International Journal on Advanced Science Engineering Information Technology

Vol.15 (2025) No. 2
ISSN: 2088-5334

Digital Transformation in Tourism Based on Android Applications for Guides and Recommendations for Tourist Destinations

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***Abstract*— Tourism plays an essential role in the global economy, including Indonesia, which is experiencing significant growth thanks to technological advances and digitalization. Challenges such as a lack of integrated information and difficulties in navigation are still often encountered. This can hamper the potential for exploring tourist destinations in the tourism sector. This study introduces "ChillGo App," designed to address these issues through digital transformation, employing the ADDIE method for a systematic approach. Materials for this research included data on 523 tourist destinations and more than 200 MSMEs in West Java, collected through various techniques such as searching, crawling, and scrapping. The method involved user needs analysis, intuitive interface design, and algorithm creation, using integer encoding for Collaborative Filtering and TF-IDF Vectorizer with Cosine Similarity for Content-Based Filtering. Evaluation with 330 respondents demonstrated the app's effectiveness in providing accurate recommendations and improving destination visibility. Results indicated that the ChillGo App effectively provides accurate recommendations and enhances the visibility of tourist destinations. Beyond serving as a guide, the ChillGo App promotes local MSMEs, supporting economic growth and cultural heritage and showcasing digital technology's role in enhancing tourism. The implications for further research suggest that integrating more advanced technologies, such as artificial intelligence and machine learning, could further enhance the App's capabilities. Expanding the dataset to include more regions could improve the app's relevance and effectiveness. This research underscores the potential of digital in overcoming traditional challenges in the tourism sector and emphasizes the importance of continuous innovation for sustainable tourism development.**

***Keywords*— Recommender system; ChillGo App; collaborative filtering; content-based filtering; destination tourism.**

Manuscript received 25 Jul. 2024; revised 12 Oct. 2024; accepted 2 Mar. 2025. Date of publication 30 Apr. 2025.

I. INTRODUCTION

Tourism is an essential economic sector throughout the world, which plays a significant role in increasing income and promoting culture in every region of the country [1]. In the current digital era, global tourism, including in Indonesia, is experiencing significant growth driven by technological advances and digitalization, better tourism infrastructure development factors, and increased accessibility [2]. Indonesia has a variety of destinations that offer natural beauty, cultural richness and unique experiences, making the tourism sector in Indonesia attract millions of tourists, both domestic and foreign, every year [3], [4]. Data shows that the tourism sector in Indonesia continues to grow, with its contribution to *Gross Domestic Product* (GDP) expected to increase to 4.1% in 2023. However, despite this growth, many tourist destinations have not fully exploited their potential due to a lack of exposure and effective promotion [5], [6].

Problems often found include a lack of integrated information about tourist destinations, difficulties in navigation and searching for local services, and much information that is still verbal [7]. This makes it difficult for both local and foreign tourists to find and sort out information related to the tourist destinations they want to visit. In this context, digitalization and digital transformation offer great opportunities to overcome these challenges [8], [9]. For example, an Android-based mobile application that can provide real-time information, personalized tourist destination recommendations according to user preferences and needs, and easy interaction between users and tourism service providers has become an important tool in transforming aspects of tourism in Indonesia. Therefore, it is necessary to develop an Android-based application designed to combine the potential of digitalization in the tourism sector

with a focus on promoting tourist destinations throughout Indonesia [10], [11].

This research focuses on developing the "ChillGo App", an innovative technology solution based on an Android mobile application. This application is designed to increase the visibility and accessibility of tourist destinations by providing relevant and helpful information for users planning tourist trips. By utilizing ADDIE's methodological approach, which includes Analysis, Design, Development, Implementation, and Evaluation, this application integrates a sophisticated recommendation system that uses Collaborative Filtering (CF) and Content-Based Filtering (CBF) modeling algorithms optimized with Neural Network.

Neural Network optimization in the CF model aims to uncover hidden patterns in user interactions and preferences, which may not be detected with traditional algorithms [12]. Meanwhile, Neural Network optimization in the CBF model is intended to enrich the analysis of tourist destination features, including city, category, price, and location, thereby providing more accurate and personalized recommendations [13].

The data used in this research includes tourist destination data covering 523 locations and 200 MSMEs as initial data in West Java Province and user application and place assessment preference data. This data is collected through searching, crawling, and scrapping methods, as well as interviews, to ensure the accuracy and depth of the information provided to users.

