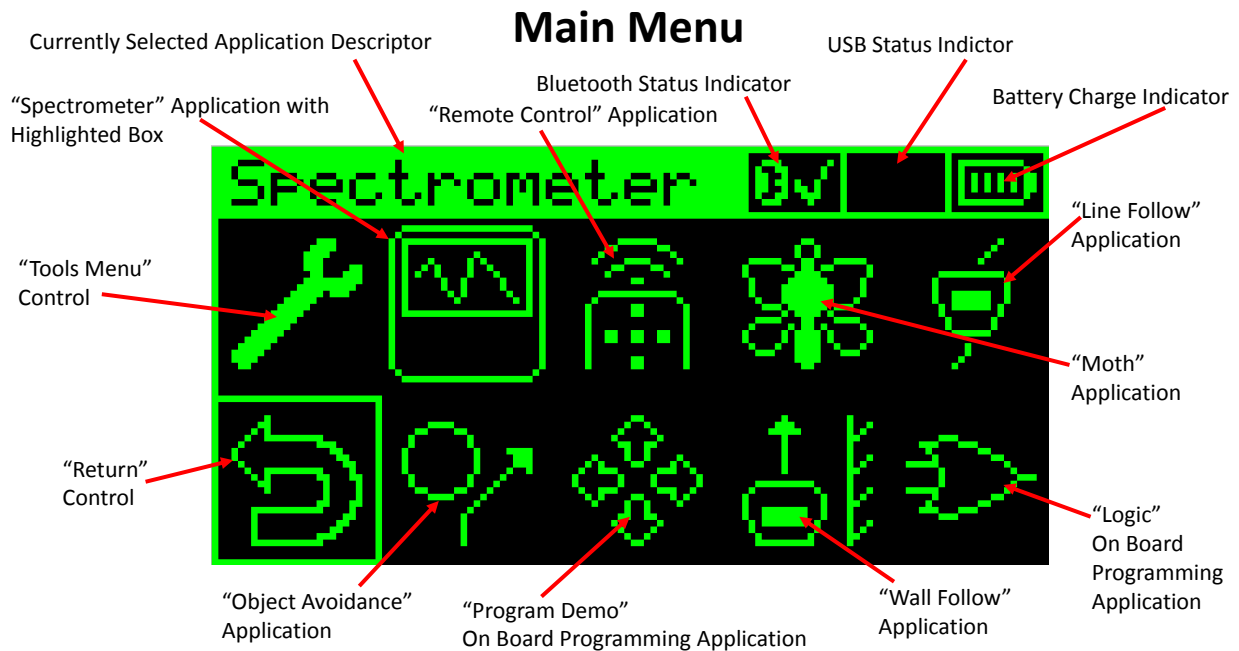
## Run Time Errors

There will be cases when the Jade Robot stops with a flash of the six topside green LEDs. Along with that will be failure information displayed on a box overlaying the current display on the Jade Robot. These errors are known as “Run Time Errors” and provide the user with information regarding the operation of the Jade Robot. There should not be any Run Time Errors with the software that comes with the Jade Robot – but ... software is never perfect. If an error is displayed, like on the screen shot below, please report it as outlined above.



## Navigating the User Interface

The User Interface built into the Jade Robot allows you to select different example applications, perform on board programming of the Jade Robot or change different operating parameters of the robot. When the user interface first comes up, it will show you the “Main Menu” that’s described in the image below:

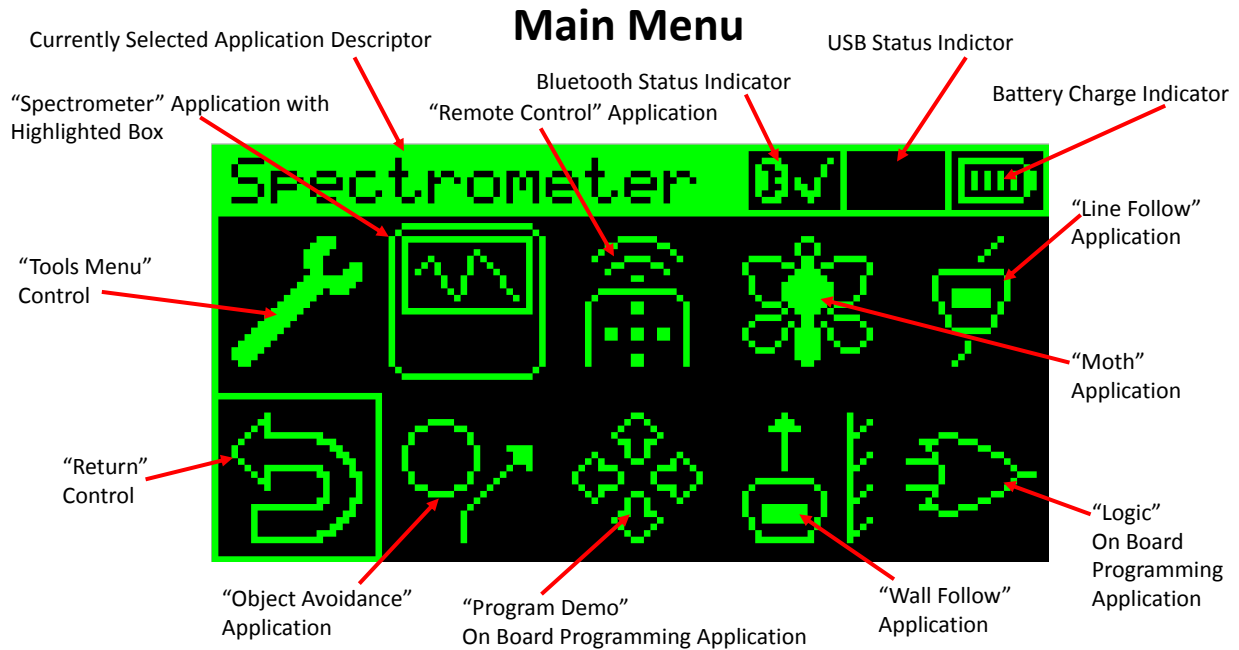


Navigation is accomplished using the white navigation buttons identified on the previous page. When the desired control is highlighted (has a box around it), it can be activated by pressing the red “Enter” button. In some cases, the white navigation buttons provide control activation. To return from an application, the convention currently used is to navigate to the bottom left hand corner where there is a “Return” Control and then press the Enter button to return to the previous menu.

A demonstration of the operation of the navigation buttons is given on the Mimetics web page: <http://www.mimetics.ca>

## User Interface “Main Menu”

The Main Menu is the initial interface for accessing applications on the Jade Robot. The primary purpose of the Main Menu is to provide a list of applications that the user is most likely to work on – although it should be noted that different applications can be added or deleted as required. It’s presented here so that the basic formatting can be shown:



The different parts of the Main Menu are:

**Currently Selected Application Descriptor:** Applications can have a short (13 character) message displayed on the OLED when the application is highlighted (this is only possible for Jade C applications and is described in the Jade C . If a message is not specified, then the execution file name is listed.

**Bluetooth Status Indicator:** Indicate if power is being supplied to the Jade Robot’s Bluetooth adapter and whether or not the Jade Robot is connected to a PC or Mac.

