AL5 ARM GUIDE

CONTENTS

1 Overview

The AL5 Arm Project

Introduction

This guide explains how to use the FlowBotics Studio AL5 Arm project.

If you have not already done so you'll need to read the FlowBotics Studio user guide and be familiar with how to launch the AL5 Arm project from the FlowBotics Studio Project Browser.

The FlowBotics Studio user guide is available from the Help button in FlowBotics Studio.

If you need information on how to assemble your robotics kit you can find it here:

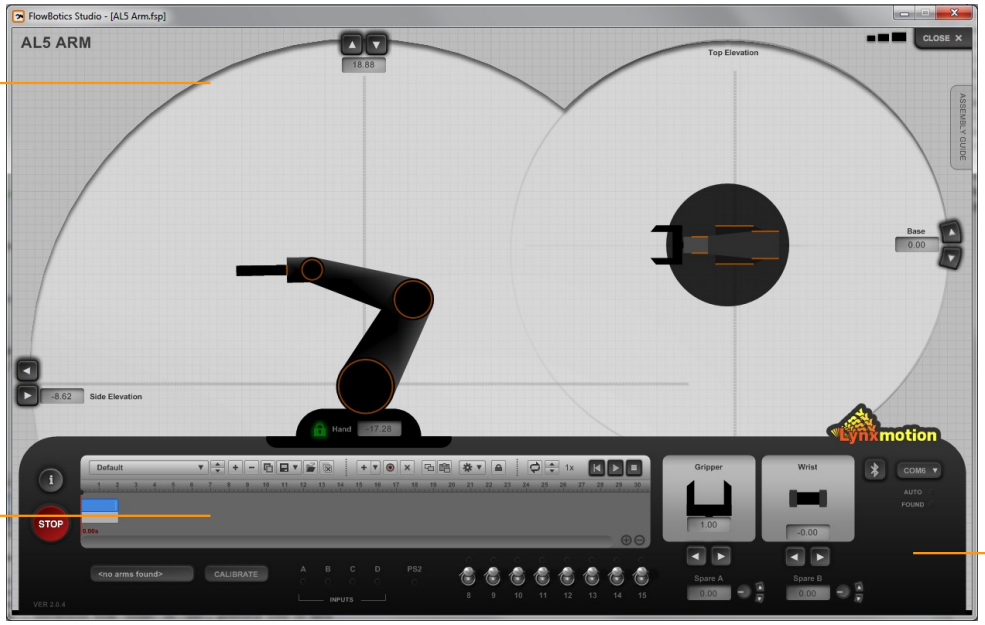
http://www.lynxmotion.com/s-2-assembly-guides.aspx

User Interface

When you open the AL5 Arm project you'll see the interface is essentially broken into two main areas, the Robot Simulator and the Control Panel.

The Simulator is used to show you how the robot is currently positioned. It also allows you to change the position of the robot.

The Control Panel contains elements for connecting to the robot, changing it and for sending and receiving data. However, the biggest part of the Control Panel is the Sequencer which allows you to program a series of movements.



Connecting

Before we go any further we'll talk about how you connect your robot to the PC so that it can communicate with FlowBotics studio projects.

Connecting Via Serial Cable

The simplest way to connect is directly using an RS232 to USB cable. Here are the steps you need to follow in order to set this up.

STEP 1 Connect the RS232 connector to the SSC-32 board on your robot

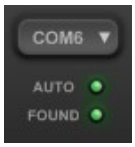
STEP 2 Plug the USB connector into the PC

STEP 3 Power on the robot

STEP 4 Run FlowBotics Studio and open the project

STEP 5 The port selector is set to Automatic (AUTO) by default and will scan through the available ports until it finds the one connected to the SSC-32. The Auto light will flash when searching.

STEP 6 When the board has been found the Auto light will illuminate permanently and so will the Found light. The selector will show the COM port that is being used.



Your robot is now connected and ready to be controlled and programmed by FlowBotics Studio

If for some reason the software can't find the board then if you know which COM port it's on you can choose this manually from the COM port selector.

Connecting Via Bluetooth

If you want to be cable free then you can set up a bluetooth connection. For this your PC will need to have Bluetooth either built in or via a USB adapter. You'll also need an RS232 to Bluetooth connector to plug into the SSC-32 such as the XBee board available from Robotshop.

Stage 1 – Bluetooth Pairing

If you already have your bluetooth adapter paired with your PC you can skip to stage 2.

