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研究計畫成果報告

計畫名稱：以 VR 建構銀髮族住宅環境影響入住意圖之研究

■重點(整合型)研究計畫
□與業界廠商合作之研究計畫

執行期間：107年05月24日至12月31日

總計畫主持人：

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Abstract

Aging populations have become common a social issue. Physical senescence leads to illnesses and declining physical functions, which render one’s limbs frail. Care facilities focus on delivering functional care and often neglect older adults’ psychological well-being and social needs. The leisure activities in which the older adults participate are mostly sedentary and devoted to static gameplay and treatment. In order to improve activity and mental health, the present study proposed interactive virtual reality (VR) games as an alternative form of leisure for the older adults living at care facilities and used an extended technology acceptance model to analyse their attitudes toward playing VR games and intention. We used structural equation modelling (SEM) to validate the proposed model and hypotheses. The results of this study showed that VR games’ perceived sociability, perceived ease of use and perceived benefits can encourage interpersonal interactions in which they discuss the particulars of these leisure entertaining activities and can decelerate older adults’ physical degeneration. Academic and practical implications from the findings are discussed at the end of this paper.

Keywords: VR Game, Perceived entertainment, Perceived sociability, Perceived benefits, Perceived barriers

1. Introduction

1.1 Research motivation

With growing access to health-related information, the standard of living and the quality of health care continue to improve. Further years, an increasing fraction of population is living to old age. World Health Organisation defines an aging society as a country in which senior citizens comprise over 7% of the total population. The proportion of Taiwan’s elderly people will have exceeded 14% of the population by 2018; more than one in four Taiwanese people will have reached old age by 2026, making the nation an ultra-ageing society, and this figure will have risen to 41.6% by 2026, of which 24.4% will be 80 years of age or over (Ministry of the Interior, 2016). Furthermore, the number of people with disabilities in Taiwan was approximately 755,000 in 2015 (483,000 of whom were in old age). Adults aged 65 years or older with chronic or major illnesses constitute 75.92% of the segment of the domestic population aged 65 years or older, suggesting that such illnesses are prevalent among Taiwan’s elderly. Poor health is a grave concern for elderly people; to improve their quality of life, they should be encouraged to live in a healthy manner and maintain their participation in social activities. By engaging in leisure activities—which offer enjoyment, enrich one’s life, and serve one’s psychological needs in a way that facilitate the pursuit of personal goals (Munk et al., 2012)—older adults can improve their quality of life and health. In particular, those with regular recreational participation can strengthen their self-esteem and physical health, achieve emotional relief, and decelerate their physical degeneration, thereby enhancing their quality of life and spending less on health care.

Health care policies tailored to senior citizens should be developed to reduce their socioeconomic disadvantages and meet their health care needs, which minimise the waste of health care resources (Park et al., 2016); research on how to formulate such measures is necessary. In that regard, providing well-designed leisure activities and opportunities for interpersonal
interaction at a local level can help older adults improve their quality of life and health (Gregory et al., 2017). The main of the study was to propose a leisure activity to improve the well-being of older adults. The daily lives of post-retirement adults can be improved via socialization, recreation, and health. Moreover, providing older adults with opportunities for socialization and recreation (e.g., in the form of video games) can enhance their brain activation and decelerate their memory degradation; accordingly, the benefits of recreational, interactive games for older adults should be studied.

While computer games have been used in health care institutions, government-funded care facilities, and educational institutions for recreational, educational, and medical purposes, health-related games (e.g., those in which characters present health-related information) for older adults have been empirically shown to enhance their attitudes toward playing the games, the acquisition of knowledge, and cognitive and physical functioning; to stimulate memorization in them; and to improve their physical health (McCallum, 2012). Care facilities mostly focus on the functional aspects of services, helping residents manage their physical health and daily living. However, the residents’ spiritual and social needs are rarely satisfied; consequently, they are prone to depression. Moreover, if they are only engaged in limited physical activities, their physical functioning will keep declining. When the older adults’ physical functioning declines to a certain extent, they will lose both control of their lives and also the ability to live independently. Under such circumstances, older adults with limited mobility and heavy dependence on their family members or relatives are prone to pessimism, which can in turn undermine their remaining physical functions and lead to excess disability (Wang et al., 2016). Therefore, older adults’ psychological health must be monitored. Leaving them alone may render them depressed. The aforementioned arguments underline the need for the development of interactive games in which older adults can move their limbs vigorously.

As digital technology continues to evolve, traditional games are increasingly digitised, and they have become an indispensable form of human recreation (Aleem et al., 2016). Digital games can be popular if they are entertaining, rule-based, and goal-oriented; if they provide outcomes and feedback; if they enable human–machine interaction, problem-solving, and social interaction; and if they present graphical elements and scenarios (Prensky, 2001a & 2001b). In particular, playing digital games based on virtual reality (VR) can heighten brain activation in older adults, decelerate their physical degeneration, and provide them with enjoyment (Khosravi et al., 2016).

1.2 Research Purpose

The VR is a recently invented but increasingly popular technology. Nakevska et al. (2017) engaged their participants in interactive storytelling in an environment with digital and physical information that exposed them to a combination of videos and sounds and to real-world and physical interaction. For using in this study, this environment provided an immersive experience that featured interactive narratives with dramatic storylines. Specially, the past study showed that feedback stimuli from this immersive experience encouraged positive interactions among the participants (Nakai & O’Malley, 2015). Such benefits make VR popular in various quarters.
Accordingly, the study focused on this technology. However, the activities of daily among older adults living at care facilities normally involve conventional games and rehabilitation; such conventional games lead to limited improvements in their physical functioning and the intensity of their physical activity. Thus, the study proposed a VR game of story recollection that was easier to play than other digital games. This proposed game even catered to older adults with marginally mobile lower limbs; the game delighted them and enabled them to interact with others to create social circles. Moreover, the game created an experience so immersive that older adults sometimes forgot the passage of time and therefore continued to stretch their limbs to facilitate their rehabilitation. The actions of older adults in this VR story-recalling game should be analysed because the actions of players in online games influence their continued use of the games and are attributable to certain intrinsic and extrinsic factors (Liu, 2016). Drawing on a theory of behaviour to analyse how young people play online games, Alzahrani et al. (2017) suggested that gaming industries can investigate intrinsic and extrinsic factors affecting young people’s behaviour in online games to identify factors that can increase their use of the games. Therefore, our study investigated older adults’ intention to use a VR story-recalling game and their behaviour in the game, thereby explicating the interaction mechanism underlying the game. No conclusive evidence exists as to the relationship between the experience of playing VR story-recalling games and the intention to use the games.

