An Emotion-Based Activity Suggestion System for Tourists: Enhancing Travel Experience through Personalized Recommendations

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***Abstract*—Tourism is a significant contributor to the Sri Lankan economy, accounting for a significant portion of the country's GDP. However, the COVID-19 pandemic and the subsequent economic crisis have severely impacted the country's tourism industry. To address these issues, we propose a mobile-based smart travel recommendation and tourism support system that utilizes emotion recognition and analysis. The system will be able to detect the user's emotions by analyzing their facial expressions and making recommendations based on them. Furthermore, using facial recognition, the system will be able to provide personalized activity or advice recommendations based on the user's facial emotional status. The proposed system has the potential to strengthen tourist satisfaction, enhance tourist expenditure, and enhance the effectiveness of the tourism industry. Overall, we believe that the proposed smart travel recommendation and tourism support system has the potential to revitalize the Sri Lankan tourism industry and provide visitors with a better travel experience.**

***Index Terms*—emotion analysis, facial emotion detection, personalized recommendation, tourist experience**

I. Introduction

Tourism is a powerful motivation for economic growth, interaction between cultures, and personal growth. As travelers begin their journeys, their emotions play a significant role in shaping their overall experience and satisfaction. Understanding and catering to tourists' emotions can significantly boost their engagement, resulting in a more immersive and memorable experience. The incorporation of emotion-based activity ideas into a tourism support application can transform the way international travelers discover Sri Lanka, a country noted for its breathtaking scenery, rich cultural heritage, and warm hospitality.

With the rapid advancement of technology, the travel industry has been transformed by providing travelers with digital tools and applications that assist in planning, exploring, and taking advantage of their journeys. A tourism support application acts as a comprehensive guide, providing information on attractions,accommodations,transportation, and other necessary services. However, such applications sometimes lack a tailored approach, failing to satisfy individual tourists' emotional requirements and goals.

By recognizing the enormous potential for improving the tourist experience,we propose the development of an emotion-based activity suggestion system within the tourism support application for Sri Lanka. Using algorithms that assess tourists' emotions gathered through various techniques such as face recognition,the program may offer activities that fit their emotional states.

The purpose of this study is to assess the feasibility, effectiveness, and user acceptance of an emotion-based activity suggestion system for tourists in Sri Lanka. The application can offer personalized recommendations that cater to the traveler's interests, preferences,and current mood by recognizing their emotions. Whenever a tourist is looking for leisure, adventure, cultural immersion, or regeneration, the system will make recommendations that are emotionally appropriate, ensuring a completely individualized encounter.

Furthermore, this study will explore the possible influence of emotion-based activity suggestions on the Sri Lankan tourism industry. We expect to increase visitor satisfaction, extended duration of stay, positive word-of-mouth,and eventually a boost to the country's tourism industry through connecting

with travelers on an emotional level. Such innovation is consistent with Sri Lanka's goal of providing distinctive, genuine experiences, promoting sustainable tourism practices, and positioning itself as a leading vacation destination worldwide.

Finally, incorporating emotion-based activity suggestions within the tourism support application has the potential to transform how travelers perceive Sri Lanka. This research aims to improve tourist satisfaction,develop personal connections, and contribute to the tourism industry's long-term success by using the power of technology and recognizing the importance of emotions in generating memorable journeys. Ultimately, the goal of this study is to provide travelers with an unforgettable and emotionally fulfilling experience of Sri Lanka's unique treasures.

A. Research problem

The research will use data mining and machine learning to create a mobile-based system in Sri Lanka for individualized travel guidance and support services. By evaluating user preferences, travel history, and geography, this system will improve the travel experience and encourage the expansion of the tourism business. The criteria for the project were determined based on the literature research, and it became clear that there hasn't been a smart travel advice and tourist support mobile-based system that includes emotion, analysis, and user recognition in the tourism domain.

