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Bachelor of Engineering

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Bachelor’s Thesis

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List of Abbreviations

ORM Object-relational mapping. The set of rules for mapping objects in a programming language to records in a relational database, and vice versa.

DBMS Database management system. Software for maintaining, querying and updating data and metadata in a database.

PSoC Programmable System-On-Chip

LED Light Emitting Diode

# Introduction

This report is focused on the main project of all first year Information Technology students at Metropolia UAS in the Smart Systems course. The project involved programming a robot to complete three tasks: battling in a sumo arena, following a line and navigating a maze. The key motivation behind this project then is to learn how to program and document the progress.

The project was approached by finding solutions to smaller side projects which would be transferrable to the main task. When discussing the final tasks in this report, it will be as the sum of the solutions to these tasks.

# Materials and Methods

## Project Tasks

### Sumo Wrestling

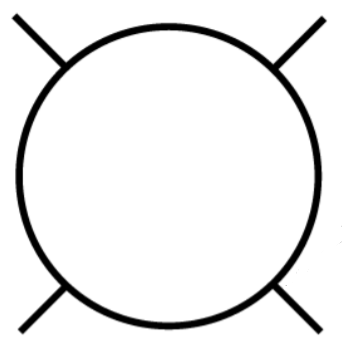
This can be considered the *first* of the final tasks as it is the least complicated. The arena for this task can be seen in the figure below. Completing this task requires the following:

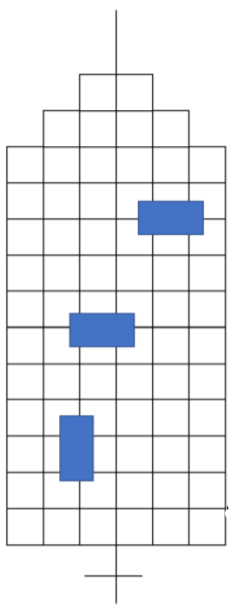
Following a line – The robot must approach the edge of the arena from one of the 4 lines on the circumference of the arena.

Detecting a horizontal line – The robot must wait at the edge of the arena until it is given a command from the infrared remote.

Detecting a collision – The robot must know it has collided with another robot and it must know on which side the collision occurred.

Detecting an object – The robot must know when an opponent is in front of it and react appropriately.





## PSoC® Creator™ Integrated Design Environment (IDE)

PSoC Creator is a program created by Cypress Semiconductor for writing programs for and compiling to PSoC hardware. This software was used for all code written during this project.