Ong & Shen (2009) highlighted the need to use VR to develop and commercialise products catering to the recreational needs of older adults and described this approach as innovative. However, since interactive VR games are unknown to older people in general, previous studies have used extended technology acceptance models (TAMs) to investigate older adults’ usage of games. For example, Hsu & Lu (2004) adopted a TAM to analyse users’ play of new online games in terms of usefulness, ease of use, and attitudes; they found that playing these games improved players’ social participation and game immersion. Wang & Sun (2016) also employed a TAM to examine older adults’ the gameplay intentions and indicated that playing the games has profound and research-worthy implications for older adults who lived on their own in terms of physical activity, perceived mobile maneuvering, social interaction, and entertainment-related newness. For our study, an extended TAM was used in the study to analyse the effects of VR story-recalling games on older adults’ sociability, recreational participation, perceived benefits and perceived barriers, and intention to use the games.

2. Literature, hypotheses development and conceptual framework

2.1 Older adults’ cognitive functioning and leisure activities

As humans enter old age, their overall physical functioning gradually declines and communication between the brain and the peripheral nervous system weakens. Park (2000) argued that significant age-related differences exist in cognitive functioning. Recently, Geiger et al. (2017) showed that moderating role of perceptual capabilities (e.g., the faculties of sight and hearing and the four limbs of the body) moderate the decline of cognitive functioning, suggesting that as people age, these capabilities should be stimulated to maintain coordination between
cognitive functions.

The field of activity theory, which focuses on the relationships between older adults’ leisure activities and their physical and psychological health, argues that elderly people should participate in as many social events as possible to enrich their lives (Charles & Karen, 2007). This theory also states that even older adults in poor health can compensate for their lost roles by partaking in different leisure activities. Some of the arguments of the theory have been validated; one such argument states that older adults with continuing participation in physical and social activities and economic production have better psychological health and greater life satisfaction (Longino & Kart, 1982; van het Bolscher-Niehuis et al., 2016). Lomranz et al. (1988) found significant relationships between the leisure activities of older adults in Israel, their frustration, and their psychological well-being. Ruuskanen & Ruoppila (1995) also indicated that by partaking in leisure activities, older adults can (a) improve the rate at which they adapt to aging, (b) develop new skills and learn to express themselves, thus experiencing enhanced self-worth, (c) gain social support to improve their self-esteem and sense of independence (Zimmer et al., 1995), and (d) re-socialise themselves to create a social network necessary for contribution to society. Moreover, the type and intensity of the leisure activities undertaken can improve one’s physical, psychological, emotional, social, and mental well-being (Ragheb, 1993; Zhang et al., 2017). Because aging and disability undermine one’s mobility, it is necessary to involve older adults in appropriate leisure activities to prevent the continued decline of their physical functioning. With active involvement in leisure, older adults can improve their physical and psychological health. In order to solve these problems of the older adults, the study was to develop a VR game as a form of leisure suitable for the senior citizens.

2.2 Scope of VR games

Recently launched games are mostly experiential, particularly those designed on the basis of VR. VR uses a simulator to generate realistic images and sounds; sensors detect the user’s reactions and transmit them to the simulator, thus creating a real-time human–machine interaction. The past scholar revealed that VR features “imagination,” “interaction,” and “immersion,” which are called the 3Is (Burdea, 1993). In terms of design, the creativity and imagination of developers are vital to VR development. For the presentation of special problems in a VR environment and the simulation of certain scenarios depend on the developers’ imagination, not just on the interface design. A typical VR system includes a head-mounted display and haptic controllers with which a user can maneuver in a virtual environment and control or touch objects. The VR system detects the user’s intuitive responses and muscular movements through sensors, processes these data, and uses a real-time 3D model, location-tracking, and 3D visual and auditory technologies to simulate the user’s sensations, thereby creating a realistic experience.

Several studies have presented VR applications. Verkuyl et al. (2017) designed virtual games on the basis of hands-on simulation that can used to facilitate instructional and learning processes. Shin et al. (2015) constructed a VR-based, gamified rehabilitation process and found noticeable improvements in health and quality of life among patients undergoing this rehabilitation process. Tussyadiah et al. (2018) developed VR-based tourist destinations to analyse visitors’ attitudes.
toward these spots and intention to explore them. The empirical result showed that VR experience significantly influenced visitors’ attitudes toward tourist attractions and intention to visit them. Specifically, in that study, because how participants felt in a virtual environment enhanced the enjoyment of their VR experiences, their participation in VR tourist attractions improved their preference for the spots and they showed positive attitudes toward particular destination spots and a stronger intention to visit them.

2.3 Technology acceptance model (TAM)

Drawing on the theory of reasoned action and the theory of planned behaviour, Davis (1989) first proposed TAMs (Fig. 1), which describe how a user comes to accept and use information technology. A TAM has two features: (a) a TAM excludes subjective norms and focuses on behaviours and attitudes, and (b) considering that behaviours and attitudes are subject to the beliefs that the user has about a specific goal, a TAM includes perceived usefulness (PU) and perceived ease of use (PEOU) to account for the effects of external variables in the user’s attitudes, intention, and usage behaviour. Moreover, the TAM model is arguably the most widely applied theory on the acceptance of information technologies; it has been adopted to empirically interpret and predict the way technologies are used (Legris et al., 2003). TAMs can also effectively predict the use of digital games (Hsu & Lu, 2004; Pando-Garcia et al., 2016).

![TAM Diagram](image)

Fig. 1 Technology acceptance model (TAM)

Attitudes toward using are found to significantly affect behavioural intention (Ajzen & Fishbein, 1980; Taylor & Todd, 1995). For example, behavioural intention is strongly influenced by attitudes toward using multimedia (Moon & Kim, 2001) and those toward using websites (Heijden, 2004). Attitudes toward using popular and enjoyable online games positively influence on the intention (Alzahrani et al., 2017; Wang & Sun, 2016). On the basis of the aforementioned arguments, H1 is defined as follows:

H1: Older adults’ attitudes toward playing VR games positively affect their intention to play the games.

In recent years, the advent of digital technology has produced popular digital games. The operation of these games involves their mechanisms and user interfaces; the easier the games are to operate, the more likely the user is to become immersed in their scenarios, derive great
enjoyment from the games, and perceive the games positively. The user interfaces of digital games are generally less complex than those of multiplayer online games. However, the design of a game determines the game’s perceived difficulty, making it necessary to analyse PEOU in a TAM (Pando-Garcia et al., 2016; Rodrigues et al., 2017). For solving these problems, Ha et al. (2007) showed that the PEOU of mobile games significantly predicts the PU and PE of the games and attitudes toward using them. Heijden (2004) suggested that the PEOU of portal websites strongly affects the PU and perceived entertainment (PE) of the websites and attitudes toward using the websites. A study of university students in Taiwan playing corporate simulation games found a positive correlation between the PEOU and PE of the games. Some studies have also established a positive relationship between the PEOU of digital games and attitudes toward using them (Bourgonjon et al., 2013; Pando-Garcia et al., 2016). For interactive games, PEOU positively affects PU (Lin et al., 2017). The PEOU and PE of mobile games are found to be positively and significantly related (Okazaki et al., 2008; Tao et al., 2009). To determine the role of VR games’ PEOU in their PU and PE and the attitudes of older adults toward playing the games, the study proposed the following hypotheses:

H2: Older adults’ PEOU of VR games positively affects their PU of the games.
H3: Older adults’ PEOU of VR games positively affects their PE of the games.
H4: Older adults’ PEOU of VR games positively affects their attitudes toward playing the games.

