A HANDBOOK FOR 3D CREATE

HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

Bachelor's thesis

Mechanical Engineering and Production Technology

Riihimäki 2016

Krishna Pandey

HAMK
HÄMEEN AMMATTIKORKEAKOULU
HÄME UNIVERSITY OF APPLIED SCIENCES

ABSTRACT

Riihimäki
Degree Programme in Mechanical Engineering and Production Technology

Author Krishna Pandey **Year** 2016

Subject of Bachelor's thesis A Handbook for 3D Create

ABSTRACT

The purpose of this thesis work was to create a handbook for 3D Create. This handbook was prepared for the use of students at HAMK University of Applied Sciences. Any beginners with 3D Create can also use it. This thesis was commissioned by HAMK University of Applied Sciences.

The main target of this thesis included the pickup and place application using two different methods: one by using conveyor belt and other without a conveyor belt. Moreover, the loading components and layouts, using a robot and extracting data to external files were also included in this thesis.

For the preparation of this thesis work 3D Create 2014 SP2, various tutorials on robot applications and a manual on 3D Create were used.

The thesis work concludes that there is a vast range of applications that can be performed using 3D Create. Some of the tasks, which can be done by using 3D Create are arc-welding, painting, palletizing and picking. But mostly the program is used for visualization and simulation of a production line. These programs can be downloaded from the Visual Component company website as demo version and they can be purchased for business or educational use. It is impossible to include the tutorials on all these applications so this thesis includes a basic tutorial on 3D Create that can be used by beginners. Additionally, a beginner can visit the Visual Component website and can watch various tutorials there to extend his/her knowledge further.

Keywords 3D Create, Visual Component, TCP.

Pages 56 p.

CONTENT

LIST OF FIGURES

1 INTRODUCTION

3D Create is a computer simulation software, which was produced by Visual Components. It was first released in 2004 by Visual Component oy with the aim of visualization and simulation. The program allows for real simulation using a robot program and configuration files.

3D Create has a wide range of applications such as welding, painting, cutting, deburring, palletizing and many more. Additionally, it is very useful for designing the complete layout of an office, a factory, companies and various kinds of workstations. It is possible to simulate these applications in 3D create before performing them by a real robot which works exactly as the one in the production line. As it is possible to simulate the work in 3D Create before using the real production line we can optimize the production.

3D Create is used in various production lines and it is a very important tool for simulating the robot, thus it is very important for an engineers or persons working in the similar fields to learn 3D Create.

This thesis work was mainly focused on creating a handbook for the 3D Create. It includes all the required basic information about the software in addition with two pick up and place applications for the Kuka robot.

The thesis is basically divided into two categories. The first part contains the basics on 3D Create. It describes the steps in using 3D Create, a program overview, knowledge about the program tabs, options, files, navigating the 3D world, toolbar navigation, loading components and layouts, using robot and extraction data.

The first application was conducted with the help of two conveyors and a basic feeder. The basic feeder was used to feed the work piece to the first conveyor which later transferred to the another conveyor with the help of Kuka robot. The gripper used in the application was a three-finger gripper.

The second application was done with the help of two tables. Unlike the first application the conveyor was not used in the second application.

2 NAVIGATING THE 3D WORLD

2.1 Viewing the screen layout

When we first open the program 3D create from our computer we will get a page as illustrated in Figure 1. The Screen Layout contains menubar, main toolbar, simulation controls, message panel and 3D world.

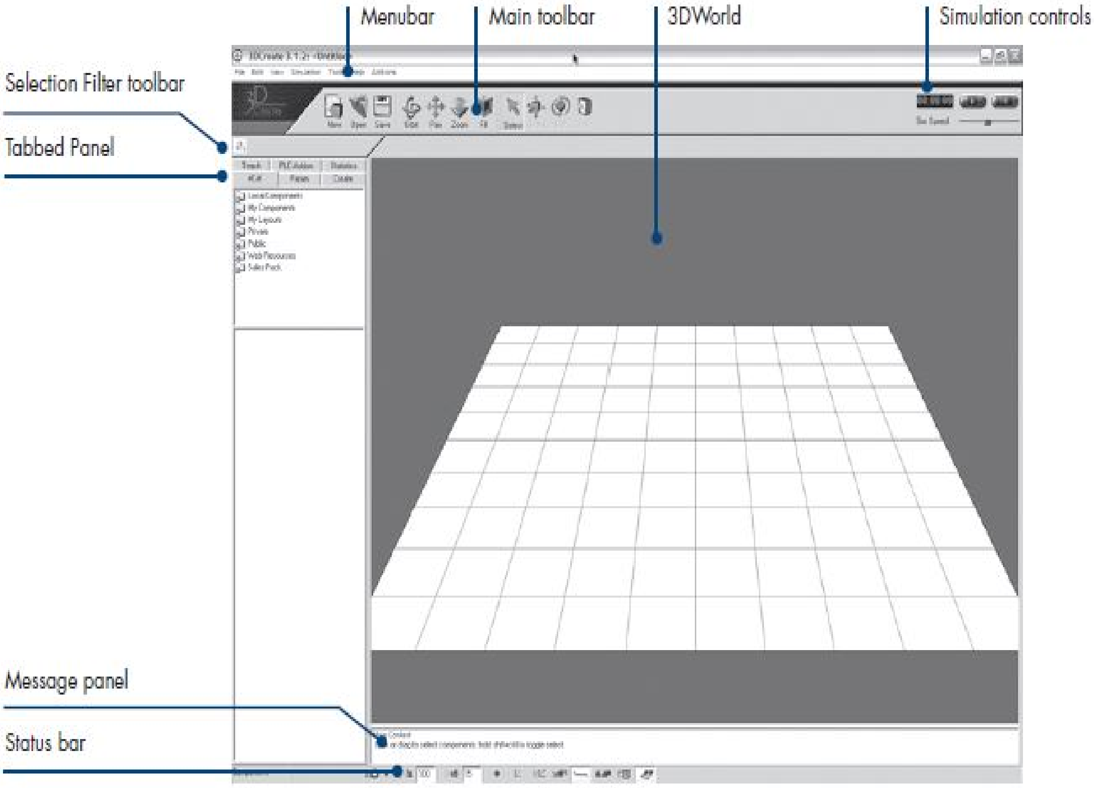


Figure 1 3D Create (Anon 2004)

3D world

This is the three-dimensional display area where all the simulation work takes place. Figure 2 shows the 3D world.

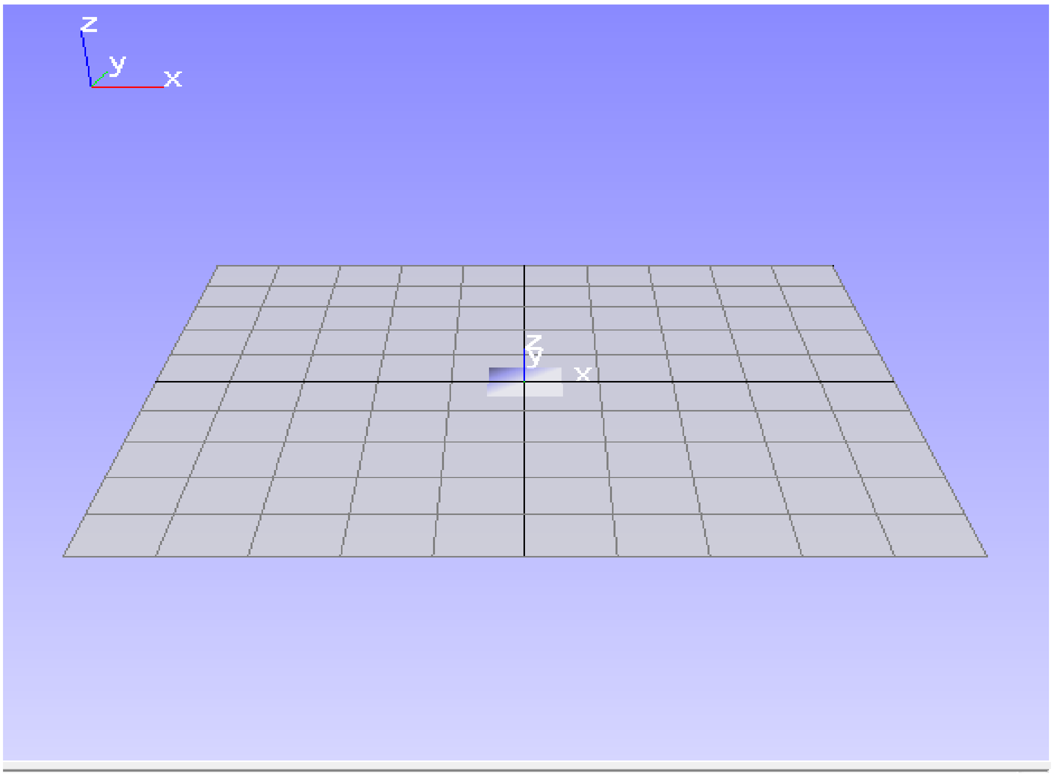


Figure 2 3D Create

Main toolbar
It is the place where we get most used command such as orbiting, panning, zooming, filling.

Simulation Control
It has tools such as play, pause, stop which controls the simulation. It also has record button which will record the simulation.

Menu Bar
It is almost similar to any other application which includes file, edit, simulation, tools and help button.

Message Panel
It displays the important message during the simulation. Message is indicated by different color codes to distinguish the type of information we received at the time of simulation.

Color codes:

Bright red: Error

Dark red: Warning

Blue: informative

Green: Debug

2.2 Toolbar navigation

We have two choices to navigate into the 3D world either by pressing the navigation tool from the navigating toolbar or by using the shortcut keys. When we press the tool from the tool bar the command is activated until we press another command or press the space button from the keyboard.

2.2.1 Orbiting

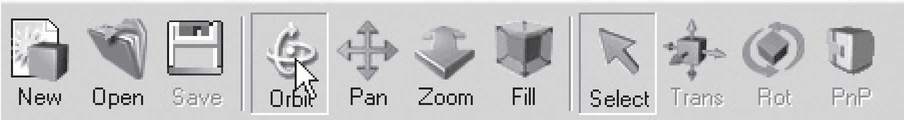


Figure 3 Orbiting (Anon 2004)

When we click the "orbit" icon in the main toolbar and move the mouse while pressing the left button of the mouse, it will orbit our viewpoint. Figure 3 shows the main toolbar when orbiting tool is selected.

2.2.2 Panning

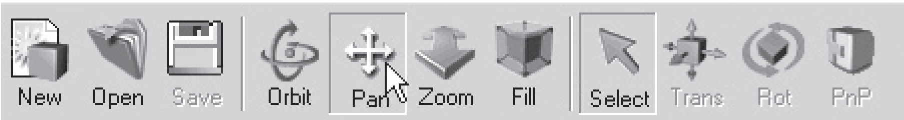


Figure 4 Panning (Anon 2004)

When we click the "panning" icon and move the mouse to the 3D world while pressing the left button, it will move the viewpoint parallel to the screen. Figure 4 shows the main toolbar when panning tool is selected.

2.2.3 Zooming

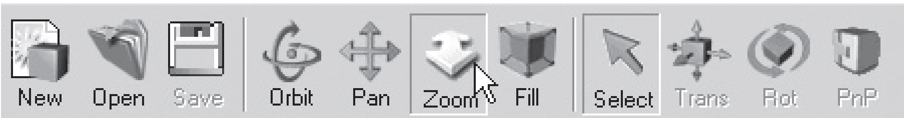


Figure 5 Zooming (Anon 2004)

When we click the "zoom" icon and move the mouse to the 3D world while pressing the left button, it will zoom in or zoom out our viewpoint. When we move up while pressing the left mouse button it will zoom in which will bring our viewpoint near whereas, moving down while pressing left mouse button will zoom out which result in moving the viewpoint further. Figure 5 shows the main toolbar when zooming tool is selected.

2.2.4 Filling

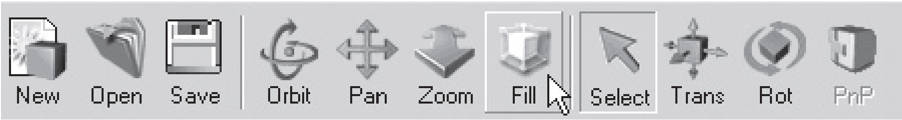


Figure 6 Filling (Anon 2004)

When we click “Fill”, it will fill our work piece in the 3D world. Figure 6 shows the main toolbar when filling tool is selected.

2.3 Shortcut navigation

Using shortcut keys is way too easy while navigating in the 3D world. It will save our simulation time as well. The only thing we need to remember while using shortcut is that the command is activated on top of previous command which means that when we end the current command the previous command will be activated again.

To orbit:

Ctrl + hold down mouse left button and drag to the 3D world.

To pan:

Alt + hold down mouse left button and drag to the 3D world.

To Zoom:

Shift + hold down mouse left button and drag to the 3D world.

To Fill:

Press shift, ctrl, F button at the same time.

2.4 Tabbed pages

The tabbed pages are the backbone of the 3D create which include all the important tabs such as “ecat, param, teach, create”. Therefore, all the work from bringing a component to the 3D world and creating and teaching a path is done with the help of these commands.

The ecat tab consists of all the available geometry, layouts and components.

Moreover, there are commands such as “recent models”, “my models” and also the eCatalog from the web.

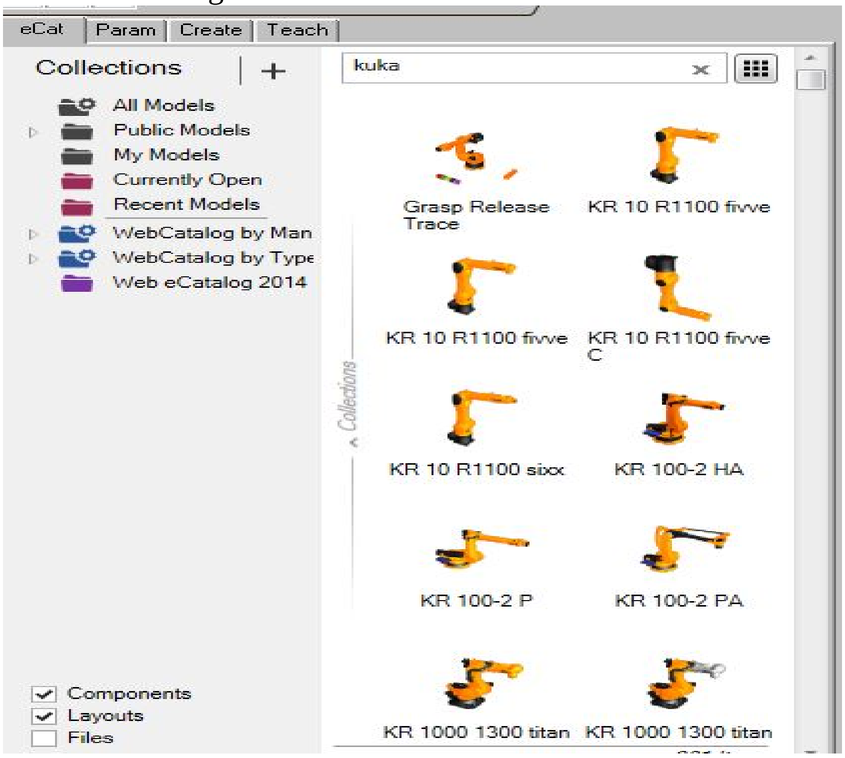


Figure 7 eCat tab

Figure 7 shows the ecat tab.

The param tab includes all the details of the selected component as can be seen from Figure 8. If there is no selected component the param tab will show an empty space.

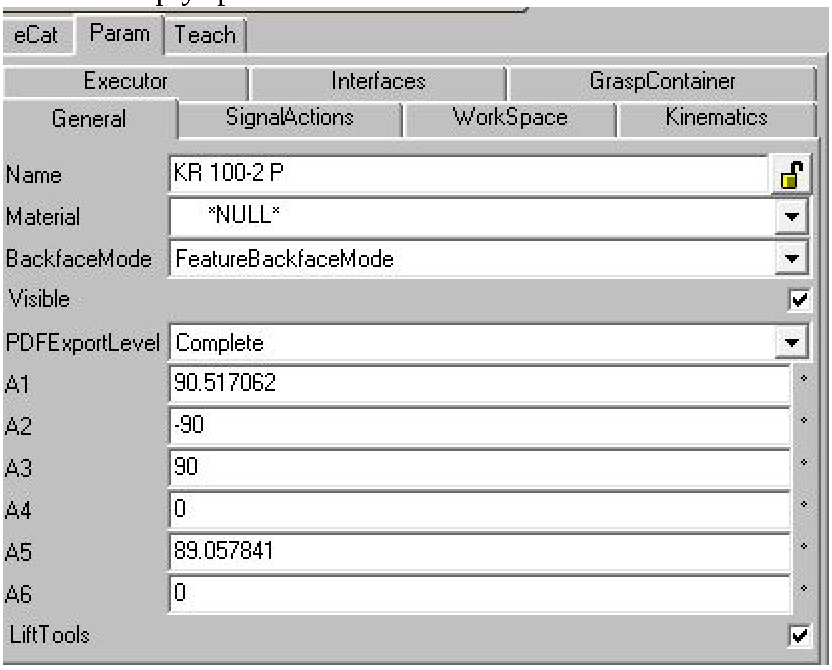


Figure 8 Param tab

The Create tab is the hierarchy structure of the component nodes which will display component node tree and node feature tree as shown in Figure 9. We are able to use geometry, behaviour, parameter for each specific node.

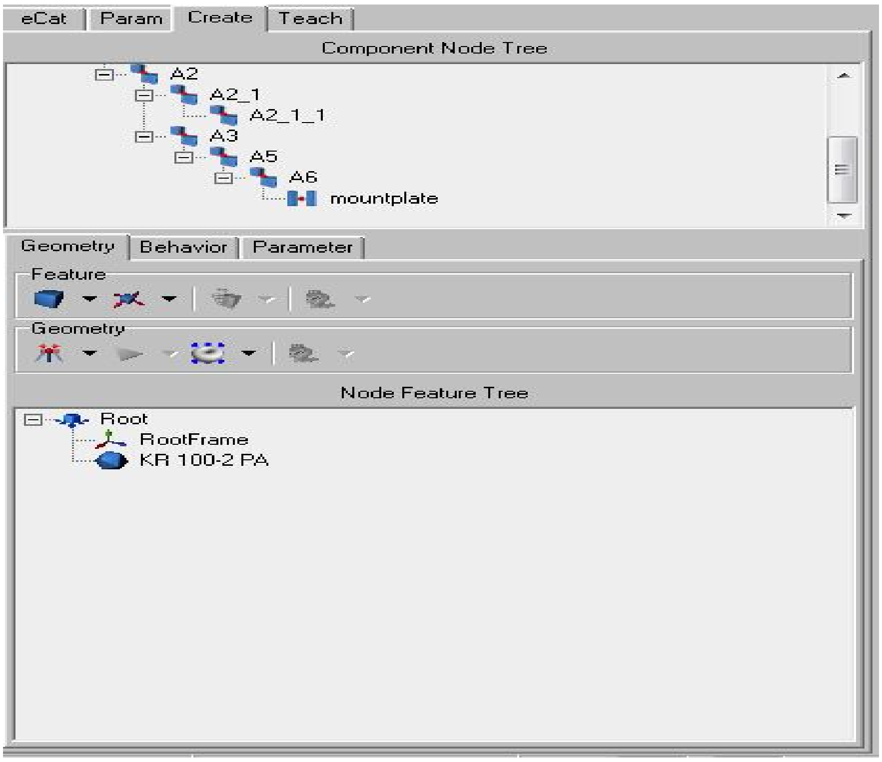


Figure 9 Create tab

The Teach tab helps to teach and program the component with robot control. Teach tab is shown from the Figure 10.

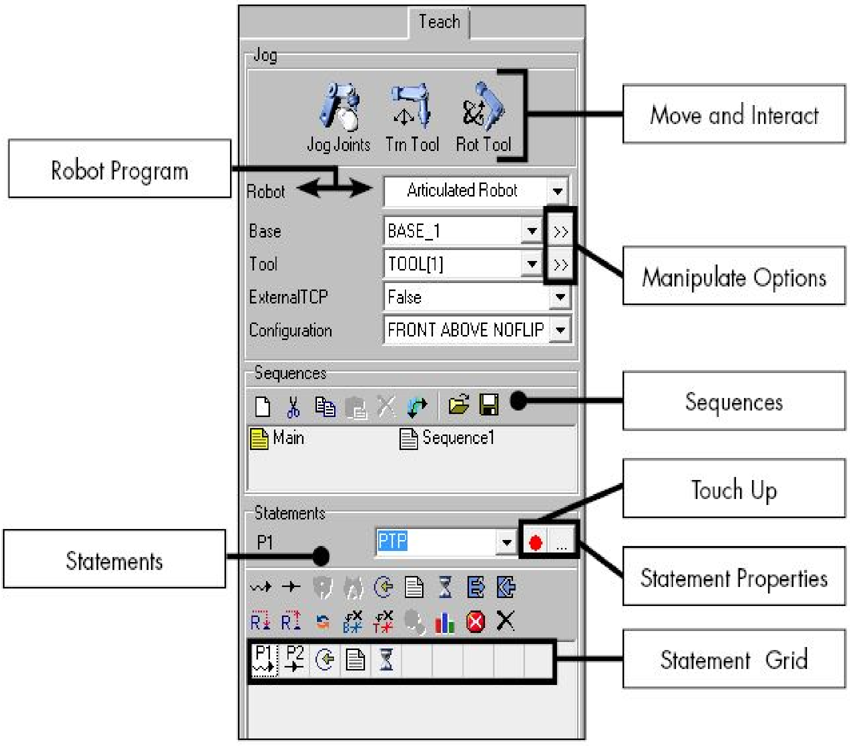


Figure 10 Teach tab (Manual 3D Create 2014 SP2,n.d.)

It consists of three types of movement for the robot and the Tool Centre Point (TCP). The jog joints help to move the robot arm, whereas the translation tool and the rotational tool help to move the robot via TCP. “Manipulate Options” is used to change the tool and the base.

“Statements” includes all the necessary movements for the robot including time delay, a gripper on and the off option.

“Statement Grid” includes a list of steps involved in the program to simulate certain work.

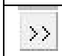
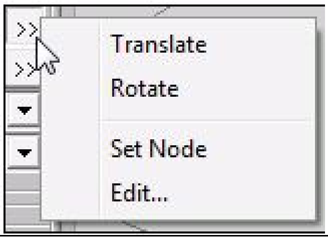
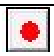
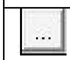
Commands	Description
Jog joints	It helps the robot arm to move
Translate tool	It allows the robot to move via the tool centre point of use. If the handles are not used, the robot is moved in XY planes.
Rotate tool	It shows the circular rotational direction from the tool centre point of use. It will change the frame orientation and the robot configuration.
Robot	It is the name of the robot which you select for your simulation.
Tool	It is the list of all the available tool in addition with all the imported tool
	This button is used to change the selected base and tool frame. 
External TCP	It has two values True or False. A true value means the work position is created at the base and a false value means the position is created at the tool frame.
Configuration	They are the specific names provided by the manufacturers for the robot joint configuration.
Sequences	These are the steps of program involved in the simulation.
	It refurbish the linear or joint movement.
	It gives the chance to see the statement properties.
Statements	It displays the step involved in the program.
Statement Grid	These are the series of the step involved in the robot program which is arranged from left to right. You can rearrange the step by dragging in the desired place.

Table 1 Some useful commands with description

3 LOADING COMPONENTS AND LAYOUTS

There are four different ways to load a component or layout to the 3D world.

a. Double click on the file from the ecat tab.
b. Drag and drop the file from ecat to the 3D world.
c. By clicking open from the main toolbar.
d. Right click the selected file and click it open from the drop down menu.

Although, this is how to select files from ecat to the 3D world the most commodious way to open a file is to double click the file from the ecat tab.

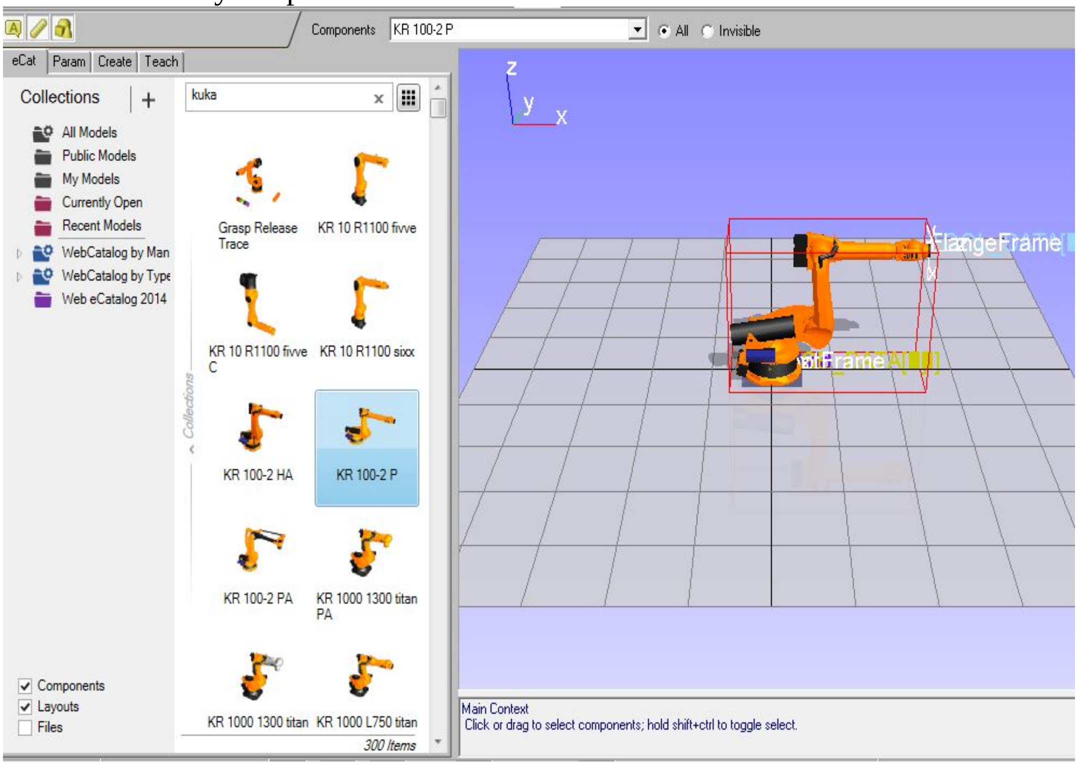


Figure 11 Loading components to the 3D world

This is similar to the drag and drop way of bringing file but this step will bring files to the middle of floor in the 3D world whereas, drag and drop will bring exactly where you drop the file in the 3D world. Loading components is illustrated from the Figure 11.

