Getting Started Guide
TM5M-700

1. Setup

1.1 Software (TMflow client)

The TM5M-700 works with a software called **TMflow client**. This can be downloaded in the following link:

https://tm-robot.com/en/wpdmdownload/tmflow-1-72-3800/

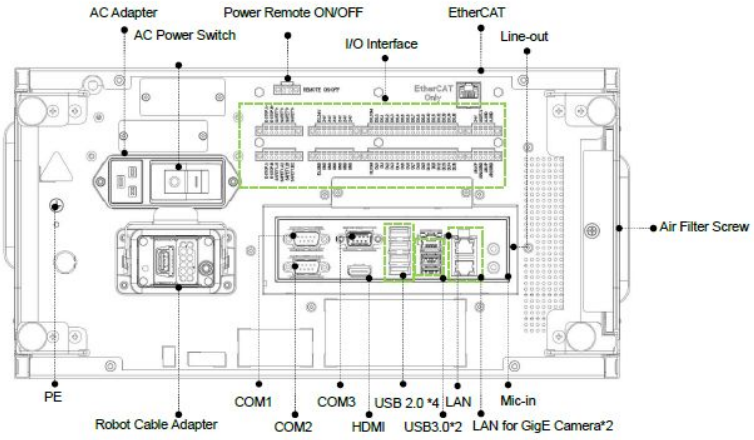
Make sure to install the version 1.72.3800 because the Cobot's version and the computer's version must match for a correct operation of the TM5M-700.

1.2 TM5M-700 Basic Components

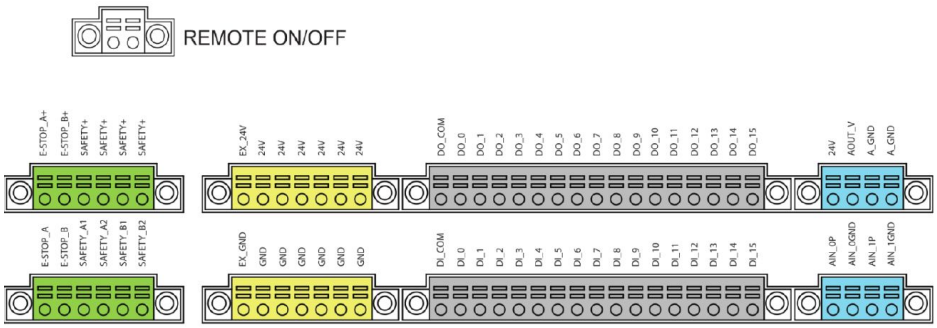
The robot is divided into three parts (**For more details of the components, please refer to the official manual of the TM5M-700**):

- **Robot Arm:** This is the principal component of the system, it is a 6 dof robotic arm including a camera located at the top of the robot. It also has 3 buttons located in the camera.
    - The **Point Button,** it stores the location of all the actuators and the position can be accessed by using the software TMflow client.
    - The **Camera Button** it can provide a quick initialization of the camera while the software is running, used in collaborative mode.
    - The **Gripper Button** it allows the gripper to close and open for every press and release of the button.

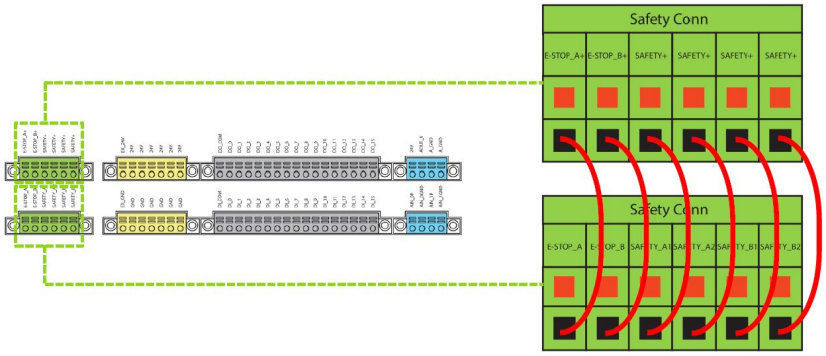
- **Control Box:** The Control Box component works as a computer in which the TMflow runs for every time the robot is booted. It also contains all the peripherals available for the communication of the component, process all the information necessary to perform any operation, I/O configuration,and source the robotic arm.



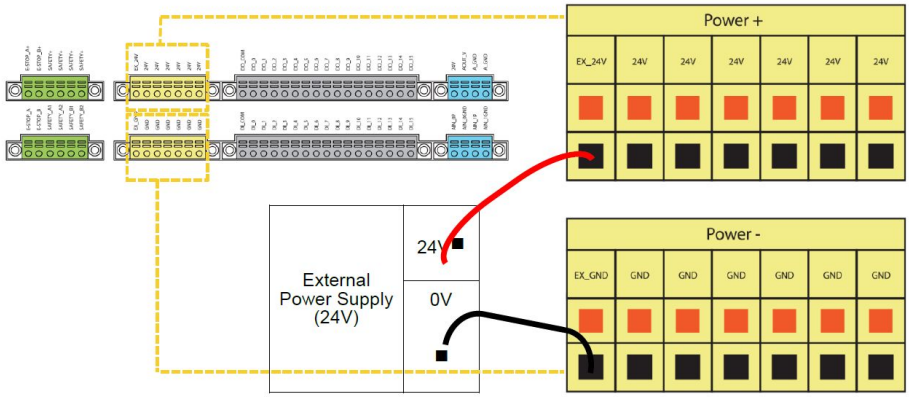
The I/O interface is composed of the following sections:



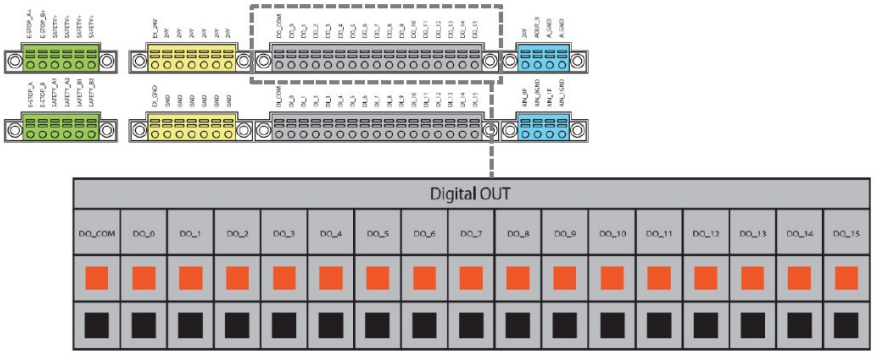
- **Safety Connectors:** Enables a disables modes of operation of the robot.



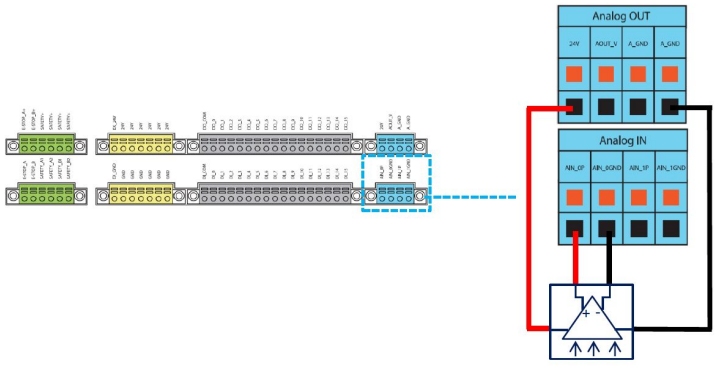
- **Power Supply:** It provides power supply of 24 v9/ olts and GND pins.



- **Digital I/O:** It provides the capability to handle digital inputs and output from external devices.

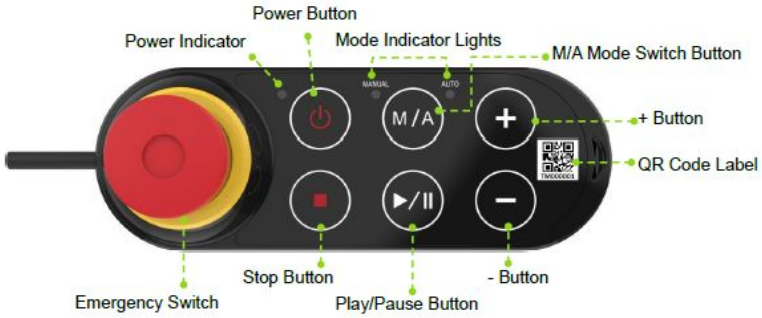


- **Analog I/O:** It supports analog inputs and outputs from any external device.



Important: When the cable from the **SAFETY_B2 and SAFETY+** is removed then the TM5M-700 is working in a **collaborative mode**, this means that the robot will move under some predefined values of **force and speed** according to the **ISO**. On the other hand, when the cable is present the robot will work in a **non collaborative mode.** In this mode the Robot can be configured with any characteristic.

- **Robot Stick:** The Robot Stick is the device that can interact, send commands to the Robotic Arm by using the following button options:



  - **M/A Button:** It can switch from Manual to Automatic or vice versa. **Important:** To change from Manual to Automatic press and hold the M/A button for 3 seconds and the press the '+' and '-' buttons in the following sequence: '+','-','+','+','-'.

  - **Stop Button:** It forces the current program to finish the execution of the program.

  - **Play/Pause Button:** It can execute or pause a program.