Davis (1989) indicated that PU influences attitudes toward using, and both PU and attitude tend to affect intention to use. Especially in multimedia research, Moon & Kim (2001) showed that the PU significantly affects attitudes toward using multimedia and intention to use it. Pando-Garcia et al. (2016) proposed that the more useful employees perceive an interactive game to be, the more likely they are to use the game for the web-based business game-training program. The result found that the PU of games designed for commercial training significantly influenced attitudes toward using the games and intention to use them. Recently, Lin et al. (2017) showed that the PU of interactive computer games significantly influences intention to use the games, particularly when users perceive them to be beneficial—in which case users are likely to continue to use the games. On the basis of the aforementioned studies, the study proposed H5 and H6 to describe the relationships between older adults’ PU of VR games, their attitudes, and their intention to play the games:

H5: Older adults’ PU of VR games positively affects their attitudes toward playing the games.
H6: Older adults’ PU of VR games positively affects their intention to play the games.

2.4 Entertainment

Moon & Kim (2001) suggested that the more entertaining multimedia is perceived to be, the stronger the attitudes toward using it will be. Webster et al. (1990) established a strong relationship between PE and attitudes toward using multimedia. The general elements of entertainment have been widely discussed among researchers focusing on children and adolescents (Barnett, 1990); however, recent studies have found that playing electronic games
improves older adults’ life satisfaction and health. When older adults perceive such games to be entertaining, they show relatively positive attitudes toward playing the games (Kahlbaugh et al., 2011; Wang & Sun, 2016). Additionally, Zhao & Renard (2018) argued that the entertaining games significantly influences attitudes toward playing them, and this quality also triggers players’ intrinsic and extrinsic motivations, thus prompting them to engage in certain behaviours (e.g., sharing their feedback on the games they have played and giving the games to others) and increase their involvement in the games. On the basis of the aforementioned studies, the study proposed H7 to determine the relationship between older adults’ PE of VR games and their attitudes toward playing the games:

H7: Older adults’ PE of VR games positively affects their attitudes toward playing the games.

2.5 Sociability

Social interaction underpins the development of today’s games because it allows a player develop a sustained recognition of a game, influence the game, further his or her personal relationships, and derive enjoyment from social participation. Social interaction lasts from hours to years; thus, if the connection between a game and its players is maintained continuously, then the provider of the game can gain commercial benefits and players can derive greater enjoyment from their socialization in the game (Kreijns et al., 2007). Interpersonal communication may be encouraged or restricted depending on the form of media used; therefore, people tend to maintain their interpersonal connections through different forms of media (Barry Wellman et al., 2003). In terms of interpersonal interaction, sociability and usability are closely linked. Although they concern the design of a technological product, they differ from each other; whereas usability (and ease of use) represents the interaction between a technological product and the user, sociability represents whether the product enables the user to interact with others (Preece, 2001a & 2001b).

This study introduced perceived sociability (PS) as an exogenous variable in an extended TAM to assess the effects of older adults’ PS of VR games on their PE and attitudes toward playing the games. The interactivity of VR games promotes idea exchange between older adults and therefore affects these people’s PE of the games and attitudes toward playing them. Recent studies have suggested that interactive games enable real-time interpersonal interaction and meet social needs, and the PS of a digital game is positively related to attitudes toward playing it (Le Hénaff et al., 2015; Wang & Sun, 2016). Moreover, some studies have found that the continued use of social-network games is attributed not only to entertainment but also to the need to connect with friends who play the same games, and in this study, players develop a sustained recognition of the games, improve their social connections, and gain enjoyment from their socialization in the games. However, for older adults living at care facilities, who spend most of the day eating, showering, and rehabilitating, opportunities for social interaction are scarce. To assess the relationship of older adults’ PS of VR games with their PE of the games and attitudes toward playing them, H8 and H9 were proposed:

H8: Older adults’ PS of VR games positively affects their PE of the games.
H9: Older adults’ PS of VR games positively affects their attitudes toward playing the games.

2.6 Health belief model

The health belief model (HBM) was proposed in the 1950s by a group of psychologists. Rosenstock (1974) elaborated on the prototype of the HBM; after Becker & Maiman (1975) revised it, the HBM became fully developed. The HBM, rooted in social psychology, was used to account for human behaviour on the basis of the concept of “value expectancy.” Nowadays, the model is predicated on the concepts of “health belief” and “clue to action.” Rosenstock (1974) divided the concept of health belief into perceived susceptibility, perceived severity, perceived benefits (PBE), and perceived barriers (PBA). However, the use of technology to prevent aging and reduce disability is seldom discussed in HBM research. Recruiting older adults, the current study excluded perceived susceptibility and perceived severity from the HBM. In this study, PBE were defined as the benefits of taking a certain action from which a person thinks he or she may derive (e.g., reducing the likelihood of illness and alleviating the grave consequences of morbidity), whereas PBA referred to the hindrances or difficulties that a person may encounter when taking a certain action and to the harm or negative influences that arise from the person’s action.

Focusing on the use of VR games as a form of leisure for older adults, this study explored the effects of elderly people’s PBE and PBA of playing the games for leisure on their intention to playing them. Therefore, PBE and PBA were used as variables to determine whether playing VR games helped older adults’ psychological health and social connectedness. The effects of both variables on older adults’ continued use of VR games was also examined because using the games may induce physical stress or the anxiety, apprehensiveness, and fear that can be attributed to technology use. Timo & Mikko (2004) showed that adolescents’ PBE of wearing a helmet while riding a bicycle (e.g., improving safety and preventing head injuries) significantly influence their intention, whereas their PBA of donning a helmet on a bike ride (e.g., difficult to wear and looking unattractive) negatively influence their intention. The current study argued that older adults may continue to play VR games if playing the games allows them to improve their psychological and social well-being, although the convolutedness and strong visual and audio effects of the games, as well as anxiety and fear over gameplay, may discourage them from playing the games. On the basis of this argument, H10 and H11 were proposed:

H10: Older adults’ PBE of playing VR games positively affect their intention.
H11: Older adults’ PBA of playing VR games positively affect their intention.

3. Research Methodology

3.1 Nostalgia of the proposed interactive VR game

In our study, the older adults enjoy recalling the days of their youth, an interactive VR game rendering what life was like when they were young was developed as a form of leisure for elderly people. Fig. 2 presents a scene in the VR game. In this nostalgia-filled game, older adults used the HTC Vive, a VR display, with software developed using Unity (a game engine), to interact with the virtual environment. The game included 3D scenes—in which the user navigated by using the
display or selecting appropriate buttons on a user interface—as well as scripts and stages.

