



ECSE 211 DESIGN PROJECT **REQUIREMENTS DOCUMENT**

Version *1.04*

02/24/2018

ECSE 211 TEAM 11



VERSION HISTORY

Title	Requirements Document			
Description	Week 1 iteration of this document			
Created By	Luka Jurisic, Documentation Manager			
Date Created	19 th February 2018			
Maintained By	Luka Jurisic			
Version Number	Modified By	Modifications Made	Date Modified	Status
1.00	Luka Jurisic	Created the document. Set out the overall structure that the document should follow	19 th February	Initial work done
1.01	Luka Jurisic	Completed the requirements for sections 1.1-1.3	20 nd February	Much work must still be done
1.02	Luka Jurisic	Completed the requirements for sections 1.4,1.6 and 3.1-3.2	21 nd February	Sections 1.5 and 2.1 remain.
1.03	Enan Ashaduzzaman	Completed section 1.5	22 nd February	Section 2.1 remains
1.04	Luka Jurisic	Completed the Document. Created a Title page and perfected the presentation of the document	24 th February	Final Version

REQUIREMENTS

1.0 CAPABILITIES

1.1 PURPOSE

The defining purpose of this project is to design a fully functioning autonomous robot that can navigate through a series of obstacles within a defined grid, capture an “enemy” flag and finally, return that flag to its area of the grid. An autonomous robot within this scope requires that it be able to localize itself within the grid and navigate, traverse and execute flag capturing without user input. As this a competition, the robot should be able to complete this entire process in a relatively fast time. Also, a key requirement set by the client entails that since there will be two distinctive obstacles, the robot will have to be able to alter its architectural configuration during its run.

1.2 SCOPE

The size of the competition grid will be 12x12 feet and is partitioned into squares of 1 foot in length. The squares themselves are separated by black lines of 7mm in thickness. The grid will be split into the following orientation: There will be two rectangular regions denoted as zones, red and green, corresponding to each player’s base. Each of the zones is surrounded by a virtual river, with two methods of traversal- going under via a tunnel, or over via a bridge.

The competition will consist of 4 1v1 rounds, in which a cumulative score will be determined based on the performance of each round. The score is evaluated based on the ability to perform as precisely as possible the key behaviours of localization, navigation, traversal and capture. Withal, the time taken serves as an imperative measure of the efficiency of the robot’s performance. The allotted time of each round has not yet been announced.

The final design of our robot, although very much still in the preliminary stages, could well serve as a prototype for possible future designs. For example, the client specifications do not require that a flag is physically captured and carried. For a future design, a capturing mechanism could be added to the robot to allow it to physically capture a flag and carry it during any obstacle traversal.

1.3 CONSTRAINTS

Hardware: The final design must be composed of at most 3 Lego Mindstorms Kits, and any additional hardware components that may be required must first be approved the client. There were no limiting specifications regarding the size or weight; however, the robot must be constructing in a manner allowing the centre to be in the corner grid square. This necessitates the robot centre be at most 30cm from its farthest point. The bricks are powered by 6 AA batteries each. The robot must be able to run for the required time for the final competition without running out of battery.

Software: The robot must be programmed and run in Java.

Budget: The client has imposed a strict deadline of the 11th April. The design process will be spread over a period of 6.5 weeks. Considering that there are 6 team members, there will be 58 allotted hours for each team member to contribute their time and energy in the completion of the project.

1.4 USER FUNCTIONS

The user is allowed to communicate with the robot preceding its operation. Information transfer is executed using wi-fi capabilities. The LCD display on the NXT brick allows for a basic user interface that can be used to further interact with robot. However, during operation, the user is not allowed to interfere as soon as it receives its parameters from the team's main computer.

1.5 OPERATING ENVIRONMENT

The surface of the competition grid has not yet been specified, and as such, this current iteration of the document cannot attest to this operating environment. However, it is known that certain black lines, regardless of surface, will be more washed out than others, which affects the robot's ability to localize. Therefore, the ambient light acting on the surface is a very important environmental factor that must be taken into consideration when performing testing. Similarly, the added presence of spectators will cause shadows that will further impact this consideration. In terms of sound, there is likely to be an abundance of it during competition day, however it is not believed that this will impact the robot's performance at all. Regarding temperature, it is assumed that it will be very close to room temperature if it is held indoors, and thus there is no need to be concerned of differing wheel grips than the one already experienced in the lab.

1.6 PERFORMANCE

The robot must be able to complete individual rounds of the competition. It will have to perform all 4 behaviours listed in section 1.2 within the given time limit and try to better the time of the opponent's robot.

2.0 LIST OF UNKNOWNNS

2.1 UNKNOWNNS AND QUESTIONS

The following is a list of current question that the team has regarding exactly how the design should be implemented. A small response indicating our possible method of resolving these issues is included. Similarly, unknownns regarding the project specifications are also listed.



Unknowns

- 1) How many speed bumps will be on the given bridge, and what will the spacing be between them?
- 2) How is our final software implementation going to communicate with game interface on competition day; how will we receive the competition parameters?
- 3) What are the exact limits imposed on the addition of external parts in terms of the ability of the 3D printing allowed/provided?
- 4) The competition surface has not been specified. This is quite an important factor as different surfaces will impose differing amounts of wheel slippage on the robot.
- 5) Will there be a certain amount of control regarding ambient light during competition? As there will be a large number of people watching each run, shadows may serve to hinder a robot's performance.

Questions

- 1) How will we be able to consistently characterize the robot's performance over variable battery voltage during competition day?
 - We can measure our 90 degree turns at different battery voltages and compare the discrepancies. Based on this, a solution can be implemented within the software.
- 2) What method of localization will be implemented?
 - We will choose the method depending on the efficiency and error. This will be done through tests to better understand which method is best suitable.
- 3) How are we going to change the wheelbase of the robot when having to traverse two obstacles of varying length?
 - Again, this can be contemplated once the mechanical design of the robot is begun, as it will give a better sense on the possible restrictions that may be encountered.

3.0 COMPATIBILITY

3.1 COMPONENT REUSE

The components used during the 5 labs are integral for this design project and so reuse is essential. However, any external components that might have previously been utilized must be given proof of authorization by the clients before they could be used. In terms of software, the classes developed during the research and development labs, such as odometry and navigation, can and will be reused for this project. Compatibility

3.2 COMPATIBILITY WITH THIRD PARTY PRODUCTS

Client specifications mandate that the robot be compatible with Eclipse IDE. The implementation of Bluetooth technology for communication is imperative.
