Constraints Document
Version 5.0
McGill University
ECSE 211
Team 20

CONSTRAINTS DOCUMENT

Project: DPM final project
Task: Construct a robot that can navigate a closed course to search and retrieve colored rings

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Author: Shaodi Sun

Edit History

Document Version	Modification	Date	Editor
1.0	Created Constraints document	18/10/2018	Shaodi Sun
2.0	Updated budget	28/10/2018	Shaodi Sun
3.0	Updated environmental constraints based on project description version 2	07/11/2018	Shaodi Sun
4.0	Added more performance-related hardware and software constraints	16/11/2018	Shaodi Sun
5.0	Finalizing Constraints Document	27/11/2018	Shaodi Sun

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1.0 Environmental Issues

The robot will be operated on a wooden, light brown surface with black lines as grid lines. The whole panel is a 15 x 9 surface composed of squares with 30.48 centimeters as side length. Each side of panel is surrounded by "fences" to prevent the robots falling out of the panel, and there are small gaps between them. Those small gaps would interfere with the ultrasonic sensor when performing localization and navigation. We done substantial tests for understanding the robot's performance to avoid interferes at the largest extent. The robot will also be operated in an indoor lab with constant temperature and humidity, but the ambient light needed to be taken into consideration when testing light sensor.

The panel will be divided into four parts, the red zone, green zone, river, and the island. The red zone is the corner of red team starts, and the green zone is the corner where green zone starts. The ring set of both teams will be placed in the island, which is marked as yellow in the panel. Two tunnels, each 11.6 x 10.6 x 9.8, is used to connect from the red zone, green zone to island. That limits the dimension of the robot. The coordinates of those zones will be provided later in final competition.

2.0 Hardware Constraints

All the available hardware components will be limited to a total of three kits of LEGO Mindstorm EV3. If additional hardware is needed, there are 3D printers available to make them. But the sensors, motors, and batteries cannot be made by 3D printer. In addition, a MarkerBot Replicator 2 rapid prototyping machine is available for fabricating parts for those inclined. Buying additional material may also be possible given the permission of instructor. But all computations must be done on board the EV3 bricks; no offloading to an external machine is permitted.

In the final demo, our robot would need to perform localization and navigation, so the robot needs to attach to an ultrasonic sensor. Then it would go through a tunnel to detect rings from a ring set, so it needs to have at least one light sensor to detect rings with different color and beep accordingly. Then it would need to grab the ring, so it needs to have a grabber for it to take the ring out of the ring set, hold it, and unload the ring after it gets back to its starting position. Additionally, the robot would need to use the black grid lines to track its location, so it needs an additional light sensor. That means we need at least two light sensors, one ultrasonic sensor, and one grabber attached to our robot.

3.0 Software Constraints

We are constrained to use Java as the main programming language in the whole project. So, all the libraries and interfaces in Java is available to us. And the number of threads is limited with EV3 system. We also need to optimize our code because of limited memory. So, we need to take efficiency of algorithm into consideration when developing software for the final project.

The other software constraint is given by the leJOS system. We can communicate to the robot by Wi-Fi, Bluetooth, USB, and also through control panel in Eclipse. By using the control panel, we

can also test the performance of motors and sensors. We can also use the console windows and debugger in Eclipse for debugging to enhance our productivity.

4.0 Availability of Resources

Each team member is taking a role which they could demonstrate their capabilities in largest possible extent. Generally speaking, other than the roles they taken, each team member also demonstrates at least beginner level Java programming language. All the team has basic knowledge with LeJOS and EV3 brick that they learned along with individual labs. The team meeting schedules will be constrained by individual team member's schedules. The team is assigned with a professor to meet every Wednesday at 10:10 AM to discuss project progress, overview work quality, and answer design questions if have any. Also, a TA will also meet with the team every Thursday at 4:30 PM to help the team with design barriers. Other than group work, sometimes individual work will also need to be done. The team members may also meet up in smaller group for specific tasks. The schedule that the whole team will follow is outlined in the GANTT chart created by project manager. The team will meet primarily on weekends to collaborate to lab. Software and documentation will be collaboratively created using team Dropbox and GitHub. All team members usually deicide group meeting time, share ideas and concerns, and update the group on work they have done individually using Messenger.

5.0 Budget

In this project's context, there are two main type of budget: time and money. The Beta demo will take place on November 14th. The source code and all documentation should be delivered in Week 6 around November 24th. Along the way, each team member has approximately 8.5 hours per week to work.

For economic budget, during week 6, we spent $19 to print poster for final presentation, and we spent $15 total to but bundle of USB drives. All the money spent are being agreed by each team member.