GROUP 21

Microsoft

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1. Introduction

1.1 Overview-Purpose Of System

The HoloLens is a mixed-reality device which enables untethered and immersive mixed reality experiences. Our system is going to run on HoloLens devices and will allow users to play an augmented reality (AR) version of chess.

Users will be able to play against an AI to practice, or against other players in real time. The system will initially be able to handle a single session and will then be scaled up to host and manage multiple game sessions simultaneously, keeping track of multiple game states at the same time. The system will keep track of turns, timers, pieces still on the board and their positions. The system will repeatedly check whether players are in check, stopping them from making a move that would not take them out of check. The system will also be capable of determining whether the game is over and who won by looking for checkmates after every turn.

Users will play the game by interacting with holograms using their hands, which the hand tracking technology of the HoloLens allows for. They will be able to move pieces, surrender, or start a game against another player or AI. The system will show a different version of the game to both players. One player will see the game from the POV of black, and the other from the POV of white.

1.2 Scope

It is our understanding that the main objective of this project is to really explore the depth of the multi-user collaborative experiences based on the mixed reality experience that is essentially the foundation of the Hololens.

In order to do this our team has been instructed to provide a multiplayer game which can provide the immersive experience that the HoloLens was designed for.

The timeline and the key milestones that have roughly been given to us consist of 3 separate phases.

These phases are:

The Initial Phase:

- Building out a chess game that a player will be able to interact with using the HoloLens.
- Setting up Photon Unity networking to be able to play the game with 2 players each using their own HoloLens

The Intermediate Phase:

- Integrate an AI opponent service which can integrate with the work done in the initial stage to make decisions based on the current state of the game

The Final Phase:

- Expanding the game using Photon to enable multiple game sessions with multiple participants in each session, both human and AI, playing different games at the same time.

In order to reach these milestones and objectives our group has developed our own goals which consist of meeting a minimum of 2 times a week with each group member and also once a week with our course demonstrator and one more time a week with the representatives from Microsoft.

1.3 Objectives And Success Criteria

After Meeting with representatives from Microsoft Brian and Carl, we got a good sense of what was required of us for the project moving forward. We were given several objectives and some secondary stretch goals.

The main objectives are:

- To provide a turn-based game of our choice that is able to run on the HoloLens
- To implement a backend service to manage game state for multiple users
- To integrate a client app that will be able to connect to the backend service and play the game
- Provide an AI opponent for the user to play against

The secondary objectives are:

- Scale out the backend to enable online, player vs player, player vs AI and games, and to be able to handle multiple games in a single session..

Success Criteria

The success criteria of this project is to develop a turn-based game which is playable in AR on the HoloLens, the user should be able to interact with the game through the use of their hands and be able to play against an AI opponent, and possibly, be able to play against a human opponent as described in the secondary stretch goal.

2. Current System

Despite already being briefly touched upon, this section aims to truly explore the capabilities and implications of the Hololens device in its entirety. This should help in portraying the importance of our work in helping us understand the technologies of the future.

The widespread rumours of metaversal integration and augmented reality futures are no secret. Technologies such as the Hololens are leading the way into this conversion, and so, understanding them will likely be a crucial skill in the coming years.
The Hololens is Microsoft's attempt at working with **AR**, using a process they describe as a “mixed reality experience”. The Hololens uses a multitude of sensors, combined with sophisticated optics and holographic processing to work seamlessly with the environment. These holograms can be used to simulate real world experiences and graphically display information right before your eyes.

3. Proposed System

3.1. Overview

Our project will allow users to utilise augmented reality in a virtual Chess game, using the Microsoft Hololens. The technology will encourage users to share an experience, regardless of their location on the globe. The project involves an array of functional and indeed non functional requirements.