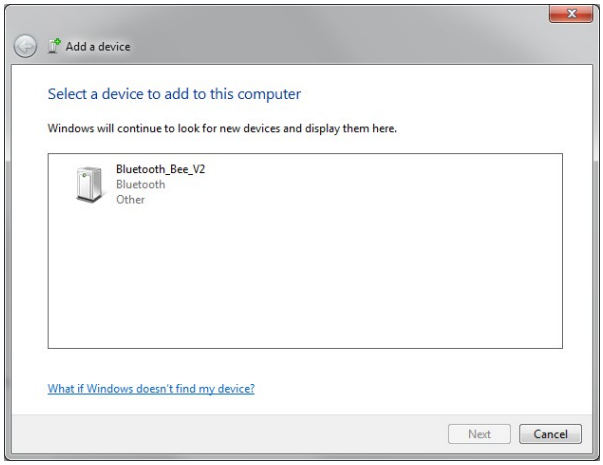
STEP 1 Connect the RS232 to Bluetooth connector to the SSC-32 board on your robot

STEP 2 Ensure your PC has its Bluetooth capability switched on

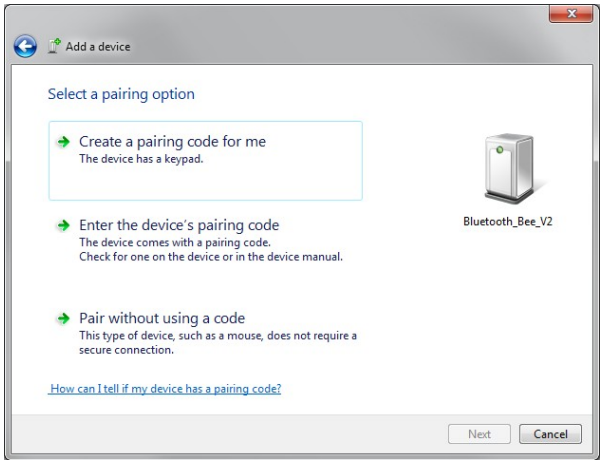
STEP 3 Power on the robot

STEP 4 We first need to pair with the Bluetooth device. Click the Start button in Windows and choose Control Panel.

STEP 5 Under Hardware And Sound click Add A Device. Windows will search for your Bluetooth device.



STEP 6 Once Windows finds your device click on it then click NextYou will be presented with a number of Pairing options.



STEP 7 For the XBee we have a pairing code to enter (1234) so we choose option and click Next.

STEP 8 Enter the code and click Add Device.

STEP 9 Windows will finish the process by adding your device to the system. You're now ready to go!

Stage 2 – Connect To The Software

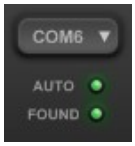
With your Bluetooth device successfully paired you can now move on and connect to the software.

STEP 1 Run FlowBotics Studio and open the project

STEP 2 In the project user interface click the Bluetooth button so that it is illuminated. This will make sure that the software uses the correct baud rate and adjusts communications for the lower bandwidth.

STEP 3 The port selector is set to Automatic (AUTO) by default and will scan through the available ports until it finds the one connected to the SSC-32. The Auto light will flash when searching.

STEP 4 When the board has been found the Auto light will illuminate permanently and so will the Found light. The selector will show the COM port that is being used.



Your robot is now connected and ready to be controlled and programmed by FlowBotics Studio

If for some reason the software can't find the board then if you know which COM port it's on you can choose this manually from the COM port selector.

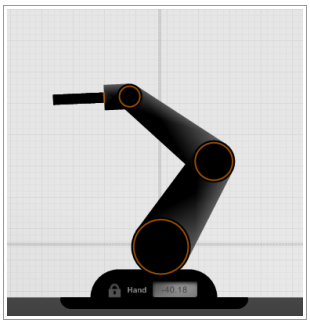
Now that you know how to connect we will continue with our tour of the project user interface.

Simulator

The Simulator shows a side elevation representation of the robot arm on the left-hand side and a top elevation of the arm (view from above) on the right-hand side.

You can directly manipulate these representations in order to position the arm using the mouse. There are also fine adjustment controls and numerical representations of the position that you can edit for ultimate precision.

Side Elevation Controls



The side elevation gives you the most control over arm position.

There are a number of different ways of interacting with the arm on screen. We'll go through these one-by-one.

Move to Target

Clicking anywhere in the side elevation will move the arms hand position to exactly where you clicked. The shoulder and elbow are defined using Inverse Kinematics so all you need to do is focus on where you want the arm to go.