3.1 Running the simulation

After we are done with the assembly of the components to the 3D world, we are now ready to simulate our work. We can also record our work and make a video of our simulation.
Run the simulation by clicking the run button in the simulation control.

We can stop the process at any time during the simulation and replay the simulation again from the same point.

We can adjust the simulation speed according to our need by dragging the slider forward or backward. If we drag the slider forward it will decrease the simulation speed and if we drag the slider backward then it will increase the speed.

If we move the mouse cursor over the clock it will show the scale of time it uses. If we do not change anything it will use hours, minutes and seconds as a default time format which can be seen from Figure 12.

If we click on the clock setting it will show us five different scales of time from which we can choose the suitable one.

- Minutes: Seconds: Fraction
- Hours: Minutes: Seconds
- Days: Hours: Minutes
- Months: Days: Hours
- Years: Months: Days

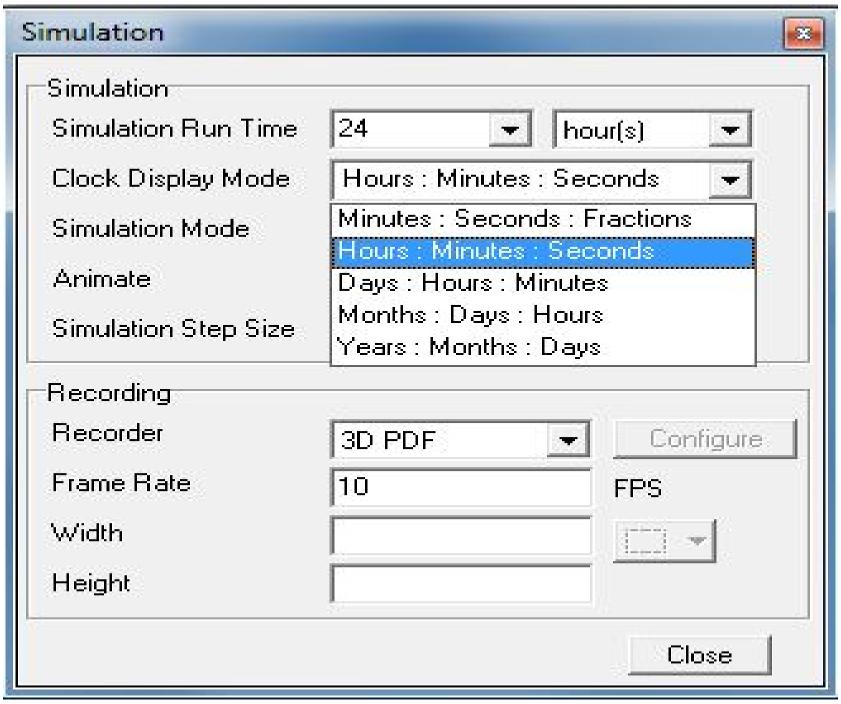


Figure 12 Simulation control display

We can reset our simulation at any time we want by clicking on the reset button. The clock will also start from zero when we start our simulation again.

4 USING ROBOT

In this chapter everything from the start of the 3D Create is described up to at least one application for the Kuka robot. First of all, we need to have 3D Create installed on our computer. Open the 3D Create either from the desktop icon or using the Windows button on the computer screen. The homepage of 3D Create like the Figure 13.

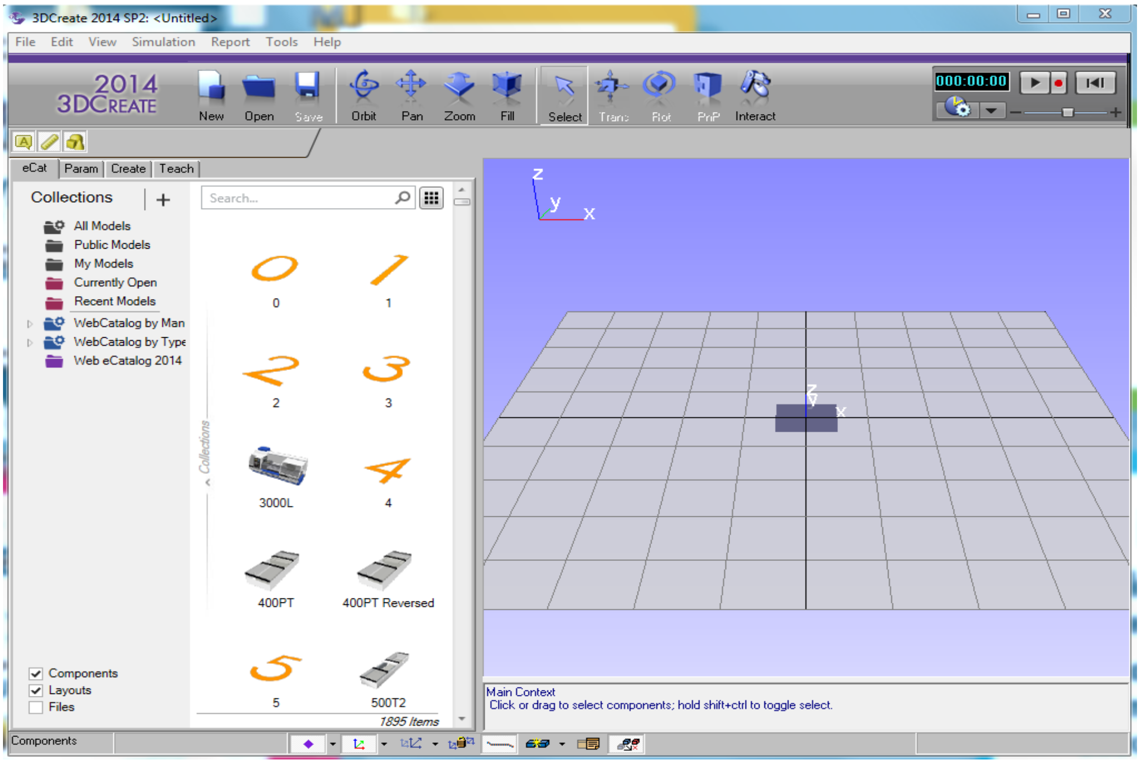


Figure 13 Homepage of 3D create

After this, we go to the ecat tab and select the suitable robot for our simulation. Here, we are using Kuka(KR 100-2-P) which is the same robot which is located in our school laboratory, for which we are doing application of pick up and place. We bring the selected robot to the 3D world by clicking on it twice or by dragging and dropping it into the 3D world. Our screen looks like the Figure 14 once we have our robot in the 3D world.

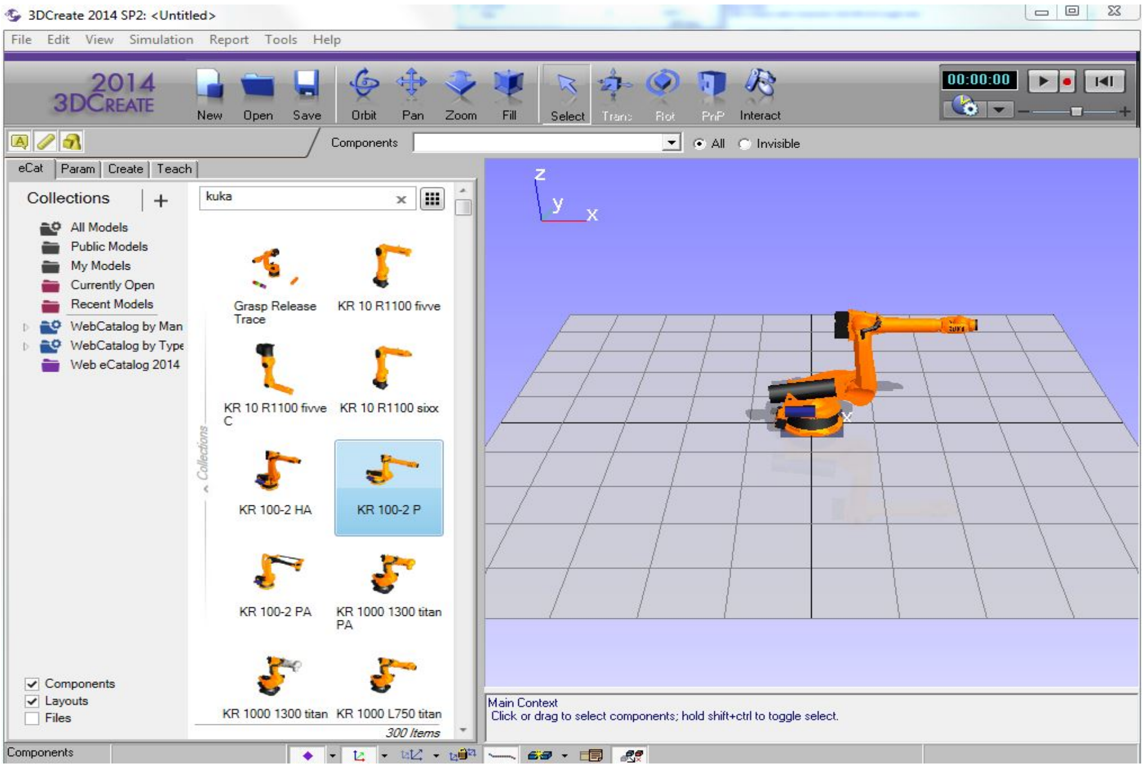


Figure 14 Selected robot in 3D world

4.1 Changing the pose of the robot

We can easily change the robot's pose by using tools like "jog joints", "trn tool" and "rot tool". Jog joints is used for the robot arm. Robot arms can be manipulated by clicking the jog joints whereas the translating and rotating is done are done through the tool centre point (TCP).

i) From the tabbed pages and "teach drop down" menu select the jog joints and then move the mouse cursor over the robot. The cursor will then change into a hand when it is placed over the robot arm.

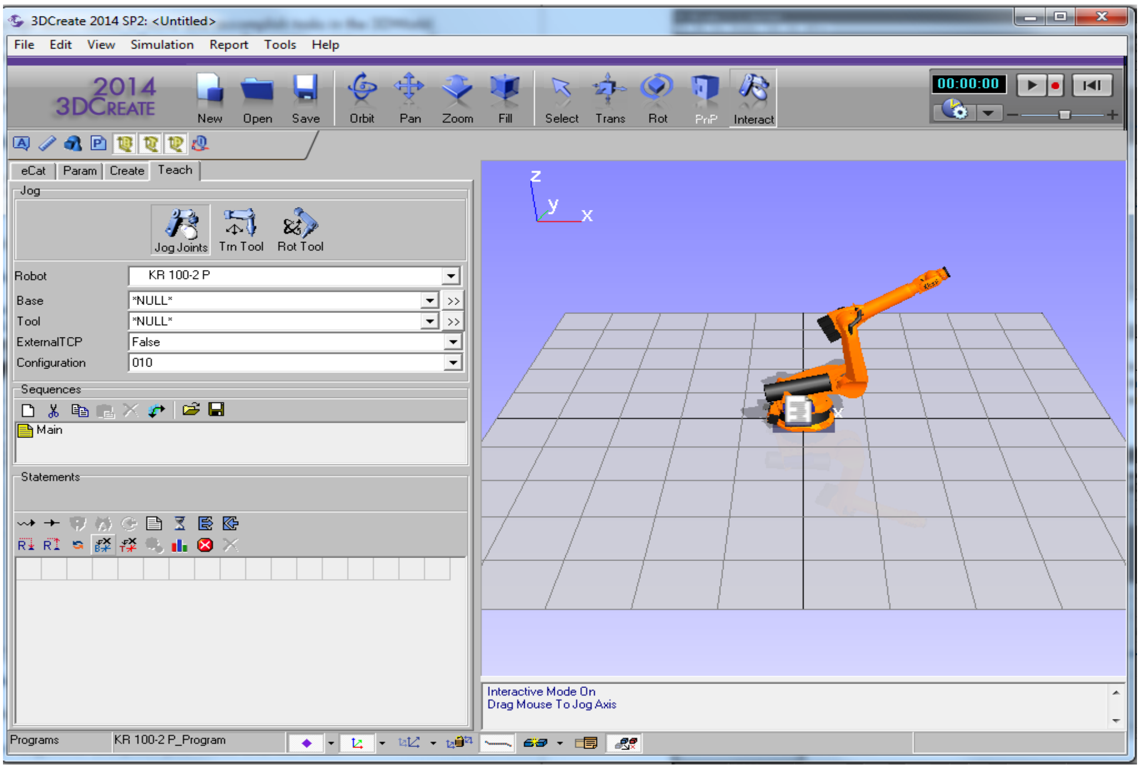


Figure 15 3D Create with jog joint activated

Figure 15 shows the Kuka robot when jog joint is activated.After ths we can move the robot joint whichever direction we like. We have to press the left button of the mouse and then move the robot joint.

ii) We can now select the trn(translation) tool for the TCP.

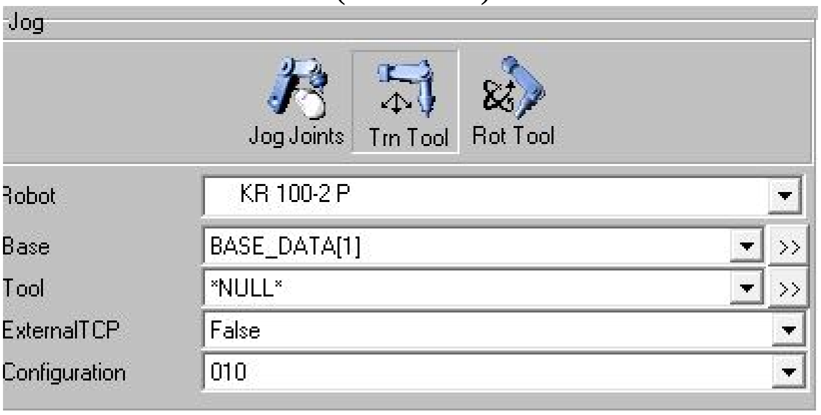


Figure 16 Trn tool

It will show the value of x,y,z directions while translating the TCP.

We can either enter the value directly to the x,y,z boxes or we can move the TCP to the desired location. We can translate the TCP by moving the different handles towards x,y,z direction.

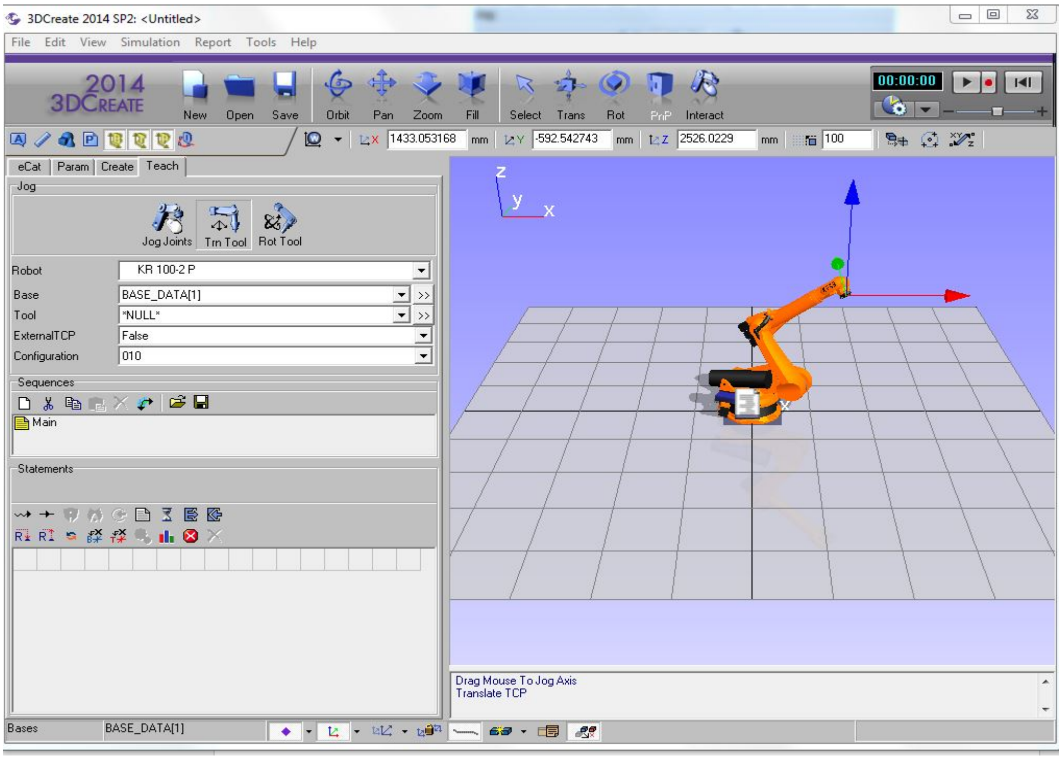


Figure 17 3D Create with trn tool activated

Figure 17 illustrates the 3D Create while the trn tool is activated.

iii) We can now click Rot(rotational) tool for the TCP as shown in Figure 18.

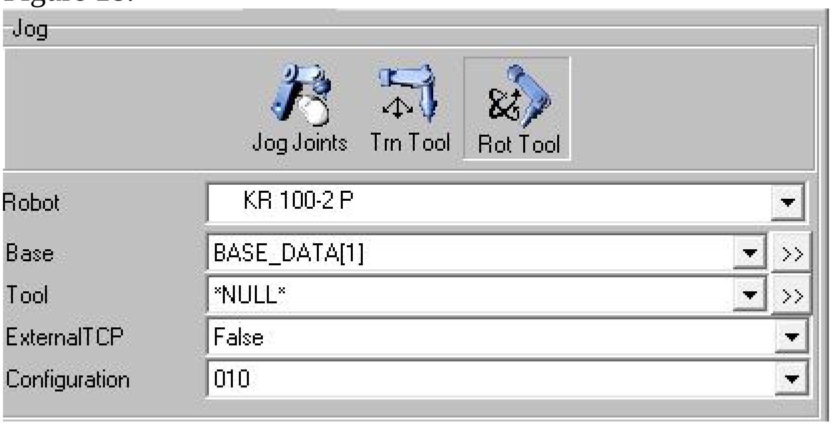


Figure 18 Rot tool

We can now easily change the robot position by adjusting the rotational handles. We just either need to drag the handles to the desired point or input the values of x,y,z as shown in Figure 19.

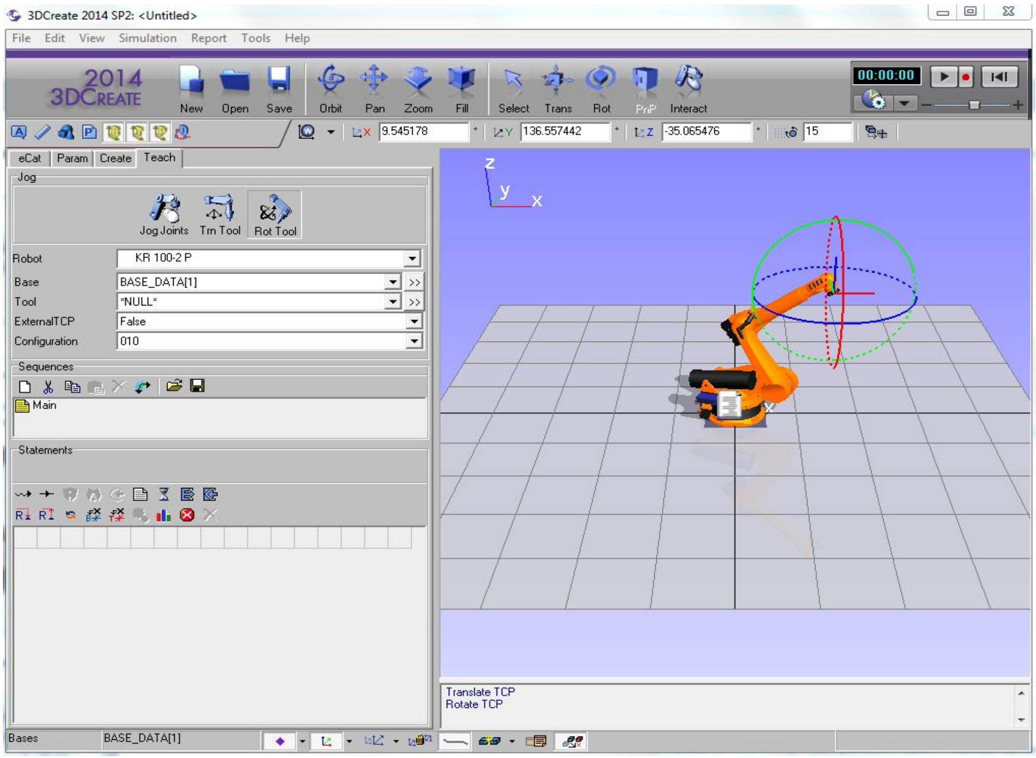


Figure 19 3D Create with Rot tool activated

iv) To change the tool setting go to the tool drop menu and select the suitable one as in Figure 20.

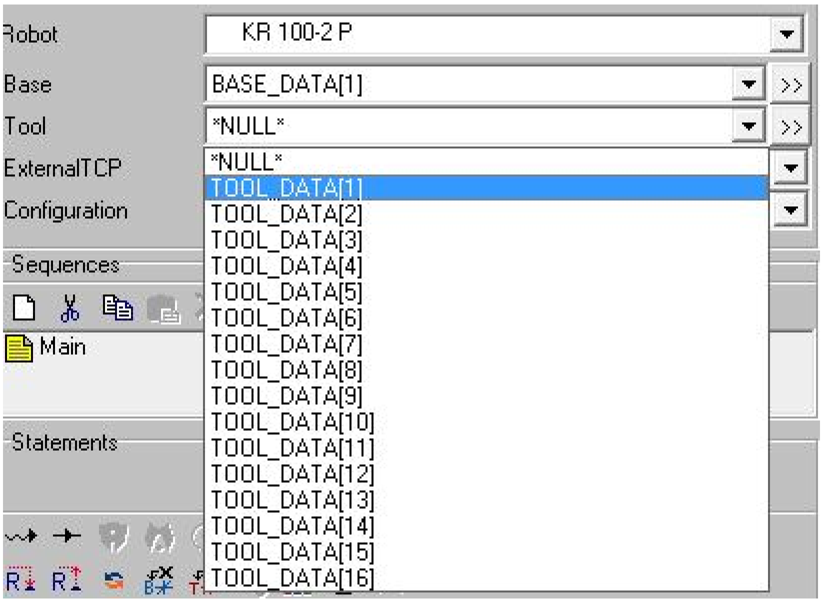


Figure 20 List of tools

v) To change the base setting go to the base drop down menu and choose the suitable one. The list of base are shown in Figure 21.

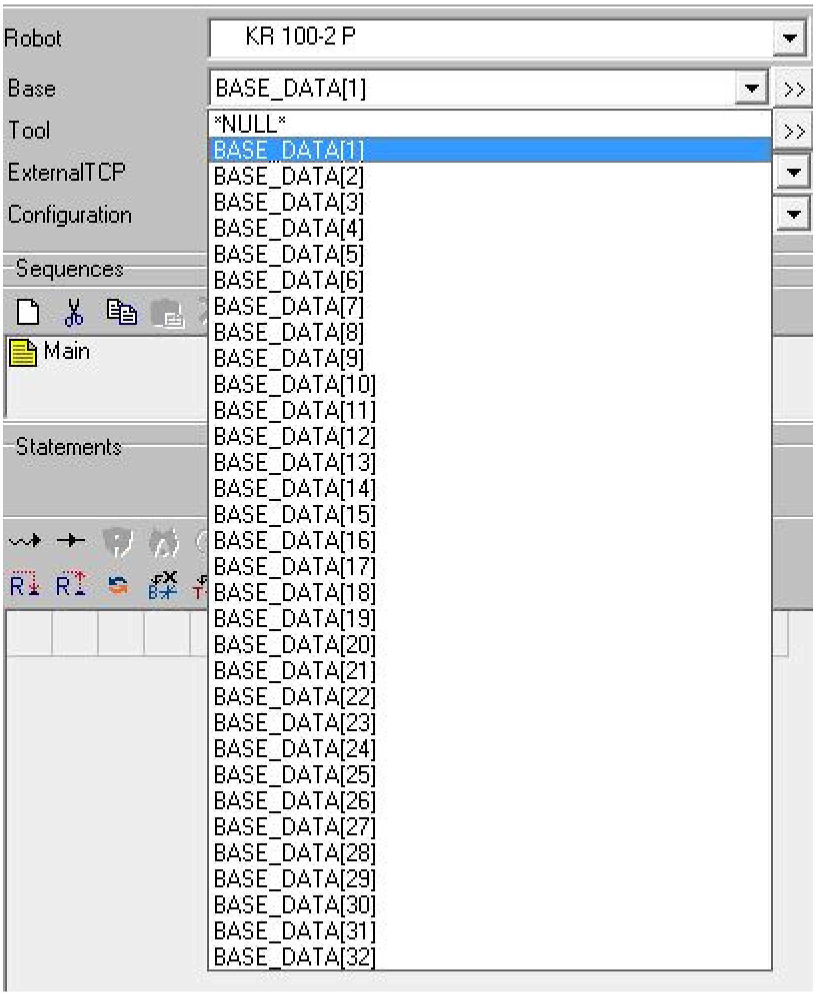


Figure 21 List of base

vi) To change the configuration setting go to the drop down menu and choose the desired one as illustrated in Figure 22.