3.2 Research model

This study adopted the TAM constructed by Davis (1989), introducing PE (Moon & Kim, 2001) and PS (Le Hénaff et al., 2015) as antecedent variables into the model to analyse older adults’ attitudes toward playing VR games (ATG). PBE and PBA were integrated as variables into the HBM (Rosenstock, 1974), and the model was subsequently used to consider older adults’ intention to play VR games (IPG). Fig. 3 presents the study framework.

![Fig. 2 Examples of a VR game scene](image)

![Fig. 3 Research model](image)

3.3 Design of the experiment

Considering that older adults’ PE and PS of playing VR games may improve their physical,
psychological, and social well-being, this study investigated the role of their PE and PS of playing the games on ATG and IPG. Given this objective, the study adopted a field-study approach, using a quasi-experimental design in which pretests and posttests were administered. The rationale behind the use of the quasi-experimental design was that the site of the study precluded the grouping of older adults through random sampling. After informed consent had been obtained from older adults, purposive sampling was performed to recruit those aged 60 years or older. The participants were subsequently divided into experimental and control groups; the experimental group played a VR game, whereas the control group played conventional games. In summary, this study analysed the effects of (a) the participants’ PU, PEOU, PE, and PS of playing the VR game on their IPG and (b) their PBE and PBA of playing the game on their IPG.

4. Data Analysis

4.1 Descriptive statistics

The sample for this study was composed of the old adults aged 60 above; they were experimented in the Geriatric Psychiatric Day Care Center with an ancillary survey in Taiwan. Research interviewers were employed. Their major duties were to invite those elders who looked to be above 60 years old, explain the purposes of our survey, read the questions, and mark the respondents’ answers. They were also instructed to assist the elders in completing the questionnaire. Two of the 52 questionnaires returned from the experimental group were invalid, whereas all 50 responses from the control group were valid. An analysis of demographic data for both groups yielded the following results. First, the majority of participants in the experimental group were female (52.00%, \(n = 26\)), whereas those in the control group were mostly female (54.00%, \(n = 27\)). Second, participants aged 60–65 years constituted the largest age class, representing 44.00% of the experimental-group sample (\(n = 22\)) and 48.00% of the control-group sample (\(n = 24\)). Third, most experimental-group participants worked in the service industry (36.00%, \(n = 18\)), while control-group participants were mostly retired (22.00%, \(n = 11\)). Fourth, the vast majority of participants in the experimental group frequently played VR games (72.00%, \(n = 36\)), whereas all participants in the control group never played VR games (100.00%, \(n = 50\)). Fifth, most experimental-group participants did not remember how many times they played VR games each week (38.00%, \(n = 19\)); all control-group participants never played VR games (100.00%, \(n = 50\)). Other descriptive statistics are shown in Table 1.

<p>| Table 1. Descriptive statistics of the experimental and control groups |
|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Item</th>
<th>Experimental group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of questionnaires ((n = 50))</td>
<td>Percentage (%)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>24 48.00%</td>
<td>27 54.00%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>26 52.00%</td>
<td>23 46.00%</td>
</tr>
<tr>
<td>Age</td>
<td>60-65</td>
<td>22 44.00%</td>
<td>24 48.00%</td>
</tr>
<tr>
<td></td>
<td>66-70</td>
<td>21 42.00%</td>
<td>17 34.00%</td>
</tr>
</tbody>
</table>
### Occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>71-75</th>
<th>&gt; 75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retired</td>
<td>5</td>
<td>10.00%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>8</td>
<td>16.00%</td>
</tr>
<tr>
<td>Service</td>
<td>18</td>
<td>36.00%</td>
</tr>
<tr>
<td>Financial</td>
<td>5</td>
<td>10.00%</td>
</tr>
<tr>
<td>Marketing</td>
<td>8</td>
<td>16.00%</td>
</tr>
<tr>
<td>Freelance</td>
<td>6</td>
<td>12.00%</td>
</tr>
</tbody>
</table>

### Experience with VR games

<table>
<thead>
<tr>
<th>Experience with VR games</th>
<th>4</th>
<th>8.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>First-time</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Limited</td>
<td>14</td>
<td>28.00%</td>
</tr>
<tr>
<td>Extensive</td>
<td>36</td>
<td>72.00%</td>
</tr>
</tbody>
</table>

### How often do you play VR games?

<table>
<thead>
<tr>
<th>How often do you play VR games?</th>
<th>4</th>
<th>8.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>5</td>
<td>10.00%</td>
</tr>
<tr>
<td>Exactly once a week</td>
<td>2</td>
<td>4.00%</td>
</tr>
<tr>
<td>Two to three times a week</td>
<td>14</td>
<td>28.00%</td>
</tr>
<tr>
<td>Can’t remember how many times a week I play</td>
<td>19</td>
<td>38.00%</td>
</tr>
<tr>
<td>At least once a day</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Multiple times a day</td>
<td>10</td>
<td>20.00%</td>
</tr>
</tbody>
</table>

### 4.2 Reliability and validity analysis

The validity of the questionnaires administered to experimental and control group was assessed in terms of construct validity, which comprised convergent validity and discriminant validity (Hair et al., 2006). Based on Fornell & Larcker (1981) mentioned, the questionnaire had high discriminant validity if the square root of the AVE of a construct exceeded the correlation coefficients of other constructs. Our results showed that for the questionnaire administered to the experimental group, construct reliability (CR) exceeded 0.8 and ranged from 0.867 to 0.943; the AVE exceeded 0.6 and ranged from 0.656 to 0.807; and the level of discriminant validity of each construct exceeded the other values of the construct and ranged from 0.810 to 0.898. Moreover, a reliability analysis was conducted to ascertain whether the questionnaire results were stable and consistent, as determined by a Cronbach’s α of > 0.7 (Hair et al., 2006). The analysis showed that for the experimental group, the Cronbach’s α for each construct exceeded 0.7 and ranged from 0.807 to 0.920, indicating that the CR of the questionnaire was highly reliable. Table 2 presents the results of reliability and validity analysis of the questionnaire administered to the experimental group.

Table 2. Results of reliability and validity analysis of the experimental group

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td></td>
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<tr>
<td>PEOU</td>
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<tr>
<td>PE</td>
<td></td>
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<tr>
<td>PS</td>
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<tr>
<td>PBE</td>
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<tr>
<td>PBA</td>
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</tr>
<tr>
<td>ATG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IPG</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
For the questionnaire administered to the control group, construct reliability exceeded 0.8 and ranged from 0.820 to 0.974; the AVE exceeded 0.7 and ranged from 0.703 to 0.888; the level of discriminant validity of each construct exceeded the other values of the construct and ranged from 0.839 to 0.962; and Cronbach’s α for each construct exceeded 0.7 and ranged from 0.848 to 0.960. Table 3 tabulates the results of reliability and validity analysis of the questionnaire.

