Team G- Robographers

**Progress Review 9
Individual Lab Report 8
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Introduction

This week our team focussed on setting up wide angle camera and calibrating them for global localization of Turtlebots as well as worked on setting up Robotics in Concert Framework to establish the swarm communication.

Individual Progress

For this progress review the first thing I did was verify if the Chromebook C720 we ordered last time supports the version and functionalities of ROS. After Sida performed installation of Ubuntu in the last progress review I wanted to verify the performance of Chromebook by running the single Turtlebot integrated program on the Chromebook and test it. Since the Chromebook was to be mounted on the Turtlebot with its lid closed, I tried to ssh into the Chromebook- Ubuntu. But it was unsuccessful. This being my first experience with Chromebook, I searched for this issue over the net and tried out few tips and tricks that professionals had posted but to my dismay, none of it worked.

Finally I decided to wipe everything and perform a Chromebook 'Powerwash' which resets the Chromebook to factory settings and reinstall Ubuntu again but this time with another method of installation. When I asked Sida about the details of her installation, she sent me the link she followed to install it. It was then that I realised that she had not performed complete Ubuntu installation. The method she followed would give you Ubuntu platform as an image on the chrome OS but not a partitioned or separate standalone Ubuntu OS.This kind of installation does not give you control as admin and root and you cannot access or modify certain files as well. I then searched another method of installation called Ubuntu- Crouton complete setup which had a similar installation process of partitioning and assigning a memory to Ubuntu and performed the complete installation. I also uninstalled chrome-OS but created a recovery drive for it incase if anything goes wrong. The chromebook is now a standalone Ubuntu OS computer. It supports all functionalities of ROS, Rocon, Turtlebot control implementation as well as Intraface.

The next task was to work on Rocon and finish its implementation but our lab PhD advisor Sasanka is performing certain experiments on swarm on his own and he suggested that we help him setup 4 cameras for global localization of Turtlebots such that both him and us could achieve this common goal since we were planning to do the same later on for next Progress Review. He wanted to set it up right away since he had an impending IROS deadline so we decided to go with this task and push Rocon for the next Progress Review although we did work on it this time as well. So, Sasanka and I first designed and fabricated four T-shaped mounts (Figure 1) such that one can attach a camera facing downwards on it and hang it from the ceiling. We fabricated four such mounts which was enough to cover the entire room. These cameras were placed in such a way (Figure 2) that two camera would have a common region of at least 1 foot on the ground. This process took about 5-6 hours since it required us to drill holes on to the false ceiling of the lab and also required us to relocate the camera after experimenting

its coverage and light effects by running usb_cam on the terminal. After setting them up Gauri and Sasanka performed intrinsic camera calibration while I wrote a code for automating the extrinsic camera calibration. The idea behind automating it was since the orientation of camera could change due to dynamic region, we need not manually calibrate the camera every time. Instead Sasanka advised me to attach April tags to the ground in the common regions of overlap. Using the coordinates of the detected April tag (Figure 3) we could use TF (Transform) package on ROS to find the positions and orientations of the camera relative to each other. So I made a node which would launch, every time the system is booted. It would take in April Tag parameters of both the cameras observing that April Tag. Once done, the node would basically find the extrinsic parameters of the camera such as relative rotation matrices and translation matrices between two cameras using the TF and Eigen package libraries. This node was launched for other pairs of cameras as well in the launch file. Once this was done we performed certain tests to verify the calibration. It was a successful attempt although it was time consuming.
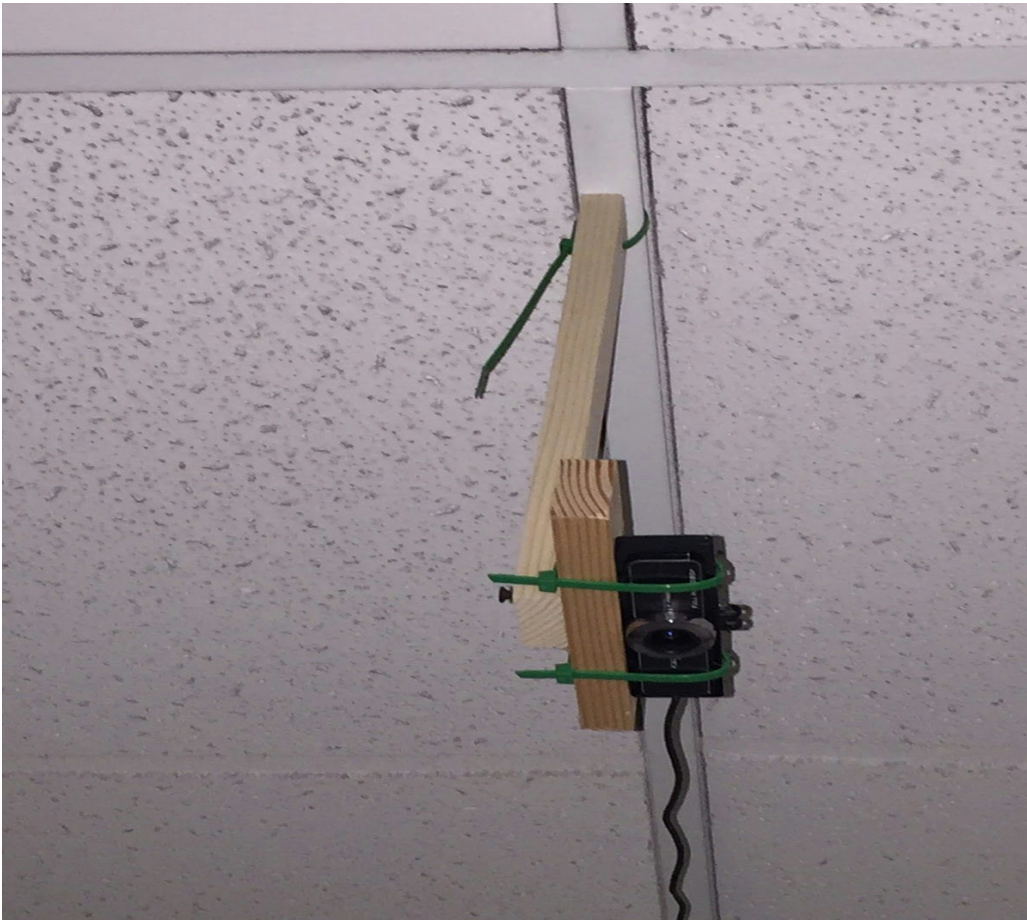

Figure 1: Camera mount hanging from the ceiling

Figure 2: Setup of 4 cameras hanging from the ceiling for global localization

Figure 3: April tags placed on the ground for automated extrinsic camera calibration

The third task was then to work on Rocon. Last time I could tele-operate multiple Turtlebots on Gazebo. This time we wanted to automate the entire process. So Tiffany programmed a node that could navigate the Turtlebot towards a goal coordinate specified by the user. We could do it successfully for a single Turtlebot. But since our work with Rocon framework was in progress, we could not test it for multiple Turtlebots.In Rocon framework whenever we want to send messages of a particular type we need to prepare 4 files and link them with the project package. These files basically establish the type of the message, set up an interface of the gateway node

which is how the hub interacts with different ROS masters in a multi-master setup. Gauri and I both probed further as to how to create these files and link them with the hub. We have partially completed it and are optimistic that this will be done in another day or two although it seems bit challenging since it requires integration of more than 10 packages in Rocon framework. Fortunately there is good documentation available and Allard also has worked on similar framework on ROS Hydro last year.

Challenges

The major challenge this time was to figure out the correct installation of Ubuntu. The detecting of the problem that caused the Ubuntu issue was a bigger challenge since there are not many users who have faced similar situation before. This challenge taught me a lesson to also be aware of not only the work they are doing but also how they are doing it. If this was known to me before a lot of time could have been saved and we could have finished Rocon setup as well. One way to do this is for the team to work together at common times. But in this semester since everyone has opted for different electives, finding that common time is hard.
Another challenge is Rocon set up. This will require two or three of us to collaborate and work. So this time Gauri and I will focus solely on fixing Rocon because without Rocon there is no scope of progress in other tasks. It has been identified as the bottleneck of our project and it is extremely important to fix it.

Team Contribution

Rohit worked on creating a new and improved design of the pan tilt before we mass produce it for other robots. He did a tremendous job identifying key issues and problems with the older pan tilt. the new design is one-third the weight, has more scope of tilting sideways and is now customised in such a way that it is easy to mount camera. The design also enabled less load over the motors.
Gauri worked on camera calibration as well. She helped me and Sasanka mount them and also did intrinsic calibration all by herself. She also gave her insights about the placements of the camera as she has done calibration before for the Turtlebot. Gauri also worked on launching multiple masters with one master controlling Intraface node and publishing Intraface/emotions topic to another node on other master. She was successful in doing that on a single machine. Sida and Gauri also worked on setting up the above setup on multiple machine but it is a work in progress. Tiffany worked on implementing autonomous navigation Turtlebot controller from one location to another for single Turtlebot. Again due to issues with Rocon she was unable to do so for multiple Turtlebots.

Future Work

 I will be working on Rocon setup. Once completed, I plan to develop the two major swarm sub-systems which is Intraface photo-clicking by multiple Turtlebots and navigation of multiple

Turtlebots. I also plan to order new Chromebooks as they have been verified and install Ubuntu on them in the same way that I did above. I have documented and posted this method of installation online if anyone like me gets stuck with the installation process and would continue to do so in future.

As far as team progress is concerned, we should also be able to integrate the two subsystems into a complete preliminary system which would be able to navigate the Turtlebot toward a person and click his photo.