Thus, "ChillGo App" aims to advance the local economy through increasing tourism and offers a framework for developing similar applications in various other regions. This application is expected to be an example of digital technology in tourism, which will improve the visitor experience, strengthen the local economy, and enrich Indonesia's cultural and social heritage by providing accurate, personalized, and innovative recommendations for each user.

II. Materials and Method

A. ADDIE Method Research

The method employed in this research is the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) approach [14], [15]. Fig. 1 illustrates this technique. It provides a clear and structured framework for systematically designing and creating digital applications. By following each stage of the ADDIE process, the study ensures that the digital transformation objectives are achieved efficiently and effectively.

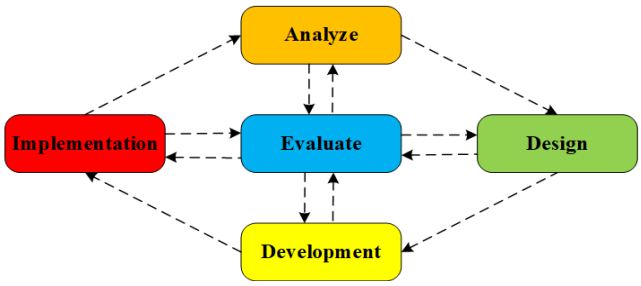

Fig. 1 ADDIE Method Research

Based on Fig. 1, the research begins by identifying and analyzing user needs, challenges faced in the tourism sector, and opportunities that can be exploited through digitalization [16]. The main focus is understanding user needs, including tour guides, and collecting data on tourist destinations spread throughout the West Java region as a dataset in developing a system recommendation algorithm model. The next step is planning the structure and appearance of the application, including the user interface and workflow involving user interaction. The next stage is the application development process starting from the stages of collecting and processing datasets, designing system recommendation algorithm models using collaborative-based filtering and content-based filtering approaches, integrating algorithm models that have been developed into cloud databases, as well as overall integration into Android applications [17]. Next, after the development stage, the implementation of the application that has been designed as a whole is carried out, testing internally and conducting trials on 330 random respondents who have been previously selected to measure how effectively and efficiently the application works in recommending and displaying tourist destinations desired by users. The subsequent evaluation stage focuses on the effectiveness and performance of the "ChilGo App" application after testing it on 330 respondents for predetermined objectives, such as increasing the visibility and accessibility of tourist destinations presented to users. Application evaluation is divided into two aspects: the evaluation aspect of the model algorithm used to recommend places and the overall application performance evaluation aspect.

B. Data Collection Process

1) Tourist Destination Data: The data included in this study was acquired from multiple tourist attractions throughout West Java Province. This data seeks to deliver extensive information on tourism spots and suggest the premier locations in various regions of West Java. Furthermore, aggregating ancillary data regarding MSMEs near tourist attractions enhances diversity. It can serve additional functions, such as employing the MSME detection feature that identifies MSMEs near the user's chosen tourist site. Fig. 2 below illustrates that the data-gathering procedure had multiple steps: data collection, labeling, pre-processing, and integration.

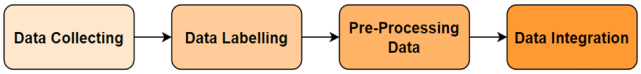

Fig. 2 Preparation Data Procedure

The initial step is to identify data from various sources related to tourist destinations and MSMEs in West Java, with data collection carried out using searching, scrapping, and crawling techniques from multiple websites to get broad and dirty picture data for later data processing [18]. Data, before preprocessing, is given a label for each data found and combined into each type of the same label. The data collected from various labels/attributes is then carried out by pre-processing. In this process, the data obtained is carried out by data cleaning, distribution data, and data reduction from the tourist destination dataset and the MSME dataset. The clean data obtained was 523 tourist destination data spread across various regions of West Java and 200 MSME data, which were then combined to form an integrated data set that was

ready to be used in the initial development of the recommendation system model in the ChillGo app application.

2) Application User Preference Data: In this research, user preference data was obtained by Google Forms and distributed to 330 randomly selected respondents across West Java. The respondents reviewed the performance of the ChillGo App, and the tourist places they visited. Three hundred performance assessments of the app and 10,217 tourist destination ratings were gathered. This data is vital for merging with tourist destination information to construct a recommendation model utilizing a Collaborative Filtering technique, seeking to suggest places based on the highest user ratings [19], [20]. Fig. 3 shows the distribution of user preferences based on their city or district of origin. This provides important insights into how the ChillGo App helps to identify regions with higher user engagement. Understanding this distribution is crucial for improving the app's recommendation algorithms.