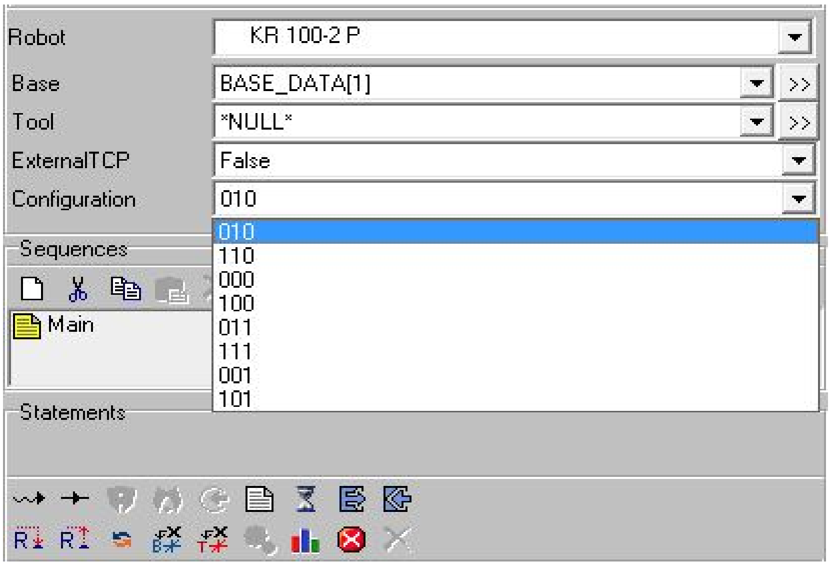


Figure 22 List of configuration

4.2 Programming robots

RSL (Robot Sequence Language) is used for the programming of a robot. It consists of three different categories: program, sequence, statement through which the whole process of programming is done.

Statement contains all the paramount tools required for the programming like movement, gripper on and off, time delay as in Figure 23.

Statement	Description
	Point to Point Motion Statement
	Linear Motion Statement
	Grasp Statement [DEPRECATED]
	Release Statement [DEPRECATED]
	Call Sequence Statement
	Comment Statement
	Delay Statement
	Set Binary Output Statement
	Wait for Binary Input Statement
	Start Remote Routine Statement
	Wait for Remote Routine Statement
	Program Synchronize Statement
	Define Base Statement
	Define Tool Statement
	Process Statement
	Statistics Statement
	Halt Simulation Statement
	Delete Currently Selected Statement

Table 2 Statements (Manual 3D Create 2014 SP2)

Figure 23 Statements

To create sequence, click on the new sequence as shown in Figure 24 which will be later called from the main sequence.

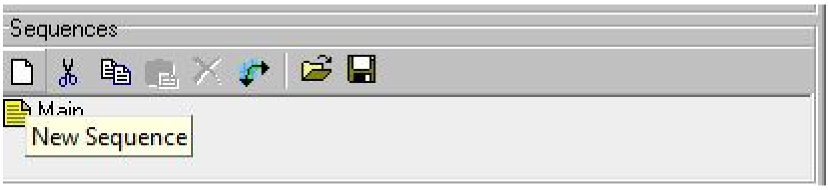


Figure 24 Sequence

There are two types of option to move the robot. One is linear movement and another is point to point movement. Linear motion moves the robot along the straight line and point to point motion moves the robot to any direction by interpolating the joint values. As from the Figure below both point to point P1 and linear movement P2 are shown.

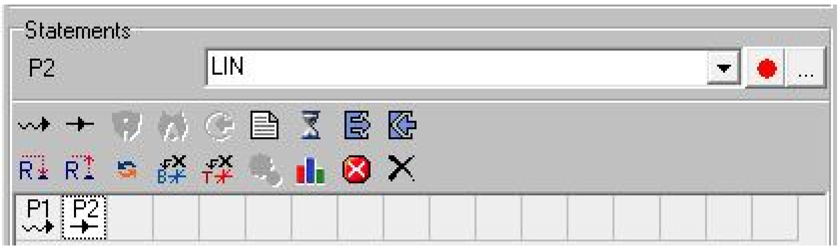


Figure 25 Robot motion

To create delay in the sequence, there is add delay statement in the statements as shown in figure 26, we have to click that and add the desired delay time.

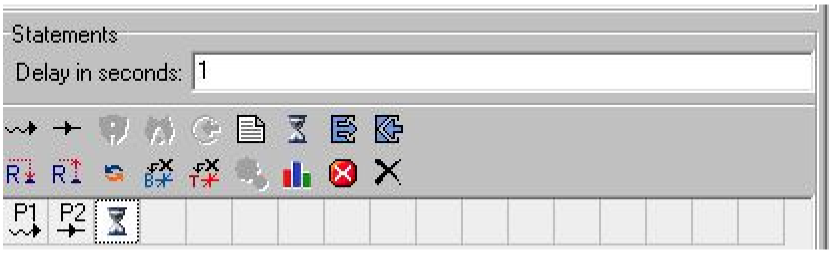


Figure 26 Add delay

As shown in figure 27, once we are done with new sequence it has to be called from the main sequence. So, we have to go to the main sequence and then add call a sub routine button.

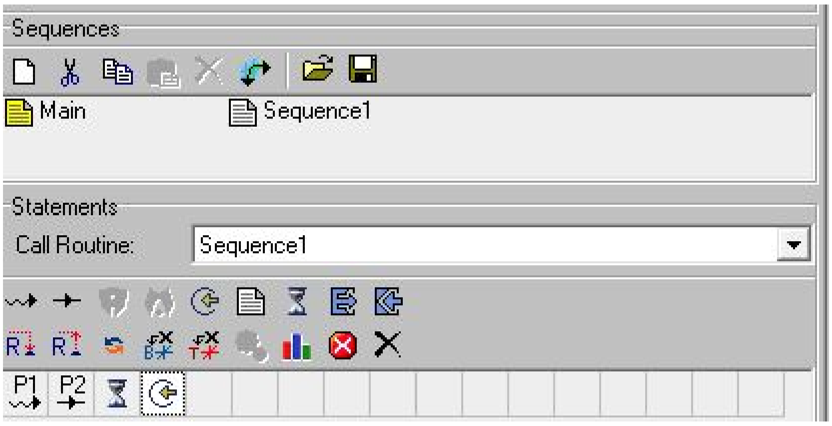


Figure 27 Call sequence

After we connect our new sequence with the main sequence, now we can start our simulation and check whether our program worked or not.

5 APPLICATION FOR KUKA ROBOT

In this chapter we are going to look through pick up and place application for the kuka robot (KR 100-2-P) in two different ways. One is by using the sensor conveyor and another is just by using the table. The robot for which we are doing this task is from our own School.

5.1 Pick up and place using sensor conveyor

Open the 3D create from your computer either from the shortcut menu or from the windows button like in Figure 28.

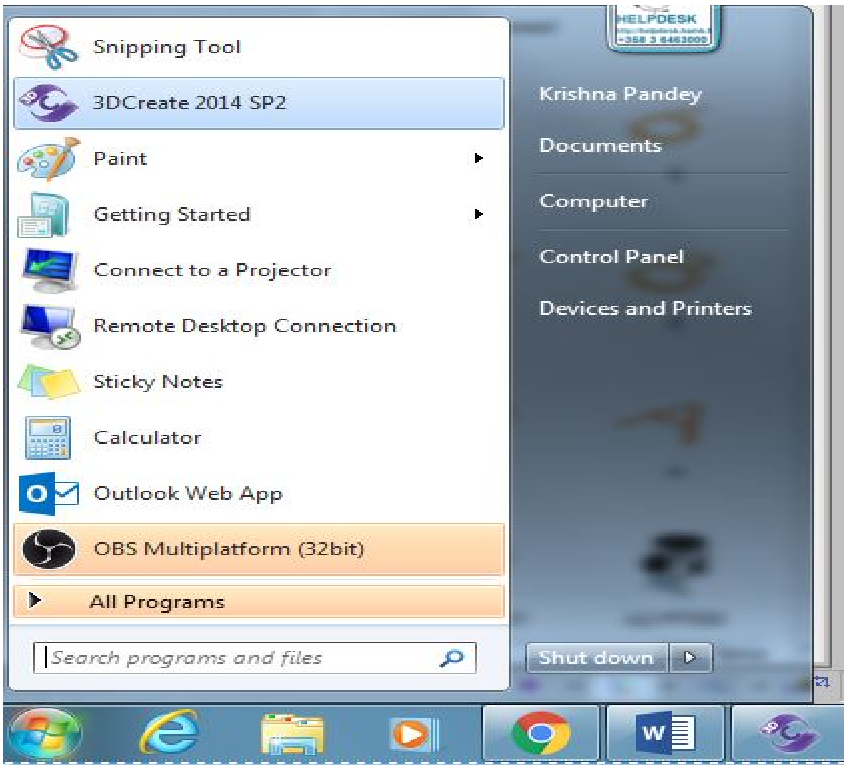


Figure 28 3D Create 2014 SP2

The one we are using here is 3D Create 2014 SP2. When we open that we will go to the home page of 3D Create.

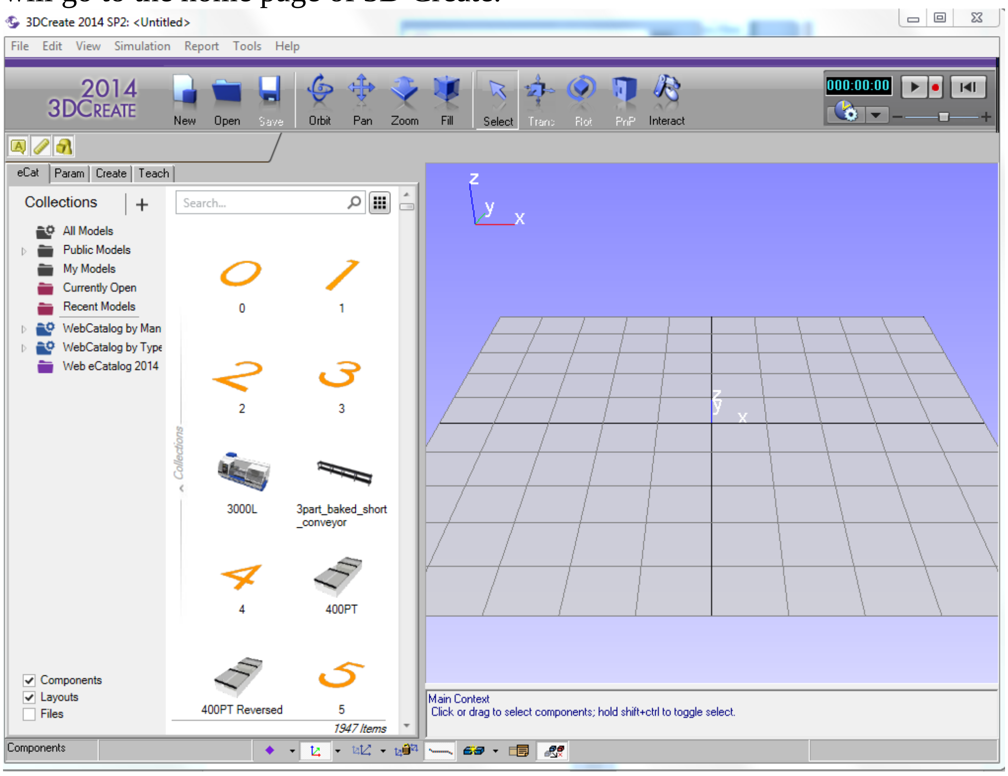


Figure 29 Home Page of 3D Create

The homepage of 3D create looks like the Figure 29. After this we can search everything we need from the eCat library. In this case we are using kuka robot (KR 100-2-P) as shown in Figure 30 which is available from its library. We can also search from the webCatalog of the manufacturer for the model which are not there in eCat. There is even option for finding the similar type of other model by searching in the webcatalog by type.

Moreover, there are places like recent models and currently open models which stores the recently opened files. It saves our time as well as helps us to find the previous search.

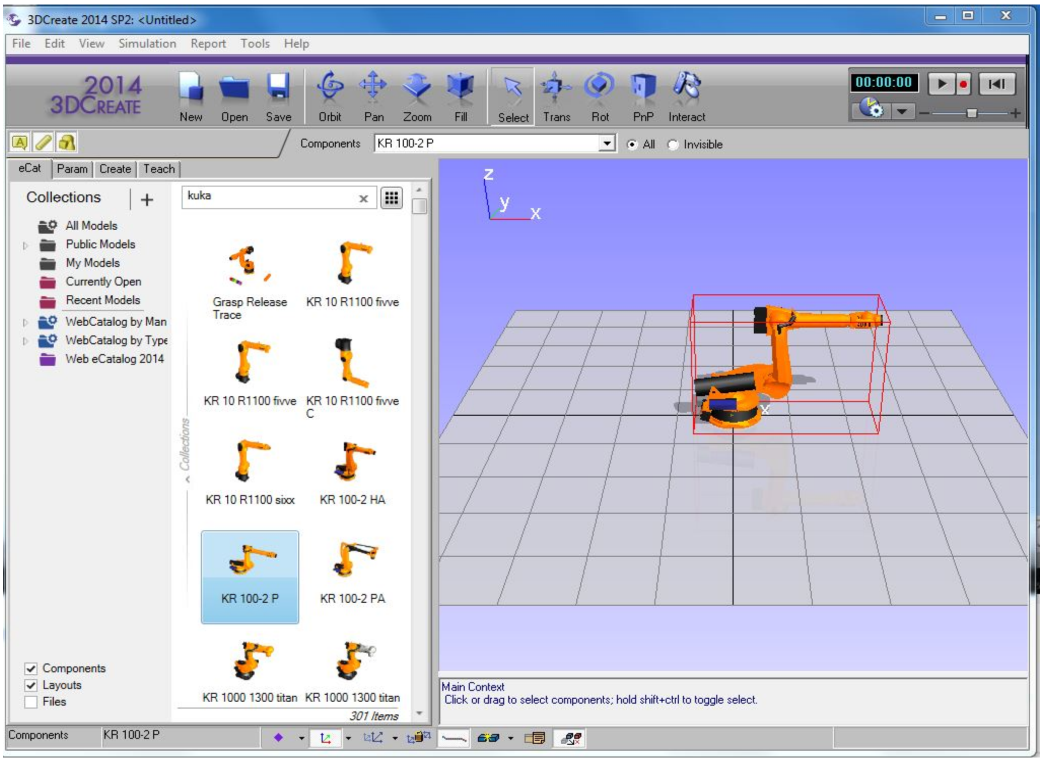


Figure 30 Kuka in 3D world

After this we will select the gripper for this robot which is shown from Figure 31. Now we have to select the correct gripper for the selected robot. Here we can find the different types of gripper like finger gripper, mechanical gripper, and vacuum gripper. There are grippers of different sizes. The one we are using here is three finger gripper which is being used in our school laboratory. The selected gripper is PZN_plus_100_1.

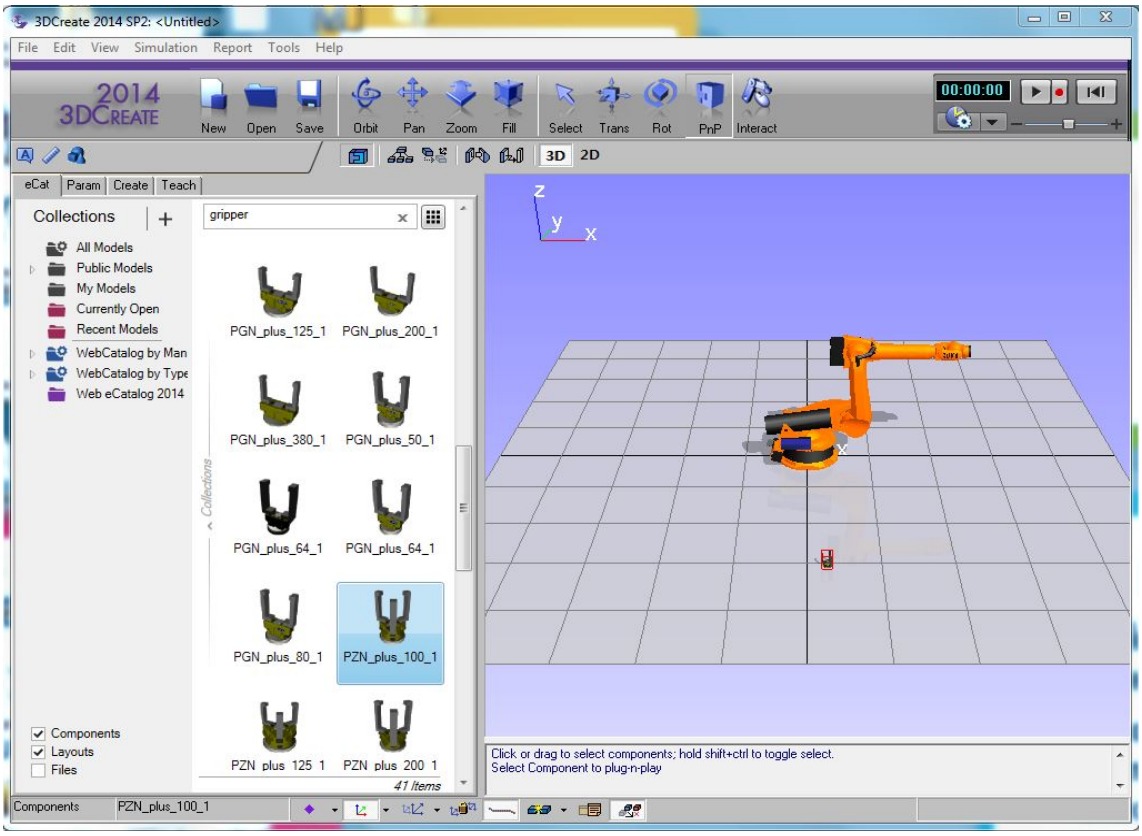


Figure 31   Kuka with gripper

When we got that gripper to the 3D world we select the gripper and drag it to the head of the robot. When it is going in the right direction it will guide us by the green line. After this step we need conveyor for the work area as in Figure 32. Here we are using two conveyors one is just the normal conveyor and another is sensor conveyor. We can always change the orientation of the robot and 3D world by using panning and orbiting.

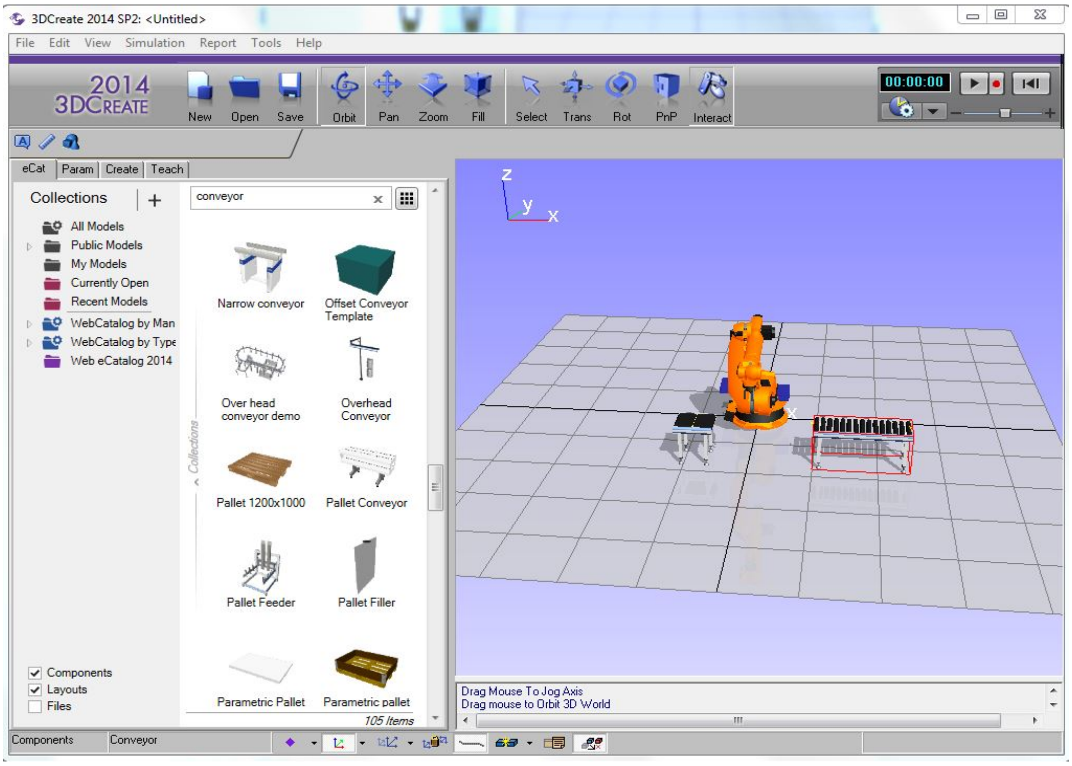


Figure 32 Selecting conveyor

We can change the detail of conveyor like conveyor height, conveyor speed, conveyor colour, conveyor capacity and the type of conveyor we are using. We have to select the conveyor we want to change and we have to click on the param tab.

Additionally, we can also choose the desired material for the conveyor and also there is option of giving the accurate weight for the conveyor as shown in Figure 33.

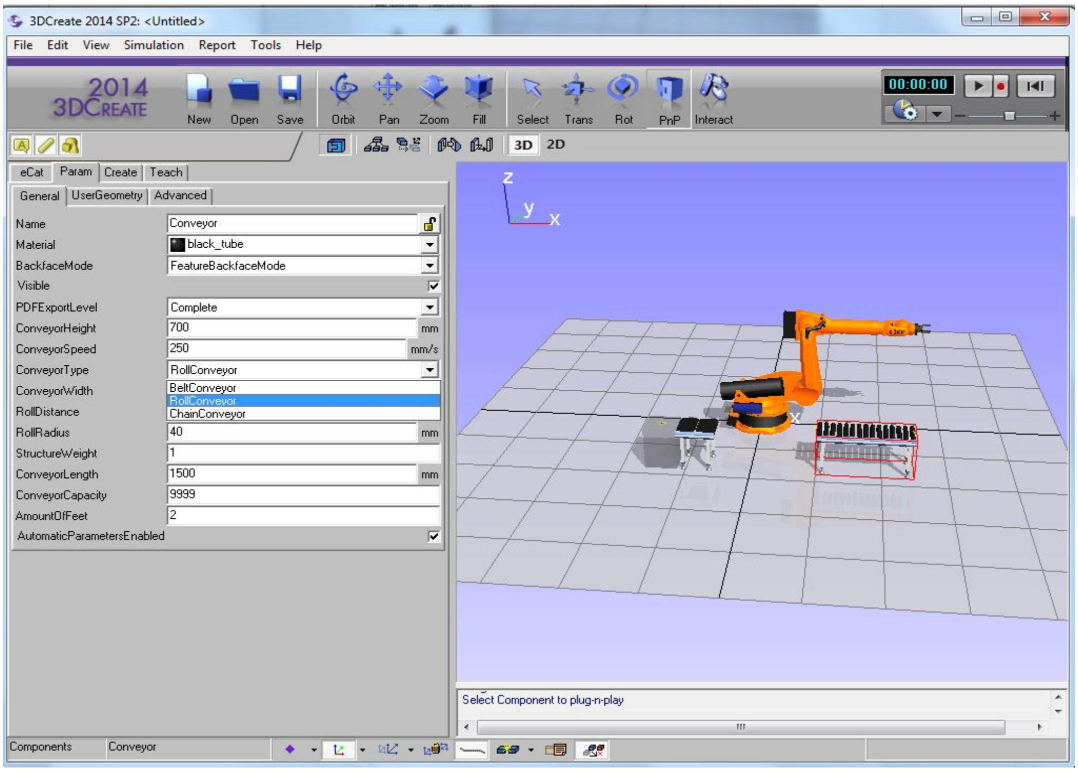


Figure 33 Conveyor Setting

For this work we are using the basic feeder for feeding which is available in eCat collection. The feeder will feed the material for this process. In this case we are using the cylinder feeder as in Figure 34. When the program is run, it will automatically feed the cylinder part which will later go through the conveyor.

