American Journal of Innovation in Science and Engineering (AJISE)

ISSN: 2158-7205 (ONLINE)

VOLUME 4 ISSUE 3 (2025)

PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

American Journal of Innovation in Science and Engineering (AJISE)

Volume 4 Issue 3, Year 2025
ISSN: 2158-7205 (Online)
DOI: https://doi.org/10.54536/ajise.v4i3.5137
https://journals.e-palli.com/home/index.php/ajise

Investigating the Effect of Mixed Reality Technology on Enhancing Virtual Tourism Experience

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Article Information

Received: April 21, 2025
Accepted: May 27, 2025
Published: September 01, 2025

Keywords

Augmented Reality, Information Systems Technology, Mixed Reality, Mobile Application, Tourist Spot, Virtual Reality

ABSTRACT

This study investigates the impact of Mixed Reality (MR) technology encompassing Augmented Reality (AR) and Virtual Reality (VR) – on enhancing the virtual tourism experience in Cotabato City's tourist spots. A quantitative research design was employed, using a survey questionnaire to collect data from 70 respondents via random sampling. The questionnaire measured user perceptions across factors derived from technology acceptance and information systems success models: perceived usefulness, perceived ease of use, perceived enjoyment, information quality, system quality, service quality, intention to use, and user satisfaction. The Kutawatu Go MR mobile application, which provides virtual tours of Cotabato City's attractions, served as the platform for the virtual tourism experience. Descriptive statistics indicated overwhelmingly positive user perceptions on all measured aspects, with mean ratings mostly in the "Agree" to "Strongly Agree" range on a 5-point Likert scale. Notably, respondents found the MR application highly useful (mean ≈4.58/5) and enjoyable (≈4.55/5), and they expressed strong intentions both to continue using the app and to eventually visit the physical sites. The instrument demonstrated excellent reliability (Cronbach's $\alpha = 0.966$). Correlation analysis revealed that key user perception factors (e.g. perceived usefulness, enjoyment, and quality dimensions) are strongly and significantly associated with both intention to use the MR system and overall satisfaction (all $p < 0.01$). These findings suggest that MR technology can greatly enhance user engagement and satisfaction in virtual tourism. The study contributes to the growing body of knowledge on immersive technologies in tourism by empirically validating theoretical models (Technology Acceptance Model and Information Systems Success Model) in a virtual tourism context. It also provides practical insights for tourism stakeholders and policymakers in leveraging MR applications to promote tourist destinations and augment visitor experiences remotely.

INTRODUCTION

Tourism is a vital industry that contributes to economic growth by generating revenue, creating employment, and fostering infrastructure development. For example, in Europe the tourism sector recorded 1.5 billion overnight stays and over €200 billion in revenue in a recent year (Eurostat, 2020). As demand for travel experiences grows, emerging technologies are being explored to enrich and reshape visitor experiences. In particular, virtual tourism – the use of digital simulations to experience destinations – has garnered increased attention through advances in Augmented Reality (AR) and Virtual Reality (VR) applications. AR involves overlaying digital information or objects onto the real-world environment (Azuma, 1997), while VR immerses users in a fully computer-generated environment (Burdea & Coiffet, 1994). The convergence of AR and VR is often referred to as Mixed Reality (MR), which blends real and virtual worlds to produce new interactive environments (Bao & Rensink, 2017). These technologies open new opportunities to reshape the visitor experience as number of studies have started to investigate the benefits of augmented (AR) and virtual reality (VR) applications in tourism context (Chung *et al.*, 2017; Jung *et al.*, 2015; Raptis *et al.*, 2018).

Prior research in tourism technology indicates that MR can significantly enhance the tourist experience by providing interactive and informative content. For instance, Chung *et al.* (2017) demonstrated that AR applications can enrich cultural heritage tourism experiences in Korea, and Jung *et al.* (2015) found that positive user perceptions of an AR attraction at a theme park increased visitors' likelihood to recommend the technology. Similarly, Raptis *et al.* (2018) argued that mixed-reality environments increase user immersion in cultural tourism games, potentially leading to more engaging experiences. Even before the COVID-19 pandemic, several studies highlighted the value of AR and VR for tourism marketing and interpretation. However, the pandemic's impact on global travel in 2020 greatly accelerated interest in virtual tourism as an alternative when physical travel was restricted. During lockdowns, virtual tours and MR applications enabled people to explore museums and tourist sites from home, helping destinations remain engaged with the public and even providing income opportunities for guides through online tours (Zhao & Huang, 2022). Despite this surge of interest, there remains a need for more empirical studies on the effectiveness of AR/VR (MR) in tourism, especially at the local destination level (Zhou, 2022).

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Cotabato City, Philippines, is an example of a culturally rich destination that could benefit from MR-enhanced virtual tourism. The city boasts diverse historical and natural attractions, yet like many destinations it faced declines in visitation due to the pandemic. To adapt, local stakeholders have begun exploring technology-driven promotions. One such initiative is Kutawatu Go, a mobile MR application that offers virtual tours of Cotabato City's tourist spots through AR and VR content. This app allows users to see 3D models, panoramic images, and informative overlays for various attractions, providing an immersive "preview" of the sites. Similar AR tourism apps have been developed in the Philippines, such as Fieldtrip Ni Juan, which uses AR to showcase 3D models of landmarks from different regions (Acaya *et al.*, 2018), and the Experience Philippines AR app launched by the Department of Tourism to bring historical Intramuros to life on visitors' smartphones (Department of Tourism, 2020). These examples underscore the growing interest in MR as a tool for tourism promotion and education in the country.

Building on this context, the present study aims to investigate the effect of Mixed Reality technology on the virtual tourism experience in Cotabato City's tourist spots. In particular, it examines how using the Kutawatu Go MR application influences users' perceptions (such as how useful, easy, enjoyable and high-quality they find the experience) and their subsequent intentions (such as willingness to keep using the app or to visit the real locations). The study is grounded in established theoretical frameworks – notably the Technology Acceptance Model (TAM) (Davis, 1989) and the Information Systems (IS) Success Model (DeLone & McLean, 1992) – to assess whether MR-induced experiences can drive user acceptance and satisfaction in a tourism context. By combining insights from these frameworks, this research addresses the gap in understanding how immersive virtual experiences translate into tangible outcomes like increased destination interest or customer satisfaction.

Research Questions

This study is guided by the following questions:

1. How do users perceive the usefulness, ease of use, enjoyment, and quality of a MR tourism application for Cotabato City's tourist sites?
2. To what extent does the MR application influence users' intention to use such technology and their satisfaction with the virtual tourism experience?
3. What is the relationship between users' perceptions of the MR system and their intention to use it or to eventually visit the actual tourist spots?
4. By answering these questions, the research will shed light on the effectiveness of MR in virtual tourism and provide practical implications for destination marketing in the new normal of travel.

LITERATURE REVIEW

Virtual Tourism and Mixed Reality in Tourism

Virtual tourism refers to technology-mediated experiences that allow people to explore destinations or cultural sites remotely. It can range from simple 360° photo tours to fully interactive VR simulations. Augmented Reality (AR) superimposes digital content (images, information, 3D models) onto the real world through a device like a smartphone or AR glasses (Azuma, 1997), thereby enhancing real environments with virtual elements. Virtual Reality (VR), on the other hand, creates a completely immersive virtual environment, typically experienced through VR headsets (Burdea & Coiffet, 1994; Blascovich & Bailenson, 2011). Mixed Reality (MR) integrates both approaches, allowing virtual objects to interact with the real world in real time (Bao & Rensink, 2017). Over the past decade, tourism scholars and practitioners have increasingly recognized the potential of AR/VR for enriching tourist experiences.

Early work by Buhalis and Law (2008) noted that advances in information technology were transforming tourism services and experiences. By the mid-2010s, research had begun focusing specifically on AR/VR applications in tourism settings. Chung *et al.* (2017) explored AR at cultural heritage sites and found that it can provide more engaging and informative visitor experiences, ultimately enhancing visitor satisfaction. Similarly, Jung *et al.* (2015) investigated AR use in a theme park and identified key factors (such as perceived enjoyment and usefulness of the AR features) that led visitors to recommend the AR experience to others. These studies suggest that when AR or MR is implemented effectively, it can increase a user's overall appreciation of a destination by providing context-rich, interactive content beyond what traditional tourism media offer.

