MTRN3060 – Minor Project Logbook

This document outlines the day-to-day observations, progress, and decisions made while completing my Minor Project. **NOTE: MTRN3060 Workshops are held on Fridays. Given students are unable to use RobotStudio while off campus, the majority of work was done during the practicals. Students were also given limited time with the robot.**

# Friday 4th August – Week 2

During this week’s practical most of my time was spent familiarizing myself with RobotStudio and figuring out how to control the robot. We were tasked with mounting a tool onto the robot, creating a workobject, and creating a simple path. Below are the highlights of lessons learned this week:

* The end effector coordinate system is very important, as the controller will attempt to line the coordinates up with the defined point. Although a point defines a single point in 3D space, its orientation is equally as important as its position.
* Creating a workobject creates reference frame similar to what is discussed in the lectures. The robot has its own reference frame that it uses to determine the position of points (Frame {A}). The workobject is another reference frame which contains the points along our path (Frame {B}). We can determine the position of the points in reference to {B} and then calculate what they are with respect to frame {A}.
* I learned a lot about selecting and manipulating geometries in RobotStudio using a number of the tools provided.

# Friday 11th August – Week 3

This week’s practical is primarily about the RAPID programming language. This is especially useful for the project, however no progress was made on the project itself. I learned a lot about the Auto Path feature, which can create a path given a 3D geometry. Below are some of this week’s highlights:

* Auto Path has a number of settings concerning the number and proximity of points being generated. Given the task this week is a simple shape it wasn’t necessary to adjust them.
* Points generated by Auto Path are tangential to the edge of the geometry being used to generate them. This causes a number of issues with singularities and points with no valid configuration. This can be fixed by rotating points.
* Auto Config is another useful feature. It’s best to manually configure the first few move instructions in a path as it will base the configurations it sets for other move instructions on the last few. Sometimes manual reconfiguration is required.
* I learned how to connect to the robot, and how to access and read the RAPID code generated by RobotStudio. And to sync and play before each simulation.
* I was also lucky enough to practice connecting to and controlling the real robot. I made an error by not checking my relation was set up properly and accidentally wiping my station RAPID code. Luckily I made a backup, and I will know not to do this in future.

# Thursday 17th August – Week 4

I determined the easiest method for writing my name out with the robot would be to create a 3D model in Fusion360 and use it’s geometry to quickly generate paths. I modelled an A4 sheet of paper with my chosen text on it at the appropriate scale. I chose a font with no sharp corners to make writing it easier. I imported it into RobotStudio and began creating paths. Here’s what I learned completing this task:

* While it would technically be faster to just manually create points to roughly spell out my name, it wouldn’t look anywhere near as good and would be more difficult to edit. I am already experienced with 3D modelling so this made the most sense to me.
* Auto Path can easily create points around a perimeter, however letters such as “e” and “o” have two perimeters to consider. To solve this I made two paths, one inside and one outside, and joined them together.
* I added a “liftPoint” above each word that the robot lifts up to when finishing a pen stroke, this eliminates smudging and makes sure I can transition between paths easily.
* I made a workobject relative to the paper. This made it easy to adjust the position of the points as a group, and ensured they wouldn’t be offset in any weird directions.
* I am currently only using the pen\_holder file from iLearn. If I want to calibrate the pen holder I will need to come up with a better solution.

# Friday 18th August – Week 4

Most of the practical from this week was focused on the pneumatic gripper, much of this could be applied to the pen holder used for the minor project. I learned how to create my own custom mechanism from the existing penholder files, and how to rig it for joint movement. I also noticed an issue with the paths generated by auto path not being accurate enough to draw letters properly. Some were skewed or cut off in places.

* I noticed I was running my simulation at v1000 and z30, which is too fast and too inaccurate. I adjusted my settings so all move instructions for when the pen touches the paper to be v30 and z15, and all movements for when the pen was off the paper to be v50 z15 and using the joint move type.
* I learned the joint move type is much better for moving where accuracy to a linear path isn’t needed. I used this movement type when moving between my home point and my liftPoint, as well as between two liftPoints. This helped reduce any errors involved and made sure the joints had the freedom to move.
* I managed to rig the pen holder so that I could jog the pen grip up and down the shaft, and the pen back and forth in the grip.
* I encountered an issue where my simulation kept using the joint 6 coordinate frame instead of my newly rigged tool. This was due to each move instruction defaulting to tool0 as soon as I removed the old tool from the robot. To fix this I had to manually change the tool for each move instruction to my new tool.

From here, I was ready to demonstrate.

# Friday 25th August – Week 5

This week was the demonstration, I made very few changes to the simulation this week. I managed to measure the distance I wanted the paper to be from the robot, the difference in Z height, the length of the pen holder and the pen itself. I altered my simulation accordingly and prepared to present. However, there were several issues regarding the demonstration.

* The time taken to perform each person’s demonstration was massively underestimated. As most people hadn’t gotten the chance to practice connecting to the robot in previous weeks, it took much more than 10 minutes per person.
* My simulation was spot on, the only error was that it was approximately 1 cm off the page. This could’ve been solved in seconds, however as previously mentioned we were short on time. This was likely due to the shape of the simulated pen holder being different to the shape of the one attached to the robot. To fix this error, I could have decreased the length of the pen gripper or lowered my workobject to account for the height difference. It would’ve been best to use the flexible characteristics of the pen holder to apply more pressure to the paper.

# Conclusion

Overall the project was a success, were it not for complications with the demonstration. Although I couldn’t write my name on the paper given time constraints, I will attempt it again with tutor supervision. My simulation shouldn’t require any additional tweaking other than lowering my workobject approximately 1cm.