



RME 40003

Robot System Design

Robot Simulation with ABB Robot Studio

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## Introduction

In this project, a simulation will be carried out on ABB Robot Studio to program the ABB robot to draw or trace the outline of the words created from SolidWorks. The word created consists of a few characters, therefore the simulated robot needs to trace each outline of the character in a closed-loop path. For each of the character outline traced by the robot arm, the robot arm will be lifted up for a certain distance then it will then move to the next top corner of the subsequent character, in order for it to start tracing it.

## Screenshot and Explanation of the Drawn Item

The 3D model drawn using SolidWorks is a three characters consists of F, Y, and P as shown below:

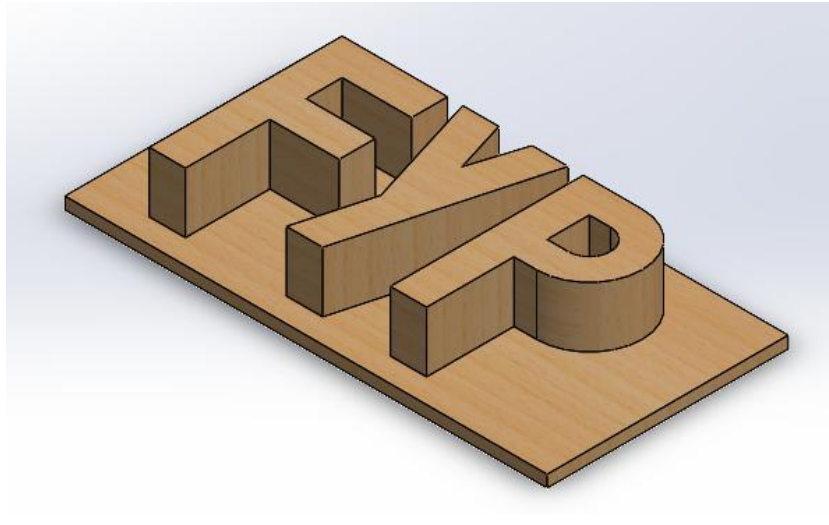


Figure 1: 3D Model Drawn in SolidWorks

The minimum distance between each character is 25 mm. The characters are extruded by 100 mm or 100 mm thickness and width of 320 mm. The character 'F' and 'Y' have both length of 175 mm whereas the character 'P' has length of 185 mm so that the proportion of the curved area and the straight surface are even.

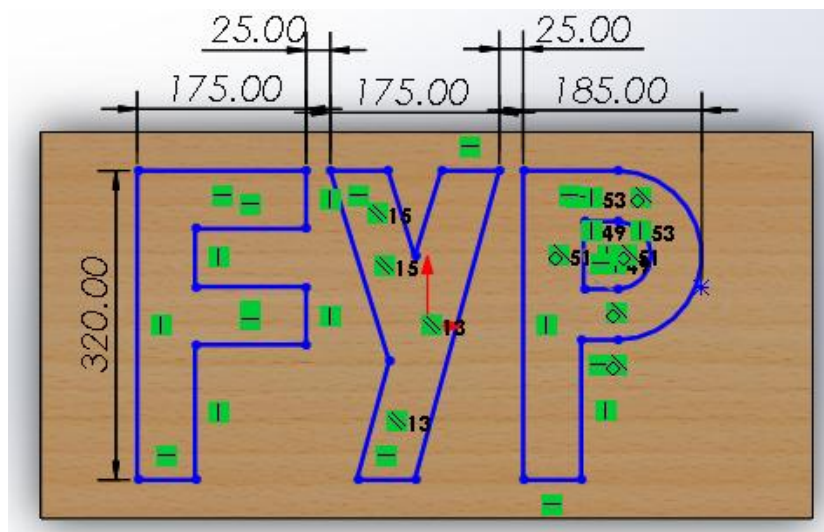


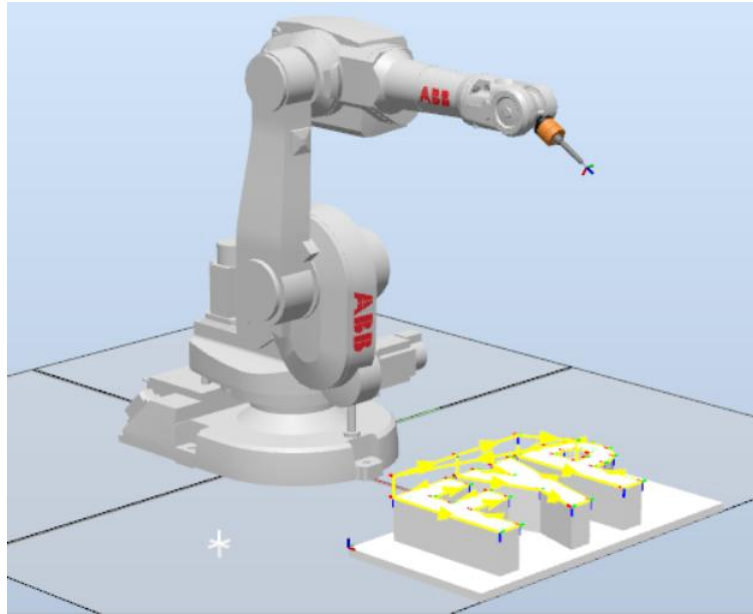
Figure 2: Dimension of the 3 characters on the base

The 3D model also consists of a thin base which measured at a dimension of 800 mm x 400 mm x 20 mm. In terms of the complexity of drawing, it is considered not too complex, as most of the outlines of the character are straight line, with the exception in the character 'P', where semi-circular paths are expected at both outer and inner section of the curved line.