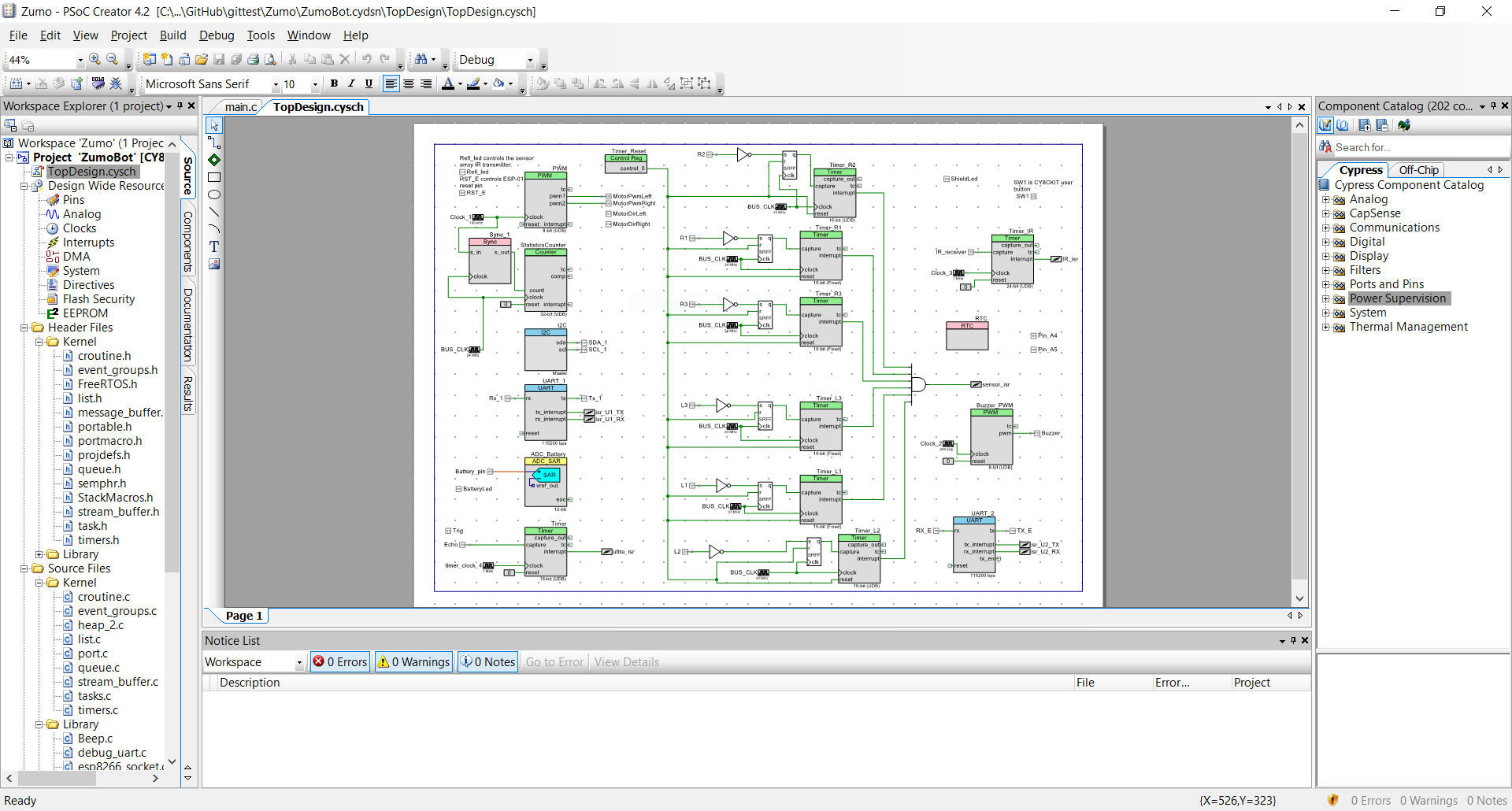


Figure 1

## CY8CKIT-059 PSoC® 5LP Prototyping Kit

The CY8CKIT-059 PSoC 5LP prototyping kit from Cypress Semiconductor was used to control the Zumo robot. Located on the PSoC is a USB connection, an LED, a button to reset the program and a programmable button that can execute programmed commands. Code was compiled and written to the PSoC by connecting it to a computer via USB and using PSoC Creator 4.2.



Figure 2.

## Polulu Zumo Robot

The Zumo robot hardware can be broken down into the following individual components: motors, 6 reflectance sensors, an accelerometer, an ultrasonic sensor, an infrared sensor and a Wi-Fi chip. A router acting as an MQTT broker is used to communicate between our computers and the robot. There is also a programmable button on the PSoC hardware itself. The libraries for controlling these components have been generously provided by Metropolia University of Applied Science.

PuTTY was used to see the output of the code written to the PSoC.

Zotero was used to track any sources used during the course of this project.

The project involved programming the robot so that it could perform 3 different tasks: fight in a sumo arena, follow a line and navigate the maze. Each task can be broken down into components that are common between all 3. These tasks were approached on a weekly basis in side projects. They are as follows: Following a line, collision detection, obstacle detection

There must always be text or a new subheading below each heading. Do not place a figure or table below a heading with no text in between.

Label each figure and table appropriately. Provide a number, title and reference (if needed) below each figure and above each table. Make sure to mention all figures and tables in the text. Each figure and table must be explained in the text and referred to by its number (… as figure 1 illustrates. /as summarized in table 1.).

Apply the Figure style for each image. This is necessary in order to prevent a page break from occurring between the figure and its caption. The Figure caption style is applied for the figure’s caption. This causes the figures to be numbered automatically.

