

BhARat: India's Ultimate AR Tour Guide App

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Abstract— In an era of globalization, fostering cultural understanding is crucial, particularly for countries like India with diverse heritage.

This paper introduces an Augmented Reality (AR) mobile app aimed at showcasing and preserving India's rich cultural tapestry.

The AR app integrates meticulously curated content, sourced from authorized channels, including models of monuments, authentic images of scriptures and cuisine, local language soundscapes, real-time crowd and visiting information, virtual try-ons, accessibility features, festival highlights, and narratives of festivals and art forms.

The app transcends geographical boundaries, promoting cultural understanding and inclusivity. It bridges cultural gaps, fostering global unity while preserving heritage.

The paper outlines the app's development, features, and potential impact on tourism, addressing challenges like language barriers and underrepresentation of traditional arts.

Index Terms—Augmented Reality (AR), Unity, Education, Tourism, User Experience, Cultural Heritage, Vuforia.

I. INTRODUCTION

In our increasingly interconnected world, the preservation and promotion of cultural heritage pose significant challenges, particularly in culturally diverse countries like India. Despite the country's rich tapestry of history and traditions, many of its historical monuments, temples, and cultural practices remain either underrepresented or inaccessible to a global audience.

Language barriers, geographical limitations, and inadequate accessibility options further compound the issue, hindering meaningful engagement with India's diverse cultural heritage.

Existing digital platforms, while offering some information about monuments and festivals, often fall short in providing comprehensive and immersive experiences that effectively showcase India's cultural treasures and foster cultural understanding and inclusivity.

The static nature of these platforms limits user engagement and fails to capitalize on opportunities for interactive storytelling and real-time experiences.

Augmented Reality (AR) technology emerges as a promising solution to address these challenges by offering immersive and educational experiences that transcend geographical boundaries and engage users of all backgrounds and abilities.

AR has demonstrated its potential across various domains, including education, entertainment, and tourism. However, there remains a need for more comprehensive studies focusing specifically on the development and evaluation of AR applications tailored to preserving and promoting cultural heritage.

This research paper aims to bridge this gap by investigating the development and effectiveness of an AR mobile app designed to showcase India's rich culture and heritage. By exploring the creation and evaluation of such an app, this study seeks to contribute to the growing body of knowledge in the field of AR applications for cultural heritage preservation and promotion. Insights gained from this research can inform future endeavors aimed at leveraging AR technology to bridge cultural divides and foster cultural appreciation on a global scale.

TABLE I. USER EXPERIENCE COMPARISON TABLE: TOURISM INTERFACES IN INDIA

Aspect	Ministry of Tourism	Incredible India	BhARat
User Experience & UI clarity	Disoriented UI	Disoriented UI	Oriented UI
Internet connection dependency	Yes	Yes	No
Immersive Experience*	No	Yes	Yes
Interactive Experience**	No	No	Yes
Descriptive local information	No	No	Yes

* Real-time views and 360-degree exploration directly integrated into the user's environment

