Robotic Applications Report

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1 Robot Strategy

1.1 Introduction

For this assignment I was required to create a robot that would navigate around a room, collect blue objects, and return them to a red bin. In this section, I will break down how I modelled the problem and then went on to implement it making use of a fetch robot [1] within a ROS environment.

1.2 Modelling

Before implementing anything, I created a state diagram (see Figure 1) to describe a system that would effectively deal with the task set.

The initial state will have the robot scan the room using its camera to find any blue objects. Once located the robot will begin navigating toward the object. If any obstacles are detected with the on-board IR sensors the robot will move around the obstacle until it has been cleared, at which point it will continue to move toward the object. Once within a set distance of that object the robot will attempt to pick it up.

Now that the object has been obtained, the robot will scan the room again with its camera to find any red objects, in this case the bin to deposit the blue object. Once located the robot will navigate

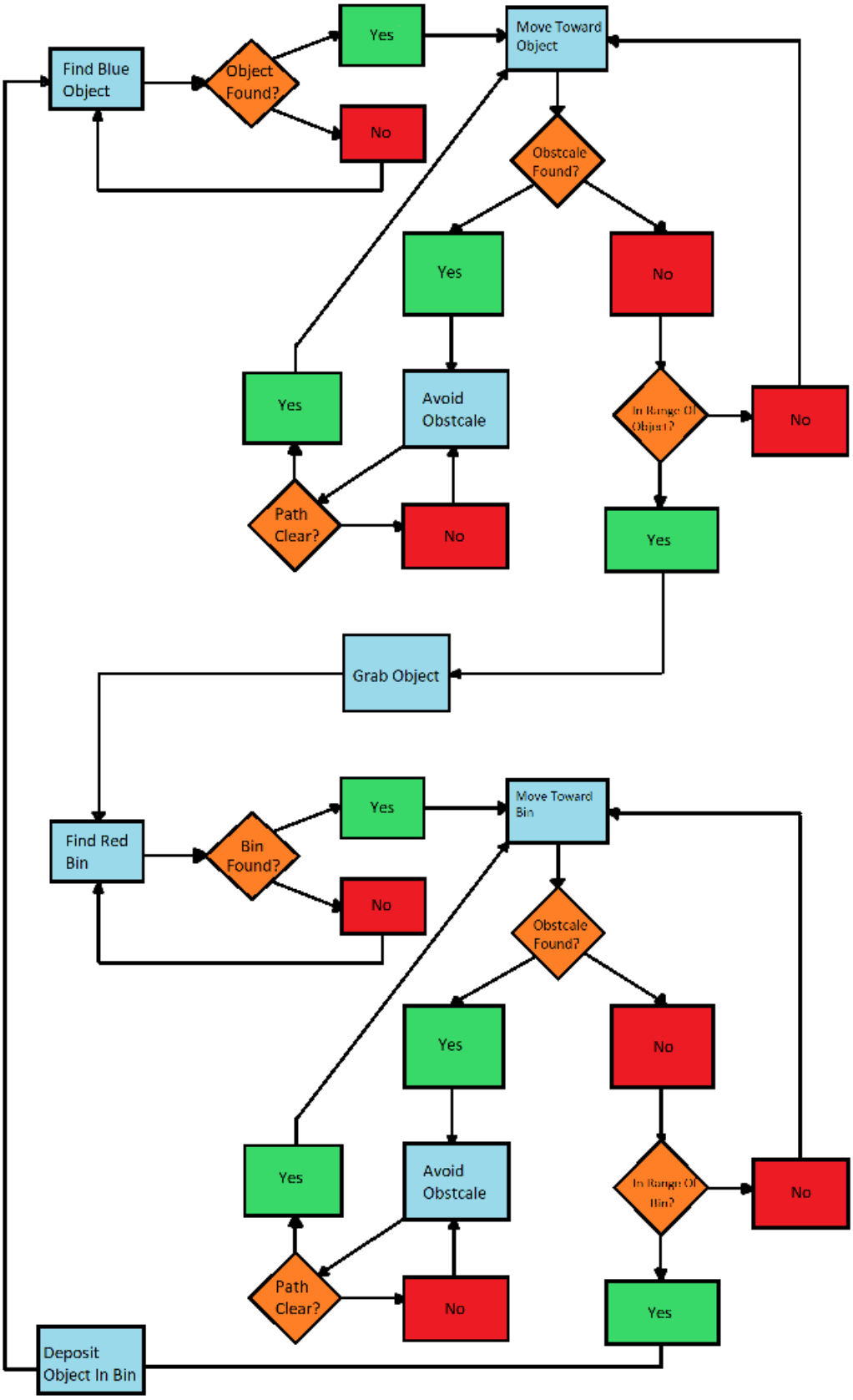

Figure 1: Controller behaviour diagram

toward the red bin. Again, if any obstacles are encountered the robot will move around the obstacle until it has been cleared, then proceed to the bin. Once within a set distance of the bin to reliably deposit the object, the object is deposited in the bin. At this point we once again scan the room for objects and repeat the loop.

1.3 Implementation

The fetch robot used in conjunction with ROS packages has access to many useful features when it comes to implementing the model such as:

- geometry msgs - for controlling wheel motors and transformations for arms and camera
- opencv apps - for making use of camera to detect object and bin
- sensor msgs - for making use of 220 degree laser scanner to detect objects

My implementation was successful in moving between blue and red objects, correctly determining distance from the object/bin to help in consistently picking up the object and depositing it in the bin.