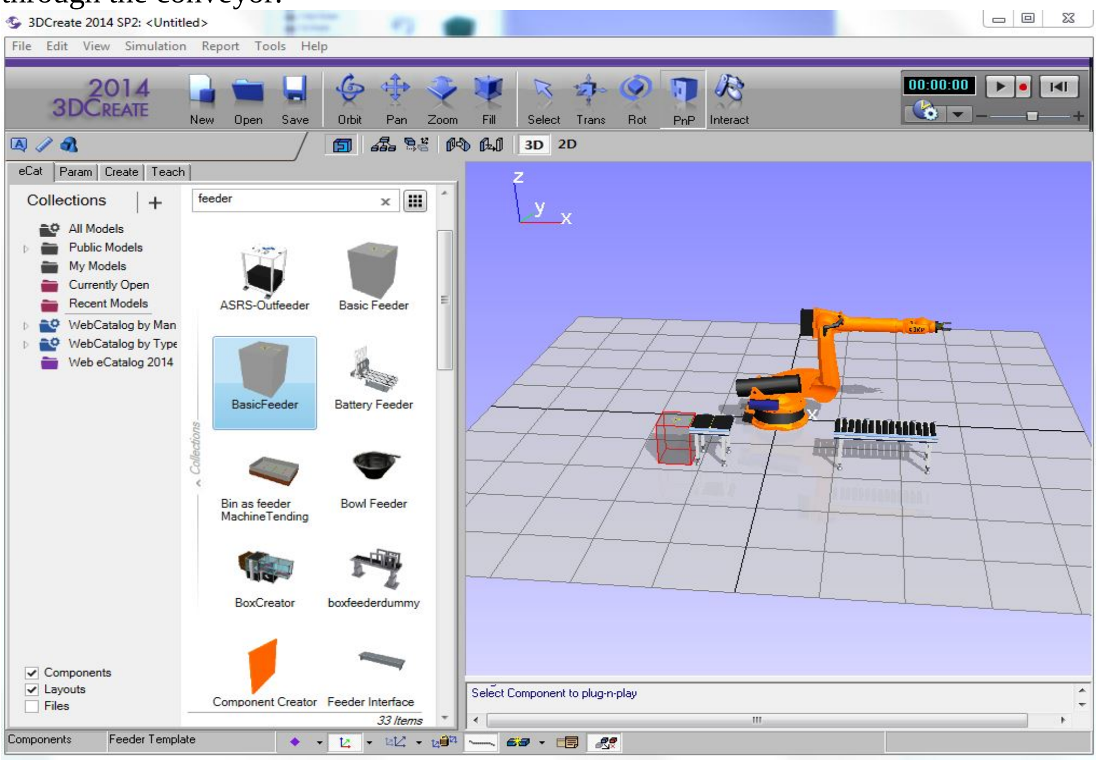


Figure 34 Basic Feeder

To connect the signal between the robot, feeder and the conveyor we do the following steps:

i) Select the robot body and click the PnP button from the main toolbar.

ii) Click on the connect signal button.

Figure 35 Connect Signals

When we click on the connect signals button we will get the list of box with signal in and out as illustrated in Figure 36.

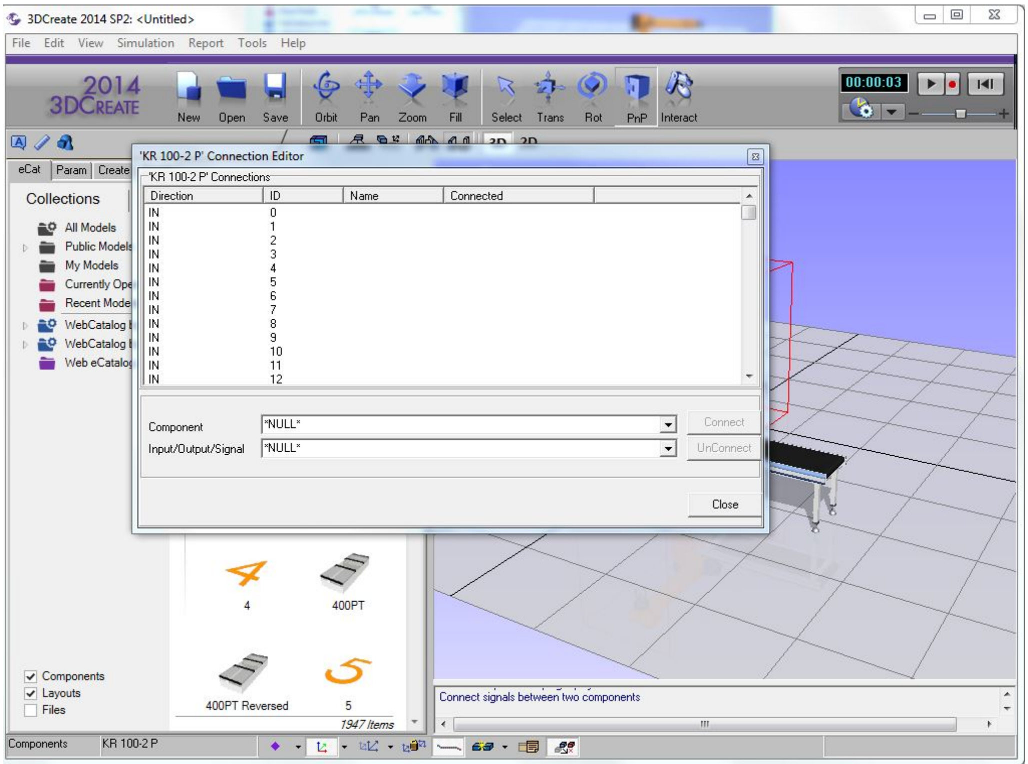


Figure 36 Signal in out

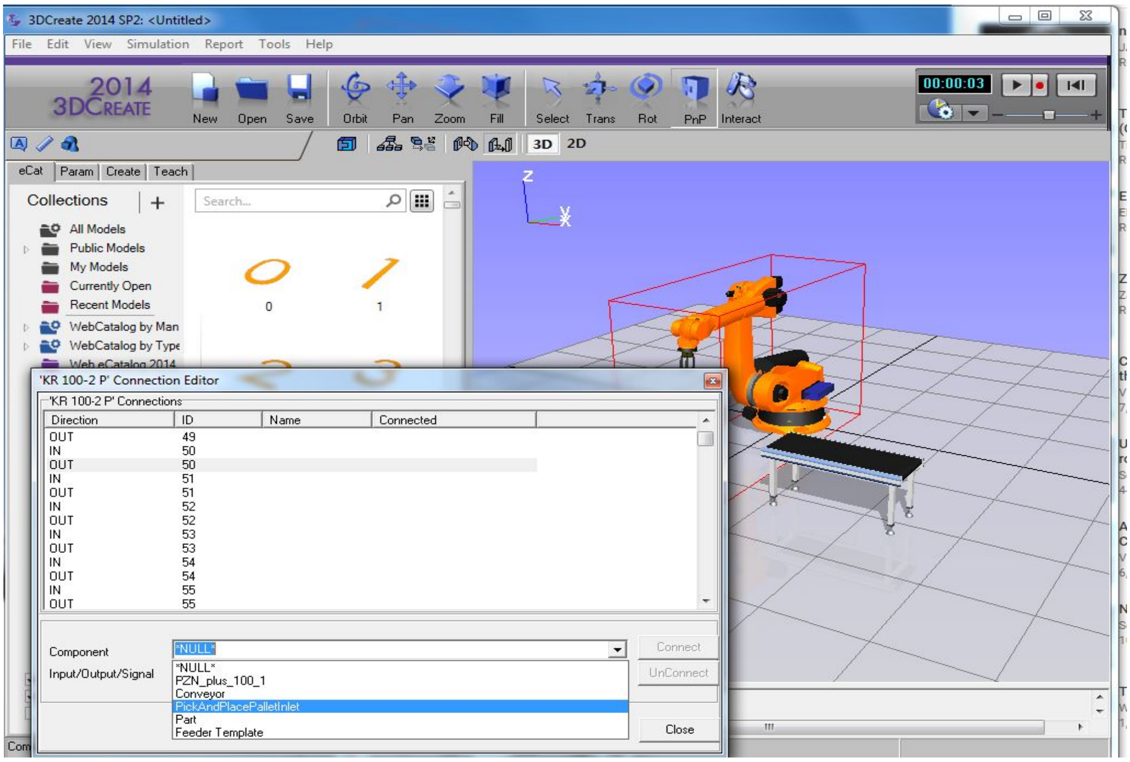


Figure 37 Connection Editor

In this step we can select the component for which we are connecting signal. Here, the out signal is pickAndPlacePalletInlet conveyor so we select that in the place of component. Furthermore, for signal we have to give command to start and stop conveyor. So, we put StartStop in the Input/Output/Signal as shown in Figure 37 and 38. This step will connect the conveyor to the system and start and stop the conveyor when needed.

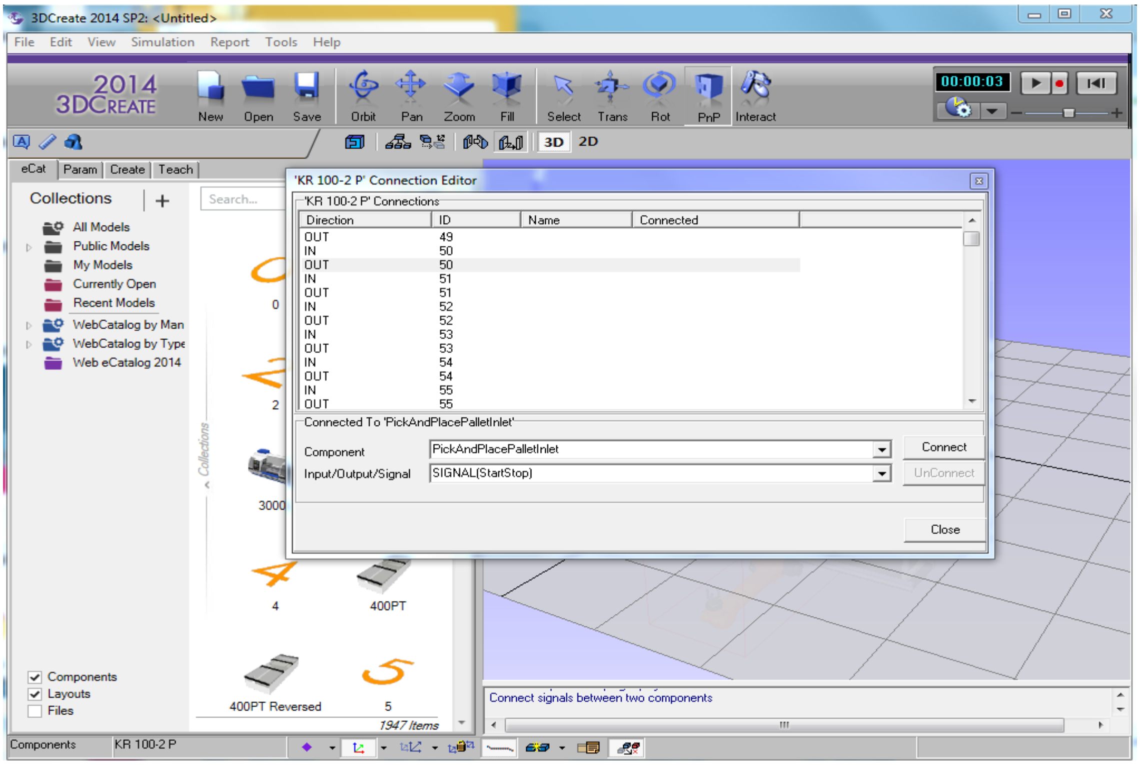


Figure 38 Connection editor for output signal

And for Input we click on In and connect to the component and then choose the signal like in Figure 39.

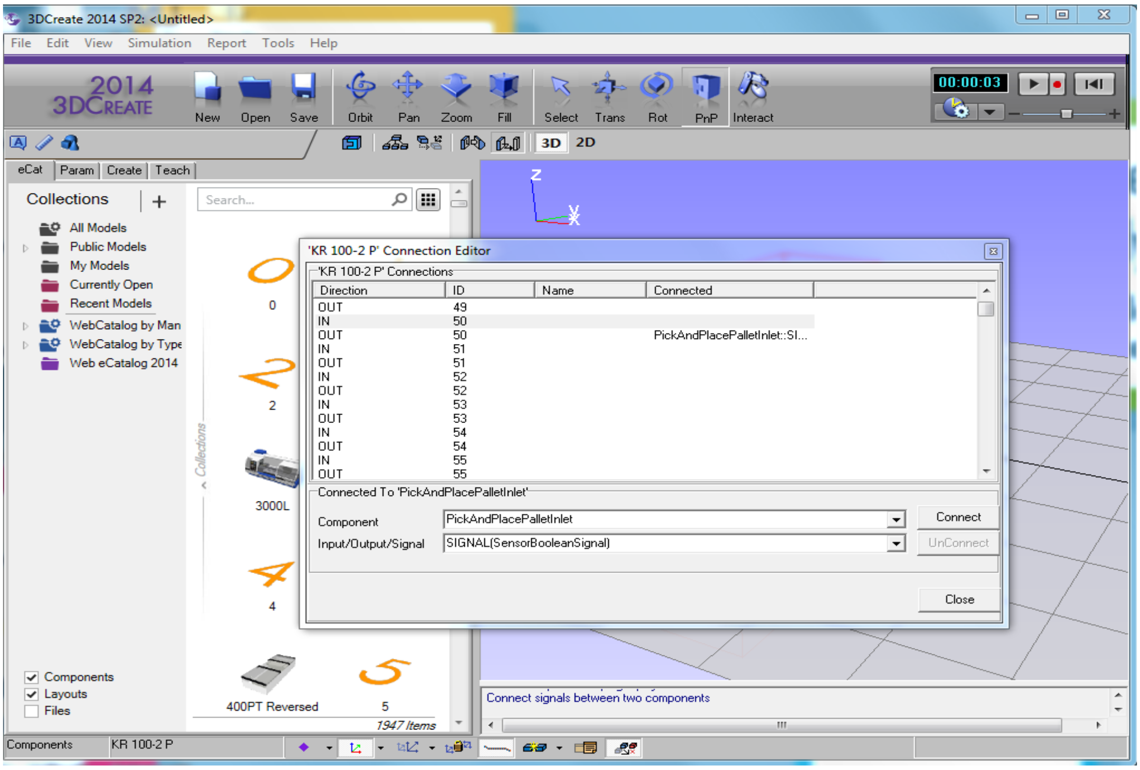


Figure 39 Connection Editor Input signal

Once we are done with the connection it will show the connected signals of input and output on the list. After this step, we can change the tool centre point.

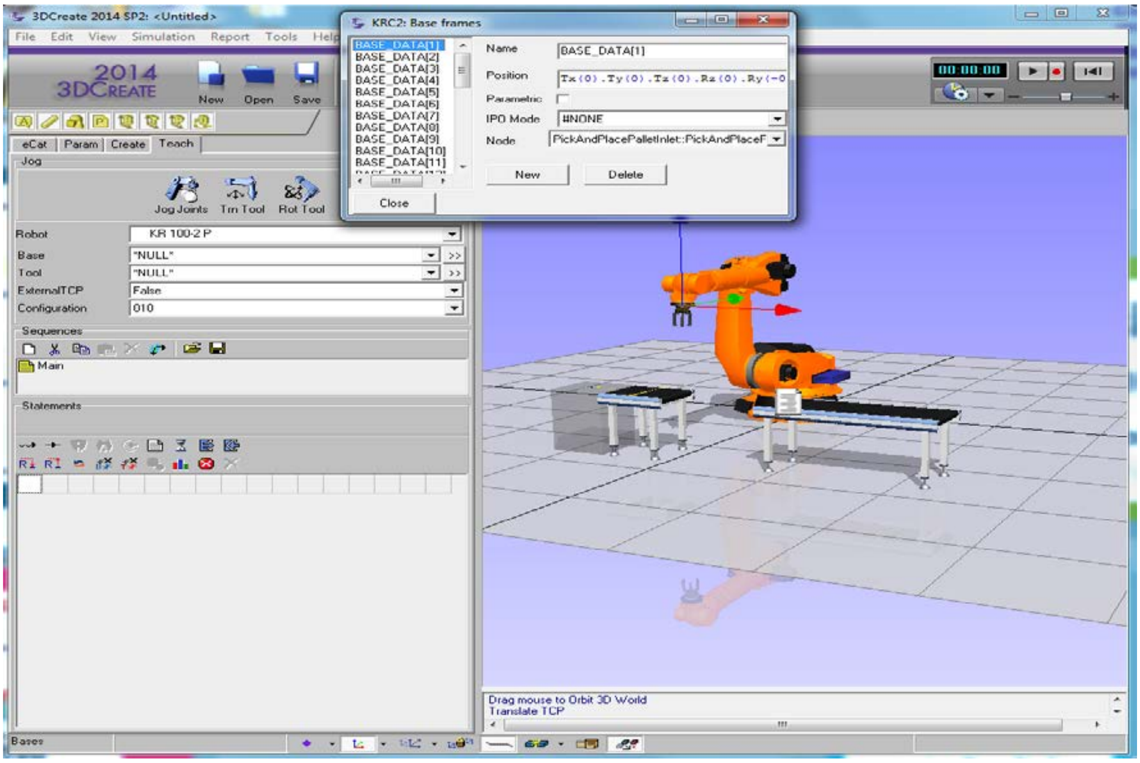


Figure 40 Base Setting

At this step, we can change base, tool setting to assign the position as demonstrated in figure 40. If we wish to use our own tool outside from the 3D Create we can click on the New button and add the new tool or base.

After this step we are now ready for the programming sequences. We can mainly move the robot by two ways

i) Point to point movement: This is the type of movement in which the robot moves irrespective of the axis which means the robot can move in any direction to move from present position to the new position.

ii) Linear Movement: This is the type of movement in which the robot moves in certain axis only at once.

Initially we write program sequences for the robot which is known as main program as in Figure 41.

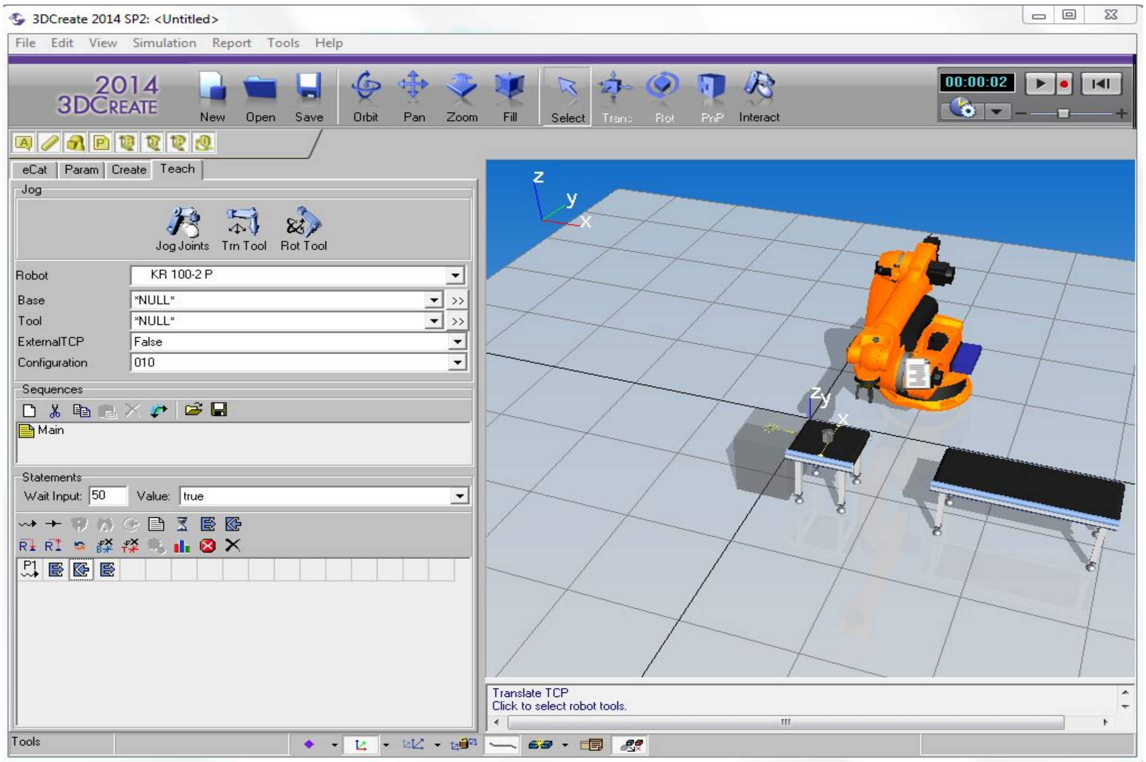


Figure 41 Creating Statement

While writing the main program we first set the point to point movement to the above shown position as P1. At previous step we set output statement and input statement as 50. If the binary output statement after P1 is 50 and the value is true the pickup and place conveyor will start. Similarly, the value of binary input is set as 50 and if the value is true which means if there is nothing in the conveyor it will proceed ahead, otherwise if there is already another part then it will wait in front of the conveyor. After that the binary output statement is set false which means that once the part is in the middle of the conveyor the conveyor will stop.

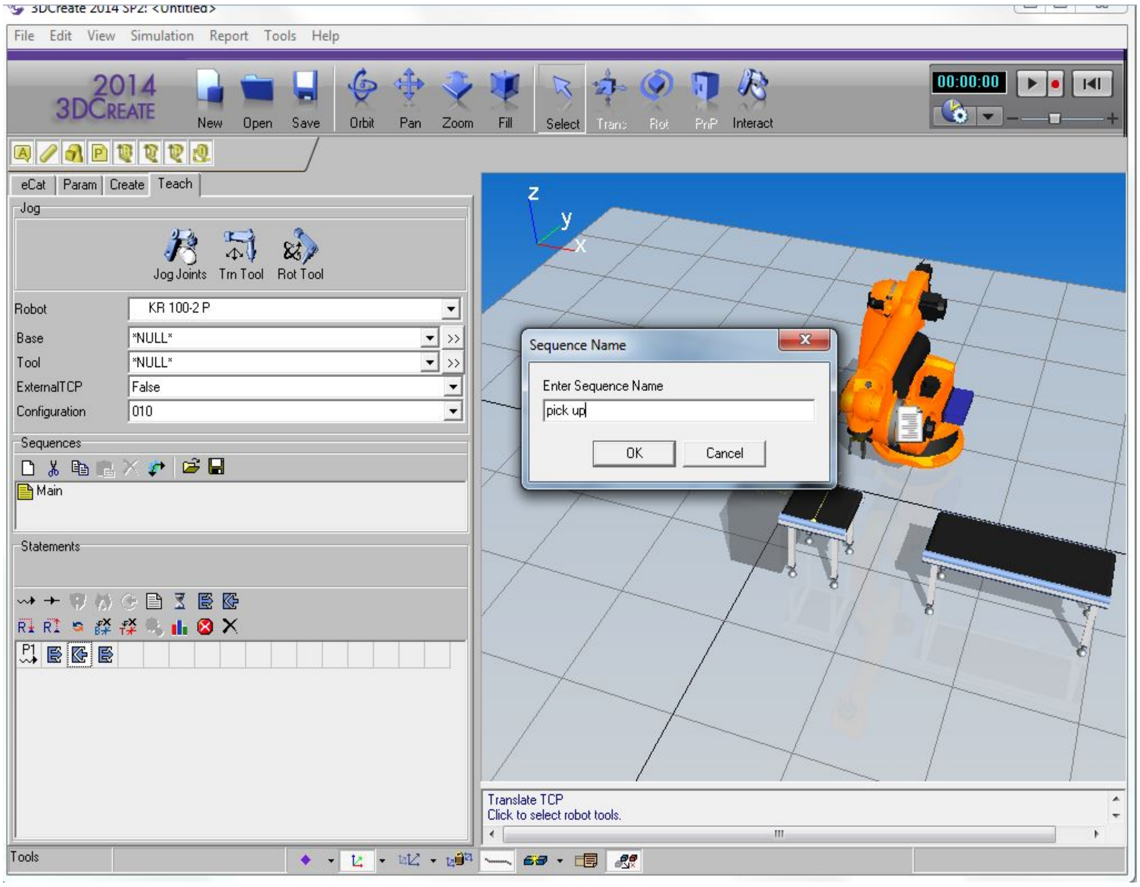


Figure 42 Program Sequence for Pick up

Then we create new programming sequence for pick up as shown in Figure 42 and we set another point to point motion P2 in sub program pick up which is shown from Figure 43.

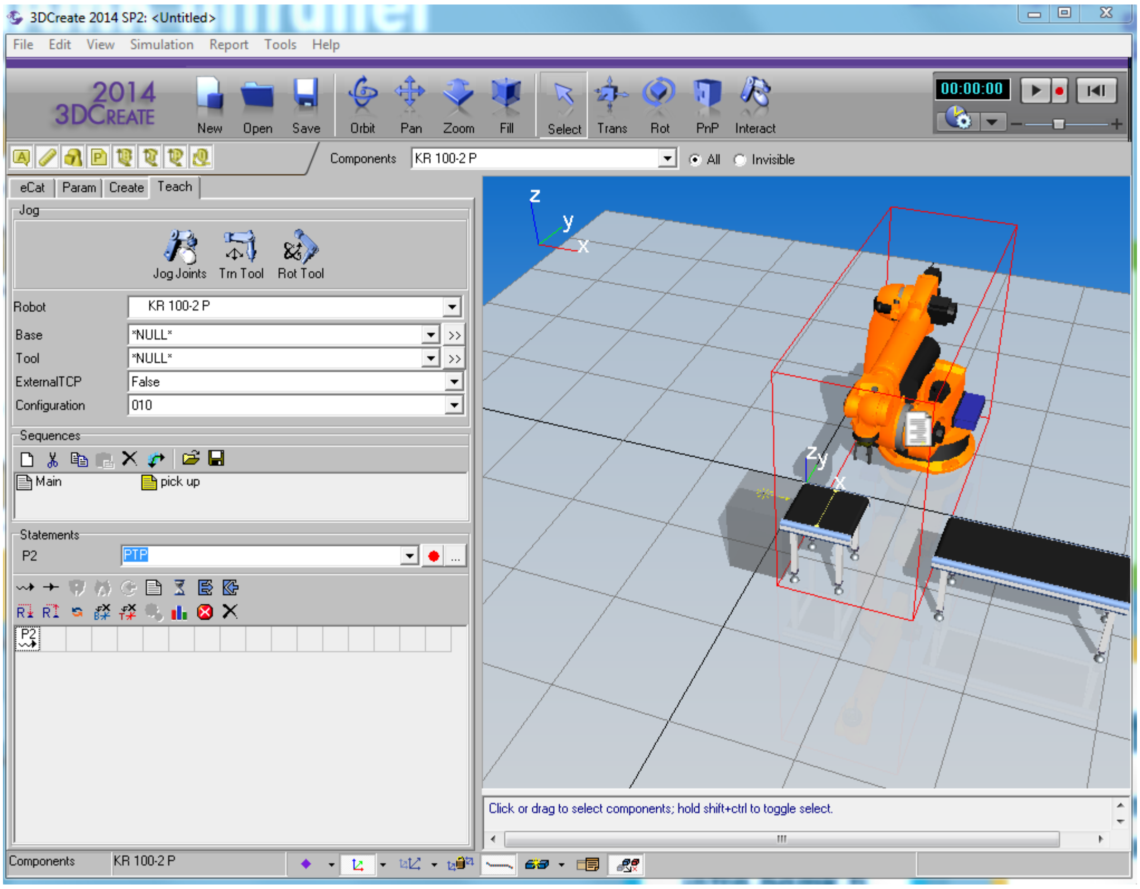


Figure 43 P2 movement

After this step we change the tool centre point. We click on the trn tool and then click on the top part of the work piece while snap filter is activated for the pick up like as shown in the Figure 44.

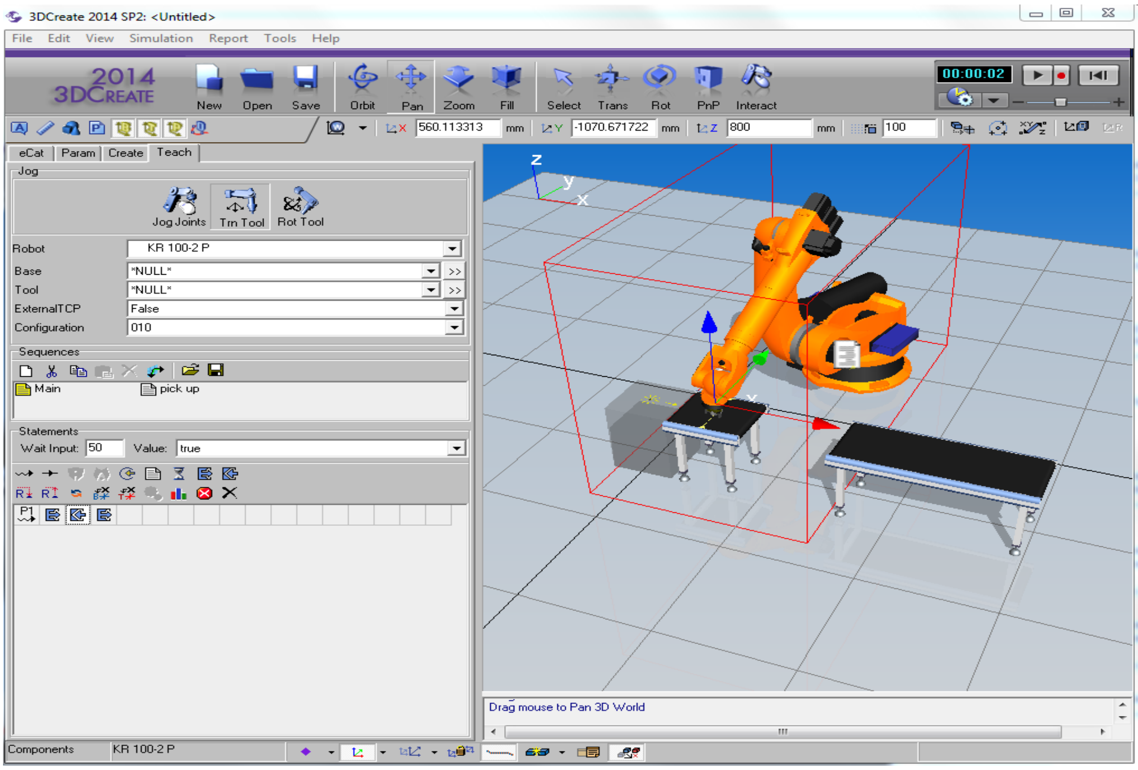


Figure 44 TCP Setting

Once it grab the work piece we assign the linear movement in the positve z axis as demonstrated in Figure 45.

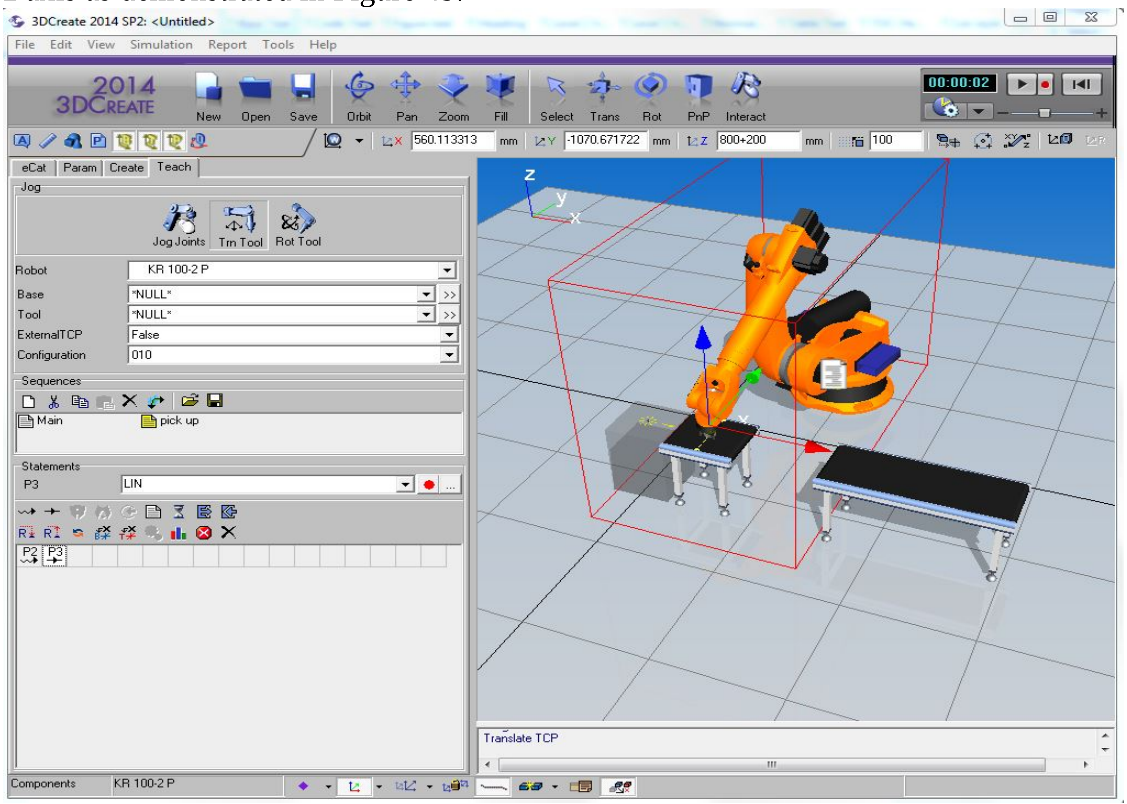


Figure 45 P3 Movement

Here P3 indicates the linear movement of the tool centre point (TCP) towards the positive z axis. After this we add two more linear movement P4 and P5 at the same position which is illustrated from Figure 46. We then bring P4 before P3 which means that while going to pick up the work piece the tool centre point moves to the position P4 and then it goes and pick up the work piece and it comes to the position P5 which is same position as P4.

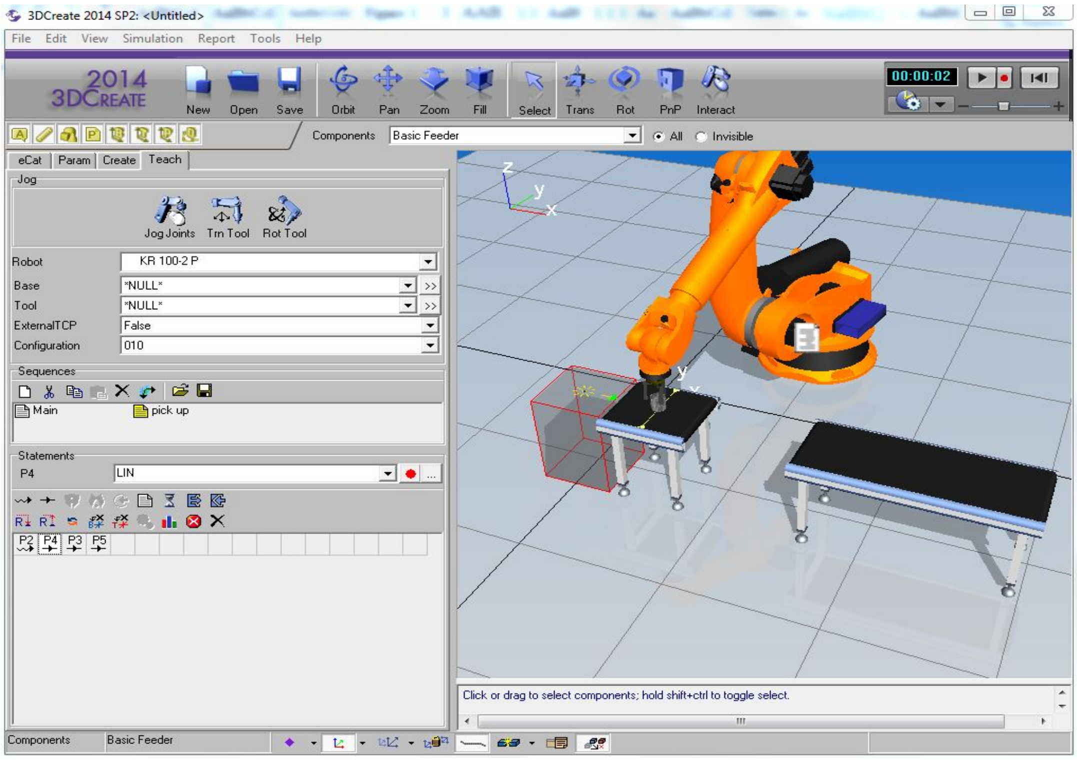


Figure 46 P5 movement

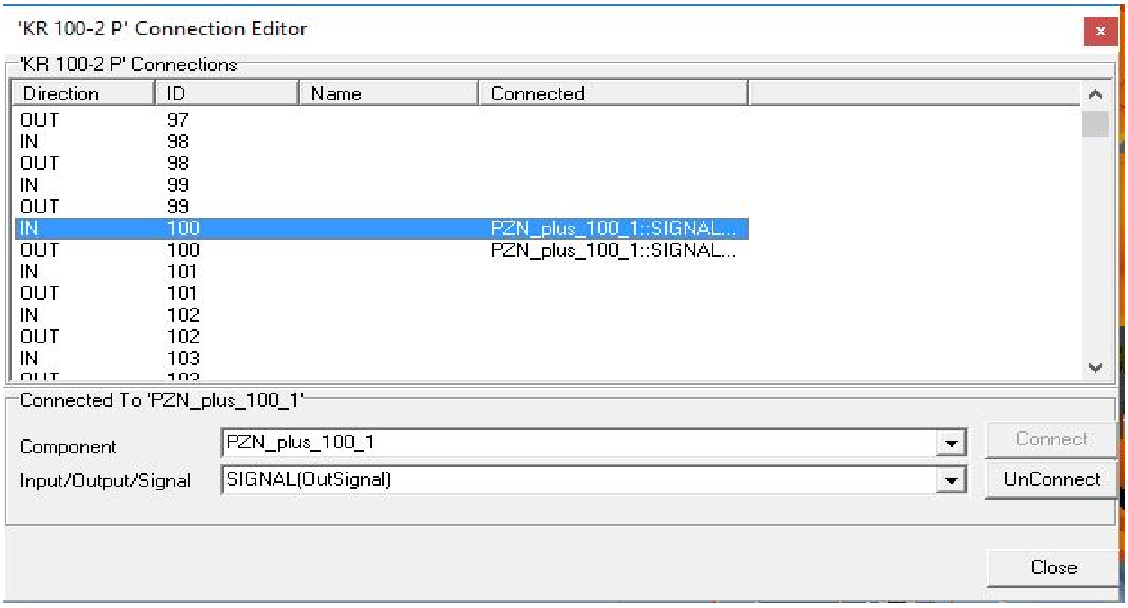


Figure 47 Gripper setting input

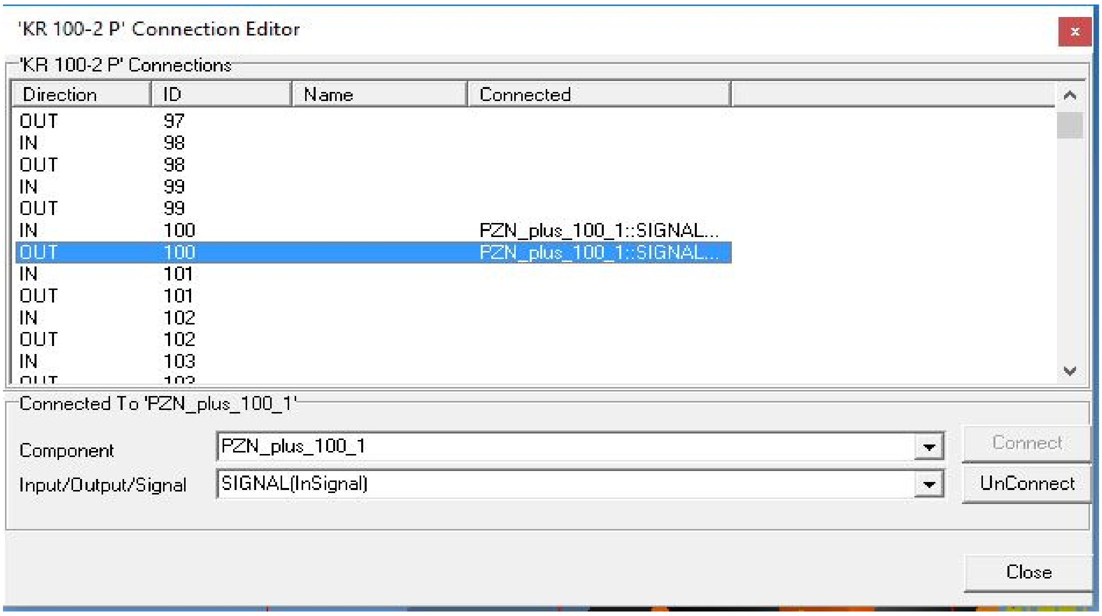


Figure 48 Gripper setting output

Like in the picture 47 and 48 from the connection editor we set the direction and ID for the gripper. If the set output is 100, value is true and this is Insignal then it will close the gripper.

After this another position P6 which will be the home position for robot is added after P2 and taken at the last as shown in Figure 49. It will repeat the program sequence.

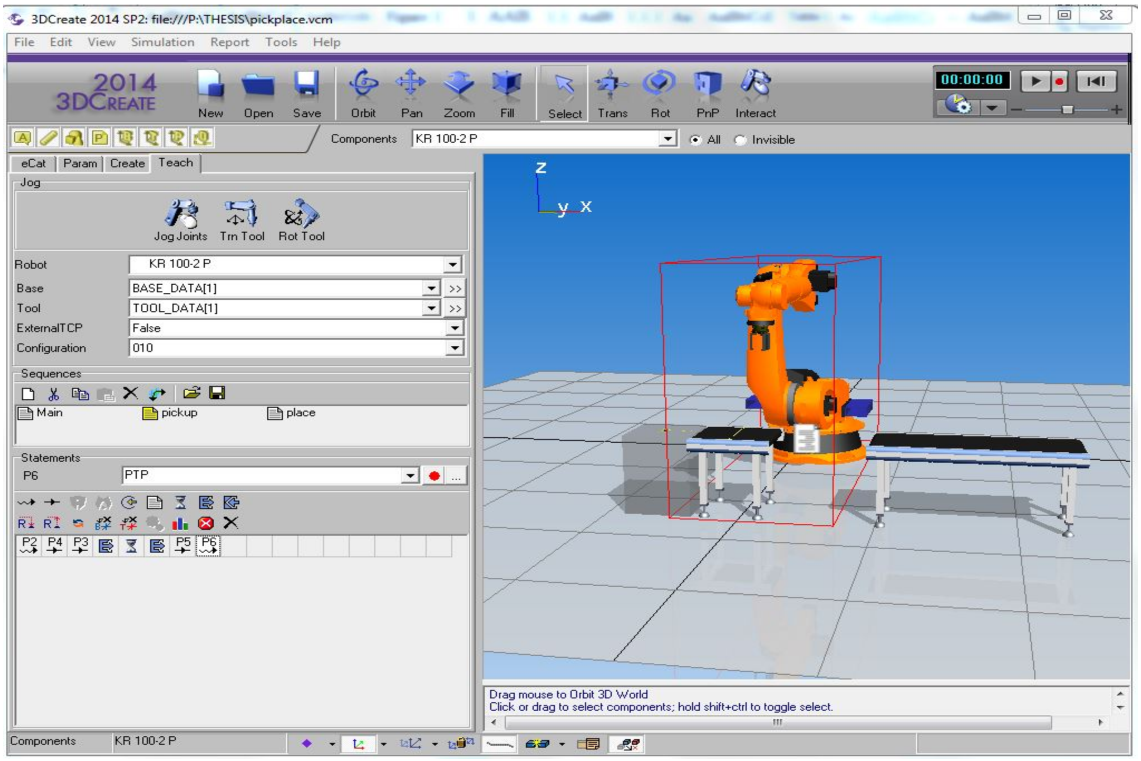


Figure 49 P6 movement

At this point the program sequence for pick up is completed and is ready to call from the main program.
We can call the program by using call routine as illustrated in Figure 50.

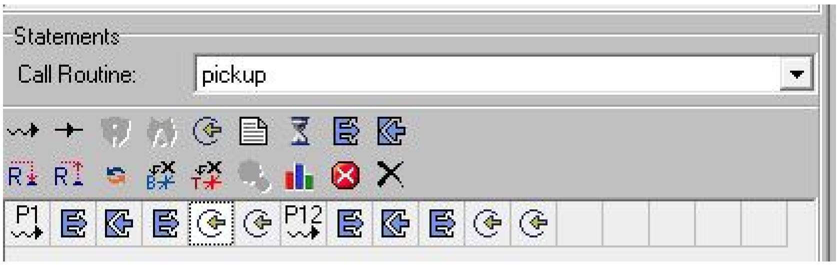


Figure 50 Call routine for pick up

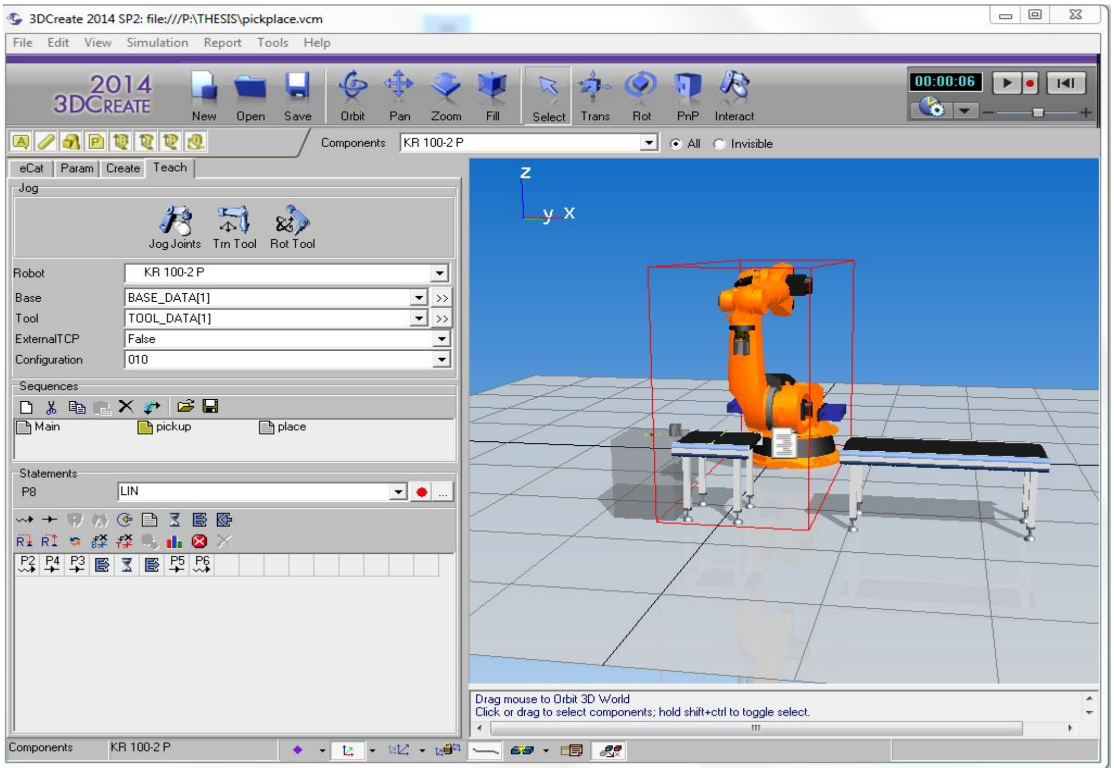


Figure 51 Home position

Up to this point, the robot started from the point P2 and then it goes to the position P4 and then P3 followed by grabbing the work piece and closing the gripper and then it goes to the position P5 followed by the home position P6. So, in this Figure 56 the robot still has the work piece at home position P6.

Now we again make a new sequence for the placing the work piece as shown in Figure 52.

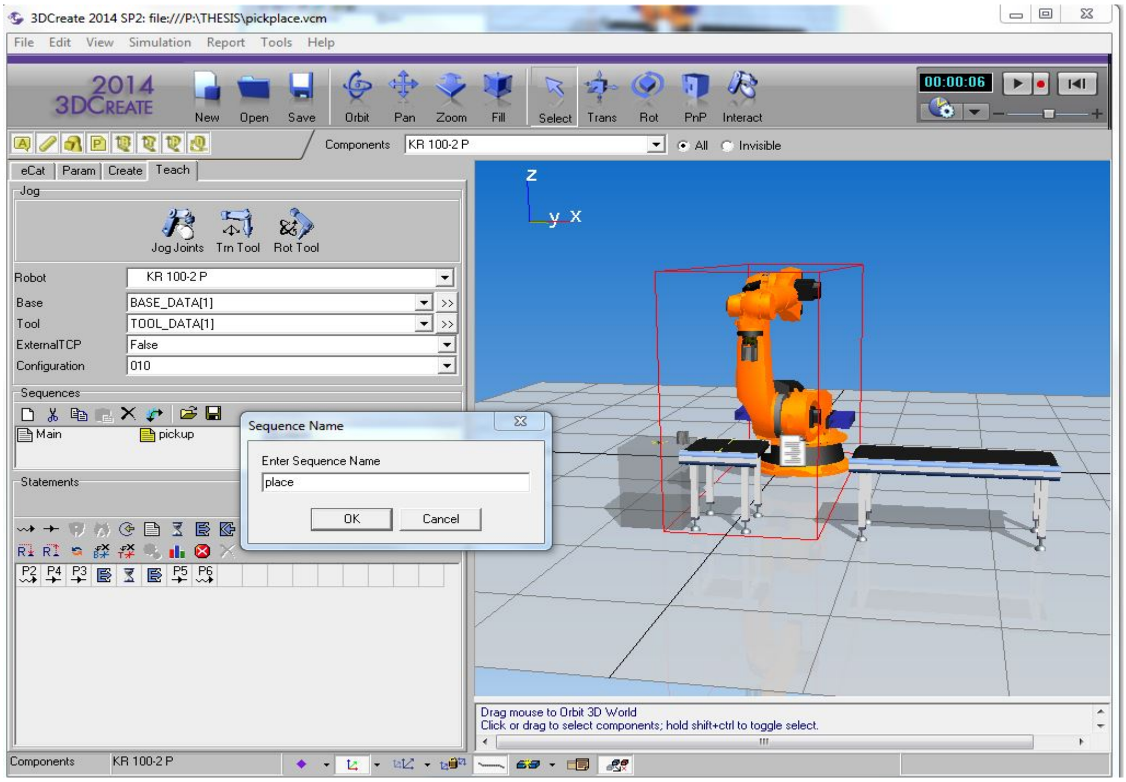


Figure 52 Program Sequence for place

Likewise, in pickup we assume the first movement of the robot to be P7. After this we go to the P4 of pick up and then activate the translate tool and then drag the tool centre point up to the next conveyor as shown in Figure 53. By doing this it will not change the position of tool centre point in other direction than x. It will move horizontally in the x direction.