**Battery Charge Indicator:** Present the amount of charge present in the Jade Robot’s battery.

**“Tools Menu” Control:** Navigate to this control and press the Enter button to go to the Tools Menu.

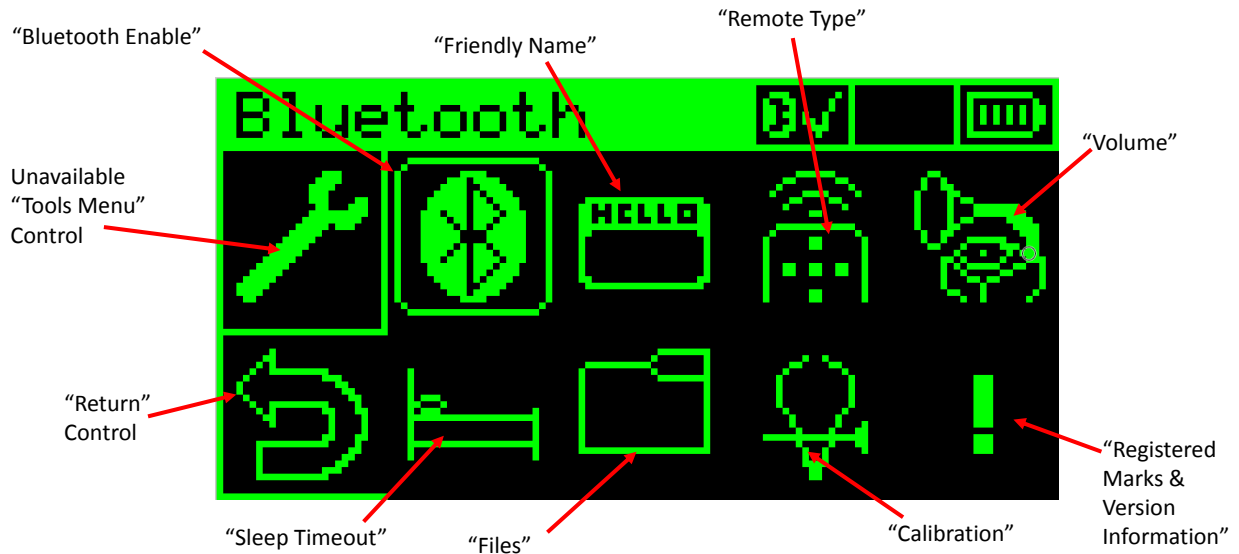
**“Return” Control:** shown in the Main Menu to indicate its position. Note that it is blocked off and the user cannot navigate to it in the Main Menu.

The operation of the different default applications are discussed later in this document.

## User Interface “Tools Menu”

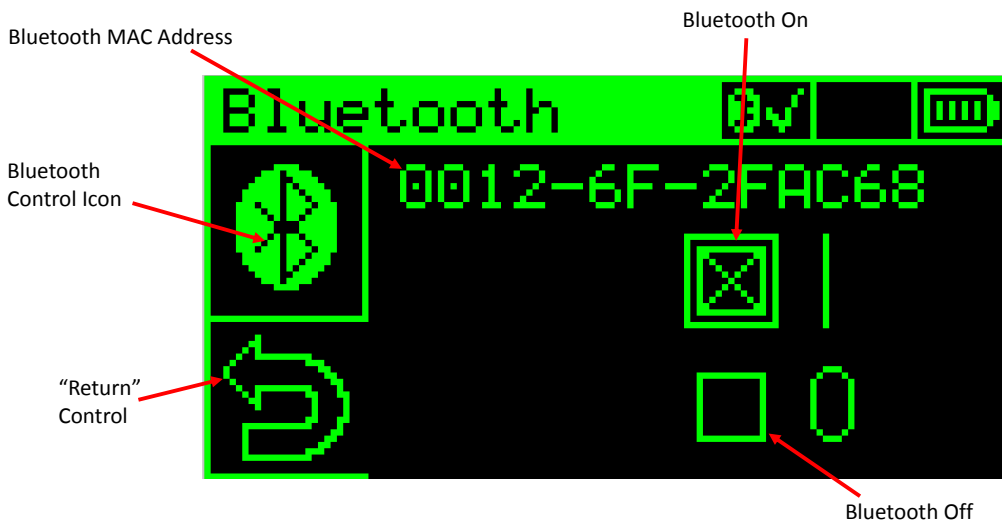
The Tools Menu is the system interface for the Jade Robot. The format of the Tools Menu follows the convention used for the Main Menu, but there are no applications and the Tools options cannot be changed or modified. The different options are described in detail after the screen image below:

### Tools Menu



**Bluetooth Enable:** To maximize battery life, the Bluetooth adapter built in the Jade Robot can be turned on and off with the reset default being turned off. Bluetooth can be turned on using the Bluetooth Enable Menu and selecting the “Bluetooth On” control. The MAC Address is just used by Mimetics.

### Bluetooth Menu

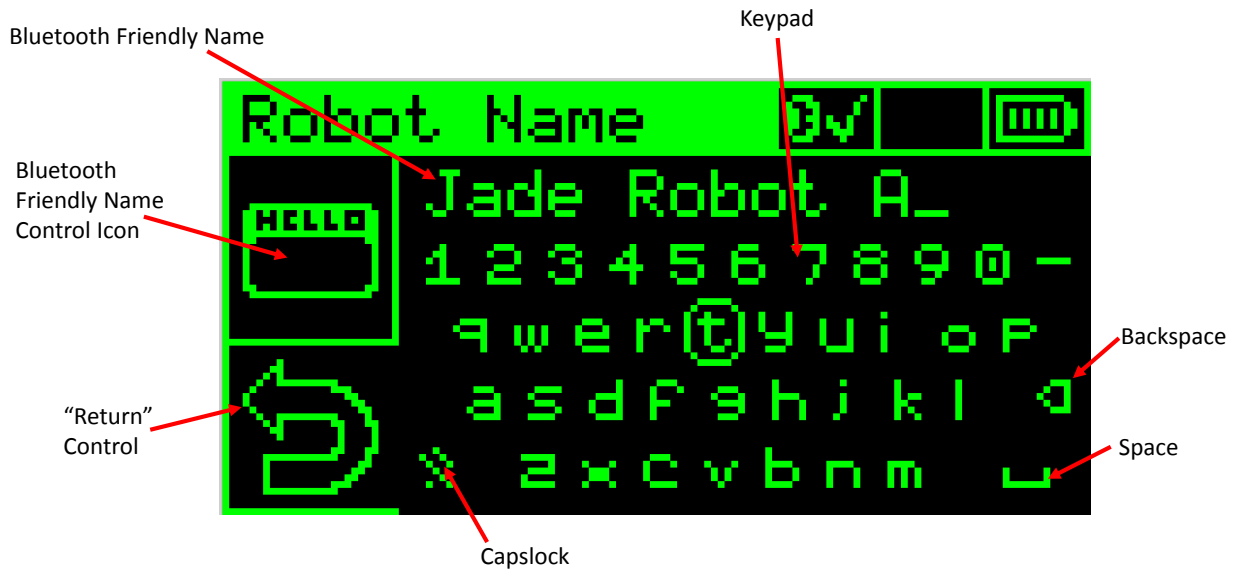


**NOTE: Bluetooth MAC Address is used by Mimetics as a Serial Number**



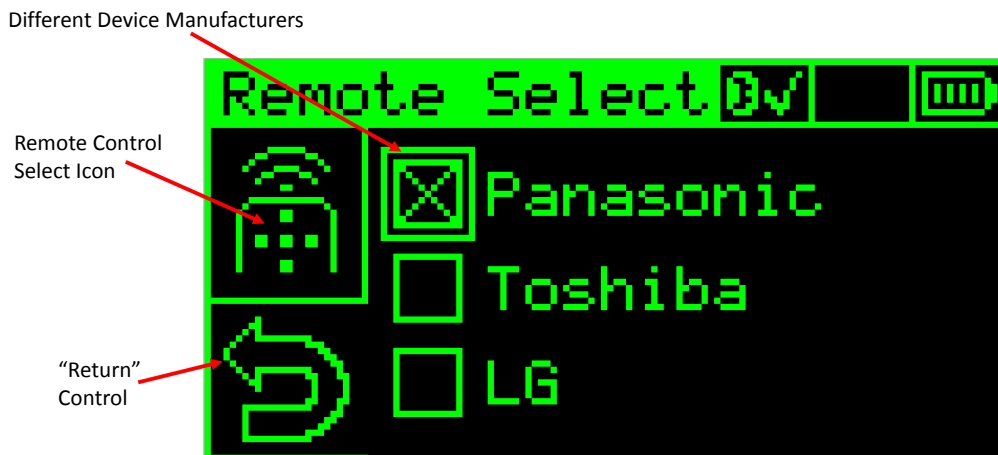
**Friendly Name:** While the user is not concerned with the Bluetooth MAC Address, the Bluetooth “Friendly Name” provides a way of uniquely identifying the Jade Robot. This is particularly important in situations where multiple Jade Robots are in use and being paired with PCs in a classroom setting. The menu acts as a simple line editor, allowing the change of the default Bluetooth Friendly Name (which is “Jade Robot”) to something different. To save the new name, the user must exit from the menu using the “Return” control. **NOTE:** the Friendly Name cannot be changed while the Jade Robot is connected to a PC or Mac.

