Personalized Point of Interest in Location-Based Augmented Reality Tourism Application

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Abstract—**In recent years, the rapid growth of the tourism industry and increasing demand for efficient and meaningful travel experiences have highlighted the need for smarter travel assistance tools. Many tourists, particularly first-time visitors, often face challenges navigating unfamiliar destinations and identifying relevant points of interest, leading to delays, inconvenience, and reduced satisfaction. During the peak tourist season, most local hotels and restaurants are overcrowded, and tourists have to find accommodation and food in unfamiliar places, which reduces their travel efficiency and experience. To address these challenges, this study proposes the PutrajayAR, a personalized Location-Based Augmented Reality (LBAR) tourism application designed to enhance tourists' efficiency and overall travel experience. The application provides AR Discovery and AR Recommendation features that dynamically present personalized points of interest based on user preferences, spatial proximity, and contextual constraints. The system was developed using the waterfall model and evaluated through black box testing, usability testing, and persuasive design assessment. The results demonstrate that PutrajayAR significantly improves user experience and satisfaction compared to non-personalized approaches, thereby validating the effectiveness of personalized LBAR systems in helping users navigate effectively and discover attractions that match their interests.**

Keywords—Augmented Reality; LBAR; PutrajayAR; AR Discovery; AR Recommendation

I. INTRODUCTION

Augmented Reality (AR) is a technology that superimposes virtual imagery onto the real-world environment, creating an interactive and immersive experience for users [1]. AR is characterized by three core features: the integration of real and virtual elements, real-time interactivity and three-dimensional (3D) registration [2]. A subset of AR, Location-Based Augmented Reality (LBAR), is a markerless and geo-referenced technology that relies on GPS, accelerometers, digital compasses and other sensors to accurately determine the device's position and orientation [3]. With the widespread availability of these sensors in modern mobile devices, LBAR applications have become increasingly accessible to the general public. In parallel, the integration of the Internet of Things (IoT) and machine learning technologies is reshaping various industries, including tourism and automotive sectors, by enabling intelligent, data-driven decision-making [4].

In the era of the Fourth Industrial Revolution (4IR), digital transformation has become a driving force in economic and social development, especially in the tourism sector, where technological innovation plays a pivotal role in shaping new experiences and efficiencies [5]. Research indicates that AR-based tourism applications are more appealing to users than traditional promotional methods due to their immersive and dynamic nature [8]. As global tourism continues to expand, travelers increasingly seek personalized, efficient, and engaging experiences. AR technology contributes significantly to this shift by enhancing tourists' ability to access contextual information, explore destinations interactively, and deepen their understanding of the places they visit [6]. From personalized recommendations and interactive navigation to virtual guides and translation tools, the applications of AR in tourism are extensive and continually evolving. The virtual tourism market alone is projected to grow at a compound annual growth rate (CAGR) of 30.2% between 2023 and 2028, reaching an estimated value of USD 23.5 billion [7].

Despite the growing adoption of LBAR in tourism applications, most existing systems primarily focus on spatial awareness and static point of interest visualization, which rely on distance or category-based filtering mechanisms. As a result, there is an absence of empirical evidence illustrating the impact of personalized LBAR recommendations on user experience, satisfaction and perceived persuasiveness within tourism contexts. To address this gap, this study investigates the following research question:

RQ: How does integrating personalized recommendations into an LBAR affect user experience, satisfaction and perceived persuasiveness in tourism applications?

Therefore, this study proposes a personalized AR recommendation mechanism that integrates user preferences and situational constraints. The system also provides empirical evidence, through a comparative evaluation, that personalized POI can significantly improve user experience, satisfaction and perceived persuasiveness compared to non-personalized approaches. Overall, LBAR technology stands out for its usability, interactivity and personalization, offering tourists a unique and engaging way to explore their surroundings. The ongoing advancements in digital technology continue to elevate the quality and innovation of tourism systems, fostering more engaging and meaningful travel experiences.

The remainder of this study is organized as follows: Section II presents the related works on Location-based Augmented Reality, Section III describes the research methodology, Section IV discusses the results and Section V concludes the study.