Table 3. Results of reliability and validity analysis of the control group

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
<th>Cronbach’s α</th>
<th>PU</th>
<th>PEOU</th>
<th>PE</th>
<th>PS</th>
<th>PBE</th>
<th>PBA</th>
<th>ATG</th>
<th>IPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU</td>
<td>0.949</td>
<td>0.861</td>
<td>0.919</td>
<td>0.928</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEOU</td>
<td>0.974</td>
<td>0.826</td>
<td>0.960</td>
<td>0.671</td>
<td>0.962</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PE</td>
<td>0.970</td>
<td>0.888</td>
<td>0.958</td>
<td>0.614</td>
<td>0.789</td>
<td>0.942</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PS</td>
<td>0.956</td>
<td>0.846</td>
<td>0.939</td>
<td>0.673</td>
<td>0.701</td>
<td>0.786</td>
<td>0.920</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBE</td>
<td>0.963</td>
<td>0.866</td>
<td>0.948</td>
<td>0.495</td>
<td>0.621</td>
<td>0.719</td>
<td>0.582</td>
<td>0.931</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBA</td>
<td>0.820</td>
<td>0.703</td>
<td>0.888</td>
<td>0.004</td>
<td>0.100</td>
<td>0.071</td>
<td>0.019</td>
<td>0.082</td>
<td>0.839</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATG</td>
<td>0.908</td>
<td>0.767</td>
<td>0.848</td>
<td>0.540</td>
<td>0.737</td>
<td>0.794</td>
<td>0.615</td>
<td>0.682</td>
<td>0.024</td>
<td>0.876</td>
<td></td>
</tr>
<tr>
<td>IPG</td>
<td>0.918</td>
<td>0.768</td>
<td>0.856</td>
<td>0.581</td>
<td>0.515</td>
<td>0.610</td>
<td>0.676</td>
<td>0.644</td>
<td>0.148</td>
<td>0.525</td>
<td>0.876</td>
</tr>
</tbody>
</table>

4.3 Structural equation modelling analysis

In line with the preliminary fit criteria, the standardised factor loadings for experimental and control groups were greater than 0.5 and lower than 0.95 (Hair et al., 2006). The t-values for both groups were significant. Therefore, the Structural equation modelling in this study exhibited high goodness-of-fit. Table 4 presents the related value of all constructs of the study. In the experimental group, perceived entertainment (PE) had an explanatory power of 74.2% \( (R^2 = 0.742) \). Perceived ease of use (PEOU) and perceived sociability (PS) were the factors in PE. Within PE, PEOU (standardised coefficient = 0.694) was a more important factor than PS (standardised coefficient = 0.264). Attitudes toward playing VR games (ATG) exhibited an explanatory power of 46.4% \( (R^2 = 0.464) \). PE (standardised coefficient = 0.594) and PS (standardised coefficient = 0.399) were the factors in ATG; PE exerted greater influence on ATG than PS did. Intention to play VR games (IPG) demonstrated an explanatory power of 57.3% \( (R^2 = 0.573) \). IPG was influenced more by perceived benefits (PBE), which had a standardised coefficient of 0.493, than by perceived usefulness (PU), which had a standardised coefficient of 0.321. PU had an explanatory power of 31.3% \( (R^2 = 0.313) \).
It was influenced mostly by PEOU (standardised coefficient = 0.559). Fig. 4 depicts the SEM results for the experimental group.

Table 4. Factor loadings of all constructs in the SEM

<table>
<thead>
<tr>
<th>Construct</th>
<th>Item</th>
<th>Experimental group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Factor loading</td>
<td>S.D.</td>
</tr>
<tr>
<td>Perceived usefulness (PU)</td>
<td>PU1</td>
<td>0.830</td>
<td>0.067</td>
</tr>
<tr>
<td></td>
<td>PU2</td>
<td>0.843</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>PU3</td>
<td>0.874</td>
<td>0.038</td>
</tr>
<tr>
<td>Perceived ease of use (PEOU)</td>
<td>PEOU1</td>
<td>0.912</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>PEOU2</td>
<td>0.840</td>
<td>0.049</td>
</tr>
<tr>
<td></td>
<td>PEOU3</td>
<td>0.918</td>
<td>0.024</td>
</tr>
<tr>
<td>Perceived entertainment (PE)</td>
<td>PE1</td>
<td>0.748</td>
<td>0.107</td>
</tr>
<tr>
<td></td>
<td>PE2</td>
<td>0.885</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td>PE3</td>
<td>0.789</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>PE4</td>
<td>0.812</td>
<td>0.054</td>
</tr>
<tr>
<td>Perceived sociability (PS)</td>
<td>PS1</td>
<td>0.934</td>
<td>0.024</td>
</tr>
<tr>
<td></td>
<td>PS2</td>
<td>0.884</td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>PS3</td>
<td>0.937</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>PS4</td>
<td>0.835</td>
<td>0.054</td>
</tr>
<tr>
<td>Perceived benefits (PBE)</td>
<td>PBE1</td>
<td>0.869</td>
<td>0.028</td>
</tr>
<tr>
<td></td>
<td>PBE2</td>
<td>0.919</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>PBE3</td>
<td>0.851</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>PBE4</td>
<td>0.757</td>
<td>0.112</td>
</tr>
<tr>
<td>Perceived barriers (PBA)</td>
<td>PBA1</td>
<td>0.945</td>
<td>0.066</td>
</tr>
<tr>
<td></td>
<td>PBA2</td>
<td>0.815</td>
<td>0.164</td>
</tr>
<tr>
<td></td>
<td>PBA3</td>
<td>0.800</td>
<td>0.172</td>
</tr>
<tr>
<td>Attitudes toward VR games (ATG)</td>
<td>ATG1</td>
<td>0.881</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>ATG2</td>
<td>0.824</td>
<td>0.071</td>
</tr>
<tr>
<td></td>
<td>ATG3</td>
<td>0.919</td>
<td>0.018</td>
</tr>
<tr>
<td>Intention to play VR games (IPG)</td>
<td>IPG1</td>
<td>0.787</td>
<td>0.067</td>
</tr>
<tr>
<td></td>
<td>IPG2</td>
<td>0.934</td>
<td>0.018</td>
</tr>
<tr>
<td></td>
<td>IPG3</td>
<td>0.753</td>
<td>0.097</td>
</tr>
</tbody>
</table>
In the control group, PE had an explanatory power of 84.3% ($R^2 = 0.843$) and was influenced more by PEOU (standardised coefficient = 0.667) than by PS (standardised coefficient = 0.318). ATG demonstrated an explanatory power of 63.6% and was influenced largely by PE (standardised coefficient = 0.703). IPG exhibited an explanatory power of 54.1% ($R^2 = 0.541$) and was influenced more by PBE (standardised coefficient = 0.480) than by PU (standardised coefficient = 0.329). PU had an explanatory power of 45.1% ($R^2 = 0.451$) and was influenced mainly by PEOU (standardised coefficient = 0.671). Fig. 5 illustrates the SEM results for the control group.

