Nama : Agung Sulaksono Ramdhani
NIM : 1103194071

Micromouse in Webots

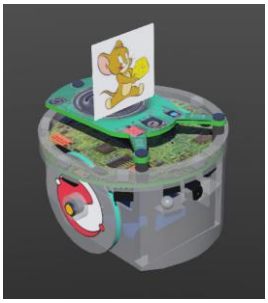
Author **Emmanouil Stefanakis**

The goal of this project is to create the Micromouse competition in Webots, a 3D robot simulator, in an effort to understand the basics of programming an autonomous agent and put the theoretical information that has been learned to work. The complexity of the topic and the short amount of time available for study and development were the main factors limiting the execution. A simulated autonomous robot that searches for a way to the center of a 16x16 block maze is the end result of this project. The robot employs four key principles to do its task: localization, mapping, path planning, and motion control. The robot maneuvers through the maze utilizing a variety of sensors to avoid obstacles and record their locations while using its own position as a guide.

A. Micromouse
- Maze Solving: Moving/searching around for the best path to reach the center. Use of searching algorithms to compute shortest path.
- Performance: The shortest path is not always the fastest. Straight lines enable the mouse to accelerate.

B. Webots
- Robot Simulation Software
- Visual 3D environment = world
- Robot Programming = controller

1. Micromouse World
   a. E-Puck Robot



   b. Maze

2. Controllers
    a. The environment

        Created using the Webots World Editor UI (adding walls, wall joints, etc.)

    b. The Robot

        The controller (in Java) is the “brains” of the Autonomous Agent and is responsible to guide the robot to the centre of the maze.

Odometry → Localization & Mapping → Searching Algorithm

    c. Odometry

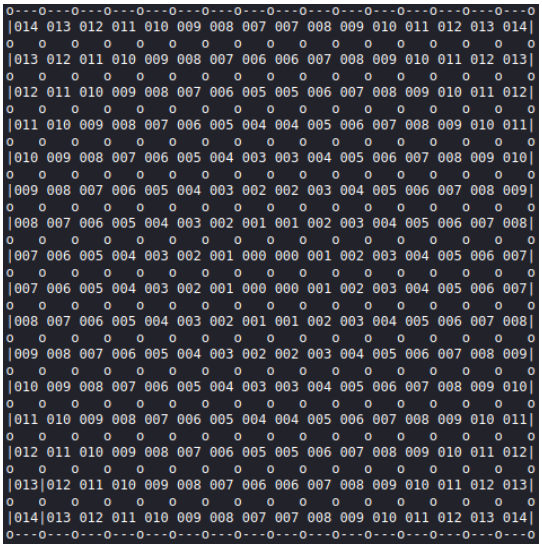
    The use of data from motion sensors to estimate change in position over time.

    d. Localization & Mapping

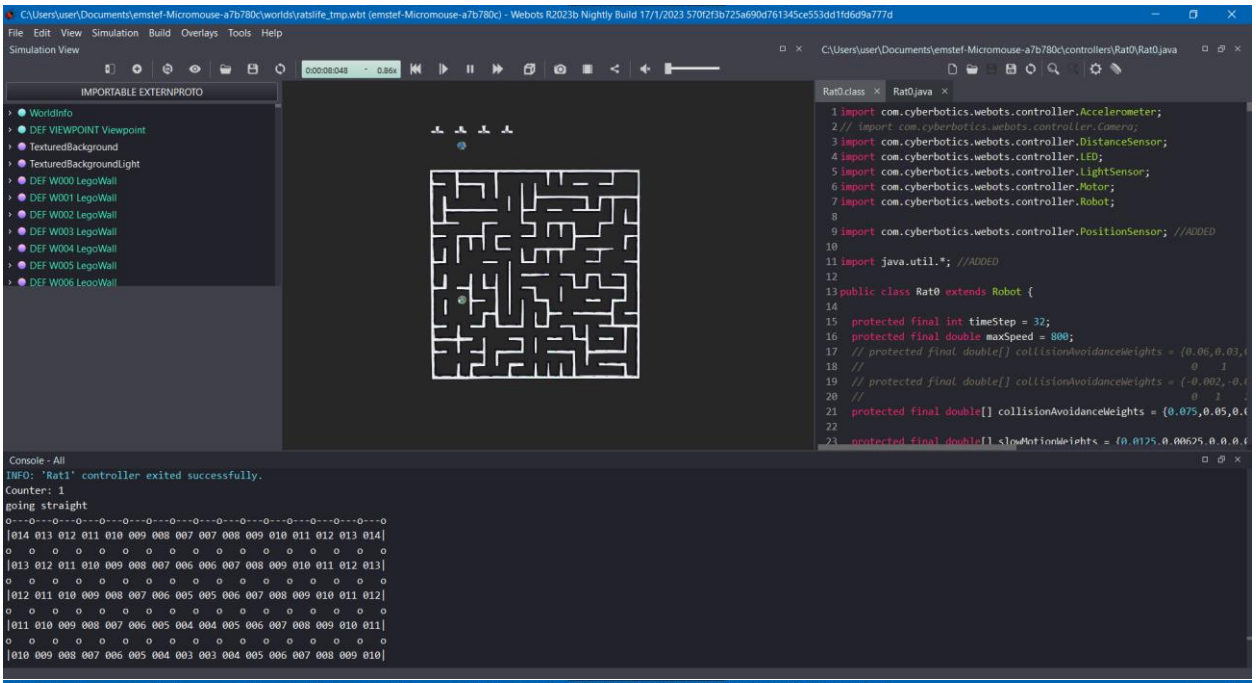
    Since the robot now can detect if it has travelled to the next cell:
    It can calculate the relative orientation by monitoring its rotation from the input of the rotary encoders given its known direction at the starting cell.

