LAB REPORT

ON

“INDUSTRIAL ROBOTICS LAB”

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1. Lab Test 1

1.1 Tasks needed to be performed: -

a) The initial task of the experiment is to get familiarized with robot movement in different coordinate systems.

b) The teaching of the tool uses a 4-point method, whereas the teaching of the base uses a 3-point method.

c) Creation & Testing of robot program to move the robot tool tip along the edges of the workpiece.

d) Testing & changing the coordinate after shifting the Workpiece.

1.2 Learning targets: -

a) Familiarizing with the Kuka Control Panel (KCP).

b) Learning about the safety precautions while operating the robot in different coordinate systems.

c) Calibration of Tool & Base Coordinate System.

d) Learning to program in Kuka Programming Language.

1.3 Steps that led to the solution: -

a) Initially, random movements of the robot were executed to familiarize different coordinate systems (E. g. Base, Tool, Axis & World Coordinate Systems) using the KCP.

b) The teaching of Tool Centre Point (TCP): -

   i. Using the 4-point method, a reference point (TCP) was taught to the robot. This method was selected from the menu and the following interface appeared showing the tool no. and name as shown in Figure No. 01.

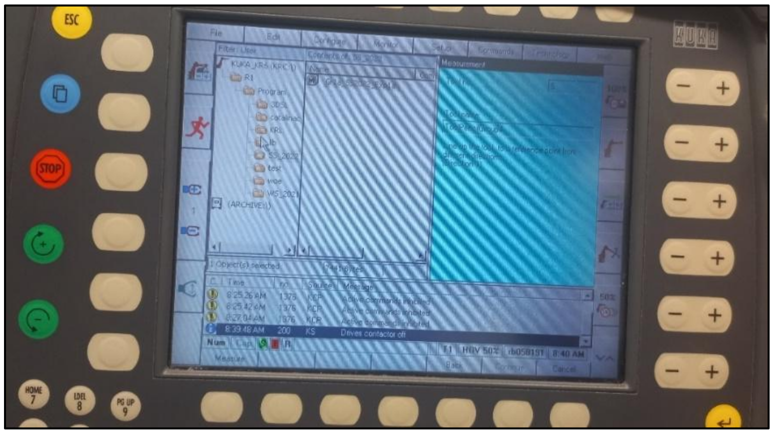


Figure No. 01: Interface of controller showing Tool No. and Name.

ii. The tool was already mounted on the flange of the robot, but the coordinate system was set concerning the flange position.

iii. Teaching was done to change the coordinate system from flange to the tool position. A pointed rod with a square base was placed on the table and its tip was selected as the reference point.

iv. The reference point was approached by the robot with four different orientations, refer to Figure No. 02. The position of TCP was measured by the robot as x= -0.337 mm, y= 2.522 mm, and z=260.84 mm. The measurement error was 0.775, refer to Figure No. 03.

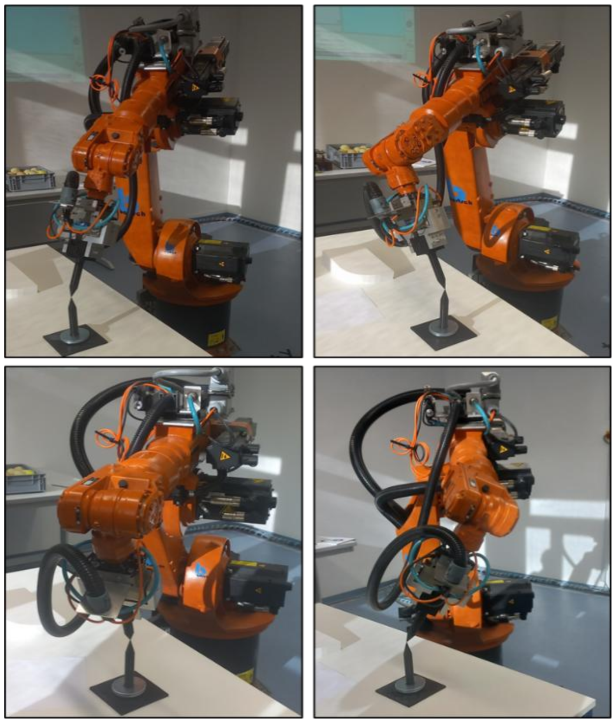
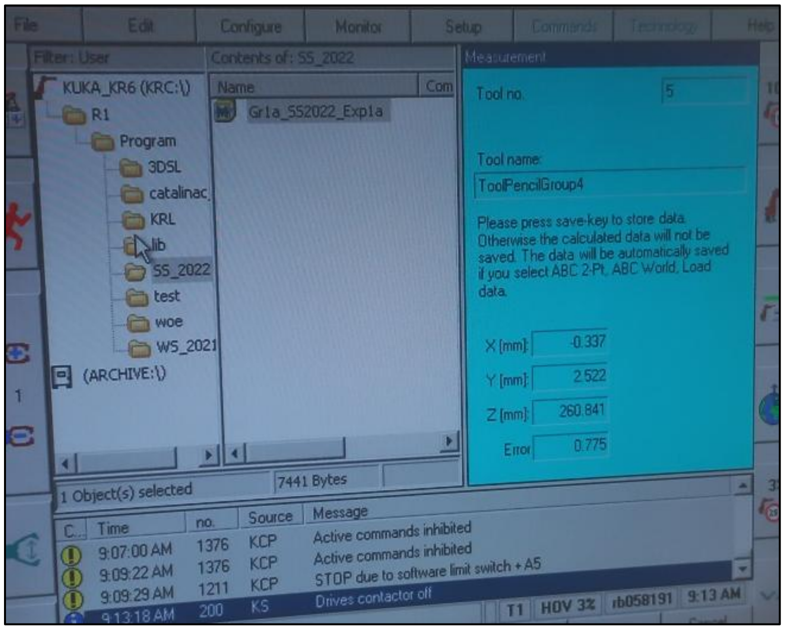


Figure No. 02: Positioning tool at the reference point with different alignments.



Tool no. 5

Tool name: ToolPencilGroup4

Please press save-key to store data. Otherwise the calculated data will not be saved. The data will be automatically saved if you select ABC 2-Pt, ABC World, Load data.

X [mm]:	-0.337
Y [mm]:	2.522
Z [mm]:	260.841
Error	0.775

1 Object(s) selected | 7441 Bytes

C...	Time	no.	Source	Message
!	9:07:00 AM	1376	KCP	Active commands inhibited
!	9:09:22 AM	1376	KCP	Active commands inhibited
!	9:09:29 AM	1211	KCP	STOP due to software limit switch + A5
	9:13:18 AM	200	KS	Drives contactor off

T1 | HOV 3% | rb058191 | 9:13 AM

Figure No. 03: Final tool data after teaching.

c) Teaching of Base: -

i. The origin of the workpiece was set as shown in Figure No. 04. The X-axis was chosen in the direction of the small edge, the Y-axis in the direction of the large edge, and Z-axis perpendicular to the upper plane of the workpiece.

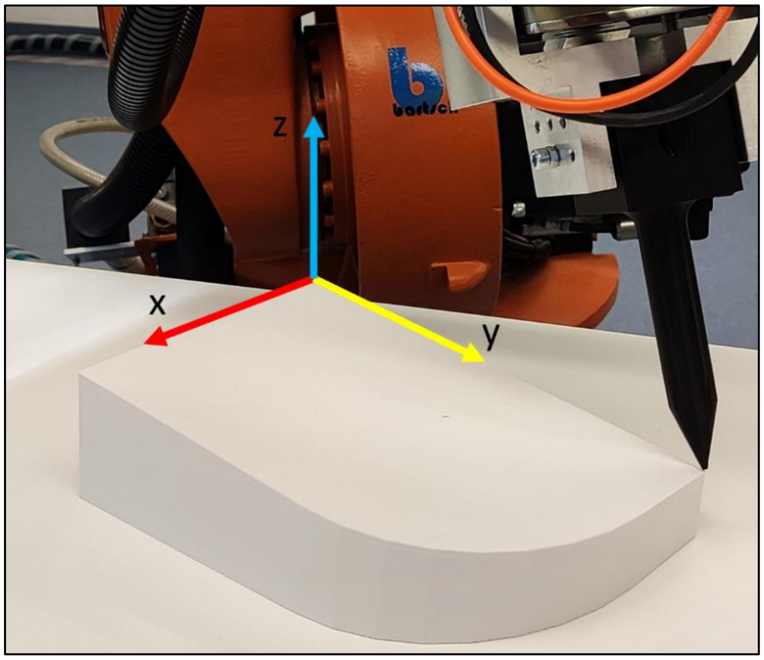
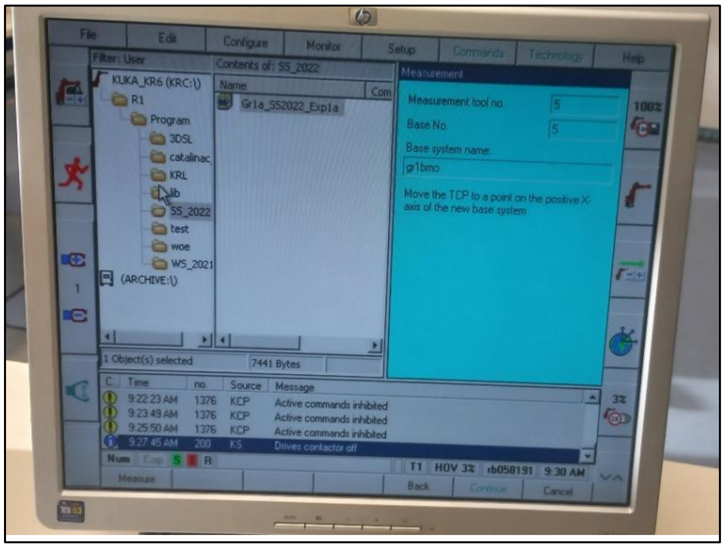


Figure No. 04: Co-ordinate system of Workpiece.

ii. To teach the position and orientation of the workpiece 3-point method was selected and a window appeared to select the tool and base number and also the base system name. Tool no. 5 and base no. 5 were selected as shown in Figure No. 05.



Measurement

Measurement tool no. 5

Base No. 5

Base system name: gr1bmo

Move the TCP to a point on the positive X-axis of the new base system

Gr1a_SS2022_Expla

1 Object(s) selected 7441 Bytes

C	Time	no.	Source	Message
!	9:22:23 AM	1376	KCP	Active commands inhibited
!	9:23:49 AM	1376	KCP	Active commands inhibited
!	9:25:50 AM	1376	KCP	Active commands inhibited
i	9:27:45 AM	200	KS	Drives contactor off

Num Cap S I R T1 HOV 3% rb058191 9:30 AM 100% 3%

Figure No. 05: Window showing the Base No., Base Name and Tool No.

iii. The TCP point was first moved to the origin and then the position was measured. Then TCP was moved to the farthest point of the workpiece representing an arbitrary point on the positive x axis and the position was measured, the farthest point was selected to improve the accuracy of the measurement. Finally, the TCP was moved to the farthest point on the XY plane, and this position was measured as shown in Figure No. 06 & the results of the teaching were as shown in Figure No. 07.

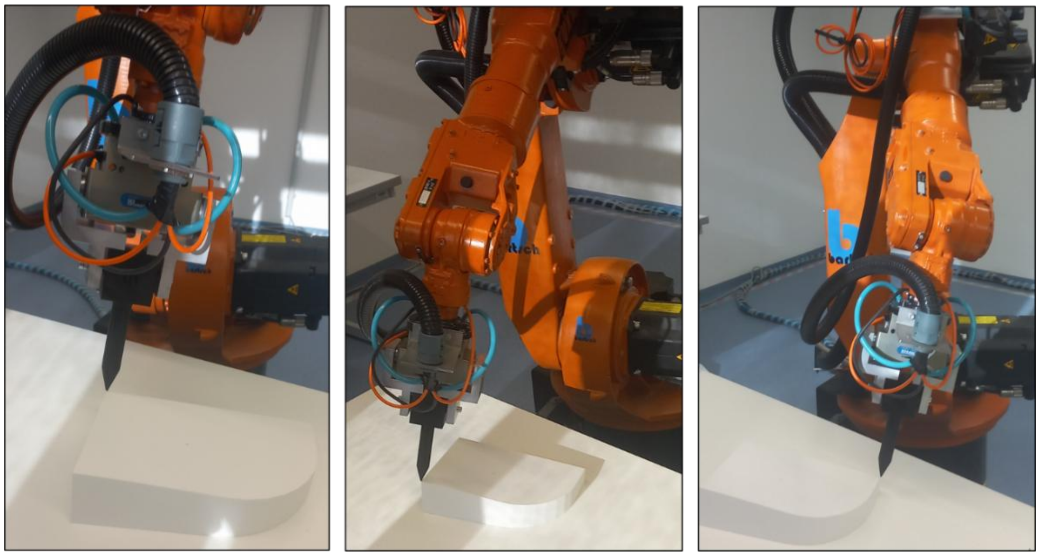
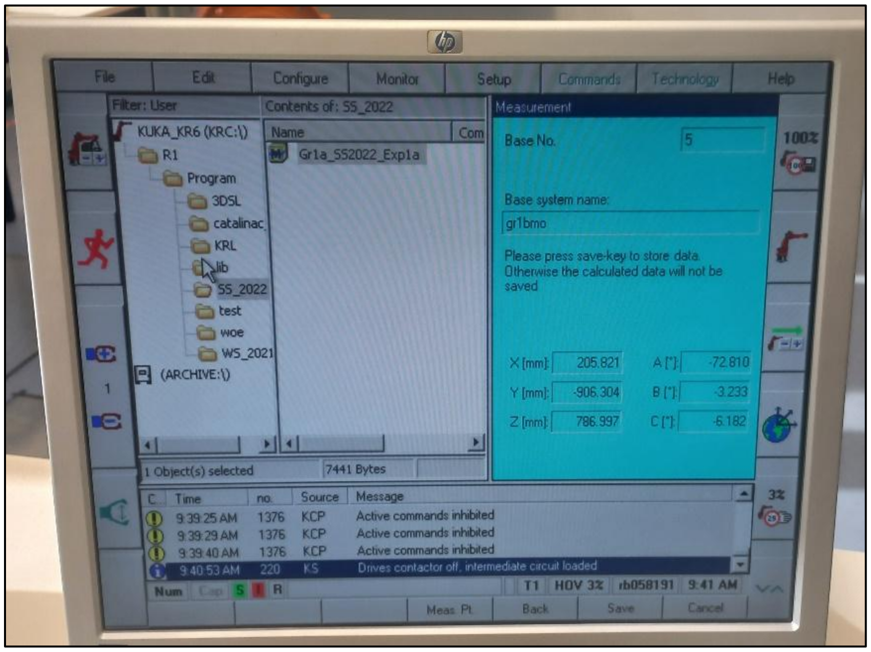


Figure No. 06: Teaching base with three-point method.