1. Virtual studies completed by Metropolia students in the academic year 2009-2010.

There must always be text between a figure or table and a new heading.

## Subheading

### Subheading

There must always be text or a new subheading below each heading. Do not place a figure or table below a heading with no text in between.

1. Virtual studies completed by Metropolia students in the academic year 2009-2010.

|  |  |
| --- | --- |
| Field of study | Studies completed, ECTS |
| Culture | 131 |
| Technology, Communication and Transport | 552 |
| Health Care and Social Services | 175 |
| Business and Administration | 52 |
| Not bound to a field of study | 18 |
| Metropolia total | 928 |

There must always be text between a figure or table and a new figure or table or a new heading.

### Subheading

There must always be text or a new subheading below each heading.

Use the Quotation style for an indented quotation. For the last paragraph immediately before the quotation, use the Body Text before Quotation or List style.

If a direct quotation is several lines long, indent the quotation and use single (1.0) line spacing. No quotation marks are used then. Always provide a reference to the source. If the direct quotation is shorter than two lines, include it in the body of the text in quotation marks, and provide a reference to the source.

After an indented direct quotation, continue the text at the left margin using the Body text style.

Use the Bulleted list style for an in-text list:

* This is the first list item.
* The second item of the list contains a long text that spans more than one row. The left margin will be automatically justified.
* This is the third list item.
* This is the fourth list item.

The items on the bulleted list begin with a capital letter. An item ends in a full stop if each item on the list is a full sentence.

The list items begin with a lower-case letter if the list items are not sentences. The last item is followed by a full stop. Thus, a thesis consists of

* words
* sentences
* paragraphs
* sections.

After the list, the text continues from the left margin in the Body text style.

You can insert numbered formulas that are displayed on separate rows:

(1)

Insert a new formula by selecting Insert/Quick parts/Formula (using the formula function). If you want to use Microsoft equation editor instead of the newer formula function, select Insert/Quick parts/Formula (using MS Equation).

An example of a listing is given below. Use Code line style to mark code lines, and create indentations with the Tab key. The caption should follow the Listing caption style.

def inventory():

cur = db.cursor()

sql = "SELECT Description FROM OBJECT WHERE Location='PLAYER'"

cur.execute(sql)

if cur.rowcount>=1:

print("You carry the following items:")

for row in cur.fetchall() :

print (" - " + row[0])

else:

print("You don't carry anything.")

return

1. A Python subroutine that outputs information about objects in possession of a player.

# Chapter Heading

References

Details of the references are given here. Use the referencing system required in your degree programme or as agreed with your supervisor.

Layout of this page in the author-date (Harvard) referencing system:

Details of the reference Details of the reference Details of the reference Details of the reference Details of the reference.

Details of the reference Details of the reference Details of the reference Details of the reference Details of the reference.

Layout of this page in the number (Vancouver) referencing system:

1. Details of the reference Details of the reference Details of the reference Details of the reference Details of the reference.
2. Details of the reference Details of the reference Details of the reference Details of the reference Details of the reference.

**Title of the Appendix**

The contents of the appendix are placed here. Below are the instructions for removing and adding appendices in a way that maintains the headers and footers in their correct form.

Instructions for removing an unwanted appendix:

1. Select the entire page(s) that form the appendix and delete the contents by hitting the Delete key.
2. As you are in the beginning of the empty appendix page (see the image below), double-click the header of the empty page and press Link to Previous button in the ribbon. The following dialogue window opens:



Click Yes.

1. If necessary, make hidden format information visible by pressing .
2. Delete the section break immediately before the appendix to be removed (see image below).



Instructions for adding a new appendix:

1. Place the cursor at the end of the last appendix.
2. Select Page Layout from the menu bar. From the ribbon, select Breaks/Section Breaks/Next Page. This causes a new appendix to appear, but the appendix number in the header is not yet correct.
3. Double click the header of the new appendix with the wrong appendix number. If the option “Link to Previous” is selected, click the corresponding button to deselect it.
4. Replace the appendix number with the correct number.

Note that the appendices need to be updated in the table of contents manually.

**Title of the appendix**

The contents of the appendix are placed here.