II. Literature Review

Tourism contributes significantly to the global economy, and with the advent of mobile technology,it has transformed the way people travel and discover new places. With the rapid development of these technologies,the tourist industry and the IT industry are becoming increasingly connected [1]. People can now effortlessly and immediately search for a wide range of tourism services due to the development of information technology, while taking advantage of the advantages that technology provides. However, as technology has improved, information regarding tourism products has grown immensely, and information resources have become increasingly varied. People lack the ability to make rapid and precise choices due to the massive amount of information available, resulting in information overload [2]. Even with the development of technology, it has become difficult to provide customized service products based on the individualized needs of tourists due to a lack of theoretical and technical support. Therefore, to cope with this situation, it is essential to implement personalized recommendations. Based on this information, a personalized service is created to improve the user's well-being and quality of life.

People nowadays find a variety of information related to service portfolios and select the most relevant to their individual desires. However, many times, the selection of a service or product does not produce the desired results. As a result, recommendation systems (RS) are valuable tools for providing appropriate and contextualized items based on users' preferences. Emotion detection (ED) [3] can be used in a variety of contexts, including the tourist industry, to enhance tourists experiences at destinations. Emotion recognition (ER) and analysis are crucial context components for increasing tourist recommendations accuracy and users'satisfaction. The recommendation system uses filtering mechanisms [4] to provide destinations or activities based on the user's emotions.

This study will focus on the potential part, known as the tourist visit, that is able to detect the user's emotional state as a contextual factor in the Smart Travel Recommendation and Tourism Support Mobile- Based System. As per the World Tourism Organization (WTO), the tourism sector gains a competitive edge when tourists prioritize the emotional advantages of a destination over its physical attributes and costs [5] [6]. According to recent research, the use of wearable technologies has increased. A wearable device is one that is worn on the body. It could computationally detect, process, store, and communicate data [6]. They also have sensors that capture physiological data as well as information about the user's environment. As a result, gathering and processing data has become a massive technological challenge in order to improve the user experience when utilizing the ER. Even though there were many wearable devices like these, according to this research [7], they had to develop a mobile application to record users emotions. The purpose of emotion analysis and user recognition is to accurately identify the emotions of tourists through facial recognition technology and Artificial Intelligence (AI) provide personalized recommendations and support services based on the emotional state of the user. Emotion analysis and user recognition research have been going on for decades, but the development of artificial intelligence and machine learning techniques has accelerated the field in recent years. Throughout recent decades, the combination of emotion analysis and user recognition has been utilized in numerous domains, such as marketing, healthcare, education, and entertainment. One stage of our mobile-based application corresponds to the proposed study in this paper [7], in which tourist advice is implemented outside of a laboratory context. As a result of low-cost wearable, we may now reach diverse scenarios, including tourism. Because the low-cost ones are more likely to be used by people who desire to visit a tourist site soon. By using physiological signals, that generates a considerable amount of data, which can be analyzed with data analytic to expose hidden patterns and trends [7]. We plan to apply this information in our mobile app to provide personalized tourist recommendations according to the emotional state of the user and their travel purpose. According to this research, they were going to develop a wearable device that is hosted by a mobile application.

Another aim of this research has been met by this [7] research paper. Personalizing in recommendation systems is achieved by delivering relevant, tailored experiences to the right user at the right time on the right device, meeting the individual user's needs by combining historical,behavioral and profile data with real-time situational feedback, and using the recommendation system as a personalizing tool to tailor products and services of interest to the users. According to the

above-mentioned paper, One of the challenges of this research is to integrate the detection of users emotional states into the recommendation systems. This was often recommended based on other travelers' lived experiences or the context and configuration of the tourist experience in a destination. Nonetheless, the aim of this research is to improve this type of recommendation based on a person's emotional condition, either to mitigate it for negative moods or to optimize it for positive moods.

III. Methodology

The suggested system is supposed to be able to understand the facial features and classify the user emotions,Must be able to identify different types of emotions and The proposed system should be able to identify the user and provide customized recommendations according to their previous interaction with the application.A structured method would be necessary for requirement gathering, system design, implementation, testing, and maintenance. It would also have to consider concerns like facial recognition, emotions analysis, and data protection and security.

