**SYSTEM DOCUMENT**

Project: Design an Autonomous Robot

Task: To design an autonomous robot that is capable of navigating to a predetermined position while avoiding obstacles and firing objects at two targets. This is to be done in the shortest time possible.

Document Version Number: 1.0

Date: Feb 19th, 2015

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**SYSTEM MODEL**

Preliminary Flowchart of the Robot's Operation

Initialization

Navigate to the target

Arrived at the target

Yes? No?

Stop

Finish recording

**HARDWARE AVAILABLE AND CAPABILITIES**

NXT Brick:

- 32-bit ARM7 microprocessor

- Bluetooth wireless communication (Bluetooth Class II V2.0 compliant)

- USB 2.0 full speed port

- 4 input ports, 6-wire cable digital platform

- 3 output ports, 6-wire cable digital platform

- 100 x 64 pixel LCD graphical display

- Loudspeaker

- Powered by 6 AA batteries

Motor:

* Capable of turning/rotating the robot in a desired angle if needed

Ultrasonic sensor:

* Able to measure a distance between 0 to 255 cm with an error of +/- 3cm
* Works better on rigid surfaces

Light Sensor:

* Able to measure certain threshold of light values with the assist of codes
* Have floodlight to increase the accuracy of the measurement

Touch Sensor

* An analog sensor that can detect when the sensor’s red button has been pressed and when it is released.
* Can be programmed to action using three conditions—pressed, released, or bumped

Color Sensor

* Digital sensor that can detect the color or intensity of light that enters the small window on the face of the sensor
* Can be used in three different modes: Color Mode, Reflected Light Intensity Mode, and Ambient Light Intensity mode.

Electromechanical limitations

Require 6 1.5V AA batteries to run.

The motor runs at 160–170 rpm, with a running torque of 20 Ncm and a stall torque of 40 Ncm.

**SOFTWARE AVAILABLE AND CAPABILITIES**

The robot will be running in a Java virtual machine called leJOS NXJ. It is capable of running things in object oriented languages such as Java, which offers several functions like array, synchronization, and exceptions.

**COMPATIBILITY**

Structurally the Lego bricks will fit well together; however, if we were to add additional components like the catapult they would have to be outlined beforehand in order to fit together with the Lego parts.

In terms of software, there should not be any compatibility issues as Java works with leJOS NXJ.

**REUSABILITY**

Over five labs during the design course, several parts of the core code can be reused on the robot to perform the designated task. The odometry code, the navigation code, and the localization code allow the robot to display the current coordinate and travel to the desired position. The ballistic code for lab 5 allows the robot to perform the task of launching the ball in order to hit the target.

**STRUCTURES**

Mechanically the goal is to complete the specific tasks of travelling to specific spots and hit the target in the least amount of time. The robot weight should be moderate in order to travel fast enough. The catapult part of the design should provide enough kinetic energy to hit the target.

Electrically we will probably replace the batteries to the rechargeable ones in order to save some budget as over the long project period the battries’ electricity will consume very fast.

In terms of software, the code should be concise in size as the robot would take longer to run a lengthy code.

**METHODOLOGIES**

Our methodology will be to divide the whole project into several subtasks, and then assign them to the group members depending on their capabilities. There will be meeting sessions every week so that we can keep track of the progress. We will also evaluate the feasibility of the ideas during each meeting session to see if there is any room of improvement.

**TOOLS**

Physically we have the NXT toolkit which allows us to build a robot. The robot will be able to perform specific tasks with the assist of the software, which will be mentioned below.

Lego Digital Designer allows us to visualize how a specific model is built in 3D so that we can build the robot physically from there. Java is the core part of the software as it provides different functions and algorithms which allows the robot to function in a specific behavior.

**GLOSSARY OF TERMS**

N/A