**Progress Report**

Week 4 (19th~25th March, 2018):

There was a difficulty in scheduling for the office hours with the teaching assistants (for Solidworks). The original office hours were scheduled to run from 1 pm to 4 pm every weekday of Week 3 (12th~16th March), to which I could not attend, as both my partner in the same part assignment and I had to attend regular classes from Monday to Thursday while the office hours were open. Since our group was still going through the ideation process, my partner and I visited during the office hours on Friday the 16th to go through the Solidworks part of the Capstone Design Manual, in order to learn the basic tools and functions we will be using in the future from the teaching assistants of the Solidworks part.

Due to the aforementioned scheduling difficulty, the office hours, then, changed to 7 pm to 9 pm on Mondays, Wednesdays, and Fridays, starting from this week. However, we could not fully utilize the office hours on Monday and Wednesday, as we had our group meeting on Monday from 7 pm (which went on until 11 pm), during which we evaluated the brainstormed ideas. The design concept was still yet to be decided, so we did not visit the teaching assistants, as we did not have the design to work with and work on.

After deciding on the ball-collecting method, our group conducted preliminary experiment, in order to finalize the design concept. However, this process ended on Thursday the 22nd, so my partner in Solidworks part and I only got around to use the office hour on Friday the 23rd to get necessary helps from the teaching assistants. Later on, we finished making the concept design, by, first, assembling the given components, then, attaching the collecting unit to the former assembly.

Week 5 (26th~30th March, 2018):

The major problem we faced in Solidworks is that neither of us were able to work separately at home due to two reasons. One, I use a laptop running on macOS, meaning that I had no way of installing the Solidworks program onto my personal laptop to work at home. Two, my partner in Solidworks part had to work on the desktop assigned to him in the laboratory where he works, because his personal computer is damaged and unusable at the moment. What is more, although I copied a file of the Solidworks installer onto my laptop (macOS), for some reason, we were unable to move the file on my laptop onto another USB drive for my partner to copy onto his desktop. Therefore, we had to schedule times to work together on the desktop assigned to our Capstone Design group, which itself is already troublesome and time-inefficient. However, there were several times when other members of our group assigned to LabVIEW were using the desktop, so we had to comprise with that also.

With that said, we managed to make time for the office hour on Monday to learn the animation function on Solidworks from the teaching assistants, so that we can insert an animation of our design concept for the presentation on Friday.

When we had our regular meeting with our advisory professor on Wednesday, we were told to put in more details into our design, so that the mechanism is clearly to for the audience of our presentation to identify. Subsequently, we scrutinized our design, which we presented on Friday.

We are yet to reflect upon the feedbacks we got from the presentation on Friday, in order to further improve our final design. Our group will start looking into the engineering problems related to our design, and thereafter, we will make necessary adjustments on Solidworks, and perhaps, should time permit, start twigging details into the design as well.

Week 6 (2nd~8th April, 2018):

The focus of this week was to come up with a new collecting mechanism based on feedbacks given from the professors during the first presentation on the preceding Friday (30th March).

On Monday (2nd April), the group meeting was held to brainstorm new ideas in translating rotary motion from motors to vertical motion, in order to get rid of the rack and pinion system, which was inefficient in terms of power management. Two ideas were, then, finalized at the end of the meeting, so that my partner and I could work on Solidworks on the 3rd (Tuesday) to visualize the system for our advisory professor to easily understand during our regular meeting on the 4th (Wednesday).

However, our advisory professor strongly suggested that we should start from the scratch and come up with a collecting mechanism that would not require the mobile platform to come to halt at every ball collecting motion.

Subsequently, another group meeting was held on the 5th (Thursday) to repeat the brainstorming and finalizing procedures. The premise of the design concept ideas was contained within the concept of which the ball collecting would be done along the movement of the mobile platform, so that the mobile platform would not have to stop. Once the new design concept was chosen, specific dimensions, along with adjustments in the mobile platform itself, were decided. Then, over the weekend (Sunday, the 8th), I worked on learning to use the weldment tool on Solidworks, since we ultimately decided that the frame of the mobile platform will be aluminum profiles.

Week 7 (9th~13th April, 2018):

On the 9th (Monday), with all the dimensions to the new design concept chosen, and having learned necessary tools for design adjustment, my partner and I started to draw and reassemble the mobile platformon Solidworks. Since there were many vacant computers in the Capstone Design Lab, my partner worked on making the parts for our newly designed collector, while I worked on reassembling the mobile platform on another computer. Although the reassembling part was finished on the day, redesigning the collector was not, as more specifications needed to be clarified in order to complete the task on Solidworks.

On the 10th (Tuesday), we gathered and continued from where we left off the night before. Working on the collector needed to be completed first, so that necessary adjustments could be made on the mobile platform. Once the former was done, I began to assemble the collector onto the mobile platform that I worked on the previous night. Some changes in positioning the front wheels (and Dynamixel motors) were made in order for the collector to function where we positioned it (relative to the mobile platform and the ground) before working on it on Solidworks.

Now that the part assigned to Solidworks is finished for prototyping, we plan to 3D-print parts that we cannot buy or make, and gather aluminum profiles to actually assemble the hardware after the midterm exam week.

Week 8 (16th~20th April, 2018):

As aforementioned, nothing much was done, because it was the midterm exam week. However, the TAs for Solidworks scheduled mandatory feedback session on Friday the 20th, wherefore allowed our group move forward with our plan, as they gave a positive feedback.

Week 9 (23rd~27th April, 2018):

On Monday the 23rd, my partner assigned to Solidworks and I got together to start working on assembling the frame for the mobile platform. With the help of Mr. Yeo, we were able to make all the necessary parts with 20-mm aluminum profiles for the frame element and acrylic plates for flooring. While assembling, we found out that some of the body space was redundant, so we decided to get rid of the said space and make necessary changes.