**Audio books in local languages and a virtual trial room for trying on Indian attire

II. LITERATURE REVIEW

N. Petrović et.al. [1] presents prototypes utilizing AR for exploration, historical reconstruction, and gamification. Developed with tools like AppSheet and AR.js, they aim to revitalize tourism. It also discusses using data mining to predict booking cancellations and supports knowledge transfer initiatives for tourism students, backed by the Ministry of Education in Serbia. P. K. Katkuri et. al [2] explores AR's integration into tourism, spotlighting the "Tourist Guide" app's immersive experiences and destination accuracy to boost tourism revenue. Developed using Unity, Vuforia, and Blender, it underwent user feedback and usability testing, alongside a review of existing AR tourism apps. Y. K. Cheah and O. Baker [3] introduced InvercARGill, a multilingual AR tourist guide for Invercargill CBD, developed using a blend of Waterfall and Scrum methods. It integrates AR, maps, and lists for attraction info and navigation. Black-box testing validated its functionality and usability. Future plans include enhancing reliability, security, and performance, and adding translation and social sharing features for user engagement. S. D. Sorna et. al [4] introduces MonuAR, an AR app showcasing Indian monuments with 3D models and voice-based information for an interactive experience. Developed using Visual Studio, Blender, Unity, and Python, it integrates Vuforia and Mapbox SDKs. Future plans include personalizing content with machine learning and enhancing chatbot communication with natural language processing. I. Bikmullina and E. Garaeva [5] aims to streamline 3D object modeling for young professionals, focusing on vertex extrusion modeling. It covers steps like texture maps, rigging, and animation in Unity. It highlights the importance of axis alignment and normal direction. Future plans include exploring other modeling techniques and improving modeling efficiency. S. Tzima et. al [6] explores the interplay between technology and content in augmented reality applications for cultural heritage. It emphasizes the importance of immersive experiences influenced by technical advancements and content quality. It likely discusses balancing innovative AR tech with historical accuracy and cultural appropriateness, along with challenges, opportunities, and best practices in creating such applications. C. Perra et. al [7] proposes an AR framework to enhance cultural heritage education at sites like museums. It features a smartphone app using ARCore to overlay virtual items. The framework offers personalized learning, eco-friendly tickets, and flexible material selection. The authors highlight AR's benefits for tourists and its potential in cultural education. A. M. Anjana Sundari et. al [8] discuss "Apparel 360°," an AR-based virtual trial room for fashion. It allows users to try on clothing and accessories using markers and AR technology, created with Unity 3D and Vuforia. Users can customize colors and sizes without needing physical inventory. The system, praised by users, provides a competitive advantage by saving time and costs. Future plans include integrating AI algorithms for personalized styling suggestions. Ozkul et. al [9] explores AR's applications in tourism across various sectors like museums, accommodations, and dining. It showcases successful implementations by major players like Marriott and innovative ventures like Inamo restaurant. Despite challenges like technological limitations and costs, AR offers immersive experiences and marketing advantages. The paper recommends addressing these barriers to drive industry advancement through wider AR adoption. Han et. al [10] examine the implementation of AR in Dublin's tourism, focusing on tourists' essential requirements for a mobile AR app. Key themes from interviews include simplicity, relevant information, safety,

and personalization. While limited to Dublin and qualitative in approach, the study highlights the importance of user-friendly design and personalized experiences in AR tourism apps. Boboc et. al [11] provides an overview of AR's use in cultural heritage over the last decade, covering topics like 3D reconstruction, virtual museums, and gamification. It highlights countries like Italy and Greece in AR research. Benefits include enhanced learning and engagement, but challenges include a lack of guidelines and limited experience hindering widespread adoption. Further research is recommended to maximize AR's effectiveness in cultural heritage preservation. Jingen Liang, L et. al [12] review AR tourism research, noting limitations in current methodologies and advocating for experimental and mixed methods. Future directions include exploring gamification, assessing AR's impact on consumer satisfaction, and understanding factors influencing AR tourist behavior. The study highlights the need for diverse research methodologies to enhance understanding of AR in tourism. Bhatt et. al [13] aims to develop an AR tourist guide app for Android devices, enhancing user experience by overlaying location-based data on the phone's camera view. It utilizes Android Studio and Unity 3D with Vuforia Engine. Future research may explore integrating emerging technology and improving user experience for enhanced tourism experiences and smart city development. Dias et. al [14] describe the creation of a virtual dressing room using Unity3D and AR to address challenges in trying on clothes during the COVID-19 pandemic. It utilizes computer vision and facial detection to enable customers to test clothing styles based on body measurements. Drawbacks include static virtual clothes and the need for high-performance equipment. Future goals involve extending the system to Android devices and integrating user preferences.

III. PROPOSED SYSTEM AND TECHNOLOGY STACK

A. Presentation Layer

Mobile App: This core component provides a user-friendly interface for tourists. It allows users to search for information, access functionalities, and interact with the system. The app could be designed for various platforms (Android, iOS) and optimized for different screen sizes.

Web Interface (Optional): Additionally, the system could incorporate a web interface accessible from laptops or tablets. This could be beneficial for planning purposes before the trip or for situations where tourists might not have access to their phones.