II. Related Work

The PutrajayAR application is developed for the Android platform, using the Augmented Reality (AR) technology through modern smartphones. The choice of Android as the primary operating system is based on its widespread usage and compatibility with a wide range of mobile devices. According to a survey by Ruqiya [9], among 60 respondents, the majority expressed a preference for Android over iOS due to its user-friendly interface and superior system compatibility. Specifically, 90% of respondents favored Android, while only 10% preferred iOS. These findings indicate that Android-based applications are more popular and accessible to users, making it a suitable and strategic platform for implementing the PutrajayAR system.

A. *Location-Based Augmented Reality*

Location-based AR aims to seamlessly link physical location coordinates with the data processing environments, allowing users to view POI (Point of Interest) annotations of specific landmarks in the real environment [10]. Implementing this technology for navigation can significantly improve user actions to reduce travel time, especially when the application is designed for pedestrian use. Fig. 1 shows an example of location-based AR for navigation [11].

Fig. 1. Location-based AR for navigation.

Various devices can be used to apply the concept of location-based AR, such as mobile phones, special AR glasses, tablets and so on. These devices will function as output devices and will display information in the form of videos, pictures, animations and 3D models that need to be used. LBAR is divided into two types, namely Indoor LBAR and Outdoor LBAR.

1) *Indoor LBAR:* Indoor LBAR uses AR technology in enclosed spaces such as shopping malls, airports, museums and other indoor environments where GPS signals may be unreliable. The user's device detects nearby Wi-Fi access points [12] or communicates with nearby Bluetooth devices [13] to estimate their location, compensating for the instability of GPS signals indoors.

2) *Outdoor LBAR:* Outdoor AR typically relies on GPS and geolocation technology. According to Blanco's study [14], regular GPS provides approximate location with a standard accuracy of about 3 meters outdoors; differential GPS can also support higher positioning accuracy, which is sufficient for many applications. PokemonGo [15] is a very clear example; it is an AR-based mobile travel game developed by Niantic that combines a virtual game world with a real-world map, encouraging players to explore their surroundings to interact with virtual characters. Players use the app to walk around their local environment to find and catch Pokémon, which are often placed near real-world landmarks, historical sites and popular locations. This encourages users to visit and learn about new places in their area or while traveling.

In this scenario, we find that LBAR features provide users with great satisfaction through traveling experience efficiency and personalization.

B. *Personalized Recommendation*

Personalized Apps are software solutions designed to adapt to the preferences, behaviors and needs of individual users, offering a tailored experience. Personalized recommendations based on user behavior and preferences can make apps feel more customized and relevant to individual users. By using data analytics and machine learning, apps can deliver content and features that resonate with users, thereby increasing their overall satisfaction and engagement [16].

C. *Existing Location-Based AR Tourism App*

The rapid growth of the tourism industry, coupled with advances in mobile technology, has led to the emergence of numerous tourism-related mobile applications designed to provide travelers with more efficient and engaging experiences. While Augmented Reality (AR) has become an increasingly prominent feature in tourism application development, existing AR-based tourism solutions still face limitations.

1) *AR City Guide:* AR City Guide is an augmented reality city guide app designed to enhance the view by combining virtual information with the real-world environment. It offers users an immersive way to explore and learn about various locations while traveling. Users can use the phone's camera to scan buildings, landmarks, or attractions, and the app overlays information such as historical facts, architectural details and cultural insights directly onto the screen

Based on the user's current location, the app suggests nearby tourist attractions, restaurants and shopping areas, often with ratings and reviews from other users. Fig. 2 shows nearby suggestions in a city.

Fig. 2. Nearby suggestions in a city.

The app also provides AR-based navigation with virtual directional arrows overlaid on top of the real-world view, making it easier for users to find their desired destination. Fig. 3 shows the app's navigation functionality.

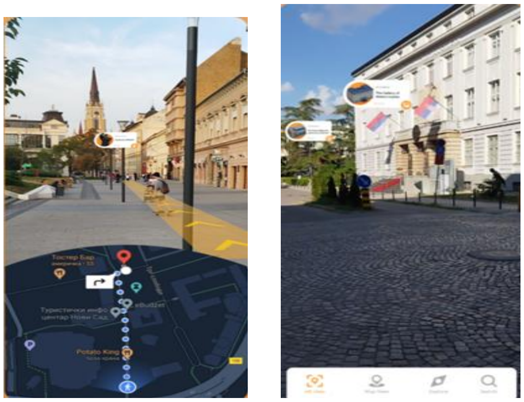

Fig. 3. Navigation function.