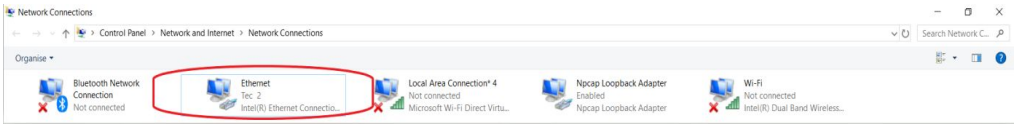
  - **+ Button:** In some configuration tools in the TMflow client such as the rotation of a specific joint, it allows to increase the amount of degrees when the button is pressed.

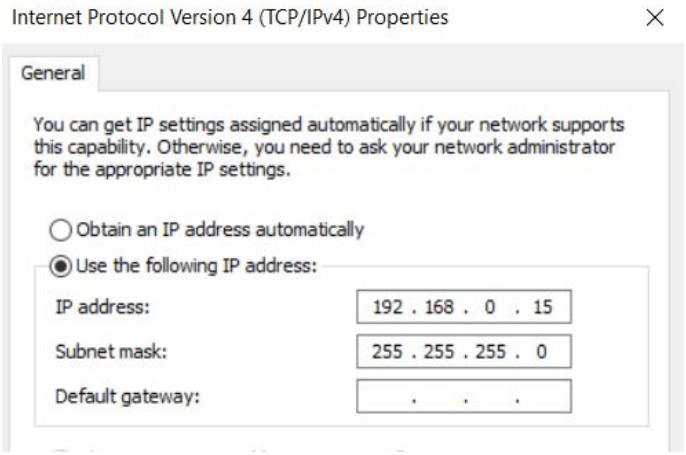
  - **- Button:** In some configuration tools in the TMflow client such as the rotation of a specific joint, it allows to decrease the amount of degrees when the button is pressed.

1.3 Communication to the Robotic Arm

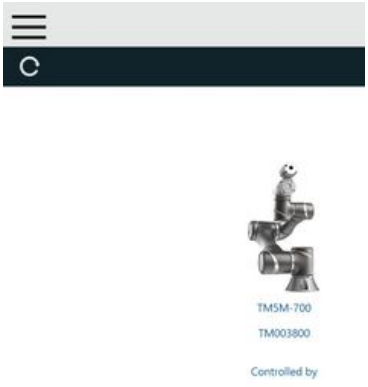
There is only one way to connect:

- **Ethernet:** To establish the communication with the TM5M-700 follow the next steps:
    - Plug an Ethernet cable to the desired computer and to the Ethernet Port mentioned in the previous section.
    - Go to the Network connections in the computer and change the IP Address as shown in the following images:

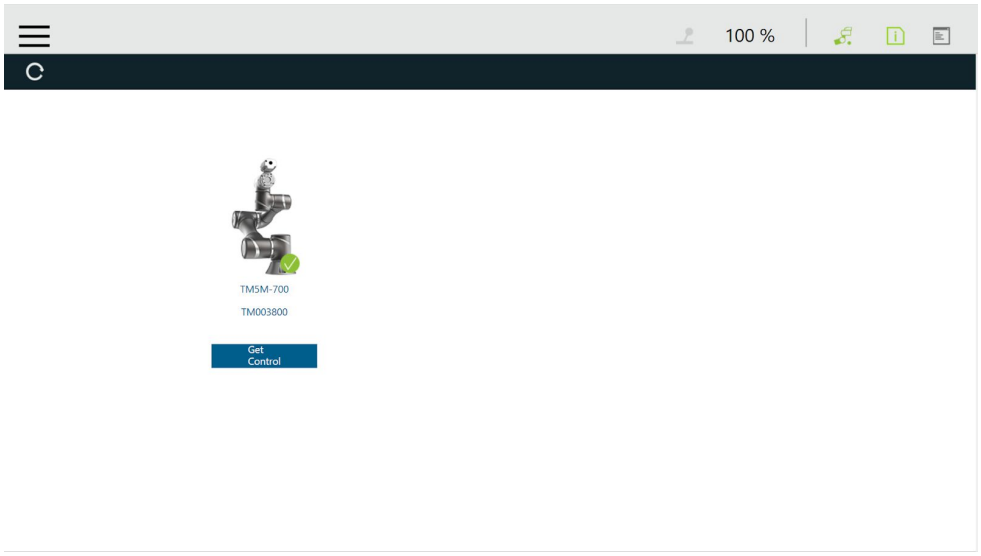




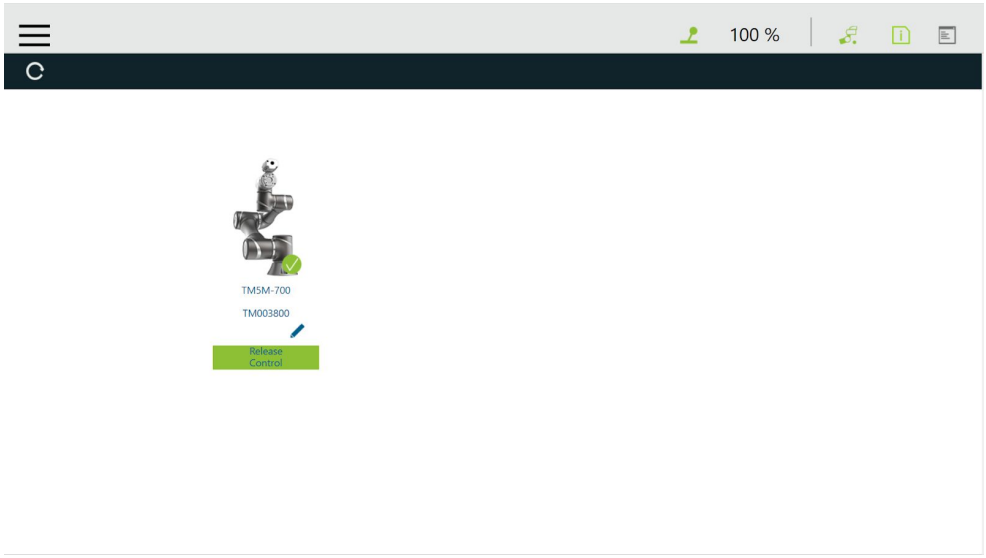
    - Open the TMflow client application of the computer and click on the refresh button. The TM5M-700 must appear as shown below:



- Click on the robotic arm image and the press “Ok” without inserting any password. Then press on the Get Control Button that appears below the image as follows:



- If all the steps were correctly followed the TMflow client should look as follows:

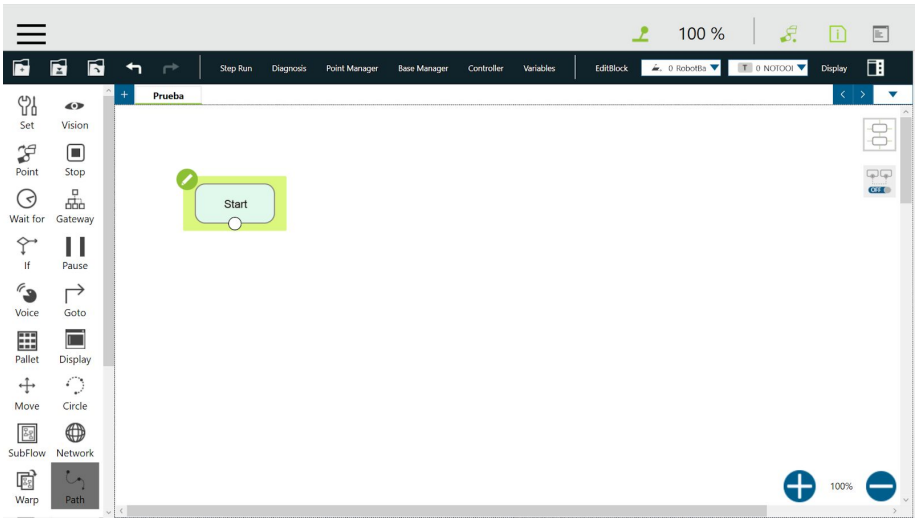


This concludes with the Setup of the TM5M-700.

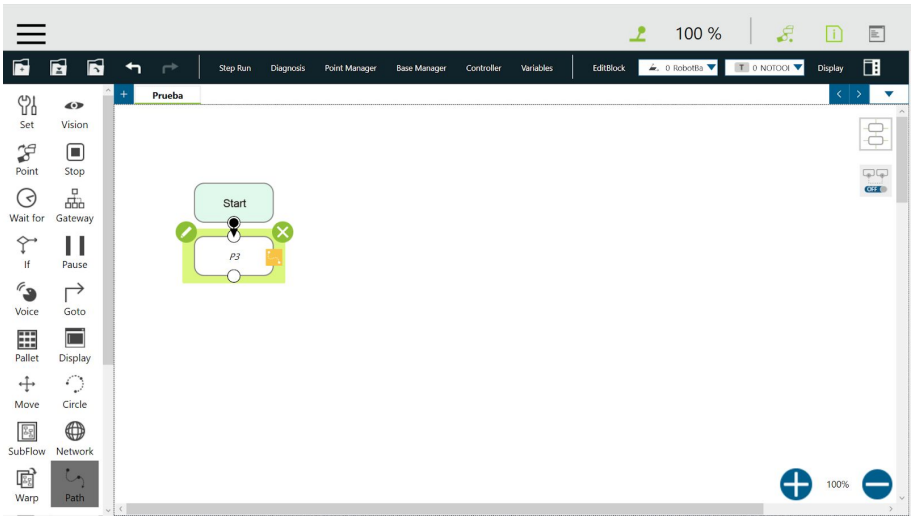
2. Create and execute a Project

In this chapter we will go through a creation and execution of a projection step by step.