### Bluetooth Friendly Name Menu



**Remote Type:** The operation of the Jade Robot’s Navigation and Enter buttons can be emulated with a DVD remote control. The three manufacturer’s devices currently supported can be changed, allowing multiple Jade Robots to work/compete in the same area.

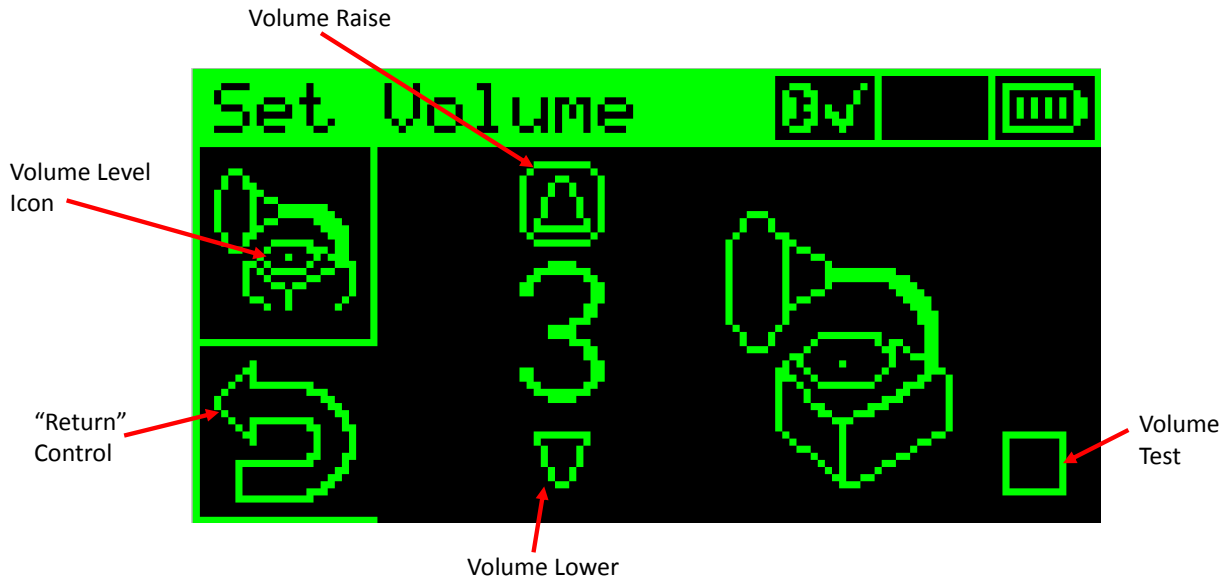
### Remote Control Type Select Menu



**NOTE: DVD Remotes ONLY to Ensure they have the Navigation Buttons**

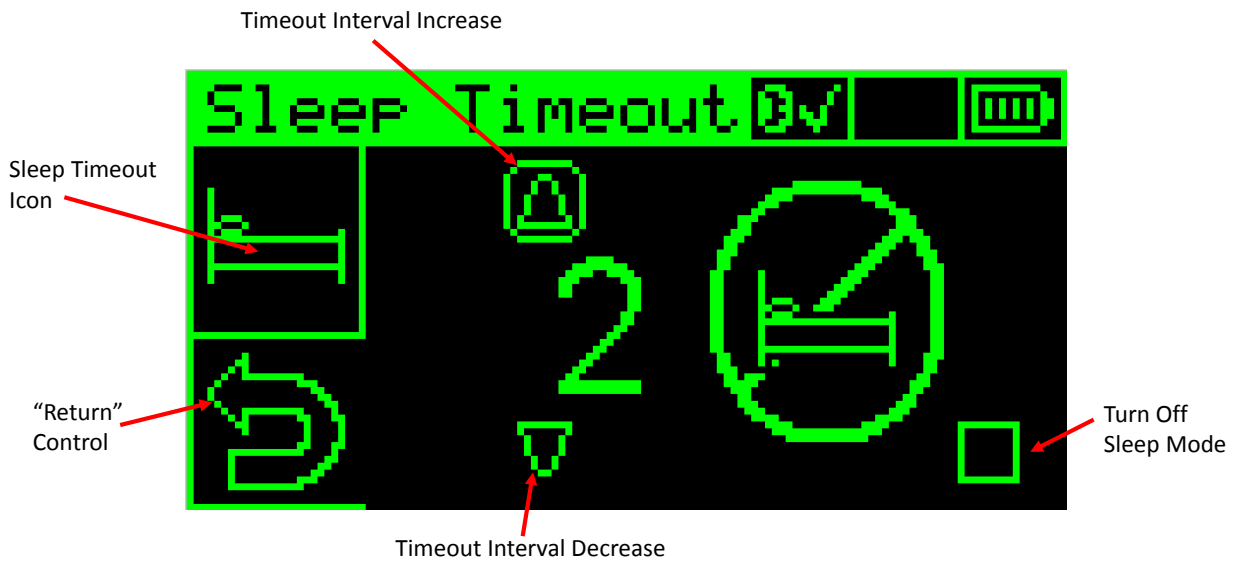
**Volume:** The volume of the Jade Robot’s speaker can be raised or lowered to the point where it is muted.

### Volume Level Menu



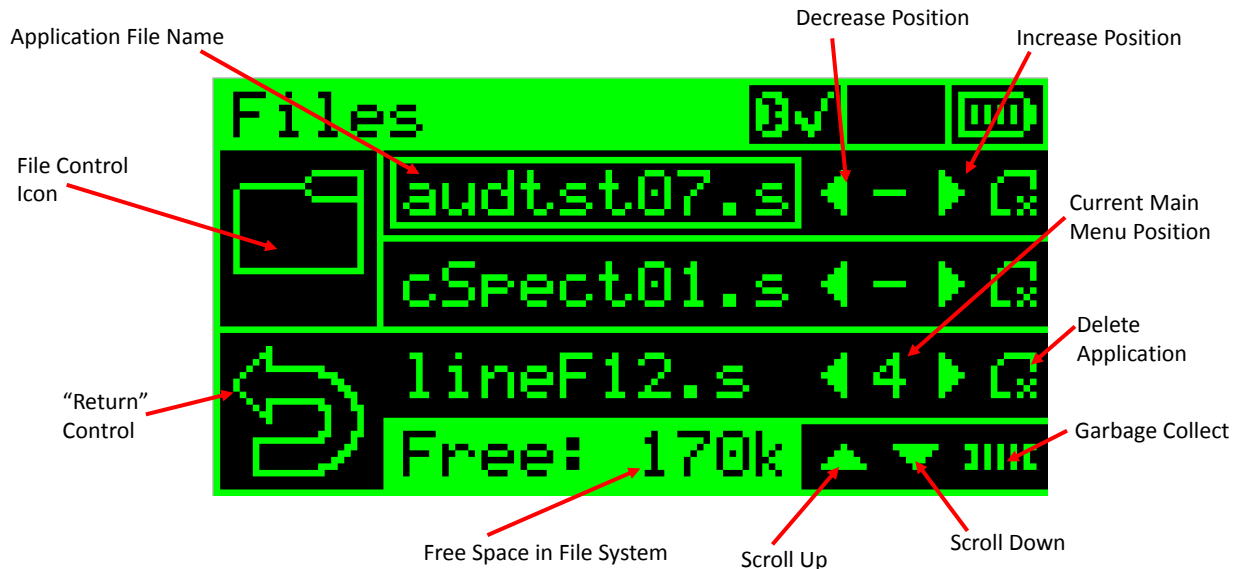
**Sleep Timeout:** Sleep Mode can automatically be invoked after a set period of time if the Jade Robot’s Navigation buttons are not being pressed, the Jade Robot is not connected to a PC and if the Main Menu or a Tools Menu is active (the Jade Robot will not go into Sleep Mode if an application is executing). The default time is two minutes and can be as high as 99 minutes. Sleep Mode can also be disabled all together. When connecting a Jade Robot to a PC, it is recommended that the Sleep timeout is set to 15 minutes.