Drag

Having clicked you can then hold the mouse button and drag the arm around to find the position you want.

Base

If you hold the SHIFT key while dragging with the mouse you can control base rotation.

Hand Tilt

You can tilt the hand by right-clicking and fragging the mouse up and down.

Wrist Rotate

By holding the SHIFT key whilst right-clicking and dragging you can rotate the wrist joint (if available on your robot arm)

Gripper

Finally, by holding the CTRL key whilst right-clicking and dragging you can open and close the gripper

Finer Control

Fine adjustments to the position of the arm can be made using the buttons at the end of each axis.

If you click and hold these buttons they will auto repeat, that is to say that they will continually nudge the arm in the applicable direction until the mouse button is released.

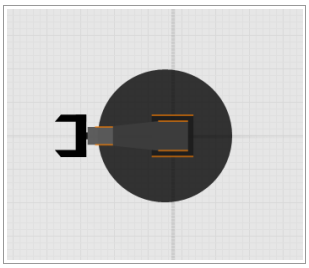
The numerical displays show the absolute position of the arm as coordinates within the side elevation. For high precision control you can click on these and change them.

Hand Lock

At the base of the arm are the controls for the hand. You can set the hand tilt explicitly by editing the numerical output.

You can also lock the hand in place which means that the software will automatically adjust the hand angle to maintain the same pointing direction as the arm moves.

Top Elevation Controls



The top elevation allows you to control the base rotation only.

Click on the top elevation and drag to rotate the arm.

Finer Control

Fine adjustments to the base rotation can be made using the buttons to the right of the top elevation. As with the side elevation these buttons will auto-repeat if held down.

The numerical display shows the base angle in degrees. Once again, for high precision control you can click on these and change them.

Control Panel

The Control Panel has several functions. First it provides some essential configuration controls for things like COM port connection and calibration.

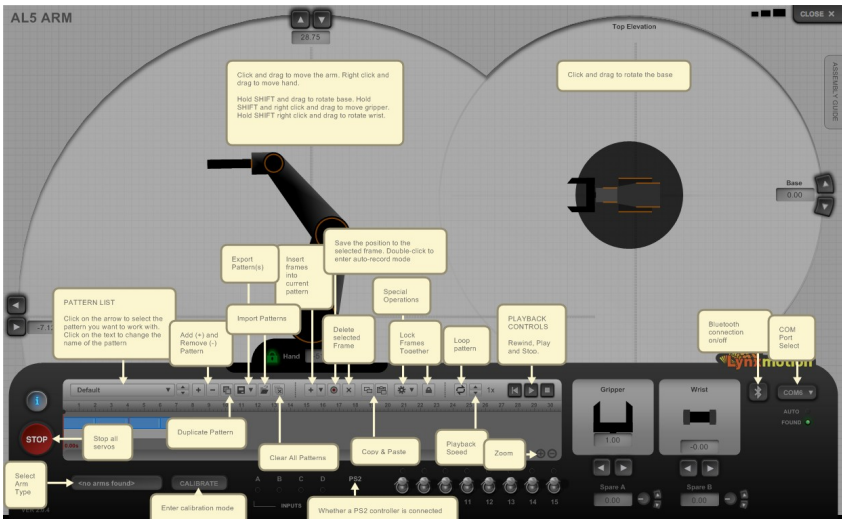
Second it contains additional controls for manipulating your robot. These compliment the ones we've already talked about relating to direct interaction with the simulator.

Finally it houses the sequencer. This is the biggest element in the panel and as such we deal with it in its very own chapter.

For now we'll focus on the other two sets of elements and we'll deal with them one-by-one starting with in-project help.

Help

There are a large number of buttons and controls on the project interface so if you ever need a quick reminder of what a particular control is for you can quickly call up the in-project Help overlay. Just click the button shown below to toggle the overlay on and off.



Emergency Stop

On very rare occasions you may need to stop your robot in its tracks. For this purpose we've added an emergency stop button. Click here and the software will immediately stop all servos and kill all communications.

Arm Type

The AL5 comes in a number of flavours each with their own dimensions and operating limits. You can select the arm that applies to you from this list.

Calibration

Small differences in robot orientation are inevitable. Even if the same person built the same kit twice in a row there would always be some small differences between the two. In order to compensate for this we have a calibration facilit.

Click the Calibration button to enter calibration mode.

This will display a number of knobs on the interface. Click and drag these to alter the servo position. You'll need to have the robot connected in order to see the servos adjust as you move the knobs.

