The Robographer: Progress Review #10

Name: Rohit Dashrathi
Team: G (The Robographers)
Teammates:
Jimit Gandhi
Gauri Gandhi
Rohit Dashrathi
Sida Wang
Tiffany May
ILR No.: # 9
Submission Date: Mar 17, 2016

1. Individual Progress

Responsibilities: Project management
Mechanical Design and Development

Softwares/tools Used: Google Drive, Google Calendar, Microsoft Excel, Solidworks

Task Description:

Following tasks were assigned to me and completed before the progress review 10:

a. Conducting team meeting and deciding goals for PR#10
b. Fabrication of multiple pan tilt units using additive manufacturing
c. Completion of the mechanical assemblies
d. Preliminary testing for inertial vibrations

a. Setting the goals for PR#10:

1. Fabrication of multiple pan tilt units
2. Photo clicking filtering for multiple persons in the frame
3. Photo clicking using multiple cameras for best smile estimation
4. Complete hardware integration of 3 turtlebots

b. Fabrication of multiple pan tilt units using additive manufacturing

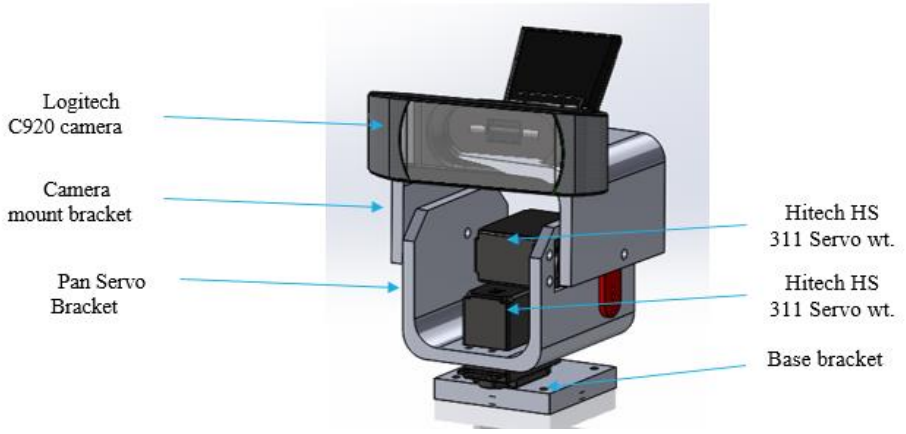


Figure 1 : Pan tilt unit (rev 2.0)

Figure 1 depicts the pan tilt unit rev-2 redesigned before PR#9. We had fabricated a working prototype of the pan tilt unit (rev 1.0) in the Fall semester using 3D printing. With its overall stable performance and structure till now, we decided to fabricate all the further required pan tilt units using 3D printing only, keeping in mind the main advantage of time saving. I used the Makerbot 2X Replicator 3D printing machines present in the MRSD laboratory for the same. Figure 2 shows the manufactured and assembled pan tilt unit.

Figure 2: Fabricated Pan Tilt camera unit assembly (rev 2.0) using 3D Printing

c. Completion of the mechanical assemblies:

After completion of the pan tilt unit assemblies, next task was to integrate these assemblies with their respective turtlebots. For this I designed 2 more parts and fabricated them using 3D printing. Following figures 3 and 4 shows the CAD drawing of these 2 parts. Pan tilt holder (figure 3) is used to assemble the pan tilt unit with the elevation rod while the elevation while the Elevation rod holder (figure 4) is used assemble the whole pan tilt-elevation mechanism with the turtlebot base.

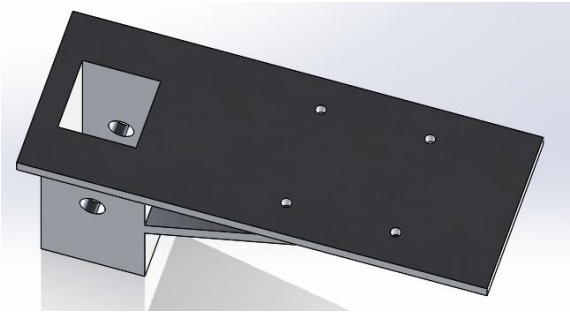


Figure 3: Pan Tilt holder design

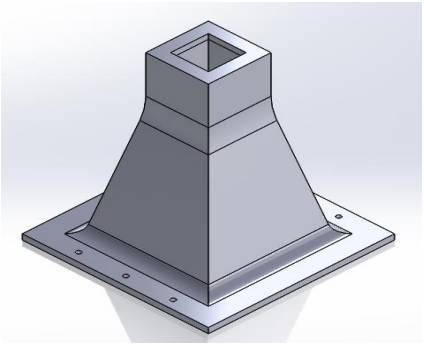


Figure 4: Elevation rod holder Design

Finally, the complete integrated system was ready with total 3 turtlebots equipped with the pan tilt camera units and demonstrated during the PR#10. 2 of the 3 turtlebots were equipped with the new pan tilt elevate unit while the remaining was the same as developed in the fall semester. Figure 5 shows the picture of the 2 turtlebots integrated with the new pan tilt units along with the elevation axis.

Figure 3: Turtlebots + new pan tilt camera unit assembly

d. Preliminary testing for inertial vibrations:

As explained in the ILR#8, the new pan tilt unit+ turtlebot assembly has a lower self-weight than the previous design described in the ILR#3. Statistically speaking, the height is reduced by 26%, length by 44% while the breadth is reduced by 27% as compared to the previous design. In addition, the elevation rod in the new unit is 1 kg lesser in weight and 0.5 feet lower in the height. This decrease in the height, weight and the overall dimensions was done to lower the effect of inertia on the robot system. After integration, the new pan tilt+ turtlebot assembly was checked with the older variant used for FVE. It was found that due to lesser height and weight of the elevation rod of new unit, the effect of inertia was low. This was evident from the sizeable reduction in the amplitude of vibrations of the elevation rod. Hence, the desired success was achieved.

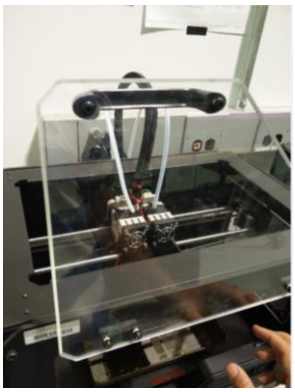
2. Challenges

Though my tasks for the PR#10 were quite straightforward, the completion involved some major challenges as described below:

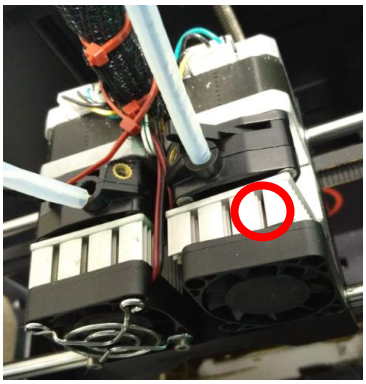
1. **Late delivery of the components:**

   We had ordered the fitments, Aluminium extrusion bars, servo motors, cameras and the Chromebooks which were expected to come by Tuesday (15th March) the most. These items were needed for the complete system integration. However, they were not shipped in the committed time frame by the manufacturers. Hence, I had to make fitments and the elevation bars by myself. Also, Ander helped us and provide some servo motors of similar configurations with our chosen ones. I tweaked the designs a little bit to match with the motor sizes. However, these activities took a lot of time. Also, the modifications to be made were tricky and damaged the motor housings which were 3D printed. Hence, I had to re-print them which added to the time expense.

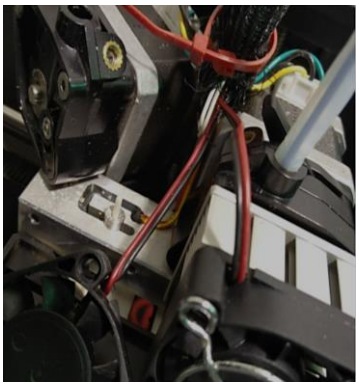
2. **Printers stopped working:**
   Our fabrication methodology heavily relies in the 3D printing procedure. However, none of the printers were not working in the last week end. Also, that being a weekend, it was not possible to obtain technical support. Hence I decided to have a go at the printers and repaired[i] them by myself. My attempt was successful and I was able to repair 2 printers which allowed me to continue the work. On the safer side, I also informed the MRSD instructor's team about the issue. The response was very quick and the 3rd printer was repaired on Monday. However, the other 2 printers failed again on Tuesday, causing a limited resource availability. This consumed a lot of time. However, I had a lot of fun while repairing the printers. Following pictures show a flow adopted by me for repairing the printers:



Removing the top lid



Removing the heat sinks



Finding and removing the clutter

Figure 4: 3D printer repair

3. Teamwork

Since the start of the project, I have taken the responsibility for the completion of the mechanical work subsystem. With the work done before PR#10, the mechanical subsystem now stands completed totally for the project. I acted as presenter for this PR. Tiffany worked on correcting the face tracking mechanism to work with the new pan tilt units. Gauri and Jimit did an inspiring work to implement the ROCON framework for clicking the photo of a single person by all 3 cameras surrounding him at desired angles of -30,0,30 deg. They worked exceptionally well while being up through all the night for 3 days before the PR#10. Sida also did very well to put a filter mechanism for photo clicking in the presence of multiple persons in the frame. She implemented this filter in such a way that even in the presence of multiple persons in the frame, only the smile of the person with the AprilTag will get detected.

4. Future Plans

My individual plans for the PR#11 for the Robographer Project:

1. **Implementation of the 'say cheese' voice prompt:**
   We have planned to implement a voice prompt 'say cheese', asking the detected person to look in the camera to and smile for better estimation of his smiling percentage. I have taken this responsibility and intend to complete this work using the ROS ROCON APPS (RAPPS).

2. **Fabricate 1 more pan tilt elevate unit:**
   During the PR#10, we showcased 2 newly made pan tilt camera units along with the one used in the FVE. However, I he planned to manufacture one more pan tilt unit with the latest design to keep uniformity.

3. **The final touch:**
   The fabrication of the mechanical part of the system is now complete with 3 turtlebots, fitted with the pan tilt camera units. However, a permanent arrangement for some important components such as the Arduino Microcontroller, the AprilTags for localization along with the wiring arrangements still needs to be done. I have planned to complete this work before the PR#11 and will make sure to present the integrated Robographer system with an aesthetic look of a finished product.

References:

[i] How to repair a Makerbot replicator 2X: https://www.youtube.com/watch?v=CyJ8lt85CIc