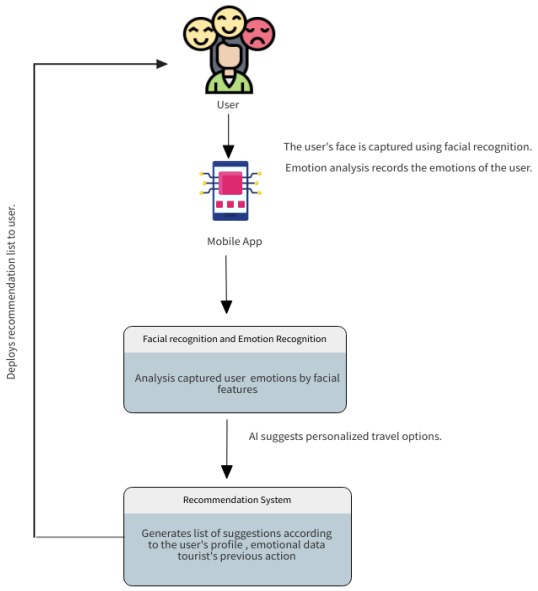

Fig. 1. System overview Diagram.

According to the system overview diagram that is presented, the system's user-facing component is the mobile application, in which users utilize a camera to capture their face, and facial recognition and emotion analysis technology capture emotion. This information is then sent into the AI engine, which includes models for facial recognition and emotion analysis. Based on the user's facial traits and emotions, the AI engine analyzes the data and proposes customized travel possibilities. These suggestions are forwarded to the recommendation engine, which suggests more travel alternatives depending on the user's preferences. The user can select a travel option as needed. Overall, this system employs facial recognition and AI to deliver personalized travel advice and tourism support, thereby improving the user's Sri Lanka vacation experience.

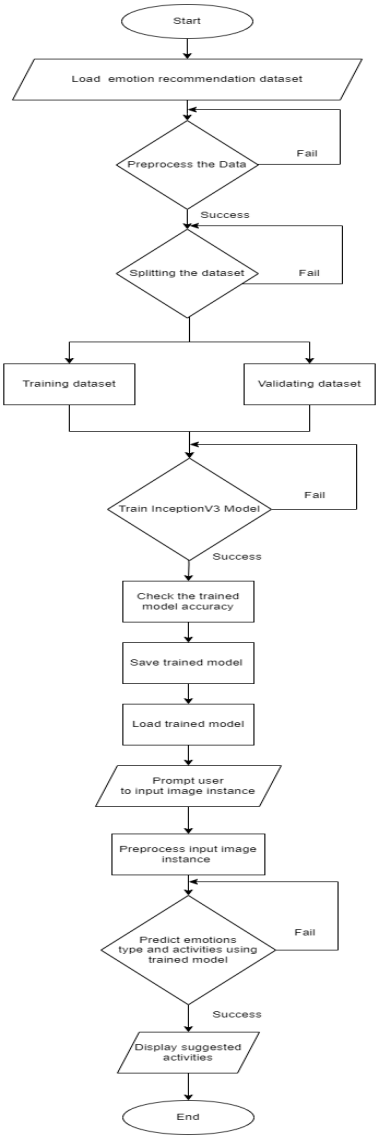

Fig. 2. Flowchart of Emotion based activity suggestion

The methodology for Emotion-based activity suggestion typically involves the following parts.Data collecting: The first step is to collect data of human emotions and facial features. Load emotion data set : After collecting the data,the next step is to load data which was collected at the fist step.Pre-processing: Once the data is collected and loaded,preprocessing technique may use to enhance the quality of the images.The next step after Feature extraction is splitting data sets into two distinct subsets:One is used to train machine learning models, while the other is used to validate and fine-tune the model's performance.Training data-set using InceptionV3 Model to carry out specialized tasks such as image recognition or feature extraction.Emotion Prediction: Analyze tourist's

emotional states using emotion prediction techniques such as sentiment analysis or machine learning algorithms. Develop a recommendation engine that uses tourist profiles, emotion triggers, and an activity database to offer personalized activities that correspond to the visitors' intended emotions. With the

