Basics to Robotics- Overview 1a

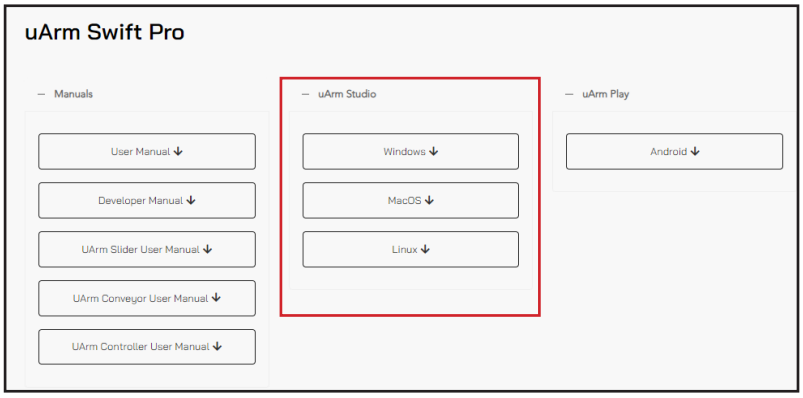
In this Module we will be diving into Robotics and Robotics Simulation by programming and creating movement of complex machines at various scales. We will start with a desktop arm called the UArm Swift Pro. Its inner workings and programming are similar to that of our Kuka's operation and workflow. The UArm allows you to learn the basics at a small and approachable scale. Gradually you will gain the knowledge required to scale up to the complexities and challenge of the Kuka arm. The assignments will run you through the following programs to operate the various equipment covered: **UArm Factory | RoboDK**

Robotics is the culmination of everything you have learned up until this point. You began with line work and plotting leading to laser cutting moving from the 2D to the 3D world. Once in the 3D world utilizing your laser cut geometry to create motion with the principles of simple mechanics. All of these techniques, principles, and equipment learned combine into a experience and knowledge base to have a deeper understanding of programmable robots that are capable of tasks larger and more efficient than human scale.

We are going to build up in scale in terms of the various programs and equipment using a more approachable, user friendly, smaller scale UArm Swift Pro. Its "brain" is an Arduino Mega 2560 and is using 3 Nema 17 motors and a servo. It is also compatible with the Grove Sensor Kits we have been using in our Electronics Module. This adaptable platform will allow you to experiment with robotic movement and coding that transfer to larger machines such as the Kuka.

UArm Swift Pro

The first step is to download UArm Studio which is located under the UArm Swift Pro Section :
https://www.ufactory.cc/download-UArm-robot



You will need to download either the Windows or Mac versions dependent on your computer. This software controls the robot arm in 3 different ways. One is with a digital joystick, allowing us to move each axis with sliders. Two is with Blockly Coding, similar to Grasshopper but a bit simpler, which allows us to make repeatable actions. Lastly with "Teach" mode allowing us to move the robot with our hands and record its actions to be repeated.

Basics to Robotics- UArm Studio 1a

UArm Studio is the proprietary software that comes with the UArm Swift Pro. It is considered an introductory software that will allow you to adjust each axis and gain an understanding of how the robot operates with approachable software and operation that is user friendly.

It will also show you the wide capabilities of the platform such as sensor implementation learned in previous modules and various tool heads that can be easily interchanged. After you have a basic understanding UArm Studio you will delve deeper into the program's various operational modes.

Step 1 Open UArm Studio

Step 2 Connect Power and USB to Computer if not already connected. Press the Power button on the base of the robot arm. (You will hear it power up and the light turn on)

Step 3 Ensure that your UArm is connected on the entry screen in UArm STUDIO by checking the right hand of the screen under the image of the UArm. It should have a green dot and say connected.

Step 4 Scroll through the "Getting Started with UArm Studio" page, this will show you a basic overview of how the software operates and the various tools available for the UArm.