Raptis *et al.* (2018) extended this understanding by examining mixed reality in a cultural tourism game, concluding that MR features heightened users' sense of presence and immersion. Immersive qualities are particularly important in virtual tourism; a higher sense of "being there" can make the virtual experience more memorable and influential on user attitudes. Other research has highlighted that AR can improve learning outcomes and engagement at heritage sites (tom Dieck & Jung, 2017) and tailor information to tourists' preferences (Kounavis *et al.*, 2012). These benefits align with the goals of tourism marketers to provide personalized and enriching experiences.

The COVID-19 pandemic (2020–2021) acted as a catalyst for virtual tourism adoption. With travel restrictions in place, destinations and museums turned to virtual tours as a way to maintain public interest. Zhao and Huang (2022) report that virtual tourism platforms saw a surge in users during the pandemic, as people sought safe alternatives to satisfy their travel curiosity. For example, several tourism boards launched VR experiences of their attractions;

the Faroe Islands' "remote tourism" campaign allowed online visitors to control a local's camera in real time (Christensen, 2020), and many UNESCO World Heritage sites offered VR tours to global audiences. This period demonstrated that virtual tourism is not only a stopgap in times of crisis but also a viable complement to physical tourism in the long term. Travelers can use virtual tours for trip-planning (to preview sites before visiting) or as a substitute when physical travel is not possible due to cost, distance, or mobility constraints (El-Said & Aziz, 2022).

In the Philippines, momentum for virtual tourism had been building even before COVID-19. Acaya *et al.* (2018) developed Fieldtrip Ni Juan, an AR mobile app showcasing tourist spots across Philippine regions with 3D models and information, intended as an educational and promotional tool for students and travelers. Another initiative was the Experience Philippines AR app introduced in 2019, which allowed users to view historical scenes of Intramuros (Manila's walled city) on their phones when pointed at certain locations or the Department of Tourism's logo (Department of Tourism, 2020). These examples illustrate how AR/MR can be applied in a local context to increase engagement with cultural heritage and potentially stimulate interest in actual visits. Kutawatu Go in Cotabato City follows this trend, focusing on a specific locale and its unique attractions.

Technology Acceptance and User Experience Theories

To systematically evaluate the effect of MR on virtual tourism experiences, this study draws on two key theoretical frameworks: the Technology Acceptance Model (TAM) and the Information Systems Success Model.

TAM, introduced by Davis (1989), is one of the most widely used models for understanding user adoption of new technology. TAM posits that two beliefs – Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) – are fundamental determinants of a user's intention to use a technology. In simple terms, if people find a system helpful for their goals (usefulness) and free of effort or frustration (ease of use), they are more likely to accept and use it. TAM has been validated in numerous domains and has been extended to include additional factors (Venkatesh & Davis, 2000; Venkatesh & Bala, 2008). In the context of tourism, TAM has been applied to study adoption of travel apps, online booking systems, and AR tour guides, generally confirming that ease of use and perceived benefits drive user acceptance (Kim *et al.*, 2015). For MR tourism applications like Kutawatu Go, TAM suggests we should examine whether users feel the app is useful for their tourism experience and easy enough to operate, as these perceptions will influence their willingness to continue using the app or recommend it.

One important extension of TAM relevant here is the inclusion of perceived enjoyment as a factor influencing technology acceptance. While TAM originally focused on utility and ease, later research acknowledged that the intrinsic enjoyment of using a system can independently motivate users (Venkatesh & Bala, 2008). A tourism-related app might be adopted not just because it is useful, but because it's fun. Enjoyment ties closely to the concept of flow (Csikszentmihalyi, 1990) – a state of deep engagement or immersion in an activity. If a virtual tourism app can create an enjoyable, game-like or exploratory experience, users are likely to spend more time on it and develop positive attitudes. The Flow Theory (Csikszentmihalyi, 1990) indicates that when users are fully absorbed and enjoying an experience, they often lose track of time and gain intrinsic satisfaction. An MR tourism experience that is enjoyable could thus enhance both the user's short-term engagement and long-term acceptance of the technology.

Another crucial perspective is the Information Systems (IS) Success Model by DeLone and McLean (1992). This model identifies key dimensions that contribute to the overall success of an information system, particularly from a user standpoint: System Quality, Information Quality, Service Quality, Use/Intention to Use, User Satisfaction, and Net Benefits. In our context:

- System Quality refers to the performance of the MR application (e.g., usability, interface design, technical stability, visual appeal).
- Information Quality refers to the quality of content it delivers (e.g., accuracy, relevance, richness of information about the tourist sites).
- Service Quality can refer to support and additional services (in an app context, this could include responsiveness of interactive features, or how well the app's services meet user needs).
- Use and Intention to Use are measures of how the system is adopted.
- User Satisfaction is the users' overall contentment with the system.
- Net Benefits would be the outcomes or value derived (which in a tourism context might translate to increased knowledge, intention to visit, or destination promotion).

For a tourism app like Kutawatu Go, high system quality might mean an intuitive interface and smooth AR/VR experience, and high information quality means the virtual tour content is informative and trustworthy. According to the IS Success Model, achieving high system, information, and service quality should lead to higher user satisfaction, which is an ultimate indicator of success. Moreover, satisfied users are more likely to continue using the system and recommend it (intention to use), creating positive net benefits such as greater destination interest or word-of-mouth marketing (DeLone & McLean, 2003).

By combining TAM and the IS Success Model, we can comprehensively evaluate the MR tourism experience: TAM contributes the usefulness and ease of use constructs (as well as enjoyment in extended form), while the IS model contributes quality dimensions and satisfaction. This integrated approach has been used in recent studies of tourism technologies (Chen & Tsai, 2019), recognizing that user acceptance of technology is multi-faceted. A conceptual framework for the study was

constructed to illustrate how these variables interrelate, positing that the MR system's qualities and the user's perceptions of usefulness, ease, and enjoyment will jointly influence their satisfaction and intention to use the system (and potentially their intention to visit the real sites).

In summary, the literature suggests that MR can significantly enhance virtual tourism experiences by making them more informative, interactive, and enjoyable. The extent of this enhancement can be evaluated through established constructs like those from TAM and the IS Success Model. This study builds on these foundations to empirically assess Kutawatu Go in Cotabato City, thereby providing evidence-based insights on MR's role in virtual tourism and guidance for future implementations.

MATERIALS AND METHODS

This research adopted a quantitative survey design to gather empirical data on user perceptions and intentions regarding the Kutawatu Go mixed-reality tourism application. The study is essentially evaluative, measuring users' responses after experiencing the MR app. Given the focus on specific constructs (usefulness, ease of use, etc.), a structured questionnaire using Likert-scale items was deemed appropriate. The questionnaire was informed by the theoretical framework: items were adapted from prior TAM and IS success model studies to fit the context of a virtual tourism app. For instance, items measuring Perceived Usefulness asked whether Kutawatu Go helped users virtually explore and plan visits to Cotabato City's tourist spots, while Perceived Ease of Use items gauged if the app was easy and intuitive to operate. Additional sections of the survey collected demographic information and basic travel backgrounds (e.g., age, gender, residence, prior experience with AR/VR), although the primary analysis focused on the core perception and intention variables.

Participants and Sampling

The target population was potential users of a virtual tourism application for Cotabato City – essentially, people who have interest in the city's tourist sites or in using digital tourism tools. The research respondents were selected from both residents of Cotabato City and individuals who were physically present in the city (e.g., visitors or students) at the time of the study, to ensure they had some familiarity or interest in local attractions. A simple random sampling technique was used to recruit participants, with the aim of minimizing selection bias and enhancing generalizability (Trochim & Donnelly, 2008). In practice, outreach was done through local community networks and social media, inviting people to participate in a "virtual tour experience" study. Each participant needed access to an Android smartphone (as the Kutawatu Go app was an Android-based prototype) or was provided with a device during the survey session. A total of N = 70 respondents completed the survey, which met the minimum sample size target set for the study. This sample size, while modest, is comparable to similar exploratory studies evaluating new technology prototypes in tourism (e.g., a sample of 60–100 is common in user experience trials). The random sampling within the accessible population helps ensure that the sample includes a mix of ages, genders, and backgrounds. Indeed, participants ranged from college students in their 20s to older adults in their 50s, with roughly equal representation of male and female respondents – reflecting a diverse user base for analysis.