Measurement

Base No. 5

Base system name: gr1bmo

Please press save-key to store data. Otherwise the calculated data will not be saved

X [mm]: 205.821 A [°]: -72.810
Y [mm]: -906.304 B [°]: -3.233
Z [mm]: 786.997 C [°]: -6.182

```
C  Time         no.   Source  Message
   9:39:25 AM   1376  KCP     Active commands inhibited
   9:39:29 AM   1376  KCP     Active commands inhibited
   9:39:40 AM   1376  KCP     Active commands inhibited
   9:40:53 AM   220   KS      Drives contactor off, intermediate circuit loaded
```

Figure No. 07: Results of teaching the base.

d) Creation of a Robot Program: -

The objective of the program was to move the robot tool tip along the edges of the workpiece. Multiple points were defined to move the robot in order to achieve the goal. The points that were used in the program are shown in Figure No. 08.

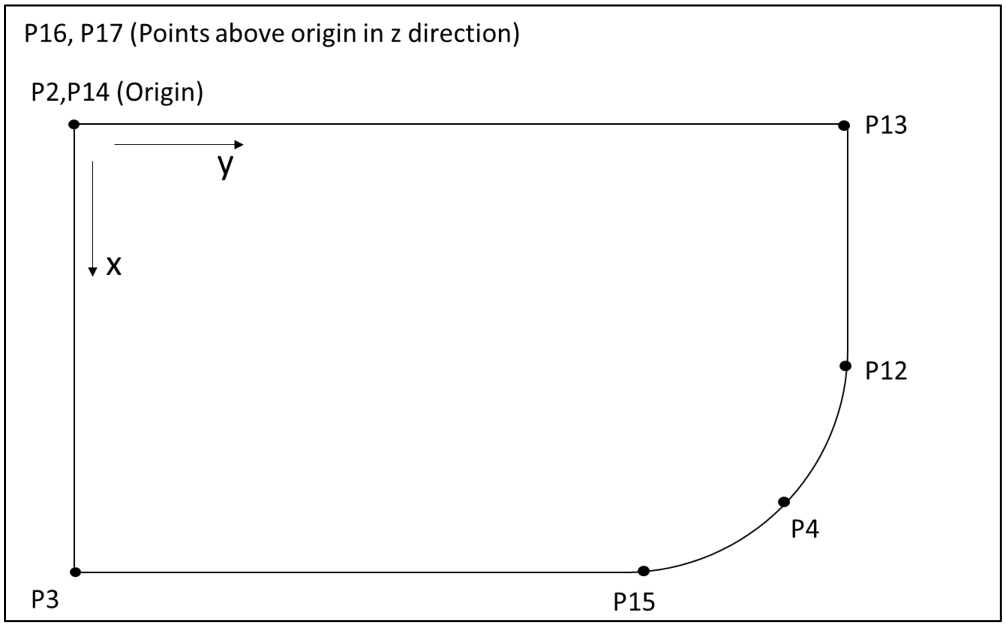


Figure No. 08: Movement of robot tool tip along given points.

Flowchart of the program tracing above shown path (Figure no. 08): -

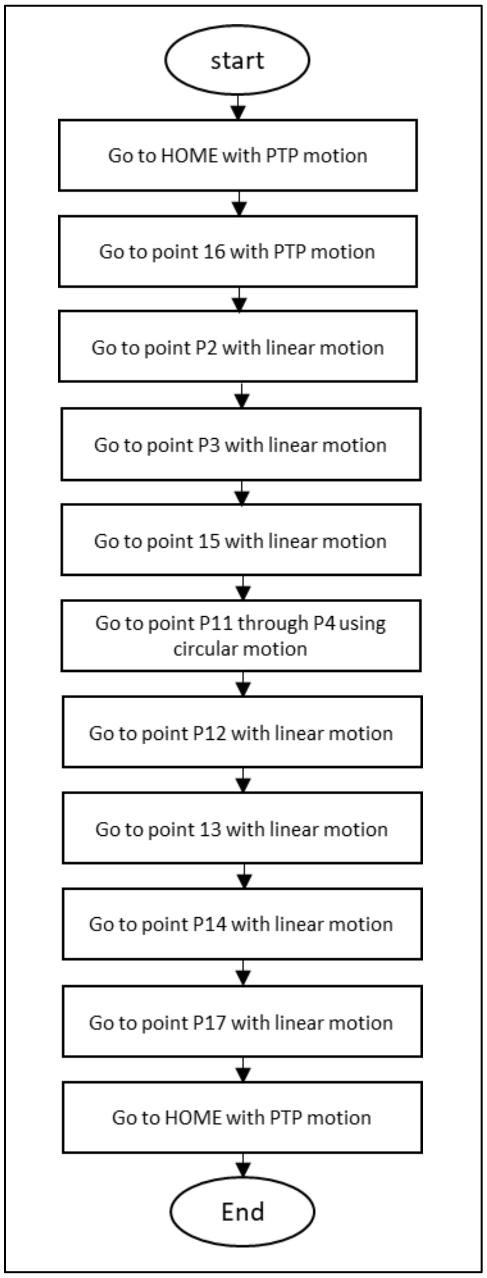
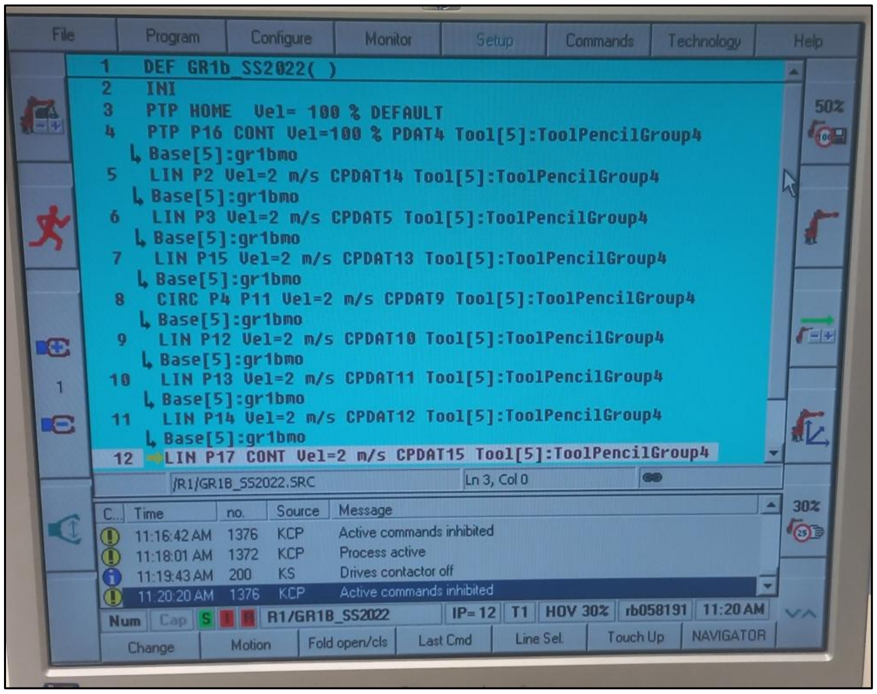

start
Go to HOME with PTP motion
Go to point 16 with PTP motion
Go to point P2 with linear motion
Go to point P3 with linear motion
Go to point 15 with linear motion
Go to point P11 through P4 using circular motion
Go to point P12 with linear motion
Go to point 13 with linear motion
Go to point P14 with linear motion
Go to point P17 with linear motion
Go to HOME with PTP motion
End

Figure No. 09: Flowchart of program to move robot tool along workpiece edge.



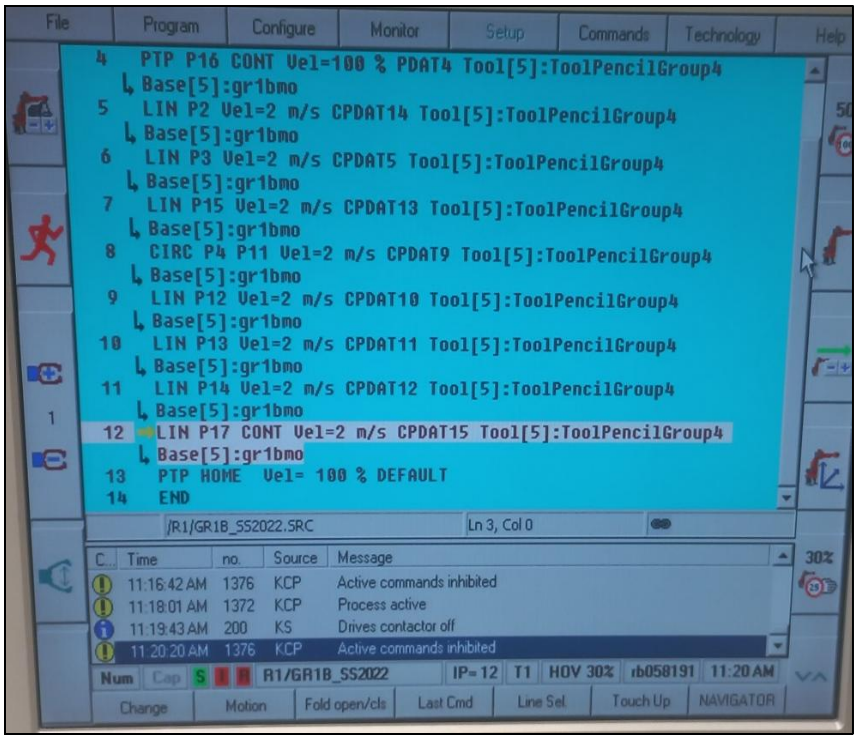
```
DEF GR1b_SS2022( )
  INI
  PTP HOME  Vel= 100 % DEFAULT
  PTP P16 CONT Vel=100 % PDAT4 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P2 Vel=2 m/s CPDAT14 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P3 Vel=2 m/s CPDAT5 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P15 Vel=2 m/s CPDAT13 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  CIRC P4 P11 Vel=2 m/s CPDAT9 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P12 Vel=2 m/s CPDAT10 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P13 Vel=2 m/s CPDAT11 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P14 Vel=2 m/s CPDAT12 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P17 CONT Vel=2 m/s CPDAT15 Tool[5]:ToolPencilGroup4
```

```
/R1/GR1B_SS2022.SRC                    Ln 3, Col 0

C...  Time         no.   Source  Message
      11:16:42 AM  1376  KCP     Active commands inhibited
      11:18:01 AM  1372  KCP     Process active
      11:19:43 AM  200   KS      Drives contactor off
      11:20:20 AM  1376  KCP     Active commands inhibited

R1/GR1B_SS2022   IP=12   T1   HOV 30%   rb058191   11:20 AM
```

Figure No. 10.1: Program to move robot tool along workpiece edge.



```
  PTP P16 CONT Vel=100 % PDAT4 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P2 Vel=2 m/s CPDAT14 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P3 Vel=2 m/s CPDAT5 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P15 Vel=2 m/s CPDAT13 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  CIRC P4 P11 Vel=2 m/s CPDAT9 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P12 Vel=2 m/s CPDAT10 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P13 Vel=2 m/s CPDAT11 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P14 Vel=2 m/s CPDAT12 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  LIN P17 CONT Vel=2 m/s CPDAT15 Tool[5]:ToolPencilGroup4
  ↳ Base[5]:gr1bmo
  PTP HOME  Vel= 100 % DEFAULT
  END
```

```
/R1/GR1B_SS2022.SRC                    Ln 3, Col 0

C...  Time         no.   Source  Message
      11:16:42 AM  1376  KCP     Active commands inhibited
      11:18:01 AM  1372  KCP     Process active
      11:19:43 AM  200   KS      Drives contactor off
      11:20:20 AM  1376  KCP     Active commands inhibited

R1/GR1B_SS2022   IP=12   T1   HOV 30%   rb058191   11:20 AM
```

Figure No. 10.2: Program to move robot tool along workpiece edge.

a) Reteaching the Base with the new orientation of workpiece: -

After implementing and testing the program the orientation of the workpiece was changed as shown in Figure No. 11.