5. Results and Discussions
The study examined interactive VR games as a leisure activity for older adults, their participation in VR games, and their social experiences in VR games. An extended technology
acceptance model was used to formalise older adults’ attitudes toward VR games and their intention to play the games. The study examined their acceptance of the games and the implications of their experiences. The findings of this study are expected to encourage older adults to engage in leisure activities that benefit them both in terms of leisure and physical health. The findings are as follows.

First, in the experimental group, ATG significantly affected IPG. This finding corresponded with those of Heijden (2004). The experimental-group participants perceived VR games positively and indicated positive attitudes toward playing the games and an intention to use and share them in the future. Therefore, H1 was validated. However, this hypothesis did not apply to the control group, in which ATG had a nonsignificant effect on IPG. Specifically, the control participants did not express any positive feelings toward VR games when they did not play them. Nor did the participants indicate positive attitudes toward playing the games or share their experiences of the benefits of playing games.

Second, in both groups, PEOU positively affected PU and PE, and this finding was consistent with those of Ha et al. (2007). Thus, H2 and H3 were both validated. Notably, control participants deemed VR games easy to operate probably because the games are humanised design in such a manner that they readily engage first-time players and afford entertainment, thus enhancing the recreational experience of older adults. H4 was validated in the experimental group but not in the control group, who might have considered playing VR games to be an act of reducing boredom and therefore did not participate actively in the games or find the time to play them.

Third, in both experimental and control groups, PU did not significantly influence ATG, suggesting that although older adults shared VR games with others, they attached limited importance to the games’ usefulness (e.g., in terms of their economic value). The nonsignificant influence of PU on ATG was probably due to (a) older adults’ prevailing perception that playing VR games means to reduce boredom or entertain oneself and (b) because they are of retirement age, they tend to pay limited attention to the VR games’ utility. Thus, H5 was not supported. However, PU significantly influenced intention to play VR games in both groups. It was probably because playing VR games allowed older adults to engage in social interaction; thus the games improved their communication skills and enhanced their enjoyment. Therefore, older adults in experimental and control groups were keen to play VR games and share the fun of playing them. This finding agreed with those of Moon & Kim (2001), and H6 was validated accordingly.

Fourth, in the experimental and control groups, PE significantly affected attitudes toward playing VR games. The participants might have been curious about VR games and might have intended to explore them. They considered the games to be entertaining and indicated positive attitudes toward them. In particular, when playing the games, experimental-group participants expressed stronger positive attitudes toward their experiences. This finding corresponded with those of Li et al. (2005). Thus, H7 was confirmed.

Fifth, in the experimental and control groups, PS significantly affected PE, validating H8. Participants in both groups derived enjoyment from playing VR games with others, and this finding corresponded with those of B. Wellman et al. (2003). Therefore, older adults should be
encouraged to network through participation in VR games. Furthermore, PS exerted a significant effect on ATG in the experimental group, validating H9. The experimental-group participants held positive attitudes toward social events and therefore shared positive beliefs about playing VR games. Specifically, playing VR games made them happy and allowed them to socialise with players their age, thus leading them to view their lives positively. However, PS had a nonsignificant effect on ATG in the control group, probably because most control participants had had no prior experience with any VR games and did not deem it necessary to socialise through participation in VR games. Encouragement from family members or friends may motivate older adults to play VR games, where they can enjoy recreational experiences that are distinctly different from their usual leisure pursuits.

Finally, in experimental and control groups, PBE significantly affected IPG, validating H10. Both groups believed that playing VR games helped reduce the likelihood of illness and alleviate the side effects of illnesses. Therefore, in a context consistent with that of Timo & Mikko (2004), the evidence of this study suggested that playing VR games can facilitate older adults’ recovery from illnesses and contribute to their physical and mental health. Yet, PBA did not significantly affect IPG in both groups, rejecting H11. This suggested that the participants were somewhat anxious about VR games, probably because they thought they were too old to play the games, perceived the games to be a pastime exclusively for young people, or were concerned that playing the games would undermine the health of their eyes.

6. Implications and limitations

6.1 Academic implications

This study contributed to the existing literature by using an extended technology acceptance model to investigate older adults’ intention to play VR games. For the older adults who participated in this study, the perceived ease of use of VR games strongly influenced the games’ perceived usefulness and entertainment value. Notably, the experimental group indicated positive attitudes toward playing VR games, whereas the control group expressed negative ones, which were reversible by recommendations from friends or family members. Moreover, perceived ease of use of VR games was greater for the experimental group than for the control group, who needed instructions. On the basis of this finding, this study proposed that establishing a social circle helps older adults learn to play VR games, thereby enriching their leisure experience and reducing their perceived barriers (e.g., anxiety and health problems) to the games accordingly.

6.2 Practical implications

The VR games can be designed to be more usable and to allow multiplayer gameplay, thereby improving interaction among older adults, facilitating them in developing interpersonal relationships, and making their leisure more meaningful. VR games’ developers could design more types for older adults to provide various VR games and social interactive issues so as to better serve their entertaining and social needs; and the VR companies can promote their game products for stimulating older adults’ brains to generate more interesting and entertaining topics to meet older adults’ need of entertainment. Moreover, since this study finds that VR games can entertain
older adults and make them less likely to be ill, VR games should be developed in a manner that provides elderly players with the greatest possible enjoyment, stimulates their brains, prompts them to move physically, and keeps them in a good mood. Promoting these benefits to older adults can encourage them to play VR games.

6.3 Limitations and future research

There are some limitations to this study that should be acknowledged. First, the samples was an experimental design from elderly care centers. Further research can collect a large number of samples for comparison and analysis of our research model. Second, this study considers VR games in the nostalgia-filled scene, thus they do not represent the playing intentions for all VR games. We suggest that future studies include older adults of different types of AR games, such as mobile phone show AR interactive games. Furthermore, our study primarily focused on older adults’ intention to play the games with VR in terms of their experiential perceiving, whereas the effects of factors such as media richness and perceived value were not considered. Finally, future studies should consider combining other theories (e.g., social gratification, hedonic gratification and utilitarian gratification) with plays and behaviour intention to fully identify factors affecting the continuance of usage intentions.

References


Aging populations have become common a social issue. Physical senescence leads to illnesses and declining physical functions, which render one’s limbs frail. Care facilities focus on delivering functional care and often neglect older adults’ psychological well-being and social needs. The leisure activities in which the older adults participate are mostly sedentary and devoted to static gameplay and treatment. In order to improve activity and mental health, the present study proposed interactive virtual reality (VR) games as an alternative form of leisure for the older adults living at care facilities and used an extended technology acceptance model to analyze their attitudes toward playing VR games and their intention. This study then used structural equation modelling (SEM) to validate the proposed model and hypotheses. The results of this study showed that VR games’ perceived sociability, perceived ease of use and perceived benefits can encourage interpersonal interactions in which they discuss the particulars of these leisure entertaining activities and can decelerate older adults’ physical degeneration. Academic and practical implications from the findings are discussed at the end of this paper.