Research Instrument

The primary research instrument was a self-administered survey questionnaire consisting of 40 Likert-scale items plus a few open-ended questions. The Likert items were statements to which respondents indicated their level of agreement on a 5-point scale (1 = Strongly Disagree, 5 = Strongly Agree). These 40 items were grouped into 8 constructs (each represented by 5 items) as follows:

Perceived Usefulness (PU)
5 items (e.g., "Kutawatu Go is useful for exploring tourist spots in Cotabato City," "Kutawatu Go improves my understanding of the tourist spots").

Perceived Ease of Use (PEOU)
5 items (e.g., "The functions of Kutawatu Go are easy to operate," "Using Kutawatu Go does not require a lot of technical knowledge").

Perceived Enjoyment
5 items (e.g., "Using Kutawatu Go is enjoyable and fun," "Kutawatu Go provides an exciting and engaging experience").

Information Quality
5 items (e.g., "Kutawatu Go provides high-quality information about the tourist spots," "The content in Kutawatu Go is accurate and comprehensive").

System Quality
5 items (e.g., "Kutawatu Go's interface is visually appealing and user-friendly," "The app runs smoothly without technical problems").

Service Quality
5 items (e.g., "Kutawatu Go is responsive and interactive," "The app provides a reliable 360° view of sites with good quality").

Intention to Use
5 items (e.g., "I intend to continue using Kutawatu Go for virtual visits," "I will recommend Kutawatu Go to others").

User Satisfaction
5 items (e.g., "Overall, I am satisfied with the Kutawatu Go experience," "Kutawatu Go met my expectations for exploring Cotabato City").

In addition to these Likert items, one open-ended question asked participants to describe their overall impression of the app and any suggestions for improvement, allowing qualitative insights to complement the quantitative data.

Before the main survey, the questionnaire was pilot-tested with a small subset of users (around 10 individuals who matched the target profile). The pilot test aimed to ensure clarity of questions and to check the reliability of each construct's items. Feedback from the pilot led to minor wording adjustments for clarity. Importantly, the pilot data were used to calculate the instrument's internal consistency. Using Cronbach's Alpha, the pilot responses yielded very high reliability ($\alpha = 0.95+$ for each multi-item construct, with an overall $\alpha = 0.966$ across all items), indicating that the items consistently measured their intended constructs. This gave confidence that the questionnaire was a reliable tool for the main study.

The Likert scale interpretations were defined as follows (these were not shown to respondents, but used in analysis): a grand mean or item mean in the range 4.50–5.00 indicates Strongly Agree, 3.50–4.49 indicates Agree, 2.50–3.49 Neutral, 1.50–2.49 Disagree, and 1.00–1.49 Strongly Disagree. These ranges were used to qualitatively interpret the mean scores of each item and construct.

Procedure for Data Collection

Participants either installed the Kutawatu Go app on their own device or used a provided device to experience a guided virtual tour of selected Cotabato City tourist spots. The virtual tour involved navigating through the app's features: viewing AR overlays (e.g., pointing the camera at a flat image target to see a 3D monument pop up), exploring 360-degree panoramic scenes of sites like Cotabato City Grand Mosque, and reading descriptions and historical facts provided in-app. This interactive session typically lasted about 10–15 minutes, ensuring that participants had a firsthand experience with the MR content.

Immediately after this trial, participants were asked to fill out the questionnaire. Researchers were on hand (if in person) to assist or clarify any questions, though respondents mostly completed the survey independently. For remote participants (some were given access to the app and an online version of the survey), instructions were provided via email and any follow-up clarifications were handled through messaging.

The data gathering procedure can be summarized in steps:

Orientation and Consent

Participants were briefed about the study's purpose and gave informed consent. They were told their responses would be confidential and used for research only.

MR Experience

Participants engaged with the Kutawatu Go application's virtual tour features.

Survey Administration

Participants completed the questionnaire, rating their agreement with each statement based on their experience.

Follow-up

Any open-ended feedback was collected, and participants were thanked for their time.

All survey responses were recorded either on paper and later encoded, or directly through an online form into a spreadsheet. The data collection phase spanned several weeks to gather the full sample of 70, given scheduling and ensuring diversity of respondents.

Data Analysis Techniques

Collected data were analyzed using statistical software. Descriptive statistics were first computed: mean and standard deviation for each survey item and each construct (by averaging the items in that construct). These helped to summarize overall respondent perceptions. As mentioned, interpretations were attached to mean values (e.g., a construct mean of 4.6 would be interpreted as "strong agreement" on that dimension).

Next, reliability analysis was re-run on the full dataset confirming high internal consistency (Cronbach's α remained > 0.95 for all scales, reaffirming the instrument's reliability).

Given the study's focus, the core analysis involved:

Comparative Means

Checking which aspects scored highest or lowest. This was useful in identifying the strengths and weaknesses of the MR tourism experience as perceived by users.

Correlation Analysis

Pearson correlation coefficients (r) were calculated to examine relationships between the independent perception variables (PU, PEOU, enjoyment, information quality, system quality, service quality) and the outcome variables (Intention to Use, User Satisfaction). This addressed whether higher perceived usefulness or enjoyment, for example, is associated with higher intention to use, which directly tests expectations from TAM and the IS Success Model. Significance levels (using a 0.01 threshold for high significance) were determined for each correlation.

Regression Analysis

A multiple regression was conducted to identify which factors significantly predict Intention to Use the MR application, and similarly which factors predict User Satisfaction. In each regression, the various perception constructs were entered as independent variables. The regression aimed to see, for instance, if perceived usefulness still had a significant unique effect on intention when controlling for other factors like enjoyment and quality. This helps in understanding the most influential drivers among the interrelated constructs.

For all statistical tests, a significance level of $\alpha = 0.05$ was used (with $\alpha = 0.01$ for highlighting highly significant results). The results were tabulated for clarity, including a table for descriptive stats of each construct and a correlation matrix summarizing relationships.

No complex inferential comparisons (like t-tests or ANOVA for demographic differences) were undertaken because the primary interest was not on subgroup differences but on overall perceptions and correlations. However, basic checks indicated no glaring differences in responses by gender or age group – responses were consistently positive across demographics, which suggests the MR experience was broadly appealing (this observation is noted qualitatively, as any formal test would be underpowered given sample size).

Ethical considerations: The study ensured voluntary participation and anonymized data. As this research involved evaluating a software application, there were minimal risks to participants beyond potential minor dizziness or device use fatigue; no such adverse effects were reported.

In summary, the methodology provided a structured way to capture and analyze user feedback on the MR tourism application. By using established measures and a clear procedure, the study maintains reliability and validity in assessing how mixed reality can enhance virtual tourism experiences.

RESULTS AND DISCUSSION

Results

After administering the virtual tourism experience and survey to 70 respondents, the data reveal consistently positive perceptions of the Kutawatu Go MR application across all evaluated dimensions. Table 1 summarizes the mean ratings for each construct (on a 1–5 scale). All grand mean scores fall well above the neutral midpoint, indicating that users generally agreed or strongly agreed with the positive statements about the MR tourism experience.

(image) Figure 1. Mean ratings of user perceptions of the Kutawatu Go MR system (5-point scale, 5 = Strongly Agree). All aspects of the virtual tourism experience were rated positively, with most means above 4.50 indicating strong agreement.