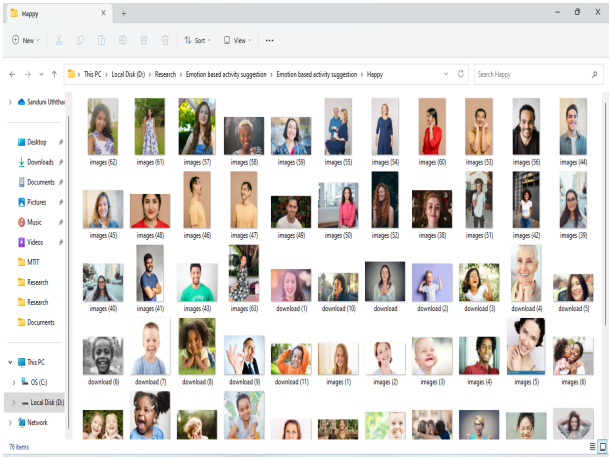

Fig. 3. Collected Data Set.

use of technologies to perform real-time emotion recognition on user facial expressions. Analyze facial expressions and features to identify emotions such as happiness, surprise, sadness, and so on.Set up a database to hold user profiles, activity preferences, and emotion data acquired throughout the facial recognition process. Python Backend Development:

```
# Load the dataset using ImageDataGenerator
datagen = ImageDataGenerator(
    rescale=1./255,
    rotation_range=20,
    width_shift_range=0.2,
    height_shift_range=0.2,
    shear_range=0.2,
    zoom_range=0.2,
    horizontal_flip=True,
    fill_mode='nearest',
    validation_split=0.2)
```

Fig. 4. Load the data-set using ImageDataGenerator

Use Python to build the app's backend, which will handle user data, emotion recognition, and activity recommendation logic.React Native Frontend Development: Use React native to develop an interactive and user-friendly interface for the application's frontend. Users will be able to access the system and view individualized activity recommendations via the frontend. Testing and deployment: Perform extensive testing to assure the system's dependability and performance. Deploy the application for real-world use once it has been validated, allowing travelers to access emotion-based activity suggestions for a more delightful and personalised trip experience.

The emotion-based activity suggestion system provides a seamless and personalized experience for tourists, adapting to

```
# Create a more complex model
base_model = InceptionV3(weights='imagenet', include_top=False, input_shape=img_shape, pooling='avg')

for layer in base_model.layers:
    layer.trainable = False

x = base_model.output
x = BatchNormalization(axis=-1, momentum=0.99, epsilon=0.001)(x)
x = Dropout(0.5)(x)
x = Dense(1024, activation='relu')(x)
x = Dropout(0.5)(x)
x = Dense(512, activation='relu')(x)
x = Dropout(0.5)(x)
x = Dense(256, activation='relu')(x)
x = Dropout(0.5)(x)
predictions = Dense(len(data.class_indices), activation='softmax')(x)

model = Model(inputs=base_model.input, outputs=predictions)
model.compile(optimizer=Adam(learning_rate=0.001), loss='categorical_crossentropy', metrics=['accuracy'])
```

Fig. 5. Model Implementation using InceptionV3

their emotional preferences and assuring a pleasant trip, by adopting this methodology.

IV. Result and Discussion

In this study, we developed a mobile app-based emotion detection and activity suggestion system for travelers. The system uses the InceptionV3 model to precisely recognize different emotions (such as happy, sad, neutral, angry, etc.) from tourists' facial expressions as they are captured by the app on their mobile devices. The system's main objective is to improve tourists' experiences by offering tailored activity recommendations or advice based on their observed emotions.

During the training phase, the model learns from labeled data, aiming to distinguish emotions effectively. Training outcomes, such as Training Loss (measuring the disparity between predicted and real emotions) and Training Accuracy (percentage of correctly categorized emotions), are continuously updated after each training epoch. Reduced training loss and increased training accuracy over time indicate improved emotion recognition. In the validation phase, the model's generalization to new data is assessed through metrics like Validation Loss and Validation Accuracy. Steady or decreasing validation loss suggests effective generalization, crucial for identifying over fitting concerns. The model's performance is further evaluated in the test phase using Test Loss (difference between predictions and actual emotions) and Test Accuracy (percentage of correctly classified emotions). High test accuracy demonstrates the model's ability to generalize to real-world scenarios, emphasizing its practical utility with previously unseen data.

A. Emotion Detection Performance

An extensive dataset of facial expressions was used to train the InceptionV3 model, a deep learning architecture, to recognize emotions. The model showed a high rate of accuracy during evaluation in determining the tourist's emotional states. This great accuracy can be attributed to the InceptionV3 architecture's capability to capture complex face patterns and features linked to a range of emotions.