Keywords: VR Game, Perceived entertainment, Perceived sociability, Perceived benefits, Perceived barriers

1. Introduction

The VR is a recently invented but increasingly popular technology. Nakevska et al. (2017) engaged their participants in interactive storytelling in an environment with digital and physical information that exposed them to a combination of videos and sounds and to real-world and physical interaction. For using in this study, this environment provided an immersive experience that featured interactive narratives with dramatic storylines. Specially, the past study showed that feedback stimuli from this immersive experience encouraged positive interactions among the participants (Nakai & O'Malley, 2015). Such benefits make VR popular in various quarters. Accordingly, the study focused on this technology. However, the activities of daily among older adults living at care facilities normally involve conventional games and rehabilitation; such conventional games lead to limited improvements in their physical functioning and the intensity of their physical activity. Thus, the study proposed a VR game of story recollection that was easier to play than other digital games. This proposed game even catered to older adults with marginally mobile lower limbs; the game delighted them and enabled them to interact with others to create social circles. For our study, an extended TAM was used in the study to analyze the effects of VR story-recalling games on older adults’ sociability, recreational participation, perceived benefits and perceived barriers, and intention to use the games.

2. Research Methodology

This study adopted the TAM constructed by Davis (1989), introducing PE (Moon & Kim, 2001) and PS (Le Hénaff et al., 2015) as antecedent variables into the model to analyze older adults’ attitudes toward playing VR games (ATG). PBE and PBA were integrated as variables into the HBM (Rosenstock, 1974), and the model was subsequently used to consider older adults’ intention to play VR games (IPG). Fig. 3 presents the study framework.

In our study, the older adults enjoy recalling the days of their youth, an interactive VR game rendering what life was like when they were young was developed as a form of leisure for elderly people. Fig. 2 presents a scene in the VR game.

3. Data Analysis

Two of the 52 questionnaires returned from the experimental group were invalid, whereas all 50 responses from the control group were valid. An analysis of demographic data for both groups yielded the following results. First, the majority of participants in the experimental group were female (52.00%, n = 26), whereas those in the control group were mostly female (54.00%, n = 27).

4. Conclusions

This study contributed to the existing literature by using an extended technology acceptance model to investigate older adults’ intention to play VR games. For the older adults who participated in this study, the perceived ease of use of VR games strongly influenced the games’ perceived usefulness and entertainment value. Notably, the experimental group indicated positive attitudes toward playing VR games, whereas the control group expressed negative ones, which were reversible by recommendations from friends or family members. Moreover, perceived ease of use of VR games was greater for the experimental group than for the control group, who needed instructions. On the basis of this finding, this study proposed that establishing a social circle helps older adults learn to play VR games, thereby enriching their leisure experience and reducing their perceived barriers (e.g., anxiety and health problems) to the games accordingly. The VR games can be designed to be more usable and to allow multiplayer gameplay, thereby improving interaction among older adults, facilitating them in developing interpersonal relationships, and making their leisure more meaningful. VR games’ developers could design more types for older adults to provide various VR games and social interactive issues so as to better serve their entertaining and social needs; and the VR companies can promote their game products for stimulating older adults’ brains to generate more interesting and entertaining topics to meet older adults’ need of entertainment.
人才培育與教材應用

設計理念&應用於教材

► 將50年、80年代與現代的住宅環境，進行創意構思與設計。
► 台灣國民高齡化，設計老年人的玩樂方式。
► 虛擬產業興起，創造新視覺的設計理念。
► 結合早期童玩、台南在地特色、未來科技之演變過程。
► 本成果之素材應用於VR教材製作與學生設計學習。
創意構想

►過去回憶: 童玩、電影、大唱片、BB CALL、轉盤式電話機、黑金剛手機、傻瓜相機。
►未來視覺: 3D列印文創商品。
►以虛擬實境結合過去生活記憶與未來科技生活，呈現新的視覺感受。

場景設計-50-70年代
50年代場景設計
小主題:童年時期
進入紅色框
播放兒歌組曲
小主題:年輕時期
進入綠色框
播放年輕組曲
小主題:壯年時期
進入紫色框
播放老年組曲
風格寫實
以大廳及懷舊家具為主

50-70 家具文物
童
家電
裝飾
進入VR選項

目前成果（50-70年代）
目前成果50-70年代-續

目前成果50-70年代-續
目前成果50-70年代-續

目前成果50-70年代-續
場景設計-80年代

80年代
場景設計-現代
現代

現代
展示台

海報、Logo

VR展示

文創商品

使用者互動方式

➤ HTC VIVE 虛擬實境技術
使用者互動方式-續

請多多指教，謝謝。
課程代號：I093201
課程名稱：VR/AR創意企劃

主題：建構AR銀髮族住宅環境

任課老師：蘇致遠、江啟惠

應用於課程設計

• 為了結合本校發展特色，本課程結合校內計畫研發成果，融入課程教學，提升學生學習的動機與創意設計，創造屬於個人特色的作品。
• 本課程內容設計結合校內計畫，計畫名稱：以VR建構銀髮族住宅環境影響入住意圖之研究。
• 本課程設計目的在建構住宅內的家具，如客廳格局，包含沙發、櫃子與客廳桌。廚房格局，包含椅子、餐具等。
Vuforia網站註冊

• 網址：http://vuforia.com
• 點選Dev Portal進入開發者頁面。

註冊或登入頁面

• 有帳號請登入
• 沒有帳號請註冊
點擊Get Development Key申請許可證

![Vuforia Developer Portal](image1)

建立新APP Name

![Add a free Development License Key](image2)
建立完成，如1-4。
License Key內容，如5。

◆ ARDM建立完成，如1-4。
◆ License Key內容，如5。
Add Target

Type:

- Single Image
- Cuboid
- Cylinder
- 3D Object

File:

-F:/Vuforia/FurnitureCard/img01.jpg- Browse...

Width:

512

Enter the width of your target in scene units. The size of the target should be on the same scale as your augmented virtual content. Vuforia uses meters as the default unit scale. The target's height will be calculated when you upload your image.

Name:

img01

Name must be unique to a database. When a target is detected in your application, this will be reported in the API.

Add

Cancel

Type:

- Single Image
- Cuboid
- Cylinder
- 3D Object

File:

-F:/Vuforia/FurnitureCard/img02.jpg- Browse...

Width:

512

Enter the width of your target in scene units. The size of the target should be on the same scale as your augmented virtual content. Vuforia uses meters as the default unit scale. The target’s height will be calculated when you upload your image.

Name:

img02

Name must be unique to a database. When a target is detected in your application, this will be reported in the API.

Add

Cancel
Type:

- Single Image
- Cuboid
- Cylinder
- 3D Object

File:

- File path: C:\Users\Furniture\Images\img03.jpg

Width:

- Width: 512

Enter the width of your target in scene units. The size of the target should be on the same scale as your augmented virtual content. Vuforia uses meters as the default unit scale. The target’s height will be calculated when you upload your image.