### Sleep Timeout Menu



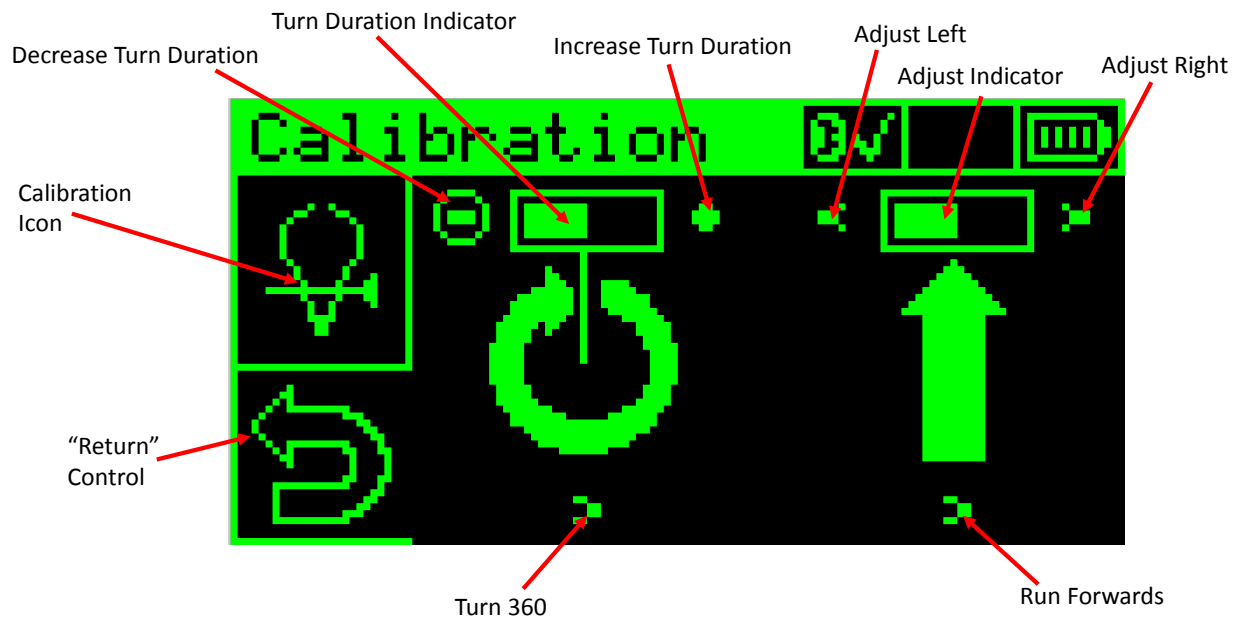
**Files:** As noted above, the Jade Robot has a file system built into it. At the time of this document's writing, there are 245 different files loaded into the system (consisting of executable, panel, image, sound and text files). The File Menu provides the ability to list the applications stored in the File System, execute them, delete them as well as bring them onto the Main Menu. It should also be noted that the user can perform a garbage collection operation on the Jade Robot.

## File Menu



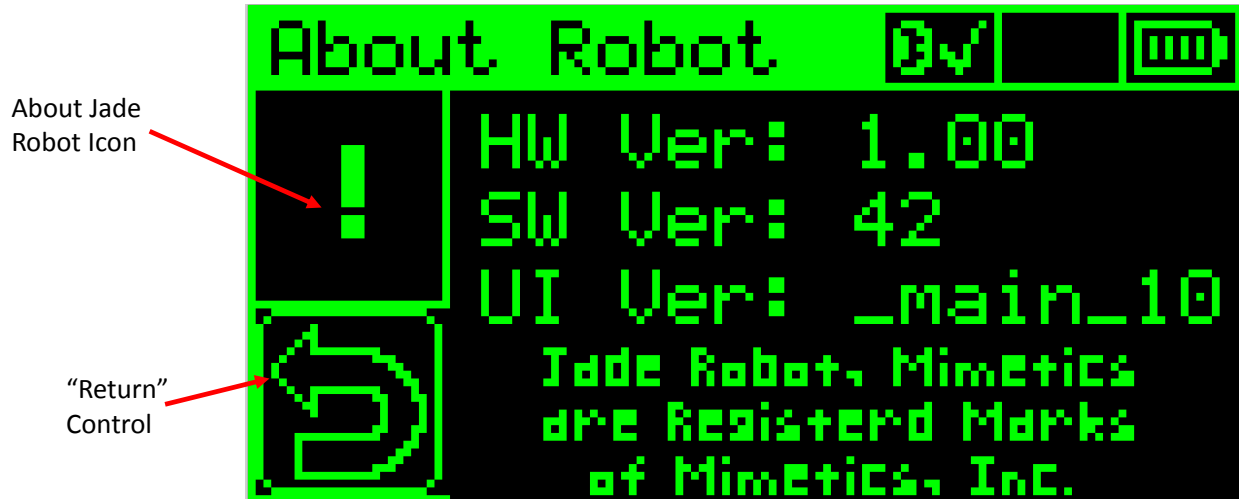
**Calibration:** The current Jade Robot is built with DC motors which can vary from motor to motor. To counteract that, the Calibration Menu can be used to validate the speed of each motor to provide straight lines and expected operating distances. The new Calibration values are saved when the user exits the Menu (through the "Return" control).

## Calibration Menu



**Registered Marks and Version Information:** This menu provides the user with a list of registered marks in relation to the Jade Robot as well as version information for the hardware and software.

## About Jade Robot Menu

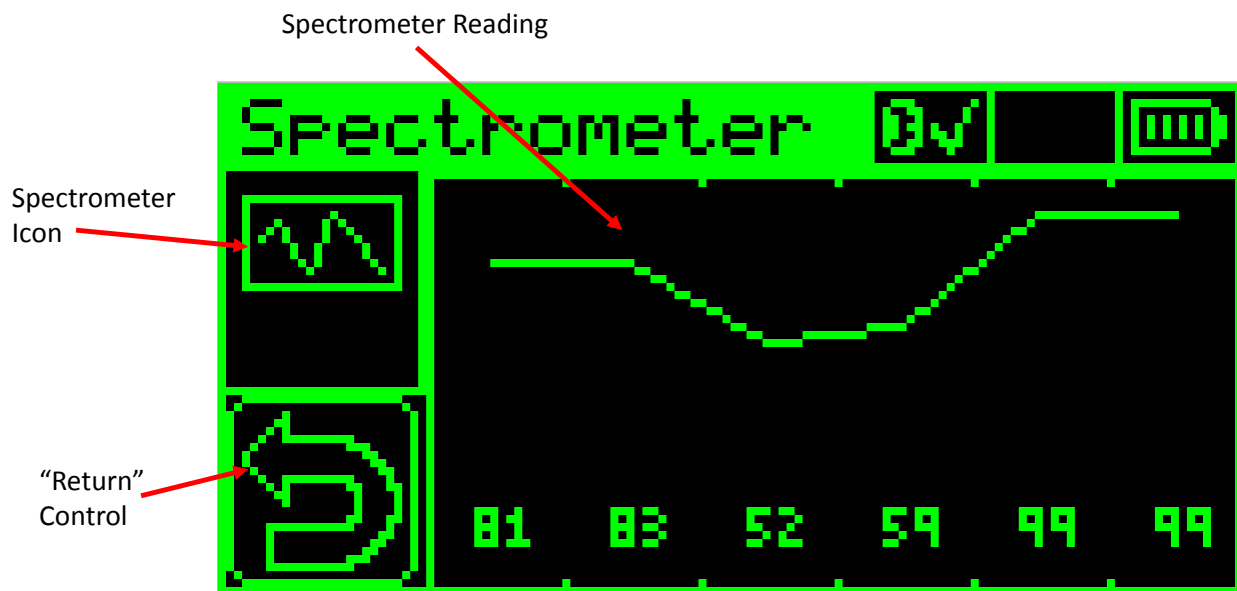


## “Main Menu” Default Applications

The Jade Robot is shipped with a number of default applications which are available for execution on the Main Menu. As noted before, the position of the applications as well as which ones that are available on the Main Menu can be changed using the “File Menu” described above.

