



Xi'an Jiaotong-Liverpool University

西交利物浦大學

Specification and Design Report

Author Zhiyong Liu

Module CSE305

Supervisor Dr. Jieming Ma

Date 25th / Nov / 2018

Chapter 1

Specification

1.1 Project Description

Now more and more people are supposed to learn knowledge about programming. However, learning programming can sometimes become boring that causes learners give up halfway. This project develops a maze game for those people who wish to learn programming knowledge. Users can learn programming knowledge by playing games at the same time.

In this project, there is a robot which is based on Raspberry Pi. This robot is to be an explorer in the maze and needs to find a path from the start position to the end position. To run out of the maze, robot is supposed to have an algorithm to execute. This project aims to design a maze solving algorithm and achieves the algorithm on the robot. In addition to this, the code programmed in this project also allows the users to design their own algorithm and execute it on robot. Users modify the codes according to algorithm designed and test it in the real maze, which achieves the aim of programming education.

Many algorithms such as wall follower, Pledge algorithm [1], and Trémaux's algorithm [2], were invented specially to deal with the maze solving problem, and each of them have their own strengths and weaknesses. Besides, a maze can be viewed as a tree or graph, some algorithms used in graph theory also have the ability to solve the maze solving algorithm. One of them is Depth-first search algorithm, it is used to traverse the tree or graph data structure. Therefore, through the Depth-first algorithm, the maze can be traversed by the robot and the path from origin to destination eventually can be found.

This project is supposed to develop a maze solving algorithm based on Depth-first search algorithm and work accurately on the robot in the real maze.

1.2 Statement of Deliverables

The Deliverable upon completion of the project is a software. The software is written in python and has multiple functionalities. In the first place, it is responsible for guiding the robot out of the maze. The software is intended to be configured in the robot in advance. When the robot moves in the maze, software will give the next step command for robot to execute according to maze

solving algorithm. Furthermore, the software allows users to modify pre-configured algorithm and design their own maze solving algorithm. The pre-configured algorithm refers to the algorithm based on the Depth-first search algorithm designed in this project. After users have learned the pre-configured algorithm, they can improve the default algorithm and run the new algorithm in the robot.

To evaluate the project, the first thing to do is to test if the designed algorithm is able to work accurately in maze solving problem. More specifically, the robot pre-configured with the software will be tested in multiple different mazes. In all tests, the number of getting out of the maze will be recorded. By calculating the success probability, the project will be measured if it can solve the maze problem. Besides, since this is a game-based learning project, the feedbacks of users will be collected. The feedbacks contains multiple aspects:

1. Whether users think the game is interesting.
2. Whether they think they can learn programming effectively through this game.
3. Whether they are satisfied with the project.
4. What other aspects they think for this project to improve.

1.3 Conduct of Project and Plan

Chapter 2

Design

2.1 Design of System

2.2 Design of evaluation

Chapter 3

Review against Plan

Reference

- [1] R. Klein and T. Kamphans, “Pledge’s Algorithm - How to Escape from a Dark Maze.” *Algorithms Unplugged*, no. Chapter 8, pp. 69–75, 2011.
- [2] “Solving a Maze,” in *Building Robots with LEGO Mindstorms NXT*. Syngress, Jan. 2007, pp. 327–348.