3.2. Functional Requirements

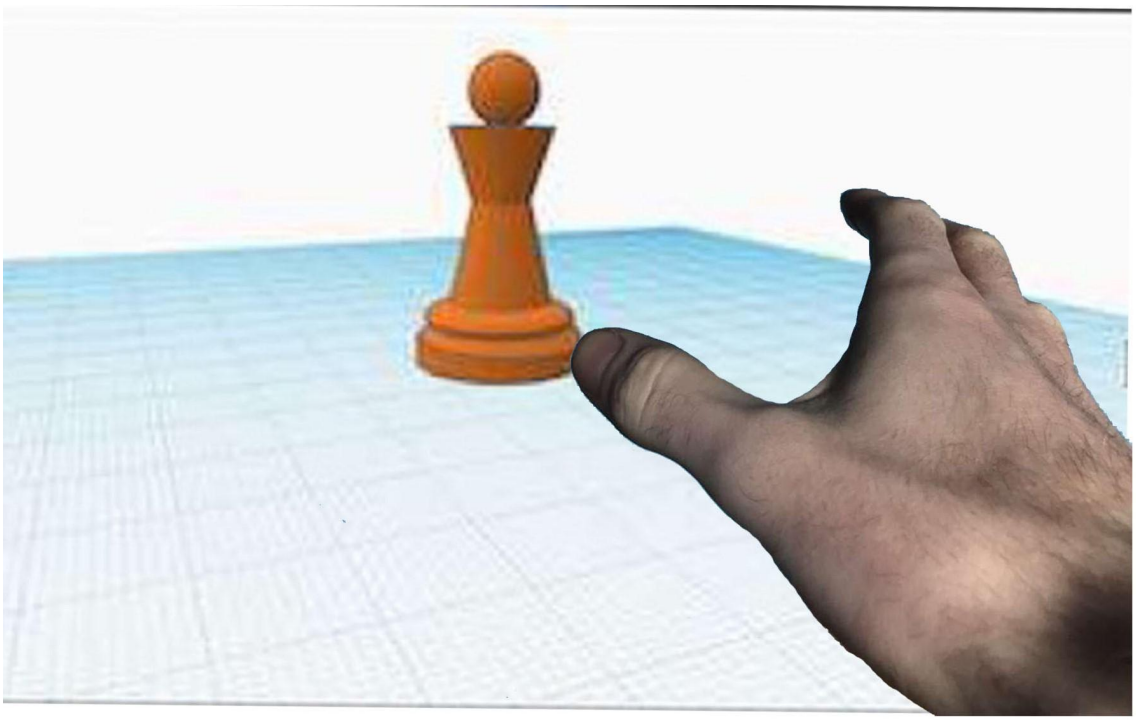
- A start screen providing initial buttons and menus to decide number of players and start the game
- The game should have an AI element for single player mode
- There needs to be a tracker to keep score of who is winning, how many rounds have been played, accumulative scores and timers for if/when a player takes too long their turn if forfeited.
- Algorithm implementation to keep track of legal moves and remove pieces when needed from the board

3.3. Non-functional requirements

- Friendly navigation and easy usability
- Well designed 3D models to avoid object clipping and keep the game immersive

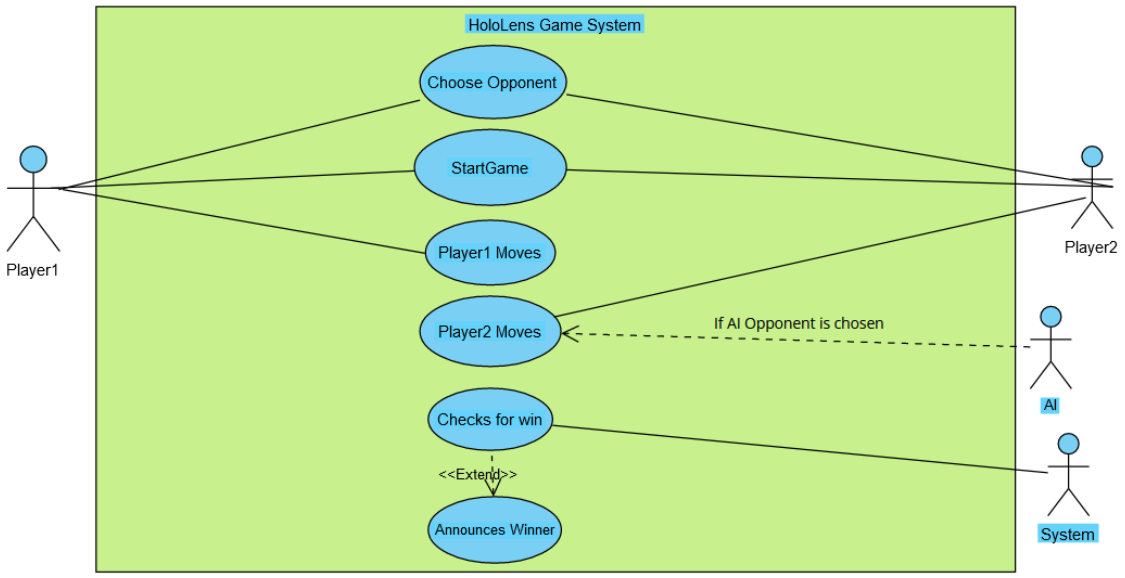
3.4. System prototype (models)

