Universitat de Lleida

Project Engineering Book

Subject: *Embedded and Ubiquitous Systems*

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Introduction

The purpose of this project is to design and develop an electronic board game that integrates strategic gameplay with interactive components. Each player will be represented by a meeple, symbolizing their presence and progress on the game board. Additionally, we designed control base to manage actions and monitor the overall status of the game.

Through this project, we will gain hands-on experience in game design, rule formulation, and teamwork. The final product aims to provide an engaging and interactive board game that showcases the combined efforts and creativity of all contributors.

1 Milestones

Throughout this project, we had multiple milestones that allowed us to make progress. For the whole duration of the project, we worked together and had the same responsibilities for this project. In total, this project took about 40 hours to complete.

The first milestone was to get a first time hands-on experience with the ESP32 and ESP01. This was done by coding simple programms such as making blinking LEDs. This also allowed us to understand the basic wiring principles of the components.

The next milestone was to understand how to code and connect the LCD display with the ESP32. This part also allowed us to understand how to install and use external libraries in our project.

As most of the technical goals had been reached with the ESP32, we moved on to the ESP01. We needed to detect movements on the board by detecting a magnet with the hall sensor. This milestone came with a few struggles with the wiring part. Indeed, some of the wires were broken and the connections weren't right from the start. After fixing these problems, we successfully managed to detect when the halls sensor was brought near a magnet.

Now that the ESP32 and ESP01 had the basic functionalities implemented, we needed to connect them using the MQTT protocol. This was done by creating a Docker pod on one of our computer with a game controller and a MQTT broker (Mosquitto) and opening a special port for the devices to connect to the broker. This step took a lot of time to get right as we had to learn the MQTT and Wifi libraries for the ESPs, and we had a few problems with our computer's firewall. Eventually we managed to connect

both the ESP32 and ESP01 to the MQTT broker, allowing to display a message on the ESP32 when the ESP01 detected a magnet with its hall sensor.

Finally, now that all the technical requirements were completed, we designed a simple "rock paper scissor" game to implement. The rules of this game are explained in a later section. Once the rules were set, we had to program the game controller in python and adjust the code of the ESPs. With this final step completed, we had a working game and a completed project.

2 Impelemented Components

2.1 ESP32 - Game Base

The ESP32 was used as a base for our game. This base is equiped with a LCD Display, and a button. The button is used to start/restart a game and the LCD screen shows the position on the meeples on the board, the player's turn, and the result of the rock paper scissor simulation. The base is also responsible for generating the random number used to play the rock paper scissor matches (generates 2 numbers between 1 and 3).

2.2 ESP01 - Meeple

The ESP01 was used as the meeple in our game. The game is designed to be played with 2 meeples, but due to unforeseen circumstances we only had 1 meeple to test and develop our game. The meeple is composed of a led and a hall sensor. A message is sent on a mqtt topic specific to the meeple when a magnet is detected by the hall sensor, allowing to keep track of the meeple's movement. The LED is used to indicate the player's turn : the active player has its LED on while the other has it off. The meeple is also responsible of generating a dice roll (generates a random integer between 1 and 6) and sending it to the game controller.

2.3 Computer - Game Controller

The game controller runs all the game logic with a python program. It manages the players positions, the rock paper scissor logic, the amount of moves left and the player's turn, and it receives every interaction with the devices (hall sensors, button) as well as requests the devices for roll dices and rock paper scissor random numbers. Eventually, the game controller detects the winner and shows it on the screen. Everything written on the

screen is sent by the game controller.

3   E-Game Rules

The game is a simple turn based rock paper scissor game. It is meant to be played by 2 players on a linear board (the game board is a line os squares). At the beginning each player starts at one end of the board and the first player's turn is decided randomly. During a player turn, a virtual dice is rolled and the player moves forwards by the corresponding amount of squares (1 square at the time so that the hall sensor can count the movements). If one of the player reaches the same square as the other player, a rock paper scissor battle is simulated, and the loser returns to its end of the board. If the winner was the active player, he can continue his movements. If a player reaches the other end of the board and wins the rock paper scissor battle against their opponents, they win the game.

Conclusion

This project taught us the basics of embedded systems and gave us a first hands-on experience with ESPs micro controllers and the basic components associated with them such as LEDs, LCD screens, buttons, etc. We used the materials presented at the beginning of each lesson, thus helping understand the concepts necessary to complete this project. In addition, we searched for our own solutions and learned how to evolve in a unknown field for us such as embedded systems.