2) Horizon Explorer AR: Horizon Explorer AR is an augmented reality application designed to provide users with an interactive experience in exploring the landscape, landmarks and terrain around them. The application allows users to view real-world landscapes through their phone camera and receive detailed information about nearby points of interest (POIs) simply by pointing the device at them. Using GPS, Horizon Explorer identifies nearby locations and overlays the information directly onto the AR display. It offers details about landmarks, cities, mountains and other geographical features visible in the distance. Fig. 4 shows the geographical features of Horizon Explorer AR.

Fig. 4. Geographical features of Horizon Explorer AR.

As users pan their camera, the application displays the distance, elevation, and names of visible landmarks, allowing users to explore the surrounding terrain and understand the spatial relationships between different points. Horizon Explorer's interface is designed for simplicity, allowing users to switch between the map view and the AR view, making it intuitive to use. It offers both metric and imperial units of measurement, catering to the needs of a global audience. Fig. 5 shows the application's map view.

3) Word Around Me: World Around Me (WAM) is an augmented reality app that helps users explore and navigate their surroundings by overlaying information about nearby places directly onto the smartphone camera display. It is popular with tourists and those exploring new cities, as it provides details about a variety of categories, such as restaurants, ATMs, hospitals, transportation, entertainment venues and shopping options. Users can lift their phone and pan to see the names, ratings, distances and directions of nearby places overlaid on the live camera feed. This AR display helps users visualize where different places are in relation to their current location.

Fig. 5. Map view.

WAM covers a variety of categories, and users can filter results to focus on specific types of places. Categories include eateries, ATMs, pharmacies, parks, hotels, and more. Fig. 6 shows the WAM filter functionality. By tapping on a specific location in the AR display, users can access more detailed information such as reviews, hours of operation, contact details and navigation options, with integration into Google Maps and Apple Maps for seamless routing.

Fig. 6. WAM filter.

D. Comparison Between LBAR Apps

Table I shows the comparison between Location-based AR (LBAR) applications.

From this study, we found that previous studies have demonstrated that AR-based tourism applications are more engaging than traditional map-based or text-based guides due to their immersive nature [6], [7]. However, most existing LBAR tourism applications focus primarily on visualization and proximity-based information delivery. Points of interest are typically displayed based on static criteria such as distance or category, without considering individual user preferences or situational context. Applications such as AR City Guide and World Around Me emphasize nearby POI discovery and AR navigation but provide limited support for helping users decide which attraction best matches their interests or constraints. As a result, users may still experience information overload and uncertainty when multiple POIs are presented simultaneously in the AR view. After comparing and studying the applications, we found that personalized LBAR technology will help tourists to travel easily, especially when they first arrive in an unfamiliar place. AR and POI displays can provide users with the exact location of buildings. Some new functions, such as POI filters and personalized recommendations also provide a higher quality of service and attract new customers.

TABLE I. COMPARISON BETWEEN LBAR APPLICATIONS

Application	AR City Guide	Horizon Explorer AR	World Around Me
Device	Smart Phone, AR Glasses	Smart Phone	Smart Phone
Language	English	English	English
Main Function	AR City Navigation. Recommend nearby landmarks based on the distance between user device and places.	Wild Terrain and Village Exploration based on user GPS detection. Calculation on the distance between users and each POI.	AR City Navigation. Filter places based on user selected categories.
Technology	• Location-based AR, • Visual Positioning System, • Simultaneous Localization and Mapping, • Real-time Location System, • GPS, • Geographic Information System • Distance Calculation	• Location-based AR, • GPS, • Geographic Information System, • Distance Calculation	• Location-based AR, • Real-time Location System, • Simultaneous Localization and Mapping, • Categorized POI,
POI Filter Types	Based on user needs and POI Categories	Based on distance	Based on user needs and POI Categories
Personalized Recommendation	Based on distance	None	None

III. METHODOLOGY

System design is a crucial stage in the software development process that defines how the system's components, architecture and data structures interact to achieve the intended functionality. It serves as the bridge between user requirements and the actual implementation, ensuring that the system is both functional and maintainable [17]. In this study, system design establishes the foundation for developing the PutrajayAR application, outlining how its modules, databases and user interfaces integrate to deliver a personalized, location-based augmented reality (LBAR) experience for tourists. According to Sommerville [18], the goal of system design is to transform the requirements specification into a blueprint that describes the overall structure of the system. For *PutrajayAR*, this involves defining the system architecture**,** database schema**,** algorithmic logic, and user interface flow to ensure that all components operate cohesively and efficiently.