**Spectrometer:** The Jade Robot’s spectrometer uses six LEDs on the bottom of the robot to create a signature of the material the Jade Robot is currently over. The reflected energy is measured and presented as a percentage on the Jade Robot’s display. Pressing the red “Enter” button ends the application.

## Spectrometer Application



The LEDs that are used with the spectrometer are:

Blue – 470nm wavelength  
Green – 525nm wavelength

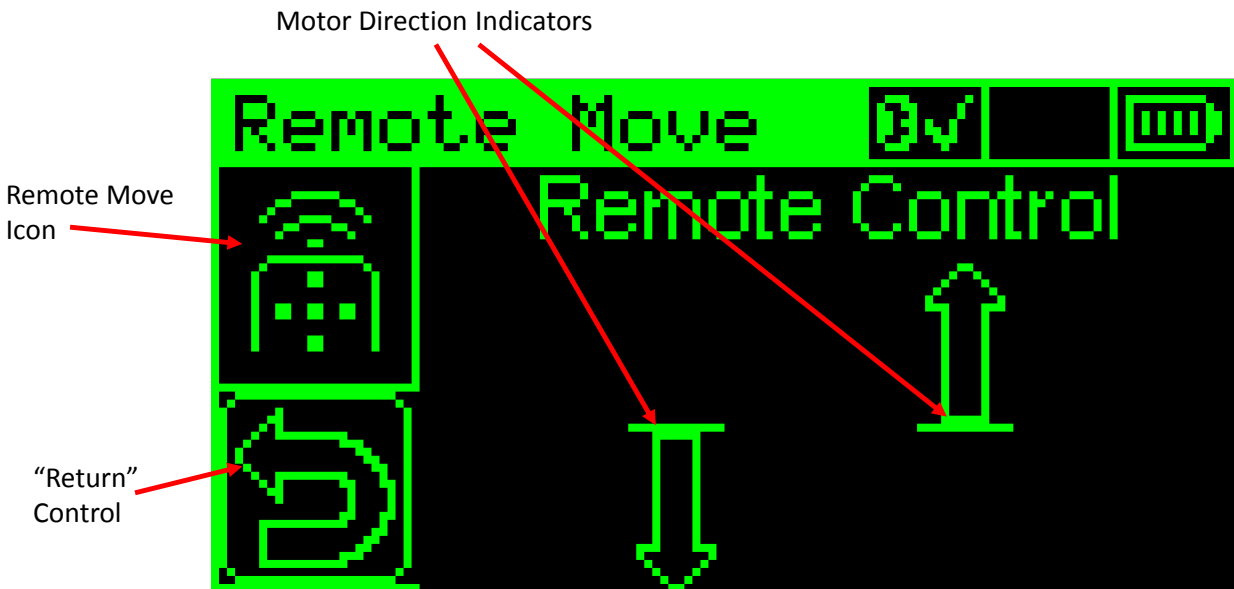
Yellow – 574nm wavelength  
Red – 660nm wavelength

880nm wavelength Infrared  
940nm wavelength Infrared



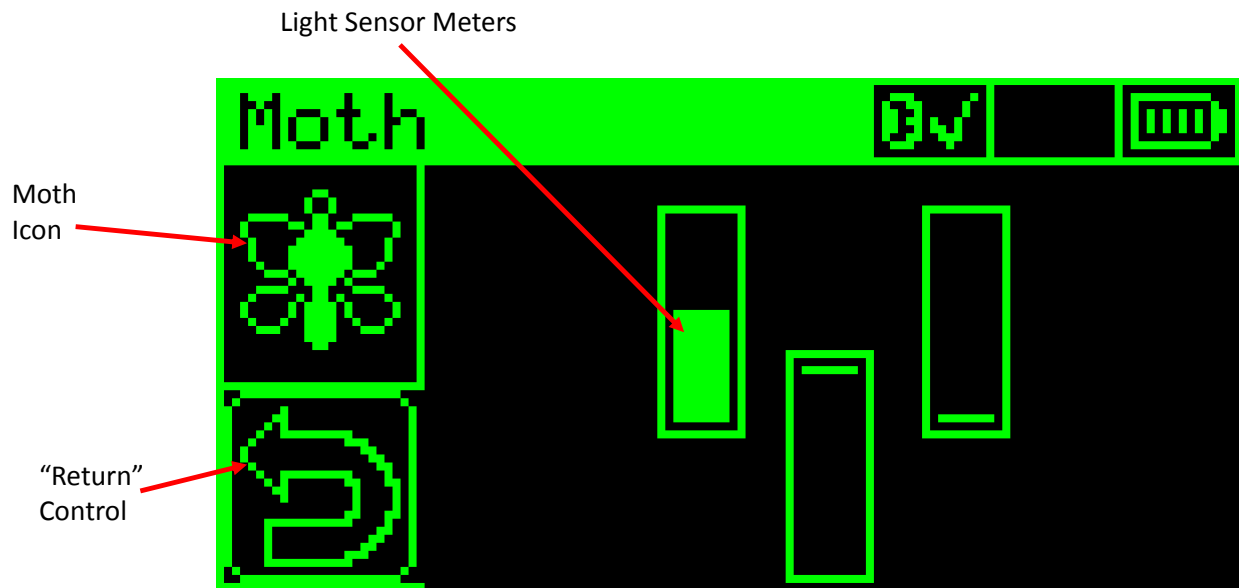
**Remote Move:** How the tracked differential drive of the Jade Robot works is shown in this application. By pressing the “Up” white navigation button, the Jade Robot will move forwards, pressing the “left” white navigation button causes the Jade Robot to turn to the left (as shown in the screenshot below) and so on. This application was originally developed for demonstrating how an IR remote control could be used to send commands to the Jade robot, but it is an excellent application for showing how the robot moves. Pressing the red “Enter” button ends the application.

## Remote Move Application



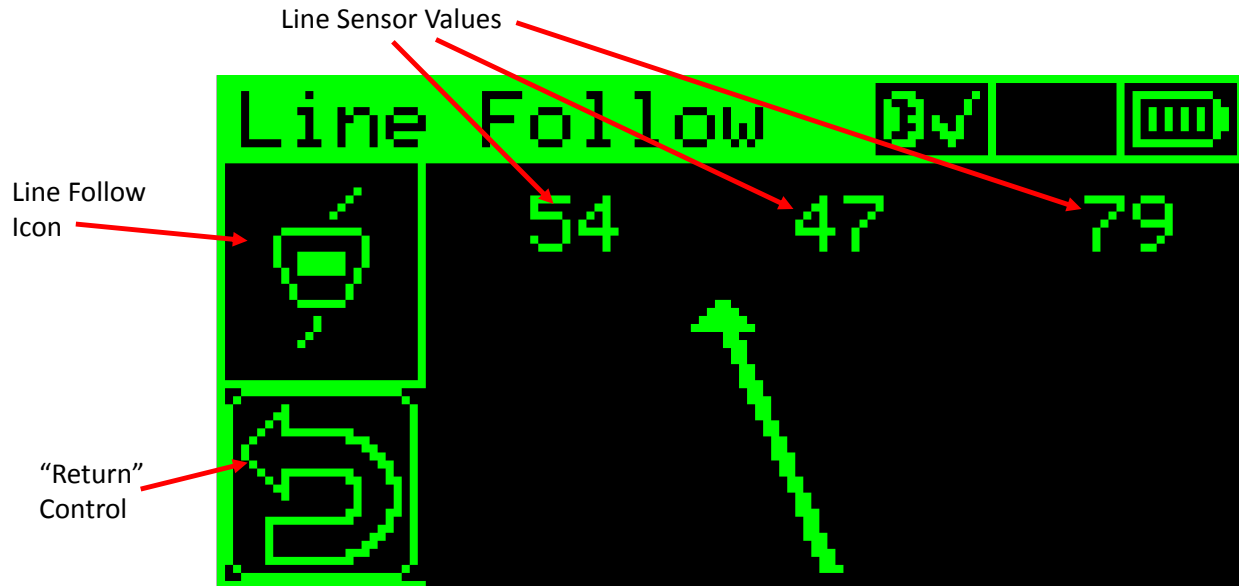
**Moth:** Grey Walter, of the Burden Neurological Institute, is normally credited with creating the first electronic autonomous robots. His robots “Elmer” and “Elsie”, were simple light seeking robots which behave like moths – they would be attracted to a light and then, when the light got too bright, they would shy away, making a seemingly random pattern about the light. The moth application replicates this behaviour. Pressing the red “Enter” button ends the application.