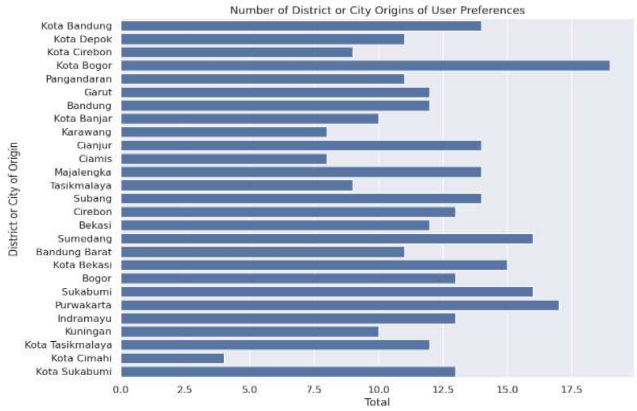

Fig. 3 Comparison District or City Origins of User Preference

Simultaneously, Fig. 4 illustrates the age distribution of individuals who submitted ratings. This demographic data is crucial for customizing the app's recommendations, ensuring that the proposed tourist sites correspond with the preferences of various age groups. This data facilitates the ongoing enhancement of more tailored and precise recommendation algorithms in the ChillGo App.

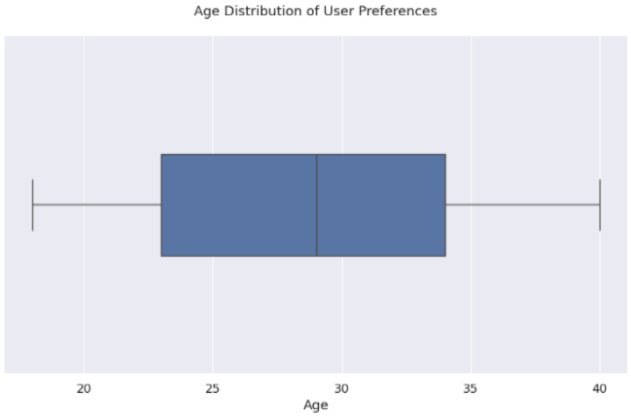

Fig. 4 Age Distribution of User Preference

C. Application System Architecture

The development of the ChillGo App in this research is divided into several stages, including data processing, model development, model deployment, and output integration. These stages ensure the seamless functioning of both the front end and back end of the application [11]. As shown in Fig. 5, the system architecture illustrates how these components work together to create an efficient and cohesive application structure.

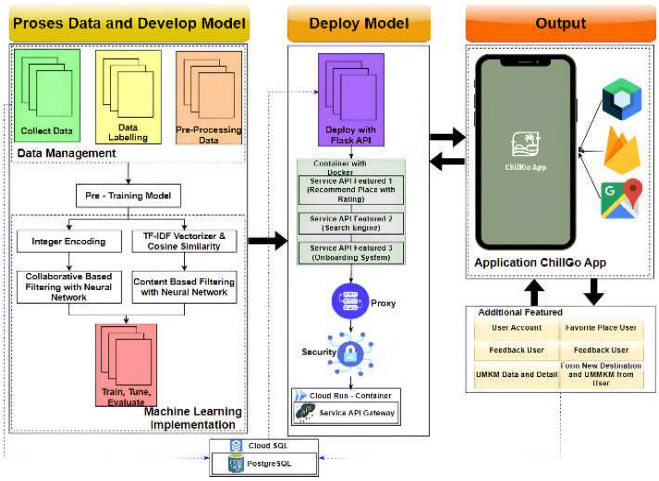

Fig. 5 Architecture System Application

Fig. 5 explains the architecture of the ChillGo App application system, which consists of 3 main stages, data processing and model development stages, model deployment, and system output integrated with the application. At the data processing and model development stage, the system processes a collection of initial data required for developing the application algorithm model. The data includes tourist destinations spread across West Java province, destination assessment preference data from users, and MSME data as supporting features. Additions that can be different from other applications [21]. The built model also uses a collaborative filtering and content-based filtering algorithm approach, which operates with a neural network. The results of this model are three types of models that are used for integration through applications which are used as the main feature of the ChillGo App application [22].