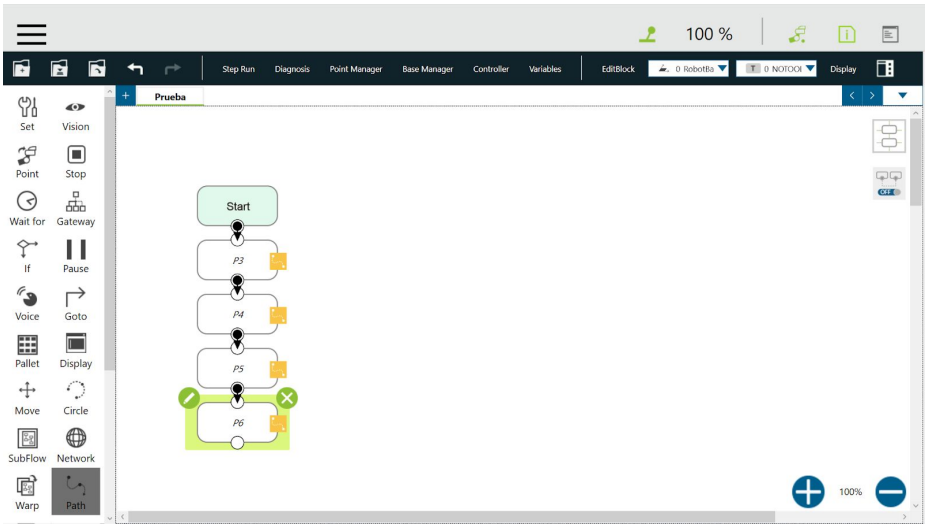
- Go to the Project Tab and create a new project with the name “Prueba”. Once the project was successfully created the screen should look as follows:



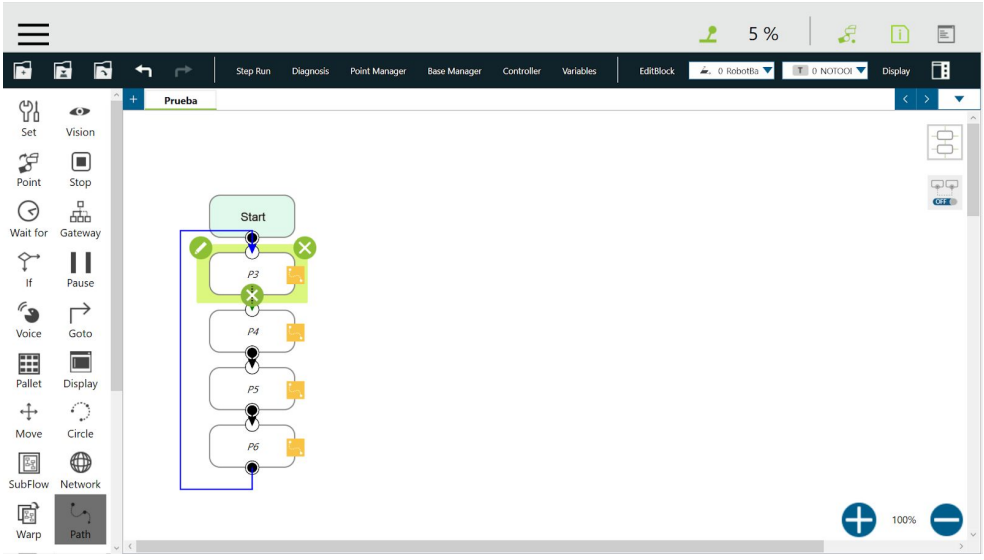
- Press the **Free Button** located in the **Robotic Arm** and position the Robot in any position that you want. When the arm is in the desired position press the **Point Button** located in the **Robotic Arm**, this should create a point in the diagram which stores the position as shown as follows:



- Repeat the same procedure for 3 points more, the diagram should look as follows:

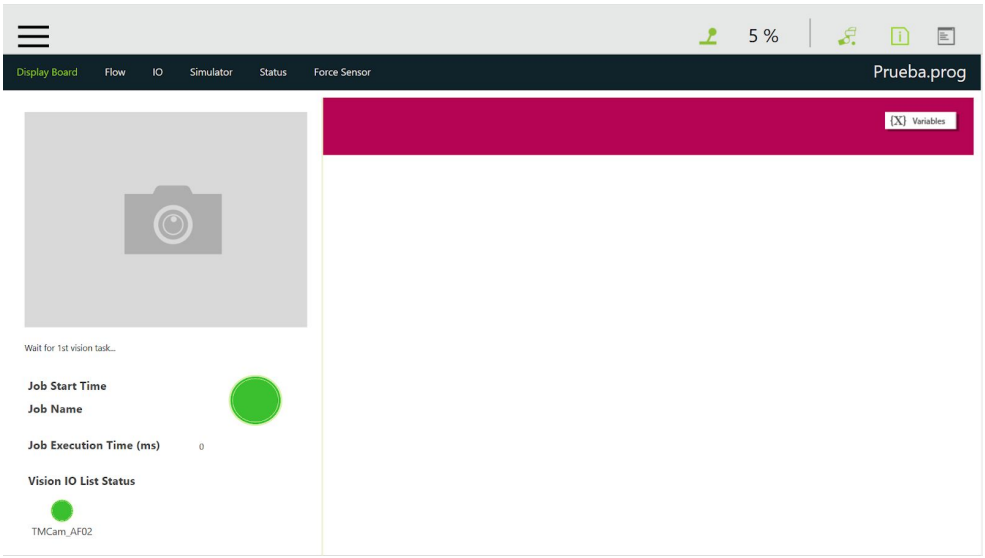


- Now press the **Play/Pause Button** from the **Robot Stick** to start the program. The arm should move from “P3” to “P6” passing all the intermediate points in the diagram.
- To make a loop of the program just click and hold on the white circle from “P6” and release it in the “P3” as shown in the following image. This should cycle the program until the program is forced to stop.

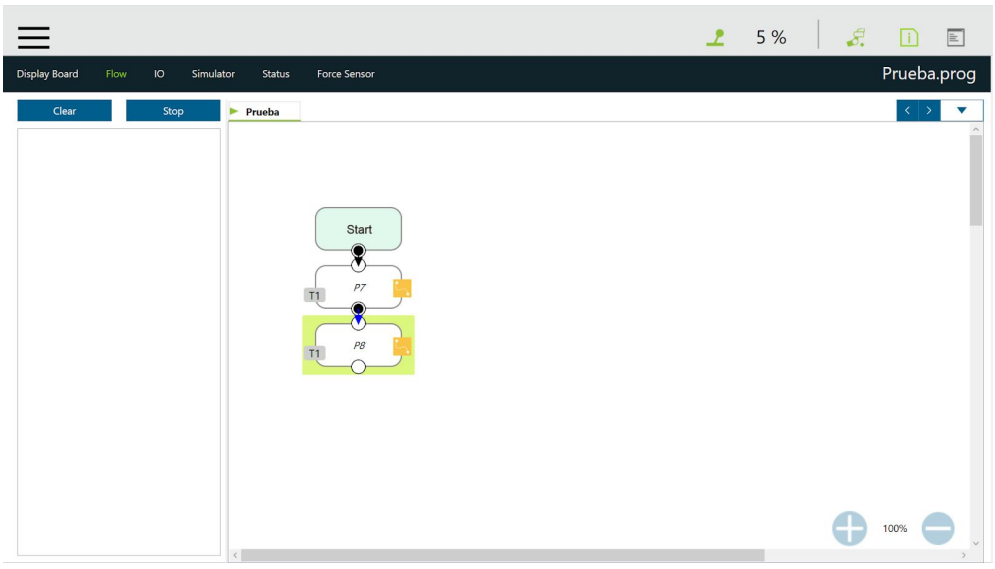


- Notice that whenever any project is executed the following window appears with the following options:

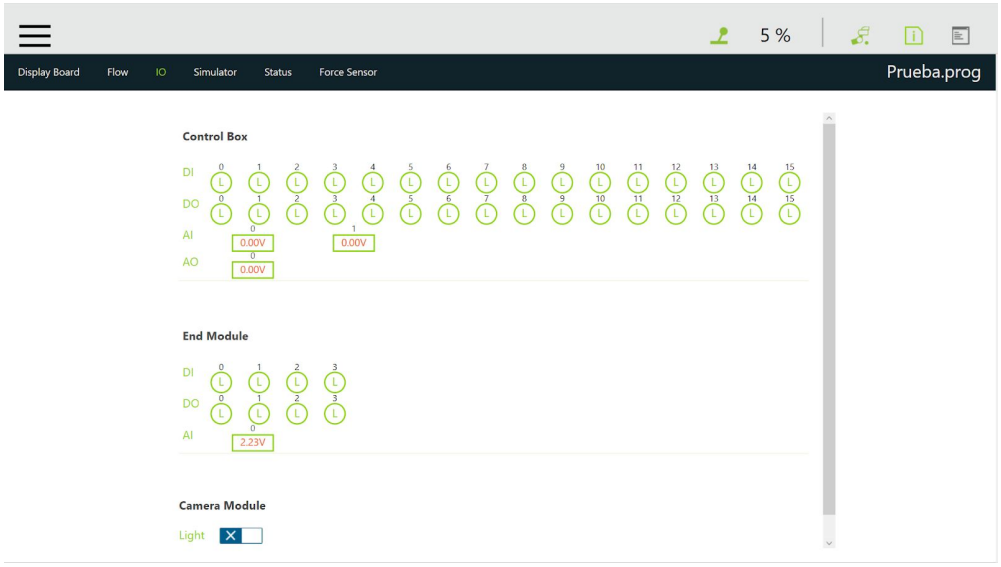
    - **Display Board:** It displays information such as variables only when it is used with the command **Display**.