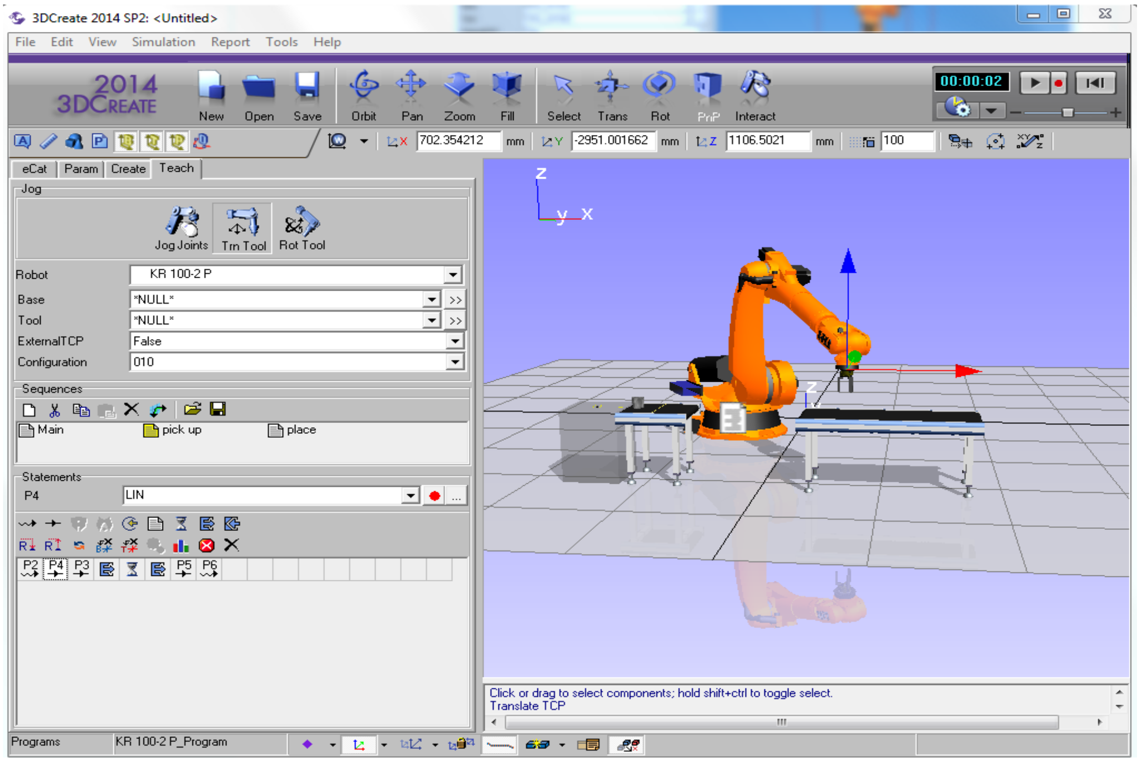


Figure 53 Changing Coveyor

We then added another linear movement in negative z axis. Earlier in pick up we assumed the distance from P3 to P4 to be 200mm. So, we go 200 mm in negative z axis to place the work piece in the conveyor as in Figure 54.

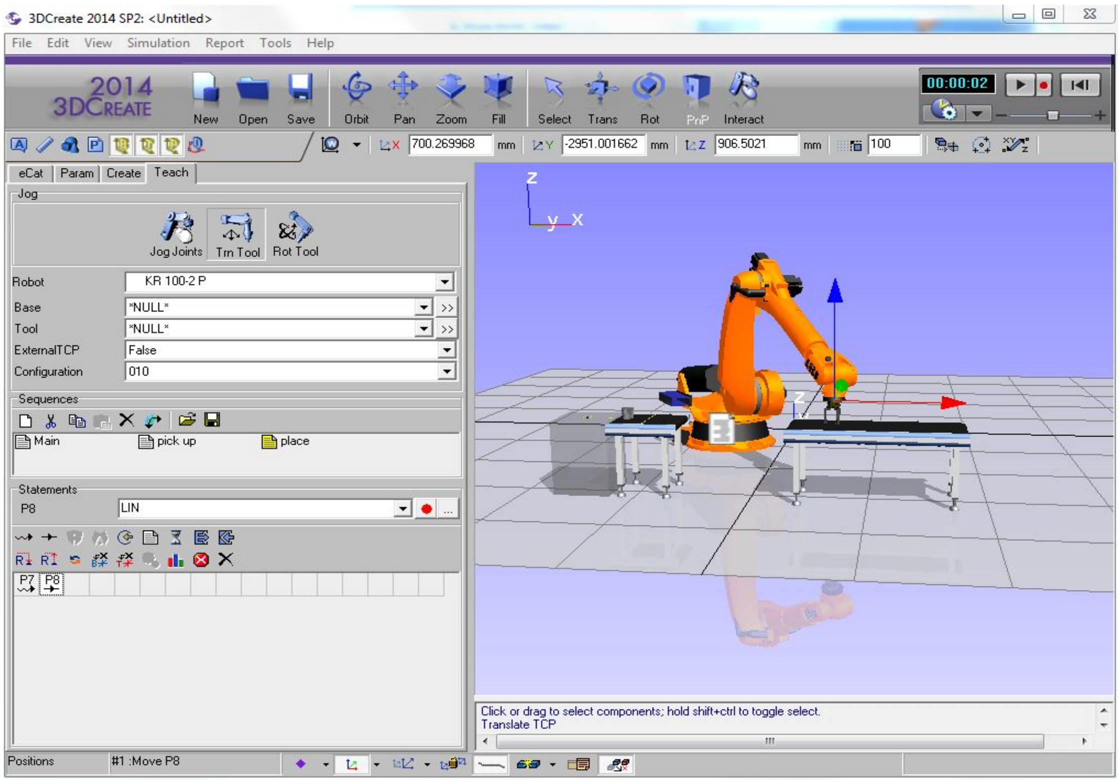


Figure 54 P8 movement

After placing the working piece in the conveyor by P8 we again move 200 mm in the positive z axis by using linear movement (P9) to be in the same position as P7. We also add another linear movement P10 at the same point to repeat the process. P11 is added after P7 and it is moved all the way to last as illustrated in Figure 55. This will bring the robot to the home position and the process will repeat.

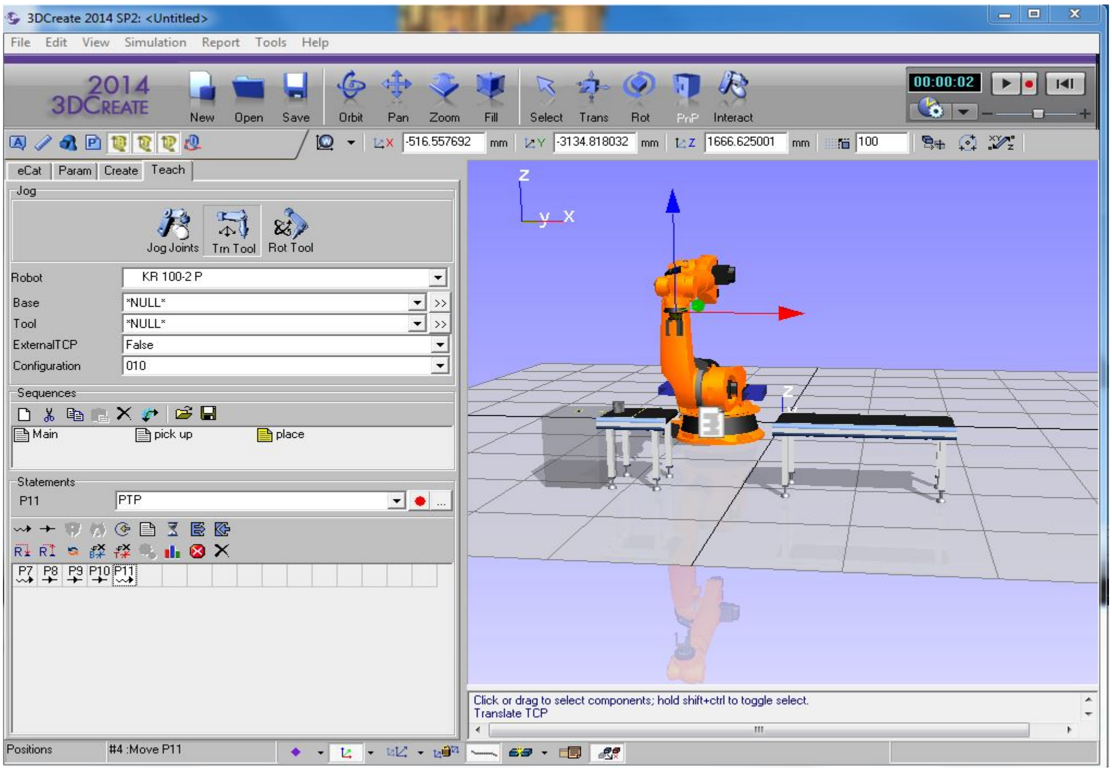


Figure 55 P11 movement

Likewise, in the figure 47 and 48 if the set output value is false it will open the gripper and leave the work piece. After placing the work piece in the conveyor it will again return to the home position.

Now the place program is also ready to be called from the main program. So, we again go to call a sub routine option and choose a place.
Our pick up and place program is ready to simulate and we can simulate by clicking on the play button from the simulation control menu. We can stop any time during the simulation and replay the simulation again from the same point.

We can adjust simulation speed according to our need by dragging the slider forward or backward. If you drag the slider forward it will decrease the simulation speed and if you drag the slider backward than it will increase the speed.

So, the final model of the pick of and place looks like the Figure 56.

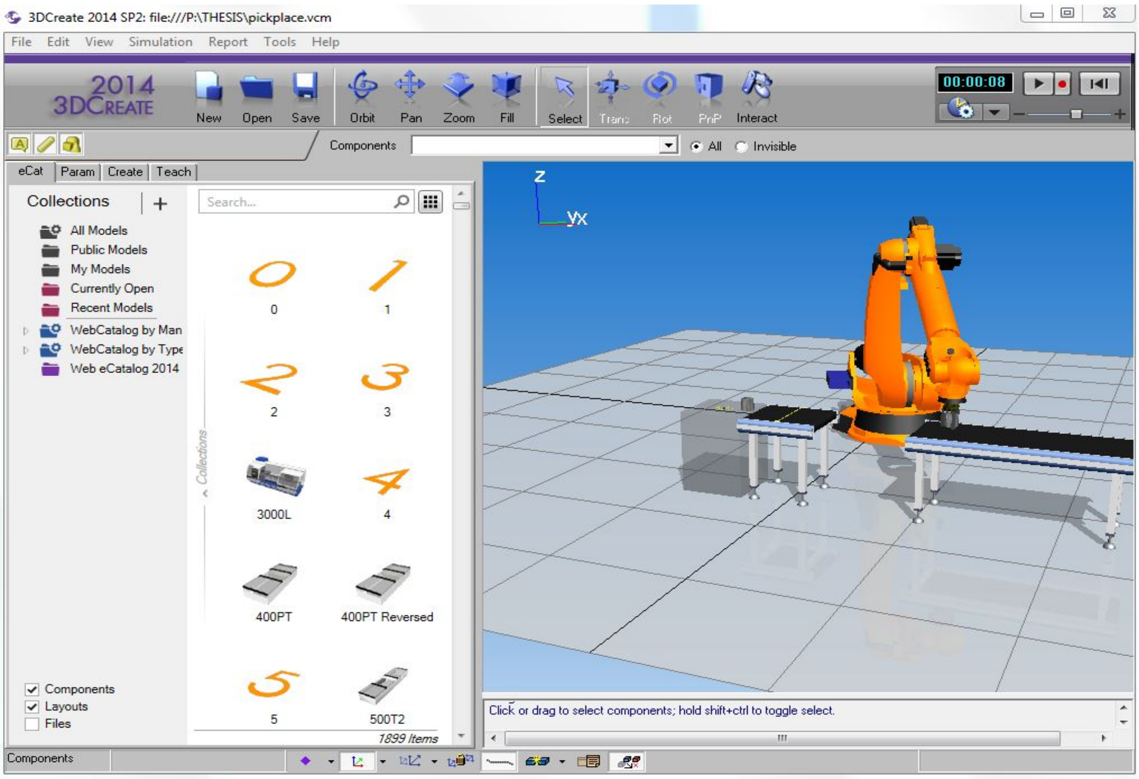


Figure 56 Final Model for pick up and place

5.2 Pick up and place without conveyor

In the first simulation task we used two conveyors but in this chapter we are going to do the same pick up and place application for kuku robot without using the conveyor. We will also create the workplace for the kuka robot. We will use two tables, work piece and the robot.

We followed the previous step to open the 3D create and bring the robot, gripper in the 3D world. We bring two tables of same length and height and the work piece in the 3D world. At this step the 3D world would look like the Figure 57.

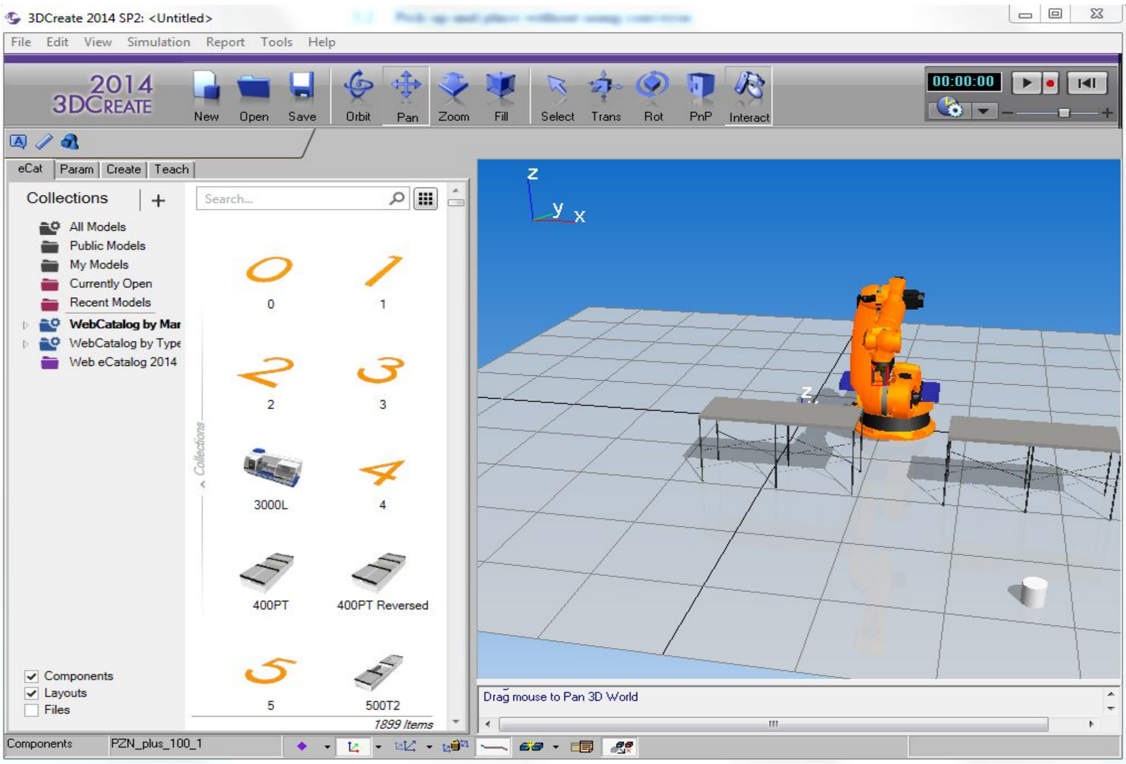


Figure 57 Kuka in 3D world

We then put the work piece into the table. For this we first select the work piece and then click on plug and play components as shown in Figure 58. In plug and play components there is snap selected components.

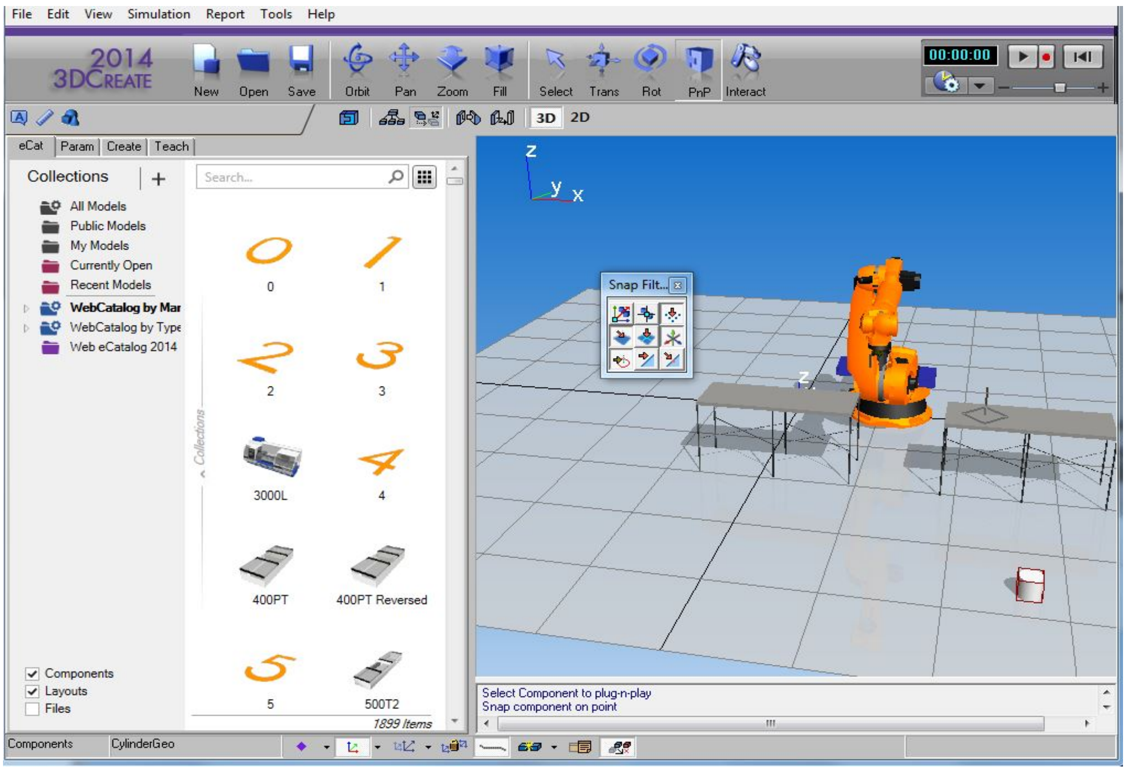


Figure 58 Snap filter

After this we move to the programming sequences to teach the robot about the position. Initially we will write the main program as in Figure 59 and then later proceed to pick up and place likewise in previous example.
We add the first point to point movement P1 at the home position.

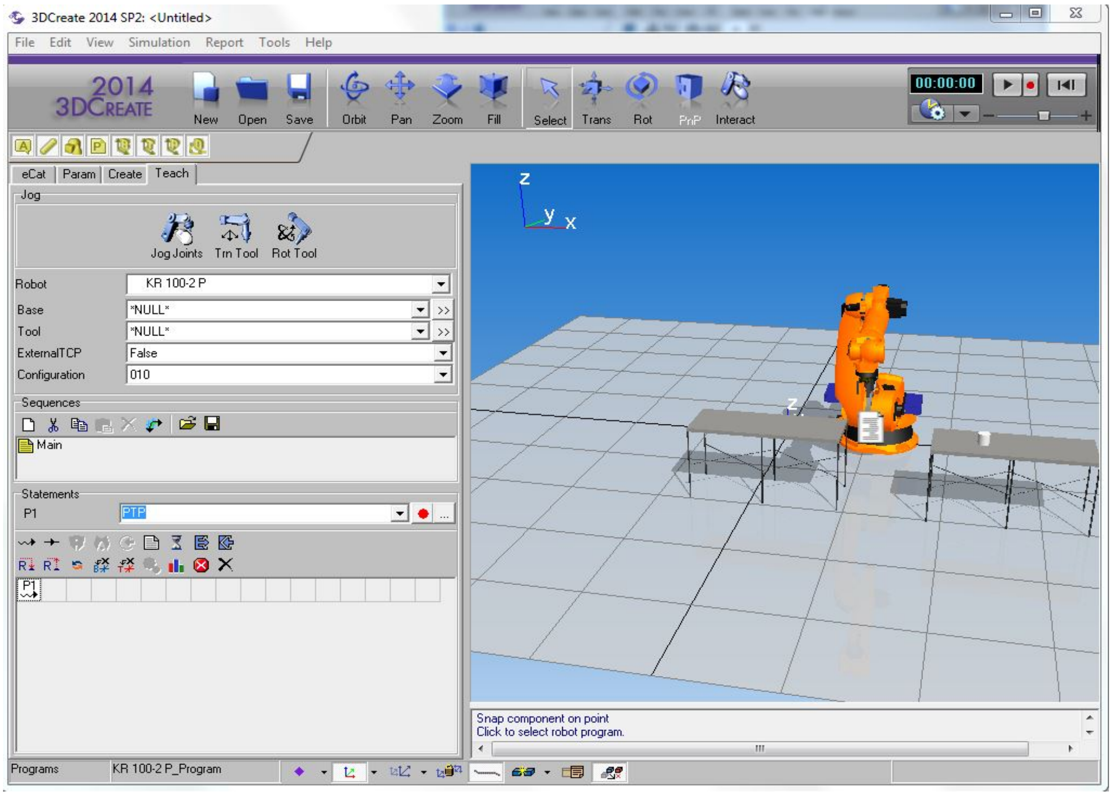


Figure 59 Main Program sequence

We then make new program sequences for pick up as demonstrated in Figure 60. In earlier example we had to activate the conveyor when there is work piece and deactivate the conveyor when there is not but for this example we did not used binary input and binary output in the main program.

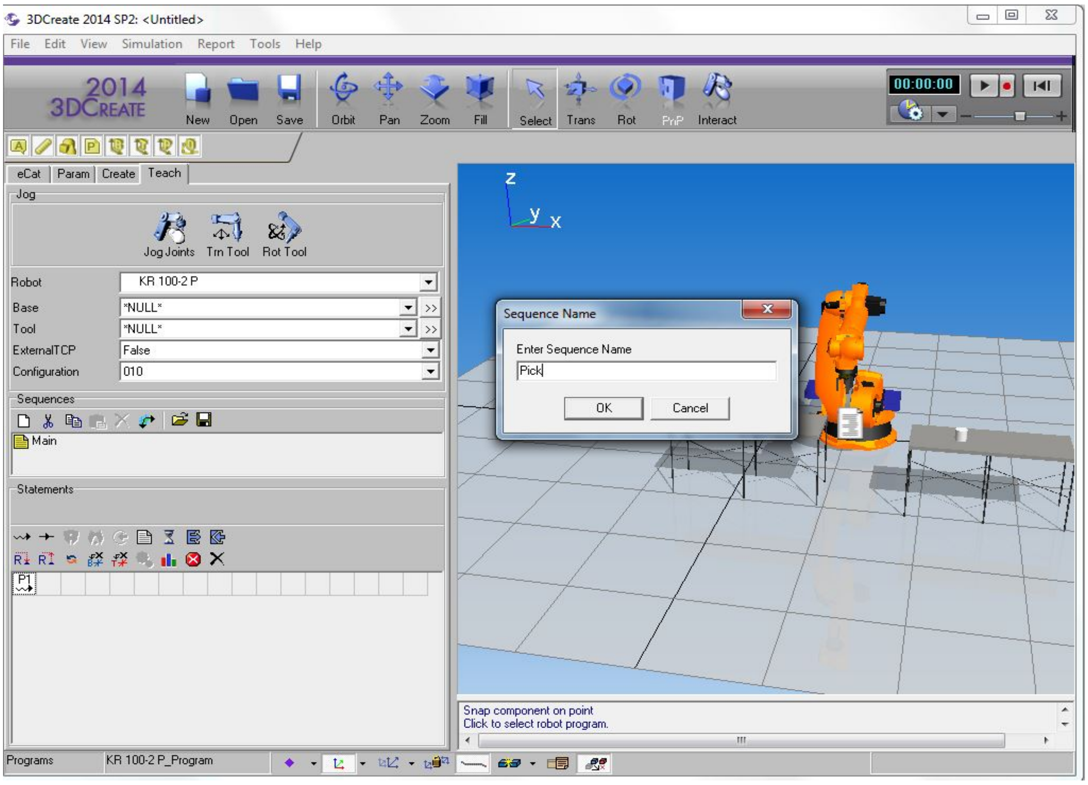


Figure 60 Program Sequence for Pick

In the Pick sub program, we add another point to point movement P2 on the same position. After this step we change the tool centre point. we click on the trn tool and then we click on snap filter to the top part of the work piece for the pick up like as shown in the Figure 61.

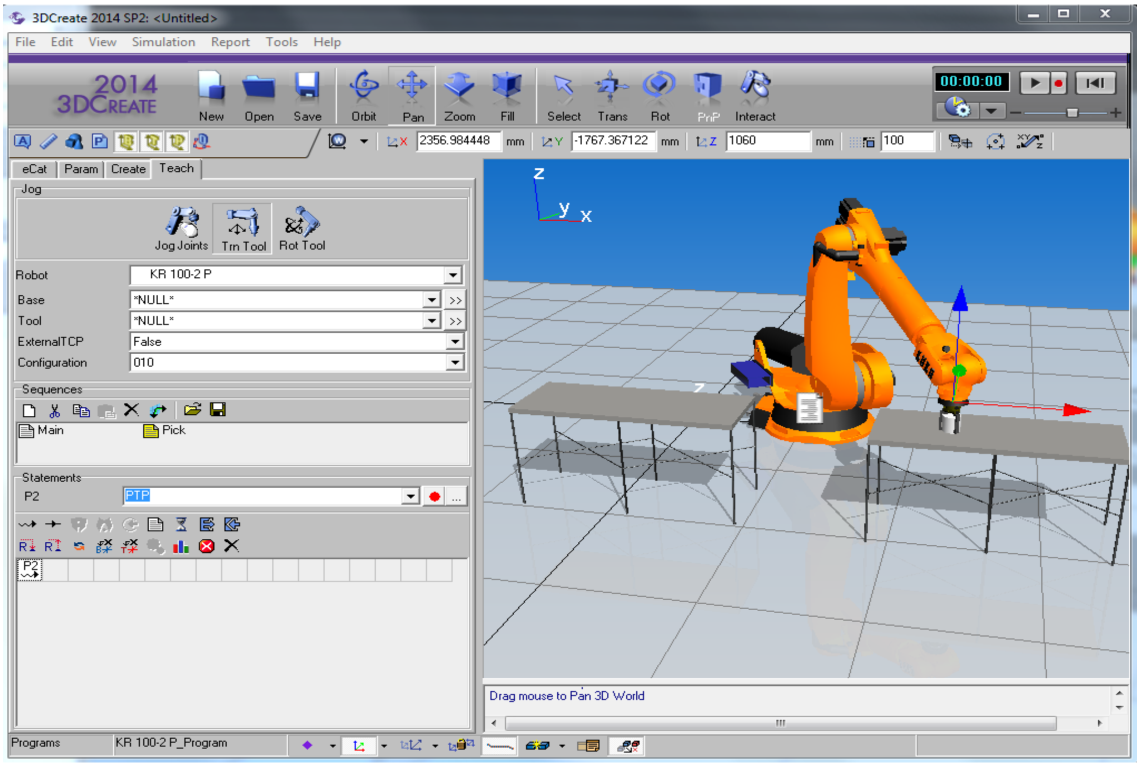


Figure 61 P2 Movement

Once it grab the work piece we assign the linear movement in the positve z axis as in Figure 62.