    e. Flood Fill Algorithm

    The centre of the maze has a weight of zero and the distance between two cells equals one (no diagonals):



3. RESULT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IMPORTABLE EXTERNPROTO
WorldInfo
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TexturedBackground
TexturedBackgroundLight
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DEF W002 LegoWall
DEF W003 LegoWall
DEF W004 LegoWall
DEF W005 LegoWall
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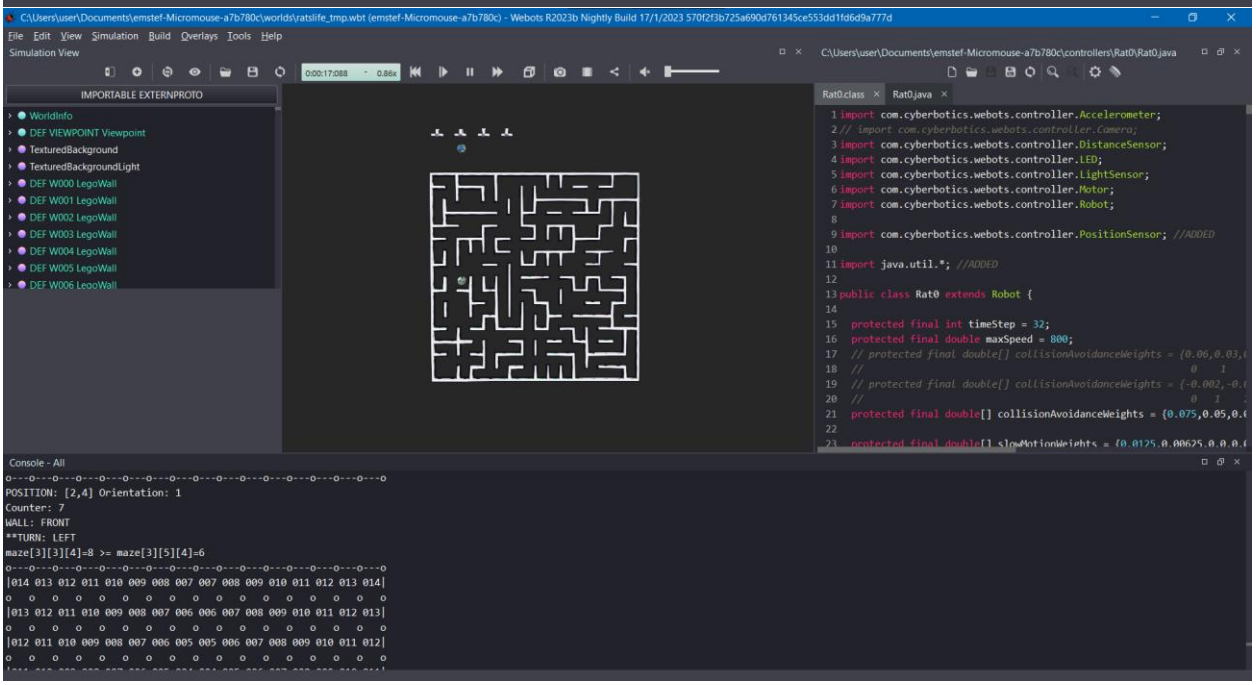
// import com.cyberbotics.webots.controller.Camera;
import com.cyberbotics.webots.controller.DistanceSensor;
import com.cyberbotics.webots.controller.LED;
import com.cyberbotics.webots.controller.LightSensor;
import com.cyberbotics.webots.controller.Motor;
import com.cyberbotics.webots.controller.Robot;
import com.cyberbotics.webots.controller.PositionSensor; //ADDED
import java.util.*; //ADDED
public class Rat0 extends Robot {
protected final int timeStep = 32;
protected final double maxSpeed = 800;
protected final double[] collisionAvoidanceWeights = {0.075,0.05,0.
Console - All
INFO: 'Rat1' controller exited successfully.
Counter: 1
going straight
o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o
|014 013 012 011 010 009 008 007 007 008 009 010 011 012 013 014|
o o o o o o o o o o o o o o o o o o o
|013 012 011 010 009 008 007 006 006 007 008 009 010 011 012 013|
o o o o o o o o o o o o o o o o o o o
|012 011 010 009 008 007 006 005 005 006 007 008 009 010 011 012|