As shown in Figure 1, the constructs Perceived Usefulness, Perceived Enjoyment, Information Quality, System Quality, and User Satisfaction each achieved mean ratings at or above approximately 4.55 out of 5, corresponding to "Strongly Agree" on the Likert scale. Meanwhile, Perceived Ease of Use, Service Quality, and Intention to Use were slightly lower but still in the high "Agree" range (mean scores between about 4.3 and 4.5). We detail these results by construct below:

Perceived Usefulness

Users overwhelmingly found the MR application to be useful in enhancing their virtual tourism experience. The grand mean for the five usefulness items was 4.58 (SD ≈ 0.08), indicating strong agreement. All individual items under this construct scored above 4.5. For instance, participants strongly agreed that "Kutawatu Go is useful for exploring tourist spots in Cotabato City" (mean = 4.57) and that "Kutawatu Go improves the understanding of tourist spots" (mean = 4.64). They also felt the app "sets a realistic visual expectation" of the sites (mean = 4.55) and "makes visiting the tourist spots more accessible" (mean = 4.57). These high ratings suggest that users perceive significant practical value in the app: it effectively acts as a virtual guide, enhancing their knowledge and trip planning for Cotabato City. This finding aligns with expectations that a well-designed virtual tour can serve as a useful tool for tourists (Davis, 1989; Chung *et al.*, 2017).

Perceived Ease of Use

The usability of the app was rated positively, though slightly lower than other constructs. The composite mean for ease of use was 4.30, which corresponds to "Agree" on the scale. Users agreed that "Kutawatu Go's functions are easy to operate" (mean = 4.28) and that the app is "simple and straightforward to use" (mean = 4.41). They also generally agreed that using the app did "not require a lot of technical knowledge" (mean = 4.37) and "does not frustrate or confuse" them (mean = 4.24). One of the slightly lower items was related to flexibility ("easy and flexible to do what I want with it," mean = 4.21), indicating some room for improvement in allowing users to navigate or control the content freely. Nonetheless, no item fell below the "Agree" range, and none of the participants indicated serious difficulty using the app. This suggests that the user interface and interactions were reasonably intuitive. The positive ease-of-use ratings are important because, according to TAM, ease of use can indirectly boost the app's perceived usefulness and user acceptance (Venkatesh & Davis, 2000). In summary, while the app could be made even more user-friendly, its current design did not pose significant barriers to users.

Perceived Enjoyment

Enjoyment was one of the highest-rated aspects of the MR experience. The grand mean for the five enjoyment items was 4.55, indicating strong agreement that the app was enjoyable. Users strongly agreed that "Kutawatu Go is enjoyable and fun" (mean = 4.65) and that it "provides excitement and entertainment in visiting tourist spots" virtually (mean = 4.57). They also felt it "offers a unique and engaging experience" (mean = 4.51) and is "a positive and enjoyable overall experience" (mean = 4.55). One item was slightly below the strong-agree threshold: "Kutawatu Go is entertaining and keeps me interested" had a mean of 4.45 (which is still high and falls in the "Agree" category). These results highlight that participants not only see the utilitarian value of the app but also genuinely have fun using it. This aligns with the notion that hedonic factors like enjoyment are crucial for user engagement in tourism apps (Venkatesh & Bala, 2008). The high enjoyment levels suggest that the MR

content (e.g., interacting with 3D models, virtually walking through sites) captures users' interest and provides an entertaining experience, potentially leading to a state of flow for some users. Enjoyment is a significant finding because it can lead to longer usage times and a greater likelihood of recommending the experience to others.

Information Quality

Participants gave very favorable feedback on the quality of information and visuals provided by the app. Although in the survey instrument "information quality" and "system quality" were separated, in practice the items for both constructs touched on content and presentation; we report them distinctly here for completeness. For Information Quality, the composite mean was approximately 4.57 (strongly agree). Users strongly agreed that "Kutawatu Go provides high-quality information and visuals" (mean = 4.54) and "accurate and comprehensive representations of the tourist spots" (mean = 4.51). They especially praised how the app "enhances their understanding and perception of the tourist spots" (mean = 4.65) and "presents the spots in a visually appealing and realistic manner" (mean = 4.65). These two items at 4.65 were among the highest scores in the entire survey, indicating that the combination of rich information and realistic imagery in MR can greatly improve users' knowledge and mental image of a destination. Essentially, respondents felt they were getting a high-fidelity preview of the actual sites – a positive sign that the virtual content is effective. High information quality is critical in virtual tourism because users rely on the app to learn about the destination; in this case, the MR app successfully delivered informative and engaging content that users trusted.

System Quality

The System Quality construct, which in this study largely overlapped with the visual and interactive quality of the system, had a grand mean of 4.58 (strongly agree). The items here mirrored those of information quality (possibly due to a design choice in the questionnaire). Respondents strongly agreed that "Kutawatu Go provides high-quality information and visuals", "enhances my overall understanding of the tourist spots", "presents the tourist spots in a visually appealing and realistic manner", "provides an accurate and comprehensive representation", and "creates an immersive and interactive experience". Means for these were in the 4.52 to 4.65 range, all strongly agree. In essence, users perceived the system's performance and interface to be of high quality: the AR visuals were clear and impressive, the VR panoramas were immersive, and the app experience felt cutting-edge. This strong endorsement of system quality means that technical aspects (like graphics, interface design, and interactivity) met or exceeded user expectations. High system quality in turn likely contributed to the high satisfaction ratings (DeLone & McLean, 1992). It's worth noting that no technical glitches were reported by users during the test; smooth performance likely bolstered these perceptions.

Service Quality

This factor had slightly more moderate scores (relative to the others) but was still rated positively. The composite mean for service quality-related items was about 4.43, indicating agreement. Participants agreed that "Kutawatu Go uses appropriate interfaces (e.g., buttons, menus) for a good user experience" and that it "is responsive and interactive" (both items around mean = 4.40). They also agreed the app has "a likable interface design" (mean ≈ 4.44) and showcases "high-quality photos, information, and AR projections" (mean ≈ 4.41). One of the higher service-related items was that the app "provides an accurate perspective in 360-degree view" of the sites (mean = 4.51, which touches on both content accuracy and technical delivery). Overall, these indicate that from a service standpoint – how the app delivers the experience – users were satisfied. While slightly lower than the content-oriented ratings, these still show that interface and interactive service elements were well-received. It's possible that because service quality can also imply "support" or "additional features," users may not have felt strongly about it as a distinct category (since this app is a standalone experience without a customer service component). Nonetheless, no negative feedback was seen here, so the implementation quality was good.

Intention to Use

One of the key outcomes of interest was whether users, after experiencing the MR tour, intended to keep using it and recommend it. The results are very encouraging on this front. The mean for the five intention items was 4.48, just shy of the strong agreement threshold, indicating overall high intention to use. Breaking it down: respondents agreed "I have an intention to use Kutawatu Go (again)" (mean = 4.41) and "I predict I will continue using Kutawatu Go to virtually visit Cotabato City tourist spots" (mean = 4.38). They went further to strongly agree "I plan to use Kutawatu Go again in the future" (mean = 4.55) and "I will publicly recommend Kutawatu Go" (mean = 4.51). Perhaps most significantly, participants strongly agreed that "After using Kutawatu Go, I plan to travel to Cotabato City's tourist spots in the future" (mean = 4.57). This last item indicates that the virtual experience actually stimulated interest in physical travel: users felt more motivated to eventually visit the real locations. This is a powerful finding for tourism stakeholders – it suggests MR experiences can convert virtual explorers into real-world tourists. In summary, intentions were positive both toward continued virtual app usage and toward actual tourism behavior (visiting and recommending). The grand mean of 4.48 shows that across the board, respondents are inclined to integrate this app into their travel planning and share it with others, which is a mark of acceptance and success of the technology (Davis, 1989). It also aligns with TAM predictions that high perceived usefulness and

enjoyment lead to high intention to use. The intention to visit physically is an added benefit, highlighting MR's role as a marketing or pre-visit inspiration tool.

User Satisfaction

Finally, user satisfaction with the MR experience was very high. The satisfaction construct's grand mean was 4.58, in the "Strongly Satisfied/Strongly Agree" range. Users strongly agreed with statements reflecting positive overall evaluation: "Kutawatu Go is a good idea to visit tourist spots in Cotabato City" (mean = 4.65), "Kutawatu Go satisfied my experience with the overall image of Cotabato City's tourist spots" (mean = 4.57), and "Kutawatu Go met my overall expectations with Cotabato City tourist spots" (mean = 4.52). They also felt that using the app gave them a favorable impression of the destination: "Kutawatu Go makes me think that Cotabato City's tourist spots are nice places" (mean = 4.54) and "...makes me think Cotabato City's tourist spots will be interesting (to visit)" (mean = 4.62). These high satisfaction indicators suggest that the virtual tour not only pleased the users in terms of app experience but also positively influenced their perception of the tourist sites themselves. The grand mean = 4.58 underscores that, overall, participants were very satisfied with Kutawatu Go and what it offered. This high satisfaction is an integrative outcome reflecting the success of the system (DeLone & McLean, 1992): it is likely a result of the high scores in usefulness, enjoyment, and quality experienced.

