THE REQUIREMENTS DOCUMENT

The goal of this document is to try to make sure that the requirements of the client are fully understood. It is composed of several sections, each of which tries to address one aspect of the specification and to try to identify all the related issues. The sections are detailed below and are reasonably generic. These can be modified in your version but only by adding extra sections. The sections given MUST be completed. Once this document is completed, you should know everything about the problem to be solved and the end device to be created. However, as the design process progresses, questions will arise which lead to answers or decisions which might contradict this document. In this case, you need to go back to the document and the client and clarify the issue and update the document appropriately. This is a living document.

Requirements Document

Project: ECSE 211 Final Project (Team 08)

Task: To construct an autonomous robot capable of locating, grasping, carrying and placing an optical beacon, while navigating within an enclosed area populated with known obstacles placed at restricted locations within the enclosure.

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* Compatibility with Third Party Products – Description of the robot’s ability to interconnect with products other than Legos platform.

2.0 CAPABILITIES

2.1 PURPOSE

The basic purpose of this project is to construct an autonomous robot capable of locating, grasping, carrying and placing an optical beacon, while navigating within an enclosed area populated with known obstacles placed at restricted locations within the enclosure. The task of the robot is to play a version of “Capture the Flag” with a single opponent where the beacon serves as the flag. Upon receiving instructions on Bluetooth radio, the robot will assume the role of either defender or attacker and proceed according to its role. If the role assigned is attacker, the robot proceeds to search for the flag, capture it, and place it at a location specified in the instructions received. Otherwise, if the defender role is assigned, then the robot proceeds to the flag location specified in the instructions received, captures the flag, and places it in an arbitrary location within the enclosure (usually chosen to make it difficult for the attacker to find).

(*what is this product intended to do – this should be as detailed a description as you can get.. You could probably start by putting in the specification that you have to date. Note that while details may change, the overall purpose is unlikely to alter. So the starting purpose for this project is to create an autonomous vehicle capable of navigating around an obstacle course, collecting pallets and moving hem to a designated drop off area.)*

2.2 SCOPE

Range of Capabilities

* Robot will operate on a 12x12 field comprising of nine 4’x4’ hardwood-covered metal panels that lock together. The surface of each panel is marked with a 4’x4’ grid that aligns precisely with adjacent panels. These are intended for navigational purposes, covered in the previous labs.
* The robot will be placed in one of the 4 corners shown, at a random position and orientation within the corresponding tiles.
* This will be a onetime operation.
* The robot will be programmed to operate in a 3D environment, whereby it can successfully place and retrieve the object, regardless of its position inside the field.

Limitations

* Budget issues: Large proportions of the budget were taken up by the initial mechanical design as well as the considerable changes which were made as the project moved ahead. High cost of disposable batteries led to the purchase of rechargeable batteries.
* Time Limitations: Each team will be restricted to 5 minutes to complete the specified tasks.

2.3 CONSTRAINTS

The main hardware constraint is the availability of 3 Legos NXT kits comprising of 3 NXT bricks, 9 servo motors, 3 light sensors, 3 sound sensors, 3 ultrasonic sensors, 3 touch sensors, 21 connecting cables as well as related Legos accessories. Additional materials may only be obtained upon the client’s permission. The scope of the machine’s design has limitations. The wheel speed is limited by motor strength. The robot requires approximately 3V to 3.6V power supply through 12 AA rechargeable batteries, which need to be recharged after 4 hour intervals.

Some of the major software constraints include limitations imposed by processor speed of the NXT brick, such as the ability to run threads simultaneously. A total of 256 kb of integrated high speed flash memory is available to the device.

Further details on component limitations can be found in the Constraints document. Additional information on hardware and software limitations can be found in the Systems document.

2.4 USER FUNCTIONS

The NXT brick interface is simple for a user to interact with. The user can select the operating mode of the machine before beginning of the demonstration. Particular variables, such as the /// can be predefined by the user at the start of the demonstration. The user can communicate with the device via the device panel or Bluetooth.

The device will not accept external input during the demonstration as it is autonomous by design. However, it will display output data through its screen for the user to evaluate and observe its performance

(*Can the user interact with this device (a) before it operates, (b) during operations?* *Is there an interface that the user will have access to for operating the device? Is this usable during the device operation? Do you set it up in a “batch” mode? – in terms of subtasks, this might be more important..)*

2.5 OPERATING ENVIRONMENT

(*Where will the device operate? What is the composition of the competition surface? Will this have an effect on the performance of the device in its navigation? Could this affect locate itself? What about ambient lighting? External sounds? Are there any restrictions due to this? What about the temperature environment, external effects, etc.? etc*.)

2.6 PERFORMANCE

The Robot must be able to fulfill the objectives laid out by the client, as discussed in the ‘Purpose’ section of this document. Of crucial importance are the hardware and software aspects, which must be achieved, for the demonstration to be considered successful. An example is the Bluetooth communications, which must work, in order for the task to be successfully accomplished.

(*Minimal performance requirements, e.g. response time to a command, how long must it operate for, how far will it have to travel, etc. Some of this will have been covered in the SCOPE and CONSTRAINTS sections and repetition may not be good – much better to reference the other section – that way changes only need to be made in one place.)*

3.0 COMPATIBILITY

3.1 COMPONENT RE-USE

The team is permitted to reuse the software created for preliminary laboratories (Lab 1 to Lab 5). This saves budget and resources, providing a useful jump off point to initiate the project rather than starting from scratch. Same applies to the hardware used in the above mentioned labs

( *Are you allowed to use existing components? (in a real design this might involve an extra cost), e.g. those developed in the labs? Is there existing software that can be leveraged? What else?)*

3.2 COMPATIBILITY WITH THIRD PART PRODUCTS

As of present, the hardware is not required to interface with components belonging third party manufacturers, although, as previously mentioned, non lego materials may be used with the client’s permission.

The software being used is eclipse, which is used to develop and compile code. Eclipse is a JVM based industrial software used to develop and compile code. It is used in synchronization with the Legos kit and software to develop an autonomous robot.

The Legos software is not currently required to interface with any other products.

(*Does the system have to interface with/connect to devices or components from suppliers other than Lego? What about software and software support?.Does the client specification mandate particular products to be used?)*

4.0 GLOSSARY OF TERMS