The detailed dimension of the character model can be referred at the Appendix section later on.

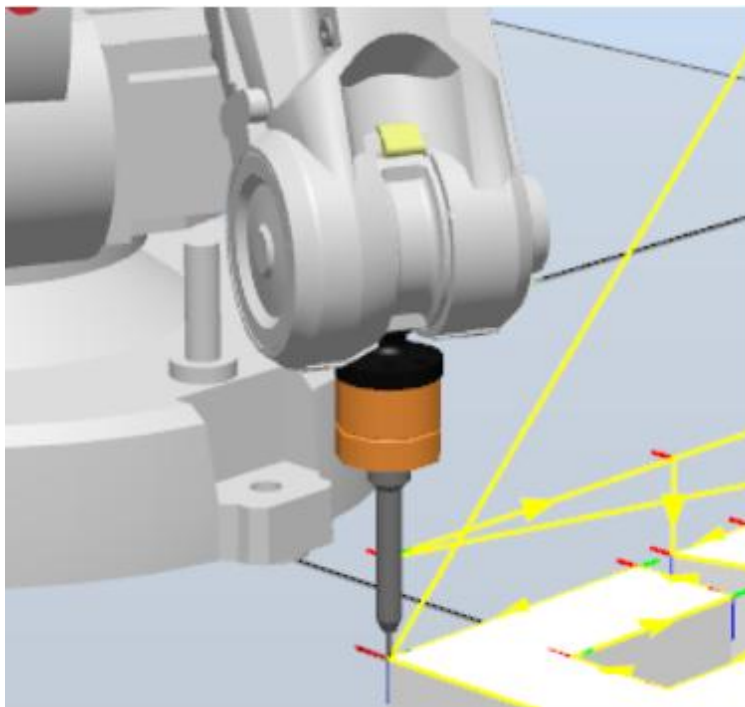
## Screenshot and Explanation of the ABB Robot Simulation

The robot model selected from the ABB Robot Studio is IRB1600\_10\_1.2m, which is a 6-DOF robot arm. The 3D model is placed 550 mm directly in front of the robot arm in positive x-coordinate system. The UCS is defined from the base of the character instead of at the bottom of the thin extruded base. Figure 3 shows the 3D layout of the robot and the 3D model in ABB Robot Studio.



*Figure 3: Home Position of the Robot*

The tool used to trace the outline of the character is actually a pen, so that the robot can also draw the character outline on a piece of paper.



*Figure 4: Close-up View of the Tool used*

There are 4 lift-offs between the pen and the model, which are listed below:

- Lift-off #1: Between the character 'F' and 'Y'.
- Lift-off #2: Between the character 'Y' and 'P'.
- Lift-off #3: Between the 'P' and the inner section of 'P'.
- Lift-off #4: Between the inner section of 'P' and the character 'F'

For the 4<sup>th</sup> lift-off when the robot has finished tracing the outline for the 3 characters (including the inner section of 'P'), the robot arm will then return to the original position and start over the same task. And for every character, the robot arm will start from the top left corner of each character and it will begin tracing the outline until a closed-loop path is reached which indicates that the robot arm has traced or drawn the outline of that particular character.

The reference frame is set to the 3D model base, which is also referred to the work object. When the robot arm needs to be lifted off at every end of the character, the offset distance required is referred to the height from the frame in z-coordinate system.

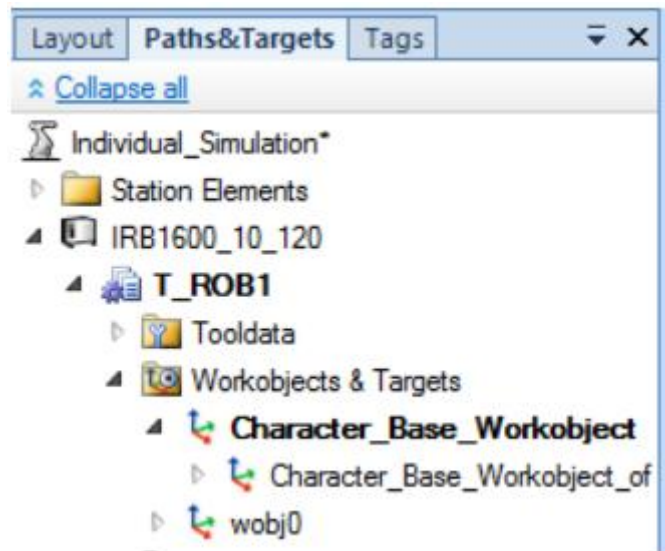


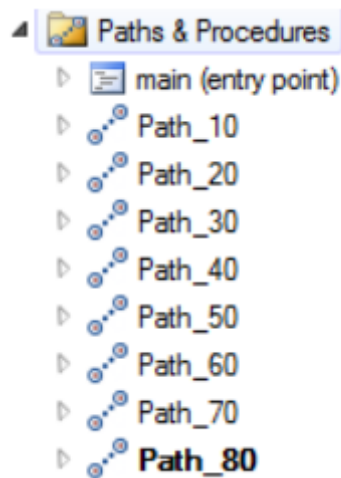
Figure 5: Setting of the Character Base as the Workobject frame

## Explanation of the Functions

In the simulation, there are several different paths which have been created, which are listed at the table below:

*Table 1: Lists of each Path name and their respective functions*

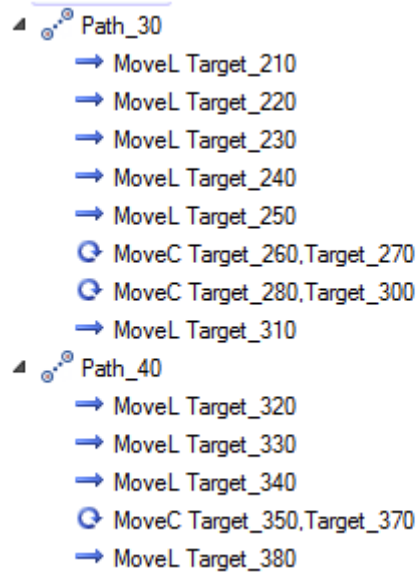
Path Name	Functions
Path_10	The closed-loop path of the drawing/tracing of the character 'F'.
Path_20	The closed-loop path of the drawing/tracing of the character 'Y'.
Path_30	The closed-loop path of the drawing/tracing of the character 'P'.
Path_40	The closed-loop path of the drawing/tracing of the inner section of character 'F'.
Path_50	Lift-off between character 'F' and 'Y'.
Path_60	Lift-off between character 'P' and 'P'.
Path_70	Lift-off between character 'P' and inner section of 'P'.
Path_80	Lift-off between inner section of 'P' and 'F'.



*Figure 6: Creating different paths in Robot Studio*

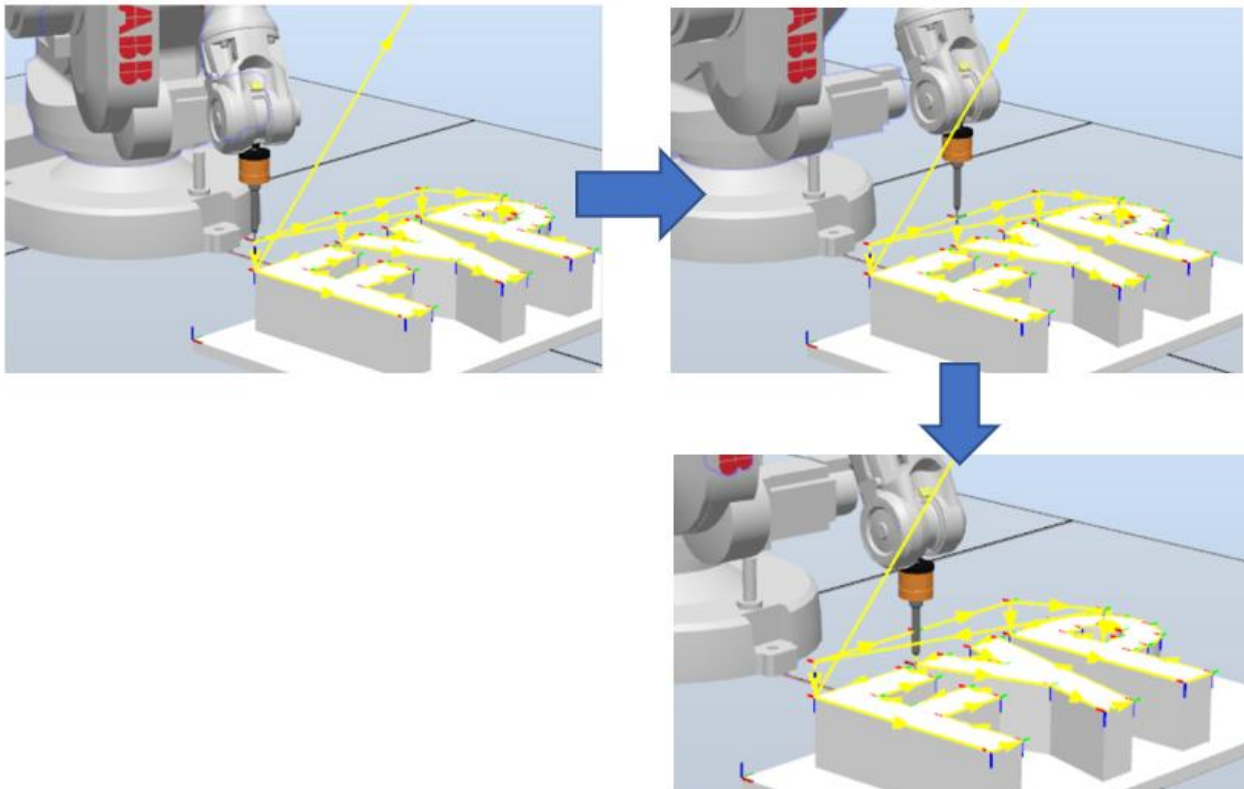
For Path\_10 and Path\_20, since every outlines of the 2 characters are in straight line, therefore no further configuration of the path type is needed. For Path\_30 and Path\_40, due to the curved surface present at the character 'P', the setting needs to be changed from 'MoveL' to 'MoveC' by selecting 2 target points along the curved line so that the program can determine the radius of the curved line which also resembles a semi-circular path. If there are 3 target points along a curved line, then one of the target points need to be deleted as the robot only can use 2 target points from the curved line to trace the path. (as shown in Figure 7 below)





*Figure 7: Types of Target Paths for straight and curved line paths*

For the lifting-up motion, Path\_50, Path\_60, Path\_70, and Path\_80 are responsible for the robot to lift off its pen from character to another or from one character to another section. For every motion, the robot will lift up its pen for 50 mm, then it will move to the coordinate above the top corner of the subsequent character.



