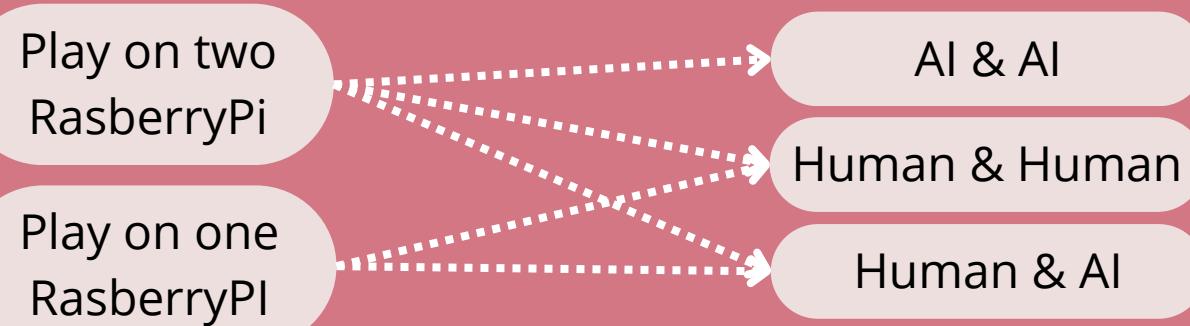


ULTIMAZE, the game with a Royal interface, an AI, an online configuration and that is playable with hand gestures

Objectives

Design a game, an Ultimate Tic Tac Toe, to play on two RaspberryPi.



Special Addition

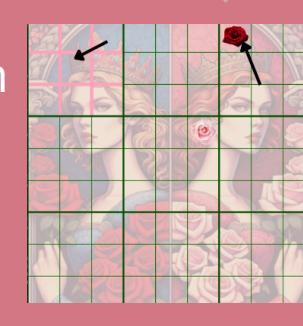
Hand Gesture Game

Use the Camera and Motion detection to play the game



Rules

- Take turn placing your pawn on the boards
- You have to play in the small board located in mirror to where the other player played in the small board



Win small boards by placing three in a horizontal, vertical or diagonal line
• Win the game by winning three small boards in a horizontal, vertical or diagonal line



The Interface

Game representation

Small Boards

```
[[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0],  
[0,0,0,0,0,0,0,0,0]]
```

Insert all functionalities in the game:

- Generalizing the functions for every possible game setup
- Threading for communication



Design

Big Board

Library : pygame

Game world: The player is a Royal that is trying to get the biggest territory against the other royal.

The Players:

- Red Rose Royal
- Pink Rose Royal

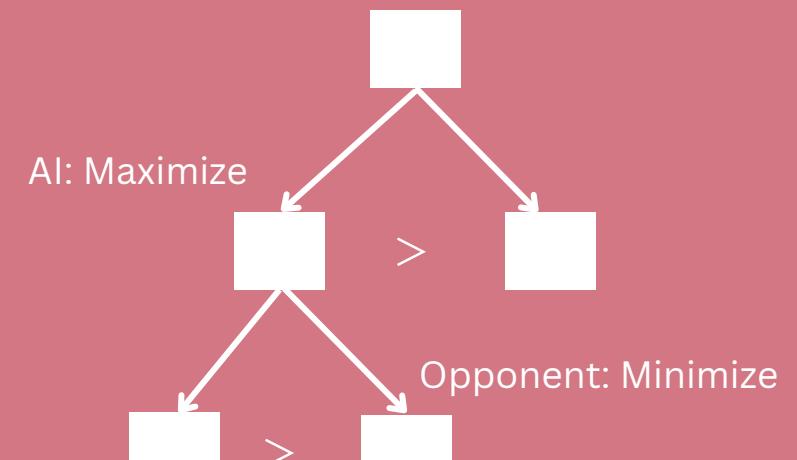
Player 1: Player -1:



The AI (Bot)

MinMax Algorithm

Game Tree Construction



- Score : representing the trend that the AI wins or no one does
- Assuming the opponent always makes the choice that minimize the AI's gain
- Move to take: the one that gives the biggest score at the end of the branch

Heuristic Evaluation Function

Priority

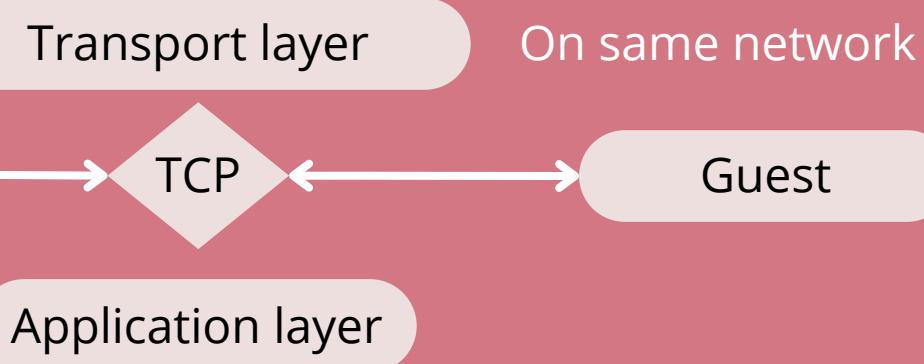
- Check win of the big & the small board (score +)
- Check opponent's potential win in the assigned board
- Center control / corners control

4	3	4	2	1	2	4	3	4
2	6	2	1	3	1	2	6	2
4	2	4	2	1	2	4	2	4
2	1	2	6	3	6	2	1	2
1	3	1	3	9	3	1	3	1
2	1	2	6	3	6	2	1	2
4	3	4	2	1	2	4	3	4
2	6	2	1	3	1	2	6	2
4	2	4	2	1	2	4	2	4

Alpha-Beta Pruning

- α : Infimum of Max
- β : supremum of Min
- In Maximizing, prune scores $\geq \beta$
- In Minimizing, prune scores $\leq \alpha$

Communication



Message: UTTT/1.0 [Command] [Attribute1] [Attribute2]\n

Commands

Game information exchange: PLAY, NEW_STATE, ACK, WIN, END
Errors: FATAL_ERROR, BAD_REQUEST, STATE_PLAY

Attributes

Position of game: Big board and small board coordinates

0	1	2
3	4	5
6	7	8

State of the whole game: Cryptographic hash of

"010101101...../0.....1....1...../.....1....1...0...."



Motion detection

Libraries

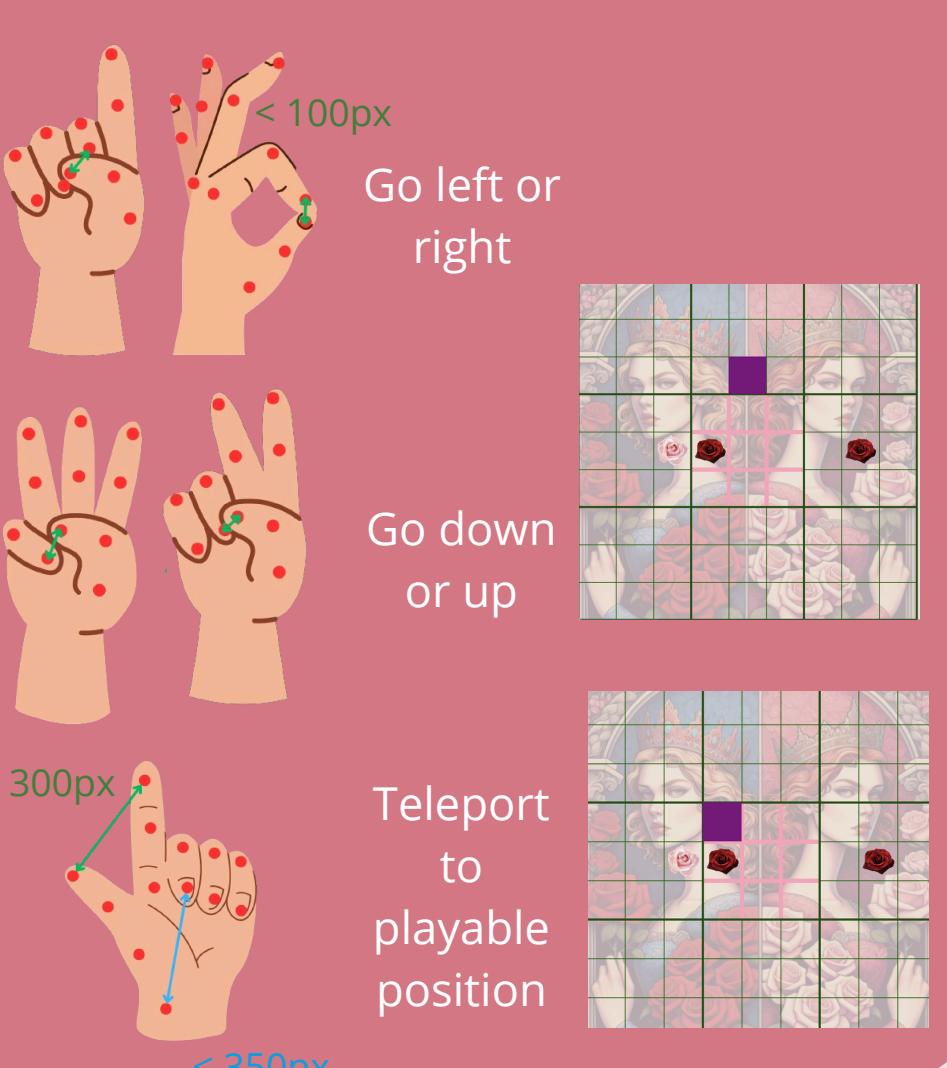
- cv2: for video capture
- mediapipe: hand model
- pyautogui: size of the primary monitor for the distance between fingers

Module for camera:
Libcamera

Play with hand



Follow were to pay



ULTIMAZE, the game you need to express your royal fantasy. Come and compete online or against our Powerful AI