A. Architecture Design

The initial phase of the design process is the architectural design, which shows the functionality of the application, including interaction design, experience, process and strategy. For the PutrajayAR application, layered design and hierarchy diagrams were used to illustrate the interactions between entities and the application.

1) Layered design: The most commonly used architectural pattern is the layered architectural pattern, or known as n-tier. The architectural pattern is widely used in design and development. This modular structure enhances scalability, reusability, and ease of maintenance [19]. It also ensures that modifications in one layer do not affect others, thereby improving development efficiency. The components in this layered architectural pattern are arranged into horizontal layers. Each layer has a specific role in the application. Fig. 7 shows the layers found in the PutrajayAR application architectural pattern. The first layer shows the presentation logic; this layer is what interacts with the user through the application interface.

Then the second layer is the processing layer. This layer shows the system functions and procedures based on the rules layer. Among the services available are that users can register an account, log in, edit their profile, use AR Discovery and AR recommendations. This layer also determines how the menus, buttons and navigation of the application work through the application interface. This second layer is also known as the business rules layer and the application core because it contains the rules that determine the overall response of the application, as well as the server that contains the main program, code definitions and basic functions of the application. Programming works in this layer almost all the time.

Finally, the data storage layer. This layer contains the data used by the application. Search, insert, delete and update operations are performed in this layer. Examples of databases used by applications are the AR Database which stores data to be displayed when the camera detects a POI without a marker and also the User Database which stores user profile information such as username, email, password and user travel preferences and so on.

2) Hierarchy Diagram: Hierarchy diagrams are used to explain the breakdown of the overall process in a system or application into a more detailed form. Users can log in directly to the application or register an account first if they do not have any account.

In addition, this application provides a profile form for users to edit and record their user information into the database. This profile requires content types that are typical user information, such as username, email and country. PutrajayAR also asks users to complete their travel choices, such as shopping, sightseeing or food hunting. For each travel choice, there are several subtopics for the user to choose from, for example, when the user chooses food hunting as the travel choice, the application will ask the user to select their subtopic, such as Malay cuisine, Chinese food or Indian cuisine.

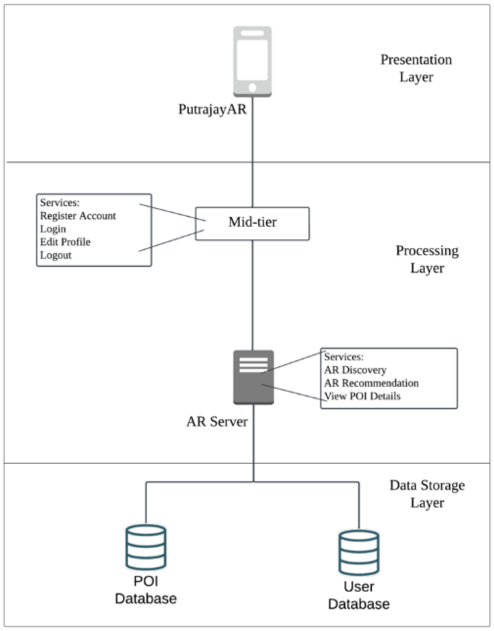

Fig. 7. Layered design of the app.

In addition, this application includes an AR Discovery feature that allows users to scan their surroundings and display nearby POIs directly on the screen. To help users easily find POIs that match their current needs, this application supports two filtering options: category filtering and distance slider. By selecting a category, the app filters and displays only relevant POIs. The distance slider allows users to adjust the search radius and view POIs within a certain range of their location.

The final module is AR Recommendations, which not only includes all the features of AR Discovery, but also enhances the experience by providing personalized POI annotation suggestions based on the user's device settings, current weather and travel preferences. For example, the app can recommend places that are open for business based on the time settings on the user's device and it can also suggest locations that align with the user's travel interests for a more personalized experience.