The next stage is the backend process, where the model that has been saved is carried out in a deployment process using the Flask API and a containerization process for several models that have been packaged using a Docker image so that the model that has been designed can be integrated via a mobile platform using Google Cloud Run as an intermediary [23].

Then, the ChillGo app application interface was built using a more modern jetpack composed of Google Maps as the Maps API from Google, which is used to process directions to tourist destinations and MSMEs. Apart from that, Firebase is used as an authentication process for the login and signup system in the ChillGo App application. Data related to the main features generated by the algorithm model and additional features are all stored via Google Cloud SQL and Postgre SQL [24], [25].

D. Flowchart System

In this research, a System Flowchart was created to visualize the work process of the "*ChillGo App*" application. The diagram created depicts the logical flow of user interaction with the application and shows how the various technical components are seamless from the start to the end of operation. This diagram aims to provide a deeper understanding of the internal mechanisms of the application and each stage in the application workflow to achieve the final goal, namely increasing the visibility and accessibility of tourist destinations to realize digital transformation in the tourism sector [26].

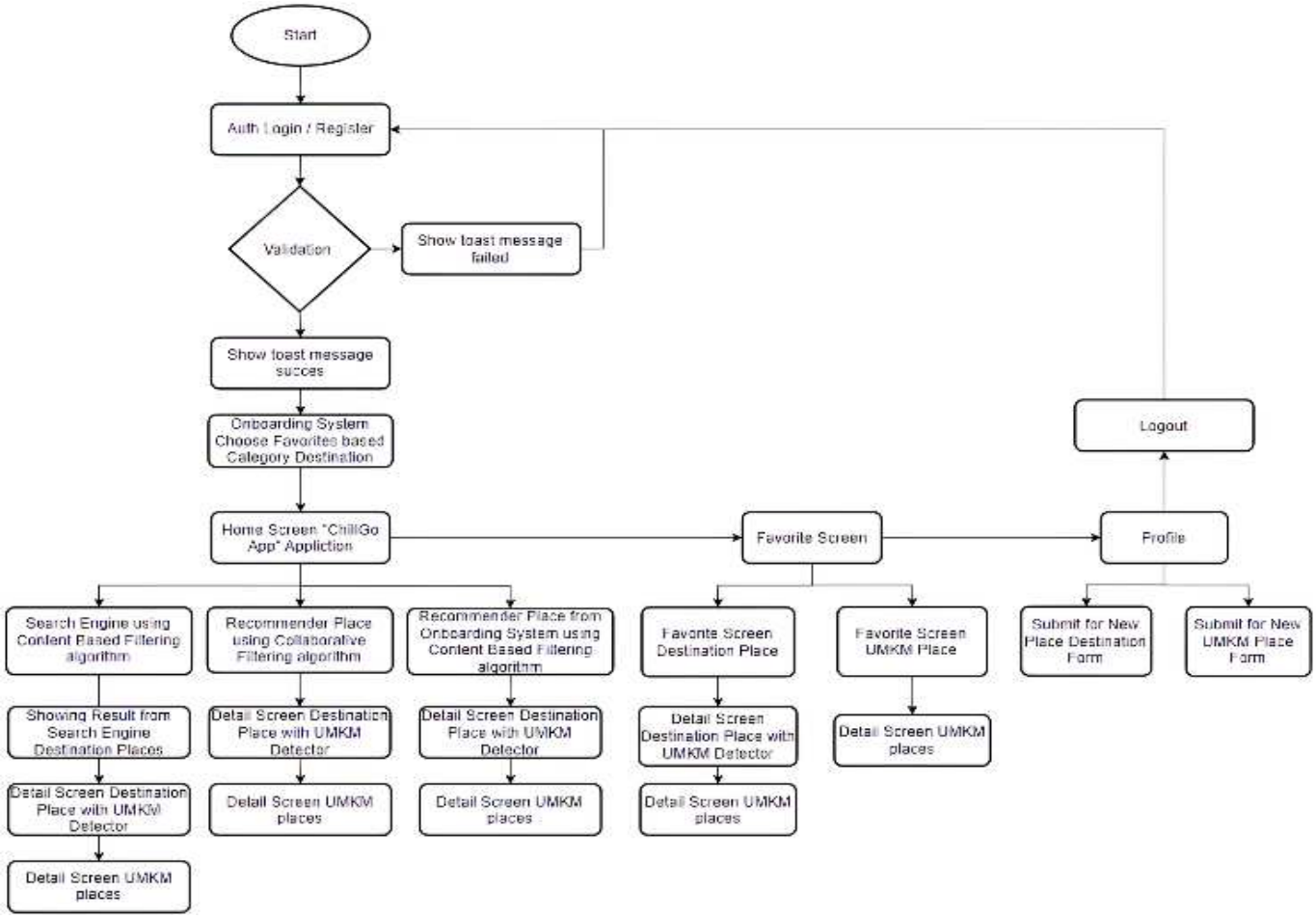

Fig. 6 Flowchart System Application

The system flowchart in Fig. 6 summarizes how the "ChillGo App" application works from start to user logout. In the first step, the user goes through an authentication process; the success or failure of this process is communicated via a 'toast' message. After successfully logging in, the user selects the favorite destination category via the onboarding system. On the main screen, the application provides a page menu for destination searches using a content-based filtering algorithm, recommendations for tourist destinations based on the highest rating of user preferences using a collaborative-based filtering algorithm, and recommendations for tourist destinations based on the favorite categories chosen by the user. Apart from that, there is a favorite page menu that displays MSME destinations and places added by users [27], [28]These features include a detailed display of tourist destinations with MSME detector capabilities around the user's selected destination. Finally, a profile menu allows users to add tourist destinations not yet registered in the "ChillGo App" application along with MSMEs in the vicinity.