3.4.1.User interface mockups



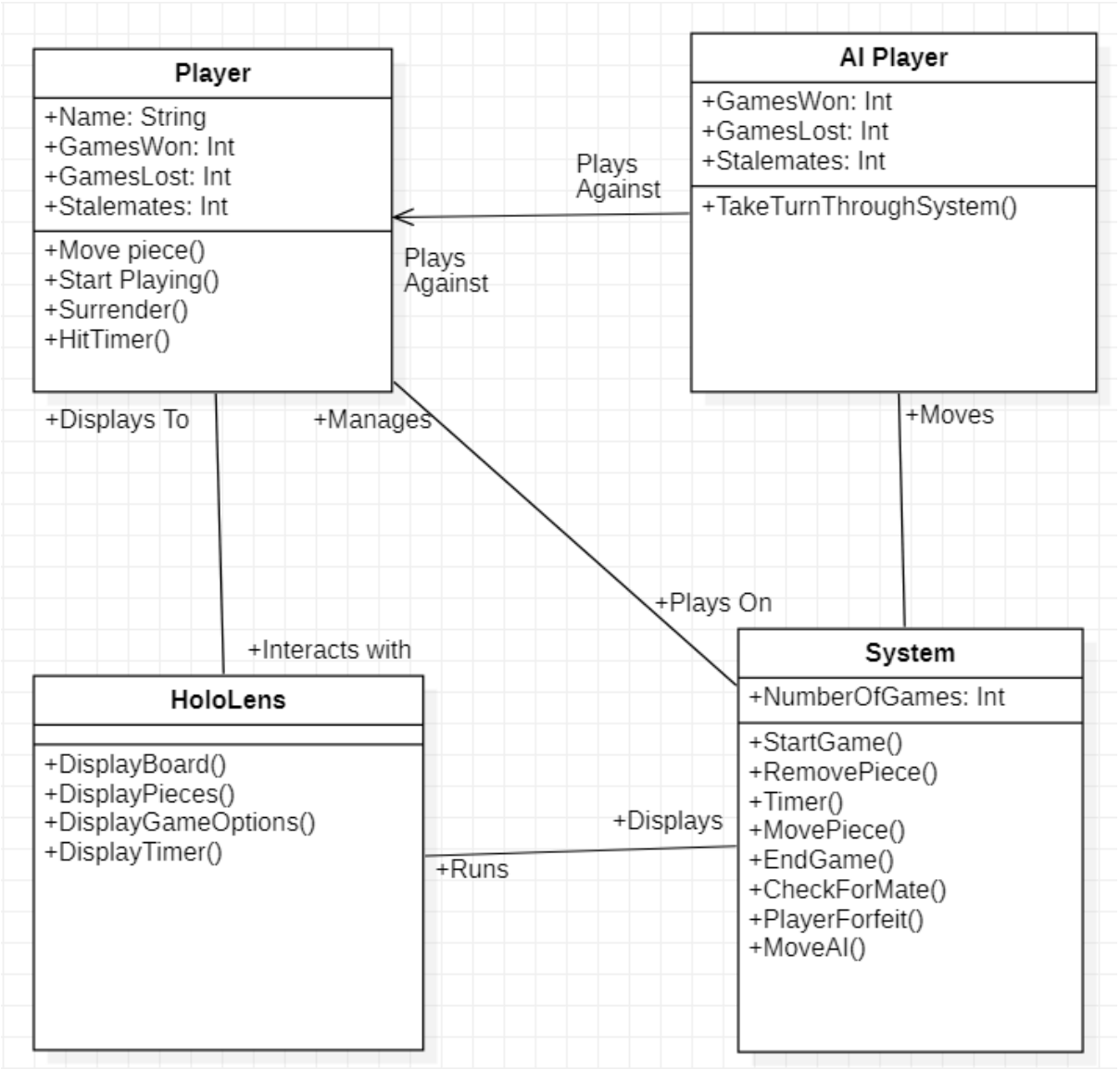
Due to the augmented reality aspect of the HoloLens the main user interface is completely interlinked with the User themselves and their surroundings. The virtual game will be projected to the user themselves utilising the built-in software of the HoloLens to do so.