B. Database Design

Database design is a set of steps that help create, implement and maintain a data management system. The main purpose of database design is to produce a physical and logical design model for a database system that will be used in application development. This design will determine the data that is stored and how the data elements are related to each other. Among the database designs that will be used for the development of the PutrajayAR application are class diagrams and data dictionaries.

1) Class diagram: Class Diagram is a structural diagram used to describe classes and attributes, methods and relationships between classes in a system. It is an important tool for object-oriented design and development, helping developers have a clear understanding of the structure and logic when building a system. Fig. 8 shows the class diagram of the PutrajayAR application. In the diagram, we can clearly see the system components and their responsibilities.

Each User class is a composition of the User Device class and the User Profile class. Each POI can belong to one POI Category, while one POI Category can include many POIs. Users can communicate with POIs through AR Suggestions. Each user can get one POI suggestion, which is a list of recommended POIs based on their profile and device settings. The POI can include one or many POIs. Another communication method between users and POIs is AR Discovery, where each user can get one result after opening the camera, which is a list of nearby POIs based on the selected category. Each AR scan result can include one to many POIs.

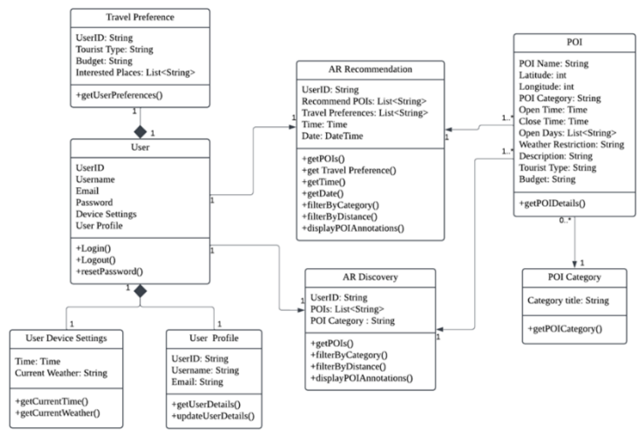

Fig. 8. Class diagram of the app.

2) Data dictionary: The data dictionary contains meta data, which is data about the database. The data dictionary is important because it determines who is allowed to access the data in it. Users do not interact directly with the data dictionary, it is only managed by the database administrator. The data dictionary contains information about the data name, data type, data length and also physical information about the data stored. There are 11 different types of data used to manipulate program programming. Each data has a specific data space allocated.

C. Algorithm Design

Algorithm design is a mathematical method or process for solving problems. Algorithm design also acts to solve problems more efficiently by minimizing the use of space, time and memory. Therefore, algorithm design plays a role in ensuring the development of applications according to the specified time. Among the algorithms that will be explained are application flowcharts and pseudocode.

1) Flowchart: A flowchart is a visual representation of the sequence and decisions required to carry out a process. Fig. 9 shows a flowchart diagram for the PutrajayAR application. This flowchart shows the activities that will be performed by the user of this application.

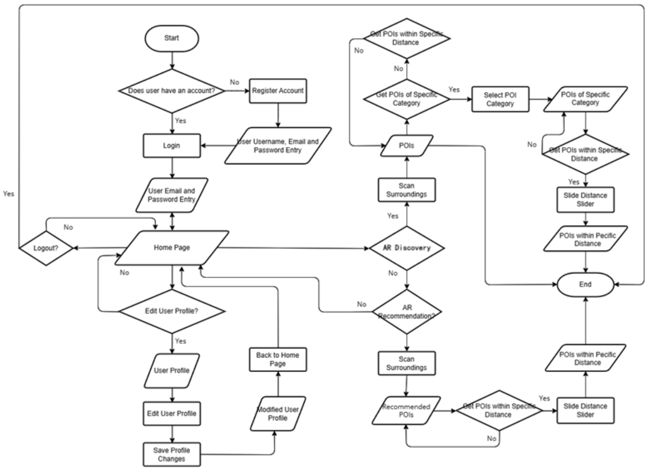

Fig. 9. Flowchart.