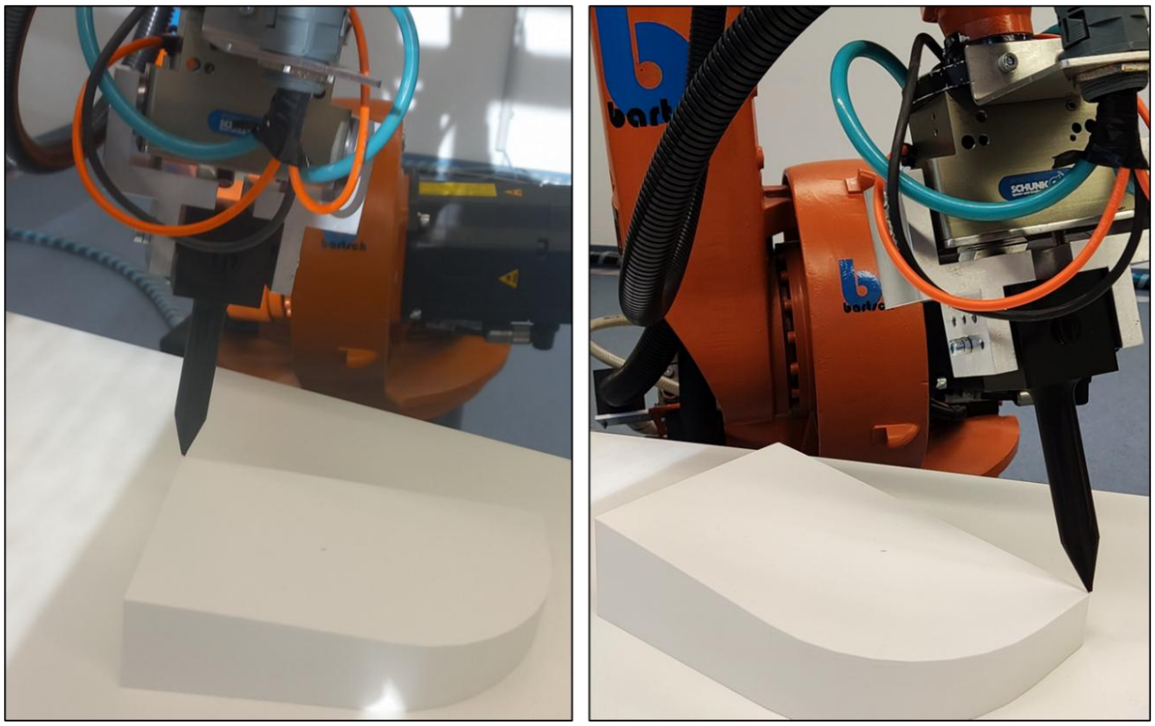
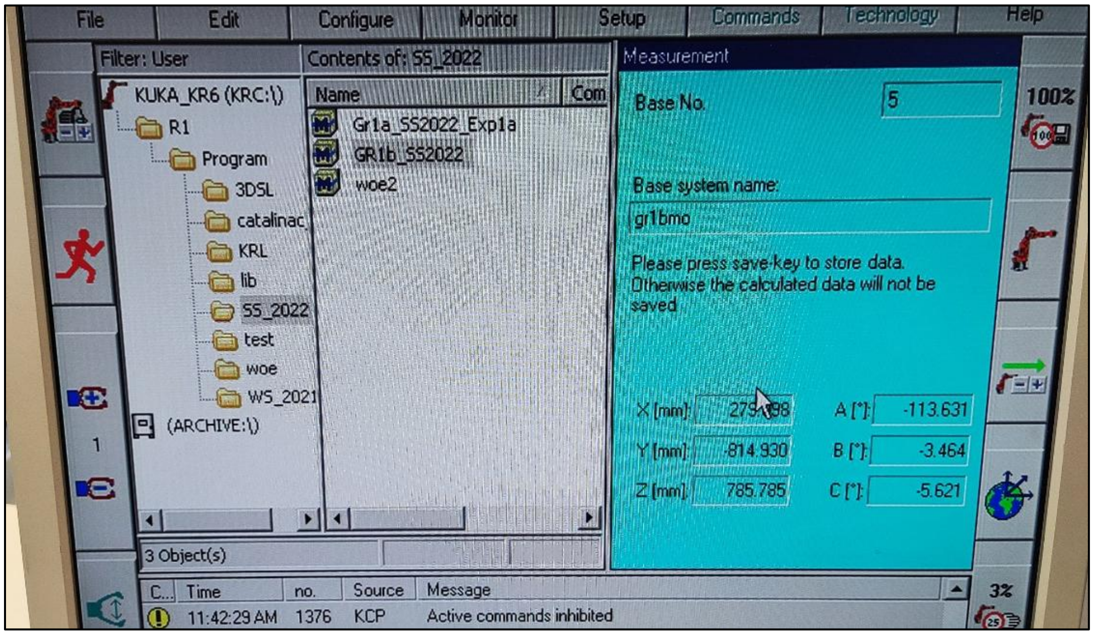


Figure No. 11: Change in orientation of the workpiece.

The Base was retaught, and the program was run and tested again for the new orientation. The results as shown in Figure No. 12.



Measurement

Base No: 5

Base system name: gr1bmo

Please press save-key to store data.
Otherwise the calculated data will not be saved

X [mm]:	279.[illegible]98	A [°]:	-113.631
Y [mm]:	-814.930	B [°]:	-3.464
Z [mm]:	785.785	C [°]:	-5.621

C...	Time	no.	Source	Message
	11:42:29 AM	1376	KCP	Active commands inhibited

Figure No. 12: Results of teaching the base.

1.4 Problem Faced and their Solution: -

a) Inappropriate assigning of points: -

Each point was created before moving the robot to the next position, but the above window stores the new point in place of the previous point Hence there was a lagging of 1 point while assigning a new point. This was realized while testing the program. This problem was solved by deleting the point P1 which was set to a HOME position and also adding a new point at the end of the program.

b) No addition of Intermediate points: -

The intermediate points which were between the Base (Object) & Home position of the Robot were not defined which resulted in close PTP movement of Tool near the Base position coming from the home position. This was solved by defining the points P16 and P17 above the robot.

1.5 Lessons Learned: -

a) Learned to control KUKA robot & Hands on experience with KUKA programming.

b) Learned about the safety precautions which need to be considered while working on site.

2. Lab Test 2

2.1 Tasks needed to be performed: -

a) The initial task of the expt. is to draw a virtual rectangle with the "Kuka.Sim" software.

b) With the help of thorn draw the rectangle & then the Santa Claus House on the white paper.

c) For completing the task different commands (WHILE, WAIT, IF) along with Gripper Close & Trace On functions & various digital inputs were used to draw the figures.

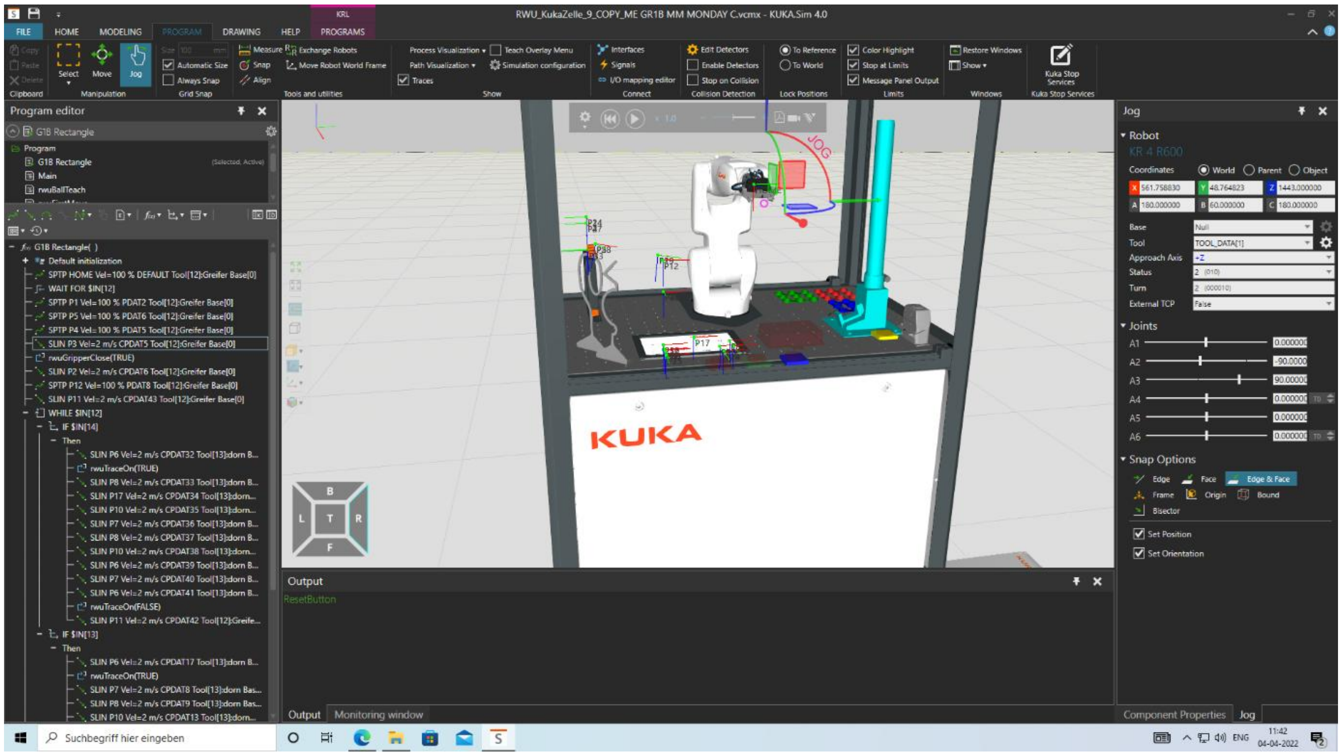
2.2 Learning targets: -

a) Familiarizing with KUKA.Sim simulation software.

b) Learning & Creating KRL (Kuka Robotic Language) program with branch statements.

2.3 Steps that led to the solution: -

a) Initially the new program was created in KUKA.Sim.



```
G1B Rectangle( )
  Default initialization
  SPTP HOME Vel=100 % DEFAULT Tool[12]:Greifer Base[0]
  WAIT FOR $IN[12]
  SPTP P1 Vel=100 % PDAT2 Tool[12]:Greifer Base[0]
  SPTP P5 Vel=100 % PDAT6 Tool[12]:Greifer Base[0]
  SPTP P4 Vel=100 % PDAT5 Tool[12]:Greifer Base[0]
  SLIN P3 Vel=2 m/s CPDAT5 Tool[12]:Greifer Base[0]
  rwuGripperClose(TRUE)
  SLIN P2 Vel=2 m/s CPDAT6 Tool[12]:Greifer Base[0]
  SPTP P12 Vel=100 % PDAT8 Tool[12]:Greifer Base[0]
  SLIN P11 Vel=2 m/s CPDAT43 Tool[12]:Greifer Base[0]
  WHILE $IN[12]
    IF $IN[14]
      Then
        SLIN P6 Vel=2 m/s CPDAT32 Tool[13]:dorn B...
        rwuTraceOn(TRUE)
        SLIN P8 Vel=2 m/s CPDAT33 Tool[13]:dorn B...
        SLIN P17 Vel=2 m/s CPDAT34 Tool[13]:dorn...
        SLIN P10 Vel=2 m/s CPDAT35 Tool[13]:dorn...
        SLIN P7 Vel=2 m/s CPDAT36 Tool[13]:dorn B...
        SLIN P8 Vel=2 m/s CPDAT37 Tool[13]:dorn B...
        SLIN P10 Vel=2 m/s CPDAT38 Tool[13]:dorn...
        SLIN P6 Vel=2 m/s CPDAT39 Tool[13]:dorn B...
        SLIN P7 Vel=2 m/s CPDAT40 Tool[13]:dorn B...
        SLIN P6 Vel=2 m/s CPDAT41 Tool[13]:dorn B...
        rwuTraceOn(FALSE)
        SLIN P11 Vel=2 m/s CPDAT42 Tool[12]:Greife...
    IF $IN[13]
      Then
        SLIN P6 Vel=2 m/s CPDAT17 Tool[13]:dorn B...
        rwuTraceOn(TRUE)
        SLIN P7 Vel=2 m/s CPDAT8 Tool[13]:dorn Bas...
        SLIN P8 Vel=2 m/s CPDAT9 Tool[13]:dorn Bas...
        SLIN P10 Vel=2 m/s CPDAT13 Tool[13]:dorn...
```

Figure No. 13: Simulation Setup in Kuka.Sim.

b) The robot was moved from the HOME position to the position above thorn using PTP movements with intermediate points.
c) The robot was programmed to grab the thorn using “rwuGripperClose ()” function once it reached over the thorn through LIN movement.
d) Then the tool was changed to “dom” and moved above the white sheet. The Z Coordinate was then adjusted until it traced the figure in the Run mode of simulation.
e) The four points of rectangle were defined using X, Y Coordinates with help of a rough sketch.

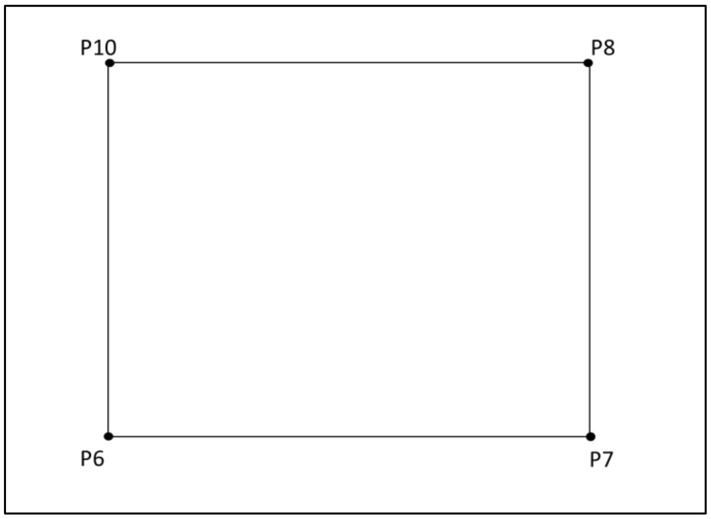


Figure No. 14: Points of rectangle being traced in program.