## Moth Application



**Line Follow:** A very traditional application for robots is the line follower. For this application, the best results seem to be with a strip of black electrical put down on a light surface. This application can be easily fooled – it is available in Jade Robot’s community projects on GitHub and can be very easily copied and experimented with. Pressing the red “Enter” button ends the application.

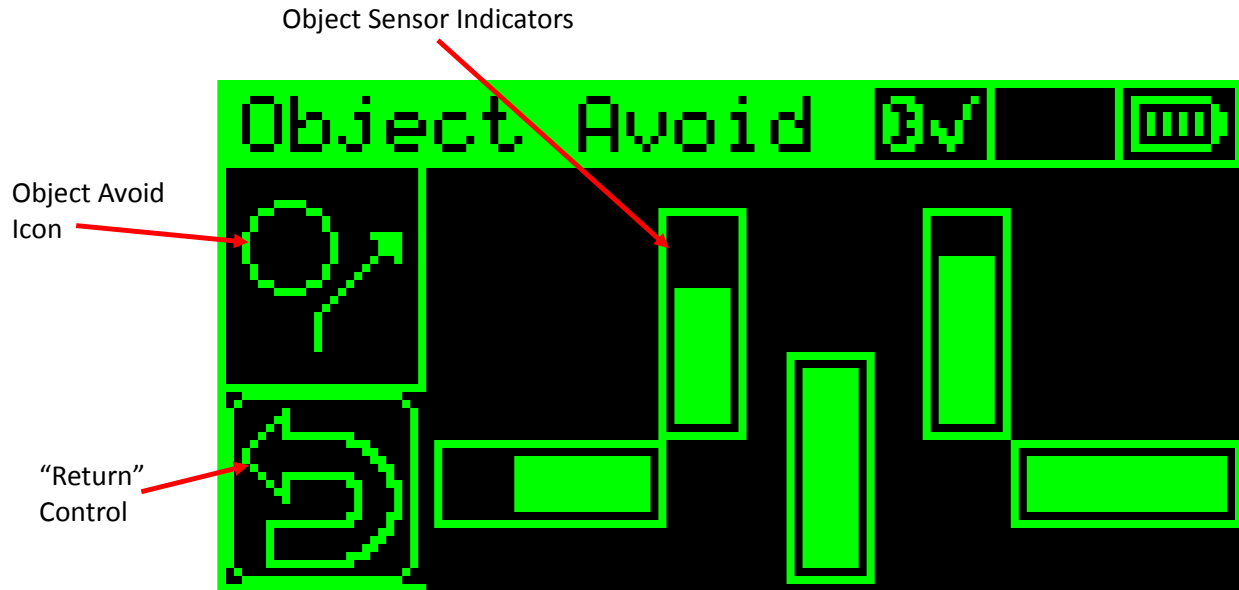
## Line Follow Application





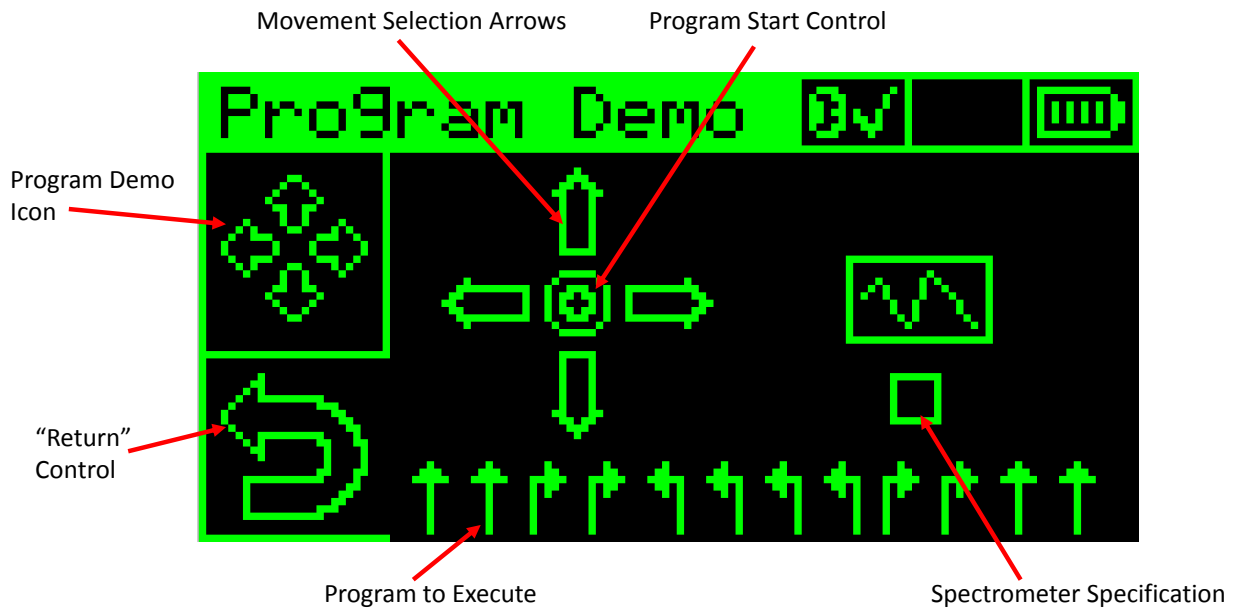
**Object Avoid:** This simple application monitors the two front object sensors and when an object gets too close (less than the value 30 returned from the object sensors) it turns away. Pressing the red “Enter” button ends the application.

## Object Avoidance Application



**Program Demo:** This application is generally the first introduction to Jade Robot Programming. By navigating to the arrows and then selecting them, a simple movement program can be created. When the program is ready, the “Program Start Control” is selected and the robot will move through the program. A spectrometer reading can be specified to take place at the end of the program – simulating a robot on another planet which is to move to a specific location and then take a spectrometer reading. Pressing the red “Enter” button ends the application.