2) Pseudocode: In algorithm design, pseudocode is a description method between natural language and real programming language, used to clearly express the logic of an algorithm. Pseudocode is often used to help algorithm designers and developers record and communicate complex algorithmic processes in a structured way. Table II illustrates the pseudocode governing the distance- and category-based POI filtering process, demonstrating how user inputs and device location data are combined to determine which POIs are displayed in the AR interface.

TABLE II. PSEUDOCODE OF THE ALGORITHM DESIGN IN SCENARIO 1

Scenario 1: The user wants to find POIs that are a certain distance from the user's device and belong to the selected category.
Parameter: Interactive Input: POI Category, Distance Adaptive Input: POI Coordinates, Device Coordinates
Pseudo code: START INPUT "Food Hunting," "300 meters" IF POI of Category Food Hunting exist AND POI Coordinates and Device Coordinates are within a 300-meter radius. THEN Display POI OUTPUT Display the POIs of Category Food Hunting within a 300-meter distance form user.

D. Interface Design

Fig. 10(a) shows the login interface of this application. The login interface has two text fields that allow the user to enter the registered email and password to log in to the application. If the user does not have an account, the user can register a new account by pressing the "Register" button and the application will switch to the account registration interface. Fig. 10(b) shows the account registration interface, where the user is asked to fill in three text fields to register a new account, namely the user's username, email and password. After completing all the text fields, the user needs to press the "Register" button to continue.

Fig. 11 shows the Home interface of the application, which contains menu options consisting of the "AR Discovery" and "AR Recommendation" buttons. Users can change their travel preferences in the Travel Preferences interface. Fig. 12 shows the Travel Preferences interface, which contains the user's traveler type, budget, and interests. Once the preference changes are saved, the system will redirect to the Home interface, and all current preferences will be considered as the basis for recommendations in the AR Recommendations interface.

Fig. 10. (a) Login interface; (b) Register account interface.

Fig. 11. Home page interface.

Fig. 12. Travel preference interface.

Fig. 13 shows the AR Discovery interface of the application. This interface consists of POI, POI Category and Distance Slider. When the user opens the camera, the POI will be displayed on the screen. By default, the POI belongs to all categories and is displayed within 100 meters from the user. The user can select the POI category to get the desired POI. If the user selects the Food Hunting Category, the screen will only display the POI that matches the food hunting.

Fig. 14 shows the AR Recommendation interface of the application, when the user opens this interface and opens the camera, the system will get the user's travel preferences from the user's profile data and display the POI that matches the user's preferences. Users can also slide the distance slider of the AR Suggestions interface to get POIs within a certain distance, if the user slides the distance to 300 meters, the screen will only display POIs within 300 meters from the user.

Fig. 13. AR Discovery interface; get POIs matched with the selected category.

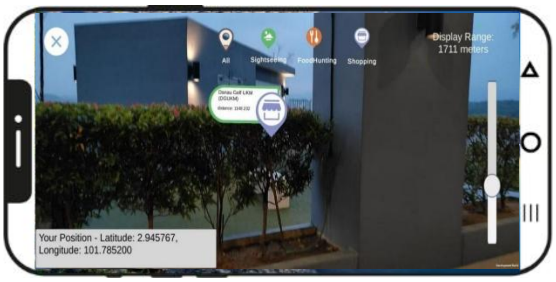

Fig. 14. AR Recommendation interface.

Fig. 15 shows the POI Details interface of this application. The user can get the POI details by clicking any POI on the screen, then the system will display the POI Details interface with the POI's related place information, such as description and opening hours.

Fig. 15. POI detail interface.

IV. Results and Discussion

A. Test Techniques

The testing of the PutrajayAR application was carried out with the aim of ensuring that all application components were well connected, functioning smoothly and met user needs well. The testing of this application was carried out using two techniques, namely black-box testing and usability testing.

1) Black-box testing: Black-box testing aims to validate the functionality of a software application by providing appropriate inputs and checking the outputs against the expected results based on functional requirements [20][21]. For the PutrajayAR application, black-box testing was carried out in four steps: test items, test case specification, test procedure specification and test log.

The functionality of the *PutrajayAR* application was verified through black-box testing, which focused on assessing whether each module performed according to its specified requirements. The testing process involved defining a set of input conditions and expected outputs for critical modules, including user authentication, profile management, AR Discovery and AR Recommendation. Each function was tested independently to ensure that valid input produced the correct results and invalid inputs were handled appropriately. The results indicated that all tested features operated successfully without critical errors or failures, confirming that the system's functional requirements were fully met. For instance, user login and registration processes returned accurate system responses and POI filtering in both discovery and recommendation modules produced consistent and correct outputs based on user preferences.