*Figure 8: Illustrations of how the pen is lifted up from character 'F' to 'Y' (Path\_50)*

In order to create the additional lift-up motion, additional targets need to be created by clicking the Target at the home panel, followed by 'Create Target', the reference is set as the Workobject so that the distance required for the robot to lift up in xyz coordinates are referred from the Workobject frame, as shown below:

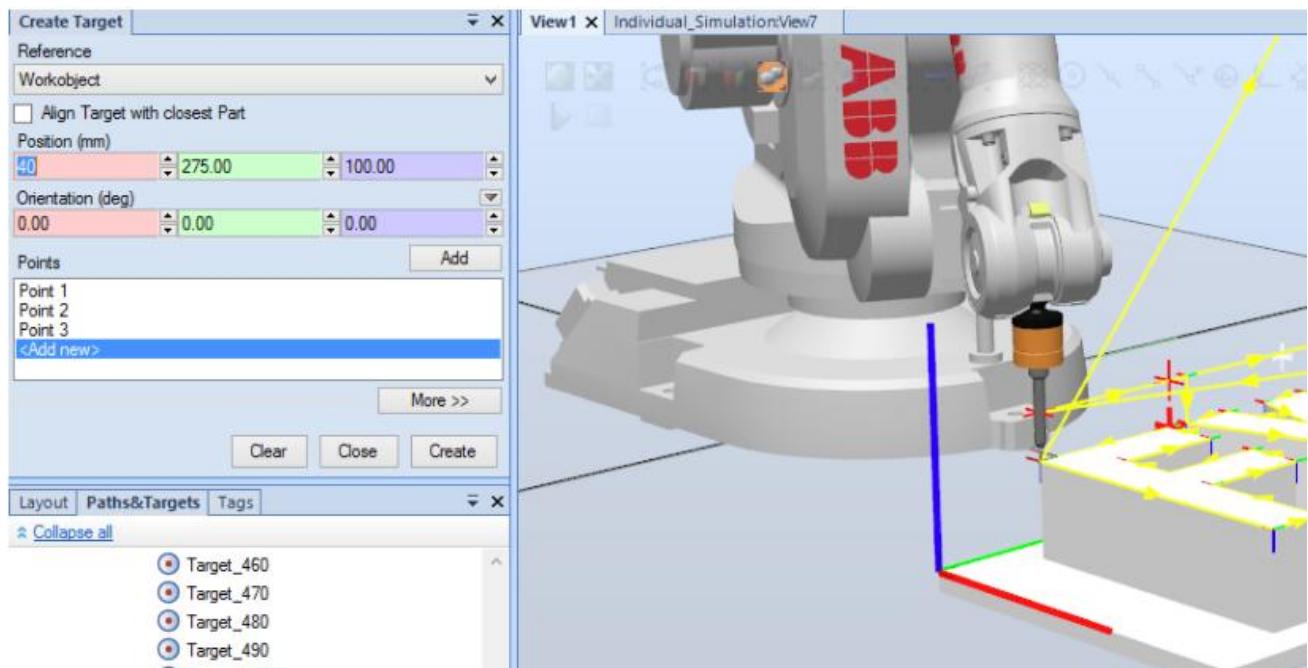


Figure 9: Setting of coordinates with respect to the Workobject for the robot to lift up the pen (Path\_50)

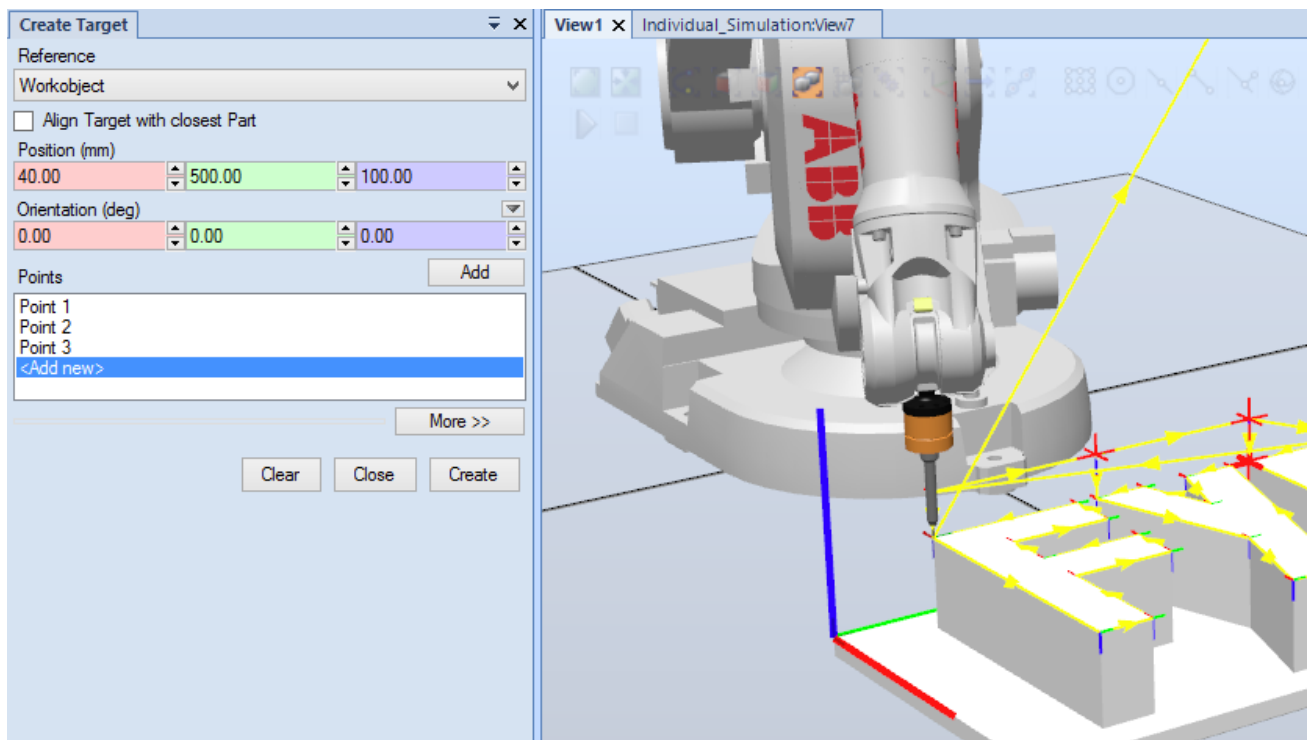


Figure 10: Setting of coordinates with respect to the Workobject for the robot to lift up the pen (Path\_60)