After getting feedback from our advisory professor through the group meeting on Tuesday (24th), we got together on Wednesday the 25th. We made changed aluminum profile parts and reassembled the body frame, on which we shall fixate presently.

After assembling the body frame, we spent time calculating the dimensions for the collector/storage unit that we planned to 3D-print. We, then, created the .STL file on Solidworks, so that Mr. Yeo can process the files to print out the parts.

Next week, we plan on realizing the collecting mechanism, so that we can make the final adjustments to the parts before 3D-printing.

Week 10 (30th April~4th May, 2018):

It had been announced that the 2nd presentation, which was held on Friday (4th May), should focus on the movement of the mobile platform and ball collecting mechanism, which we took the meaning that presenting the ball releasing mechanism was optional.

As such, my partner assigned to Solidworks part and I worked on manufacturing the collecting system only. We got together on Monday (30th April) to start working on our assignments. The incline components that we had completed prior had design flaws, so we, first, worked on redesigning those parts. Afterwards, we meticulously calculated the dimensions necessary for the swinging arm of the collector mechanism, so that we could 3D-print the arm that both fits the purpose (of smooth collecting motion) and meets our imagined design outlook as perfectly as possible.

On Tuesday (1st May) when we got our 3D-printouts of the parts, although the incline platforms were perfectly fixed, the collector arm had severe flaws. Fortunately, we could quickly identify the deficiencies, and we consequently could make adjustments to our design on Solidworks.

However, on Thursday (3rd May; Mr. Yeo of technical support was off-work on Wednesday, so Thursday was the earliest day we could get our new 3D-printouts) we identified another (severe) problem when we assembled the collector arm to the Dynamixel actuator. Our design caused too great a disturbance the actuator to overcome. What is more, the 2nd presentation was to be held the following day, so we could not go any further in terms of manufacturing tangible products.

Thus, we decided to work on making further adjustments after the 2nd presentation.

Week 11 (7th~11th May, 2018):

Since it was the long weekend due to national holiday, our group, as a whole, took a break from our work, and could only have gotten together to hold a meeting on Tuesday (8th May). We looked over our calendar plans, and the group leader assigned each member to specific tasks to be completed due given dates. My partner assigned to Solidworks along with myself was given the task to complete the working prototype of the ball collecting and releasing mechanisms, in order to carry out test-drives starting on the 17th (next Thursday).

On Tuesday (8th May) we got the motors (that we ordered online to use for the swinging arm of the collector and door for the release system). These motors were structurally different from the driver motors that we used to test our previously manufactured collector arm, so we had to design additional components that will allow us to connect the collector arm to the new motors. Alongside this, we made adjustments to fix the deficiency regarding the disturbance, so that the motor torque could overcome it.

Then, on Thursday (10th May), we started working on the storage unit and release mechanism. The storage unit was designed to be a cuboidal box with an open surface in the front for the balls to be collected straight away. Rather than making .STL files on Solidworks, we made the storage walls out of acrylic plates. We previously considered having one of the storage walls as a door that would fall and open (door that is hinged at the bottom) to release the collected balls, which would remain shut until the break system at the top of the door would be rotated via motor. However, we came up with a thin bar that would be directly connected to the motor, that would block the balls from falling out until rotated upwards to release the balls out of the storage.

All the components for the collecting and releasing mechanisms were gathered and assembled on Friday (11th May), and we are now at the stage of prototype testing.

Week 12 (14th~18th May, 2018):

The main goal of this week was to assemble every component so that the mobile platform was set ready to carry out practice runs for the demo.

However, it was pointed out by our advisory professor during out regular meeting, that the extra actuator used for the release mechanism was an over-engineering (in the sense that the task was too trivial for such an actuator with higher level of capability). He, then, suggested that we should come up with a mechanical release mechanism that uses the movement of the collector arm, effectively reducing the number of extra actuators from two to one.

In the end, we came up with a key system, which allowed us to reduce the number of extra actuators as intended. Simply put, we put gears on the collector arm, which is connected to the gear on the bar that blocks the balls from falling out of the storage unit; the gears will only turn when the collector arm rotates in the direction opposite to that when collecting, which in turn activates the key to rotate the gears.

Additionally, we put an incline to the flank of the mobile platform, where the incline of the storage unit meets the frame of the platform, in order to guide the release of the ball into the submission basket.

Week 13 (21st~26th May, 2018):

The mission of this week was to finalize the hardware completion, as we decided to change the axial position of the pair of front wheels, so that the rolling of the mobile platform can be reduced. However, pushing the front wheels resulted in clash with the release guide. So we 3D-printed an improved release guide, whose bottom part is carved to allow the front wheel to roll underneath with ease.

Then, we improved the wear on the mounting hubs of the mechanum wheels. We replace the plastic hubs with metal hubs, so that wear is minimized. However, the metal hubs were auxiliary components to the Dynamixel actuators, not the mechanum wheels, so we had to make secondary hubs that connect the wheels to the metal hubs. After two fruitless trials and with the help of Mr. Yeo, the technical support personnel, we were able to manufacture appropriate mounting hubs. The mechanum wheels are well mounted to the Dynamixel actuators, so there should be no slipping.

It was identified that the acrylic storage unit caused problem for the vision of the webcam, as light reflecting off the ceiling of the storage hindered the vision. Consequently, the ceiling was cut out, so that the vertical walls are stuck to, but at the same time hindrance to vision was removed.

As of this week, the hardware part is pretty much completed. The only thing we need to work on is positioning the wires that connect each electrical component to the converter unit.