2) Usability testing: Usability testing is a method used to evaluate and test products from a user perspective. This test aims to verify that the product is suitable and easy to use [22][23]. Usability testing of the PutrajayAR application was conducted to obtain reactions or feedback from target users when they use this application. This feedback is very important to identify weaknesses and shortcomings of the application that are not noticed by the developer. Representative users aged 20–30 were asked to perform common tasks within the app to evaluate the intuitiveness, ease of use, interface clarity and overall user satisfaction.

B. Test Result

The success of this usability test was made possible through the participation of 40 respondents of various ages and genders. Each participant was given access to the PutrajayAR app to explore its features and functionalities. After using the app, they were asked to complete a questionnaire designed to gather feedback on their user experience. This structured approach ensured that insights were collected directly from real users, thus providing valuable data to evaluate the usability of the app.

1) Respondent demographics: Out of the 40 participants, 52.5% (21 respondents) were male, while 47.5% (19 respondents) were female. All respondents were residents of Putrajaya and were between the ages of 20 and 30. Table III shows the distribution of participants by age and gender.

TABLE III. Respondent Demographics

Age	Gender		Amount	Percentage
	Male	Female		
22	8	2	10	25.0%
24	2	4	6	15.0%
26	8	7	15	37.5%
27	2	4	6	15.0%
29	1	2	3	7.5%
Amount	21	19		
Percentage	52.5%	47.5%		

2) User satisfaction: User satisfaction testing was conducted to assess user perceptions and experiences across four key aspects: usability, satisfaction, ease of use and ease of learning. The questionnaire items used in this evaluation were adapted from the USE (Usefulness, Satisfaction and Ease of Use) questionnaire, a well-established instrument for measuring software usability [24]. This approach aligns with the ISO 9241-11:2018 standard, which defines usability as the extent to which a system can be used by specified users to achieve specified goals effectively, efficiently and satisfactorily [25] (International Organization for Standardization, 2018). Participants rated their experience on a five-point Likert scale and the results were analyzed to determine perceived satisfaction and system usability. Similar methodologies have been widely used in software usability research for assessing user experience quality and satisfaction [26]. Table IV presents the mean and scores for each test section.

TABLE IV. MEAN VALUES OF THE TESTING QUESTIONS ABOUT USER SATISFACTION

Construct	Non-Personalized		Personalized	
	Mean	Standard Deviation	Mean	Standard Deviation
Usefulness	3.59	0.61	4.38	0.64
Satisfaction	3.95	0.53	4.17	0.47
Ease of Use	4.21	0.49	4.46	0.39
Ease of Learning	4.22	0.48	4.50	0.40

In this test, the average score for all domains was above 3.68, indicating that users strongly agreed with the positive statements about the PutrajayAR application. For each section, the average score recorded for the personalized functions was higher than that of the non-personalized functions. Based on these findings, it can be concluded that users showed a high level of overall satisfaction with the application and showed a clear preference for its personalized features.

3) Persuasive design: Persuasive design testing was conducted to assess the extent to which PutrajayAR helped users achieve their goals, interact with them and persuade them across three key aspects: primary task support, dialogue support and persuasive perception. The questionnaire items used in this evaluation were adapted from Letho's study on factors influencing persuasive perceptions of behavior change [27]. Table V presents the mean scores for each test section.

For the test for persuasive perception, the main task aspect achieved an average score of around 3.68 on a 5-point Likert scale, with the remaining two aspects achieving mean scores exceeding this value, indicating that users agreed with the positive statements about the PutrajayAR application. For each section, the mean scores recorded for the personalized functions were higher than the non-personalized functions. Based on these findings, it can be concluded that users gave a relatively high overall rating to the persuasive design of the application and showed a clear preference for its personalized functions.