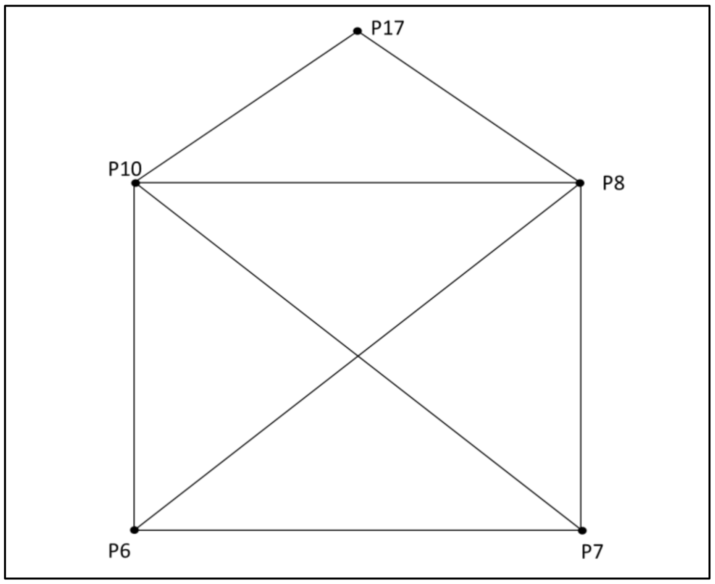
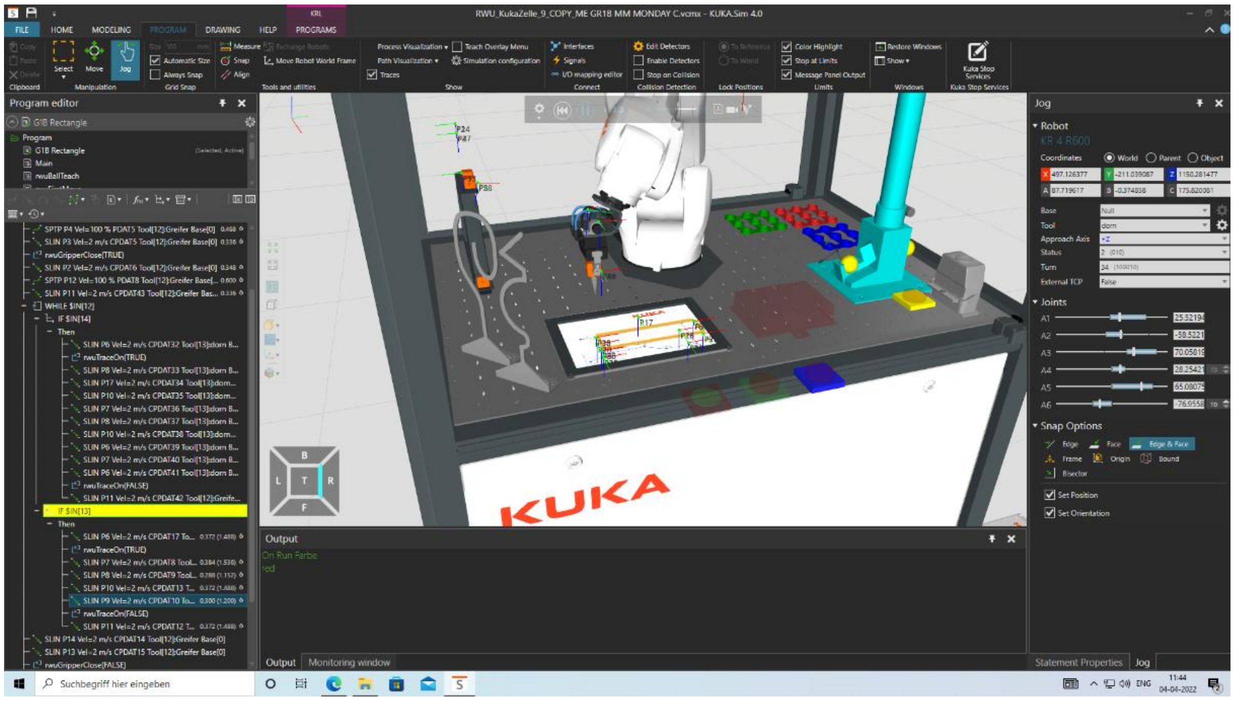


Figure No. 15: Points of Santa Claus being traced in program.

f) With the known data points the robot was moved in LIN movement. Once the rectangle was drawn a new point was added to draw the Santa Claus House.

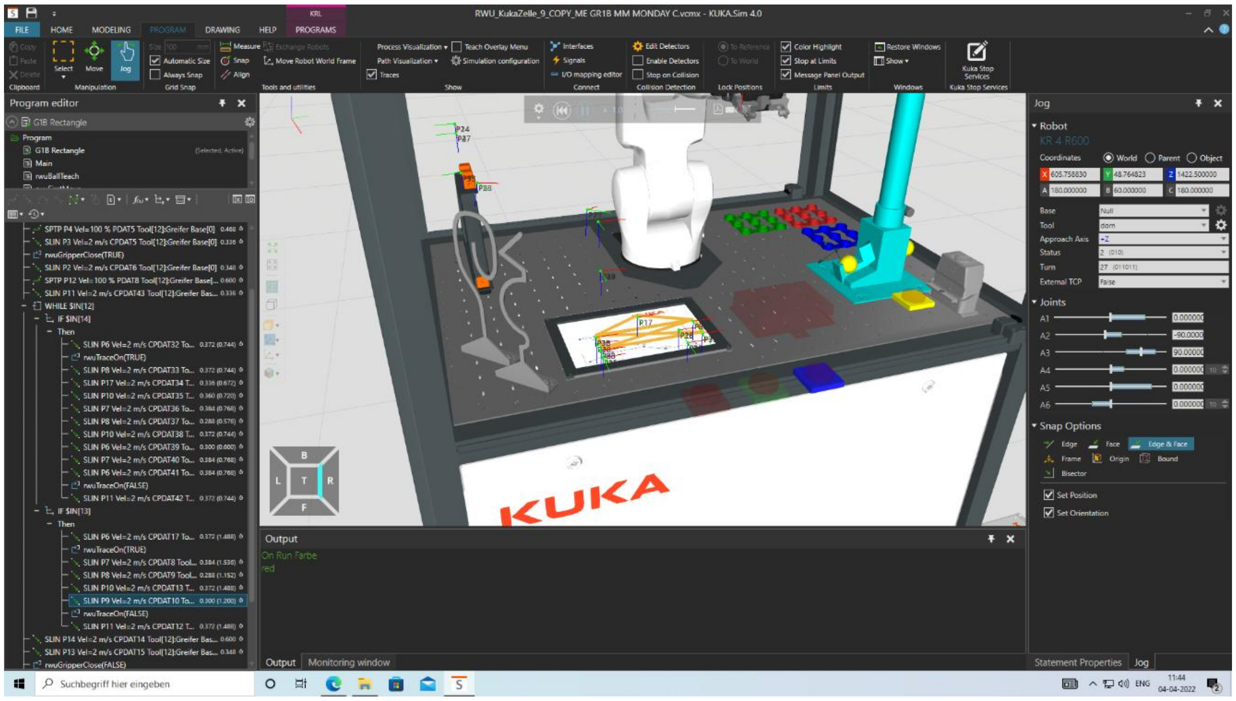


```
Program
  G1B Rectangle        (Selected, Active)
  Main
  rwuBallTeach

SPTP P4 Vel=100 % PDAT5 Tool[12]:Greifer Base[0]   0.468
SLIN P3 Vel=2 m/s CPDAT5 Tool[12]:Greifer Base[0]   0.336
rwuGripperClose(TRUE)
SLIN P2 Vel=2 m/s CPDAT6 Tool[12]:Greifer Base[0]   0.348
SPTP P12 Vel=100 % PDAT8 Tool[12]:Greifer Base[...   0.600
SLIN P11 Vel=2 m/s CPDAT43 Tool[12]:Greifer Bas...   0.336
WHILE $IN[12]
  IF $IN[14]
    Then
      SLIN P6 Vel=2 m/s CPDAT32 Tool[13]:dorn B...
      rwuTraceOn(TRUE)
      SLIN P8 Vel=2 m/s CPDAT33 Tool[13]:dorn B...
      SLIN P17 Vel=2 m/s CPDAT34 Tool[13]:dorn...
      SLIN P10 Vel=2 m/s CPDAT35 Tool[13]:dorn...
      SLIN P7 Vel=2 m/s CPDAT36 Tool[13]:dorn B...
      SLIN P8 Vel=2 m/s CPDAT37 Tool[13]:dorn B...
      SLIN P10 Vel=2 m/s CPDAT38 Tool[13]:dorn...
      SLIN P6 Vel=2 m/s CPDAT39 Tool[13]:dorn B...
      SLIN P7 Vel=2 m/s CPDAT40 Tool[13]:dorn B...
      SLIN P6 Vel=2 m/s CPDAT41 Tool[13]:dorn B...
      rwuTraceOn(FALSE)
      SLIN P11 Vel=2 m/s CPDAT42 Tool[12]:Greife...
  IF $IN[13]
    Then
      SLIN P6 Vel=2 m/s CPDAT17 To...   0.372 (1.488)
      rwuTraceOn(TRUE)
      SLIN P7 Vel=2 m/s CPDAT8 Tool...   0.384 (1.536)
      SLIN P8 Vel=2 m/s CPDAT9 Tool...   0.288 (1.152)
      SLIN P10 Vel=2 m/s CPDAT13 T...   0.372 (1.488)
      SLIN P9 Vel=2 m/s CPDAT10 To...   0.300 (1.200)
      rwuTraceOn(FALSE)
      SLIN P11 Vel=2 m/s CPDAT12 T...   0.372 (1.488)
SLIN P14 Vel=2 m/s CPDAT14 Tool[12]:Greifer Base[0]
SLIN P13 Vel=2 m/s CPDAT15 Tool[12]:Greifer Base[0]
rwuGripperClose(FALSE)
```

```
Output
On Run Farbe
red
```

Figure No. 16: Rectangle drawn on white sheet.



```
Program
  G1B Rectangle        (Selected, Active)
  Main
  rwuBallTeach

SPTP P4 Vel=100 % PDAT5 Tool[12]:Greifer Base[0]   0.468
SLIN P3 Vel=2 m/s CPDAT5 Tool[12]:Greifer Base[0]   0.336
rwuGripperClose(TRUE)
SLIN P2 Vel=2 m/s CPDAT6 Tool[12]:Greifer Base[0]   0.348
SPTP P12 Vel=100 % PDAT8 Tool[12]:Greifer Base[...   0.600
SLIN P11 Vel=2 m/s CPDAT43 Tool[12]:Greifer Bas...   0.336
WHILE $IN[12]
  IF $IN[14]
    Then
      SLIN P6 Vel=2 m/s CPDAT32 To...   0.372 (0.744)
      rwuTraceOn(TRUE)
      SLIN P8 Vel=2 m/s CPDAT33 To...   0.372 (0.744)
      SLIN P17 Vel=2 m/s CPDAT34 T...   0.336 (0.672)
      SLIN P10 Vel=2 m/s CPDAT35 T...   0.360 (0.720)
      SLIN P7 Vel=2 m/s CPDAT36 To...   0.384 (0.768)
      SLIN P8 Vel=2 m/s CPDAT37 To...   0.288 (0.576)
      SLIN P10 Vel=2 m/s CPDAT38 T...   0.372 (0.744)
      SLIN P6 Vel=2 m/s CPDAT39 To...   0.300 (0.600)
      SLIN P7 Vel=2 m/s CPDAT40 To...   0.384 (0.768)
      SLIN P6 Vel=2 m/s CPDAT41 To...   0.384 (0.768)
      rwuTraceOn(FALSE)
      SLIN P11 Vel=2 m/s CPDAT42 T...   0.372 (0.744)
  IF $IN[13]
    Then
      SLIN P6 Vel=2 m/s CPDAT17 To...   0.372 (1.488)
      rwuTraceOn(TRUE)
      SLIN P7 Vel=2 m/s CPDAT8 Tool...   0.384 (1.536)
      SLIN P8 Vel=2 m/s CPDAT9 Tool...   0.288 (1.152)
      SLIN P10 Vel=2 m/s CPDAT13 T...   0.372 (1.488)
      SLIN P9 Vel=2 m/s CPDAT10 To...   0.300 (1.200)
      rwuTraceOn(FALSE)
      SLIN P11 Vel=2 m/s CPDAT12 T...   0.372 (1.488)
SLIN P14 Vel=2 m/s CPDAT14 Tool[12]:Greifer Bas...   0.600
SLIN P13 Vel=2 m/s CPDAT15 Tool[12]:Greifer Bas...   0.348
rwuGripperClose(FALSE)
```

```
Output
On Run Farbe
red
```

Figure No. 17: Santa Claus drawn on white sheet.

g) The detail use of digital inputs of the buttons are as follows: -

1. Button 12 pressed = Start the program once the user presses the button.
2. Button 12 released = Put the thorn back and stop the program
3. Button 13 pressed = Draw rectangle
4. Button 14 pressed =Draw Santa Claus House

A program was created to move the robot thorn through these points as shown in following flowchart: -

