April Tag Detection

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Objectives

Calculating distance using ROS Transform package from the **current location** of the rover to the **goal location** or location of the tag.

1. write a broadcaster node
2. write a listener node
3. write frame node
4. write a launch file
5. write a program that use *Similar Triangle Method*

Materials & Methods

The following materials were required to complete the research:

- April tag cube
- Rover with camera
- ROS installing both on the rover and laptop
- Mater

equation used with in different methods for statistical analysis:

$$D = (WxF)/P \tag{1}$$

$$Matrix \quad Multiplication \tag{2}$$

Equation 1 was used for *similar triangle method* were W is the actual width, F is the focal length, and P is the pixel width on the camera image.
Equation 2 are calculations that is programmed into the ROS transform library involving *quaternion* number.

Introduction

NASA Swarmathon involves university and community college students to participate in virtual and/or physical robotics competition. Through this program students are expected to learn ROS (Robotic Operating System), develop an autonomous foraging algorithm, and assemble a Swarmie rover. By doing so, students not only learn about new robotic technology, but also have the opportunity to add to future NASA space exploration research.

Results 2

Data collected using the *similar triangle method* clearly shows the method was inaccurate as April tag was very cloth or far from the rover.

# Tests	Distances	Results
Test 1	0.23	0.262
Test 2	0.49	0.284

Table 1: Result using similar triangle method

Using the ROS transform, the distance seem very accurate and reliable. Weather the April tag was close or far our distance was most exactly similar to the actual distance.

# Tests	Distances	Results
Test 1	0.23	0.23
Test 2	0.49	0.49
Test 3	0.40	0.40

Table 2: Result using ROS transform

Results 1

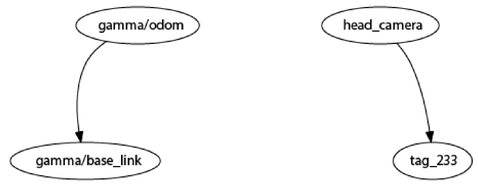
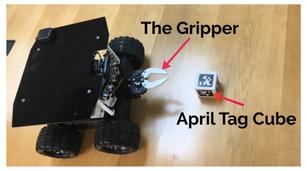


Figure 1: Transform by Odom and April tag package

As show in figure 2, we can see the constructed complete transform tree. According to ROS- *Robot Operating System*-transform there must be a single *parent_link* to for every link, but a link can have more than one *child_link*. Since we have this set up we can easily listen to any transformation between the different link on the tree.



Base on the frames that was broadcaster by the *Odom/EKF* and the *Apriltag_detection* we wrote a broadcaster and a listener node that in order to the transform the camera coordinate frame of the tag cube to the real world coordinate frame. note: *gamma* is the name of the rover.

Figure 2: Image of the rover

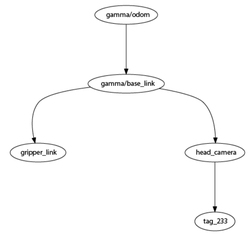
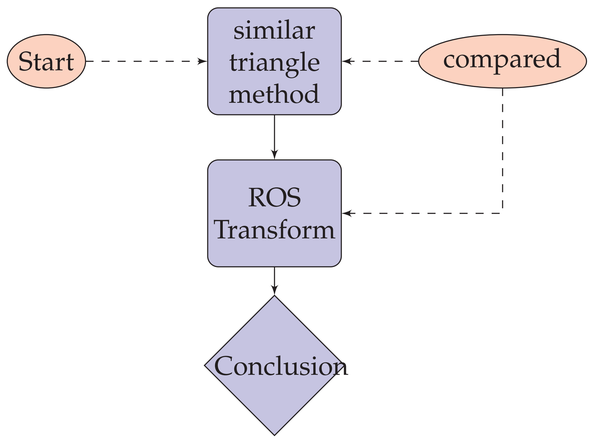


Figure 3: Complete tree of the transform

Conclusion



- Since the similar triangle method do not consider the angle in which the rover camera is focus to the ground, it assumes the camera view to be a square.
- In reality the camera view on the ground is trapezoid which makes it challenging to obtain the exact value of the distance.
- The April tag detection package enable as to use ROS Transform.
- Therefore, we found ROS transform to be more an effective.

References

[1] Melanie E. Moses Joshua P. Hecker. Beyond pheromones: Evolving robust, adaptable, and scalable ant-inspired robot swarms. *Swarm Intelligence*, 9(52):47–70, Feb 2015.

Future Research

Since April tag_detection library and ROS transform are well tested and proven to be most reliable compared to the other method we tried.

I want to effective use them to maximized the accuracy of the rover *autonomous* movement to grape the April tag cube.

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