E. Research Instrument

In this research, designing and adapting the assessment was based on a literature review with minor adjustments to ensure suitability for the context of this research. Using a five-point Likert scale from strongly disagree to agree strongly, this is to measure various aspects of the ChillGo App user experience [29]. To assess the quality of the information presented by the application, 330 respondents were asked to evaluate the accuracy, ease of understanding, relevance, and level of personalization of the information provided. Aspects of system quality are explored through questions related to ease of use of the application, accessibility, navigability, and speed of response. Furthermore, service quality is measured through application visuals, personalization of the services offered, and ease of use. User satisfaction is measured through three main items: satisfaction with the features presented, the level of pleasure and happiness that users feel regarding their choices using the application, and the extent to which the application meets the user's expectations [30]. This discussion also evaluates users' intentions to continue using the ChillGo

app, recommends the application to others, and integrates the application into their daily activities.

III. Result and Discussion

A. User Interface Application

The design of the ChillGo App focuses on developing an interactive and intuitive interface that gives users tailored recommendations and thorough information on selected tourist spots. The user interface is designed to simplify navigation and enhance overall user experience by providing critical features and information in an accessible manner.

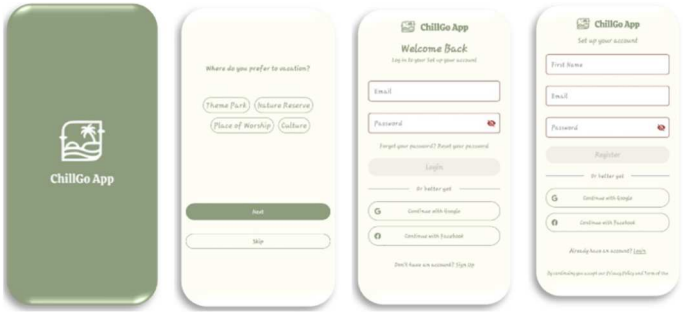

Fig. 7 User Interface Application 1

Fig. 7 displays the ChillGo App's beginning screen, which contains an onboarding mechanism to give the user a first impression of chosen tourist categories. The screen also provides login and sign-up choices before entering the app's primary home screen.