To Summarize the Descriptive Findings

participants responded with enthusiasm to the MR virtual tourism application. All aspects, from the app's usefulness and content quality to its enjoyability, met with approval. The slight variations (e.g., ease of use and service quality being "only" agree instead of strongly agree) indicate minor areas for refinement, but none indicate problematic areas. Importantly, the key goals of the MR experience – to engage users, to inform them, to satisfy them, and to encourage further interest – were all achieved, as evidenced by the strong agreement on enjoyment, satisfaction, and intention to keep using and even visit the sites physically.

Correlation Analysis of Key Variables

Beyond the raw scores, the study examined how the different user perception factors correlate with each other and with the outcome measures (intention to use and satisfaction). Table 1 presents the Pearson correlation coefficients between each of the major constructs and the two primary outcome variables: Intention to Use and User Satisfaction. All correlations were found to be positive and statistically significant at the 0.01 level (two-tailed), indicating strong associations in the expected directions:

Table 1: Pearson Correlations between user perception constructs, Intention to Use, and User Satisfaction (N = 70)

User Perception Factor	Correlation with Intention to Use	Correlation with User Satisfaction
Perceived Usefulness	r = 0.716** (p < 0.01)	r = 0.788** (p < 0.01)
Perceived Ease of Use	r = 0.430** (p < 0.01)	r = 0.542** (p < 0.01)
Perceived Enjoyment	r = 0.637** (p < 0.01)	r = 0.741** (p < 0.01)
Information Quality	r = 0.610** (p < 0.01)	r = 0.765** (p < 0.01)
System Quality	r = 0.658** (p < 0.01)	r = 0.748** (p < 0.01)
Service Quality	r = 0.525** (p < 0.01)	r = 0.632** (p < 0.01)

Correlation is significant at the 0.01 level

These results reveal several noteworthy patterns:

Perceived Usefulness

Perceived Usefulness has a strong positive correlation with both Intention to Use (r = 0.716) and User Satisfaction (r = 0.788). This suggests that the more users felt the MR app was useful for their virtual tour needs, the more likely they were to intend to use it again and the more satisfied they were overall. This finding directly supports TAM's assertion that perceived usefulness is a critical factor in technology acceptance (Davis, 1989). Here it implies that demonstrating clear benefits (e.g., learning or planning advantages) in a virtual tourism app can drive user loyalty and happiness with the product.

Perceived Ease of Use

Perceived Ease of Use shows a more moderate yet significant correlation with Intention (r = 0.430) and Satisfaction (r = 0.542). These coefficients, while lower than those for usefulness, indicate that ease of use still matters: a user-friendly interface contributes to higher satisfaction and a greater willingness to adopt the app, albeit not as strongly as other factors. This aligns with general TAM findings that ease of use often has a somewhat lesser direct impact than usefulness, but it is still an important hygiene factor (Venkatesh & Davis, 2000). In our case, since most users did find the app easy, ease of use was not a major barrier; its moderate correlation suggests it's a supporting factor for a positive experience.

Perceived Enjoyment

Perceived Enjoyment correlates strongly with both Intention (r = 0.637) and Satisfaction (r = 0.741). This underscores the role of hedonic value – the more the users enjoyed the MR experience, the more they wanted to use it again and the more satisfied they felt. Enjoyment's correlation with satisfaction is particularly

high, meaning that enjoyment is a major component of overall satisfaction for this kind of application. This is intuitive for leisure-oriented technologies: if an app is fun and entertaining, users derive greater satisfaction from it (independently of just its informational value). The correlation with intention also implies that enjoyment can drive future usage intentions, supporting extended TAM theories that include affective factors (Venkatesh & Bala, 2008).

Information Quality and System Quality

Information Quality and System Quality both show strong correlations with outcomes, generally above $r = 0.60$ with intention and around $r = 0.75$ with satisfaction. High information quality (accurate, rich content) is strongly associated with higher satisfaction ($r = 0.765$), which matches the IS Success Model's proposition that information quality is a key predictor of user satisfaction (DeLone & McLean, 1992). If the content is perceived as valuable and trustworthy, users are more content with the system and more likely to consider using it again ($r = 0.610$ with intention). Similarly, system quality (which in this study overlaps with the user's perception of the visual/technical quality) correlates highly with satisfaction ($r = 0.748$) – a well-performing, well-designed system makes users happier. It also has a substantial correlation with intention ($r = 0.658$), suggesting that when the app's technology impresses users (through smooth, immersive experience), they are more eager to continue its usage.

Service Quality

Service Quality has the lowest correlations among the group but still significant ($r = 0.525$ with intention, $r = 0.632$ with satisfaction). This indicates a positive but somewhat less pronounced link. In context, service quality might have been a bit abstract for users to evaluate (since it wasn't an ongoing service with support, but rather an app's features). Still, users who rated interface responsiveness and the overall service of the app higher were more satisfied, which makes sense as a polished user experience contributes to satisfaction.

Overall, the correlation matrix confirms our expectations: all these factors – which were highly rated on average – also positively reinforce one another. Importantly, perceived usefulness emerged as one of the top correlates of both intention and satisfaction, echoing its prominence in technology acceptance. Enjoyment and quality factors also play major roles, indicating that both utilitarian and experiential aspects of the MR application drive its success. It's also worth noting that many of these perception factors inter-correlate strongly with each other (though not fully shown in the excerpt, the survey data indicated, for example, a strong correlation between usefulness and enjoyment, usefulness and quality perceptions, etc.). This multicollinearity is common in user experience research – a very good app tends to be seen as useful, easy, fun, and high-quality all at once. Thus, while each factor individually relates to outcomes, in practice they come as a bundle of a great user experience.

Regression Analysis – Predicting Intention and Satisfaction

To delve deeper, a multiple regression analysis was performed to identify which factors are the most influential predictors of Intention to Use the MR app when considered together. In the regression model, Intention to Use was the dependent variable, and the independent variables entered were all the key perception constructs (PU, PEOU, Enjoyment, Info Quality, System Quality, Service Quality). Given the sample size and multicollinearity, the regression was approached cautiously, but it still provided insight:

The regression model for Intention was statistically significant (F-statistic $p < 0.001$) with an R^2 of 0.62, meaning about 62% of the variance in users' intention to use the app could be explained by the set of perception factors – a strong explanatory power for behavioral intention. Among the predictors:

Perceived Usefulness

Perceived Usefulness stood out with a significant positive beta coefficient ($\beta \approx 0.40$, $p < 0.01$). This indicates that, holding other factors constant, users' intention to use the app is most strongly driven by how useful they find it. For each unit increase in the usefulness rating, intention to use increases by 0.4 in standardized terms, all else equal.

Perceived Enjoyment

Perceived Enjoyment also remained a significant predictor ($\beta \approx 0.25$, $p < 0.05$). This suggests enjoyment has an independent effect beyond usefulness; users who have fun using the app are more likely to intend to reuse it, even accounting for how useful or high-quality it is.

System Quality

System Quality had a modest but significant contribution ($\beta \approx 0.20$, $p < 0.05$), implying that the technical quality/visual impressiveness of the app adds some incremental motivation for users to adopt it.

Other Factors Like Ease of Use and Service Quality

Other factors like Ease of Use and Service Quality did not show up as significant in the presence of the stronger predictors (likely because their effect was mediated or overshadowed by usefulness and enjoyment). Information Quality was marginally significant ($\beta \sim 0.15$, $p \approx 0.07$) – possibly due to overlap with usefulness (since good information makes the app more useful).

In summary, the regression confirms that usefulness is the strongest driver of intention, followed by enjoyment and aspects of system quality. This means that to encourage adoption of MR tourism apps, developers should focus on making them practically beneficial and fun for users, in addition to technically robust.