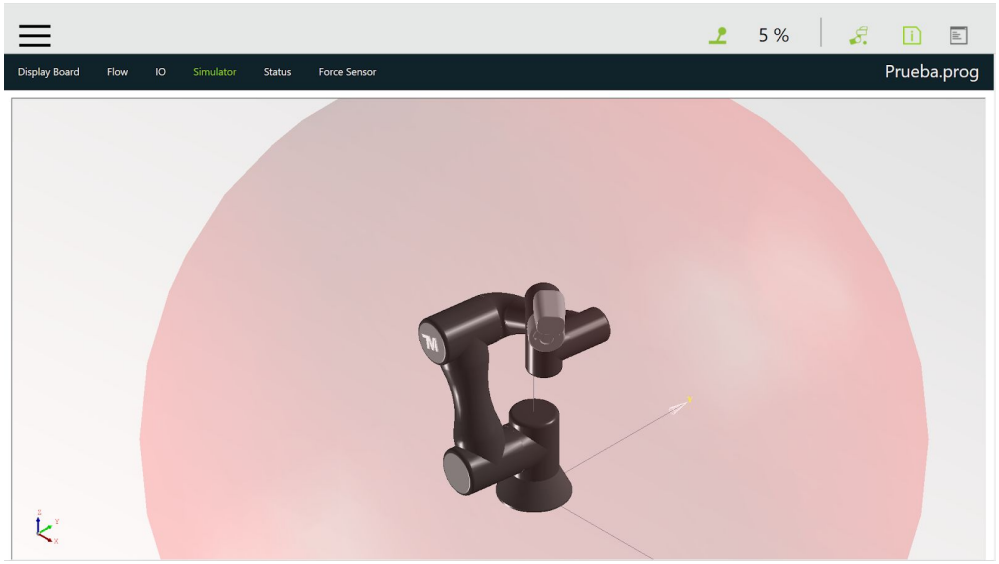
    - **Flow:** It highlights the block that is been executed in real time in the block diagram.



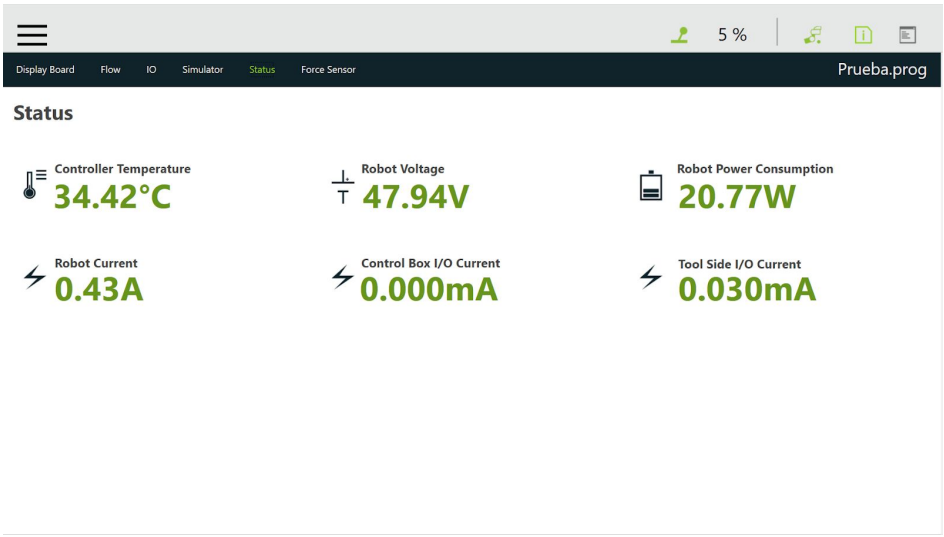
- **IO:** It provides the status of all the I/O ports.



- **Simulator:** It provides a real time simulation of the movements of the robotic arm.



- **Status:** It displays information of the voltage, current, temperature, and more features of the robot.

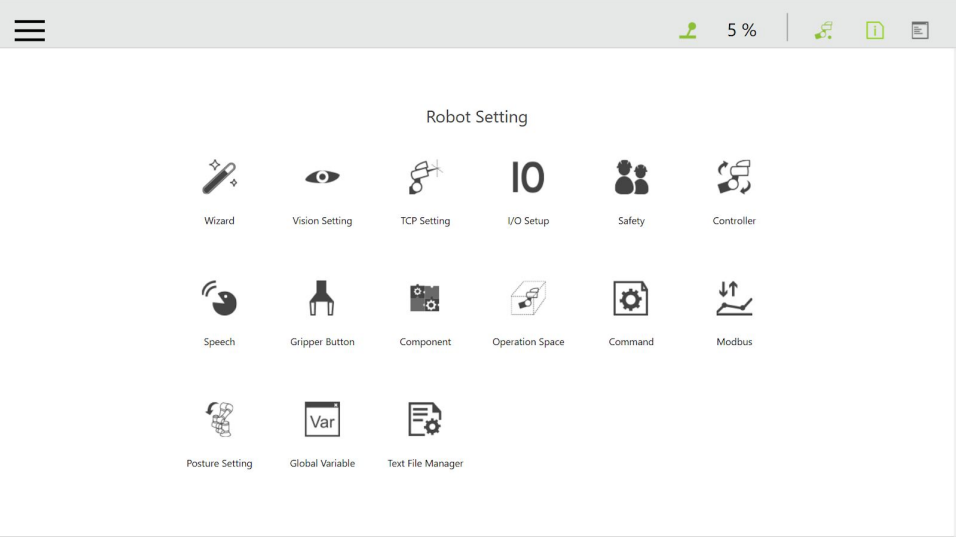


- **Force Sensor:** It shows information of any additional sensor attached to the robotic arm.

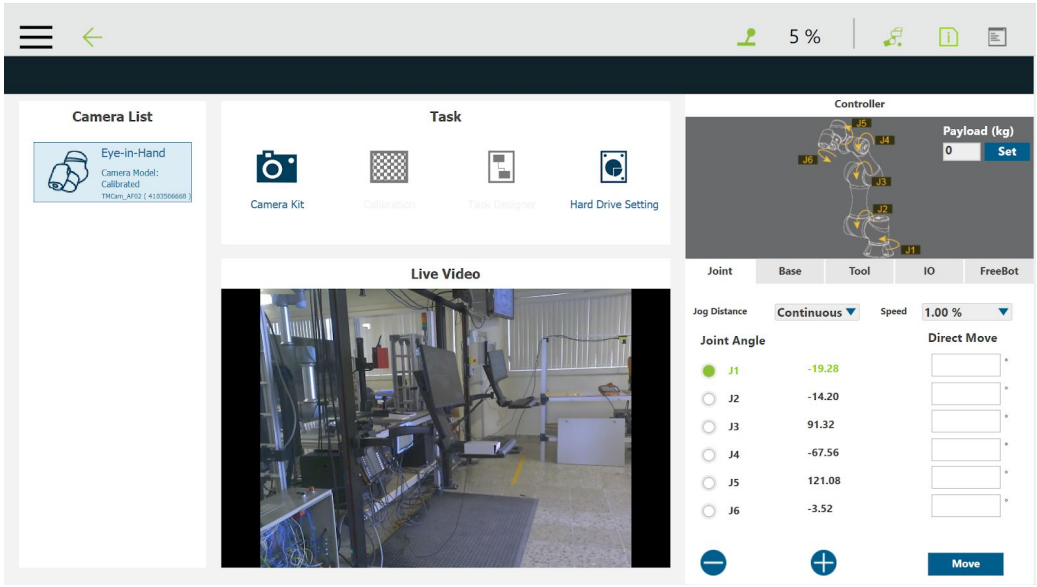
This concludes with the creation and execution of the TM5M-700.

3. Settings

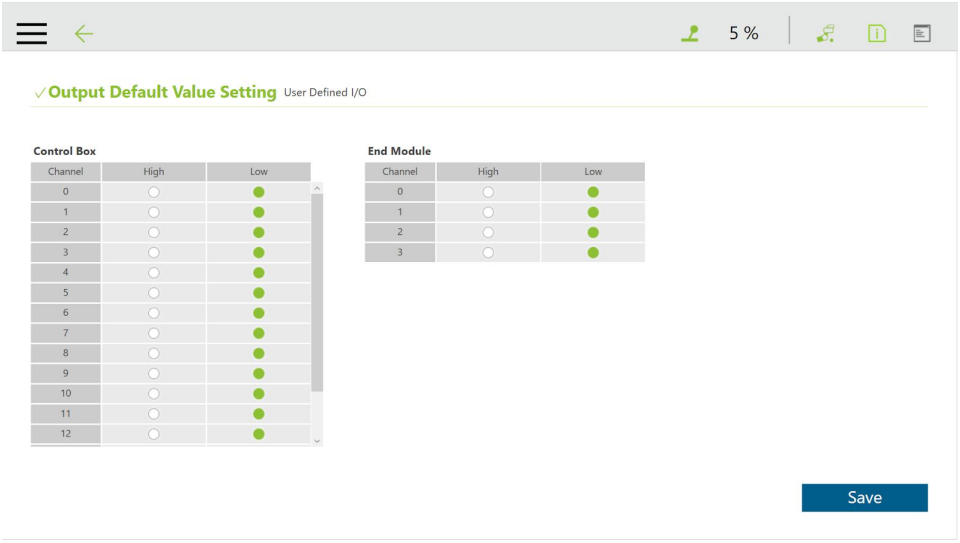
The settings provide a customization of many features available in the robotic arm. Only the most important features will be described:



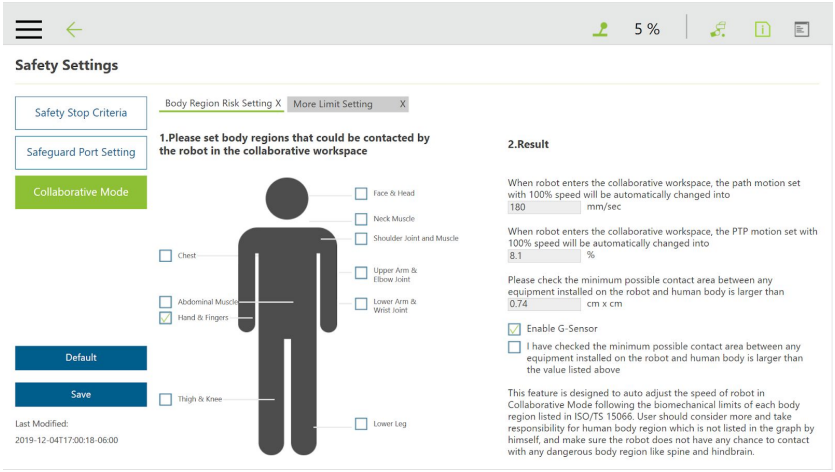
- **Vision Setting:** It pops up a window with the configuration settings of the camera. The configuration settings of the camera will be discussed on chapter 5.



- **IO Setup:** This works as a default value for the I/O ports.



- **Safety:** It provides settings to protect from potential hazards. In this section you can configure maximum speed of the motors, set limits of the movement of the joints, and also provide some information to the TM5M-700 about the body regions that are in contact with the operator.



- **Gripper Button:** It provides the configuration of the **Gripper Button** to perform a specific task.

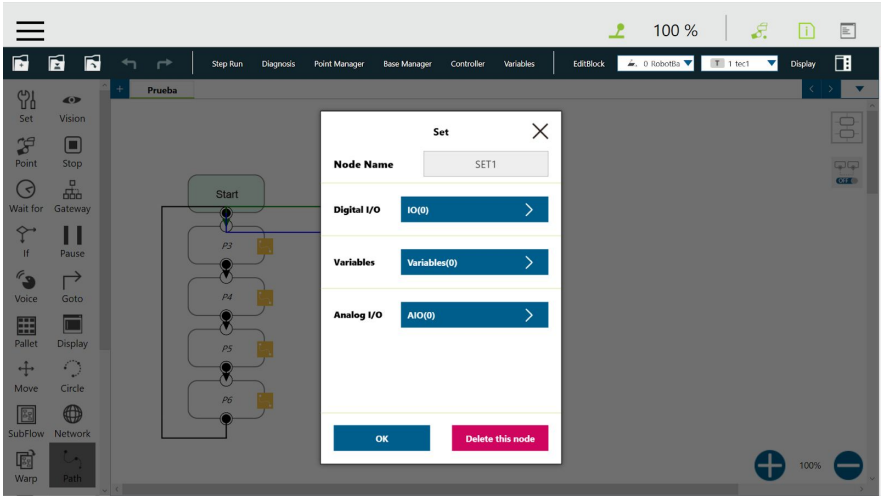
- **Operation Space:** It shows the workspace of the robot for and also it provides the tools to control the joints.

- **Global Variable:** Provides a list of all the available global variables in the system.

4. Project Essential Commands

In this chapter, only the most used commands will be described, for a more detailed information and complete description of the commands please refer to the TM5M-700 documentation.

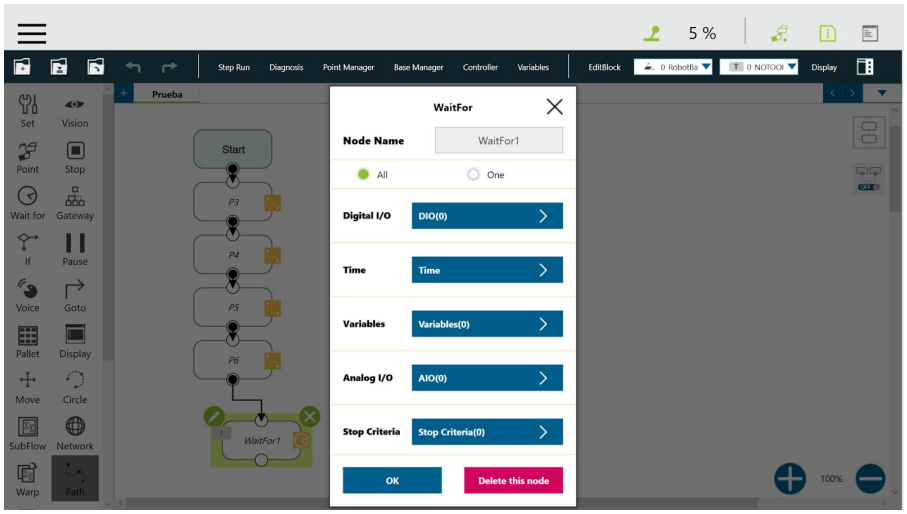
- **Set:** This option allows the I/O and variables to be set to any value.



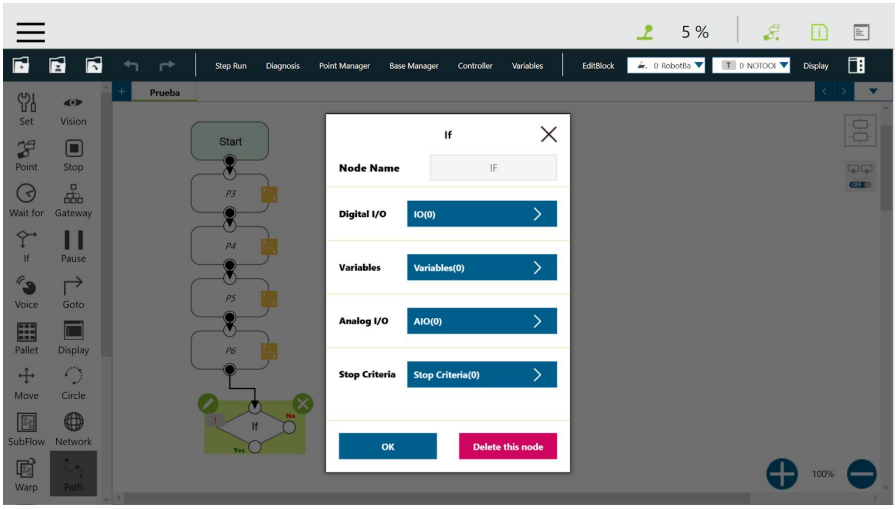
- **Point:** This options stores the position of the robotic arm and stores it in a block. This is the same function called when press the **Point Button** in the robotic arm**.**

- **Stop:** The Stop command works as the **Stop Button** from the **Robot Stick**.

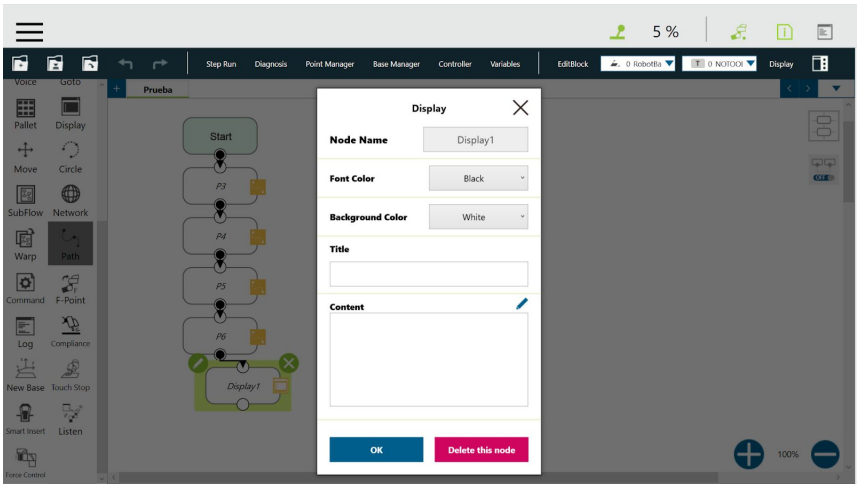
- **Wait For:** It allows to stop the execution of the program until a I/O arrives, specific time, or a variable satisfies a condition.



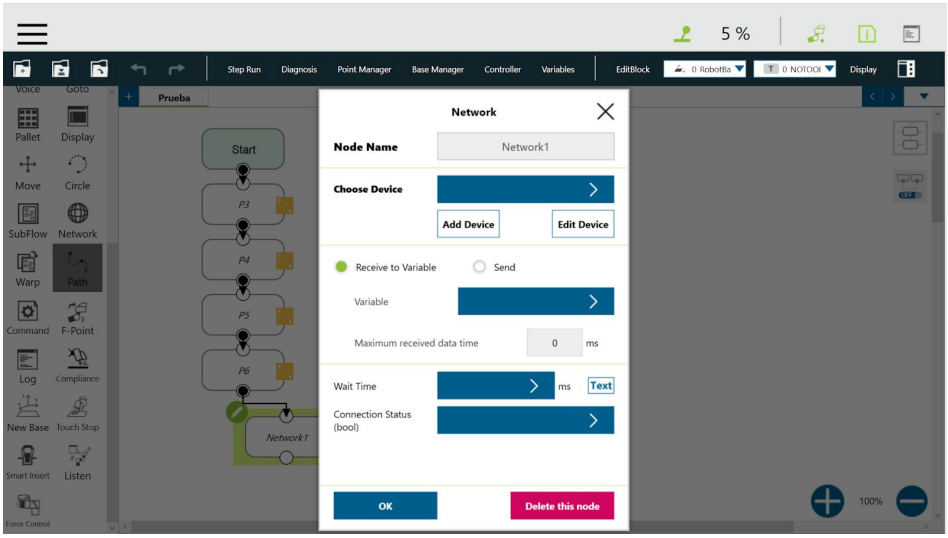
- **If:** Compares the value of a I/O, variable, or Stop criteria to satisfy or not the given condition. The path followed will differ depending on the result.