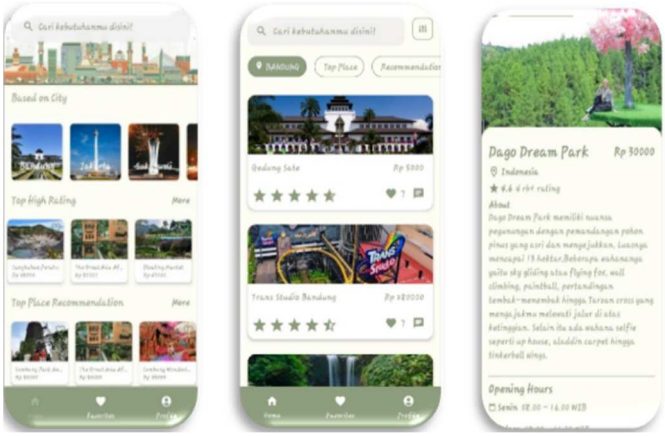

Fig. 8 User Interface Application 2

Fig. 8 depicts the implementation of the recommendation system, which integrates machine learning techniques to provide extensive descriptions and recommendations based on existing user data and preferences. Fig. 9 illustrates other capabilities, such as the MSME detector, which allows users to track local MSMEs inside selected tourist sites. It also provides directions via Google Maps and a menu page for users' favorite tourist attractions.

B. Recommender System Application

In developing models for the recommendation system in the ChillGo App application, there are differences in approaches to pre-training between the two types of models used. In the Collaborative Filtering (CF) model, the approach involves integer encoding. This technique converts categorical data into numerical form by creating a one-to-one relationship between categorical values and integer numbers [31]. On the other hand, the Content-Based Filtering (CBF) model applies TF-IDF Vectorizer and cosine similarity in the Pre-Training stage of the model. This TF-IDF Vectorizer functions to convert text into a numeric vector, providing an assessment of the importance of specific data in a data set based on the frequency of its appearance [32]. Meanwhile, Cosine Similarity evaluates how similar one text is to another. In this context, the built content-based filtering model allows the application to offer suggestions based on content similarity that are similar to the interests or visit history of previous users.

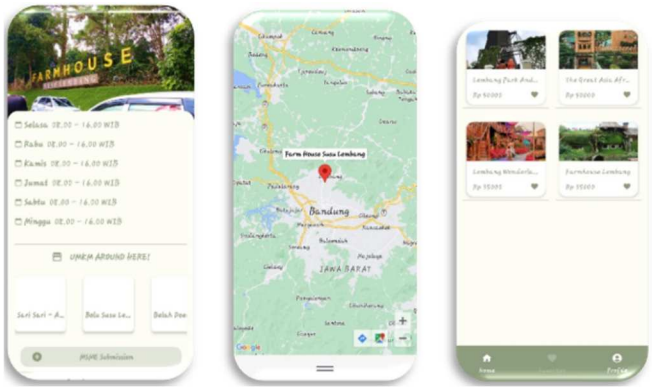

Fig. 9 User Interface Application 3

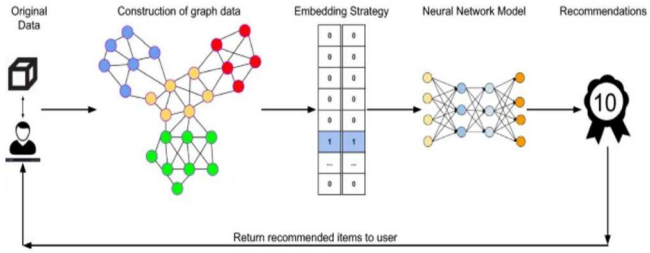

Fig. 10 Recommender System with Neural Network Optimization

After going through the two models' pre-training stage, we set a series of hyper-maters for the Collaborative Filtering and Content-Based Filtering algorithms. The main objective was to optimize the model to produce a minimum level of prediction error before it was integrated with the interface of the ChillGo App application, as shown in Table I.

TABLE I
HYPERPARAMETER COLLABORATIVE FILTERING AND CONTENT-BASED FILTERING

Models	Hyperparameter
Collaborative Filtering (CF)	Epochs = 100; Optimizer = Adam; Embedding Size = 50; Dropout Rate = 0.2; Learning Rate = 10^{-3}; Learning Rate Decay Steps = 10^{5}; Learning Rate Decay Rate = 0.96; Regularization L2 = 10^{-6}.
Content-Based Filtering (CBF)	Epochs = 100; Optimizer = Adam; Dropout Rate = 0.5; Learning Rate = 10^{-3}; Batch Size = 32; Validation Split = 0.1.

In developing the ChillGo App, a performance study of the system recommendation model was undertaken by

monitoring evaluation measures such as MSE, RMSE, Precision, Recall, F1-Score, and NDCG. These metrics are used to measure the success of each model by giving accurate and relevant tourist location recommendations for ChillGo App users. Table II below illustrates the evaluation findings for both the Collaborative Filtering (CF) and Content-Based Filtering (CBF) models, comparing their effectiveness across these key metrics [33], [34].