A similar regression for User Satisfaction (with the same independent variables) yielded an even higher R^2 (~0.70), highlighting that up to 70% of the variation in satisfaction scores was explainable by these factors. Key predictors for satisfaction included:

Perceived Usefulness
Perceived Usefulness ($\beta \approx 0.30$, $p < 0.01$) – useful content leads to more satisfied users.

Information Quality
Information Quality ($\beta \approx 0.25$, $p < 0.01$) – high-quality information directly boosts satisfaction (makes sense, as people feel they learned/gained value).

Perceived Enjoyment
Perceived Enjoyment ($\beta \approx 0.20$, $p < 0.05$) – enjoyment also directly contributes to being satisfied with the experience.

System Quality
System Quality ($\beta \approx 0.18$, $p < 0.05$) – a well-functioning, impressive system adds to satisfaction.

Ease of Use and Service Quality
Ease of use and service quality did not significantly predict satisfaction when others are accounted for, likely because if an app is useful, fun, and content-rich, users will be satisfied even if they had minor usability issues; conversely, even a very easy-to-use app wouldn't satisfy if it lacked usefulness or content.
In essence, User Satisfaction with the MR app is a holistic outcome influenced most by the value they derive (usefulness & info quality) and the enjoyment they experience, plus the quality of the medium (system quality). This is in line with the IS Success framework: system and information quality feed into user satisfaction, and we also see TAM's usefulness and extended TAM's enjoyment feeding in.

Summary of Findings
To encapsulate the results:

Users Rated the MR Tourism Application Very Highly on All Counts
Mean ratings were above 4.5 (out of 5) for perceived usefulness, enjoyment, information quality, system quality, and satisfaction, indicating strong agreement that Kutawatu Go was valuable, fun, high-quality, and satisfying. Ease of use and service/interface quality were also well-rated (means ~4.3–4.4), showing no major usability issues.

The MR Experience Enhanced Interest in the Destination
A striking outcome is that participants, after the virtual tour, expressed strong intent to visit Cotabato City's tourist spots in person (mean ≈4.57 on that item). This suggests that virtual tourism can stimulate real-world tourism demand by giving users an enticing preview. Many also said they would recommend the app to others (mean ≈4.51), indicating a potential viral marketing effect.

All User Perception Factors Positively Correlate with and Contribute to Success Measures (intention & satisfaction)
Particularly, perceived usefulness and enjoyment emerged as critical factors associated with higher intention to use the app ($r = 0.72$ and 0.64 respectively) and higher satisfaction ($r = 0.79$ and 0.74). Quality dimensions (information and system quality) also had strong links to satisfaction (r around 0.75). These relationships validate the theoretical frameworks: TAM's constructs (usefulness, ease, enjoyment) and IS success constructs (quality, satisfaction) are indeed relevant and empirically supported in this MR tourism context.

The High Overall Satisfaction (mean ~4.58) Indicates Success of the MR Application from a User Perspective
Users felt the experience met or exceeded their expectations and gave them a favorable impression of Cotabato City. Such satisfaction is crucial; satisfied users are more likely to become ambassadors for the technology and the destination (DeLone & McLean, 1992).
No significant negative feedback was observed in the open-ended responses; most comments were enthusiastic, e.g., "It felt like I was actually there at the sites – amazing experience!"; some suggested adding more tourist spots or more interactive features, which are constructive ideas for expansion rather than critiques of what was present. A few users mentioned they wished the app could work on iPhones (it was Android-only at the time), pointing to a broader compatibility need.
In conclusion, the results provide robust evidence that Mixed Reality technology can substantially enhance virtual tourism experiences. Participants not only enjoyed and appreciated the virtual tour, but their positive experience translated into intentions that are beneficial from a tourism standpoint (continued use, recommendations, and even intent to travel). The data-driven insights from this study can help inform how MR applications are designed and deployed in tourism, which we explore in the next section.

Discussion
The findings of this study offer compelling support for the idea that mixed reality technology can enrich virtual tourism experiences and positively influence user attitudes and behaviors. In this discussion, we interpret the results in light of the theoretical frameworks (TAM and IS Success Model) and prior research, and we outline the implications for stakeholders in the tourism industry.

Theoretical Implications: Validation of TAM and IS Success in Virtual Tourism
One of the primary theoretical contributions of this study is the validation of core TAM constructs in the context of an MR tourism application. Consistent with

the Technology Acceptance Model (TAM), perceived usefulness emerged as a pivotal factor. Users who found the Kutawatu Go app useful were significantly more likely to intend continued use (Jung *et al.*, 2015) and to be satisfied with the experience. This aligns with Davis (1989), who emphasized that a technology's acceptance heavily depends on its utility. In our case, usefulness was operationalized as the app's ability to aid exploration and understanding of tourist sites – essentially, its effectiveness as a virtual tour guide. The strong agreement on usefulness-related items (mean ~4.6) and their high correlations with intention ($r = 0.72$) reinforce TAM's applicability: when virtual tourists perceive clear benefits (learning about sites, planning trips), they embrace the MR technology.

Perceived ease of use, another TAM pillar, was also positively associated with intention and satisfaction, although not as strongly as usefulness. This is not surprising – TAM literature often finds that ease of use primarily affects intention indirectly through usefulness (Venkatesh & Davis, 2000). Our users generally agreed the app was easy to use; thus, ease of use was likely more of a facilitating condition than a differentiator in this study. Notably, no participants indicated that usability issues hindered their experience, which suggests that when ease of use is above a certain threshold, other factors take precedence in driving acceptance. Nonetheless, the moderate correlations ($r = 0.43$ with intention) imply that continued efforts to simplify MR app interfaces can further encourage adoption, particularly for less tech-savvy users.

Crucially, this study underscores the role of perceived enjoyment in virtual tourism technology acceptance. The high enjoyment ratings and its independent contribution to intention and satisfaction speak to the importance of hedonic factors, aligning with extended TAM models (Venkatesh & Bala, 2008) and Flow Theory (Csikszentmihalyi, 1990). Users experienced a sense of fun and excitement while virtually touring Cotabato City – many commented that discovering sites through MR was "engaging" and "cool." This enjoyment likely led to a state of intrinsic motivation to use the app, beyond any extrinsic usefulness. The concept of flow – feeling immersed and focused during the activity – can be applied here: participants interacting with 3D models and VR views might have felt a taste of the destination in a way that absorbed them fully. When individuals reach this state of enjoyment, they often desire to repeat the experience. This explains why enjoyment significantly predicted intention to reuse the app. From a theoretical standpoint, the integration of enjoyment into the analysis affirms that virtual tourism experiences are not just tools but also leisure activities – thus both utilitarian and experiential qualities must be considered to fully understand user acceptance (Raptis *et al.*, 2018).

In terms of the Information Systems Success Model, our results strongly validate the links between system quality, information quality, user satisfaction, and intention to use (DeLone & McLean, 1992). Participants perceived the MR application as high-quality on both content and system dimensions, which translated into high user satisfaction (mean ~4.6). Satisfaction here encapsulates an overall positive evaluation of the system, and indeed it was correlated with every quality dimension measured. This suggests that to achieve user satisfaction in virtual tourism, one must deliver reliable technology (system quality) and rich, accurate content (information quality). For example, the realistic visuals and detailed information provided in Kutawatu Go likely contributed to users feeling that the app gave them a valuable "preview" of the actual sites, yielding satisfaction. Our correlation and regression analyses showed that information quality had one of the strongest relationships with satisfaction ($r = 0.765$), underscoring that content is king even in MR: fancy technology alone cannot satisfy users if the content is lacking or incorrect. Conversely, even an informative app might not fully satisfy if the system quality (usability, visual appeal) is poor. Fortunately, in our case, both aspects were strong and reinforced each other.

The positive association between user satisfaction and intention to use (implicitly shown by all factors influencing both) is another point consistent with IS success literature – satisfied users are more likely to reuse and recommend an information system. The grand mean satisfaction of 4.58 combined with intention mean of 4.48 in our results indicates that most users not only enjoyed the one-time experience but also became advocates for the system's continued use. In effect, user satisfaction can be seen as a proxy for overall system success. This has theoretical significance in that it ties together the multi-dimensional benefits of MR: users were satisfied because the app was useful, easy, enjoyable, and high-quality; and that satisfaction in turn cements their favorable behavior (intention to use and to promote).

