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Trip Backer: A Fuzzy Logic Based Approach to E-tourist Attractiveness Assessment

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***Abstract*: An approach for calculating the e-tourist attractiveness of a country as a tourist destination is proposed using a fuzzy inference system. The approach uses publicly available data about the country collected from travel and tourist websites through an automated system for website scraping and data parsing. The inputs are then fuzzified and aggregated into complex indicators of transport, tourism, and entertainment infrastructure using the union of fuzzy sets. Mamdani fuzzy inference is then carried out using a rule base developed by experts in the travel and tourism domain. The rule base is also simplified and reduced to check for adequacy, and the levels of e-tourist attractiveness for a number of countries are determined as quantitative indicators of competitiveness in the global E-tourism and travel market.**

***Keywords*: fuzzy inference, fuzzy set, E-tourism.**

1. Introduction

The Indian tourism industry has grown significantly in recent years, driven by factors such as increased accessibility, improved infrastructure and facilities, and a growing middle class with more disposable income. The government has also been actively promoting tourism as a way to boost economic growth and create jobs. The industry has been a major contributor to the country's economy, generating foreign exchange earnings and supporting the development of other sectors such as hospitality and transportation. The Indian tourism industry is also diverse, with a wide range of offerings, including cultural, historical, and natural attractions, as well as adventure and eco-tourism.

However, the Indian tourism industry also faces some challenges, including a lack of standardization and quality control in some areas, inadequate infrastructure and facilities in some destinations, and a need for better marketing and promotion. Overall, the Indian tourism industry has great potential for growth and can play a key role in the country's economic development. The government and the private sector are working together to address these challenges and take advantage of the opportunities to promote the Indian tourism industry.

Therefore, it is important to have a way to measure and compare a country's e-tourism attractiveness in order to identify areas for improvement and to promote the country as a destination.

2. Problem Statement

The proposed approach in this article is to develop a decision support system that uses a multidimensional set of quantitative indicators located in the public domain on the web to evaluate the e-tourist attractiveness of a number of countries. The system uses the theory of fuzzy sets and fuzzy inference systems to process the data and provide a quantitative measure of a country's e-tourist attractiveness.

The concept of e-tourist attractiveness is introduced as the opinion of a tourist, formed on the basis of data obtained from various sources posted on the web. This assessment will serve as a quantitative measure to evaluate the degree of availability of information about a country on the web from the point of view of a tourist and a traveler, and therefore, the degree of competitiveness of a country in the world tourism and travel market in the context of globalization.

Recommendation systems are software agents that aim to solve the problem of information overload and enable real- time decision-making. They have been used effectively in the tourism industry to assist travelers in making decisions about destinations and travel options. Research has shown that the accuracy of these systems relies on the richness of available data. The quality of the data plays a crucial role in providing accurate recommendations to users. Sparsity, which is a common issue in these systems, has a significant impact on the accuracy of recommendations in various domains such as healthcare, tourism and e-commerce.

In the tourism sector, recommender systems have been widely exploited resulting in apps that offer personalized guides to tourists. Suggestions in tourism recommendation tools can be produced via filtering information, services, products, contextual data, such as time, location, budget, weather conditions and an enormous dataset of options, locations, cultural heritages points of interest, hotels, attraction, so as to cover users' interest, preferences and needs. All the above-mentioned difficulties are considered under study to find a better solution.