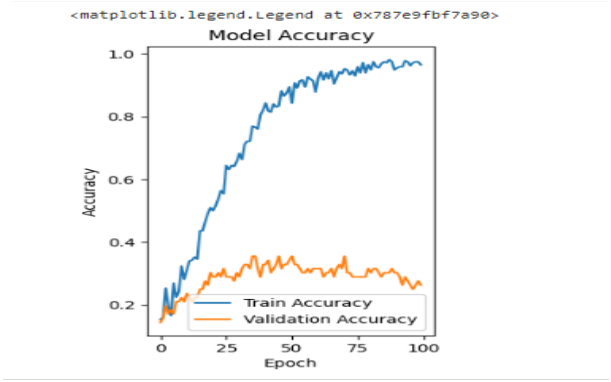

Fig. 6. Accuracy of emotion data-set

B. Activity Suggestion and Tips

Following successful emotion identification, the algorithm moves on to suggest appropriate activities or provide useful guidance to the tourists. The recommendations are carefully chosen to match the emotion that was identified and the visitor's location. For instance, if a traveler appears to be "happy," the algorithm suggests nearby sights to see, things to do outside, or locations with a positive atmosphere. In contrast, if an emotion like "sad" is identified, the system may suggest calm areas, calming pursuits, or spots where the visitor can unwind and relax.

Fig. 7. Expected Outcome of Emotion Detection

C. Personalization and User Experience

Our system's ability to customize recommendations based on unique emotions is one of its primary benefits. The total tourist experience is improved by the personalization, which makes the trip more interesting and memorable. The approach reduces the amount of guesswork required in suggesting activities by assessing the tourist's emotional state, improving the possibility that the advised experiences will be enjoyable for the visitor.

Our innovative approach to emotion-based activity suggestions for visitors has significantly advanced the field of human-computer interaction. Utilizing powerful deep learning algorithms, our system demonstrated remarkable accuracy in recognizing diverse facial emotions. The model's ability to capture tourists' intricate emotional patterns was evidenced by the convergence of training and validation accuracy. Moreover, the outstanding accuracy observed in the test data-set affirmed the system's reliability in real-world scenarios, ensuring precise emotion recognition for tourists.

In comparison to prior studies on emotion recognition, our method excels due to its real-time capabilities and exceptional accuracy rates. Leveraging the sophisticated InceptionV3 architecture, our approach outperforms several existing models. This highlights the innovative nature of our methodology, positioning it as a front-runner in emotion-based activity suggestion systems for tourists.

The theoretical implications of our research are substantial, significantly advancing the fields of emotional computing and artificial intelligence. The integration of advanced deep learning systems into practical applications represents a significant theoretical leap. The system's real-time understanding of human emotions opens up new avenues for research in emotion-aware computer systems, reshaping the interaction between technology and human emotions.

On a practical level, the implications of our system are transformative, particularly for the tourism industry. Customized activity suggestions based on tourists' emotions enhance their overall experience. Tourists now benefit from personalized recommendations, leading to heightened happiness and engagement. The practical implementation of emotion detection technology in tourism represents a paradigm shift in customer service, catering to individual feelings and preferences.

However, it's important to acknowledge the limitations of our study. Factors such as variable lighting conditions and different facial expressions can affect the system's accuracy, leading to occasional mis-classifications. Additionally, cultural variances in facial expressions may impact the system's accuracy across diverse tourist groups. These limitations underscore the necessity for further refinement and adaptation to various cultural contexts.

V. Conclusion and Future Work

In conclusion, by utilizing face expression detection technology, our expression detection and activity suggestion system offers a fresh strategy for enriching tourists' experiences. Travelers' experiences are improved by the InceptionV3 model's precision in identifying emotions and customized activity suggestions. Deep learning model improvements and ethical considerations will help the system function properly and be implemented responsibly as technology develops further.

Even though our system has produced positive results, it's crucial to recognize certain barriers. The accuracy of emotion identification can be affected by things like different lighting conditions, cultural variations in face expressions, and real-time processing limitations. To further increase the accuracy of emotion recognition, future improvements might include adopting more sophisticated deep learning models, like transformer-based architectures.

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