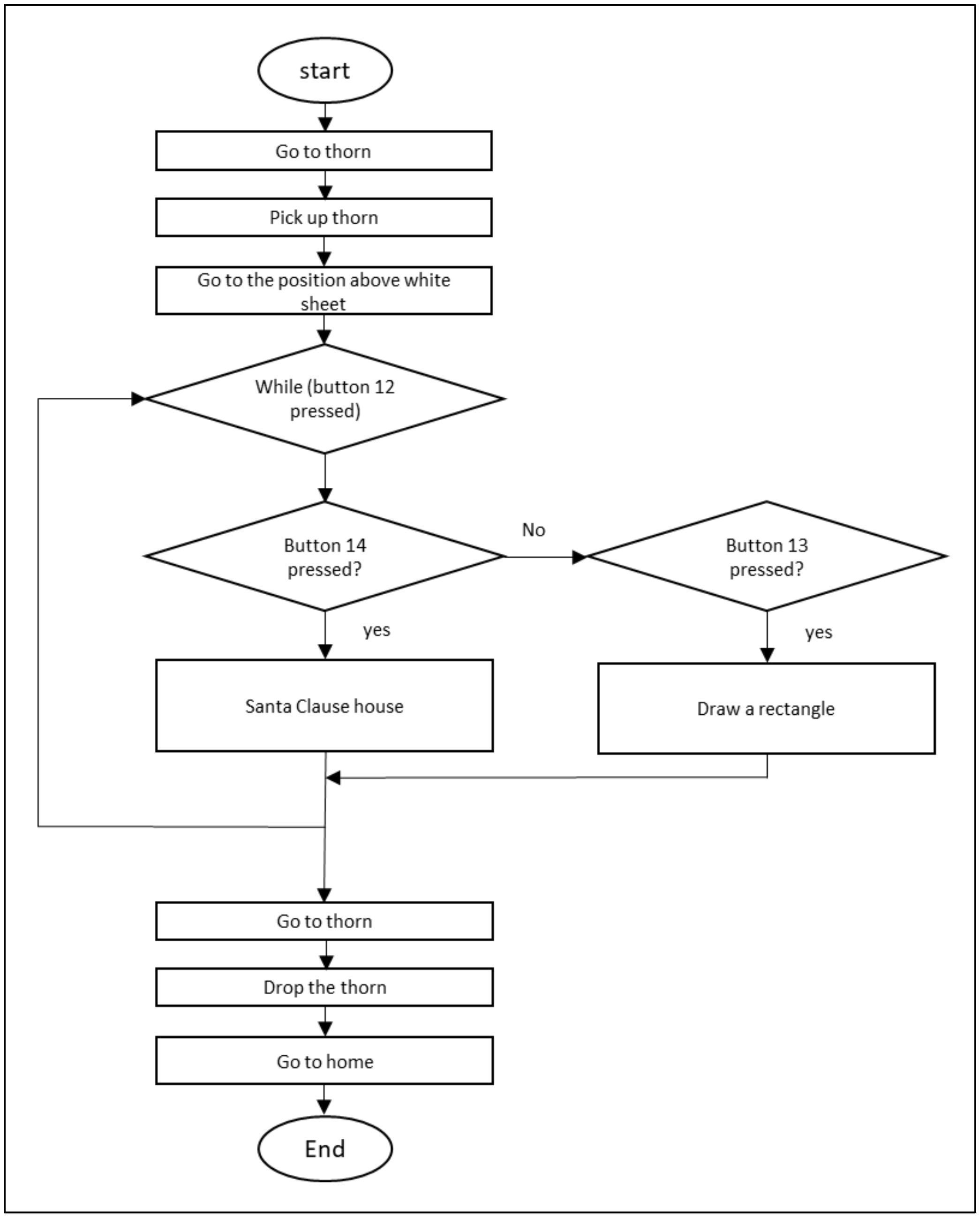
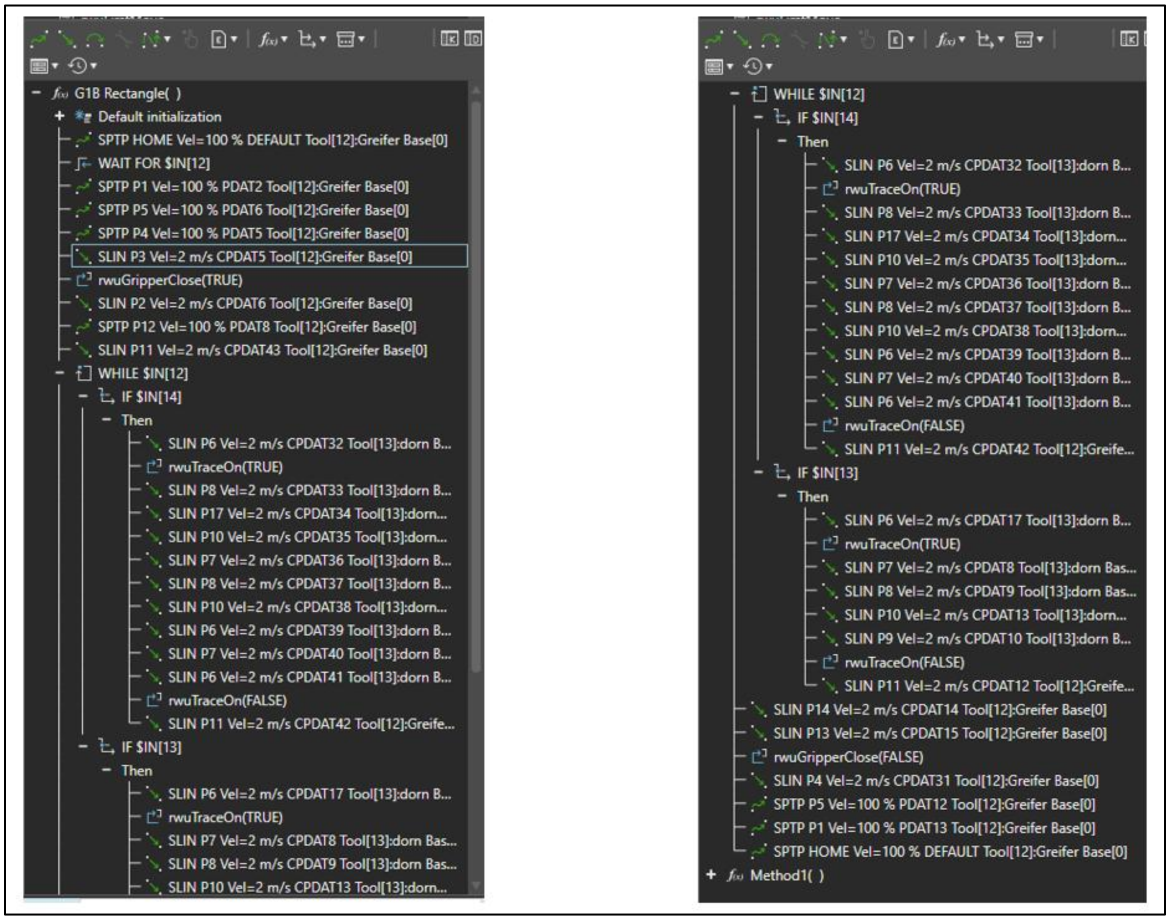


Figure No. 18: Flowchart of the program for lab test 3.



```
- G1B Rectangle( )
  + Default initialization
  SPTP HOME Vel=100 % DEFAULT Tool[12]:Greifer Base[0]
  WAIT FOR $IN[12]
  SPTP P1 Vel=100 % PDAT2 Tool[12]:Greifer Base[0]
  SPTP P5 Vel=100 % PDAT6 Tool[12]:Greifer Base[0]
  SPTP P4 Vel=100 % PDAT5 Tool[12]:Greifer Base[0]
  SLIN P3 Vel=2 m/s CPDAT5 Tool[12]:Greifer Base[0]
  rwuGripperClose(TRUE)
  SLIN P2 Vel=2 m/s CPDAT6 Tool[12]:Greifer Base[0]
  SPTP P12 Vel=100 % PDAT8 Tool[12]:Greifer Base[0]
  SLIN P11 Vel=2 m/s CPDAT43 Tool[12]:Greifer Base[0]
  - WHILE $IN[12]
    - IF $IN[14]
      - Then
          SLIN P6 Vel=2 m/s CPDAT32 Tool[13]:dorn B...
          rwuTraceOn(TRUE)
          SLIN P8 Vel=2 m/s CPDAT33 Tool[13]:dorn B...
          SLIN P17 Vel=2 m/s CPDAT34 Tool[13]:dorn...
          SLIN P10 Vel=2 m/s CPDAT35 Tool[13]:dorn...
          SLIN P7 Vel=2 m/s CPDAT36 Tool[13]:dorn B...
          SLIN P8 Vel=2 m/s CPDAT37 Tool[13]:dorn B...
          SLIN P10 Vel=2 m/s CPDAT38 Tool[13]:dorn...
          SLIN P6 Vel=2 m/s CPDAT39 Tool[13]:dorn B...
          SLIN P7 Vel=2 m/s CPDAT40 Tool[13]:dorn B...
          SLIN P6 Vel=2 m/s CPDAT41 Tool[13]:dorn B...
          rwuTraceOn(FALSE)
          SLIN P11 Vel=2 m/s CPDAT42 Tool[12]:Greife...
    - IF $IN[13]
      - Then
          SLIN P6 Vel=2 m/s CPDAT17 Tool[13]:dorn B...
          rwuTraceOn(TRUE)
          SLIN P7 Vel=2 m/s CPDAT8 Tool[13]:dorn Bas...
          SLIN P8 Vel=2 m/s CPDAT9 Tool[13]:dorn Bas...
          SLIN P10 Vel=2 m/s CPDAT13 Tool[13]:dorn...
```

```
  - WHILE $IN[12]
    - IF $IN[14]
      - Then
          SLIN P6 Vel=2 m/s CPDAT32 Tool[13]:dorn B...
          rwuTraceOn(TRUE)
          SLIN P8 Vel=2 m/s CPDAT33 Tool[13]:dorn B...
          SLIN P17 Vel=2 m/s CPDAT34 Tool[13]:dorn...
          SLIN P10 Vel=2 m/s CPDAT35 Tool[13]:dorn...
          SLIN P7 Vel=2 m/s CPDAT36 Tool[13]:dorn B...
          SLIN P8 Vel=2 m/s CPDAT37 Tool[13]:dorn B...
          SLIN P10 Vel=2 m/s CPDAT38 Tool[13]:dorn...
          SLIN P6 Vel=2 m/s CPDAT39 Tool[13]:dorn B...
          SLIN P7 Vel=2 m/s CPDAT40 Tool[13]:dorn B...
          SLIN P6 Vel=2 m/s CPDAT41 Tool[13]:dorn B...
          rwuTraceOn(FALSE)
          SLIN P11 Vel=2 m/s CPDAT42 Tool[12]:Greife...
    - IF $IN[13]
      - Then
          SLIN P6 Vel=2 m/s CPDAT17 Tool[13]:dorn B...
          rwuTraceOn(TRUE)
          SLIN P7 Vel=2 m/s CPDAT8 Tool[13]:dorn Bas...
          SLIN P8 Vel=2 m/s CPDAT9 Tool[13]:dorn Bas...
          SLIN P10 Vel=2 m/s CPDAT13 Tool[13]:dorn...
          SLIN P9 Vel=2 m/s CPDAT10 Tool[13]:dorn B...
          rwuTraceOn(FALSE)
          SLIN P11 Vel=2 m/s CPDAT12 Tool[12]:Greife...
  SLIN P14 Vel=2 m/s CPDAT14 Tool[12]:Greifer Base[0]
  SLIN P13 Vel=2 m/s CPDAT15 Tool[12]:Greifer Base[0]
  rwuGripperClose(FALSE)
  SLIN P4 Vel=2 m/s CPDAT31 Tool[12]:Greifer Base[0]
  SPTP P5 Vel=100 % PDAT12 Tool[12]:Greifer Base[0]
  SPTP P1 Vel=100 % PDAT13 Tool[12]:Greifer Base[0]
  SPTP HOME Vel=100 % DEFAULT Tool[12]:Greifer Base[0]
+ Method1( )
```

Figure No. 19: KRL Program of the lab test 2.

2.4 Problem Faced and their Solution: -

a) Collision of Robot: -

The robot collided with the nearby object during its movement from the HOME position to the thorn rack. This was due to the PTP movement given to the Robot and in order to avoid this problem, intermediate points were added.

b) Trace On Function: -

The Trace on Function was immediately called after the gripper Close function was set to TRUE. Due to this the path was traced while moving from Thorn rack to White sheet and it continued until the function was set to FALSE. The Trace on function was later repositioned in the program corresponding to the point on the white sheet.

c) Crashing of KUKA.Sim file: -

The program failed and a serious error occurred during the reopening of the program file. This was due to the deletion of the assigned points of the rectangle inside the If statement. The Else statement, inside the If statement, was reluctant as a result the decision was made to remove the Entire block of statements. As a result, references given in the IF structure were missing which caused this problem. To avoid this problem, we saved our program file by taking all the Points outside of the If statement before deleting it.

d) Tip of Thorn embedding inside White sheet: -

The tip of the thorn was embedded inside the white sheet & due to this, it was unable to see the traced/highlighted rectangle. The tip was adjusted just above the white sheet and multiple simulations were run to approx. adjustment in Z-axis, which was a tedious and time-consuming task. Hence for saving time, it was finally decided to adjust the position of the tip during the simulation which worked very smoothly, and finally the rectangle was seen after proper adjustment of the Thorn's tip.

2.5 Lessons Learned: -

a) Hands on Experience on Kuka Robotics Language (KRL) & generating robot program.

b) Usage of commands like IF, WHILE, etc. along with RWU_Gripper, Trace_On Functions while programming.

3. Lab Test 3

3.1 Tasks needed to be performed: -

a) The program ‘rwuBallTeach’ was to be copied and renamed.

b) Initially a simple program was to be made to move the robot to the feeder and pick up the ball.

c) The balls were supposed to be sorted in respective pallet using loop control structures, conditional statements and the predefined functions like rwuPallete ().

d) Finally, all the shortcomings of program were to be eliminated so that the program could run on real system.

3.2 Learning targets: -

a) Getting experience of KUKA programming.

b) Learning about implementation of control loop structures and conditional statements in KUKA programming.

c) Learning to implement safe fail methods in simulation before implementing on real system to avoid damage of real system.

3.3 Steps that led to solution: -

a) Creating a robot program for collecting the balls: -

   i. The ‘rwuBallTeach’ program was copied and renamed and then the programming was started in this file.

   ii. Initially, a sensor is used to check if the ball is available in the feeder. If a ball is in the feeder, then programming was done in order to pick up the ball from the feeder and move it above the colour sensor to detect the colour of the ball. This was done using the predefined points in the * .dat file.

b) Implementing the sorting algorithm: -

   i. Counter variables for each pallet were declared at the start of the program which referred to the number of balls in the pallet. These variables were initialized with the value of 0.

   ii. Then the ball was placed in the respective pallet using conditional statements and the rwuPallete () function. The counter and position of the respective pallet were passed as parameters to the function.

iii. All these programs were placed in a loop to repeat this procedure. The flowchart of the program is as below.