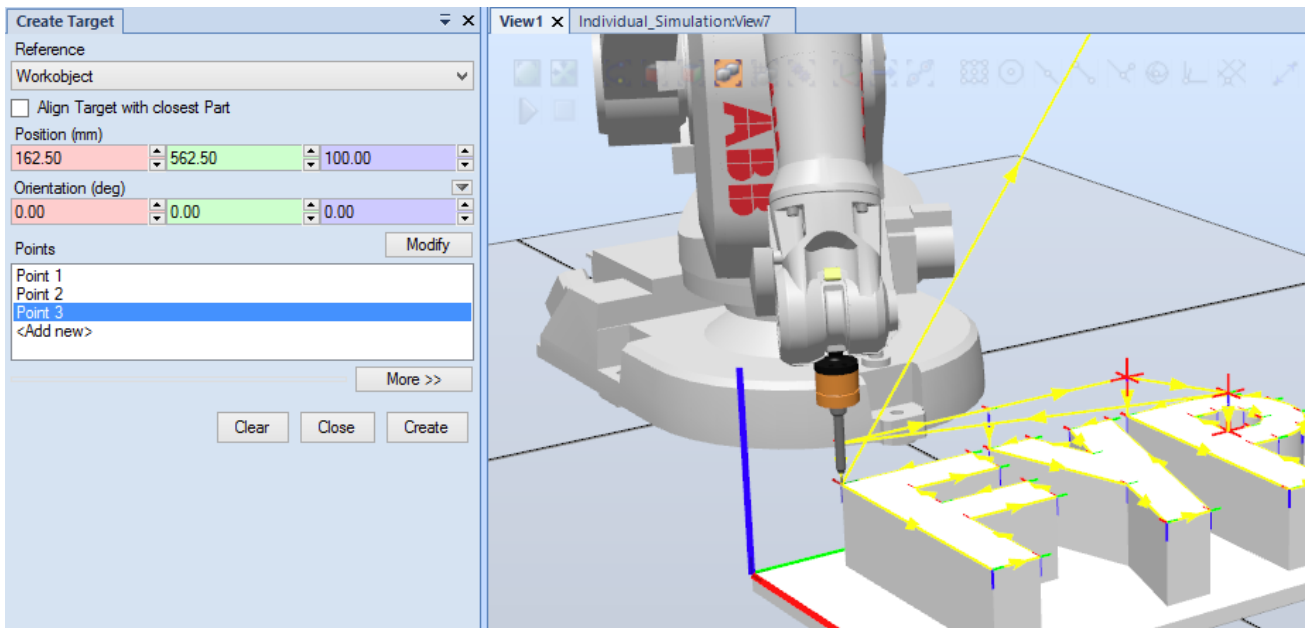


Figure 11: Setting of coordinates with respect to the Workobject for the robot to lift up the pen (Path\_70)