TABLE II
EVALUATION PERFORMANCE RESULTS THE TWO MODELS

Models	Metrics Evaluasi					
	MSE	RMSE	Precision	Recall	F1-Score	NDCG
Collaborative Filtering	0.13	0.36	0.62	0.97	0.76	0.88
Content-Based Filtering	0.12	0.35	0.40	0.64	0.49	0.91

C. Featured Application

1) Main Features of ChillGo App: ChillGo App comes with four main features that are different from the application of Machine Learning algorithm models. There are recommendations for places based on the highest rating preferences from previous users using a collaborative-based filtering algorithm approach. The next feature is the search engine place as a tourist destination search feature based on place names which will display details of the tourist destination you are looking for and provide ten recommendations for other tourist attractions based on the city/district of origin of the tourist destination search results which is an integration of the content based filtering algorithm model in the algorithm. Recommendation system. In addition, the onboarding feature displays recommended tourist destinations primarily on the application's main screen, which the user selects based on existing tourist categories (Natural Reserves, Culture, Amusement Parks, and Places of Worship). The last main feature is an MSME detector that recommends the location of the nearest MSMEs to the tourist destination the user selects.

2) ChillGo App Supporting Features: Apart from the main features presented, the ChillGo App also provides supporting features to increase security, comfort, and user satisfaction. There is a login/signup feature that plays a key role in maintaining the confidentiality of user data. There is a favorite places feature; with this feature, users can create a list of their favorite tourist destinations, making it easier to get detailed information about the destinations they want to visit. Next is the Give Feedback feature, which allows users to provide feedback through ratings and reviews for the tourist destinations they have visited. Apart from that, a direction feature on Google Maps provides guidance and directions to destinations, whether tourists or MSMEs nearby, thus providing comfort and convenience for users.

D. Analysis Respondent Result

1) Level of User Satisfaction with the Application: The survey analyzed significant components of the ChillGo App, such as simplicity of use, interface design, information accuracy, performance, and data security. Table III demonstrates that users typically find the program straightforward (average rating of 4.09). However, lower ratings for performance stability (3.83) and data security (3.84) show that improvements in these areas could raise overall satisfaction. Enhancing app performance and improving security measures will undoubtedly boost user confidence and happiness.

TABLE III
LEVEL OF USER SATISFACTION WITH THE APPLICATION

#Q	Questionnaire	Scale					Avg
		1	2	3	1	5	
#Q1	Ease of use ChillGo APP application is easy to use	10	20	50	100	150	4.09
#Q2	The interface design of ChillGo App is satisfying and intuitive	5	15	60	120	130	4.08
#Q3	The information provided by the ChillGo App is accurate, reliable and updated	8	22	70	110	120	3.95
#Q4	The ChillGO App application can run smoothly and without interruption	15	25	80	90	120	3.83
#Q5	I feel my personal data is safe when using ChillGo App	12	18	100	80	120	3.84
#Q6	I think ChillGo App can be recommended to others for travel to tourist destinations	7	13	60	130	120	4.04

2) Effectiveness of Recommendation Algorithms and Influence on Tourist Satisfaction: The recommendation system is essential to user pleasure. Table IV indicates that the app generally gives recommendations that meet user preferences (rating 4.18). However, the diversity of recommended destinations obtained a lower score (3.91), indicating that broadening the range of destinations could boost user experience. This feedback can guide modifications in the algorithm, making it more diversified and tailored to user preferences.

TABLE IV
EFFECTIVENESS OF RECOMMENDATION ALGORITHMS AND INFLUENCE ON TOURIST SATISFACTION

#Q	Questionnaire	Scale					Avg
		1	2	3	1	5	
#Q1	ChillGo App recommends tourist destinations according to user preferences and interests	5	15	45	100	162	4.18
#Q2	ChillGo App offers a wide selection of interesting tourist destinations	10	20	75	110	115	3.91
#Q3	Overall satisfied with the quality of the tourist destination recommendations provided by the ChillGo App	8	27	85	100	110	3.84

#Q	Questionnaire	Scale					Avg
		1	2	3	1	5	
#Q4	Using the ChillGo App enriches the travel experience by providing useful information and recommendations	6	18	86	95	125	3.95
#Q5	I will use the ChillGo App to plan future trips	14	26	79	105	111	3.87

3) Usability Testing: The usability testing results in Table V reveal that users generally found the software intuitive, but there were some issues [35]. The grade for "quickly learning to use the app" was 3.67, indicating that the onboarding process might be shortened to make it easier for new users. Additionally, the feedback system obtained a rating of 3.70, suggesting that enhancing how the app communicates problems or advice to users could boost the entire experience. Focusing on two areas, simplifying the onboarding process and boosting user feedback, would likely lead to a smoother and more rewarding user experience.