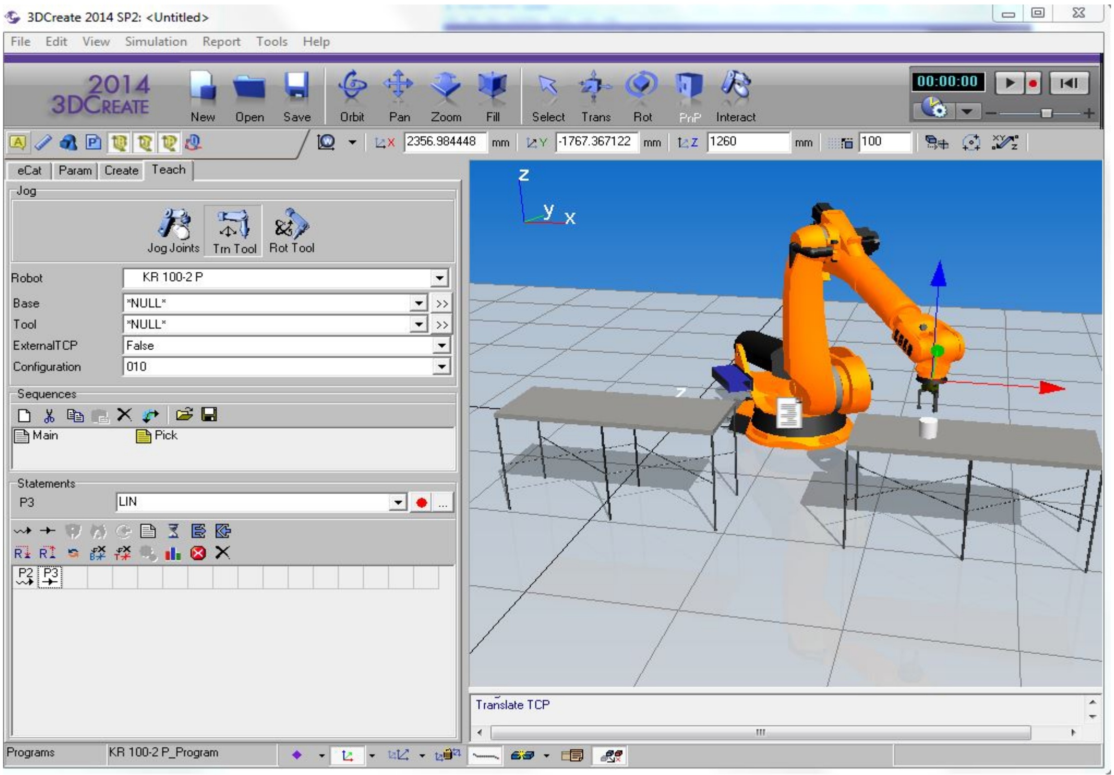


Figure 62 P3 movement

Here P3 indicates the linear movement of the tool centre point(TCP) towards the positive z axis. After this we add two more linear movement P4 and P5 at the same position as shown in Figure 63. We then bring P4 before P3 which means that while going to pick up the work piece the tool centre point moves to the position P4 and then it goes and pick up the work piece and it comes to the position P5 which is same position as P4.

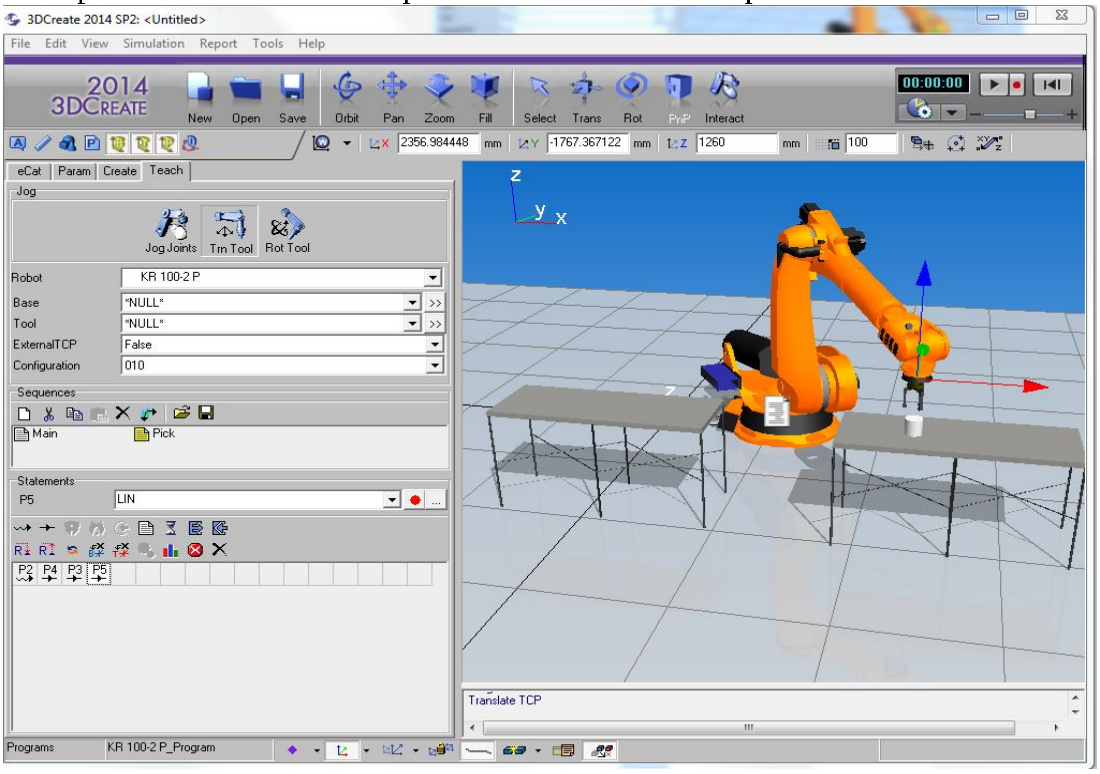


Figure 63 P5 Movement

While setting the gripper we set binary output and binary input at 100 to open and close the gripper. So now we add binary output whose value is 100 as illustrated in Figure 64. If that is true it will close the gripper when the work piece is inside it and we add time delay of 1 second.

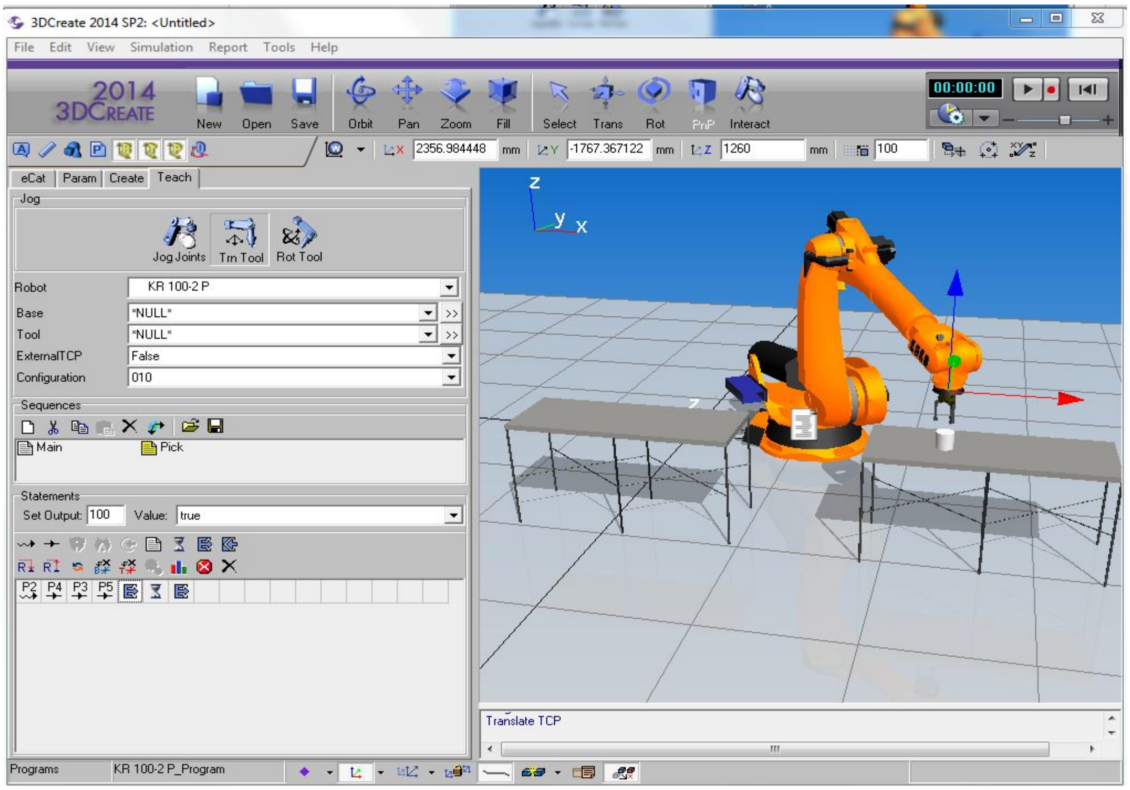


Figure 64 Gripper open and close

After this another position P6 which will be the home position for robot is added after P2 and taken at the last as in Figure 65. It will repeat the program sequence.

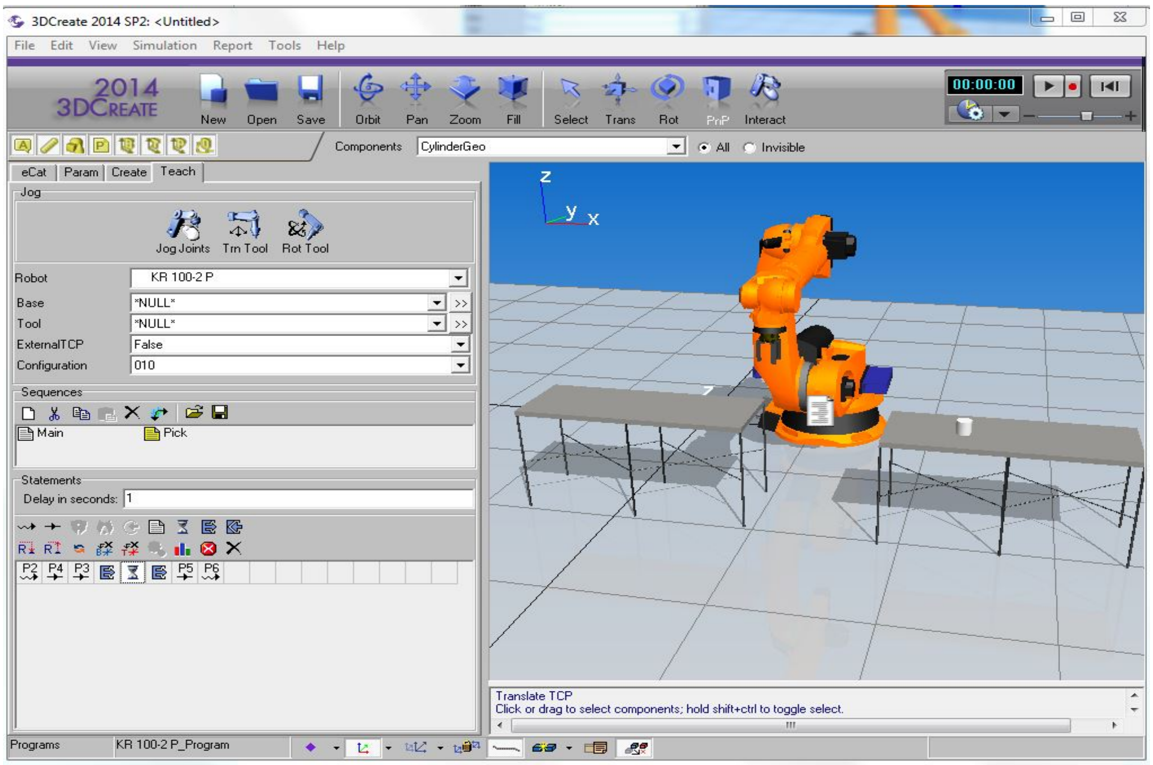


Figure 65 P6 movement

Until now the robot started from the point P2 and then it goes to the position P4 and then P3 followed by grabbing the work piece and closing the gripper and then it goes to the position P5 followed by the home position P6. So, in this figure at home position P6 the robot still has the work piece.

Now we again make a new sequence for the placing the work piece as shown in Figure 66.

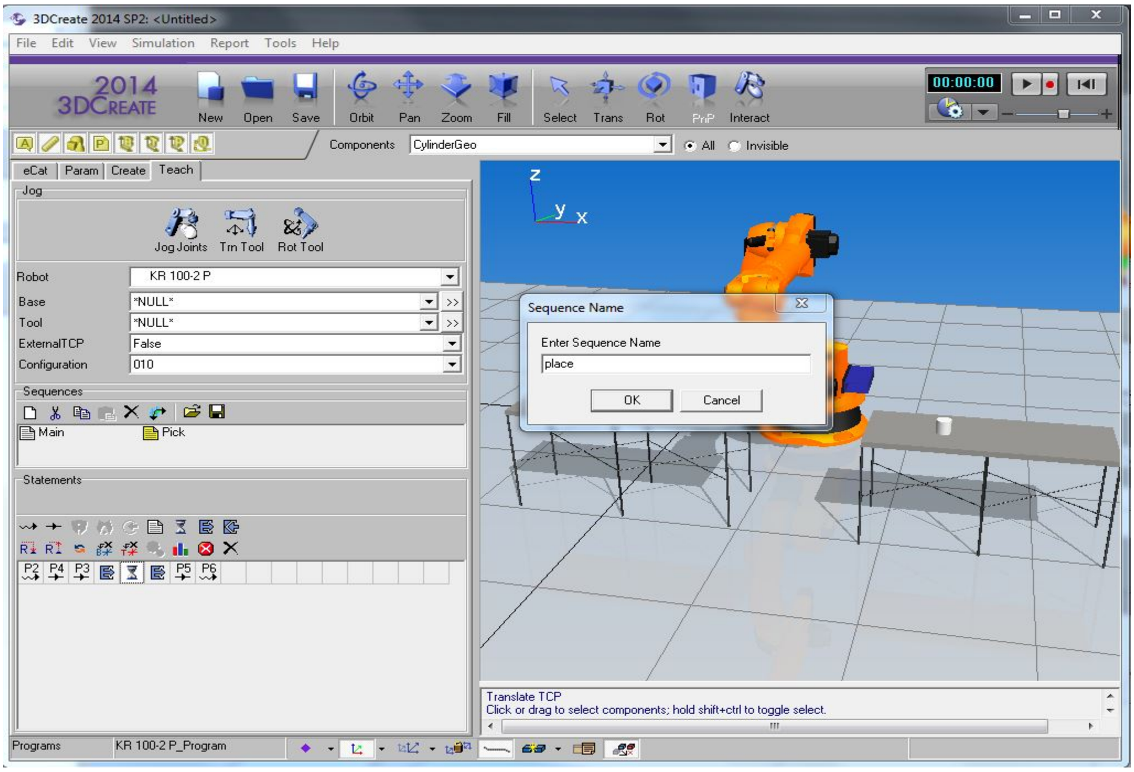


Figure 66 Program Sequence for Place

Likewise, in pickup we assume the first movement of the robot to be P7 as demonstrated in Figure 67. After this we go to the P4 of pick up and then activate the translate tool and then drag the tool centre point up to the next table. By doing this it will not change the position of tool centre point in other direction than x. It will move horizontally in the x direction.

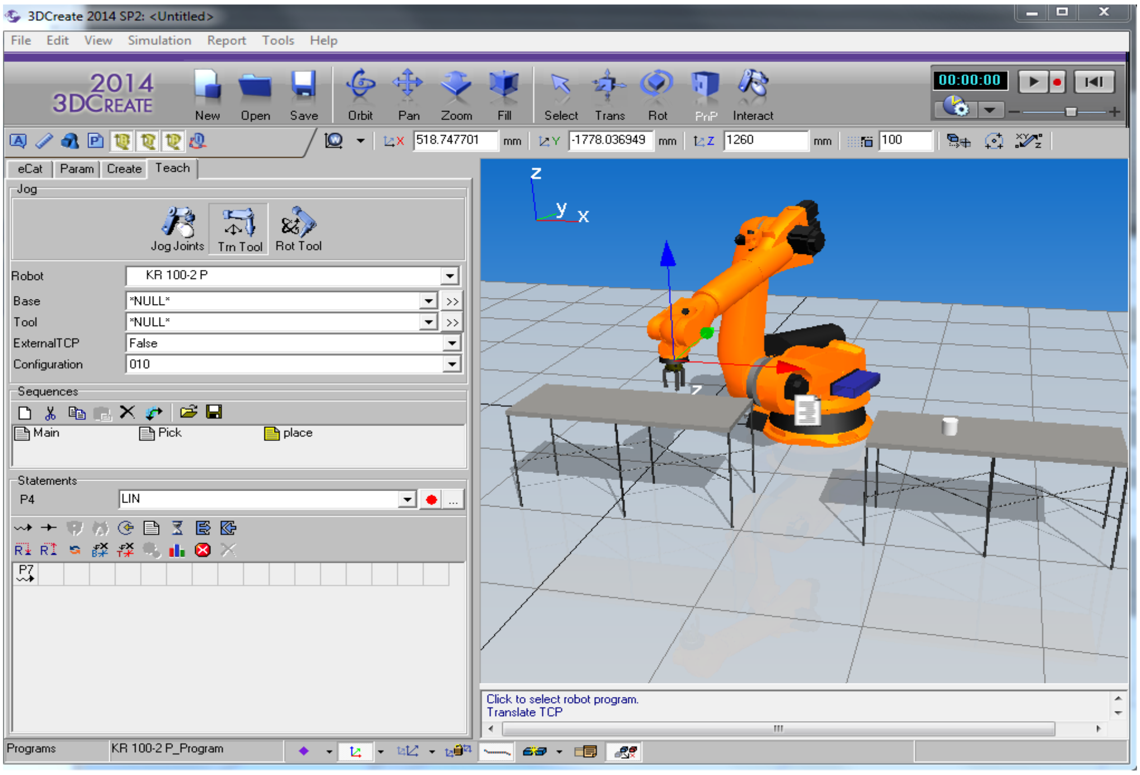


Figure 67 P7 Movement

We then added another linear movement in negative z axis. Earlier in pick up we assumed the distance from P3 to P4 to be 200mm. So, we go 200 mm in negative z axis to place the work piece on the table as shown in Figure 68.

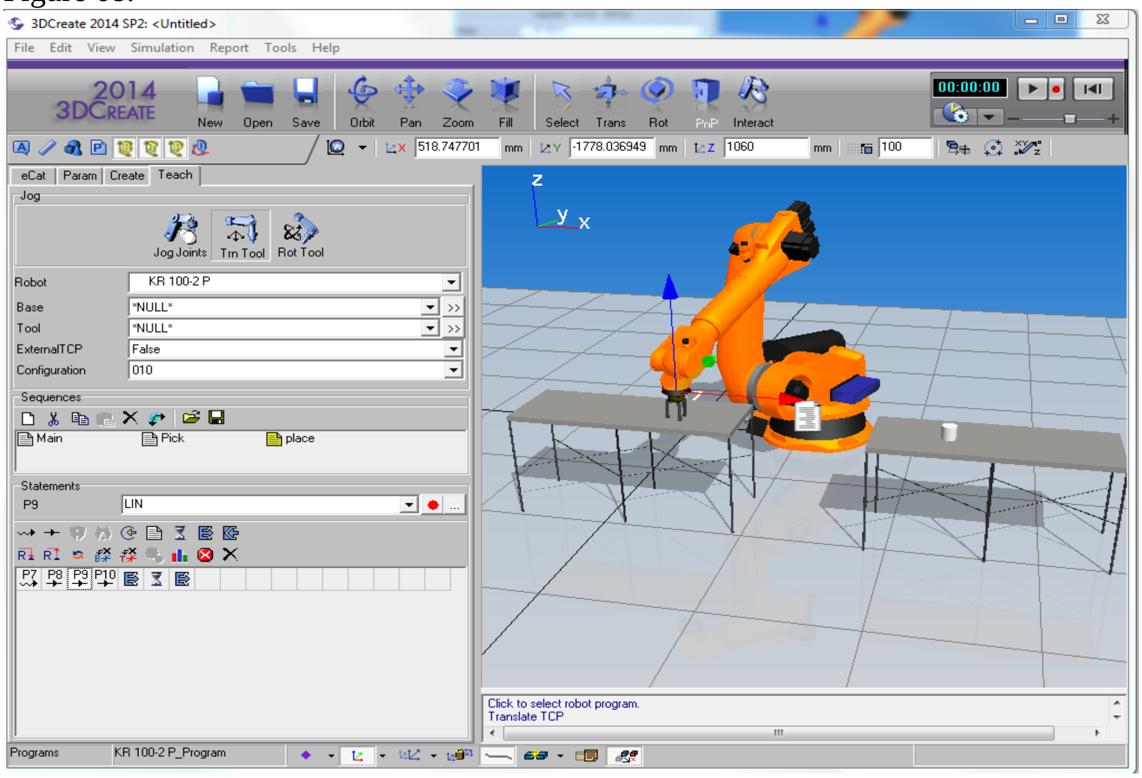


Figure 68 Placing the workpiece

After placing the working piece on the table by P8 we again move 200 mm in the positive z axis by using linear movement (P9) to be in the same position of P7. We also add another linear movement P10 at the same point to repeat the process. P11 is added after P7 and it is moved all the way to last as illustrated in Figure 69, this will bring the robot to the home position and the process will repeat.

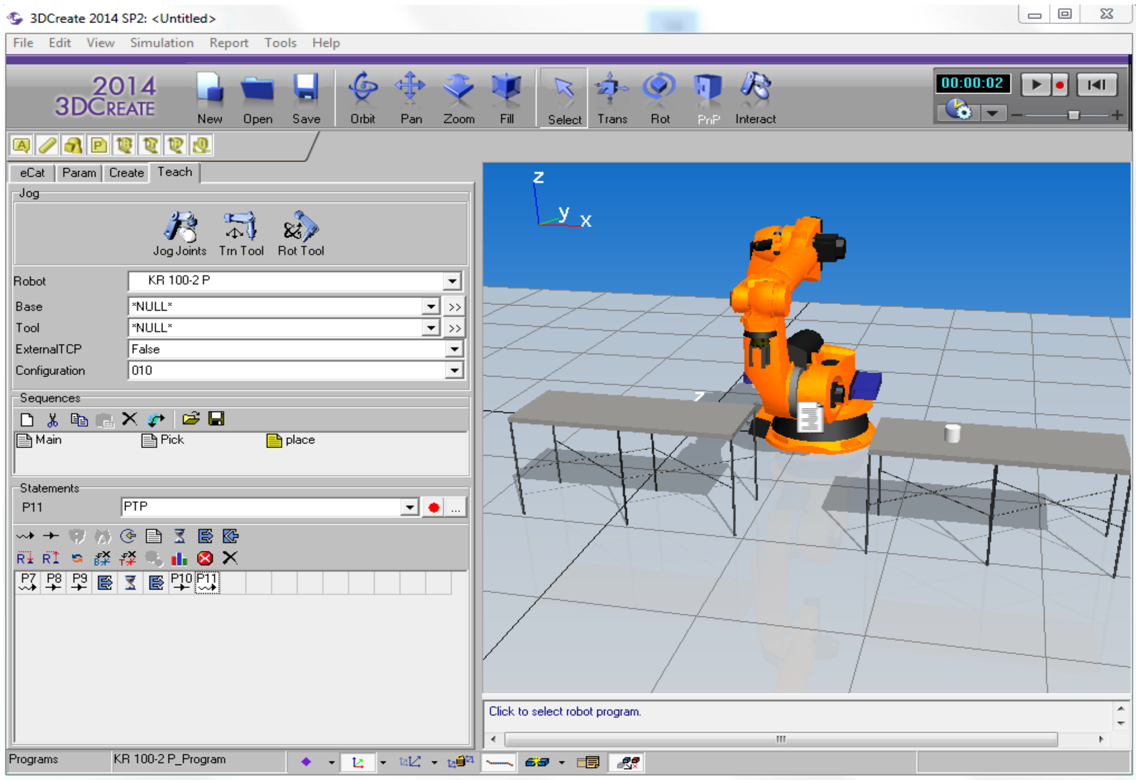


Figure 69 P11 movement

For the gripper to open we set binary output to be 100 and if it has work piece in it, it will open the gripper. We set the time delay of 1 seconds. This is also explained from the figure 47 and 48.

Now the place program is also ready to be called from the main program. So, we again go to call a sub routine option and choose a place.
For this program we are also going to design wall and door. So, we go to the eCat and search hall wall and hall door. We can change the length and height of wall and door as per our need. The front view of the final work area after putting wall and door looks like the Figure 70.