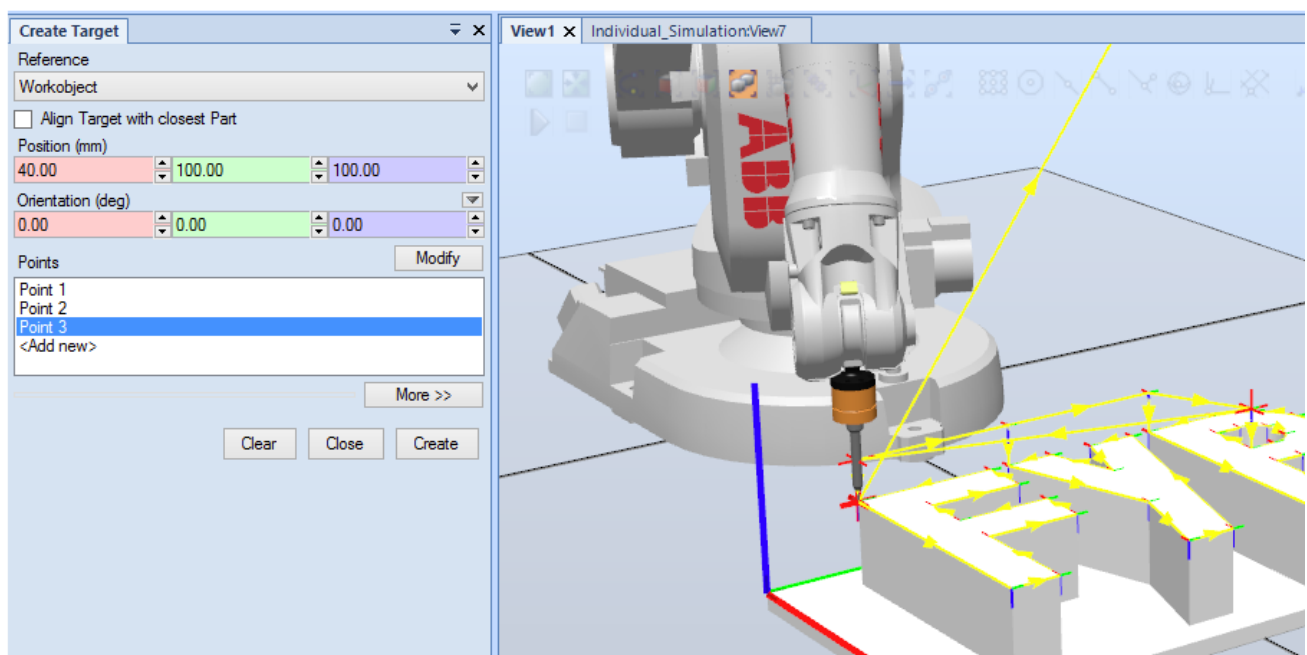


Figure 12: Setting of coordinates with respect to the Workobject for the robot to lift up the pen (Path\_80)

From Figure 9 to 12, the position (mm) of each target point are inserted into the panel on the left, once the target is created, a red marking will be shown at the point where the pen will be lifted up, moved to the next point right above the subsequent character, and also the starting point of the subsequent character.

The program flow of the simulation can be explained using the lines of RAPID written in Robot Studio as shown below:

```

74  PROC main()
75      !Main Code
76      !Add your code here
77      Path_10;
78      Path_50;
79      Path_20;
80      Path_60;
81      Path_30;
82      Path_70;
83      Path_40;
84      Path_80;

```

Figure 13: Code Snippet for the Main Program

Based on the code snippet above, Path\_10, Path\_20, Path\_30, and Path\_40 are the RAPID code where the outlines of the characters are traced or drawn. Path\_50, Path\_60, Path\_70, and Path\_80 are the lines of code where the lifting up of the pen is involved. Therefore, these 4 functions are included between the functions for drawing the character outline.

```

86  PROC Path_10()
87      MoveL Target_10,v300,fine,pen\WObj:=Character_Base_Workobject;
88      MoveL Target_20,v300,fine,pen\WObj:=Character_Base_Workobject;
89      MoveL Target_30,v300,fine,pen\WObj:=Character_Base_Workobject;
90      MoveL Target_40,v300,fine,pen\WObj:=Character_Base_Workobject;
91      MoveL Target_50,v300,fine,pen\WObj:=Character_Base_Workobject;
92      MoveL Target_60,v300,fine,pen\WObj:=Character_Base_Workobject;
93      MoveL Target_70,v300,fine,pen\WObj:=Character_Base_Workobject;
94      MoveL Target_80,v300,fine,pen\WObj:=Character_Base_Workobject;
95      MoveL Target_90,v300,fine,pen\WObj:=Character_Base_Workobject;
96      MoveL Target_100,v300,fine,pen\WObj:=Character_Base_Workobject;
97      MoveL Target_110,v300,fine,pen\WObj:=Character_Base_Workobject;
98  ENDPROC

99  PROC Path_20()
100      MoveL Target_120,v300,fine,pen\WObj:=Character_Base_Workobject;
101      MoveL Target_130,v300,fine,pen\WObj:=Character_Base_Workobject;
102      MoveL Target_140,v300,fine,pen\WObj:=Character_Base_Workobject;
103      MoveL Target_150,v300,fine,pen\WObj:=Character_Base_Workobject;
104      MoveL Target_160,v300,fine,pen\WObj:=Character_Base_Workobject;
105      MoveL Target_170,v300,fine,pen\WObj:=Character_Base_Workobject;
106      MoveL Target_180,v300,fine,pen\WObj:=Character_Base_Workobject;
107      MoveL Target_190,v300,fine,pen\WObj:=Character_Base_Workobject;
108      MoveL Target_200,v300,fine,pen\WObj:=Character_Base_Workobject;
109  ENDPROC

```

Figure 14: Function for Path\_10 and Path\_20 (Tracing Character 'F' and 'Y')

In the function Path\_10 and Path\_20, all the moving targets are configured using MoveL syntax as the character 'F' and 'Y' do not contain any curved path.

```

110 PROC Path_30()
111     MoveL Target_210,v300,fine,pen\WObj:=Character_Base_Workobject;
112     MoveL Target_220,v300,fine,pen\WObj:=Character_Base_Workobject;
113     MoveL Target_230,v300,fine,pen\WObj:=Character_Base_Workobject;
114     MoveL Target_240,v300,fine,pen\WObj:=Character_Base_Workobject;
115     MoveL Target_250,v300,fine,pen\WObj:=Character_Base_Workobject;
116     MoveC Target_260,Target_270,v300,fine,pen\WObj:=Character_Base_Workobject;
117     MoveC Target_280,Target_300,v300,fine,pen\WObj:=Character_Base_Workobject;
118     MoveL Target_310,v300,fine,pen\WObj:=Character_Base_Workobject;
119 ENDPROC

120 PROC Path_40()
121     MoveL Target_320,v300,fine,pen\WObj:=Character_Base_Workobject;
122     MoveL Target_330,v300,fine,pen\WObj:=Character_Base_Workobject;
123     MoveL Target_340,v300,fine,pen\WObj:=Character_Base_Workobject;
124     MoveC Target_350,Target_370,v300,fine,pen\WObj:=Character_Base_Workobject;
125     MoveL Target_380,v300,fine,pen\WObj:=Character_Base_Workobject;
126 ENDPROC

```

Figure 15: Function for Path\_30 and Path\_40 (Tracing entire Character 'P')

