CONSTRAINTS DOCUMENT

Project: ECSE211 Project Fall 2019

Task: Identify the constraints of the design solution from various perspectives

**Document Version Number**: *Version 1.2*

**Date:** October 19th 2019

**Author:** Cheng Chen

**Edit History:** (*record who changed the document, when and why)*

|  |  |  |  |
| --- | --- | --- | --- |
| *Version Number* | *Date* | *Author* | *Description* |
| *Version 1.1* | *Oct 19th, 2019* | *Cheng Chen* | *Initial draft* |
| *Version 1.2* | *Oct 27th, 2019* | *Xirui Zhang* | *Added software constraint* |
| *Version 1.3* | *Nov 26th, 2019* | *Xirui Zhang* | *Updated software constraint and budget* |
| *Version 1.4* | *Nov 28th, 2019* | *Xirui Zhang* | *Final Update* |

1. TABLE OF CONTENTS

a. ENVIRONMENTAL ISSUES 2

b. HARDWARE CONSTRAINTS 3

c. SOFTWARE CONSTRAINTS 4

d. AVAILABILITY OF RESOURCES 4

e. BUDGET 5

1. ENVIRONMENTAL ISSUES
2. The robot must be placed on a relatively clean floor since the robot can experience much more slips on a floor with lots of dusts. Slips of the wheels can affect the odometer readings severely because we cannot get accurate readings of the tachometers.
3. The color of the lines on the floor cannot be similar to the color of the floor. For example, the color of the lines can be black on a white floor instead of dark grey lines on a black floor. High color contrast between the lines and the floor can make it easy for our design team to implement the software algorithm for detecting the lines. Low color contrast makes the design harder because the light sensor will read similar data on the floor and the lines. If there exists some noise, it is really hard to differentiate between the data from the floor and the lines.
4. The tunnel that the robot needs to go through limits the height and weight of the robot. As indicated in the project description v1.0, the tunnel has specific dimensions which adds on the constraints of the dimensions of the robot which contrasts with the Hardware Constraints b listed below.
5. We used the ultrasonic sensor for localization. In order for this to work, the floor must have walls on each side because the ultrasonic sensor uses the reflected ultrasonic waves to determine the distances between the wall and uses this information to calculate the angles the robot turned. Without the walls, the ultrasonic sensor will not be able to receive ultrasonic waves that reflects the robot’s actual position on the floor.
6. The blue region in the figure below indicates the river on the board. It demonstrates a physical barrier on the tiles which the robot cannot travel on. Therefore, it is crucial to be able to identify the river and implement software algorithms compatible with it (refer to the software constraints below).

A picture containing text

Description automatically generated

1. HARDWARE CONSTRAINTS
2. The robot we designed is a catapult style ball launcher. We used two motors from the kit. We found out through tests that these two motors are able to provide enough acceleration to launch the ball to the distance specified in the requirements document. However, there will be a limit for the launching distance because of the limit of the speed and acceleration of the motors. If we want to launch the ball to a greater distance, we can use springs or elastic bands to exert larger forces on the ball.
3. To increase the odd of sinking one ball into the bin, the robot needs to carry as many balls as possible resulting in a more complicated software and hardware design. An extra loader mechanism needs to be implemented and the robot will have a larger dimension which conflicts with the Environmental Issues c.
4. Besides, the constraint might be the components to be used throughout the project. As described in the project description v1,0, we will be using ultrasonic sensors to implement robot localization and to detect the other player in navigation. The imprecise readings and unstable performance may contribute to errors or failure of the project.
5. SOFTWARE CONSTRAINTS
6. One main software constraint is that we are constrained to use java as our main language and eclipse as the main development tool. Not all of our team members are proficient in java and some of use prefer other development platform.
7. Due to the capacity of the processors, the number of threads to be used in the software is limited. Using too much threads may lead to processor overload and therefore affects its performance.
8. A finite state machine needs to be implemented on the robot. Throughout its movement, the robot is required to perform different tasks in different stages, such as localization at the starting corner and object avoidance on the island. Different unit algorithms should be called at different times to avoid conflict.
9. All the software components need to be compatible with Wi-Fi class.
10. AVAILABILITY OF RESOURCES
11. Our team members are all current full-time undergraduate students, which means that our capabilities will be very limited. However, all of us are coming from three different majors: electrical engineering, software engineering and computer engineering. Each of us will be assigned tasks that are related to expertise to maximize efficiency.
12. Our team is assigned with a TA that can help us with the problems we might encounter throughout the project. We also have a 30-minute meeting with Professor Ferrie every week for constant feedback and suggestion on our project.
13. BUDGET
14. The major budget of this project is time. Everyone on the team has other courses to spend time on, which means we have to manage the time spent on this project properly. As described in lectures, the delivery date is November 29th and the maximum amount of time is 58.5 hours for each team member. The time spent on this project each week for each person will be discussed and assigned by the project manager based on the availability of that person for that specific week. For example, if one of the team members has midterms that week, his/her time spent on this project will shortened and the time will be compensated next week.
15. We can only use the components from the three Mindstorms kits to build the robot for the project. In other words, we will use limited resources to fulfill the requirements described in REQUIREMENTS DOCUMENT.