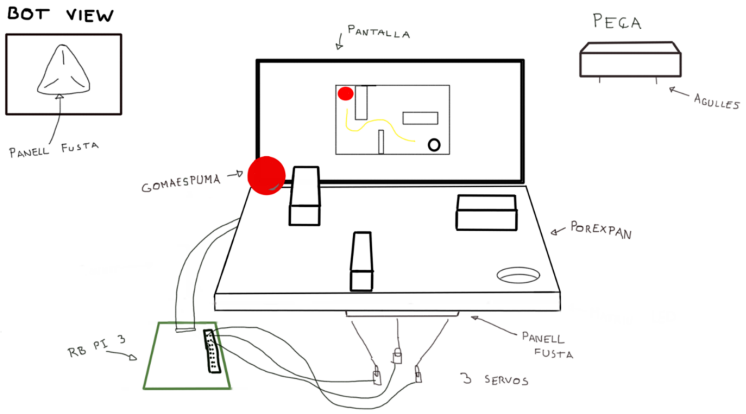


BALLBOT

This project aims to recreate the maze game with a ball. This ball will move with the movement of the board, in order to reach the final destination.

PROJECT SPRINT #0
DATE: 5th April 2021

Juan Carlos Martinez Moreno 1566936
Victor Bosch Pueyo 1566583
Alvaro Caravaca Hernández 1566685
Luis Fernando Paz Galeano 1567369

Table of Contents

Project description 1

Electronic components 1

Hardware Scheme 2

Software Architecture 3

Amazing contributions 4

Extra components and 3D pieces 5

Simulation Strategy 6

Foreseen risks and contingency plan 6

Sprint #0
Date: 05 April 2021

BALLBOT

This project aims to recreate the maze game with a ball. This ball will move with the movement of the board, in order to reach the final destination.

Project description

This project aims to recreate the maze game with a ball. This ball will move with the movement of the board, in order to reach the final destination.

To give it a different point of view, it will be the same BALLBOT who moves the board, and it will be the player who designs the circuit. Therefore, the robot must be able to adapt to the board each time the user modifies it.

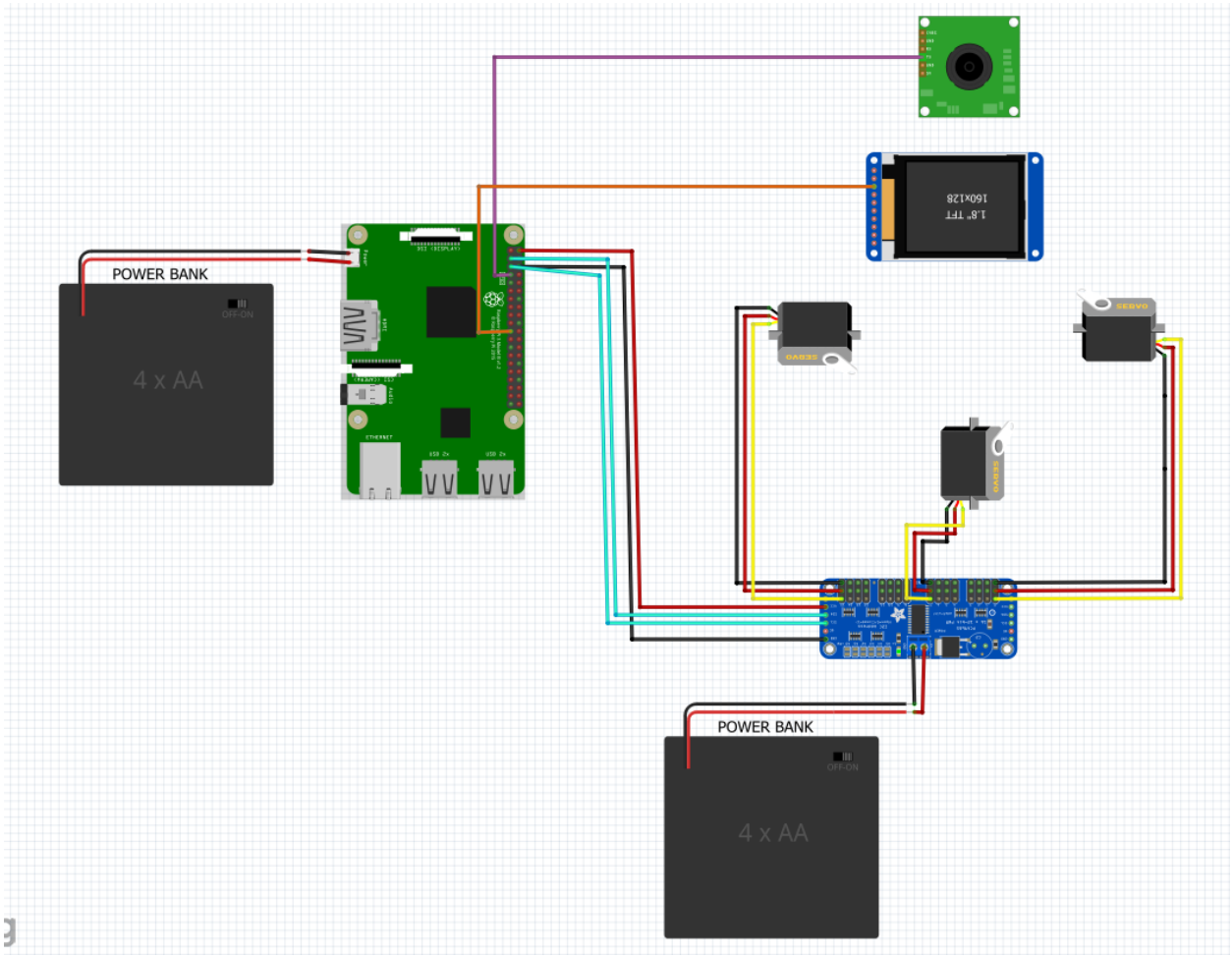
In addition, there will be a screen showing the circuit that captures the camera, and the circuit that the robot has calculated to take the ball to its final destination will be drawn in real time.

Electronic components

This is the list of the used components:

- *RASPBERRY PI 3*
- *CAMERA*
- *SD*
- *SERVOMOTOR (3)*
- *SCREEN*
- *POWER BANK*

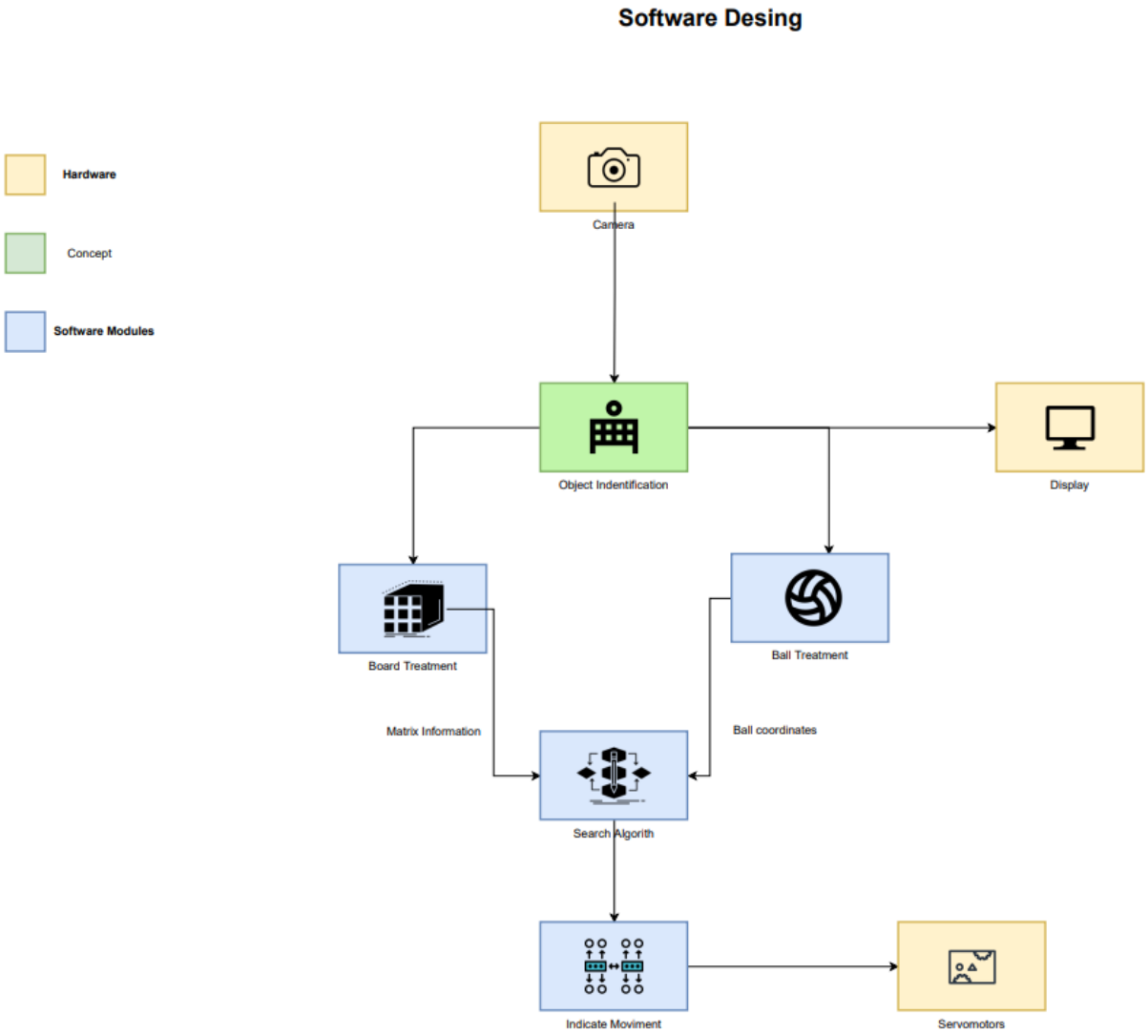
Hardware Scheme



The connections will go as follow:

- *Both power supplies will be connected to a Power Bank*
- *Camera connected to Raspberry Pi camera module*
- *Screen connected to Raspberry Pi display module*
- *Raspberry Pi pin 6 (GND) to PCA9665 GND pin*
- *Raspberry Pi pin 2 (5V) to PCA9665 VCC pin*
- *Raspberry Pi pin 3 (GPIO 2) to PCA9665 SDA pin*
- *Raspberry Pi pin 5 (GPIO 3) to PCA9665 SCL pin*
- *3 servos connected to PCA9665 0, 8 and 15*

Software Architecture



- *Board treatment: Identify the structure of the maze (position and orientation of the walls, identification of start and goal points).*
- *Ball treatment: identifying the ball's position; necessary for calculating the path to follow.*
- *Search algorithm: determine the path the ball must follow to reach the goal point (there are different types of search algorithms, for example: backtracking, branch&bound).*

- *The module indicates to the servos what type of movement they need to perform (orientation, force, etc.)*

Amazing contributions

The following features make our project unique:

- *The structure of the maze is built through user interaction.*
- *Mazes can be solved in an infinite number of ways.*
- *The robot's ability to guide the ball to the goal.*
- *Control of the edges, because the ball cannot go out of the board.*
- *Device for displaying the path to be taken, or the path that is currently being taken.*

Our project deserves at least a grade of 8-9 for its originality, since it combines two different ideas: an existing project that involves balancing a ball on a platform, and a labyrinth in which the ball will move to reach the goal. A big challenge here is combining algorithms that solve different problems very quickly with computer vision to continuously see the labyrinth and determine the optimal path. Also, we will deal with some physical restrictions, like the material of the board (porexpan, so soft...) or the walls, that can be broken.

Extra components and 3D pieces

- *POREXPAN BOARD*
- *POREXPAN PIECES*
- *WOOD PLANK*
- *RED FOAM BALL*
- *CAMERA SUPPORT*

The porexpan board will be used as the main board of the BALLBOT. In there, the porexpan pieces will stick together through needles. The pieces will be the walls of the labyrinth, and it will be the player who creates the entire labyrinth using those pieces. The material has to be porexpan so that all the pieces can be removed from the board easily.

The red foam ball will be the ball that the robot will move by the inclinations of the board in order to get into the final destination.

Simulation Strategy

In order to create the simulation of the robot, we would use the Coppelia simulator. With three servo motors we can simulate the board treatment. With this, we can introduce a ball with realistic physics and understand the movement of it.

Finally, we will put a camera to implement that module.

Foreseen risks and contingency plan

Risk #	**Description**	**Probability** (High/Medium/Low)	**Impact** (High/Medium/Low)	**Contingency plan**
1	That the ball leaves the board while the board is moving.	Hight	Hight	When the robot is not detecting the ball, stop the execution of the robot. A possible solution will be putting walls on the edges of the board.
2	Non-robust algorithm that doesn't calculate the path that leads to a possible solution.	Medium	High	Have other search methods with more features. (Dynamic Programming). If any methods find a solution, display an error message on the screen.
3	That the material of	Medium	High	Change the board material

	the maze board is very heavy.			type to a lighter one or make the board smaller.
4	Robot components do not provide enough performance in case the complexity of the robot increases.	Low	High	Immediately notify the budget department (Teaching team).
5	Don't show the path of the ball on the screen.	Medium	Low	Go with another type of feedback.
6	That the agent takes a long time to solve the game.	Medium	High	Have other search methods with more features. (Dynamic Programming).

References

This project has been inspired by the following Internet projects:

https://la-tecnologia.com/tips-arduino/equilibrador-de-bola-con-plataforma-stewart/