B. Business Logic Layer

API Gateway: This component acts as the entry point for user requests from the presentation layer. It manages routing and authentication, ensuring only authorized requests reach the appropriate backend services.

Business Logic Services: These services handle the core functionalities of the app based on user requests. Examples include:

Search Service: Processes user queries for information about monuments, events, etc., and retrieves relevant data from the database.

Booking Service: Facilitates booking for events, integrating with third-party ticketing platforms or managing internal booking systems.

Content Delivery Service: Handles streaming or downloading of audio books, managing access rights and data transfer securely.

Virtual Trial Room Service (if applicable): Uses image recognition or augmented reality (AR) technology to allow users to virtually try on clothes or accessories.

Photography Assistance Service (if applicable): Provides guidance on capturing creative photos using the device's camera, potentially offering AR overlays or filters for specific landmarks.

Data Processing and Transformation: This layer might be responsible for handling large data sets, transforming raw data from the database into user-friendly formats (e.g., generating summaries, extracting key information).

C. Data Access Layer

Database: This stores all the application's data, such as information about monuments, events, audio books, and user accounts. The proposed database will be MySQL(Structured database) based on the type of data that needs to be stored.

External Data Sources: The system might integrate with external APIs to access real-time information, such as weather updates, traffic conditions, or live event details.

This layered architecture ensures modularity, scalability, and maintainability. Each layer can be developed and modified independently, allowing for easier upgrades and adaptation to future needs.

D. Additional Functionalities

Multilingual Support: The system could be available in multiple languages to cater to a wider range of tourists. This could be achieved through user interface translations or leveraging multilingual content providers.

Offline Functionality: Certain functionalities, such as browsing monument information or accessing downloaded audio books, could be available offline for situations where internet connectivity is limited.

Personalization: The system could personalize recommendations and information based on user preferences, interests, and past behavior. This could involve leveraging user data (with proper consent) to suggest relevant events, restaurants, or attractions.

By implementing these diverse layers and functionalities, the BhARat system aims to offer a comprehensive and user-friendly experience for tourists, empowering them to navigate their journey smoothly and enjoy a memorable experience.

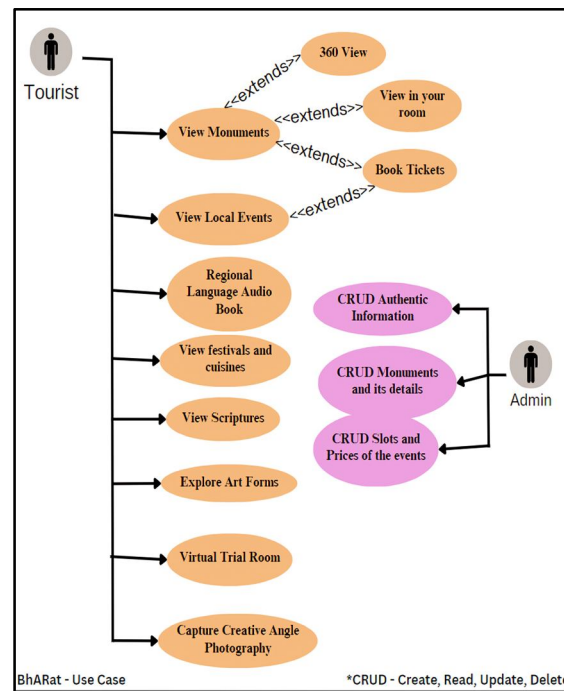


Figure 1. Use Case Diagram of the proposed system

TABLE II. COST BREAKDOWN OF THE TECHNOLOGIES USED

Technology Used	Cost Breakdown
App Development	 Unity Pro - \$170/month  vuforia Vuforia AR Engine - Free
Database Server	 MySQL Cloud Storage - \$88/month
Cloth Simulation	 Unity Plugin - No Additional Cost
Payment Gateway	 Razorpay - Free setup
3D Modelling	 Blender 3D - \$7-8/model (Detailed Texturing)
Audio Content	 Rapid API - \$5/month

IV. IMPLEMENTATION

A. Augmented Reality Based 3D Model

Utilizing Augmented Reality (AR) to visualize 3D monuments is a multi-step process that starts with collecting data on the monuments from the internet and other sources. The basis for developing an educational experience for users is this data, which includes information about the creators and the value of each monument. Either by recording it or by using text-to-speech software such as Google Translate, this data is transformed into voice data in order to improve accessibility and user engagement. The application's ability to integrate voice data makes it more user-friendly for a wider range of age groups, providing a more immersive experience and an alternative to viewing text-based information.