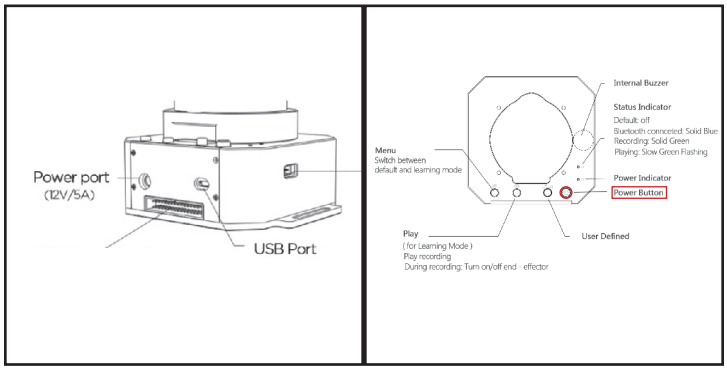
Step 5 Open the Control Tab, and become familiar with the different blue sliders. Check which tool is attached to the UArm and switch the toggle to check if it works (it will turn blue when activated and you will see it move).

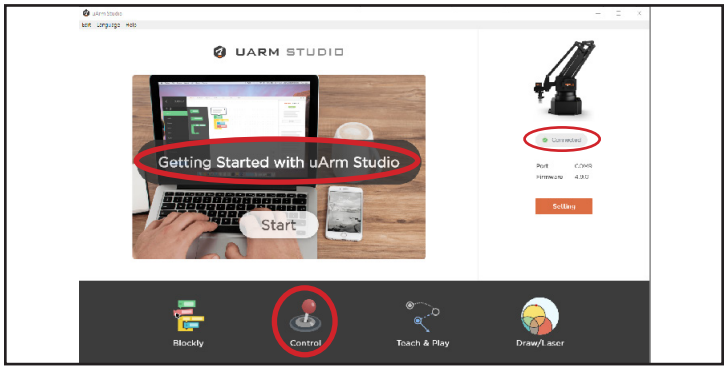
Step 6 Now, set to a slower speed, play with each axis of the arm as well as the tool currently attached to the arm. Reference the diagram to the right to see which axis is controlled by which slider.

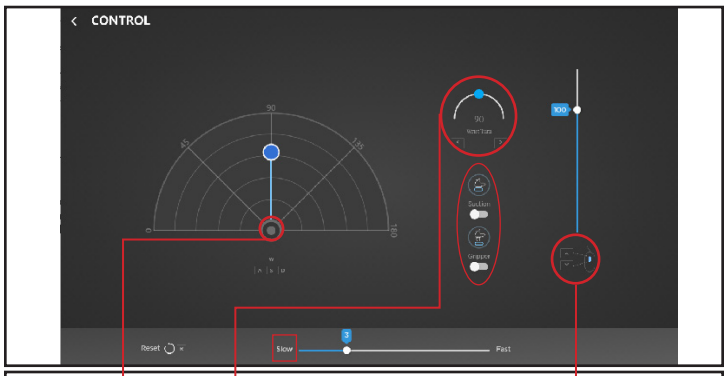
*Do not over extend the robot arm, cause any lift of the base off the table, or exceed safe speeds. Please keep area clear of unnecessary objects and stay out of range will in operation.

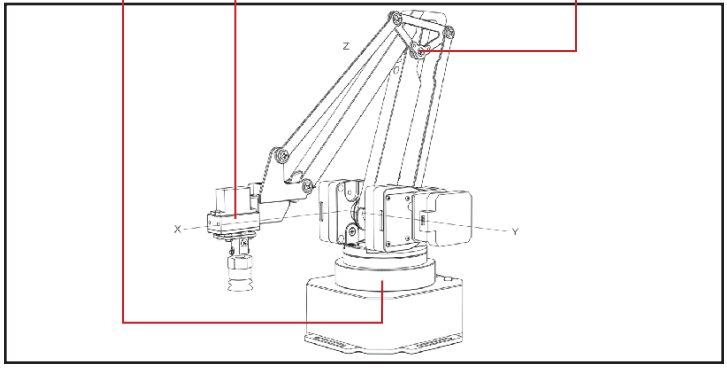
Step 7 Try to grab the red cube on the desk using the control mode.

