

**Extra point #2**  
**Max 2 points**

Expected delivery of extapoint2.zip must include:

- zipped project folder
- this document compiled in pdf
- Application note in pdf (MAX 1 page)

Purpose of Part 2: to enhance the Quoridor game using the KEIL **IDE** environment for the SoC LPC1768 and the LANDTIGER Board.

This part is evaluated to assign a maximum of 2 extra points for qualified students taking the exam with a mark  $\geq 18$

## Quoridor

Quoridor is an abstract board game published in 1997 by Gigamic.



### 1) Rules of the game

Each player is equipped with a **token** and **eight barriers**. The game board is a 7x7 wooden square, with the peculiar feature that the lines dividing and forming the squares are grooved, allowing walls to be inserted.

Each player starts from the center of their perimeter line (the 4<sup>th</sup> square), and the goal is to get their token to the opposite perimeter line. The player who achieves this objective first wins.

On their turn, a player has two choices:

1. They can choose to move their token horizontally or vertically;
2. He/she can choose to place a wall. The wall cannot be jumped over but must be navigated around.

At every step of the game, there are always two players: the moving player (the one who is making the choice), and the opponent. Their roles alternate at every step.

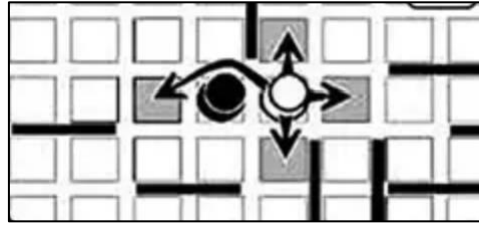
- If two tokens (the moving player and the opponent) are facing each other, the moving player can jump over the opponent and position themselves behind them if there is no barrier behind the opponent.
- It is not allowed to "trap" a player with the help of walls; you must always leave them a way to reach the goal.

- A move must be chosen within 20 seconds, or else it loses the turn.

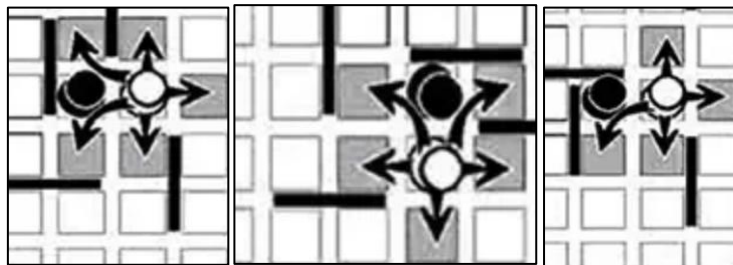


**NEW (Face-To-Face situations), just to be sure that you implemented the following scenarios:**

- If players are facing each other, you can jump an extra square as in the figure below.



- In case players are facing each other, and there is a wall behind the opponent, you can move to the square next to the opponent, as Figures below show.



You can find the complete set of rules [here](#).

## 2) How to write an Application Note file (MAX 1 PAGE)

An "Application Note" is a form of technical writing with the following purposes:

1. It has an instructional or tutorial style.
2. It is targeted to a specific audience of users.
3. It is typically a focused description of **how to** do something, including an introduction to the topic as well as precise implementation details, results, and recommendations. It is more than just the repetition of information from part of a spec sheet. For example: the writer should have done something with the information from a spec sheet, and describe how it was done or how ONE should do it.
4. It often includes references to other manuals, documents, or books where the user may gain more or related information.

### 3) Implementation on the LandTiger Board

In Keil  $\mu$  Vision, use the LANDTIGER board to enhance a Quoridor game.

Please deliver a zip folder with all the files of your project.

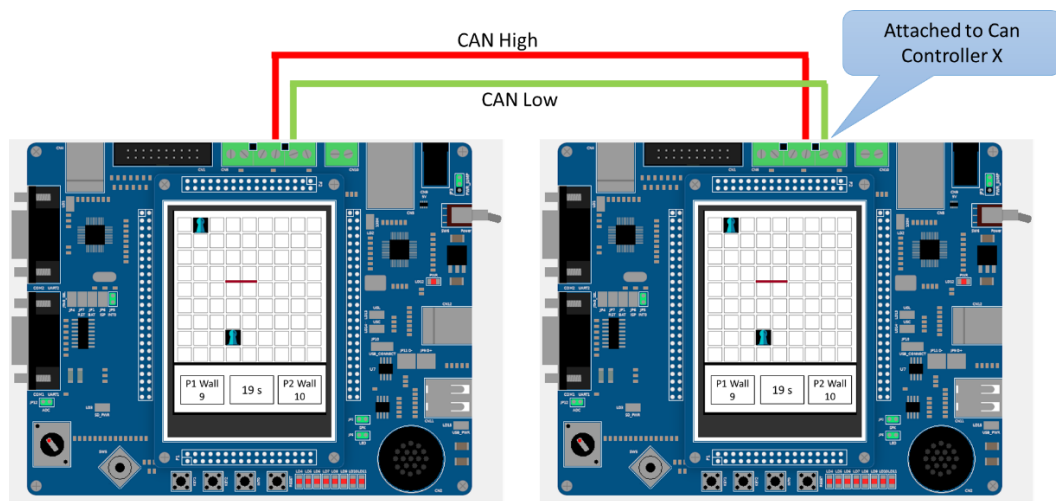
#### Specifications

**Note that images are only for explanation purposes.**

You must enhance the Quoridor game for the LandTiger board.

#### 1) Multiplayer Mode

You are required to implement a multiplayer mode (1 vs. 1) of Quoridor game by connecting two LandTiger Board through the **CAN bus**, as Figure below shows.



You must choose and adequately configure the CAN controllers of the LandTiger Boards (same Baud Rate, and properly configure the ID filters!).

This part must be developed using the LandTiger Boards (not the emulator!).

#### a. Specification for coordinates

The system in charge of handling the coordinates information is crucial. It must be commonly defined among all the Extra Point implementations to play in multiplayer mode effectively.

Figure 1 shows a coordinate system (using integer coordinates on the LCD).

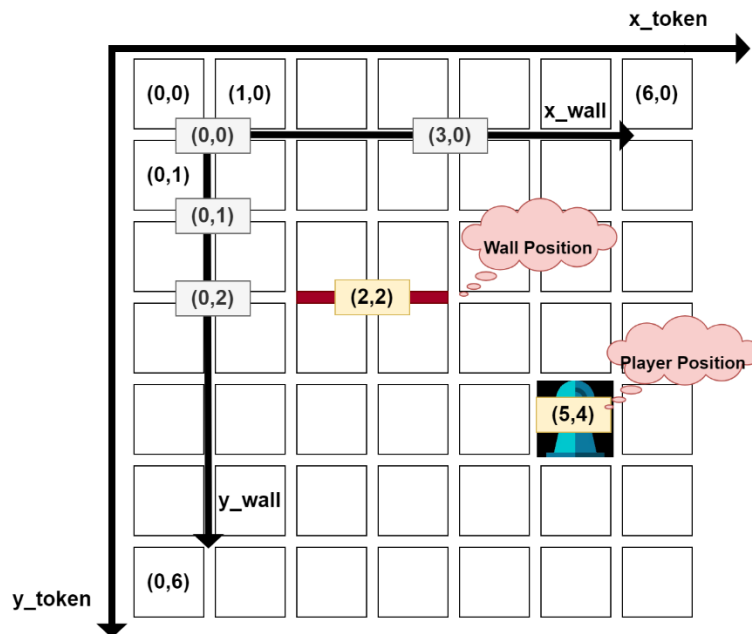


Figure 1 Coordinate System

The  $y\_token$  and  $x\_token$  are the axes used to represent the player's center. For example, Player in (5,4) represents the center of the square where the player is placed.

Where the  $y\_wall$  and  $x\_wall$  are the axes used to represent the center of the wall. For example, wall in (2,2) represents the center of the wall in which the wall is placed.

Please note that the  $x\_wall$  and  $y\_wall$  axis are coordinate within the Player move coordinate system.

In case you implemented the Coordinate management differently, you must develop a coordinate converter system to match the coordinates in the exchanged information among all the projects.

Through the CAN bus, you must exchange information (in the data field of the CAN Frame) according to the data structure defined in the previous extra point.

PlayerID	PlayerMove/WallPlacement	Vertical/Horizontal	Y	X
8 bits	4 bits	4 bits	8 bits	8 bits

In simple words (x and y in the aforementioned data structure):

- Wall position (*WallPlacement*) must represent the wall's center in the wooden square on the LCD.
- Player position (*PlayerMove=0*) must represent the player's center in a given square on the LCD.

## 2) Non-Player Character (NPC)

Nonplayer character (NPC) development:



- Develop the “Artificial Intelligence” for your opponent.
- Your opponent plays a turn right after you place a wall or move your character.
- The specifics of the implementation are up to you; try to implement something better than a random choice (i.e., decision tree, genetic algorithm, etc.).
- Be careful if you are using recursion!!!!
- IMPORTANT: The opponent cannot cheat!



In particular:

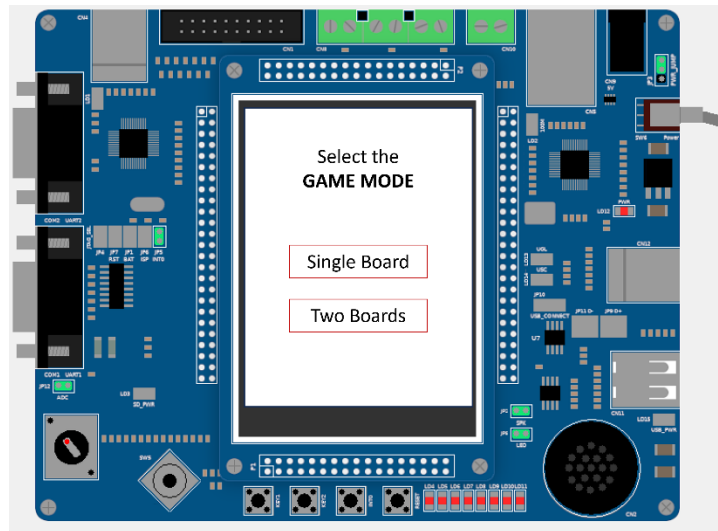
1. The opponent has eight walls.
2. The opponent cannot move more than 1 square per turn.
3. The opponent must follow the **rules**.

### 3) Menù implementation

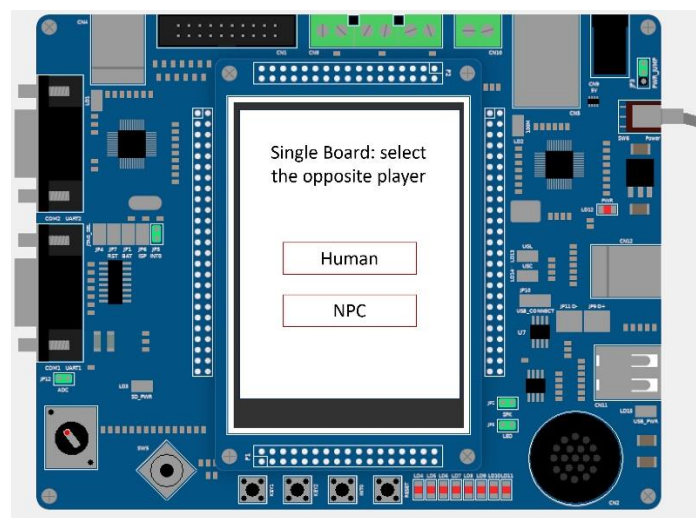
Start the game by implementing a Menu, for selecting the game mode: single board, and two boards. This menu is shown after INT0 is pressed (in multiplayer mode, who presses INT0 becomes the player 1).

Suggestion: You need a sort of handshake between the “Two Boards“ in multiplayer mode. For example, passing a move with a player ID equal to 0xFF. In case the handshake fails, it means that you cannot play in multiplayer mode (i.e., there is no other LandTiger board attached) and the system shows an error message.

Use the JOYSTICK to move between the options and the JOY SEL to confirm the choice.  
First GUI view could be:



If **Single Board** is pressed, the next GUI view should be:



You can choose the opposite player (Human – extrapoint1), or NPC (new feature).

If the **Two Boards** option is pressed, the next GUI option will be:

