Asian Health, Science and Technology Reports, 33(4), 4311. AHSTR

The Design of Augmented Reality (AR) Technology for Providing Information in Hostels

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Received: 20 September 2025; Revised: 12 December 2025; Accepted: 16 December 2025; Available online: 19 December 2025

Abstract

The purposes of this research were 1) to design augmented reality (AR) technology for hostels, especially an information-providing system, and 2) to explore the satisfaction of the hostel operator and hostel guests towards augmented reality (AR) technology for hostels. In this study, the participants were three hostel operators, 52 hostel guests, and three experts in AR technology design. The data collection procedure was divided into two stages: the design stage and the evaluation stage. During the design stage, data were collected from hostel operators, hostel guests, and experts using questionnaires and in-depth interviews. The focus areas of data collection included the needs for AR technology design, specific requirements for AR presentations, and suggestions for information needed to facilitate AR technology use in hostels. In the evaluation stage, experts assessed the application development forms for the AR technology. Furthermore, the satisfaction forms completed by the hostel operator and guests were analyzed, focusing on both design and function satisfaction, alongside any suggestions they provided. The data were then analyzed by using mean ($\bar{x}$), standard deviation (S.D.), and content analysis. Based on the data analysis, it was found that the AR technology for hostels was successfully designed as a facilitator to provide necessary information, and both the hostel operator and hostel guests reported highly positive satisfaction. It should be noted that the study's sample size was limited, and the research primarily relied on TikTok as the delivery platform. Research findings and recommendations for applying the research results and for further research are also discussed. It is hoped that these findings will provide useful information and guidelines for hostels and those who are interested in applying and using AR technology in their businesses and studies.

Keywords: Design, Augmented Reality (AR), Information-Providing System, TikTok, Hostels

Introduction

Nowadays, after the COVID-19 outbreak, economic development and various businesses have begun to recover. This includes promoting both domestic and international tourism. Also, the hotel and accommodation industry has been stimulated again to promote safe tourism and trade by maintaining social distancing and self-service, which is convenient and is an appropriate method for the post-COVID-19 outbreak. Therefore, economic and business development through technology is considered very important, especially augmented reality (AR) technology, which is a technology that combines the real world with the virtual world through webcams, mobile cameras, computers, and the use of various software that allows objects that look like people, animals, and objects, or as we specify them to appear on the screen as 3D objects floating above the real surface (Samoepuean, 2022). In addition to AR technology being able to stimulate tourists' interest, it can also provide information on marketing or advertising to tourists (Ghandour et al., 2021).

For the current hotel business, AR technology has begun to be used to facilitate and provide services in some places (Vujović et al., 2021). However, for small hotels, including hostels, it is not yet widely seen. Modern technology should be used to promote the business because, currently, Thailand has more than 2,000 hostels, accounting for 12% of all accommodations. The management of the hostel business has relatively low operating

costs and has limitations in terms of space and service staff, such as the accommodation format that will have many people sleeping together, often arranging rooms with bunk beds to save space. In addition, the hostel must have a common area that guests can use together, such as a bathroom, kitchen, living room, reading corner, and so on (Pimsuwan et al., 2020)

Virtual Reality (VR) is an immersive technology and is often used as an umbrella term for technologies that focus on immersive experiences for viewers or users, including Augmented Reality (AR), Mixed Reality (MR), and Extended Reality (XR). Therefore, when referring to VR technology, it is generally referring to a computer-simulated reality that creates a completely new imaginary environment or world, such as a room, city, or universe, which is different from the real world. VR is a virtual reality technology that creates a three-dimensional (3D) computer-generated environment in which the user can move and communicate, which is simulated and made perceptible to the user through one or more of the five senses in real time (Guttentag, 2010; Yung & Khoo-Lattimore, 2017).

Virtual reality (VR) technology creates an imaginary world that allows the user to interact with a simulated environment. AR technology creates an interactive experience by overlaying digital content onto the user's real-world environment. In reality, AR technology is created by generating a virtual environment and adding it onto the real environment using computer-generated multimedia, such as adding text, images, and graphics so that these creations will act as part of the real world. AR technology offers a way of digitally viewing the real world, such as through a smartphone camera, adding virtual content, such as additional images, objects, and information that can be seen through a device (Mealy, 2018).

AR technology operates with several key components. It begins with the use of a camera on a portable device, such as a mobile phone, to capture images of the environment. These data are then processed through a Cloud system or through software processing in order to analyze and extract data, such as 3D models, images, text, or audio. These data are then combined with the real environment through a rendering process, resulting in an augmented image that is then displayed on a mobile device's display (Abou El-Seoud & Taj-Eddin, 2019), as shown in Fig. 1 below.

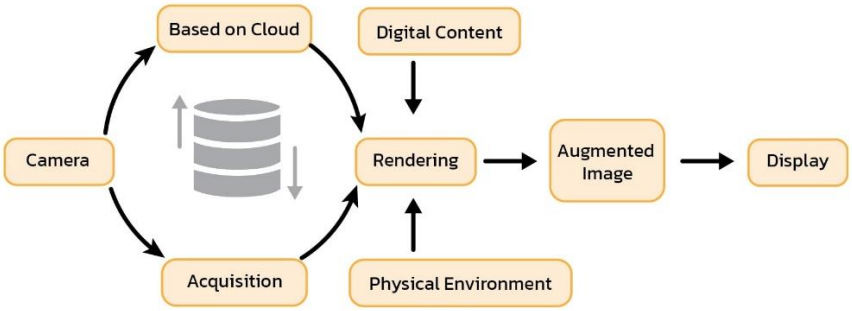

Figure 1 Augmented reality flow (adapted from Abou El-Seoud & Taj-Eddin, 2019, p.6)

VR and AR are often referred to as the fourth wave of disruptive technologies, following the advent of personal computers, the Internet, and remote computer systems. AR has evolved from laboratory experiments in the military, industry, science, and medicine, and has evolved into applications in education, architecture, tourism, and hospitality. This modern technology is also being used in the gaming and marketing worlds, as well as in the hotel, resort, and tourism industries (Vujović et al., 2021).

Bonetti et al. (2017) discussed the importance of Augmented reality (AR) and virtual reality (VR) as evolving technologies used both in-store and online to enhance the sales environment and enhance the shopping experience. These researchers synthesized relevant elements, including customer acceptance, to be useful for future research.

Giousmpasoglou and Hua (2020) conducted a study focusing on the use of self-service technologies (SSTs) in budget hotels in the UK, aiming at promoting customer service, creating operational efficiency, and involving guests in a smarter service design. This study aimed to explore the implications of SSTs in budget hotels in the perspectives of management and guest satisfaction. It was revealed that SSTs was beneficial to the budget hotels in terms of a managerial perspective. Also, both hostel managers and guests were satisfied with the use of SSTs in budget hotels in Bournemouth. It was concluded that the use of SSTs with advanced technologies (e.g., artificial intelligence (AI) and Internet of Things (IoT)) would definitely improve the hospitality industry.

Gupta and Sharma (2021) studied the use of Kiosks as self-service technology in hotels in order to explore the possibilities and challenges in improving the services and also investigated the customers' satisfaction. Interviews were employed to collect primary data from hotel managers, executives deploying kiosks in eight different hotels in the UK and India, and 200 customers. It was found that the customers were satisfied with the Kiosks because they were easy to use, fast to run, and fun to operate. However, there were still some problems, for example, a lack of human interaction in case customers need help, financial feasibility, and customer demographics.

Borison (2021) implemented AR technology in Marriott Hotels, allowing potential guests to see more than just static images of the hotel. By simply scanning the advertising materials, guests can access this AR technology, which allows them to see different perspectives of the hotel, making it more interesting to visit before actually staying.

As for hostels, which were considered as small budget hotels, there is still a research gap that has not been studied much in terms of using AR technology to provide necessary information and promote this kind of business. Therefore, this present study was interested in exploring this research gap further.

In order for hostel operators to reduce costs related to hiring workers and managing information systems and public relations during the post-COVID-19 pandemic, which may have problems with investment and excessive budget, AR technology provides a good option for developing the hotel business. The researchers in this present study recognized the importance of using AR technology to promote the hotel industry, especially hostels, as this would benefit hostel operators and help hostel guests conduct self-service. Therefore, in this research project, the researchers aimed to design AR technology capable of providing information within hostels and to explore the satisfaction of the hostel operator and hostel guests towards AR technology for hostels. The researchers selected Phitsanulok Province as a case study because it is one of the main tourist attractions in the lower northern region of Thailand. In Phitsanulok Province, there are many natural tourist attractions and important historical sites that are listed as World Heritage Sites, which has led to a robust hotel industry in the area. The researchers hope that the findings in this study will provide useful information and guidelines for hostels and those who are interested in applying and using AR technology in their businesses and studies.

Materials and Methods

Participants

The participants of this study were divided into three groups. For the first group, the participants were three experts in designing AR technology. They were chosen by purposive sampling. For the second group, the participants were three hostel operators in Phitsanulok Province. That is, two hostel operators were involved in the design stage, and one hostel operator was involved in the evaluation stage. It should be noted that Nap Corner Hostel was chosen in an actual study because it met the study's requirements and has been in operation since 2017. The last group consisted of 52 Thai hostel guests (i.e., 31 people participating in the design stage and 21 people in the evaluation stage), selected through convenience sampling. Regarding ethical issues, this research was reviewed and approved by the Institutional Review Board (IRB) (IRB No. P2-0251-2567). Participant names would remain confidential at all stages, and the results of this study are to be used for academic purposes only.

Research Instruments

In this study, nine sets of research instruments were used to collect data. It is important to note that the Item Objective Congruence (IOC) validity tests of these research instruments were assessed by experts, and they met the requirements. They were then employed at different stages of data collection, which were divided into two stages: the design stage and the evaluation stage, as shown below.

Design stage

1) Questionnaire conducted with 31 people

The questionnaire was given to 31 people who had stayed at the hostel. The contents of the questionnaire were as follows.

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

2) Questionnaire conducted with two hostel operators

The questionnaire was given to two hostel operators who ran their hostel business in Phitsanulok. The contents of the questionnaire were as follows.

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

3) Questionnaire conducted with three experts

The questionnaire was given to three experts who were specialized in AR technology design. The contents of the questionnaire were as follows.

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

4) Interviews with two focused groups (5 people each group)

The interviews were conducted with two focused groups of people who experienced and enjoyed staying at hostels. The contents of the interviews were as follows.

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

5) Interviews with two hostel operators

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

6) Interviews with three experts before proceeding with the design.

- The need for AR technology design for hostels
- The need for AR presentations
- Suggestions on information needs to facilitate the use of AR technology

Evaluation stage

1) An evaluation form for the development of an AR application used for hostels

This evaluation form was used with three experts in AR technology design, aiming to develop an AR application used for hostels before installing it in the hostel (i.e., Nap Corner Hostel). The contents of this evaluation form are as follows.

- Evaluating the design quality of AR technology for the hostel
  - Overall layout of AR technology
  - The use of colors in AR design
  - The use of typography in AR design
  - Character design for the hostel
  - Motion of images, graphics, and models in AR technology
  - The attraction of AR technology can attract the attention of hostel guests
- Evaluating the usability quality of AR technology for the hostel
  - Being easy to understand before using it
  - Being convenient and easy to use with mobile devices
  - Providing comprehensive information throughout the hostel
  - Providing accurate and precise information
  - Being efficient in the use of AR technology for the hostel
- Other suggestions

2) An evaluation form regarding the satisfaction of the hostel operator with augmented reality (AR) technology for hostels.

The satisfaction evaluation was conducted with the hostel operator of Nap Corner Hostel. The contents of the evaluation form were the same as those used in the evaluation form conducted with the experts. The focus of the evaluation was the design satisfaction with AR technology for the hostel, functional satisfaction with AR technology, and other suggestions.

3) An evaluation form regarding the satisfaction of the hostel guests with augmented reality (AR) technology for hostels.

The satisfaction evaluation was conducted with 21 hostel guests. The contents of the evaluation form were the same as those used in the evaluation form conducted with the experts and the hostel operator. The evaluation focused on three main areas: design satisfaction with AR technology for the hostel, functional satisfaction with AR technology, and additional suggestions.

Data collection procedure

The research procedure was divided into three phases. The details of each phase are discussed below.

Phase 1: Designing AR technology for hotels

The researchers studied relevant documents and research to analyze a guideline for creating an AR technology prototype for hostels. The data obtained from this study were used to create an AR technology prototype for hostels. At first, two hostel operators in Phitsanulok were involved in the design stage before an actual study was conducted, with the aim of designing an information-providing system. A questionnaire and an interview were conducted with these two hostel operators. Also, a questionnaire was distributed to 31 people, and two focus groups were interviewed to collect data for the design of the information-providing system. After that, the obtained data were used to design the prototype of the information-providing system using AR technology. The hostel prototype was subsequently evaluated by three experts specializing in AR technology design. Their comments and recommendations were used to improve the AR technology prototype for hostels. Fig. 2 below shows the AR technology prototype for hostels used in this study.

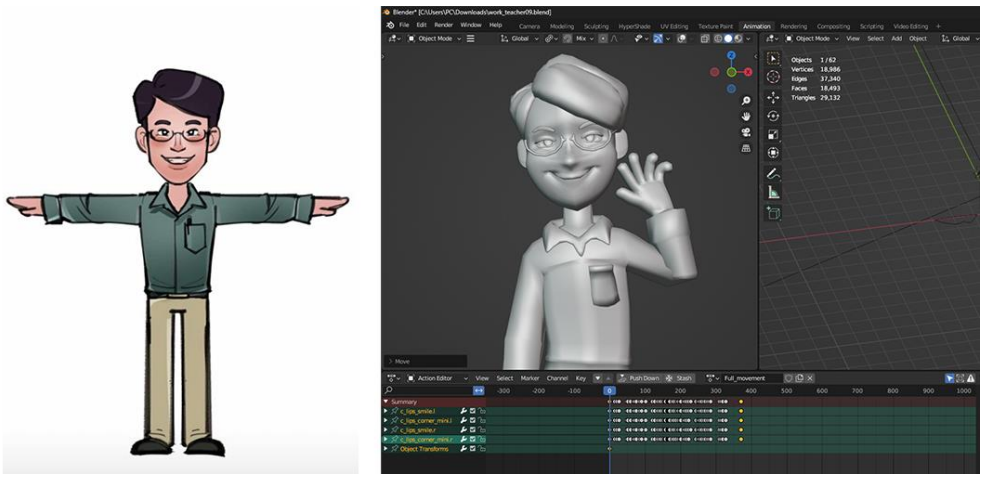

Figure 2 The AR technology prototype for hostels

Phase 2: Testing the AR technology prototype for the hostel

The researchers then installed the AR prototype for hostels at the studied hostel. This AR technology prototype was installed in five area points: 1) check-in area, 2) living room, 3) bedroom, 4) information board, and 5) check-out area. This prototype was installed and tested for one month. Fig. 3 below shows the installation of the AR technology prototype for the hostel.

Figure 3 The installation and testing of the AR technology prototype for hostels

Phase 3: Assessing the satisfaction of the hostel operator and hostel guests towards AR technology designed for hostels

After the AR technology prototype was tested for a month, the satisfaction of the hostel operator and 21 hostel guests towards the AR technology for hostels was assessed using the evaluation forms. The obtained data were then analyzed and summarized.

Data Analysis

The statistical methods for analysis were selected based on the data characteristics and the research objectives.

1) The data obtained from the questionnaire about the needs for AR technology design and AR presentation for hostels were analyzed by calculating mean ($\bar{X}$) and standard deviation (S.D.).

2) The data obtained from the evaluation form for the development of AR application used for hostels were analyzed by calculating mean ($\bar{X}$) and standard deviation (S.D.).

3) The data obtained from the evaluation forms regarding the satisfaction of the hostel operator and hostel guests towards AR technology for hostels were analyzed by calculating mean ($\bar{X}$) and standard deviation (S.D.).

4) Regarding the data obtained from the interviews and in the recommendation section of the needs for the AR technology design and AR presentation and the satisfaction evaluation forms of the hostel operator and hostel guests towards AR technology for hostels were analyzed by using content analysis.

Results

The research results of this study are presented according to the research objectives. As for the first research objective, it was to design augmented reality (AR) technology for hostels. The data obtained from the questionnaires and interviews conducted with the hostel operators, the hostel guests, and the experts in the design stage were employed for the design of AR technology for hostels. The results of designing AR technology for hostels and the design process of information system using AR technology are shown in the figure below.

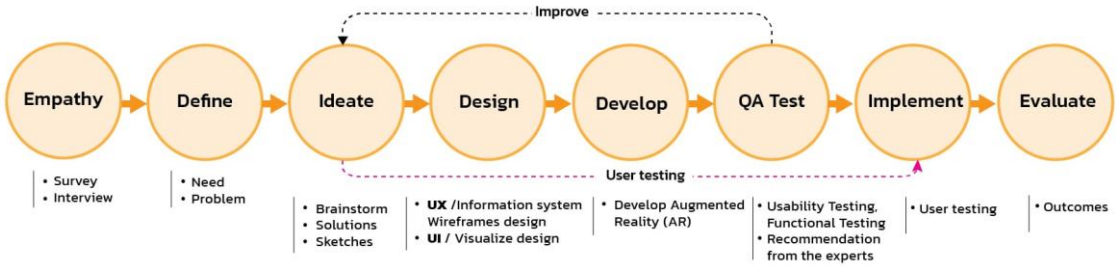

Figure 4 Design process of information system using AR technology (adapted from Chuenchaichon et al., 2024, p. 13)

As shown in the figure above, the design process of the information system through AR technology is divided into eight steps as follows:

1. Empathy: The researchers studied and collected relevant information to analyze and design questionnaires and interviews to be used with groups of hostel operators, hostel guests, and experts. The data obtained were then analyzed to find design guidelines.

2. Define: After the researchers obtained the results from the questionnaires and interviews of all three groups of hostel operators, hostel guests, and experts, the researchers then studied the problems, needs, limitations, and suggestions for using AR technology in the design to provide information within the hotel.

3. Ideate: The results were used to brainstorm and find design guidelines by prioritizing problems and needs, including the information system within the hotel, and drafting ideas to organize the information system.

4. Design: In this step, the researchers used the data obtained from the Ideate step to design the user experience (UX), which involves structuring the information system and creating a User Flow, a User Path Map, and a Wireframe to see an overview of the information structure within the hostel. After that, it entered the user interface (UI) design step to design the appearance and visual elements to be beautiful, such as choosing color tones, using fonts, graphic design, and cartoon characters. Next, AR technology was installed to further test the system. A detailed explanation of the design process can be found below.

4.1 User Experience (UX): In the process of designing the user experience (UX), the researchers used the data obtained initially from the data collection, data analysis, and the process of finding design guidelines to design an information system to see the connections in providing information within the hostel. In this process, the researchers consulted with the hostel operator to review the initial results and make necessary improvements. This was followed by the next steps: designing the User Flow and creating the Wireframe, which are classified as follows.

4.1.1 As for the design of the information system, the information system within the hostel could be separated into details as shown in Fig. 5 below, and it can be divided into five points/areas as follows:

- Check-in: This is the first point where guests arrive. This point is located in front of the hostel. Guests must receive a key or key card before entering the hostel themselves (Self-service). This point provides more information than other points because identity verification is required to receive the key or key card. It informs guests of the accommodation rules and provides instructions on how to contact staff for assistance. This information is delivered using 3D animation.
- Living room: As for this common area shared with other guests, at this point, information will be provided, including the use of the kitchen and cooking facilities, washing machine use, and bicycle rental. Information is provided in the form of images and audio.
- Bedroom: Since a bedroom is a shared living area with other guests, it is necessary to clearly state the rules for staying in this room so as not to disturb other guests, including contacting the hostel staff when equipment is broken or there is an emergency. This point provides information in the form of pictures and sounds.
- Information board: General information includes frequently asked questions by tourists, such as interesting restaurants, shops, souvenir shops, interesting tourist attractions, and travel schedules for buses and trains, and so on. This section provides information in the form of images and audio.
- Check-out: It is used for returning keys and key cards, including contacting staff when in doubt. This point provides information in the form of images and sounds.

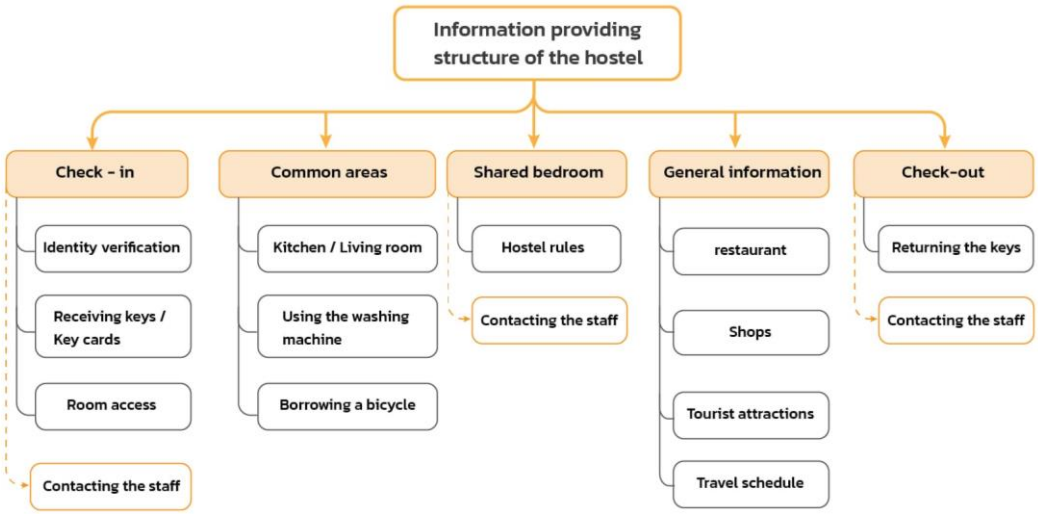

Figure 5 Information-providing structure of the hostel

4.1.2 As for the design of User Flow and Wireframe Prototype, the researchers obtained the data from the completed information-providing structure of the hostel (Fig. 5) to further develop it by designing and arranging the data connection format in the form of a wireframe prototype as shown in Fig.6. This information was provided through AR technology and was used through the TikTok application, which is a very popular application today, especially for the target group of hostel guests. The usage format can be divided into two methods: 1) opening the camera on a mobile phone to scan the QR code to enter the hostel page in the TikTok application and 2) opening the TikTok application, selecting Search, and typing the name of the hostel to enter

the page. After that, users can select the Icon effect to choose the effect name according to the signs posted at various points, as shown in Fig. 6. At each information point, voice narration is accompanied to enhance user convenience and information reception. There is also a QR code to link to other web information. Other interesting information includes recommended restaurants, interesting activities and festivals, as well as train and bus schedules.

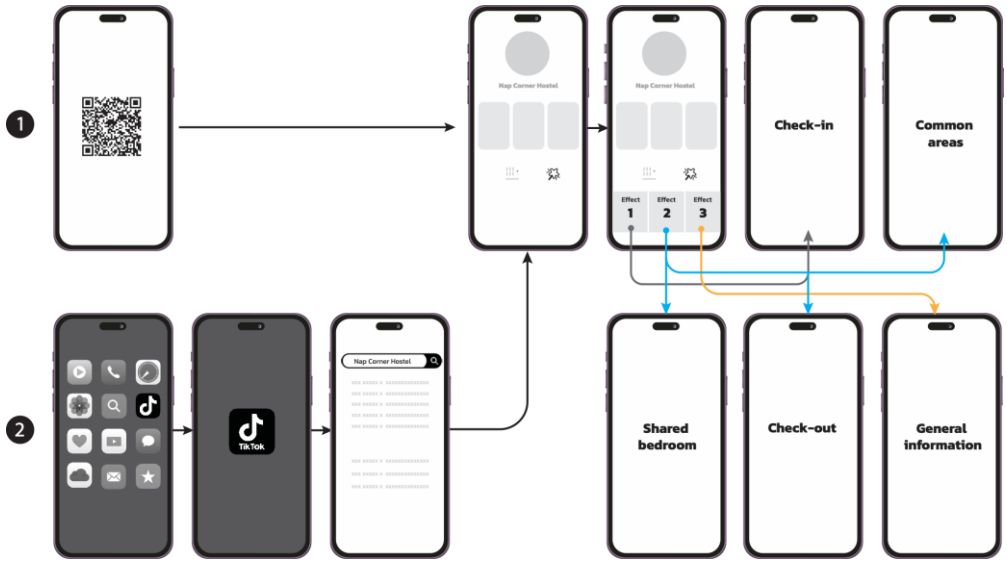

Figure 6 Wireframe design of the information system

4.2 User Interface (UI): It is the process of designing the appearance and elements of the image to be beautiful, selecting color tones, using fonts, and designing graphics and cartoon characters. The design process can be divided into four steps: 1) Mood & Tone design, 2) Style Guide design, 3) Icons and Button design, and 4) 2D and 3D Character design.

4.2.1 **Mood & Tone design**: The researchers designed the color tone according to the colors used by the hostel in its logo design and interior decoration. The hostel has used the casual groups based on the concept and theory of Shigennobu Kobayashi's Image Scale (Horiguchi & Iwamatsu, 2018; Kobayashi, 2009). Shigenobu Kobayashi's World Image Scale theory is to group personality in design by dividing it according to the scale of colors that express personality according to the words that conveys emotional meaning. Colors in the casual group are suitable for teenagers, students, university students, and the general public. The colors used show friendliness, fun, and cheerfulness as shown in Fig. 7 below.

Figure 7 Image scale for 3-color combinations (1995 to present) (Horiguchi & Iwamatsu, 2018) and Mood & Tone for the design of the hostel in this study

4.2.2 **Style Guide design:** This is the step in determining the direction of the design. The researchers designed the style guide based on the personality of the hostel operator and the image of the hostel, which is friendly, kind, and welcoming. Therefore, the font style was chosen for its curves, and the button design and curve frame were selected to make the design look gentle and friendly, as shown in the figure below.

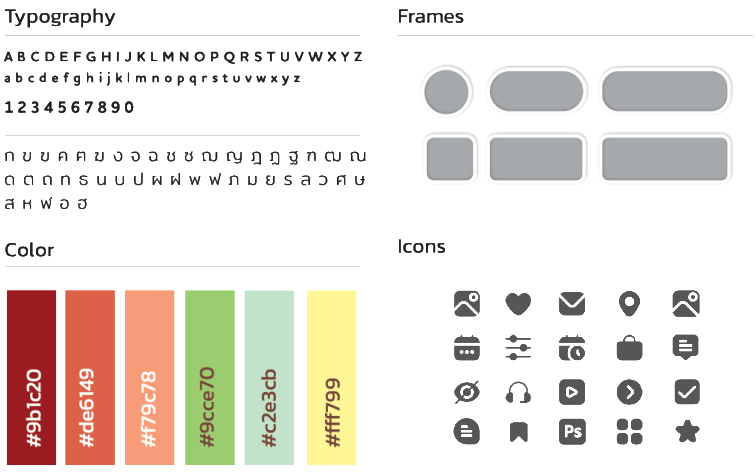

Figure 8 Style guide for designing the information system in the hostel

4.2.3 **Icons and Button design:** The researchers chose to use the fonts according to the Mood & Tone and Style Guide. The fonts were chosen for their ease of reading and friendliness. The colors of the hotel – orange, green, and yellow – were used in the design. The icon design was intended to be easy to understand, with a simplified image system, and cartoon characters were used to increase interest and match the target group, as shown in Fig. 9.

Figure 9 Image of the use of fonts in design and icon design

4.2.4 **2D and 3D Character design**: The researchers selected the character design based on the interview with the hostel operator to determine the presentation format and characteristics they would use to provide information to hostel guests. Based on the interview, the hostel operator chose cartoon characters to represent his personality and friendliness. This approach aimed to build confidence and a sense of security for guests. The researchers then incorporated the hostel operator's attire and demeanor into the character design to present information within the hostel, allowing guests to sense and appreciate the operator's friendliness. The design was revised and verified by the hostel operator before being used to provide information within the hostel. The researchers designed both 2D and 3D elements to enhance interest, as shown in Fig. 10. The researchers used 3D characters at the check-in point to greet guests, as this is the first point to impress them. Since 3D images are difficult to access due to large file sizes, which can cause slow or interrupted access for guests with phones and low-quality internet connections, the researchers therefore displayed these characters only at one check-in point. The 2D characters were used to provide information at other points within the hostel, as their small file size allows quick viewing and adds variety for guests.

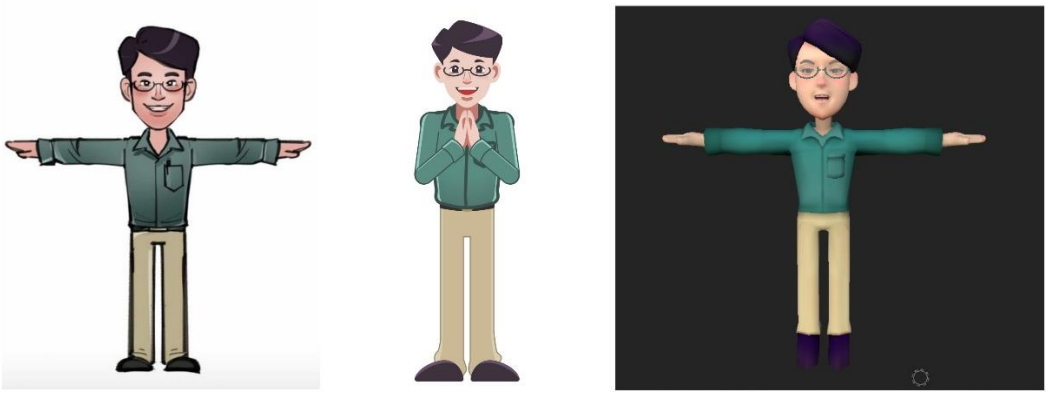

Figure 10 2D and 3D sample images of the hostel operator character design

5. AR technology & installation: After completing the above process, the researchers proceeded to the process of creating the information system via AR technology using the Effect House program (Fig. 11), which can be used to create effects including 3 D and 2 D animations, sounds, and text, as well as effects that interact

with screen touches by using with TikTok application. The researchers chose to present the hostel information via TikTok because it is widely used today. Users do not need to download a new program to their devices. It is a reliable application with functions that enable AR technology at no additional cost and can be used to create a variety of effects.

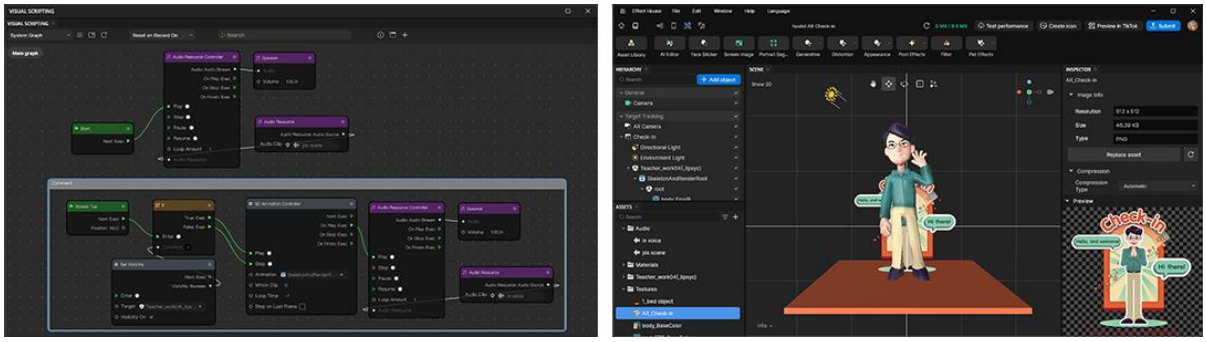

Figure 11 The process of creating the information system through AR technology using the Effect House program

6. Quality Assurance (QA) Test: After designing the information system through AR technology for the hostel, the researchers evaluated its quality in usability testing, functional testing, and the information system with the experts in AR technology design to bring back their suggestions for further improvement before testing it with the hostel operator and hostel guests.

7. Implement: After improvements and revisions based on the experts' feedback, the researchers tested the information system using AR technology with the hostel operator and hostel guests. The guests could use their mobile phones to scan QR codes at five key service points, as categorized in the information-providing structure of the hostel (Fig. 5). After scanning the QR code, the guests pressed a button to open the TikTok application installed on their phone. If it was not installed, a notification prompted them to install the application before use. After logging in, the users were required to select an effect with the specified name. Once selected, they used a camera to scan the image to display the information that the researchers had designed at various points, as shown in Fig. 12.

Figure 12 How to use the information system through AR technology

8. Evaluation: It is to evaluate satisfaction with the use of AR technology to provide information within the hostel and to summarize the research results and disseminate the knowledge. The results of the evaluation of the AR application for hostels, as assessed by the experts are shown in Table 1 below.

Table 1 Results of the evaluation for the development of the AR application used for hostels, as assessed by the experts

Evaluating the design quality of AR technology for the hostel	**Experts (n=3)**	
	Mean ($\bar{X}$)	**S.D.**
1. Overall layout of AR technology	4.33	0.57
2. The use of colors in AR design	5.00	0.00
3. The use of typography in AR design	4.33	0.57
4. Character design for the hostel	4.66	0.57
5. Motion of images, graphics, and models in AR technology	4.00	0.00
6. The attraction of AR technology that can attract the attention of hostel guests	5.00	0.00
Evaluating the usability quality of AR technology for the hostel	**Mean ($\bar{X}$)**	**S.D.**
1. Being easy to understand before using it	4.00	0.00
2. Being convenient and easy to use with mobile devices	4.33	0.57
3. Providing comprehensive information throughout the hostel	4.66	0.57
4. Providing accurate and precise information	5.00	0.00
5. Being efficient in the use of AR technology for the hostel	4.33	0.57
Total	4.51	0.50

As Table 1 shows, the overall satisfaction was highly positive across all aspects ($\bar{X}$=4.51, S.D.= 0.50). Especially, the use of colors in AR design, the appeal of AR technology to attract hostel guests, and the provision of accurate and precise information were most satisfying. As for the experts' recommendations, infographics with lots of text should be used to make it easier to understand. Also, information about medical treatment should be added in the event of illness. For future research, the Chinese and English languages should be added.

Regarding the second research objective, it was to explore the satisfaction of the hostel operator and hostel guests with augmented reality (AR) technology for hostels. The results are shown in the table below.

Table 2 Results of the evaluation for the satisfaction of the hostel operator and hostel guests towards AR technology for hostels

Evaluating the design quality of AR technology for the hostel	**Hostel Operator (n=1)**		**Hostel guests (n=21)**	
	Mean ($\bar{X}$)	**S.D.**	**Mean ($\bar{X}$)**	**S.D.**
7. Overall layout of AR technology	5.00	-	3.95	0.59
8. The use of colors in AR design	5.00	-	4.10	0.77
9. The use of typography in AR design	4.00	-	4.24	0.77
10. Character design for the hostel	5.00	-	4.29	0.78
11. Motion of images, graphics, and models in AR technology	5.00	-	4.19	0.60
12. The attraction of AR technology that can attract the attention of hostel guests	4.00	-	4.10	0.77

Evaluating the usability quality of AR technology for the hostel	Mean ($\bar{X}$)	S.D.	Mean ($\bar{X}$)	S.D.
6. Being easy to understand before using it	4.00	-	3.62	0.97
7. Being convenient and easy to use with mobile devices	5.00	-	3.67	0.91
8. Providing comprehensive information throughout the hostel	5.00	-	4.10	0.83
9. Providing accurate and precise information	5.00	-	4.38	0.67
10. Being efficient in the use of AR technology for the hostel	5.00	-	3.71	0.90
Total	4.72	-	4.03	0.81

In the view of the hostel operator, the information-providing system using AR technology was, overall, highly satisfying across all evaluation aspects ($\bar{X}$=4.72). Notably, based on the data from the recommendation section of the satisfaction evaluation forms, this AR technology could help the business run more effectively. Hostel guests could understand all essential information from start to finish without asking for assistance from the hostel staff. Also, the use of voice to convey information within the hostel could help them understand it easily and conveniently. They did not need to read all the long messages.

However, there were some suggestions for further development of the information system. Firstly, when the guest starts using it by scanning the QR code, it should be easily accessible with only a single scan and immediately use. However, for this system, there were a few steps until the cartoon character appeared and provided the information. Secondly, the safety of the guest's personal information should be a concern as there has been a lot of scamming these days. When the guest was asked to scan a QR code, and they felt uncomfortable because they knew the system could access their personal information. Thirdly, when scanned, while the cartoon character was describing the bedroom rules, the information that appeared should be frozen on the screen as a still image with accompanying audio. This is because if the guest moved the mobile phone screen back and forth, it could be challenging to read the information on it. Fourthly, for each effect (i.e., 1, 2, or 3) that provides information to the hostel guests, there should be a way to contact the hostel, such as live chat via Line. A contact Line number on screen should be included before the end of the cartoon character's speech. Finally, it was recommended to provide an application usage guide with sample images to make it easier for guests to access the screens displaying each effect, as shown in the figure below.

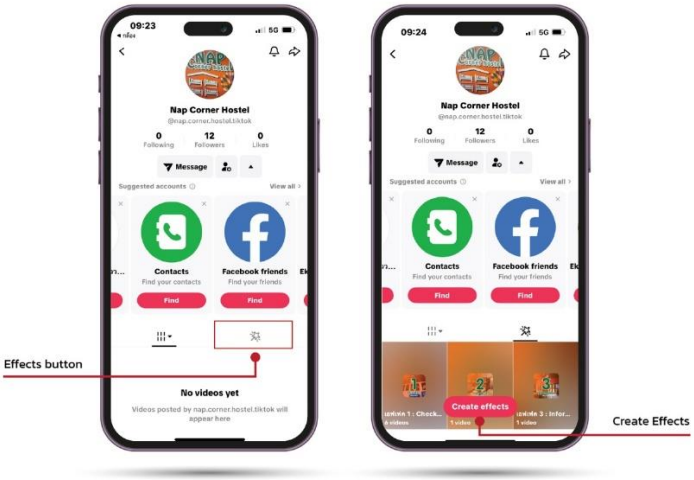

Figure 13 Example of use to create effects in the TikTok application

As for the hostel guests' view, they reported that their satisfaction with the information-providing system using AR technology was also highly positive across all evaluation aspects ($\bar{X}$ =4.03, S.D.=0.81). In particular, this AR technology for the hostel provides accurate and precise information, and they were satisfied with the overall design quality. However, based on the data obtained in the recommendation section of the satisfaction evaluation forms, it was recommended that there should be more guidance on how to use QR code scanning and the TikTok system, which can be confusing for first-time users. Also, the steps for using or scanning through TikTok seem too complicated and difficult to use. There should be direct scanning without using TikTok to make it more convenient and less complicated. In this hostel, the QR code display location is not prominent, making it difficult for guests to find.

Additionally, the color scheme should be adjusted to avoid overlapping with the surrounding area. Besides, it should minimize the number of texts and use more images or icons to present information, making it easier to understand. The characters should also be designed more cutely, which would increase interest. Also, since the font size is too small on some mobile phones, making it difficult to read, the font should be larger. Moreover, this format is suitable for younger audiences, such as students, but it may be difficult for those who do not use technology, such as older adults. Importantly, multiple languages should be available to accommodate international tourists, and the information should be downloaded to guests' phones for further reading, as some guests want to save the file for later reading. Finally, smaller file sizes, such as for 3D video, should be considered for use. It is because, for those using older phones and slow internet connections, the video may be choppy and not as smooth as it should be.

Discussion

Significant findings can be summarized and discussed in accordance with the research objectives as follows.

According to Research Objective 1, which was to design augmented reality (AR) technology for hostels, the technology for hostels was successfully designed and used as a facilitator to provide necessary information in hostels. Moreover, based on the expert's analysis of the development of the AR application used for hostels, the results were highly positive across all aspects. Especially, the use of colors in AR design, the attraction of AR technology to hostel guests, and the provision of accurate and precise information were most satisfying. These findings align with Durgekar et al. (2024), who explored and reviewed the design and experience of mobile applications, and the results show that the development of mobile applications is crucial. Especially, the emphasis on Interface (UI) and User Experience (UX) needs to be placed, as these directly affect users, for example, their behavior, emotions, and usability. Importantly, in terms of UI elements, including animation, language, font, placement, icons and shapes, and color, these affect and boost usability, perception, and satisfaction of the users. This also goes parallel with several studies (e.g., Ayada & Hammad, 2023; Estuar et al., 2014; Kuo et al., 2022; Seifi & Moshayeri, 2024), indicating that the use of color, including overall aesthetics, plays an important role in enhancing user satisfaction and impacting user behavior. In this present study, the researchers emphasized the design of the UI, based on UX data gathered, so that the design of AR technology could attract the attention of hostel guests.

Regarding Research Objective 2, the satisfaction of both the hostel operator and hostel guests toward the use of AR technology was found to be highly positive. Overall, this AR technology for the hostel was convenient

and easy to use on mobile devices and provided accurate and precise information. As discussed above, it is undeniable that the attractive design of the User Interface (UI) positively affects user satisfaction. This might be because the TikTok app is available and popular, so reinstalling it is not difficult to reinstall, and users are typically
well-acquainted with its interface. It is an acceptable application, so users feel comfortable and trust it.

Regarding receiving information, most users preferred listening to reading. As a result, the users were easy to understand. Also, providing information with images/pictures/visuals increases interest and better perception. Therefore, both the hostel operator and hostel guest found this AR technology useful, helpful, and attractive.

It is important to note that this study has some limitations. Firstly, the sample size was small. However, even though the samples were small because the data collection period was not a high season for tourism, the hotel guests still used the application. They were fully committed to providing the information. Therefore, the information obtained reflected reality from the user's perspective and was helpful to this study. Apart from the small sample size, other limitations included single-site testing, reliance on a single mobile application (i.e., TikTok), potential digital divide (e.g., among elderly users), and a lack of multilingual support.

Conclusion and Suggestions

This study successfully designed AR technology for hostels to serve as a facilitator for providing necessary information. Moreover, the hostel operator and hostel guests were highly satisfied with the design and the use of this AR technology, especially the use of colors in AR design, the attraction of AR technology, and the provision of accurate and precise information. The recommendations for applying the research results and for further research are as follows.

Recommendations for applying the research results

Those interested can apply the process of designing an information-providing system in this study. The results of this study and analysis can be used to develop information-providing systems across different contexts. Moreover, smaller file sizes, such as for 3D video, should be considered for users of older phones and slow internet connections to ensure the video plays smoothly. Besides, a save file function should be added to facilitate future use by tourists. Also, information about medical treatment should be added in the event of illness.

Recommendations for further research

For further research, for those interested in developing AR technology to provide information in hostels, Chinese and English languages should be added to this AR technology to explore which information it can provide to international guests, especially those from China and English-speaking countries. In addition, future research directions, such as testing with international users, comparing platforms (e.g., TikTok vs. standalone AR apps), or long-term usability studies, should be considered. Also, future research on other tourism contexts, for example, museums, temples, or art galleries, is worth conducting.

Author Contributions

Author 1(Chayanis Chuenchaichon): Conceptualization of the research, Research design, Literature review, Data collection and interpretation, and Data analysis.

Author 2(Yutthasak Chuenchaichon): Theoretical guidance, Development and design of methodology, Manuscript writing, Manuscript review and editing, and Corresponding.

Conflict of Interests

The authors declare no conflict of interest.

Funding

This research was funded by the Faculty of Architecture, Art and Design, Naresuan University.

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