- **Display:** This option allows to display information such as variables or text to the **Display Board** (From the previous chapter).



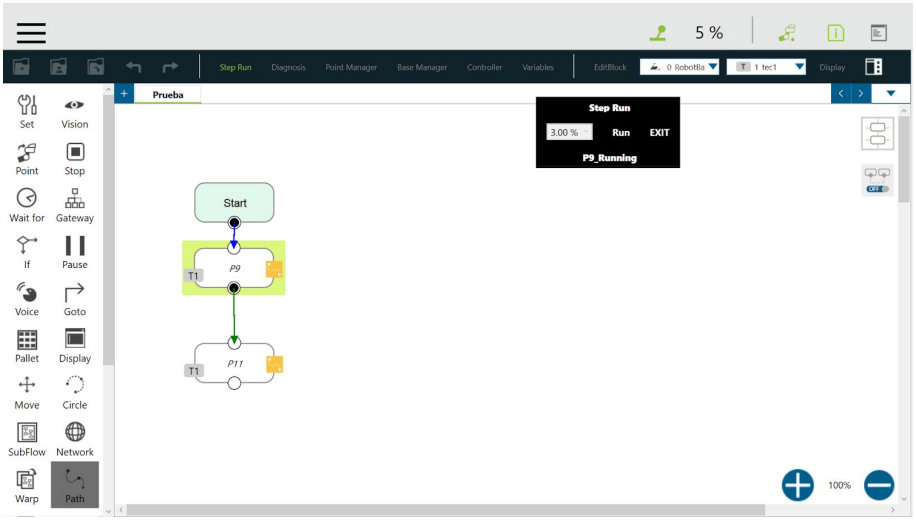
- **Network:** This tool is a must for the communication between devices. It allows to send and receive of any kind of data through the network.



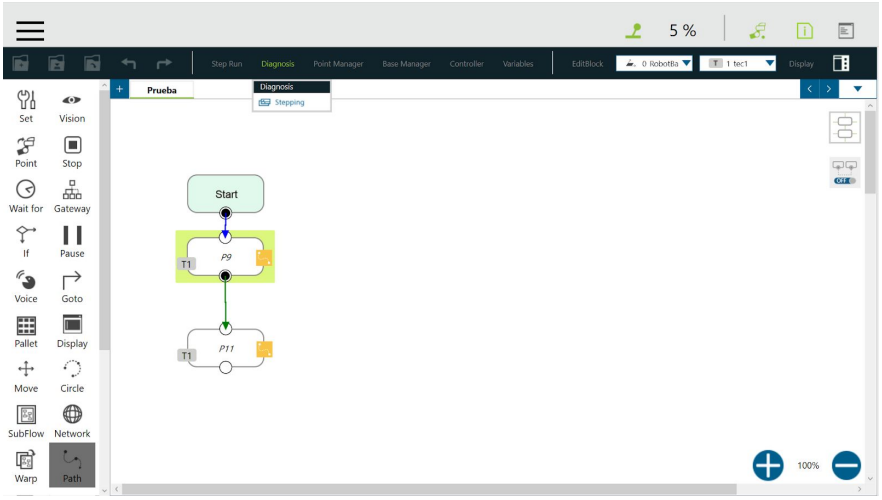
- **Vision:** It enables the vision system for a future inspection. This can be color thresholding, object recognition, landmark alignment and more features that will be described in the following chapter.

In addition there are more tools available in the toolbar of the as shown in the following image:

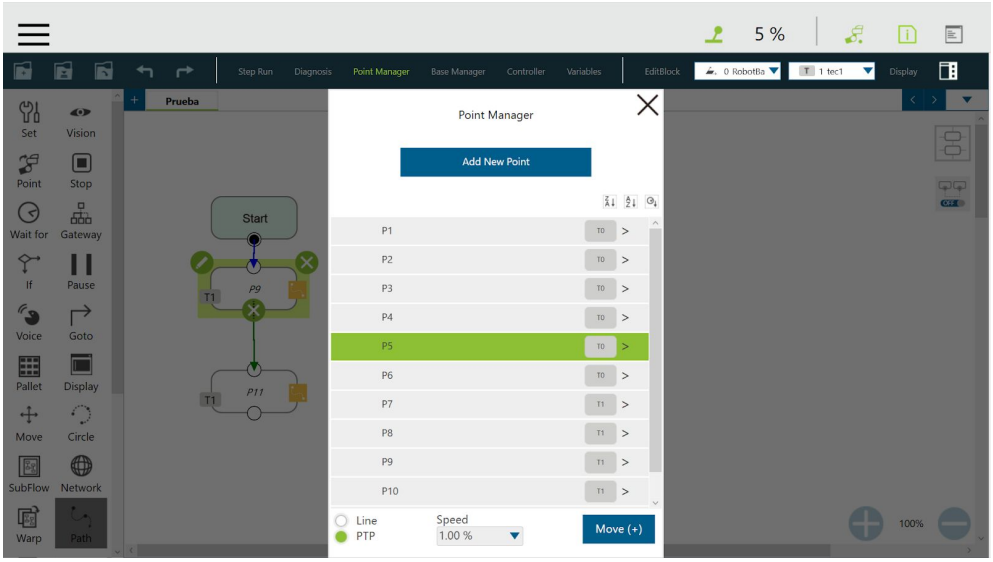
- **Step Run:** It executes the current node by pressing and holding the Run button, as soon as the button is released the execution is paused.



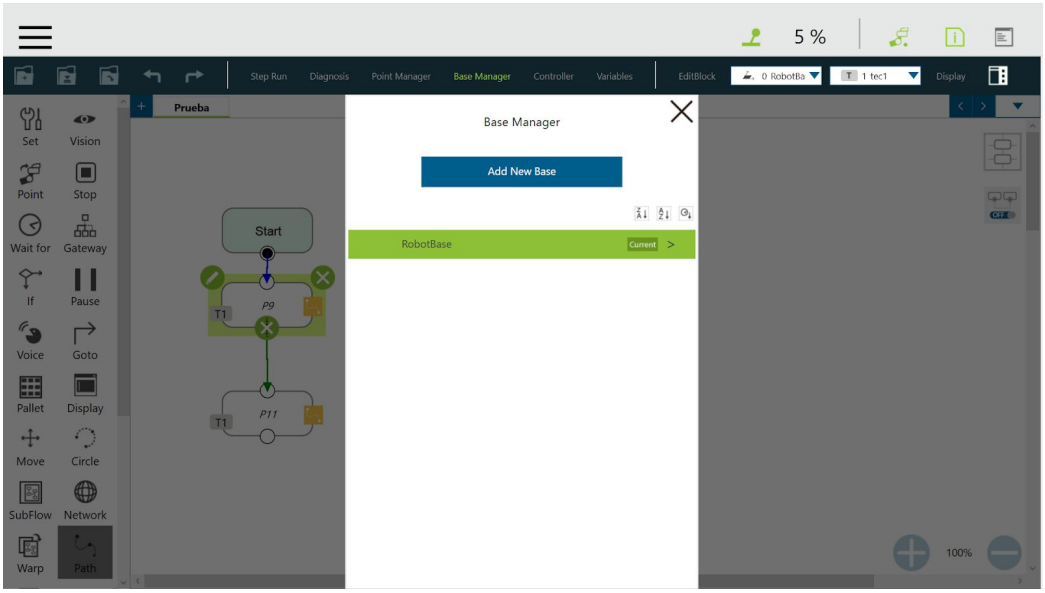
- **Diagnosis:** It allows the program to be executed from node to node. To run a node the **Play/Pause** button must be pressed.



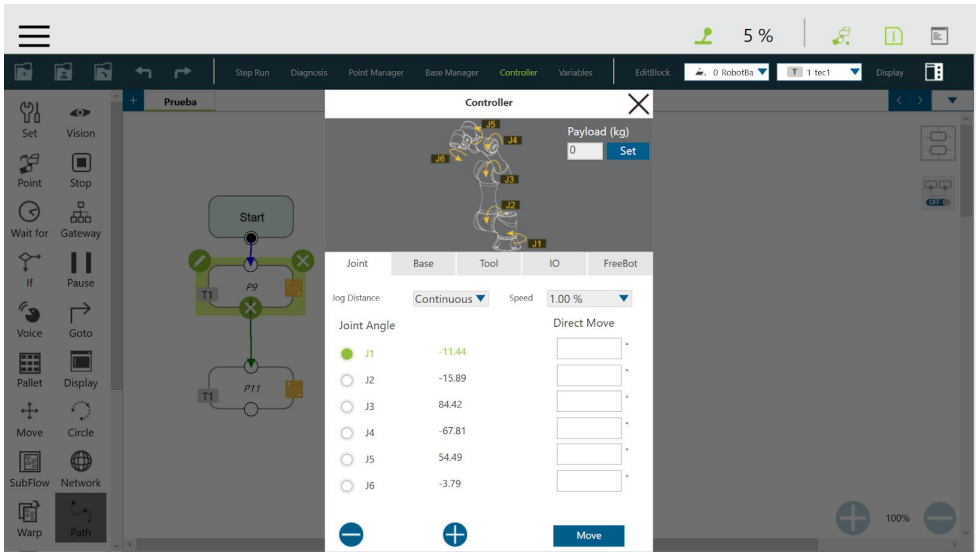
- **Point Manager:** Provides a list of all the points created in memory. Here it is possible to edit any point.



