CHAPTER

6

BOARD GAMES IN HANDHELD AUGMENTED REALITY

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6.1   INTRODUCTION

Augmented reality (AR) seamlessly blends the real and virtual realms, integrating virtual elements into the physical environment through digital devices. This dynamic experience enriches the real world with computer-generated content such as text, images, and videos. AR, characterised by the convergence of real and virtual worlds, three-dimensional (3D) registration, and real-time interactivity, enables users to perceive virtual objects overlaid onto the real world. This capability extends from sophisticated options like head-mounted displays (HMD) to accessible devices such as smartphones.

A board game, as the name indicates, is a game that involves game pieces moving around a designed surface or "board" with suitable strategies and skills concerning the game rules applied. Among all the board games in the world, we can categorise them into a few categories. Board games vary, some demanding strategic prowess, others relying on chance and luck, and some combining both elements. Each board game typically has a defined goal, often centred around defeating opponents by adhering to a specific set of rules. Choosing hand gesture interaction over touchscreen tapping enhances the interaction with AR board game pieces. Among hand tracking technologies, ManoMotion was selected

for its real-time gesture-tracking capabilities with minimal requirements. As per ManoMotion's official website, it seamlessly operates with just the RGB camera of a smartphone, eliminating the need for additional devices like Leap Motion or Microsoft Kinect and contributing to a more accessible and cost-effective user experience.

In our work, the board game we choose is the Chinese Chess game also known as Xianqi and AR technology is used to digitalise the Chinese Chess. Among the popular board games in the world, Chinese Chess is one of them with an estimated hundreds of millions of players worldwide (Tseng et al., 2018). As stated by Chen et al. in 2008, AR can improve the user's feeling of certain information by the combination of virtual objects with the real world. Smartphone-based AR applications can apply direct interaction through hand gestures and the possible scope of AR applications can be expanded. Based on the analysis done by Georgiadis and Yousefi (2017), the user felt more natural when using hand gesture interaction.

6.2   HANDHELD AUGMENTED REALITY

Handheld AR and mobile AR applications both leverage AR technology, but they differ in terms of device form factor, user experience, and potential use cases. Handheld AR devices are typically portable devices that overlay digital content onto the user's field of view. These devices offer a hands-free AR experience, allowing users to interact with digital content while keeping their hands free for other tasks. Mobile AR applications run on smartphones or tablets equipped with AR-capable cameras and sensors. Users view AR content through the device's screen, holding it up to overlay digital content onto their physical environment.

Handheld AR devices provide a more immersive AR experience compared to mobile AR applications, as users can see digital content overlaid directly onto their physical environment without needing to hold up a smartphone or tablet. Handheld AR devices may support gesture-based or voice-based interaction methods, allowing users to

interact with digital content using natural gestures or voice commands. Voice-based interaction enables the hands-free operation of AR devices, allowing users to control and interact with digital content without the need to touch or manipulate physical controls. This hands-free interaction enhances user convenience and enables more intuitive control of AR applications. Mobile AR applications typically rely on touchscreen-based interaction methods, such as tapping, swiping, and dragging, for user input. While these interaction methods are familiar to most users, they may not always be as intuitive or immersive as gesture-based interaction on handheld AR devices. Figure 6.1 shows the two users playing AR Chess using their handheld devices. There was a printed marker placed on the table, when the handheld device on the camera and tracked the marker, an AR chess game board appeared on top of it.

Figure 6.1 Augmented reality chess on portable devices (Source: Yusof et al., 2019)

Handheld AR devices may also track users' body movements, allowing them to control digital content by moving their arms, hands, or heads. For example, users can wave their hands to dismiss a notification or perform a specific gesture to launch an application. Some handheld AR devices support spatial gestures, where users interact with virtual objects by moving them through physical space. For example, users can grab and move virtual objects using hand movements or gestures. Users can perform specific hand movements or gestures to interact with digital