3.4.2.Use cases (including text narratives)

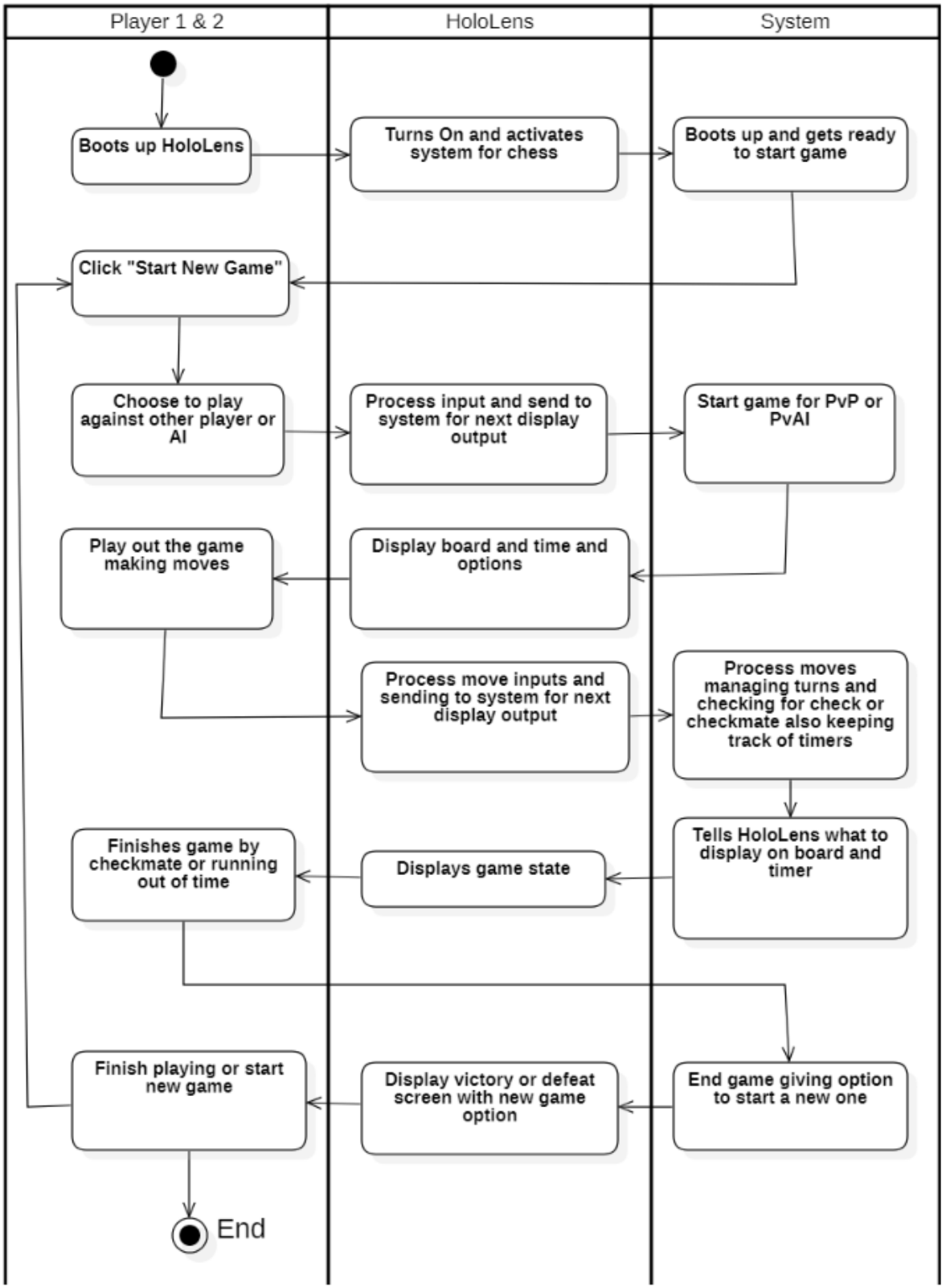


In this use case Player1 begins by choosing an opponent, they can choose a human opponent or an AI. If a human opponent is chosen the steps to start a new are mirrored.
Player1 always begins the turn based game by taking their turn first, This is followed by Player2 taking their turn. Note that if AI is chosen the game starts immediately as the AI does not need to start the game or choose an opponent.
After each move the System checks to see if a player has won the game and if this is the case announces the according player as the winner.

3.4.3.Object model



2.4.4.Dynamic model



4.1 Definitions And Abbreviations

AR: Augmented Reality

AI: Artificial Intelligence

The HoloLens: A mixed-reality device which enables untethered and immersive mixed-reality experience

Mixed reality: Mixed reality combines the physical and digital worlds and interacts with 3D humans, computers and the environment

Holograms: Three-dimensional images formed by light and sound that reflect real physical objects

4.2 References

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