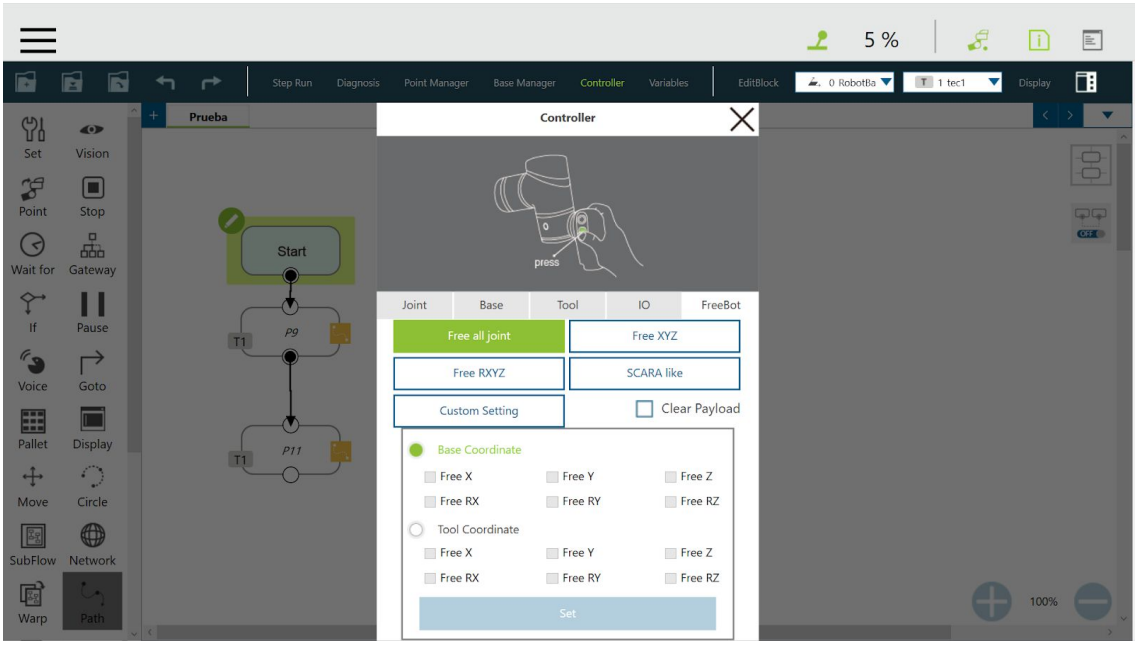
- **Base Manager:** Allow the creation of new reference. In the example the world reference is placed in the base of the robot arm.



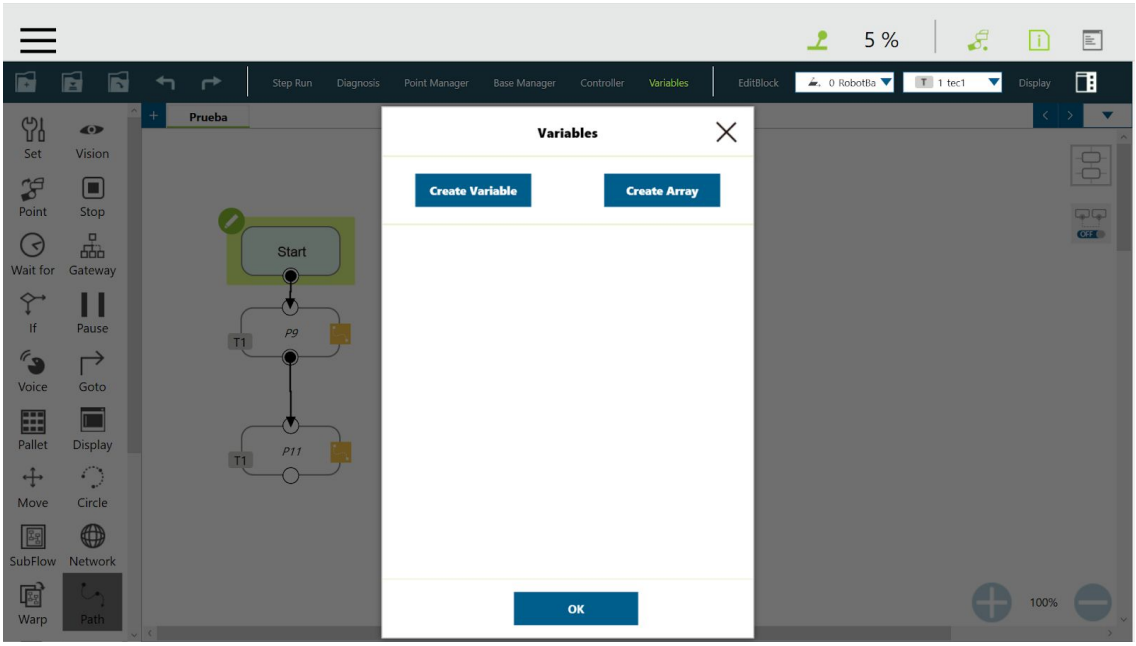
- **Controller:** It provides an interface to control the robot motors joint values, by giving a position with respect to the **Base** or **Tool.** It also provides a Set or reset of the I/O ports.

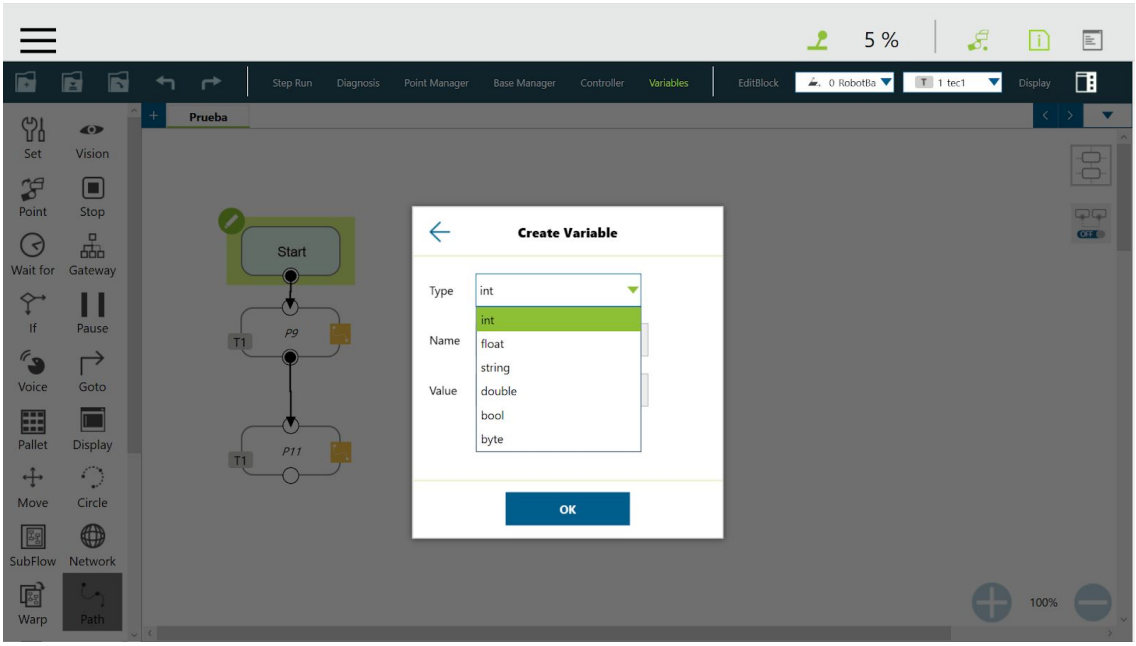


Finally it provides a **Freebot** option that allows the robot to custom the movement of the robotic arm. This gives the TM5M-700 the capability to behave like a SCARA arm and more options to fix some specific joints.



- **Variables:** Allow the Creation of New Variables or New Arrays of many different types such as:





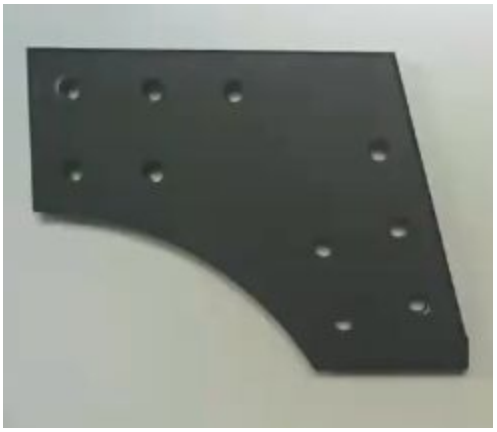
5. Vision

The vision system is really important for any robotic arm, one of the most typical examples is the pick and place which needs an object recognition system to pick the correct object and place it to another place. In this chapter we will go from the calibration to an actual example of object recognition with the TM5M-700 camera.