The next stage is to use Blender, a flexible 3D graphics application, to create 3D models of the monuments. The intricate elements and architectural nuances of each monument are faithfully captured in these models through their thorough design. It is imperative to make certain that the models are formatted and sized optimally to meet the requirements of the application and the intended devices. The models also need to work with marker pictures that are used for augmented reality tracking. In addition to guaranteeing visual integrity, the production of low-poly models with vivid colors also makes integration into the AR environment easier.

The use of Vuforia Engine, which permits marker-based AR interactions, is essential to the AR experience. Vuforia Engine uses the device's camera to identify and track certain images, or "Image Targets," which enable the application to superimpose 3D objects and music when the marker is scanned. This marker-based method makes sure that virtual content is accurately aligned with the physical world, which increases user immersion. In addition, Mapbox and Area Targets are utilized to precisely highlight significant spots in the augmented reality setting. Area Targets improve location-based services by tracking and improving spaces, while Mapbox supplies location data and powers the maps used in the application. This combination provides users with a thorough exploration experience and guarantees accurate mapping of monument locations. Users' immersive experiences and smooth interactions are given top priority in the system's architecture. The program provides users with an engaging and educational experience by integrating precise mapping of monument sites, accurate 3D models, informative speech data, and marker-based augmented reality technologies.

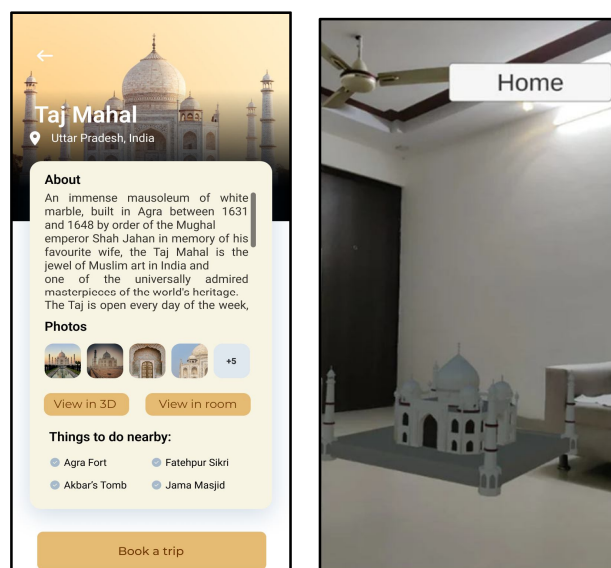


Figure 2. UI Interface and Interactive 3D AR Model

B. Virtual Dressing Room

The purpose of this feature is to use augmented reality to develop an AR virtual dressing room for cellphones. A smartphone camera is a necessary requirement for identifying, identifying, and tracking human body movements in order to interact with suggested software contents, such as virtual dressing, in real-time. As shown in Fig 3, with the use of body measurements, skeleton joint locations, and garment needs, virtual clothing is smoothly tailored to the user's body. An augmented reality-controlled bone armature is used to construct and affix a Blender 3D clothing model to the user's body. Success in capturing lifelike 3D skeletal motion is ensured by validation. The virtual dressing room becomes more realistic as the apparel responds to the user's movements

through the use of a smartphone camera as shown in Fig 4. Users manipulate motion in a manner akin to puppeteering by interacting with virtual clothing. Accurately lining up a mesh model and skeleton in 3D software is essential for seamless synchronization. Performance is maximized via mesh binding to the skeleton. The gap between the virtual and physical domains is closed by this process.