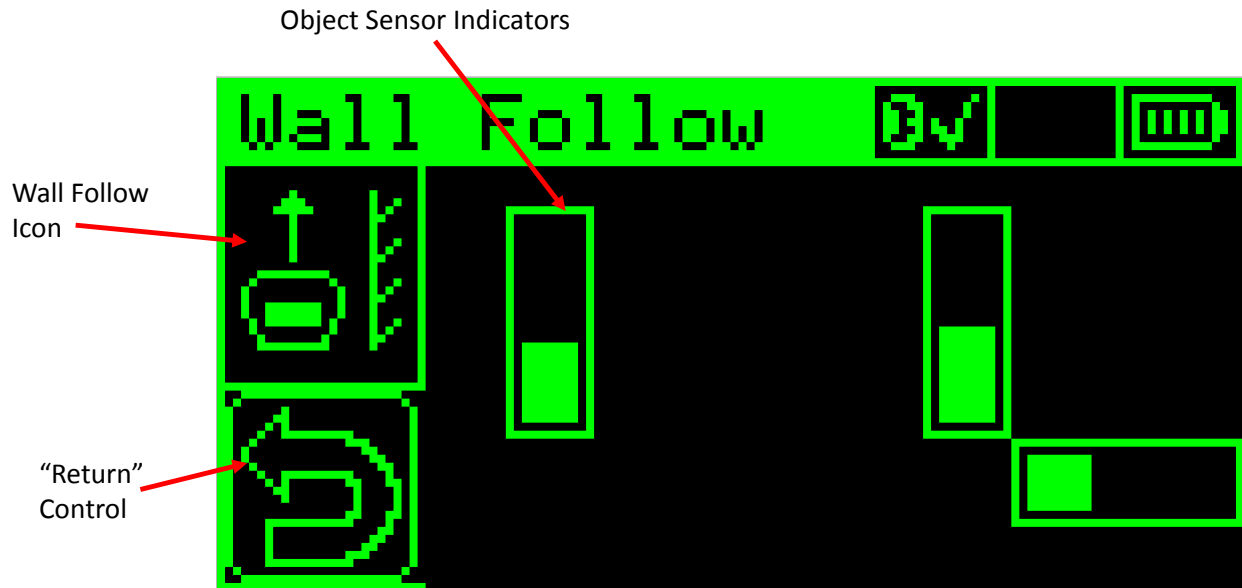
## Program Demo Application



**BONUS:** If there are multiple Jade Robots available, program all of them with the same program, set them in a line and start the programs all at the same time. This is what is typically called the “Jade Robot Line Dance”!

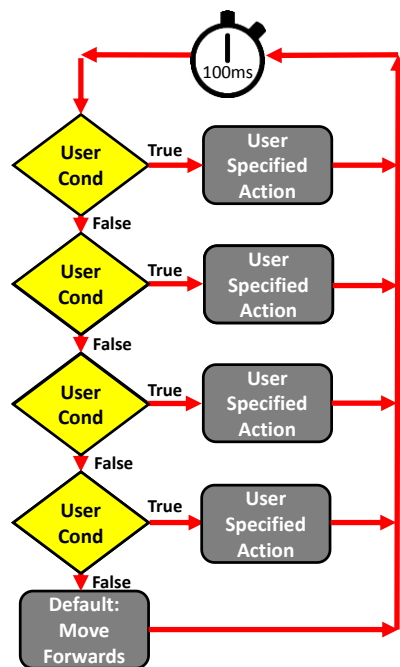
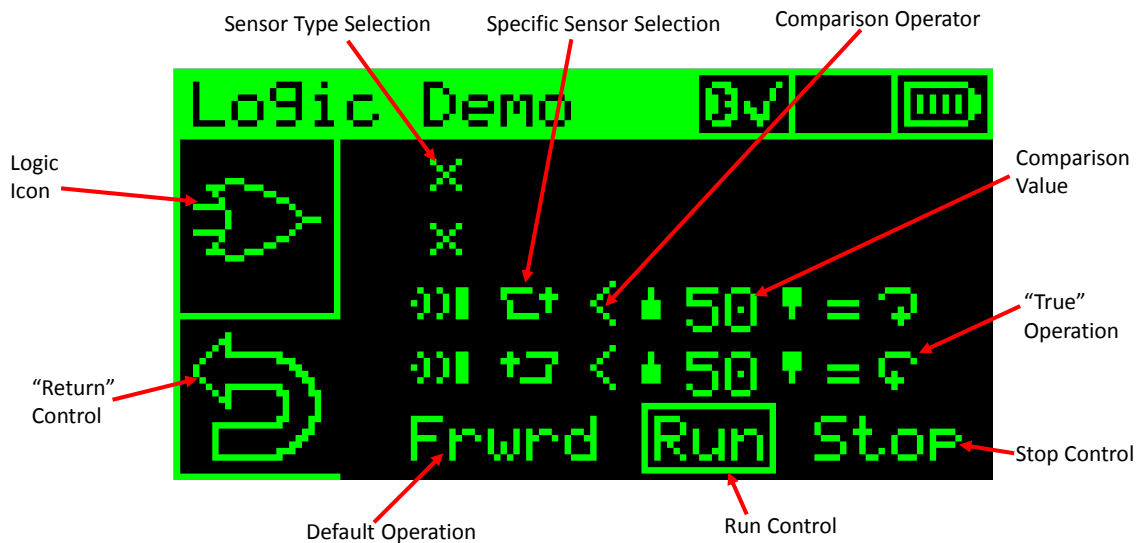
**Wall Follow:** The wall follow application does just that, it will follow a wall to its right side. The application was originally developed to demonstrate a simple algorithm for navigating a maze – if a person keeps one hand on a wall of the maze, they will eventually reach the end of the maze. Pressing the red “Enter” button ends the application.

## Wall Follow Application



**Logic:** The final built in application allows the user to create a surprisingly complex program on the Jade Robot. The program normally runs forwards, but will continually poll sensors as set out in “Sensor Type Selection” (changing from “X” or nothing to “Object Detect”, “Light Sensor” and “Line Sensor”) and then specifying which sensor is to be used, the value to compare against (and how to compare against it, less than or greater than) and what to do (different motions are available). The higher the comparison is in the list of four, the higher priority it is given.

### Logic Application



The program that is executed can be illustrated as: Each specified condition is checked and if it is true, then the Jade Robot performs the specified action. If none of the specified conditions are true, the Jade Robot simply moves forwards. Surprisingly complex applications can be created using this application.

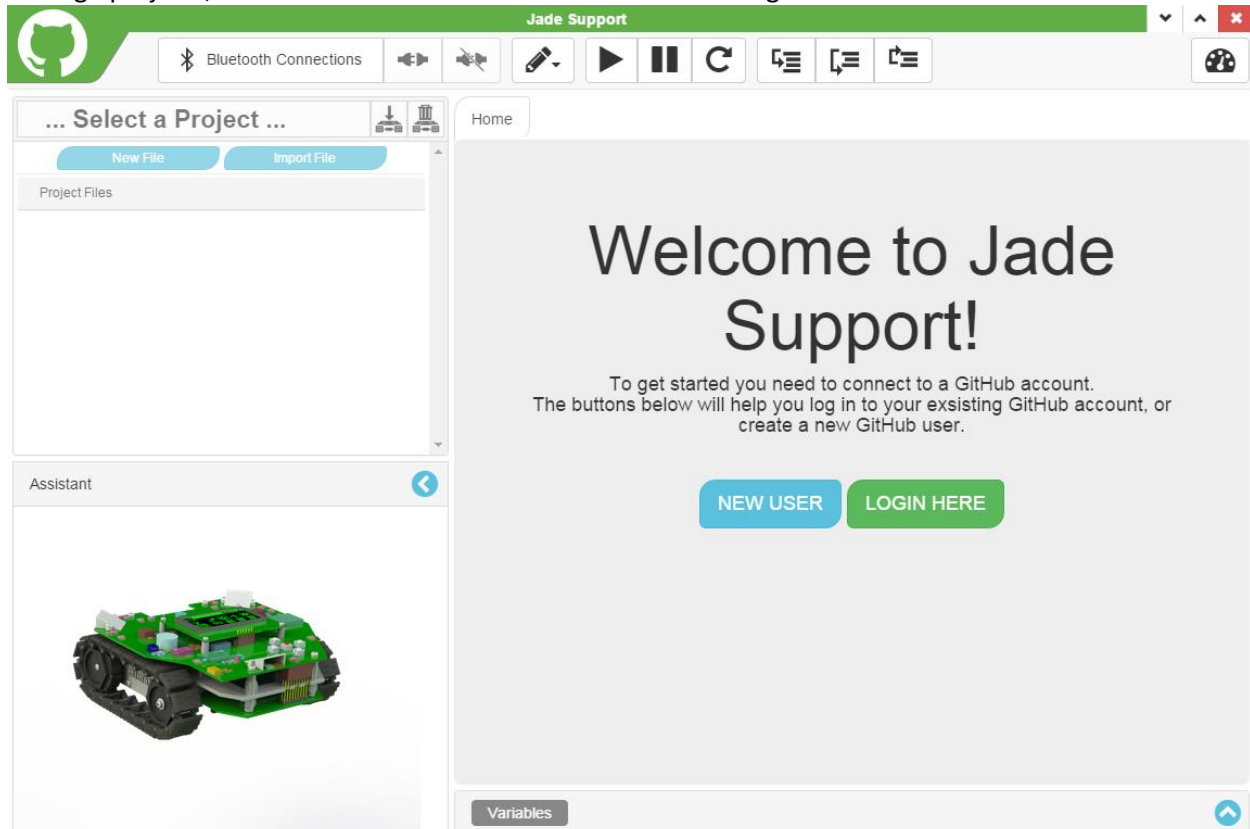
Just as a note, in the sample screen showing the “Logic” application, there is an error. It is a simple object avoidance program, but when an object to the right is detected, the “True” operation it to turn right and the opposite is true for the left sensor. In a true object avoidance program, the robot would turn away from any sensed objects, not towards them.