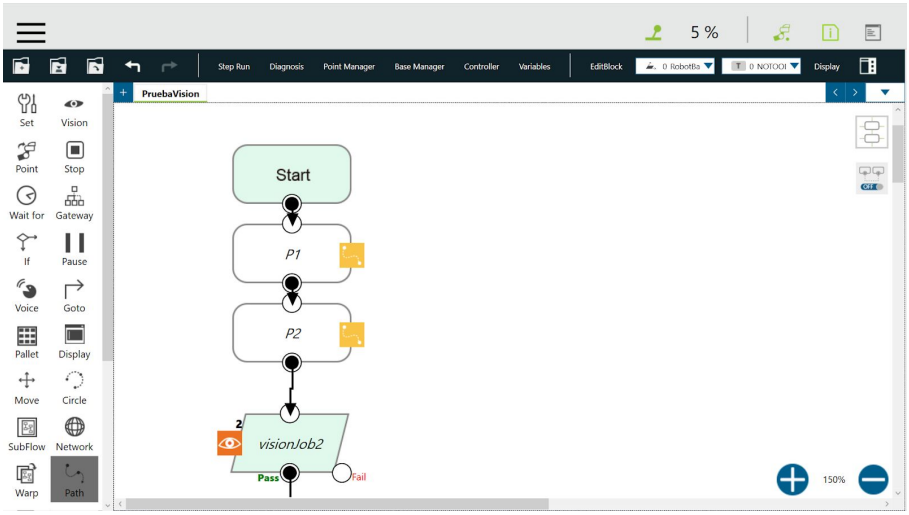
5.1 Calibration

Create a new project and call it “PruebaVision” and follow the next steps:

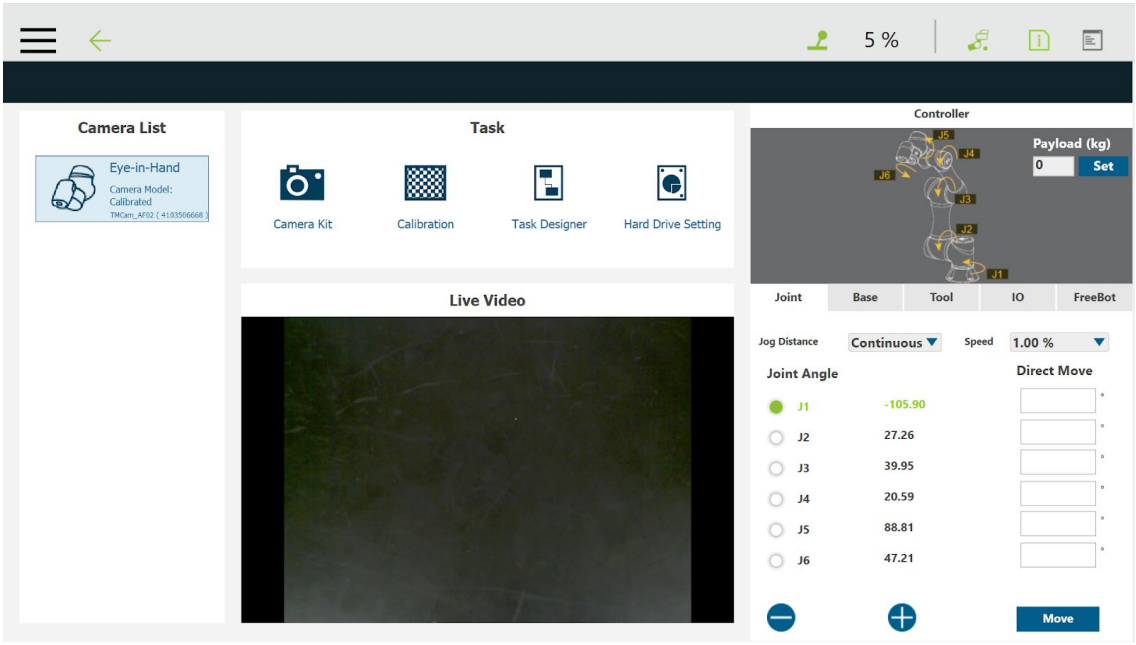
- Locate the robotic arm near a table and choose an object that will be recognized by the camera, in this case it will be used the following object:



- Look for the Vision command located on the left side of the window and put it in the block diagram. In my case I add two previous locations of my robot as shown below:



- Click on the pencil icon located in the Vision block. Then go to the **Vision Job** and create a new vision job with any name. As soon as the name is given a new window will pop up and must looks like as follows:

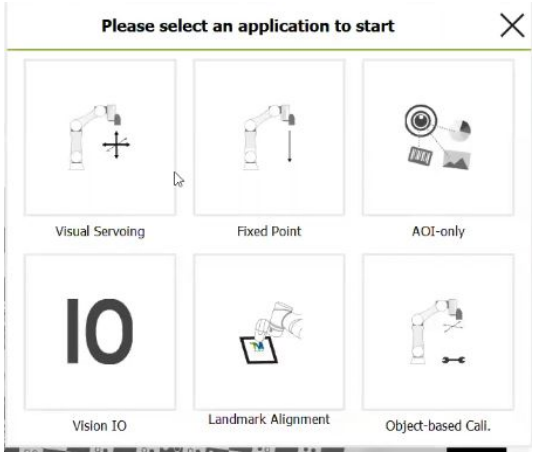


- Then click on the **Calibration** option and select the **Automatic**. Afterwards place the calibration grid from the TM5M-700 and click on the next buttons until the calibration is finished.

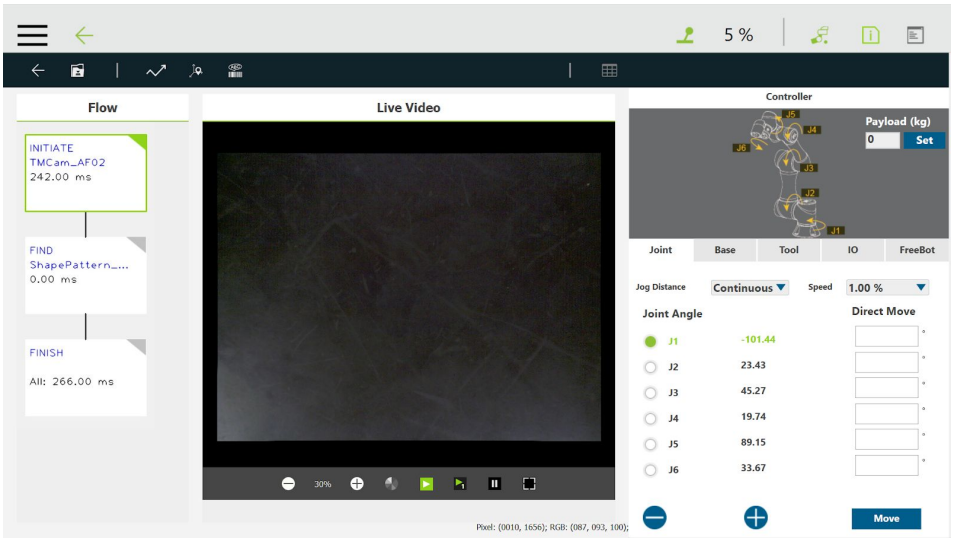
5.2 Object Recognition

Once the Calibration is concluded follow these steps to recognize the object:

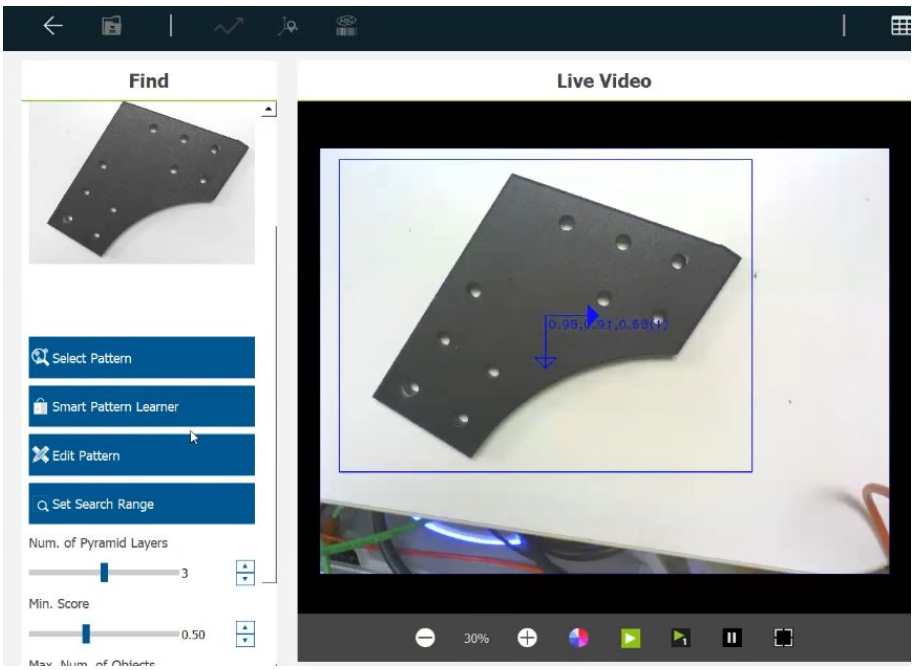
- Go to the **Task Designer** option and select the **Fixed Point** option as shown:



- Then select the calibration name that we just have done in the previous steps. A new window should pop up as shown as follows:
    - **INITIATE:** This block provides the information of the initial position of the robot when starting the Vision task.
    - **FIND:** The find block provides with the tools to provide the object recognition.



- Inside the Find block, you can use **Select Pattern** to select the area of the object as shown below:



- Finally save it and complete the program by adding some other points to verify if the when the Vision task Passed or Failed as shown in the following Image: