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Summary

We solved the issues faced last week regarding the Jetson Nano board and the 3D printer, and the vehicle design is being carried out. The off-road SLAM and Path Planning methods have been developed based on ORB SLAM 2 and Batch Informed Trees (BIT*), respectively.

What FarmVroong completed this week:

- Install the motor on the car

The output printed last week was not completed normally for unknown reasons. The frame was reprinted after tapping on the board. Fig.1. shows the progress of frame output and the motor mounted on the vehicle with the frames. When the print is working, to prevent damage to the tape, the level of the z-axis of the extruder was adjusted, and the part where the tape was easily damaged was overlapped in the same direction as the moving direction of the extruder. As a result, the printer completed the work without damaging the tape.

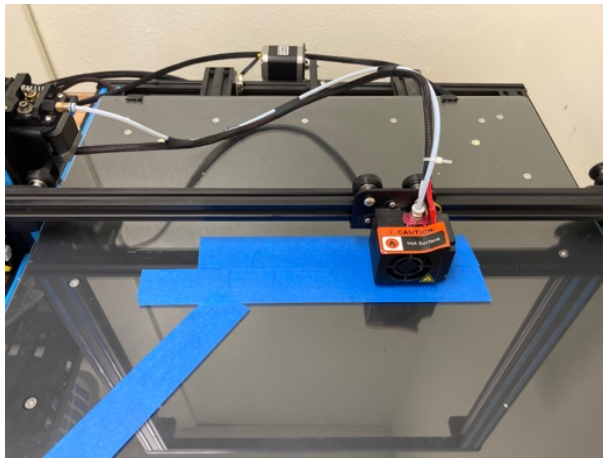


Fig. 1. (a) the progress of frame output on the tapped bed (b) the motor mounted on the vehicle with the frames.

- Reflash Jetson nano board

Last week, the Jetson nano board died, and we could not figure out this issue. The board was reflashed and reinstalled operating system, Ubuntu 18.04. As a result, the board booted normally, and there was no issue. We thought the issue happened due to the abnormal flashing result. The problem was resolved, and we did the development environment setting again.

- Review BIT* method

The off-road Path Planning method would be developed based on BIT*. Therefore, we reviewed the papers [1-2] and the open source library, Open Motion Planning Library (OMPL)

[3]. Edge selecting and cost calculating parts would be changed by applying the GPS data to increase the performance in the off-road environment.

OMPL consists of many state-of-the-art sampling-based motion planning algorithms. However, it does not contain BIT* algorithm. Instead, Autonomous Space Robotics Lab (ASRL) [5] developed BIT* and included it in OMP [4]. We would develop the off-road path planning based on the research of ASRL.

Things to do by next week

- Develop the off-road SLAM code
- Develop the off-road Path Planning code
- Design and test a circuit

Problems or challenges:

- GPS data

GPS data is collected from the vehicle sensor; however, mapping in SLAM collects map points data in configuration space. Therefore, we must calculate the GPS coordination of the map points. We are considering the following two ways.

Option 1. Calculate each map point GPS coordination immediately using the GPS data of the vehicle and the depth information recognized by the RGB-D camera.

Option 2. Calculate the GPS coordination of entire map points by comparing the relative distance to the reference point of the GPS coordinates.

References

[1] J. Gammell, S. Srinivasa, and T. Barfoot, "Batch Informed Trees (BIT*): Sampling-based Optimal Planning via the Heuristically Guided Search of Implicit Random Geometric Graphs."

[2] J. D. Gammell, T. D. Barfoot, and S. S. Srinivasa, "Batch Informed Trees (BIT*): Informed asymptotically optimal anytime search," *The International Journal of Robotics Research*, vol. 39, no. 5, pp. 543–567, Jan. 2020

[3] M. Moll, "The Open Motion Planning Library," *Kavrakilab.org*, 2013. <https://ompl.kavrakilab.org/>

[4] "The Open Motion Planning Library (OMPL)," GitHub, Jun. 13, 2022. <https://github.com/utiasASRL/batch-informed-trees>

[5] "ASRL // Autonomous Space Robotics Laboratory," *asrl.utias.utoronto.ca*. <http://asrl.utias.utoronto.ca/>

[6] raulmur, "raulmur/ORB_SLAM2," GitHub, Oct. 11, 2017. https://github.com/raulmur/ORB_SLAM2