Unfortunately when implementing the object avoidance and arm transformations, it caused a bug that would prevent the robot from detecting the objects/bins and would start colliding into objects. As such these parts have been removed/commented out. I believe the issue is likely something to do with the twist messages not being sent/received correctly once arms transformations are used, since in the original implementation the arm is manipulated at the start to move above the robot and out of the way making it easier for the robot to plan arm transformations to grab the object and not hit things in the way. Given more time I would correct this issue.

1.4 Conclusion

In general I believe my modelling of the problem was clean and I effectively created a complete model for the task set. The implementation however definitely requires some work, as the issue I ran into effectively stopped large parts of the implementation from working. I would like to clean up the implementation further by instead of having different variables for bins and objects, combine the two into a goal variables and simply switch between the blue and red moments. This would make my code cleaner and more concise.

2 Ethical Consideration - Help! Robots Stole my job! Are blue collar jobs under attack?

Media organizations often use sensational headlines to communicate the common fears of job redundancy that robots bring to many workforces [2]. Undoubtedly, such headlines are intended to draw readership and ultimately in today's world maximize advertising. As robotics continue to develop and expand in their uses, so to will the anxiety of job security for many people around the world.

It's not a new topic and unlikely to go away any time soon. Just like with the industrial revolution, with great technological revolutions comes large economic changes, and with that inevitable job loss. Some estimates go as high as 20 million manufacturing jobs could be lost to robots by 2030 [3]. If these are the forecast for just the next decade, what does the future for the typical blue collar worker look like? The two major results of our new 'robotic revolution' will be job loss and more optimistically, job creation [4].

The first and more politically pressing matter is that of job loss. Just like the early 1800s when textile machines were sabotaged and destroyed in fear that they would make tailoring jobs obsolete, today's workers share the same fears and for good reason. If you weren't a specialized tailor you weren't going to retain your job against the textile factories of the 1800s. The argument is that those performing routine and often labour intensive jobs will likely be the first affected by any robotic displacement, and due to the nature of the work are often toward poorer end of the economic spectrum compounding the seriousness of the issue.

But it's not all doom and gloom. The inevitable increase of robots in the workplace, working 24/7 and with meticulous accuracy does not necessarily lead to job loss. For all there efficiency, robots and AI still have a long way to go before they can hold the same creative, emotional and intuitive abilities humans have. These such aspects of a task will still require human input and so it's not unlikely many tasks will still require some level of human operator. The more hopeful outcome of the coming revolution will be robots becoming a common place tool for workers to use to eliminate previously menial tasks.

This is already taking place. In 2017, the Houston Chronicle reported that Amazon hired 2,500 full-time employees to manage its new fulfilment warehouse in Houston TX [5]. Amazon more then doubled its hiring for the center as though the technology of robots quickly and efficiently moved stock around, human oversight was just as important to ensure high levels of quality. And with the success of these centres word spreads and demand grows. "Customer demand is expected to increase," spokeswoman Ashley Robinson stated. "We need to hire more folks to make sure we can keep up." With today's expectations for on demand products, business will need to incorporate automated systems to keep up and compete, but if Amazon is any indicator, such uses of technology will create an abundance of new jobs to fill the void of those lost.

Perhaps a more important question would be to ask what would the world where technologies of the past were forbidden or not utilized for fears they would eliminate jobs look like? Imagine the 21st century with no computing, a technology that now dominates and improves the lives of almost every person on the planet. Never before has society had access to so much powerful technology, so why stop now? The advent of the computer undoubtedly eliminated countless jobs, but so to did it fundamentally change the way the entire global economy functioned and with that created not just jobs, but entire industries. To not utilize and advance these new brilliant technologies would to be to rob future generations of untold wonders and large improvements to their quality of life.

Society will undoubtedly need to evolve with the new technology and keep a keen eye on those whose jobs are at risk and implement strong safety nets to re-skill and reposition them in the economy of the future. The new jobs will be there so it is important today that we start talking about how we move old workforces into the future. As someone who worked in a call center for three years, I welcome our new robotic overlords, and so should you.

3 Self Assessment

Overall I believe I produced a clear and concise modelling for the fetch robot. The implementation as stated definitely needs some work, but isn't too far off from completing the task as set. The code itself is clear and readable, though the subscribing and publishing section at the beginning of the *detectAndRetrieve()* function could be cleaned up a bit.

The reporting is clear, readable and well formatted. The ethics section demonstrates understanding of the topic and cites sources appropriately.

With regards to my grade for this assignment:

- 18/30 for completing the scenario. We do not complete the task set but assuming no obstacles are in the way we do navigate accurately around the environment as required. I believe small changes to the code could result in a full solution.
- 8/10 for the screen cast. The screen cast clearly demonstrates the capability of the robot and the commentary clearly describes how the robot is completing each step a long with its limitations.
- 10/20 for the ROS usage. I need to improve my understanding of the ROS environment and how to better make use of it. My use in the assignment is pretty standard with not much alterations from the practical implementations. My lack of understanding here really hinders my ability to complete the task set.
- 16/20 for the strategy section of the report. I believe I clearly explained how the modelling was done and how implementation both worked and failed. In conjunction with comments in the code nothing is left ambiguous. Everything is well formatted.
- 17/20 for the ethics section of the report. My ethics report clearly demonstrates understanding of the topic and cites sources appropriately. This section is completed fully and is well written.

I believe a grade of 68 would be fair. I would specifically like feedback on ROS usage along with suggestions on why doing an arm transformation at the start might cause problems with navigating the robot later.

References

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