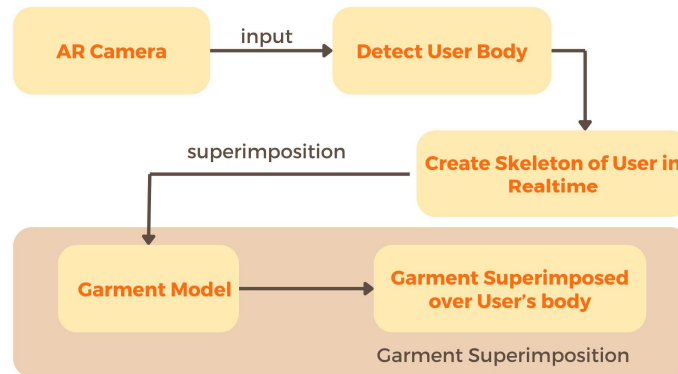


Figure 3. Block diagram of working of virtual dressing room



Figure 4. Virtual try-on of Indian attire

C. Additional Functionalities

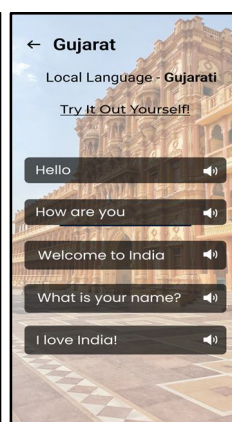


Figure 5. Interactive Regional Audio Player

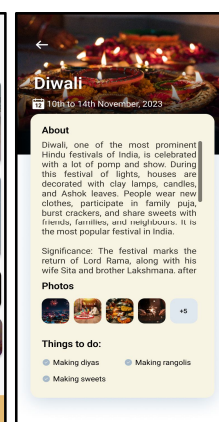
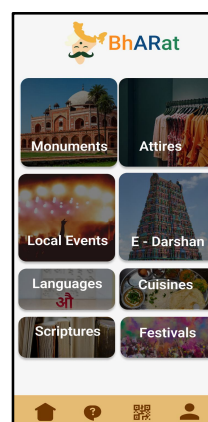


Figure 6. Homepage and Festival Page of the BhARat app

The tourist app seeks to provide users with an extensive and captivating platform for discovering India's rich cultural legacy by aggregating meticulously curated information. Authentic content from approved channels is essential to the app's performance as it guarantees dependability and accuracy. Users can explore a wide range of subjects and include in-depth information on monuments, texts, and cuisine. The application also includes soundscapes in the local language produced by the Google Text-to-Speech API, which improves accessibility and fosters cultural immersion for users with varying linguistic backgrounds. Users may efficiently organize their visits with the use of real-time crowd and visitation information, and the user experience is further streamlined by elements like ticket buying, accessibility information, and monument visiting hours. The app also features art forms and festivals, telling stories and offering insights into India's rich cultural heritage.

V. CONCLUSION & FUTURE SCOPE

In conclusion, the development of BhARat is a vital move in the direction of safeguarding and encouraging the nation's rich cultural legacy in the face of globalization.

Through the integration of meticulously curated content and the use of Augmented Reality technology, the app provides educational and immersive experiences that extend beyond regional barriers, promoting inclusivity and cultural understanding on an international scale.

Beyond tourism, BhARat has the ability to address broader problems including language obstacles and a lack of traditional arts. Through the provision of real-time crowd and visitation data, virtual wardrobes, accessibility features, and stories about festivals and artistic expressions, the app not only improves the traveler experience but also acts as a medium for cross-cultural dialogue and understanding.

There are multiple avenues that this field can go in the years to come for research and growth. First and foremost, BhARat's features and content will need to be updated and expanded on a regular basis in order to keep up with changing cultural contexts and technical developments. Collaborations with regional governments, cultural institutions, and local communities can also improve BhARat's content and encourage community involvement in cultural preservation initiatives.

More inclusive and authentic depictions of India's cultural variety can be found in the app by combining indigenous traditions and points of view. Furthermore, including the app into cultural awareness initiatives and school curricula might improve students' comprehension of India's past and promote cross-cultural interaction.

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