Proceed to M6A1b









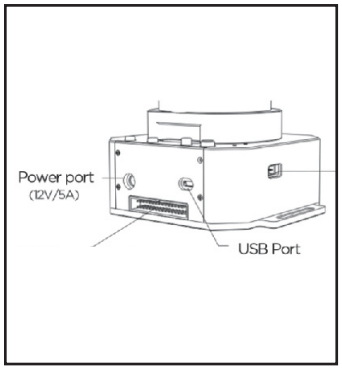
Basics to Robotics - Teaching 1b

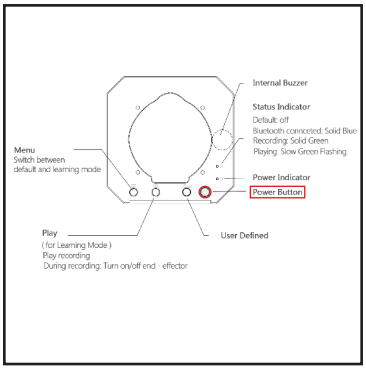
UArm Studio's "Teach and Play" mode allows for quick programming of the robotic arm's position and tool. There are two options for programming in this mode which are software control and hardware control. As seen in the picture below, there are instructions on how to program the robot arm through the use of the buttons on the base of the arm.

These will allow you to position and activate the tool in 3D space. As an alternative, you can do the same thing through software control by using the "Start Recording" button next to the image.

Step 1 Open UArm Studio

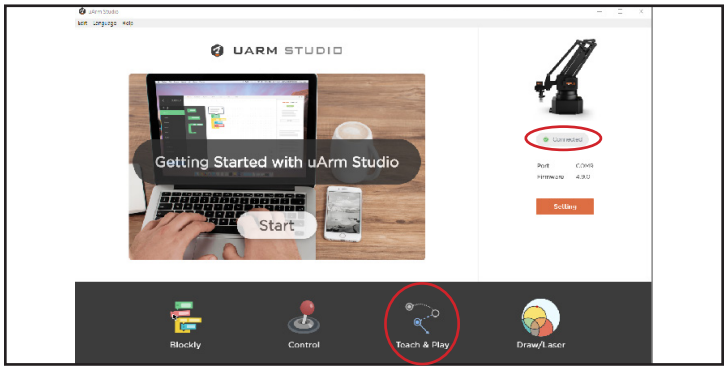
Step 2 Connect Power and USB to Computer if not already connected. Press the Power button on the base of the robot arm (You will hear it power up and the light turn on)





Step 3 Ensure that your UArm is connected on the entry screen in UArm STUDIO by checking the right hand of the screen under the image of the UArm. It should have a green dot and say connected.

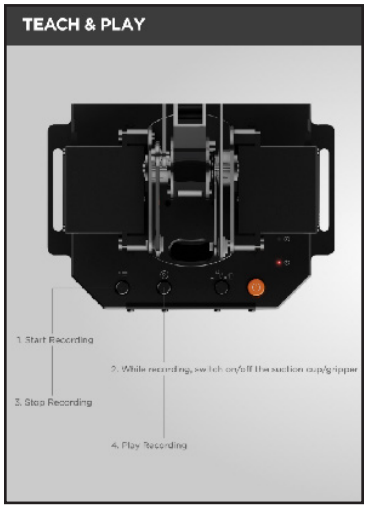
Step 4 Review the "Getting Started with UArm Studio" to examine the controls and understand the workflow for recording movement.



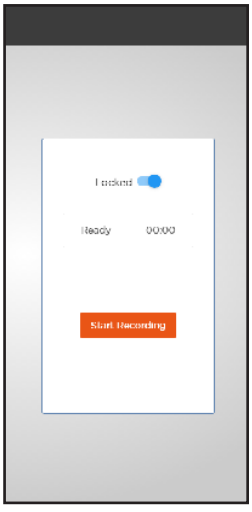
Step 5 Select the "Teach and Play" Mode

*Make sure the "Locked" toggle is turned off to operate the robot arm. Do not over extend the robot arm, cause any lift of the base off the table, or exceed safe speeds. Please keep area clear of unnecessary objects and stay out of range will in operation.

Hardware Control



Software Control



Step 6 Attempt a "Sweeping" recording where you have the arm complete a full range of motions with the software control option. Then finish the recordings and select play to see how it mimics your motions.