Path\_30 and Path\_40 shows the code for tracing the entire character 'P', including the inner D-shaped outline of its character. As shown from figure above, one or two of its code are configured in MoveC syntax as the character 'P' does have some curved outline along its outer and inner edges.

```

127 PROC Path_50()
128     MoveL Target_390,v50,fine,pen\WObj:=Character_Base_Workobject;
129     MoveL Target_400,v300,fine,pen\WObj:=Character_Base_Workobject;
130     MoveL Target_410,v50,fine,pen\WObj:=Character_Base_Workobject;
131 ENDPROC
132 PROC Path_60()
133     MoveL Target_420,v50,fine,pen\WObj:=Character_Base_Workobject;
134     MoveL Target_430,v300,fine,pen\WObj:=Character_Base_Workobject;
135     MoveL Target_440,v50,fine,pen\WObj:=Character_Base_Workobject;
136 ENDPROC
137 PROC Path_70()
138     MoveL Target_450,v50,fine,pen\WObj:=Character_Base_Workobject;
139     MoveL Target_460,v300,fine,pen\WObj:=Character_Base_Workobject;
140     MoveL Target_470,v50,fine,pen\WObj:=Character_Base_Workobject;
141 ENDPROC
142 PROC Path_80()
143     MoveL Target_480,v50,fine,pen\WObj:=Character_Base_Workobject;
144     MoveL Target_490,v300,fine,pen\WObj:=Character_Base_Workobject;
145     MoveL Target_500,v50,fine,pen\WObj:=Character_Base_Workobject;
146     MoveL Target_510,v1000,z100,pen\WObj:=Character_Base_Workobject;
147     MoveL Target_520,v1000,z100,pen\WObj:=Character_Base_Workobject;
148     MoveL Target_530,v1000,z100,pen\WObj:=Character_Base_Workobject;
149 ENDPROC

```

Figure 16: Function for Path\_50, Path\_60, Path\_70 and Path\_80 (Lifting up of the Pen)

In Figure 16, the 4 functions above are the functions which is responsible for lifting up the pen. Path\_50, Path\_60, and Path\_70 consists of 3 lines such that each of the line is responsible for lifting up the pen, move to the next character, and lifting down the pen respectively.

## Conclusion

In overall, the simulation allows the student to expose to what the robot can do in real life as we know that the simulation done inside Robot Studio is almost identical to the robot mechanism in real life, with the exception that the virtual controller is replaced by the physical controller which is required to be turned on for the robot to perform the desired task. In terms of robustness to changes in the environment, since the robot model is trained in such a way that the robot arm is only able to draw the character when it is placed at the fixed xyz-coordinates system. Any changes of the distance in any coordinates will cause the need for the robot arm to recalibrate the position. As a result, the paper needs to be placed at the correct distance from the robot, as well as the height of the placement of paper, so that the robot arm can only draw out the characters on the paper. For the motion speed, it is set at v300 for outline tracing and v50 for the robot to lift up the pen, move to the next target and lift down the pen. Therefore, this speed is considered practical and appropriate for the robot in real life as the robot is able to draw out the character without damaging the paper or item below it.