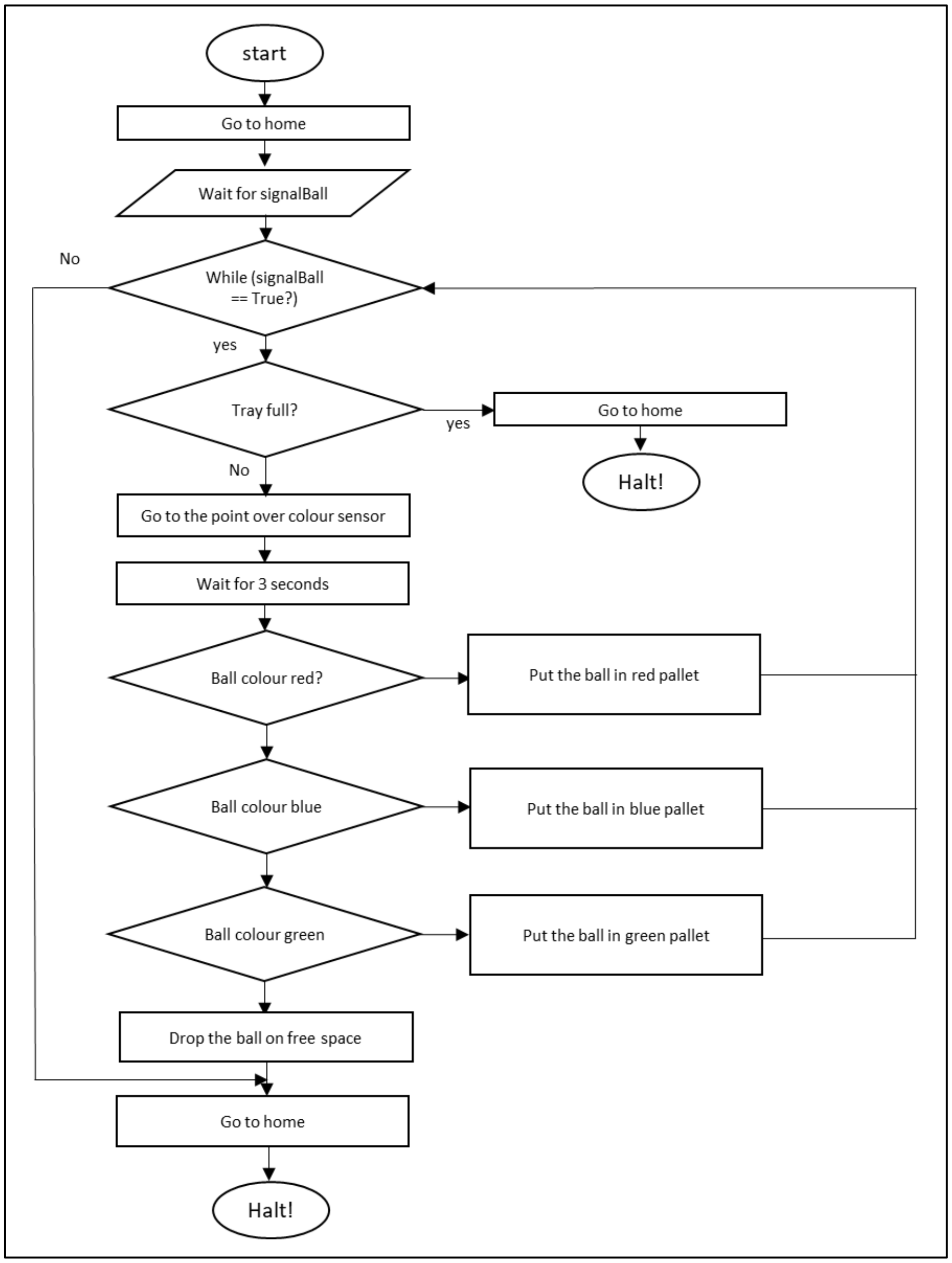
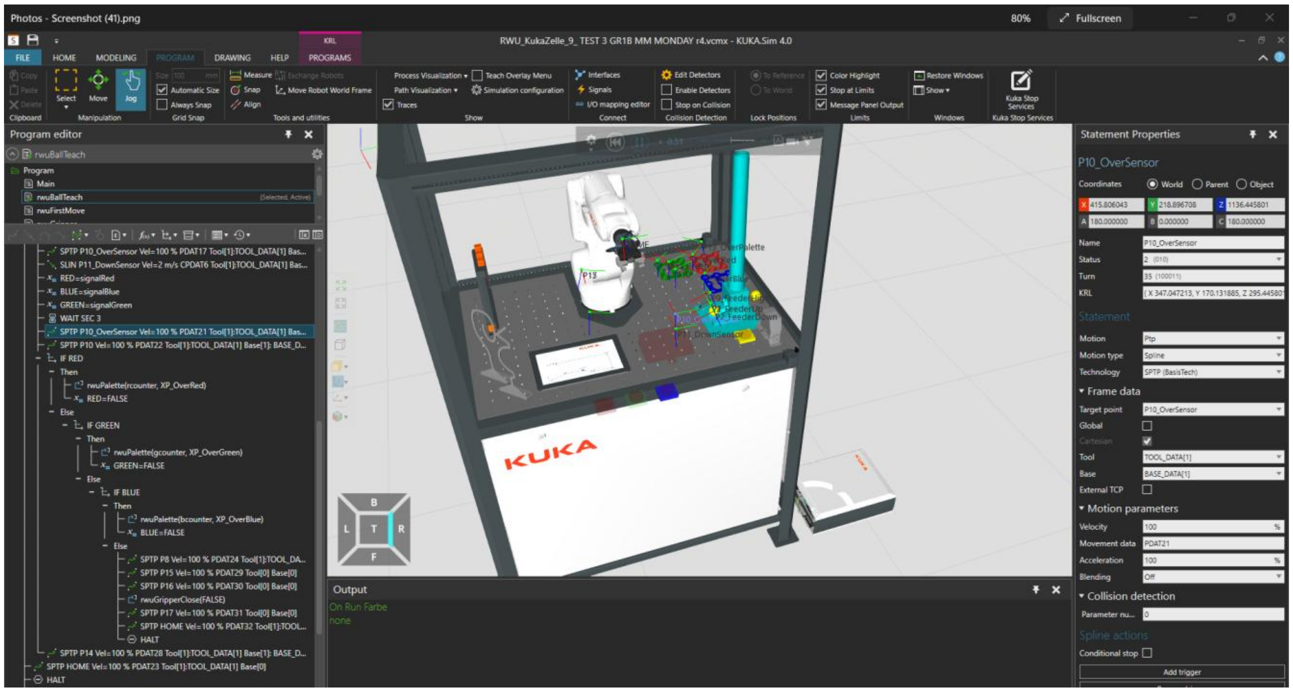

start
Go to home
Wait for signalBall
No
While (signalBall == True?)
yes
Tray full?
yes
Go to home
Halt!
No
Go to the point over colour sensor
Wait for 3 seconds
Ball colour red?
Put the ball in red pallet
Ball colour blue
Put the ball in blue pallet
Ball colour green
Put the ball in green pallet
Drop the ball on free space
Go to home
Halt!

Figure No. 20: Flowchart of the program for sorting algorithm.



Program editor — rwuBallTeach

```
SPTP P10_OverSensor Vel=100 % PDAT17 Tool[1]:TOOL_DATA[1] Bas...
SLIN P11_DownSensor Vel=2 m/s CPDAT6 Tool[1]:TOOL_DATA[1] Bas...
RED=signalRed
BLUE=signalBlue
GREEN=signalGreen
WAIT SEC 3
SPTP P10_OverSensor Vel=100 % PDAT21 Tool[1]:TOOL_DATA[1] Bas...
SPTP P10 Vel=100 % PDAT22 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
IF RED
  Then
    rwuPalette(rcounter, XP_OverRed)
    RED=FALSE
  Else
    IF GREEN
      Then
        rwuPalette(gcounter, XP_OverGreen)
        GREEN=FALSE
      Else
        IF BLUE
          Then
            rwuPalette(bcounter, XP_OverBlue)
            BLUE=FALSE
          Else
            SPTP P8 Vel=100 % PDAT24 Tool[1]:TOOL_DA...
            SPTP P15 Vel=100 % PDAT29 Tool[0] Base[0]
            SPTP P16 Vel=100 % PDAT30 Tool[0] Base[0]
            rwuGripperClose(FALSE)
            SPTP P17 Vel=100 % PDAT31 Tool[0] Base[0]
            SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL...
            HALT
SPTP P14 Vel=100 % PDAT28 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0]
HALT
```

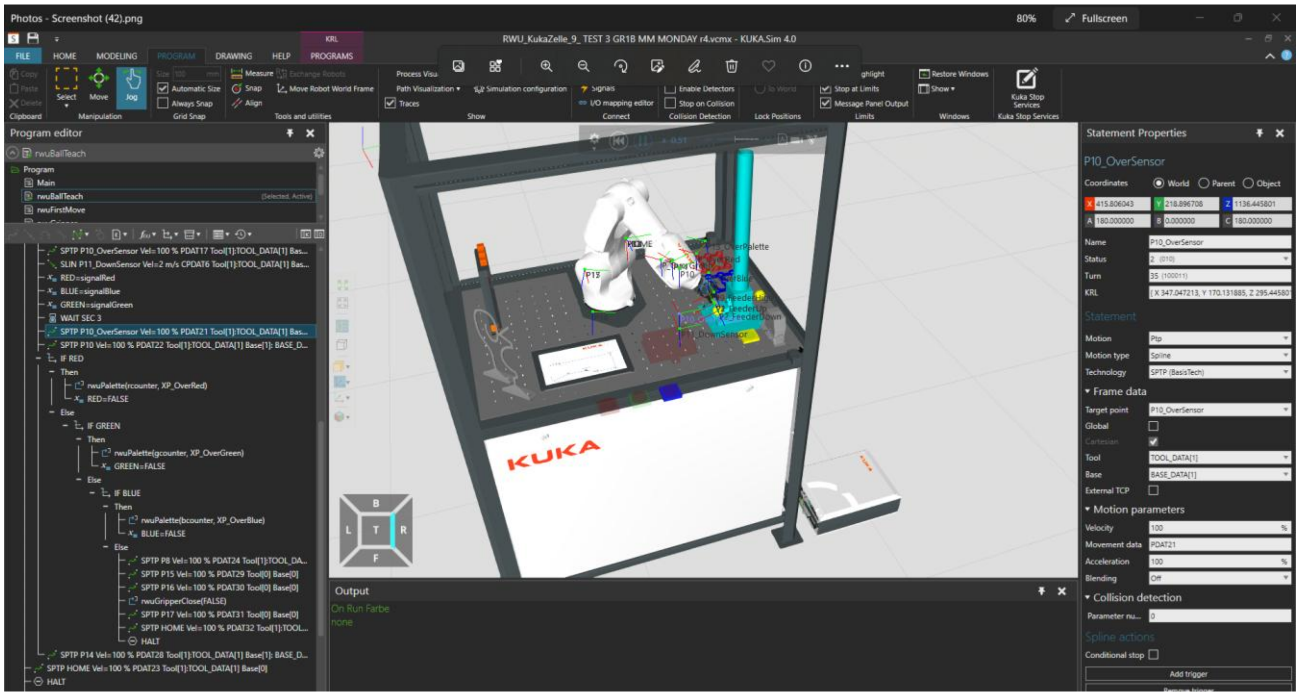
Statement Properties — P10_OverSensor

Coordinates	[✓ World] Parent Object
X	415.806043
Y	218.896708
Z	1136.445801
A	180.000000
B	0.000000
C	180.000000
Name	P10_OverSensor
Status	2 (010)
Turn	35 (100011)
KRL	{ X 347.047213, Y 170.131885, Z 295.44580
Motion	Ptp
Motion type	Spline
Technology	SPTP (BasisTech)
Target point	P10_OverSensor
Global	☐
Cartesian	✓
Tool	TOOL_DATA[1]
Base	BASE_DATA[1]
External TCP	☐
Velocity	100 %
Movement data	PDAT21
Acceleration	100 %
Blending	Off
Parameter nu...	0
Conditional stop	☐

Output

```
On Run Farbe
none
```

Figure No. 21: Home Position of Kuka Robot in Simulation World.