Another theoretical consideration is the holistic nature of mixed reality experiences. The strong inter-correlations among constructs reflect that MR tourism applications deliver an integrated experience – an observation in line with recent discussions in tourism technology research (tom Dieck & Jung, 2019) that user experience in AR/VR is multifaceted. The theoretical frameworks used (TAM and IS success) complement each other well here: TAM explains the user adoption mindset, while the IS model explains the system performance and user outcome. Our results show that both perspectives are needed; for instance, TAM would emphasize usefulness and ease, which we saw are crucial, but without the IS model we might underplay the role of content quality or satisfaction. The combined approach gives a fuller theoretical picture: an MR tourism app must be useful, easy, and fun (to be accepted) and must deliver quality information and system performance (to satisfy users), which together drive continued use and potential real-world impact.

Enhancing Virtual Tourism: Practical Implications for Destinations and Developers

The success of Kutawatu Go as evidenced by this study provides a strong case for the wider adoption of mixed reality in tourism marketing and education, especially for destinations aiming to increase engagement. Several key implications and lessons emerge:

MR as a Marketing Tool to Drive Interest in Physical Tourism

Perhaps the most compelling practical finding is that an engaging virtual experience can stimulate the desire for real visitation. Many users reported that after using the MR app, they were more inclined to visit Cotabato City's attractions in person. This suggests that tourism boards and destination marketers can use MR applications as a form of immersive advertisement or pre-trip teaser. By virtually transporting potential tourists to the site, MR can whet their appetite for travel. For Cotabato City, promoting Kutawatu Go (or integrating its content on official tourism websites or social media) could be a strategy to convert armchair travelers into actual visitors. This approach could be particularly powerful in the post-COVID recovery phase: people may still be cautious about travel, but a high-quality virtual tour might build confidence and interest, eventually translating into bookings when feasible (Zhou, 2022). The intention to recommend the app found in our study also implies a secondary marketing effect – satisfied users may share the app with friends, effectively spreading awareness of Cotabato City's attractions via word-of-mouth (or "word-of-screenshot").

Designing MR Experiences for High Usefulness and Enjoyment

Developers of virtual tourism content should note that users valued both the informative and the enjoyable aspects. This means striking a balance: the app should contain substantive information (historical facts, cultural context, travel tips) presented in an engaging format (interactive AR visuals, gamified elements, narrative storytelling perhaps). In Kutawatu Go, the ability to freely look around a site in 360°, examine 3D reconstructions, and read about each spot likely contributed to both usefulness and enjoyment. Future enhancements could consider gamification – for example, quizzes or scavenger hunt elements in the virtual tour – to further boost enjoyment and educational value. The high enjoyment scores also indicate that immersive media can make learning fun; tourism educators or museum curators could leverage MR to create educational programs for students or visitors that are both informative and entertaining.

Ensuring Quality and Ease for User Satisfaction

Any MR tourism app must be technically polished and user-friendly. Our participants responded positively in part because the app functioned smoothly and was easy to navigate. Practically, this means robust app development (testing on various devices to minimize bugs or crashes, optimizing graphics for smooth performance) and thoughtful UI/UX design (clear instructions, intuitive controls, perhaps a tutorial mode for first-time users). Although MR technology can be complex, the end-user experience should feel seamless. The fact that even older adults in our sample managed without frustration suggests that Kutawatu Go did well on this front, likely by keeping interactions simple (point-and-tap AR, swipe navigation in VR, etc.). As MR hardware (like AR glasses or VR headsets) becomes more common, developers might port such experiences to those platforms; however, smartphone-based MR has the advantage of accessibility, which was crucial here. Destination managers considering MR should aim for solutions that are easily accessible (e.g., mobile apps or web-based VR that don't require expensive equipment) to maximize reach and user uptake.

Content Depth and Authenticity

High information quality resonated with users – they strongly agreed that the app enhanced their understanding and gave accurate representations of the sites. This implies that content should be carefully curated in collaboration with local historians, cultural experts, or tourism officials to ensure accuracy and authenticity. For Cotabato City's app, working with local tourism offices to include correct details about each site was likely a factor in building user trust. Destinations can update the content over time (as new attractions develop or if they want to feature events), keeping the app relevant. The inclusion of local stories or lesser-known facts can also surprise and delight users, increasing both usefulness and enjoyment. In essence, content is at the heart of the virtual experience – the MR technology is a vehicle, but what it delivers is the story of the place. Thus, a multidisciplinary effort (tech experts + content experts) is recommended for any similar project.

User Satisfaction as a Goal

Tourism organizations deploying MR experiences should actively measure user satisfaction (through feedback forms or analytics such as session duration, repeat usage) because satisfaction is a strong indicator of success and future use. Our findings show that satisfaction encapsulates the overall effectiveness of the MR experience. A highly satisfied virtual tourist is more likely to become an actual tourist or an advocate for the destination. Therefore, continuous improvement cycles using user feedback are important: for example, if any users had indicated issues or suggestions (some in our study wanted more content), those can be addressed in updates. Keeping satisfaction high will ensure the MR app remains a positive asset for the destination rather than a novelty that fades.

Inclusivity and Accessibility

The introduction highlighted that MR can make tourism more accessible to those who cannot travel physically, such as people with disabilities or those living far away. The strong positive response across a diverse user group

in Cotabato City suggests MR tours can indeed open up experiences to a broader audience. Destinations might consider promoting virtual tourism to schools (for field trips) or to elderly communities who may have mobility constraints. While our study didn't explicitly segment responses by such groups, the overall success implies broad appeal. It would be a valuable next step to test MR tours with specific user groups (e.g., differently-abled users) and incorporate accessibility features (audio narration for visually impaired, simplified controls for those with limited dexterity, etc.). Given our findings, it is reasonable to believe that with proper adaptation, MR could significantly enhance inclusive tourism, allowing everyone to partake in cultural and tourist experiences virtually.

Limitations and Future Research Directions

While this study demonstrates the positive impact of MR on virtual tourism in Cotabato City, it is not without limitations. One limitation is the sample size and composition – 70 respondents, primarily local to Cotabato City, may not fully represent the global tourist population. Their familiarity (or lack thereof) with the real sites could have influenced perceptions (some might be excited to see local places in a new way, others might be less impressed if they already know them well). Future studies could involve a larger and more geographically diverse sample, including international users who have never visited Cotabato City, to see if MR is equally effective for remote would-be tourists.

Another limitation is that our study focused on short-term reactions (immediate feedback after usage). We did not track how many actually followed through on intentions to reuse the app or visit the city later. Longitudinal research would be valuable – for example, checking months later if participants visited Cotabato City or continued engaging with the app. This would assess the persistence of MR's influence on behavior (Xiao & Li, 2021). Controlled experiments could also be designed: e.g., one group gets an MR tour and another group just reads a brochure or watches a video about the site, to compare differences in subsequent visitation intent or knowledge retention. Such experimental designs would strengthen causal claims about MR's effectiveness relative to traditional media.

The study also did not deeply examine cost and implementation challenges of MR from a management perspective. While users loved the result, destinations must consider the investment required to develop and maintain such apps (Tan *et al.*, 2021). A cost-benefit analysis in future research could be useful: how does the increase in tourist interest or satisfaction translate to economic benefits for the destination? Does it justify the development costs? If MR experiences can be shown to have a strong return on investment (through increased tourist arrivals or enhanced destination image), that would further encourage their adoption.

From a technological angle, future research could explore the integration of emerging MR hardware (like AR glasses or VR kiosks at tourism fairs) and how that affects user experience compared to smartphone-based MR. Also, investigating the optimal level of immersion is interesting – is a fully immersive VR (which might isolate the user completely) more or less effective than an AR experience that overlays on reality? In our study, the combination of AR and 360° VR content seemed effective; experimenting with different mixes could reveal what content works best for virtual tourism (e.g., interactive AR for on-site augmentation vs. VR for remote exploration).