Step 7 Now, that you understand the process use both the software control mode to push the red cube around the table (make sure to mark your starting point of the red cube with tape or piece of scrap paper)

Proceed to M6A1c

Basics to Robotics - Block Coding 1c

After completing the previous pages you now have a better understanding of the basic movement, operation, and workflows. Now we will be begin with incorporating the use of simple code to control movement and create scripts. UArm Studio's Blockly control mode illustrates programming of the robotic arm's position and tools with a user friendly puzzle piece interface. This gives an approachable introduction to the way code functions and creates different operations, which is similar to Arduino Code. Also, it is compatible with our Grove Sensors from Module 5 which act as data inputs. This makes programming complex movements interacting with environmental data and generating loops easier and quicker.

Step 1 Open UArm Studio

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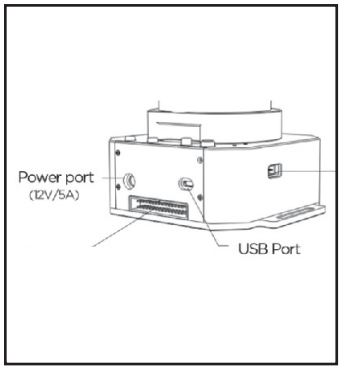

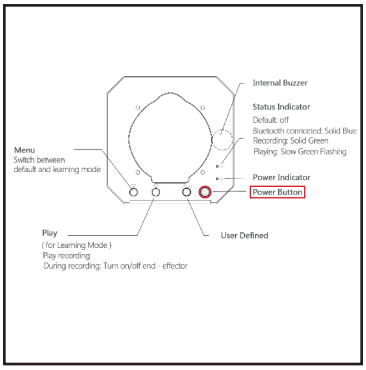

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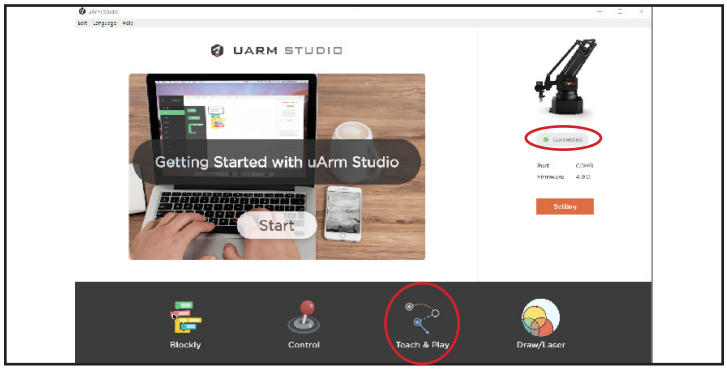
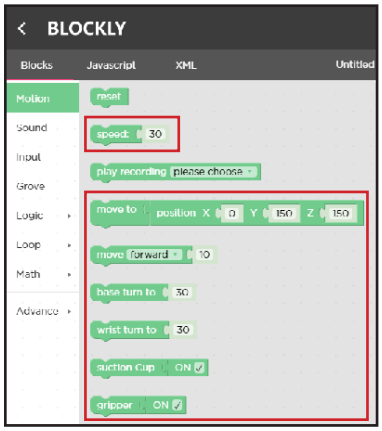
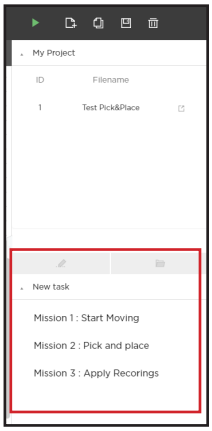
Step 4 Review the "Getting Started with UArm Studio" to examine the controls and understand the workflow for recording movement.



* Do not over extend the robot arm, cause any lift of the base off the table, or exceed safe speeds. Please keep area clear of unnecessary objects and stay out of range will in operation.

Step 5 Select the "Blockly" Mode and select the "Motion" tab to start creating blocks of code with each of the highlighted components (select current attached tool). You will need to complete the missions by following the prompts under the task menu to the right of the screen.





*You will need to input numbers or select different options from the drop down bars. Make sure to test the numbers before playing script. Wrist and base turn is based on the 180 degree turn radius.

Step 6 Complete "Missions" 1: Start Moving
Step 7 Complete "Missions" 2: Pick and Place
Step 8 Complete "Missions" 3: Apply Recordings

Proceed to M6A2