TABLE V
USABILITY TESTING RESULT

#Q	Questionnaire	Scale					Avg
		1	2	3	1	5	
#Q1	This application increases my efficiency in searching for tourist destinations	10	30	80	120	90	3.76
#Q2	The recommendation feature of this application makes it easier for me to find and search for new tourist destinations	15	25	75	115	100	3.79
#Q3	The navigation in this application is intuitive and easy to understand	12	28	90	110	90	3.72
#Q4	I can use this application without any technical difficulties	8	22	100	120	80	3.73
#Q5	I quickly learned how to use the ChillGo App	20	40	70	100	100	3.67
#Q6	This application provides feedback that helps users learn from their mistakes	15	35	85	95	100	3.70
#Q7	This application meets my expectations as a user	18	32	78	102	100	3.71
#Q8	I would recommend this ChillGo App to others	10	20	60	130	110	3.94

E. Potential for Future Development

The present iteration of the ChillGo App has proven efficient in delivering precise and pertinent recommendations while assisting local MSMEs; nevertheless, chances exist for further enhancement. A weakness noted in this study is the absence of integrated suggestions among tourist destinations. In practical situations, visitors frequently request recommendations for subsequent places based on proximity, thematic relevance, or previous travel experiences, facilitating a more coherent and efficient travel experience.

To mitigate this restriction, subsequent iterations of the ChillGo App may incorporate a dynamic itinerary recommendation tool. This feature may employ route optimization algorithms or multi-criteria decision-making techniques to recommend the optimal location based on geographic distance, user preferences, and travel history. Moreover, geolocation data analytics and real-time user behavior monitoring could significantly improve the app's capacity to deliver contextually pertinent recommendations.

Applying these characteristics would not only enrich the travel experience by leading tourists from one site to another but also increase the flow of visitors to adjacent attractions, thereby increasing local tourism. Future studies could explore machine learning approaches, such as reinforcement learning or clustering algorithms, to strengthen the app's capability to link related attractions. Moreover, partnerships with local tourism boards and MSMEs could provide new data sources to enhance further and customize the recommendations. By overcoming this constraint, the ChillGo App might turn from a location recommendation tool into a comprehensive vacation planning helper, giving consumers a smooth and connected tourism experience.

IV. CONCLUSION

This research successfully developed the "*ChillGo App*," an Android-based application aiming to revolutionize travel experiences through digitization by providing a personalized recommendation system and combining MSME detection technologies. By integrating machine learning technology, this application addresses fundamental obstacles in the tourism business, such as fragmented information and navigation difficulties. The app's intuitive and interactive interface promotes access to vital information, considerably increasing the user experience. Adopting collaborative filtering and content-based filtering algorithms enhanced with neural networks has proven effective in providing accurate and contextually relevant recommendations, as evidenced by the evaluation metrics.

The ChillGo App's main and auxiliary elements, including onboarding, place search, and MSME detector, help enhance the visibility of tourism destinations and economic support for local MSMEs. Positive findings from user satisfaction surveys and usability testing reveal a high degree of acceptance, highlighting the simplicity of use, interface design, information correctness, and overall feature set. Despite its successes, one disadvantage of this study is the lack of related recommendations across tourist attractions. Addressing this constraint in future editions of the ChillGo App could significantly enrich the travel experience by proposing related venues based on proximity, preferences, and thematic relevance. This upgrade could transform the app into a comprehensive travel planning tool, improving local tourism by increasing tourist flow between linked attractions. Overall, this study not only gives practical solutions to existing difficulties but also establishes a foundation for designing comparable applications in the future. The findings underline the necessity of continuing investment in technology and innovation to progress the tourism sector and foster economic growth sustainably.

ACKNOWLEDGMENT

We thank all involved in this research for meeting our expectations. Special thanks to the publisher for accepting this paper and making it a reference for other researchers.

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