TABLE V. MEAN VALUES OF THE TESTING QUESTIONS ABOUT PERSUASIVE DESIGN

Construct	Non-Personalized		Personalized	
	Mean	Standard Deviation	Mean	Standard Deviation
Primary Task Support	3.59	0.61	4.38	0.64
Dialogue Support	3.95	0.53	4.17	0.47
Perceived Persuasiveness	4.21	0.49	4.46	0.39

In addition, 2 open-ended questions, as shown in Table VI, were used to test the persuasive design of the PutrajayAR personalization.

TABLE VI. OPEN-END QUESTIONS FOR PERSONALIZATION

Question		High Frequency Words	Amount
No.1	Any suggestions for improving the app's features or personalization?	Recommendations Include Region-based Local Events	4 2 2 2 2
No.2	How did the personalized recommendations influence your decision-making?	Recommendations Influenced Confidence	2 2 2

Word Frequency Analysis was used to analyze open-ended question data. For the open-ended question "Any suggestions for improving the app's features or personalization?" Analysis of user responses revealed that the term "recommendations" appeared most frequently (4 times), followed by "region-based" (2 times), "local" (2 times) and "events" (2 times). These keywords highlight the key areas where users believe improvements are necessary. Users generally suggested enhancing the personalization features of the app by focusing on more accurate recommendations, region-specific content, and greater control over customization options.

For the open-ended question "How did the personalized recommendations influence your decision-making?", the analysis revealed that the word "recommendations" appeared most frequently (2 times), along with "influenced" (2 times) and "confidence" (2 times). These keywords indicate that the personalized recommendations generally helped users make quicker and more confident decisions by filtering down choices and providing relevant suggestions. However, a few respondents reported minimal impact, mentioning that they either ignored the recommendations or found them only moderately useful.

C. Discussion

This study examined the LBAR system by integrating personalized POI recommendations directly into LBAR tourism application that improves user experience, satisfaction and perceived persuasiveness compared to non-personalized approaches. The findings provide both technical validation of the proposed system and empirical insights into the role of personalization in LBAR tourism applications. Functional testing confirmed that core modules of PutrajayAR operated reliably and met the specified design requirements. Besides, user evaluation results show that the personalized mode consistently outperformed the non-personalized mode through usability and persuasive design testing. Higher scores in usefulness, satisfaction, ease of use, ease of learning, primary task support, dialogue support and perceived persuasiveness indicate that personalization embedded within the LBAR interface enhances both interaction quality and decision-making effectiveness.

The persuasive design findings further support this advancement by demonstrating that personalized AR recommendations increase users' confidence and perceived support when selecting POI. Moreover, Qualitative feedback reinforces this observation, with users reporting that personalized recommendations reduced uncertainty and improved decision efficiency. These findings validate personalization as a core interaction strategy rather than an optional enhancement in LBAR tourism systems.

V. Conclusion

This study sets out to address a key limitation in existing location based on augmented reality tourism applications, which lack effective personalization elements to support tourists' decision-making in unfamiliar environments. PutrajayAR was designed and developed as a personalized location-based augmented reality tourism application that combines user profiles, contextual constraints and real-time spatial data to deliver point of interest recommendations through an augmented reality interface. The findings from system testing and user evaluation provide clear evidence that personalization embedded within the augmented reality interaction layer offers measurable benefits beyond conventional non personalized location based augmented reality approaches. Results from usability and persuasive design evaluations indicate that personalized augmented reality recommendations significantly improve perceived usefulness, satisfaction, ease of use, and decision confidence. These outcomes show that users benefit from the contextual relevance achieved when LBAR content is dynamically filtered based on individual preferences and situational factors. This validates the core research premise that personalized LBAR systems are better suited to support tourists' efficiency and experiential quality than generic distance or category-based augmented reality guides. This study also contributes empirical support for the role of personalization as a critical design dimension in LBAR tourism systems. Rather than treating personalization as an optional feature layered onto navigation or discovery tools, the results show that integrating personalization directly into real-time LBAR point of interest annotation enhances both functional effectiveness and user perception. The comparative evaluation between personalized and non-personalized modes further reinforces that these gains are attributable to the personalization mechanism itself, not simply to the presence of augmented reality technology. In conclusion, the development and evaluation of PutrajayAR demonstrate that personalized LBAR applications represent a meaningful advancement over existing augmented reality tourism solutions. By empirically linking personalized augmented reality interaction to improved user outcomes, this study provides design insights and validation for future research and development of intelligent and context aware augmented reality tourism systems.

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