Program editor — rwuBallTeach

```
SPTP P10_OverSensor Vel=100 % PDAT17 Tool[1]:TOOL_DATA[1] Bas...
SLIN P11_DownSensor Vel=2 m/s CPDAT6 Tool[1]:TOOL_DATA[1] Bas...
RED=signalRed
BLUE=signalBlue
GREEN=signalGreen
WAIT SEC 3
SPTP P10_OverSensor Vel=100 % PDAT21 Tool[1]:TOOL_DATA[1] Bas...
SPTP P10 Vel=100 % PDAT22 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
IF RED
  Then
    rwuPalette(rcounter, XP_OverRed)
    RED=FALSE
  Else
    IF GREEN
      Then
        rwuPalette(gcounter, XP_OverGreen)
        GREEN=FALSE
      Else
        IF BLUE
          Then
            rwuPalette(bcounter, XP_OverBlue)
            BLUE=FALSE
          Else
            SPTP P8 Vel=100 % PDAT24 Tool[1]:TOOL_DA...
            SPTP P15 Vel=100 % PDAT29 Tool[0] Base[0]
            SPTP P16 Vel=100 % PDAT30 Tool[0] Base[0]
            rwuGripperClose(FALSE)
            SPTP P17 Vel=100 % PDAT31 Tool[0] Base[0]
            SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL...
            HALT
SPTP P14 Vel=100 % PDAT28 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0]
HALT
```

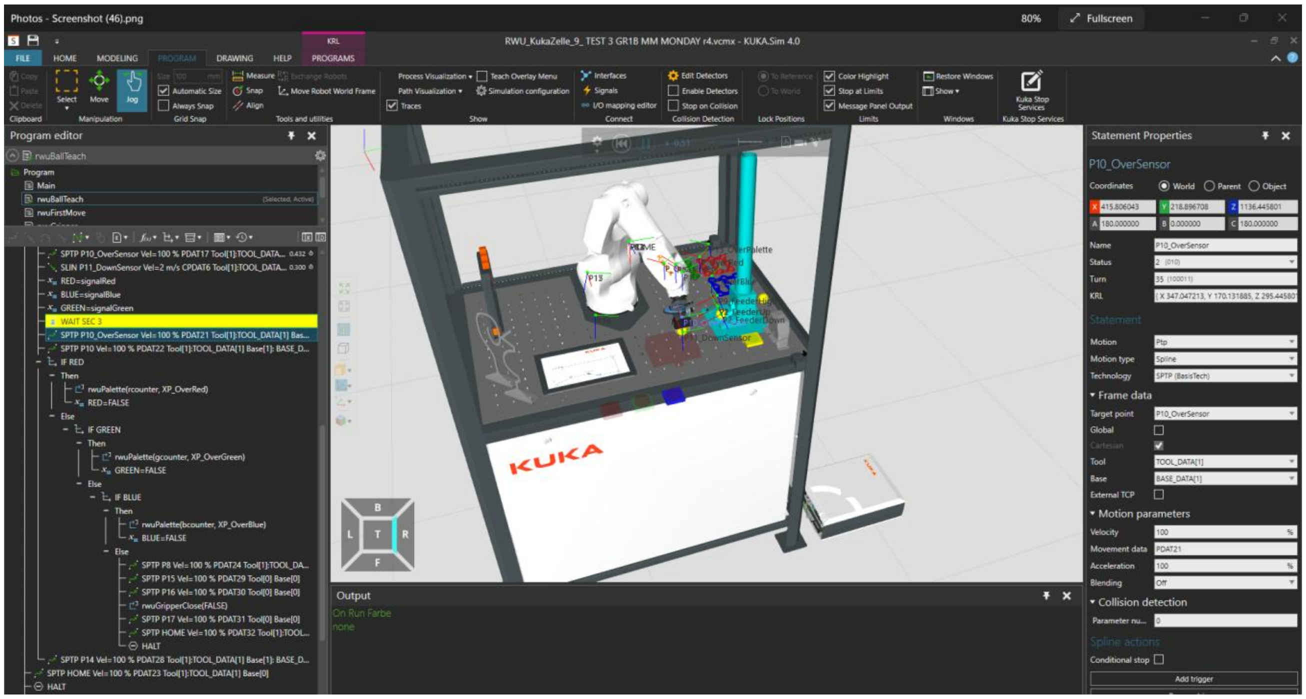
Statement Properties — P10_OverSensor

Coordinates	[✓ World] Parent Object
X	415.806043
Y	218.896708
Z	1136.445801
A	180.000000
B	0.000000
C	180.000000
Name	P10_OverSensor
Status	2 (010)
Turn	35 (100011)
KRL	{ X 347.047213, Y 170.131885, Z 295.44580
Motion	Ptp
Motion type	Spline
Technology	SPTP (BasisTech)
Target point	P10_OverSensor
Global	☐
Cartesian	✓
Tool	TOOL_DATA[1]
Base	BASE_DATA[1]
External TCP	☐
Velocity	100 %
Movement data	PDAT21
Acceleration	100 %
Blending	Off
Parameter nu...	0
Conditional stop	☐

Output

```
On Run Farbe
none
```

Figure No. 22: Picking up of Ball from Ball Feeder.


Photos - Screenshot (46).png
RWU_KukaZelle_9_ TEST 3 GR1B MM MONDAY r4.vcmx - KUKA.Sim 4.0
FILE
HOME
MODELING
PROGRAM
DRAWING
HELP
PROGRAMS
Program editor
Output
KUKA

```
rwuBallTeach
Program
  Main
  rwuBallTeach                                                          (Selected, Active)
  rwuFirstMove

  SPTP P10_OverSensor Vel=100 % PDAT17 Tool[1]:TOOL_DATA...  0.432
  SLIN P11_DownSensor Vel=2 m/s CPDAT6 Tool[1]:TOOL_DATA...  0.300
  RED=signalRed
  BLUE=signalBlue
  GREEN=signalGreen
  WAIT SEC 3
  SPTP P10_OverSensor Vel=100 % PDAT21 Tool[1]:TOOL_DATA[1] Bas...
  SPTP P10 Vel=100 % PDAT22 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
  IF RED
    Then
      rwuPalette(rcounter, XP_OverRed)
      RED=FALSE
    Else
      IF GREEN
        Then
          rwuPalette(gcounter, XP_OverGreen)
          GREEN=FALSE
        Else
          IF BLUE
            Then
              rwuPalette(bcounter, XP_OverBlue)
              BLUE=FALSE
            Else
              SPTP P8 Vel=100 % PDAT24 Tool[1]:TOOL_DA...
              SPTP P15 Vel=100 % PDAT29 Tool[0] Base[0]
              SPTP P16 Vel=100 % PDAT30 Tool[0] Base[0]
              rwuGripperClose(FALSE)
              SPTP P17 Vel=100 % PDAT31 Tool[0] Base[0]
              SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL...
              HALT
  SPTP P14 Vel=100 % PDAT28 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0]
HALT
```

Output

```
On Run Farbe
none
```

Statement Properties

P10_OverSensor

Coordinates: (● World) ○ Parent ○ Object

X 415.806043	Y 218.896708	Z 1136.445801
A 180.000000	B 0.000000	C 180.000000

Name	P10_OverSensor
Status	2 (010)
Turn	35 (100011)
KRL	{ X 347.047213, Y 170.131885, Z 295.44580

Statement

Motion	Ptp
Motion type	Spline
Technology	SPTP (BasisTech)

Frame data

Target point	P10_OverSensor
Global	☐
Cartesian	✓
Tool	TOOL_DATA[1]
Base	BASE_DATA[1]
External TCP	☐

Motion parameters

Velocity	100 %
Movement data	PDAT21
Acceleration	100 %
Blending	Off

Collision detection

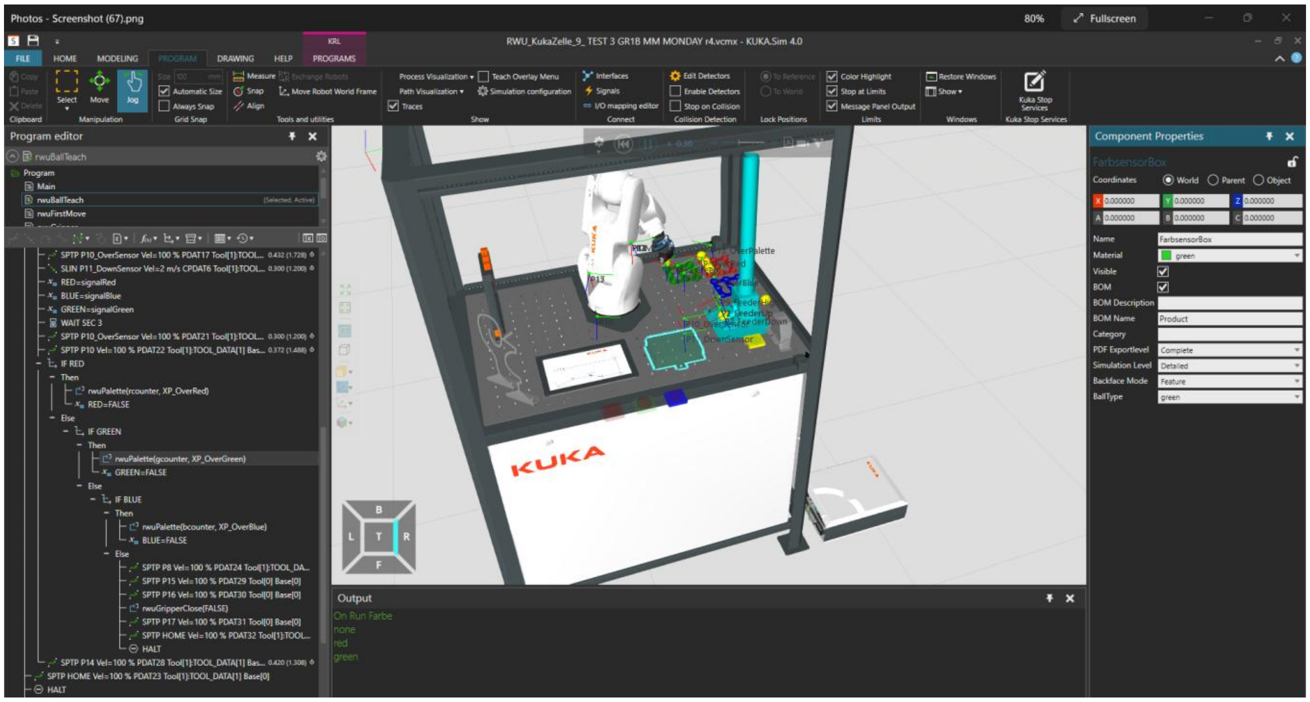
Parameter nu...	0

Spline actions

Conditional stop ☐

Add trigger

Figure No. 23: Ball colour checking through colour sensor.


Photos - Screenshot (67).png
RWU_KukaZelle_9_ TEST 3 GR1B MM MONDAY r4.vcmx - KUKA.Sim 4.0
FILE
HOME
MODELING
PROGRAM
DRAWING
HELP
PROGRAMS
Program editor
Output
KUKA

```
rwuBallTeach
Program
  Main
  rwuBallTeach                                                          (Selected, Active)
  rwuFirstMove

  SPTP P10_OverSensor Vel=100 % PDAT17 Tool[1]:TOOL...  0.432 (1.728)
  SLIN P11_DownSensor Vel=2 m/s CPDAT6 Tool[1]:TOOL...  0.300 (1.200)
  RED=signalRed
  BLUE=signalBlue
  GREEN=signalGreen
  WAIT SEC 3
  SPTP P10_OverSensor Vel=100 % PDAT21 Tool[1]:TOOL...  0.300 (1.200)
  SPTP P10 Vel=100 % PDAT22 Tool[1]:TOOL_DATA[1] Bas...  0.372 (1.488)
  IF RED
    Then
      rwuPalette(rcounter, XP_OverRed)
      RED=FALSE
    Else
      IF GREEN
        Then
          rwuPalette(gcounter, XP_OverGreen)
          GREEN=FALSE
        Else
          IF BLUE
            Then
              rwuPalette(bcounter, XP_OverBlue)
              BLUE=FALSE
            Else
              SPTP P8 Vel=100 % PDAT24 Tool[1]:TOOL_DA...
              SPTP P15 Vel=100 % PDAT29 Tool[0] Base[0]
              SPTP P16 Vel=100 % PDAT30 Tool[0] Base[0]
              rwuGripperClose(FALSE)
              SPTP P17 Vel=100 % PDAT31 Tool[0] Base[0]
              SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL...
              HALT
  SPTP P14 Vel=100 % PDAT28 Tool[1]:TOOL_DATA[1] Bas...  0.420 (1.308)
SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0]
HALT
```

Output

```
On Run Farbe
none
red
green
```

Component Properties

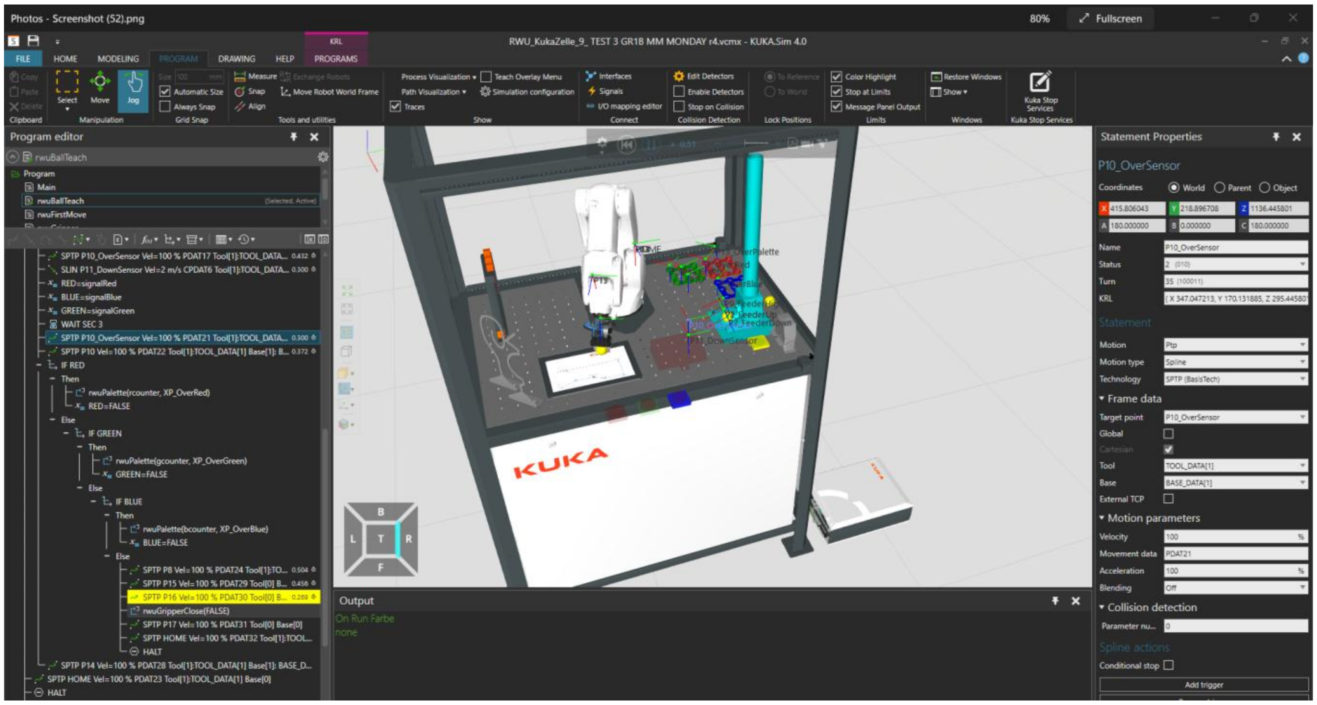
FarbsensorBox

Coordinates: (● World) ○ Parent ○ Object

X 0.000000	Y 0.000000	Z 0.000000
A 0.000000	B 0.000000	C 0.000000

Name	FarbsensorBox
Material	🟩 green
Visible	✓
BOM	✓
BOM Description	
BOM Name	Product
Category	
PDF Exportlevel	Complete
Simulation Level	Detailed
Backface Mode	Feature
BallType	green

Figure No. 24: Ball sorting as per colour in Palate.