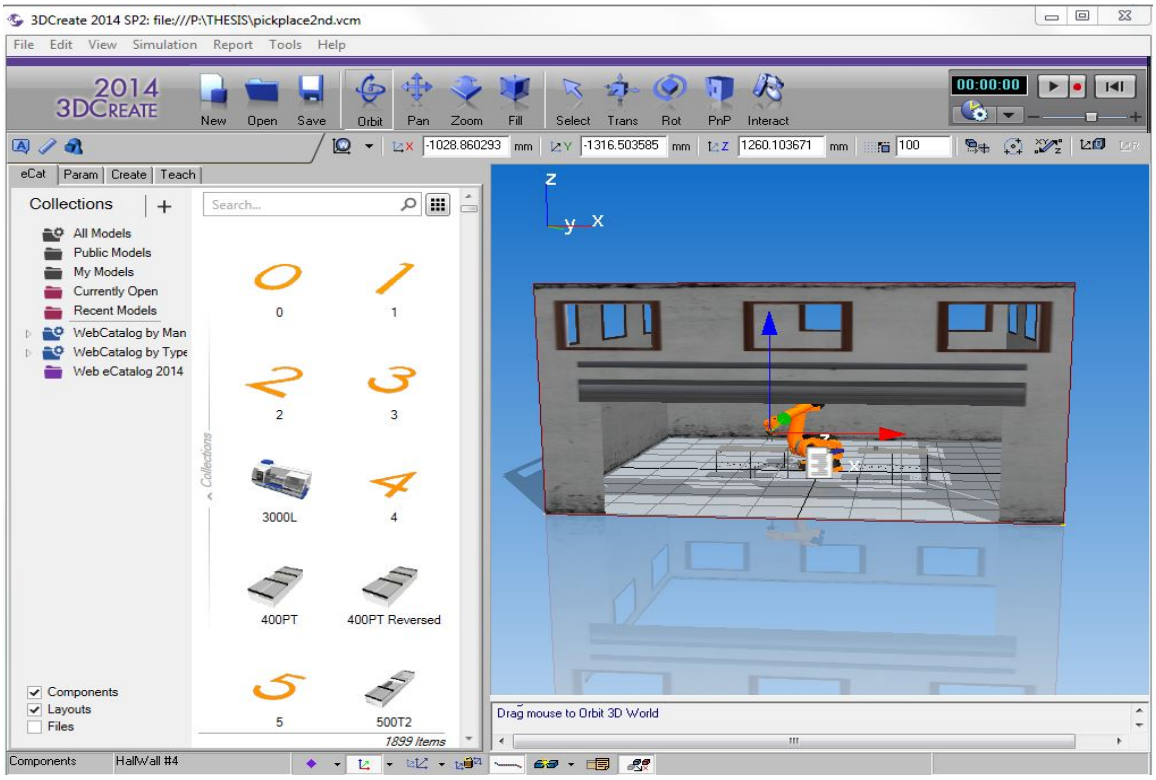


Figure 70 Front view of final model

The top view looks like the Figure 71.

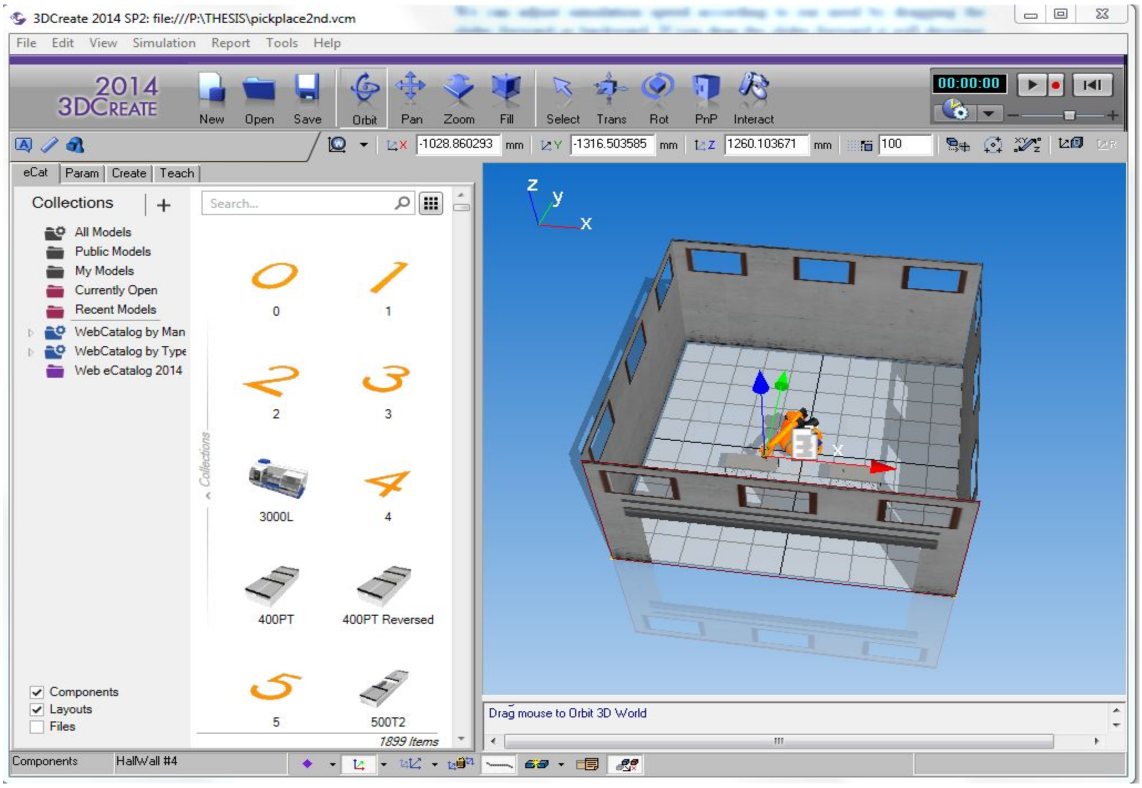


Figure 71 top view of final model

Our pick up and place program is ready to simulate and we can simulate by clicking on the play button from the simulation control menu. We can stop any time during the simulation and replay the simulation again from the same point.

We can adjust simulation speed according to our need by dragging the slider forward or backward. If you drag the slider forward it will decrease the simulation speed and if you drag the slider backward than it will increase the speed.

6 EXTRACTING DATA

6.1 Exporting image

We can export our images from 3D world to the external files by doing the following ways:

i) Click on view and from the drop down menu click on setting where we can select the background colour as we want for the image as shown in Figure 72.

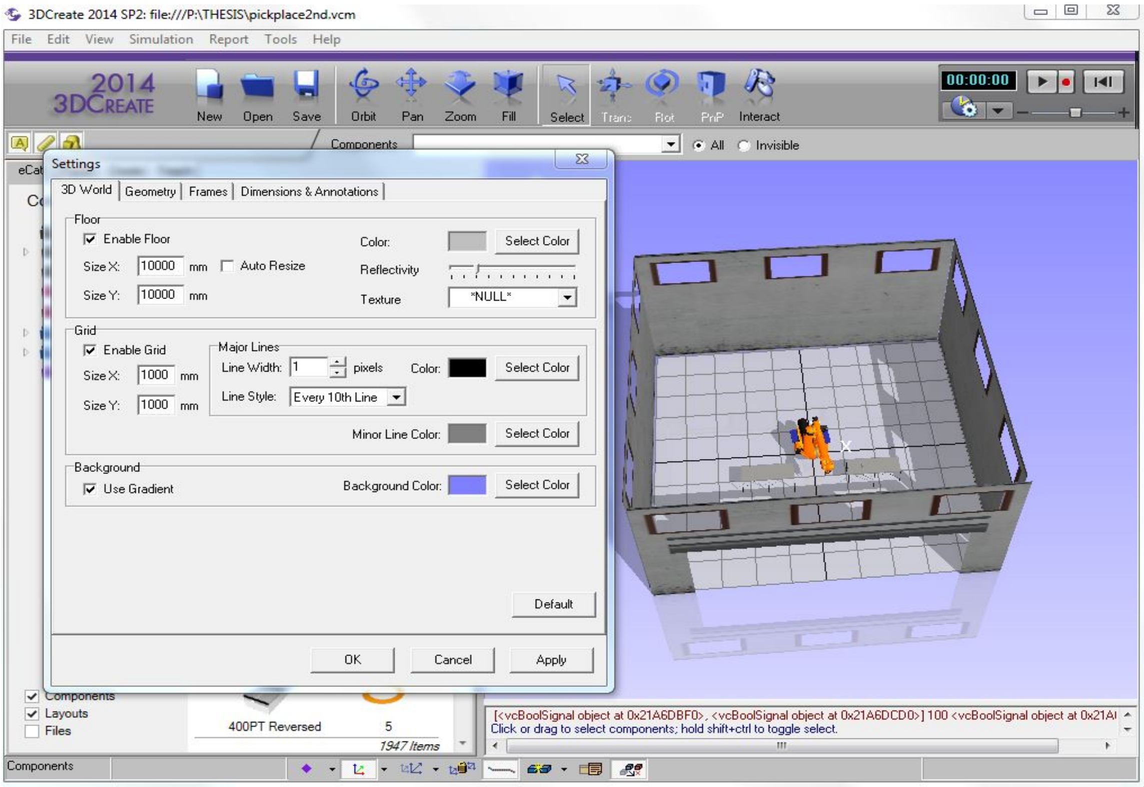


Figure 72 Adjusting background colour

ii) Click on view and rotate light from the drop down menu to change the light setting as illustrated in Figure 73.

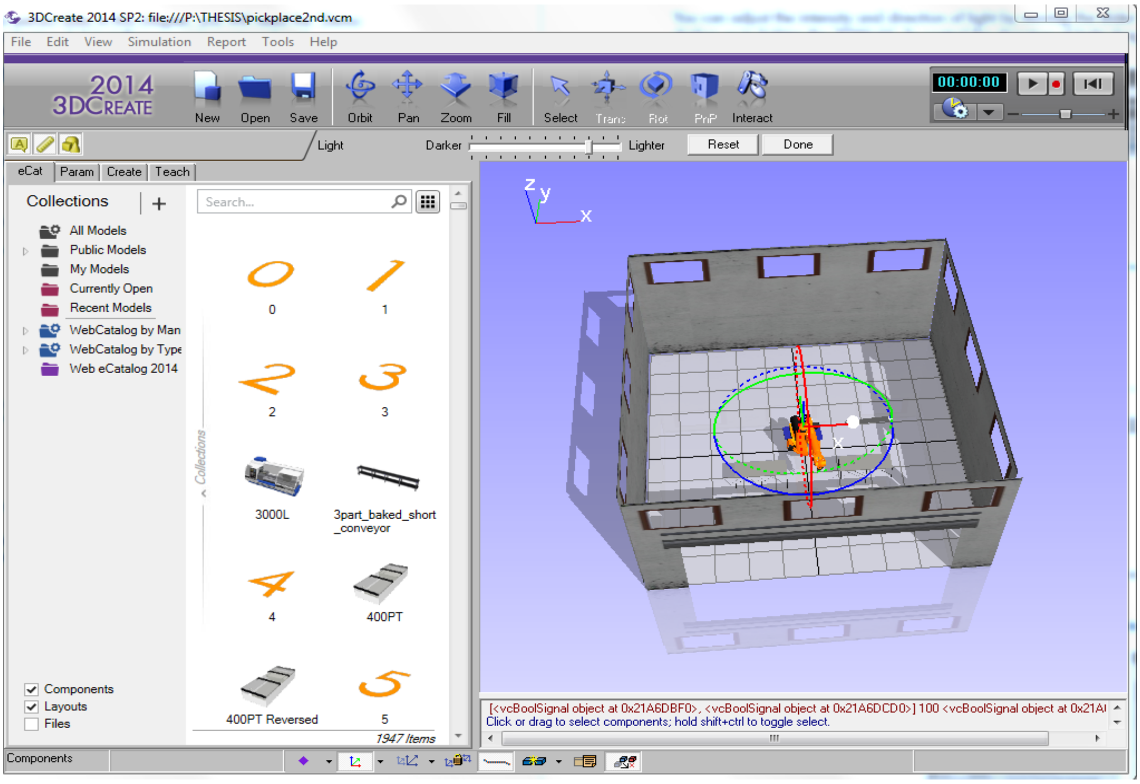


Figure 73 Adjusting Light

We can adjust the light intensity and the direction on light by rotating the blue and green circles. Moreover, we can always go back to the original setting by clicking on reset button.

iii) Select the desired view point for the image.

We can nevigate the 3D world until we find the desired view point for the image. The selected viewpoint will be exported as the image later.

iv) Click on file and then export from the drop down menu and click screen bitmap as shown in Figure 74.

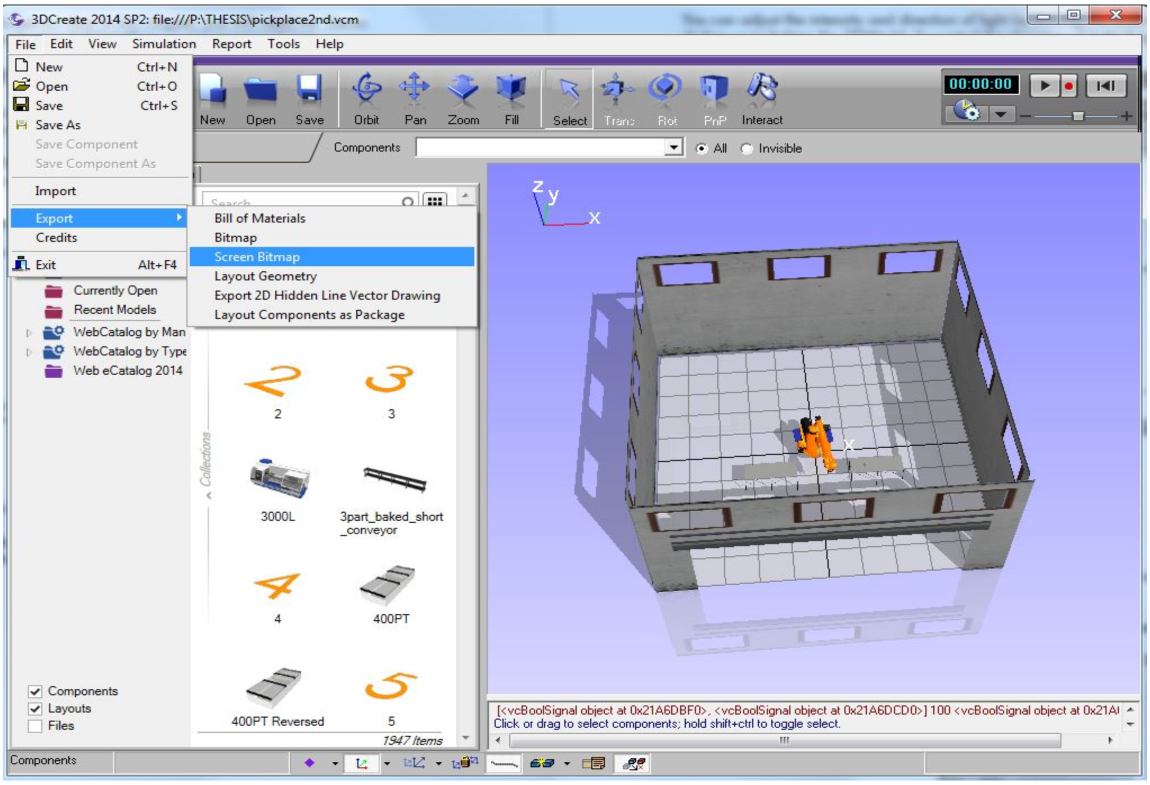


Figure 74 Screen Bitmap

v) Click on file and then export and bitmap from there to change the screen resolution as in Figure 75.

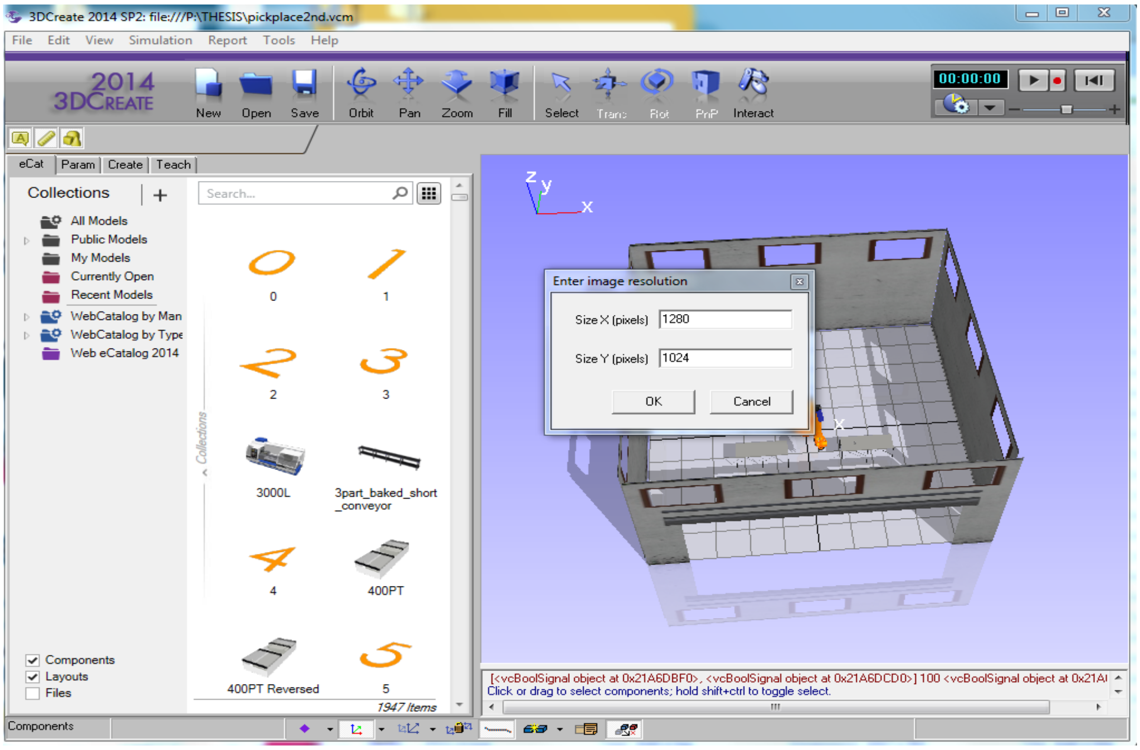


Figure 75 Screen Resolution

vi) Click OK to save the final image.

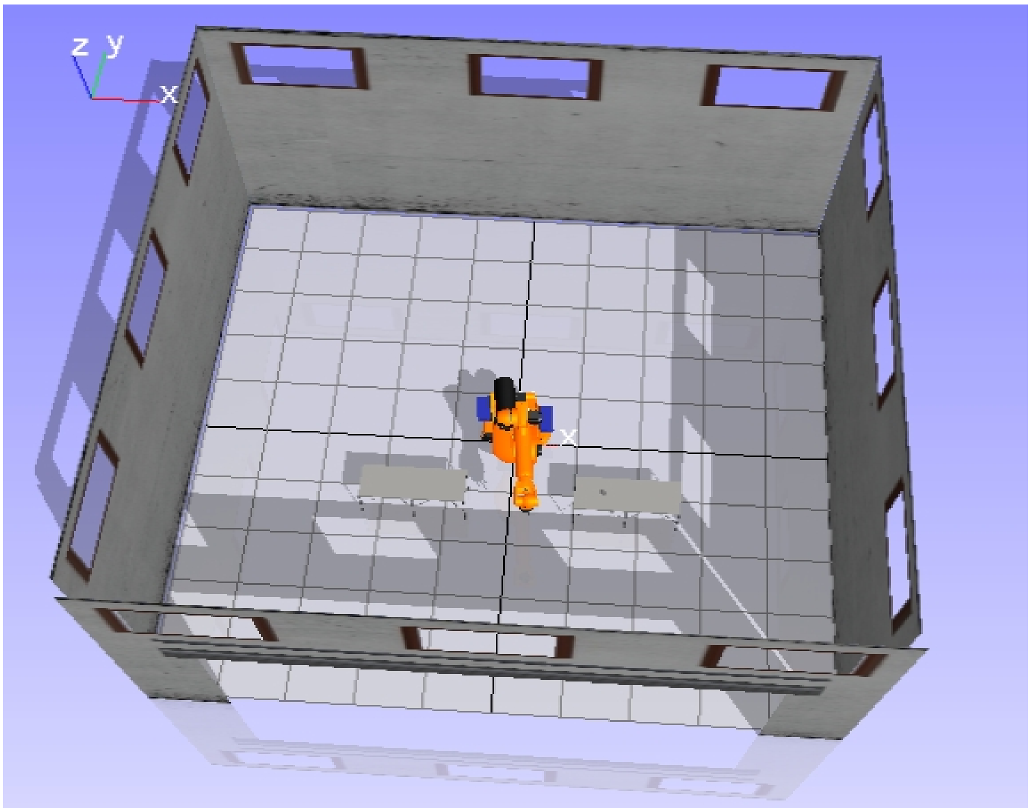


Figure 76 Final Image

The final image will look something similar to the Figure 76.

6.2 Exporting geometry

We can export entire geometry from the 3D world to the external files. We can later change the dimensions and edit as per our need.

To export the geometry, we do the following ways

i) Click on file, export and then layout geometry.
ii) Select the desired location and file format as in Figure 77.

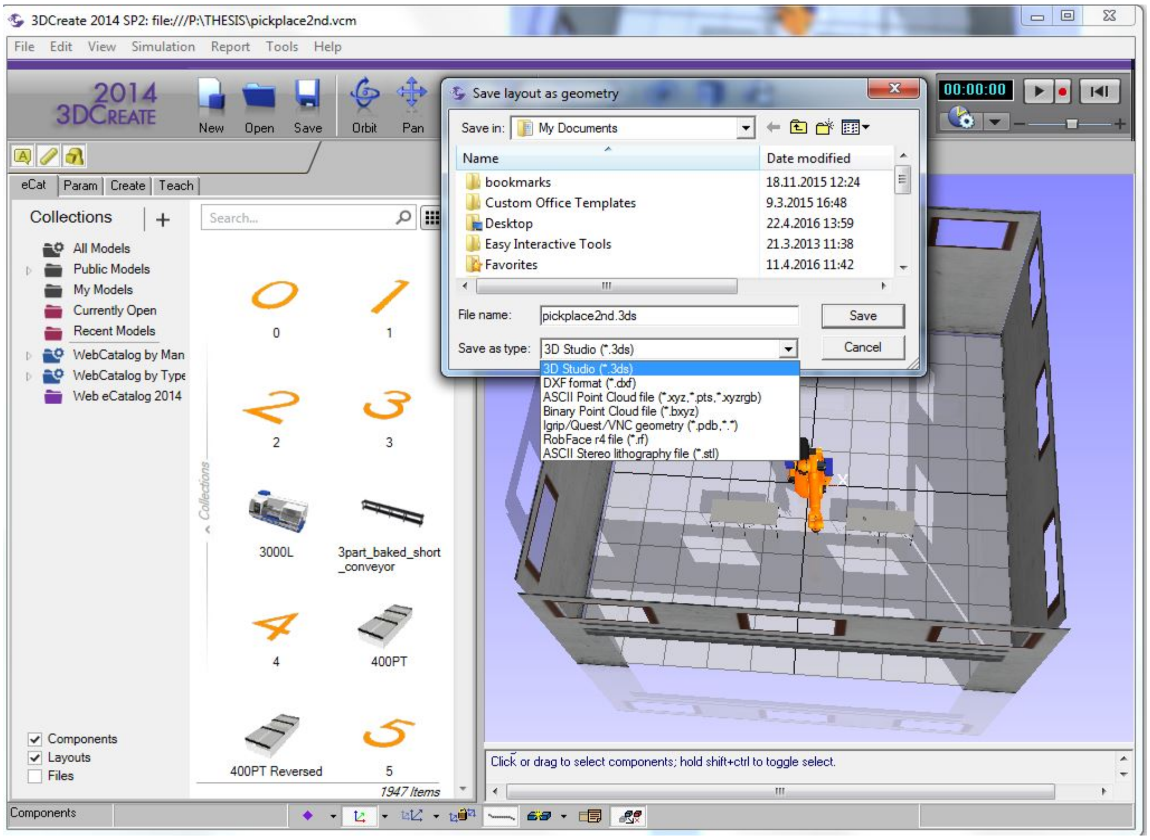


Figure 77 Exporting Geometry

7 CONCLUSION

The 3D Create is very helpful and effective for the simulation of various robot handling processes such as welding, painting, cutting, palletizing. It is very useful for designing a complete layout of the office, factory, company and various kinds of work stations. Companies can save a lot of time by using 3D Create, compared to what they did before.

3D Create is suitable for companies which have a history of designing production lines in CAD because it will let them reuse their old CAD files as the foundation for the simulation of production line.

As 3D Create has a wide range of applications it is very difficult and time consuming to include tutorials of all these into this thesis work. This thesis offers a very useful and easy way to learn about 3D create for the beginners. In order to expand the knowledge on 3D Create it is best to visit the Visual Component company to study the manual of 3D Create at the help center and to practice using various kinds of applications.

As for education institute like HAMK, it would be better to include simulation software like 3D Create in some courses because it would let student know about simulation advantages and its uses in real world. Today everything is simulated before performing in the real working environment So, anyone with the knowledge about the simulation can be an asset.

Overall, this thesis work was a good method for learning the 3D Create software. It gave the author knowledge about robots, their application; equipment for robots and the 3D Create software itself. The aim of this thesis work was accomplished, as the main idea of the thesis work was to create a handbook for the 3D Create. The tutorials and the background information about the 3D Create can be used by any user to boost their knowledge with 3D Create.

SOURCES

Anon, (2004). *3D simulation software*. [online] Available at: http://download.visualcomponents.net/elib/3.1/eCat/EquipmentLibrary/6%20Support/Quickstart/Quickstart.pdf [Accessed 29 Apr. 2016].

Bélanger, S. (2015). *How to Control a Robotiq Gripper*. [online] Blog.robotiq.com. Available at: http://blog.robotiq.com/how-to-control-a-robotiq-gripper [Accessed 13 Mar. 2016].

YouTube. (2015). *Basic tutorial - visual components*. [online] Available at: https://www.youtube.com/watch?v=rmAaY7DSpHc [Accessed 5 Mar. 2016].

3D Create 2014 SP2. User Manual and Reference Guide.