## Appendix A: CAD Drawing



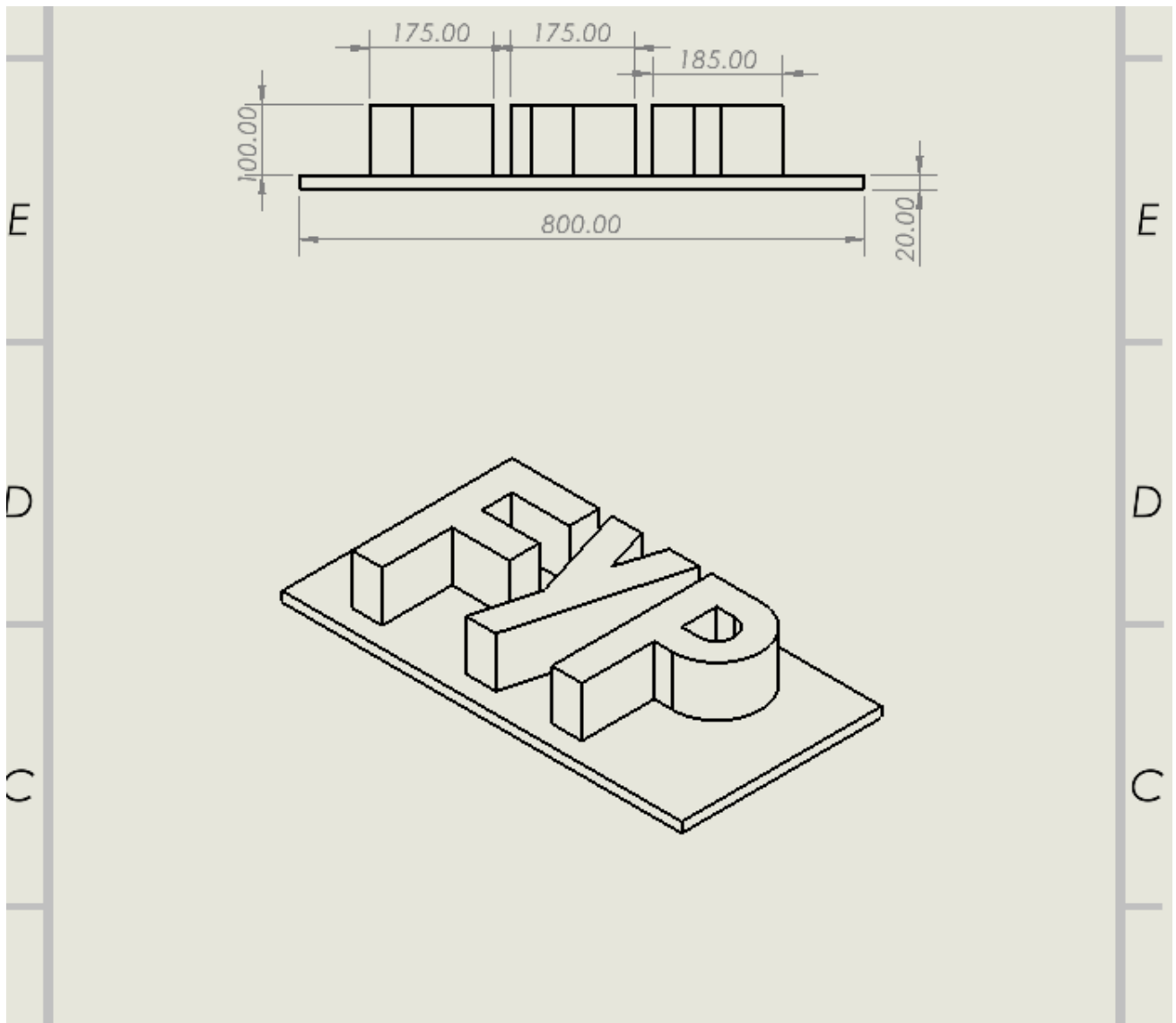


Figure 18: Dimension of the 3D model drawn from the side



## Appendix B: RAPID Source Code

```
MODULE Module1
  CONST robtarget
Target_10:=[[40,100,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_20:=[[360,100,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_30:=[[360,160,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_40:=[[220,160,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_50:=[[220,275,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_60:=[[160,275,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_70:=[[160,160,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_80:=[[100,160,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_90:=[[100,275,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_100:=[[40,275,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_110:=[[40,100,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_120:=[[40,300,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_130:=[[236.892113763,361.162312643,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_140:=[[360,327.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_150:=[[360,387.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_160:=[[40,475,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_170:=[[40,415,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_180:=[[128.52727921,387.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_190:=[[40,360,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_200:=[[40,300,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
  CONST robtarget
Target_210:=[[40,500,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
```

```

CONST robtarget
Target_220:=[[360,500,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_230:=[[360,560,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_240:=[[215,560,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_250:=[[215,597.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_260:=[[198.288987008,648.931209576,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_270:=[[154.538987008,680.717445176,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_280:=[[100.461012992,680.717445176,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_300:=[[40,597.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_310:=[[40,500,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_320:=[[162.5,562.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_330:=[[92.5,562.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_340:=[[92.5,597.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_350:=[[110,627.810889132,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_370:=[[162.5,597.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_380:=[[162.5,562.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_390:=[[40,100,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget Target_400:=[[40,300,150],[0,0,1,0],[-1,0,-1,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget Target_410:=[[40,300,100],[0,0,1,0],[-1,0,-1,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_420:=[[40,300,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_430:=[[40,500,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_440:=[[40,500,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];

```

```

CONST robtarget
Target_450:=[[40,500,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_460:=[[162.5,562.5,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_470:=[[162.5,562.5,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_480:=[[162.5,562.5,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_490:=[[40,100,150],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_500:=[[40,100,100],[0,0,1,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+09,9E+09,9E+09]];
CONST robtarget
Target_510:=[[326.669182372,400,839.5],[0.5,0,0.866025404,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+
09,9E+09,9E+09]];
CONST robtarget
Target_520:=[[326.669182372,400,839.5],[0.5,0,0.866025404,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+
09,9E+09,9E+09]];
CONST robtarget
Target_530:=[[326.669182372,400,839.5],[0.5,0,0.866025404,0],[0,0,0,0],[9E+09,9E+09,9E+09,9E+
09,9E+09,9E+09]];
!*****
!
! Module: Module1
!
! Description:
! <Insert description here>
!
! Author: Alan Chuah
!
! Version: 1.0
!
!*****

!*****
!
! Procedure main
!
! This is the entry point of your program
!
!*****
PROC main()
!Add your code here
Path_10;
Path_50;
Path_20;

```

```

Path_60;
Path_30;
Path_70;
Path_40;
Path_80;
ENDPROC
PROC Path_10()
  MoveL Target_10,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_20,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_30,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_40,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_50,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_60,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_70,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_80,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_90,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_100,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_110,v300,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_20()
  MoveL Target_120,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_130,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_140,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_150,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_160,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_170,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_180,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_190,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_200,v300,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_30()
  MoveL Target_210,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_220,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_230,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_240,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_250,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveC Target_260,Target_270,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveC Target_280,Target_300,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_310,v300,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_40()
  MoveL Target_320,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_330,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_340,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveC Target_350,Target_370,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_380,v300,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC

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PROC Path_50()
  MoveL Target_390,v50,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_400,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_410,v50,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_60()
  MoveL Target_420,v50,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_430,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_440,v50,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_70()
  MoveL Target_450,v50,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_460,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_470,v50,fine,pen\WObj:=Character_Base_Workobject;
ENDPROC
PROC Path_80()
  MoveL Target_480,v50,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_490,v300,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_500,v50,fine,pen\WObj:=Character_Base_Workobject;
  MoveL Target_510,v1000,z100,pen\WObj:=Character_Base_Workobject;
  MoveL Target_520,v1000,z100,pen\WObj:=Character_Base_Workobject;
  MoveL Target_530,v1000,z100,pen\WObj:=Character_Base_Workobject;
ENDPROC
ENDMODULE

```