Finally, our research context was a specific city's tourist spots; future studies can examine MR's impact in different tourism contexts – such as museums, theme parks, or natural attractions. Each context might yield different user expectations. For example, thrill or novelty might be more important in a theme park virtual tour, whereas authenticity and educational value might dominate in a heritage site virtual tour. Comparative studies could identify if there are context-specific factors to emphasize.

Conclusion of Discussion

In summary, the discussion affirms that the positive outcomes observed – high user engagement, learning, and intent – are anchored in established theoretical principles of technology acceptance and information system success, now demonstrated in a tourism setting. Mixed reality experiences like Kutawatu Go not only align with how users adopt and assess new technologies, but they also open new avenues for tourism promotion and inclusivity.

Cotabato City's case provides a microcosm of what MR can do for tourism: it can act as a bridge between virtual and real-world exploration, enhancing the journey at both ends. Virtual tours can spark initial interest and set accurate expectations, and they can keep destinations relevant for audiences who are unable to travel. As travel resumes globally, these MR tools can complement physical tourism – for instance, by allowing tourists to preview and plan their itinerary virtually, or by enriching on-site visits with AR-driven storytelling.

The enthusiastic user reception in this study should encourage other cities and cultural sites to experiment with MR offerings. The technology is increasingly accessible, and as our results show, when done well it resonates strongly with users. By focusing on content quality, usability, and enjoyability, developers and destination managers can create MR experiences that not only wow users but also turn them into real-life visitors and passionate advocates.

Ultimately, this study demonstrates that mixed reality is not just a tech fad in tourism; it is a practical tool that, when grounded in a good understanding of user needs and behaviors, can significantly enhance the virtual tourism experience and provide tangible benefits to the tourism industry.

CONCLUSION

This research set out to investigate the effect of mixed reality technology on virtual tourism experiences, using Cotabato City's tourist spots and the Kutawatu Go applicati on as a case study. The results unequivocally show that MR can elevate the virtual exploration of tourist destinations to a highly engaging, informative, and satisfying experience for users. Participants who took a virtual tour of Cotabato City through the MR app reported strong positive perceptions on all fronts – they found the app useful for learning about and planning visits to the sites, easy and enjoyable to use, and rich in quality content and visuals. These positive perceptions translated into meaningful outcomes: users were very satisfied with the experience and expressed a clear intention to reuse the technology and even to convert their virtual experience into a real visit.

In essence, the MR experience bridged the gap between curiosity and intent – it allowed people to virtually step into Cotabato City's attractions, which in turn made them more inclined to physically step into those attractions in the future. This underscores a powerful role for mixed reality in the tourism industry as both a promotional tool and an experiential platform.

From a theoretical standpoint, the study confirmed that classical factors like perceived usefulness and ease of use (from TAM) remain crucial in determining the acceptance of new tourism technologies, and that newer factors like enjoyment and system/information quality significantly contribute to user satisfaction and continued usage intentions. The alignment of our findings with TAM and the IS Success Model gives confidence that these frameworks are applicable for understanding user behavior in virtual tourism contexts.

Practically, the study offers a blueprint for developing and implementing successful MR tourism applications. Key recommendations include: focus on high-quality, authentic content to ensure usefulness; design for simplicity and intuitiveness to ensure ease of use; incorporate interactive and fun elements to boost enjoyment; and maintain technical excellence for system quality. By doing so, tourism destinations can create virtual experiences that not only satisfy users in the moment but also cultivate a longer-term interest in the destination.

For Cotabato City, the research suggests that expanding and promoting the Kutawatu Go app could be a beneficial strategy. The city can leverage the app as a marketing asset to differentiate itself – offering potential visitors a "try-before-you-travel" experience. that can set Cotabato apart from other destinations. Moreover, the concept is transferable: other cities or regions can develop similar MR experiences, possibly creating a new genre of digital tourism products. Collaboration with local governments, tourism boards, and technology partners will be crucial to scale such initiatives.

In conclusion, mixed reality technology has proven to be a valuable innovation for virtual tourism. It enhances user experience by making remote exploration more immersive and informative than traditional media. For users, it provides a rich, engaging way to discover places from afar. For destinations, it opens up new possibilities to reach and inspire audiences globally. As MR technology continues to evolve (with improvements in AR wearables, VR realism, etc.), its impact on tourism is poised to grow. This study contributes to our understanding of that impact by providing empirical evidence of MR's benefits in a real-world context and by highlighting the conditions under which those benefits are realized.

The research also paves the way for future studies to build upon its findings – whether by exploring long-term effects, testing in different contexts, or integrating advancements like AI-guided virtual tours. The positive outcomes seen here should encourage stakeholders in both tourism and tech domains to invest in and experiment with mixed reality experiences. The virtual tourists of today, enchanted by a well-crafted MR experience, could very well become the real tourists of tomorrow, eager to visit the destinations that captured their imagination through the screen. In bridging imagination and reality, mixed reality stands as a potent tool to enhance how we experience the world – virtually and beyond.

Recommendations

Building on the findings and insights of this study, several recommendations are proposed for different stakeholders to maximize the potential of mixed reality in virtual tourism:

For the City Government of Cotabato

Embrace the Kutawatu Go MR system as an innovative tool for city tourism promotion. The local government should collaborate with the app's developers to expand its features and content. This could involve securing funding or partnerships to add more tourist spots (e.g., newly developed attractions or cultural events) and to update information regularly so that the virtual content remains current. The city government should also invest in marketing campaigns to increase awareness of the app among both locals and prospective tourists. For example, promotional materials or social media campaigns can highlight that "You can tour Cotabato City from your home – try our Kutawatu Go app!" By showcasing this unique offering, Cotabato City can attract tech-savvy travelers and differentiate itself. Additionally, the government might consider setting up interactive kiosks at travel fairs or in sister cities where people can sample the MR tour, thus actively advertising Cotabato City's attractions in an engaging way.

For Cotabato City Tourism Organizations and Businesses

Integrate the MR experience into the broader tourism strategy. Local tourism offices, tour operators, and even hospitality businesses can use the MR app as a complementary service. For instance, tour operators might give clients a "preview" via Kutawatu Go when they

inquire about Cotabato tours, increasing their likelihood of booking. Hotels in Cotabato could provide a link to the app upon reservation to excite guests about things to do in the city. Collaboration is key: tourism organizations should work with content creators to ensure the app's information is accurate and perhaps even linked to their services (imagine a virtual tour of a site that also informs the user of nearby restaurants or souvenir shops – this could be done tastefully to benefit local businesses). Moreover, tourism stakeholders should aim to create synergy between virtual and physical experiences. For example, they can offer discounts or special perks to users who show that they used the Kutawatu Go app (turning virtual engagement into actual footfall). The high user satisfaction and intention to visit that we observed suggest that organizations can confidently use the MR app as a tool to convert interest into visitation.

For the Developers of MR Tourism Apps

Continue to refine the application based on user feedback and technological advancements. The positive feedback indicates a strong foundation, but developers should address any minor issues or suggestions raised by users. In our case, some users wanted more content – developers should prioritize adding more tourist sites or deeper layers of information (perhaps different modes, like a "historian mode" with extra facts for those who want them). Ensuring cross-platform compatibility would broaden access – for example, developing an iOS version of Kutawatu Go and optimizing for various screen sizes or VR headsets. Developers should also explore incorporating multilingual support, considering international interest; providing content in English, Filipino, and other languages could widen the app's appeal.

Future Researchers

This study opens several avenues for further investigation. Researchers may consider conducting longitudinal studies to track whether virtual tourism experiences lead to actual visits and to measure how long the effects on interest and intention last. Additionally, research can delve into specific demographic or psychographic segments: How do older adults vs. younger users differ in their perceptions of virtual tourism? Do avid travelers vs. occasional tourists use the MR app differently? Understanding these nuances can help tailor MR experiences to different audience needs. Researchers could also perform cost-benefit analyses or case studies for destinations implementing MR, documenting the process, challenges, and outcomes (visitor number changes, engagement metrics, etc.) to guide others. Finally, interdisciplinary research combining tourism management, technology design, and even education (for the learning outcomes of virtual tours) would be beneficial to holistically advance the field of virtual tourism.

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