o o o o o o o o o o o o o o o o o o o
|011 010 009 008 007 006 005 004 004 005 006 007 008 009 010 011|
o o o o o o o o o o o o o o o o o o o
|010 009 008 007 006 005 004 003 003 004 005 006 007 008 009 010|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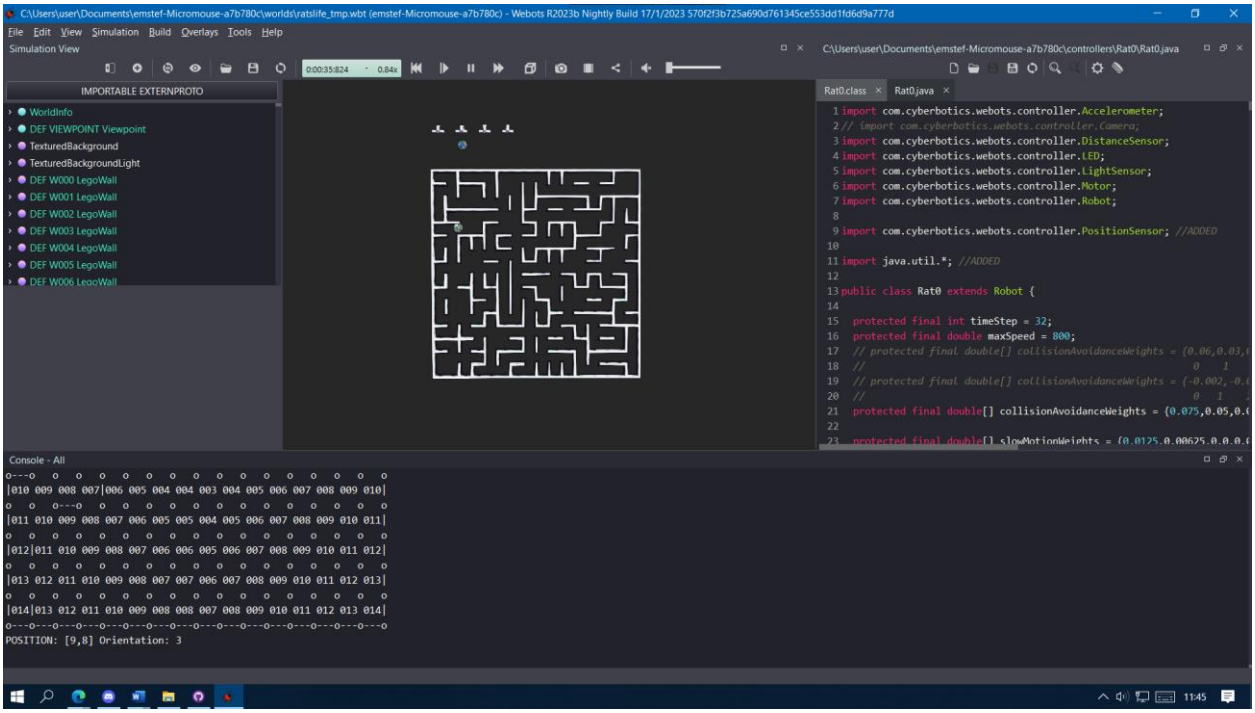
Console - All
o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o
POSITION: [2,4] Orientation: 1
Counter: 7
WALL: FRONT
**TURN: LEFT
maze[3][3][4]=8 >= maze[3][5][4]=6
o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o
|014 013 012 011 010 009 008 007 007 008 009 010 011 012 013 014|
o o o o o o o o o o o o o o o o o o o
|013 012 011 010 009 008 007 006 006 007 008 009 010 011 012 013|
o o o o o o o o o o o o o o o o o o o
|012 011 010 009 008 007 006 005 005 006 007 008 009 010 011 012|
o o o o o o o o o o o o o o o o o o o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o---o o o o o o o o o o o o o o o o
|010 009 008 007|006 005 004 004 003 004 005 006 007 008 009 010|
o o o---o o o o o o o o o o o o o o
|011 010 009 008 007 006 005 005 004 005 006 007 008 009 010 011|
o o o o o o o o o o o o o o o o o o
|012|011 010 009 008 007 006 006 005 006 007 008 009 010 011 012|
o o o o o o o o o o o o o o o o o o
|013 012 011 010 009 008 007 007 006 007 008 009 010 011 012 013|
o o o o o o o o o o o o o o o o o o
|014|013 012 011 010 009 008 008 007 008 009 010 011 012 013 014|
o---o---o---o---o---o---o---o---o---o---o---o---o---o---o---o
POSITION: [9,8] Orientation: 3
11:45