The knobs are zero at the vertical position. If you hold the CTRL key on your keyboard and click on a knob it will reset it to zero.

Gripper Control

To define the gripper position use the gripper control. Click on the control and drag to open and close the grippers.

For fine control there are open and close buttons. You can click and hold these to continuously open or close the gripper.

The gripper position is at 1.0 when fully open and zero when closed. You can see this in the numeric display. This can also be edited for ultra precision.

Wrist Control

The wrist control is next to the gripper control. Click and drag to rotate the wrist. The image shows the gripper as if you were facing it head on so it will show when the gripper closes as well.

Once again there are fine adjustment buttons and a numerical display showing the exact angle in degrees (-90 to 90). You can of course edit this value by clicking on it.

Spare Servos

We've included a couple of controls for addressing two spare servos (pins 6 and 7 on the SSC-32). There are knobs for setting these. We also have the usual fine tuning options.

Output Switches

There are eight switches on the control panel which allow you to use pins 8 to 15 on the SSC-32 as digital outputs.

Input LEDs

There are four input LEDs that indicate the state of the 4 digital inputs on the SSC-32 board. These are labeled A,B,C and D just like they are on the SSC-32.

You can program your robot to respond to these inputs. See the Programming Guide for more information.

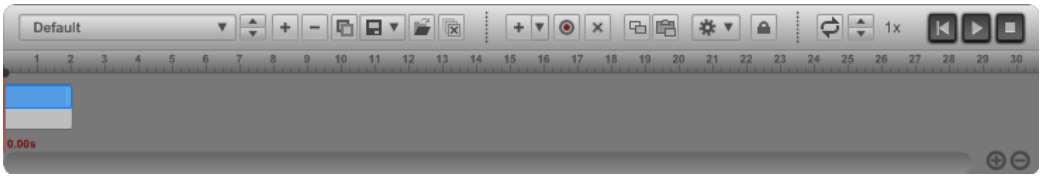

A
B
C
D
INPUTS

2 Sequencer

Orchestrating Movement

Patterns

The sequencer allows you to make your robot move over time by transitioning from one position to another. Each transition we call a frame and a sequence of frames we call a pattern.



You can create as many patterns as you like. You can play patterns back manually or, as you'll see in the Programming Guide you can program them to run depending on some other action or outcome.

This section describes the pattern management functions of the Sequencer.

Pattern List

The pattern list is the first control on the sequencer. If you click on the arrow on the right-hand edge you'll see a list of the patterns that have been created and by selecting one you can move to that pattern. You can also scroll through the list one-by-one using the up and down arrow buttons.

Clicking on the name of a pattern will allow you to change this. Simply type in the box then press the Return key or click away.

Pattern Management

Add Pattern

To add a pattern click the add button. A new pattern will appear in the list and its name will open for editing.

Remove Pattern

Click the remove pattern button to delete the currently selected pattern from the list. This action is irreversible so you will be asked for confirmation.

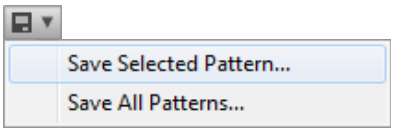
Duplicate Pattern

If you want to make a new pattern based on an existing one then you can duplicate it.

Saving Patterns

IMPORTANT: If you want to keep any patterns you create then you must export them otherwise they will be lost when you return to the project browser.

To do this click the export button.



You can choose whether to export all your patterns or just the currently selected one. Patterns are saved to files so you'll need to pick a filename and folder to save to. If a pattern uses sub patterns these will be saved even if you choose only to save the selected pattern.

Loading Patterns

If you have saved patterns that you want to restore then click the Import button. You will be asked to choose a previously saved pattern file.

The patterns in the file will be added to the list. They do not replace the pattern list. Also it doesn't matter how many patterns the file contains, all of them will be imported.

Clear All

If you want to start from scratch you can clear all the patterns from the list using the clear all button.

Frames

We now know how to manage patterns now lets see how you build one. As we said earlier a pattern is made up of frames. A frame represents a transition between robot states over time.

In addition to frames, you can also add other patterns to a pattern. This allows quite complex series of movements to be built up very quickly and easily.

Adding and Deleting

To add a frame click the Add button. A new frame will be added at the end of the pattern. The duration of the frame will be whatever the last frame duration was. The frame will record whatever position the robot is currently set to.

You can add a sub pattern to the pattern by clicking the arrow to the right of the Add button. A drop list of the available patterns will appear. Select one and it will be added to the end of the pattern.

To delete a pattern or frame from a pattern, click the Delete button

Timeline Locking

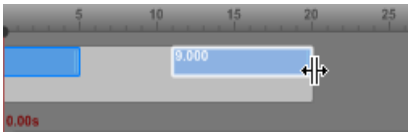
The timeline is locked by default. This means that frames will automatically run from one to the next – you cannot create space in between. Moving a frame past another one will move it along the order in the timeline.

If the timeline is unlocked then you can move frames independently of each other and also create gaps of time in between.

Moving and Resizing

To move a frame on the timeline, simply click on it and drag it to the time you want it to start. The start time will be displayed as you drag. How frames move relative to each other is determined by whether the timeline is locked (see previous section).

To resize a frame grab the right-hand edge and drag it.



When moving or resizing the mouse snaps to the nearest unit on the timeline. If you hold SHIFT while moving or resizing no snap will be applied.

When the timeline is unlocked then if you hold CTRL while dragging or resizing a frame all frames to the right of the selected frame will be moved so that the time interval between the selected frame and the next one is maintained.

Recording to a Frame

When you add a frame it will record the state that the robot is currently in. If you want to change this state first select the frame by clicking on it. Next move the robot to the position you want to record. When you're happy press the record button.

The frame will flash to indicate that it has been updated.

Auto Record

If you want changes you make to be automatically recorded you can lock the record button in place by double-clicking on it. Now whenever you change the robot position the currently selected frame will be updated.

The record button will light up to show that auto record is on.

To switch auto record off, double-click on the record button again.

Copy and Paste

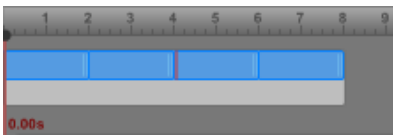
Sometimes you might want to copy the robot state from one frame to another. To do this we have copy and paste. To copy the data from a frame, select it then click the Copy button.

To duplicate the data on another frame, select the target frame and click the Paste button.

Pause Before Frame

You can insert a pause before a frame commences. This is useful if you want the sequencer to stop and wait for some external event before continuing. First select the frame then click the Operations button and select Toggle Pause Before Frame. A red line will show at the start of the frame to show the pause.

To remove the pause select the frame again and select Toggle Pause Before Frame after clicking on the Operations button.



Remove Gaps Between Frames

If the timeline is unlocked then you can instantly remove all the gaps between frames and push them up against each other by clicking the Operations button and choosing Remove Gaps Between Frames from the menu.

Reverse Frames

It's useful to be able to reverse the order of frames in a pattern. To do this click the Operations button and choose Reverse Frames.

Pattern Playback

Once you have some frames in a pattern you can try playing it. Click the Play button to start the sequencer playing the current pattern.

The play button lights up in green when the sequencer is playing.

To stop playing click the Play button again or click the Stop button.

You can reset the play position to the star by clicking the Reset button.

You can also move the play position manually. Click on the black handle at the top of the playback position line and drag to move it.

Playback Control

You can change the speed of playback by changing the speed multiplier. Click the up and down arrows to alter this.

Normally a pattern plays to the end then stops. However, sometimes you want a pattern to repeat. You can toggle this by clicking the Loop button.

3 PS2 Control

Using The PS2 Controller

Introduction

The project has been pre-configured to work with the wireless Lynxmotion PS2 controller. To use the controller simply plug in the wireless adapter. The project should detect the adapter within a matter of seconds and the PS2 light will illuminate on the project user interface.

IMPORTANT – Use in Analog Mode

The Lynxmotion PS2 controller must be switched into analog mode in order for it to work correctly with the project. To do this press the Analog button on the centre of the controller. The 'NEGCON' light should illuminate to show that analog mode has been started.

Controller Mappings

The controller has been configured to control the project as indicated below. Note that the controller movements in this case have been made to move by a single step. Holding a button or stick position will cause the software to auto repeat.

Left Thumb Stick Left / Right	Arm forward / back
Left Thumb Stick Up / Down	Arm up / down
Right Thumb Stick Left / Right	Wrist Rotate
Right Thumb Stick Up / Down	Hand Tilt
Upper Trigger Buttons (1)	Base Rotate
Lower Trigger Buttons (1)	Gripper Open / Close
Cross Button	Toggle Lock Hand

If you load in the demo pattern for the project then you can trigger this by pressing the Triangle button.