Photos - Screenshot (52).png
RWU_KukaZelle_9_ TEST 3 GR1B MM MONDAY r4.vcmx - KUKA.Sim 4.0
Program editor
Output
On Run Farbe
none
Statement Properties

```
rwuBallTeach
Program
  Main
  rwuBallTeach                                   (Selected, Active)
  rwuFirstMove

  SPTP P10_OverSensor Vel=100 % PDAT17 Tool[1]:TOOL_DATA... 0.432
  SLIN P11_DownSensor Vel=2 m/s CPDAT6 Tool[1]:TOOL_DATA... 0.300
  RED=signalRed
  BLUE=signalBlue
  GREEN=signalGreen
  WAIT SEC 3
  SPTP P10_OverSensor Vel=100 % PDAT21 Tool[1]:TOOL_DATA... 0.300
  SPTP P10 Vel=100 % PDAT22 Tool[1]:TOOL_DATA[1] Base[1]: B... 0.372
  IF RED
    Then
      rwuPalette(rcounter, XP_OverRed)
      RED=FALSE
    Else
      IF GREEN
        Then
          rwuPalette(gcounter, XP_OverGreen)
          GREEN=FALSE
        Else
          IF BLUE
            Then
              rwuPalette(bcounter, XP_OverBlue)
              BLUE=FALSE
            Else
              SPTP P8 Vel=100 % PDAT24 Tool[1]:TO... 0.504
              SPTP P15 Vel=100 % PDAT29 Tool[0] B... 0.456
              SPTP P16 Vel=100 % PDAT30 Tool[0] B... 0.269
              rwuGripperClose(FALSE)
              SPTP P17 Vel=100 % PDAT31 Tool[0] Base[0]
              SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL...
              HALT
  SPTP P14 Vel=100 % PDAT28 Tool[1]:TOOL_DATA[1] Base[1]: BASE_D...
SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0]
HALT
```

P10_OverSensor

Coordinates	(●) World ( ) Parent ( ) Object
X	415.806043
Y	218.896708
Z	1136.445801
A	180.000000
B	0.000000
C	180.000000
Name	P10_OverSensor
Status	2 (010)
Turn	35 (100011)
KRL	{ X 347.047213, Y 170.131885, Z 295.44580
Motion	Ptp
Motion type	Spline
Technology	SPTP (BasisTech)
Target point	P10_OverSensor
Global	☐
Cartesian	✓
Tool	TOOL_DATA[1]
Base	BASE_DATA[1]
External TCP	☐
Velocity	100 %
Movement data	PDAT21
Acceleration	100 %
Blending	Off
Parameter nu...	0
Conditional stop	☐

Figure No. 25: Placing of ball on another place whose colour is neither Red, Green nor Blue.

3.4 Problem Faced and their Solution: -

a) Collision of Robot: -

The robot collided with the nearby object during its movement from the HOME position to the thorn rack. This was due to the PTP movement given to the Robot and to avoid this problem, intermediate points were added.

b) The decision to make once the pallet is full: -

When the respective pallet has filled the robot still collected the ball from the feeder, after checking of respective ball colour, the robot stopped in position between the Feeder setup & Pallet. To resolve the problem, a Counter variable was used to check if the pallet is full. If yes, the Robot was programmed in such a way that it would go to the home position & halted without picking the ball from the feeder.

c) Colour Recognition of Ball: -

When no ball or other colour was detected then the robot was programmed to place the ball in the free space on the base (white sheet or any other position) and then it moved to the home position.

d) Colour Sensing Time & Signal Storage: -

After sensing the colour of the ball by the color sensor, it was unable to retain the data. Hence the function WAIT SEC was used to wait for 3 seconds over the sensor for data storing purpose.

3.5 Lessons Learned: -

a) Learned to implement new functions such as WAIT SEC
b) Learned to implement fail safes.

4. Lab Test 4

4.1 Tasks needed to be performed: -

a) Ensuring the program that was created in simulation is adaptable to the real system before loading it onto the robot.

b) Test the program by running it point by point and reteach the points if the points are incorrect or there are any chances of collision.

c) Check all the functions of the program.

4.2 Learning targets: -

a) Familiarizing with the C2 type Kuka Control Panel (KCP).

b) Learning about the possible problems that may occur while executing the program on real-system.

4.3 Steps that led to solution: -

Compensating the change in dimensions between simulation and real system: -

The dimensions of the real system and the simulated system were not the same. Following changes were made in the program: -

i. Deletion of manually created intermediate points in the simulation.

ii. The rest points were set as the reference points in the *.dat file which was done in editor mode.

iii. The *.src file used was the same, only the *.dat file was changed while uploading the program to the robot controller.

4.4 Problem Faced and their Solution: -

a) Gripper Operation: -

During the program stopping or resetting, the gripper remained closed. To solve this problem gripper open function was used at beginning of the program.

b) Collision of Robot: -

The robot collided while coming back from pallet no. 3 & going to Feeder_UP point. To avoid a point named XP13_OverPalette was added after the rwuPallete () function & XP9_FeederHigh was added after the XP13_OverPalette.

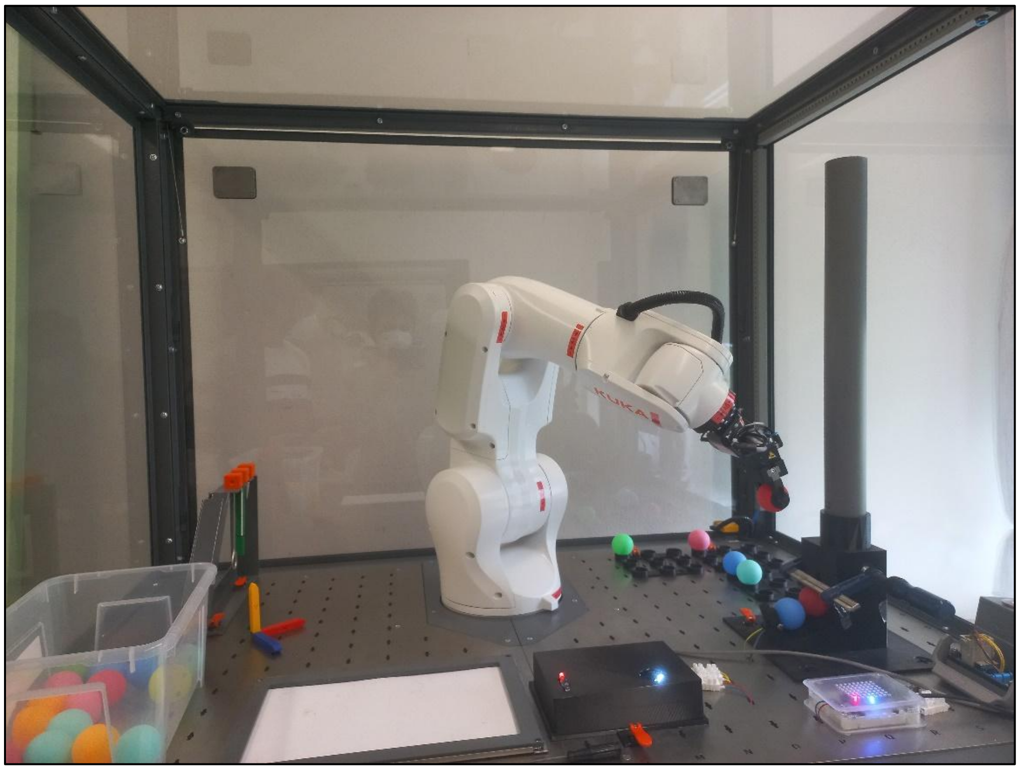


Figure No. 26: - Ball sorting system.

4.5 Lessons Learned: -

Problems which occur while transferring from simulation to real system were identified and noted.

ANNEXURE

```
&ACCESS RVP
&REL 12
&PARAM DISKPATH = KRC:\R1\Program\stud22
DEF rwuSS22Monday1b()
  DECL INT rcounter
  DECL INT bcounter
  DECL INT gcounter
  DECL BOOL RED
  DECL BOOL BLUE
  DECL BOOL GREEN
;   SIGNAL signalBall $IN[15] ;Feed has ball
;   SIGNAL signalRed $IN[16] ;Ball is red
;   SIGNAL signalGreen $IN[17] ;Ball is green
;   SIGNAL signalBlue $IN[18] ;Ball is blue

  SIGNAL signalBall $IN[12] ;Feed has ball
  SIGNAL signalRed $IN[9] ;Ball is red
  SIGNAL signalGreen $IN[10] ;Ball is green
  SIGNAL signalBlue $IN[11] ;Ball is blue
  ;FOLD INI;%{PE}
    ;FOLD BASISTECH INI
      GLOBAL INTERRUPT DECL 3 WHEN $STOPMESS == TRUE DO IR_STOPM()
      INTERRUPT ON 3
      BAS(#INITMOV, 0)
    ;ENDFOLD (BASISTECH INI)
    ;FOLD USER INI
      ;Make your modifications here
    ;ENDFOLD (USER INI)
  ;ENDFOLD (INI)
  ;FOLD SPTP HOME Vel=100 % DEFAULT Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
    ;FOLD Parameters ;%{h}
      ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=DEFAULT; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
    ;ENDFOLD
    SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PDEFAULT), $APO = SAPO_PTP(PDEFAULT), $GEAR_JERK[1] =
SGEAR_JERK(PDEFAULT), $COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
  ;ENDFOLD
  rwuInitToolBase()
  rwuGripperClose(FALSE)
  bcounter=1
  rcounter=1
  gcounter=1
  WAIT FOR signalBall
  WHILE signalBall
    IF rcounter == 10 THEN
      ;FOLD SPTP HOME Vel=100 % PDAT26 Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
        ;FOLD Parameters ;%{h}
          ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=PDAT26; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
        ;ENDFOLD
        SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PPDAT26), $APO = SAPO_PTP(PPDAT26), $GEAR_JERK[1] = SGEAR_JERK(PPDAT26),
$COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
      ;ENDFOLD
      rwuGripperClose(FALSE)
      HALT
    ENDIF
    IF gcounter == 10 THEN
      ;FOLD SPTP HOME Vel=100 % PDAT25 Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
        ;FOLD Parameters ;%{h}
```

```
          ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=PDAT25; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
        ;ENDFOLD
        SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PPDAT25), $APO = SAPO_PTP(PPDAT25), $GEAR_JERK[1] = SGEAR_JERK(PPDAT25),
$COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
      ;ENDFOLD
      rwuGripperClose(FALSE)
      HALT
    ENDIF
    IF bcounter == 10 THEN
      ;FOLD SPTP HOME Vel=100 % PDAT27 Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
        ;FOLD Parameters ;%{h}
          ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=PDAT27; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
        ;ENDFOLD
        SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PPDAT27), $APO = SAPO_PTP(PPDAT27), $GEAR_JERK[1] = SGEAR_JERK(PPDAT27),
$COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
      ;ENDFOLD
      rwuGripperClose(FALSE)
      HALT
    ENDIF
    SPTP XP1_FeederUp
    SPTP XP2_FeederDown
    rwuGripperClose(TRUE)
    SPTP XP2_FeederUp
    SPTP XP9_FeederHigh
    SPTP XP10_OverSensor
```

```
SLIN XP11_DownSensor
RED=signalRed
BLUE=signalBlue
GREEN=signalGreen
WAIT SEC 3
SPTP XP10_OverSensor
SPTP XP13_OverPalette
IF RED THEN
  rwuPalette(rcounter, XP_OverRed)
  RED=FALSE
ELSE
  IF GREEN THEN
    rwuPalette(gcounter, XP_OverGreen)
    GREEN=FALSE
  ELSE
    IF BLUE THEN
      rwuPalette(bcounter, XP_OverBlue)
      BLUE=FALSE
    ELSE
      ;FOLD SPTP HOME Vel=100 % PDAT32 Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
        ;FOLD Parameters ;%{h}
          ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=PDAT32; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
        ;ENDFOLD
        SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PPDAT32), $APO = SAPO_PTP(PPDAT32), $GEAR_JERK[1] = SGEAR_JERK(PPDAT32),
$COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
      ;ENDFOLD
      rwuGripperClose(FALSE)
      HALT
    ENDIF
  ENDIF
```

```
    ENDIF
    SPTP XP13_OverPalette
    SPTP XP9_FeederHigh
  ENDWHILE
  ;FOLD SPTP HOME Vel=100 % PDAT23 Tool[1]:TOOL_DATA[1] Base[0] ;%{PE}
    ;FOLD Parameters ;%{h}
      ;Params IlfProvider=kukaroboter.basistech.inlineforms.movement.spline; Kuka.IsGlobalPoint=False;
Kuka.PointName=HOME; Kuka.BlendingEnabled=False; Kuka.MoveDataPtpName=PDAT23; Kuka.VelocityPtp=100;
Kuka.VelocityFieldEnabled=True; Kuka.ColDetectFieldEnabled=True; Kuka.CurrentCDSetIndex=0;
Kuka.MovementParameterFieldEnabled=True; IlfCommand=SPTP; SimId=
    ;ENDFOLD
    SPTP XHOME WITH $VEL_AXIS[1] = SVEL_JOINT(100.0), $TOOL = STOOL2(FHOME), $BASE =
SBASE(FHOME.BASE_NO), $IPO_MODE = SIPO_MODE(FHOME.IPO_FRAME), $LOAD = SLOAD(FHOME.TOOL_NO),
$ACC_AXIS[1] = SACC_JOINT(PPDAT23), $APO = SAPO_PTP(PPDAT23), $GEAR_JERK[1] = SGEAR_JERK(PPDAT23),
$COLLMON_TOL_PRO[1] = USE_CM_PRO_VALUES(0)
  ;ENDFOLD
  rwuGripperClose(FALSE)
  HALT
```