If this was the case in an executing robot, the user would simply stop the program’s execution, navigate to the two movement commands and change them.

## Programming the Jade Robot

The previous sections describe how to use and program the Jade Robot using its built-in user interface. The Jade Robot can also be controlled and programmed through its Bluetooth and USB interfaces.

The primary programming interface is known as “Jade Support” and provides users with the ability to manage projects, download them into the Jade Robot and debug them.



Jade Support is a Google Chrome App and will work on Windows (XP, Vista, 7 \* 8) or Mac (“Mavericks” or later) system that has the latest version of Chrome and has a Bluetooth Interface. It can be installed from here: <https://chrome.google.com/webstore/detail/jade-support/gchcbahadlpkgkpenlkfgdgkdjedepod>

For more information regarding using Jade Support, go to the introductory document.

## Bluetooth Connections

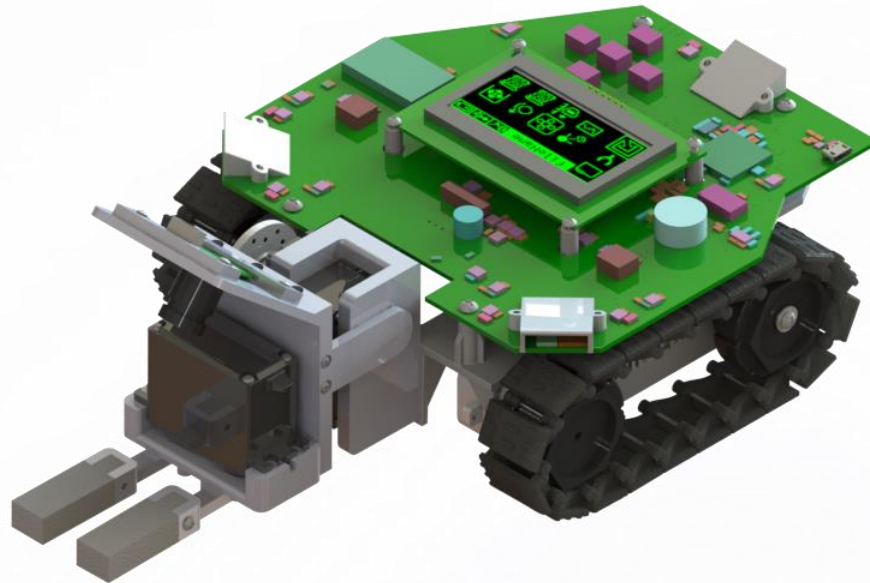
Detailing how to pair the Jade Robot and connect to Jade Support for the various versions of Windows and Mac OS X would require 20+ pages, so for efficiency, the Mimetics web page has this information tabbed so that the user can work through their specific operating system. The basic process for connecting the Jade Robot to Jade Support is:

1. Bring the Jade Robot out of Sleep Mode (press and hold the Down Navigation Button).
2. Navigate to Tools → Bluetooth and turn on the Jade Robot's built in Bluetooth adapter (the blue LED by the Bluetooth adapter will start flashing).
3. Navigate to Tools → Friendly Name and give the Jade Robot a unique name.
4. Navigate to Tools → Timeout and specify a 15 minute timeout for the Jade Robot.
5. On the PC or Mac, start the Bluetooth utility, ensure the system's Bluetooth Adapter is on and start searching.
6. When the "Friendly Name" for the Jade Robot appears, select it and pair it with the system. If asked for a PIN code, enter "1234".
7. On PC systems, when the pairing is complete, record the "com" port number.
8. Go to the Chrome Web Store and using the link (<https://chrome.google.com/webstore/detail/jade-support/gchcbahadlpkgkpenlkfgdgkdjedepod>) install and launch Jade Support.
9. Either use an existing GitHub account or create a new one and allow Jade Support to access it.
10. Connect to the Jade Robot using the Windows "com" port on the Friendly Name on a Mac.

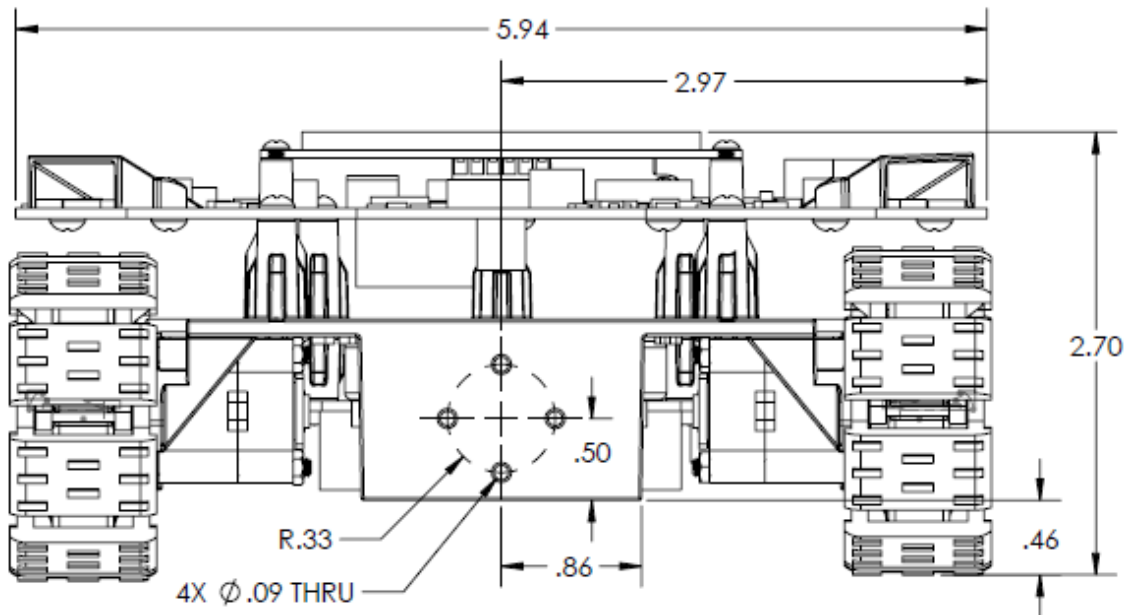
Everything is ready for programming the Jade Robot. Please see the "Jade Support Introduction" document for directions on how to use community projects as well as create new ones.

## Expanding the Jade Robot

The Jade Robot has been designed for user expansion. Probably the most popular expansion option is to add a gripper and camera to the Jade Robot. Plans for a 3D printed version of the gripper will be available shortly.



The dimensions of the Jade Robot from the front are:



Additional information and documentation will be available in the near future.

## Supporting Documents

Currently None

## Glossary

ASCII – Standard 8 bit character set. See <http://en.wikipedia.org/wiki/ASCII>



## Document Updates

Date	Changes	Author
2014.11.11	Initial Release	Myke Predko