Name:

- Name: img03

Name must be unique to a database. When a target is detected in your application, this will be reported in the API.

Add Target

Type:

- Single

File:

- File path: C:\Users\Furniture\Images\img03.jpg

Width:

- Width: 512

Enter the width of your target in scene units. The size of the target should be on the same scale as your augmented virtual content. Vuforia uses meters as the default unit scale. The target’s height will be calculated when you upload your image.

Name:

- Name: img04

Name must be unique to a database. When a target is detected in your application, this will be reported in the API.
下載Database套件

Download Database

5 of 6 active targets will be downloaded

Name:
ARDMDB

Select a development platform:
- Android Studio, Xcode or Visual Studio
- Unity Editor

Cancel  Download
建立新專案 ARDM

• 切換平台為 Android，並按 Switch Platform 鈕。

下 載 Vuforia Unity SDK

• 網址：https://developer.vuforia.com/downloads/sdk
匯入Vuforia Unitypackage

- 啟動Unity
- 新增專案，名稱ARFirstShow
- 匯入vuforia-unity-6-2-10.unitypackage

匯入AR素材包-ARDMDB
儲存場景、刪除攝影機

- 首先儲存場景，File→Save Scenes。
- 刪除攝影機Main Camera。

AR Camera與Image Target設定

- 從Vuforia→Prefabs將
  - ARCamera*1
  - ImageTarget*5
- 拖曳至Hierarchy中。
修改Hierarchy視窗中ImageTarget

主要辨識內容
餐椅的虛擬按鈕
沙發的虛擬按鈕
茶几的虛擬按鈕
餐具的虛擬按鈕

貼上License Key。
Max Simultaneous Tracked Images設為5，一次最多辨識5張圖。
設定MainTarget物件

設定Target_ChairBtn物件
設定Target_SofaBtn物件

設定Target_TableBtn物件
設定Target_TablewareBtn物件

素材匯入
建立資料夾1

- 點選Project→Create→Folder，建立Image資料夾，如左圖。
- 點選Image，按右鍵選擇Import New Asset匯入(拖曳)圖檔。

建立資料夾2

- 點選Project→Create→Folder，建立FBX資料夾，如左圖。
- 點選FBX，按右鍵選擇Import New Asset匯入(拖曳)圖檔。
建立資料夾3

• 點選Project → Create → Folder，建立Audio資料夾，如左圖。
• 點選Audio，按右鍵選擇Import New Asset匯入（拖曳）圖檔。

建立資料夾4

• 點選Project → Create → Folder，建立Scripts資料夾，如左圖。
• 點選Scripts，按右鍵選擇Import New Asset匯入（拖曳）圖檔。
素材調整與辨識物設定

- 將4個圖檔轉成UI。

將模型縮小

- 點選FBX→chair椅子模型，點選屬性Model按鈕，修改Scale Factor為0.01，縮小椅子模型，並按Apply。
- 重複上述動作，設定sofa、table、tableware模型的Scale Factor屬性值。
設定chair、sofa、table、tableware四個物件的Animation Type為None。

指定辨識物與設定

將chair、sofa、table、tableware拖曳至Hierarchy→MainTarget中。
• 選取Hierarchy→MainTarget→chair，修改Transform屬性值。

• 選取Hierarchy→MainTarget→sofa，修改Transform屬性值。
• 選取Hierarchy ➔ MainTarget ➔ table，修改Transform屬性值。

• 選取Hierarchy ➔ MainTarget ➔ tableware，修改Transform屬性值。
調整完成畫面

• 將Hierarchy→MainTarget下的chair、sofa、table、tableware的物件active狀態取消勾選。
虛擬按鈕製作

在Hierarchy→Create→3D Object→Plane，新增平面。
將平面Plane拖曳至Target_ChairBtn下成為子物件。

設定平面屬性值，如下圖。
在Project→Create→Folder，新增Material資料夾，如左圖。
點選Material資料夾，並點選Project→Create→Material，新增New Material，更名為Button。

設定Button屬性

1. 選擇Button
2. 選擇Material
3. 選擇Texture
4. 設定Texture屬性
再設定Button屬性

將Button拖曳給Plane
選取Plane物件後，更改名稱為ChairBtn，並修改Transform屬性值。

重複使用材質球

複製ChairBtn，並拖曳至Target_SofaBtn下成為子物件，並更名為SofaBtn。

重複步驟，將Target_TableBtn與Target_TablewareBtn完成。
UI製作-右轉按鈕

• 在Hierarchy→Create→UI→Button，新增Button。
• 將Button下的Text刪除。

修改Canvas的UI Scale Model屬性為Scale with Screen Size

修改Button名稱為ModelRotateRight
再設定 ModelRotateRight

繼續設定 ModelRotateRight
UI製作-左轉按鈕

• 在Hierarchy→Create→UI→Button，新增Button。
• 將Button下的Text刪除。
修改Button名稱為ModelRotateLeft

再設定ModelRotateLeft
設定完成畫面

在 Hierarchy → Create → Folder，更名為 TSM。

Reset TSM 資料夾
新增TSM的Scripts

在TSM的Scripts設定屬性

・藉此追蹤辨識圖的辨識狀態。
統整資源管理

• 在Hierarchy → Create → Folder，更名為Manager。
• Reset Manager資料夾
建立播放機

- 在Hierarchy→Create→Audio→Audio Source，建立一個播放機。
- 更改名稱為AudioPlayer，Reset Transform，取消Play On Awake。
再建立第二個播放機

- 在Hierarchy→Create→Audio→Audio Source，建立第二個播放機。
- 更改名稱為SoundEffectPlayer，Reset Transform，取消Play On Awake。

聲音管理

- 在Hierarchy→Manager，點選Add Component新增Scripts→Audio Manager腳本。
設定Manager的Audio Manager屬性如下。

按鈕事件設定

在Hierarchy→Target_ChairBtn→ChairBtn的屬性，點選Add Component→Scripts→Raycast Model。
設定ChairBtn的Raycast Model屬性

- 主要目的是當點擊ChairBtn後，會在MainTarget辨識物中開啟chair模型，其餘模型則關閉。同時播放出場聲音與點擊按鈕的音效。

重複前面二頁步驟，設定SofaBtn物件

- 注意Show Object欄位設定
重複前面步驟，設定TableBtn物件

* 注意Show Object欄位設定
左右旋轉按鈕事件

- 在Hierarchy→ModelRotateRight物件，點選右邊屬性Add Component→Scripts→Button Event。

- 設定ModelRotateRight物件的Button Event屬性如下。
• 在Hierarchy⇒ModelRotateLeft物件，點選右邊屬性Add Component⇒Scripts⇒Button Event。
• 設定ModelRotateLeft物件的Button Event屬性如下。

成果展示