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Table 1
Literature Survey

Journal	Prototype name	Goal	Methods employed
https://ieeexplore.ieee.org/abstract/document/8333162	iTour	A Java-based IoT framework that aims to involve citizens in the tourism development process	
https://link.springer.com/chapter/10.1007/97 8-3-319-75175-7_36	MuseFy	A mobile application which adapts its' UI and provides personalized assistance to users	
https://ieeexplore.ieee.org/abstract/document/8372027	CURUMIM	A tourism recommender system that uses data availableon the Facebook social network, in order to offer personalized recommendationto its' users and positively surprise them	Content Based (CB) and Collaborative Filtering (CF)techniques to discard from thewhole set of possible places to recommend
https://ieeexplore.ieee.org/abstract/document/7406686	TreSight	A context - aware recommendation system named that integrates IoT andbig data analytics for SmartTourism and sustainable cultural heritage in the city of Trento, Italy	
https://www.scopus.com/record/display.uri?eid=2-s2.0-85047728383&origin=inward&txGid=bf7253 0b90d4df3cf08b03cc9 76cd2ca	Find Tourist Profile	Detects users' preferencesimplicitly, based on the geo-location of social media photos	Deep Learning and FuzzyLogic techniques
https://app.dimensions.ai/details/publication/pub.1092982117	HotCity	A social contextcrowd-sourcing platform that exploits users' social geo-tagged data such as likes and check ins as well as their location in order to highlight popular "spaces" and locals' preferences	
https://www.scopus.com/record/display.uri?eid=2-s2.0-85050682028&origin=inward&txGid=c7071 24f4a2f8a83affb4068f bdbcee1	Novel Pre-Tourist Experience module	used in the Find Trip Platformso as to implicitly gain tourists' preferences via socialmedia photos and recommend attractions	For tourist classification: Convolutional Neural Network and Fuzzy logic/ForTourism recommendation: collaborative filtering approach
https://arxiv.org/abs/1807.05759	ToARist	A tourism AR application that is based on User-Centered design	combination of task analysis,expert guidelines and user- centered evaluation

3. Fuzzy Logic

A. Fuzzy Logic

Fuzzy logic is based on the theory of fuzzy sets, which isa generalization of the classical set theory. Saying that the theory of fuzzy sets is a generalization of the classical set theory means that the latter is a special case of fuzzy sets theory. To make a metaphor in set theory speaking, the classical set theory is a subset of the theory of fuzzy sets, as shown in figure 1.

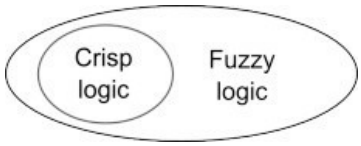

Fig. 1.

Definition: Let X be a set. A fuzzy subset A of X is characterized by a membership function. f a: X → [0, 1]. (In theory, it is possible that the output is greater than 1, but in practice it is almost never used.) Note: This membership function is equivalent to the identity function of a classical set.

Fuzzifier:

The membership function can be constructed by several methods: inference, neural networks, ranks ordering, genetic algorithms, inductive reasoning, intuition. Modeling using fuzzy logic does not require accurate justification of the type of membership function and the type of functions does not have much influence for use in fuzzy systems; the essential properties of the curves are the approximate location, the number of terms (partitions) and overlap. Therefore, in this study, we plan to choose membership functions based on expert opinions that are based on contextual and semantic knowledge about the subject. We will define membership functions in the classes of piecewise linear triangular, trapezoidal, s- and z-functions

Fuzzy Rule Base:

The fuzzy inference system is based on a fuzzy rule base, i.e., the set of if-then rules that define the relationships between the inputs and outputs of the system, where generally antecedent and consequent are fuzzy sets. These rules represent the empirical knowledge about the domain from the domain experts.

Fuzzy Inference Engine:

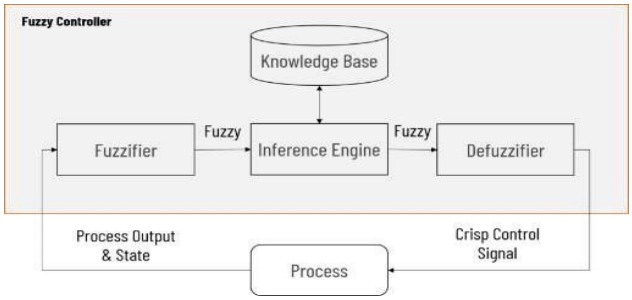

Fig. 2. Fuzzy Inference System

Crisp input about tourism (category of destination, location of hotels, user reviews, price of stay) is given to the fuzzifier, which applies fuzzy membership function and maps the actual readings into fuzzy value (i.e., the value between 0 to 1).

Inference engine applies fuzzy rules from knowledge base

and produce the fuzzy output, which is again between 0 and 1. This output cannot be used directly into any process or system. It needs to be mapped into original domain. Defuzzifier is the inverse process of fuzzification, it converts the fuzzy output into crisp output, which can be fed to the process. Crisp sets are internally converted to fuzzy sets.

Recommendation System:

Recommendation systems are designed to help users navigate through the vast amount of information available to them. These systems use various techniques to suggest relevant items to users, such as collaborative filtering, content-based filtering, knowledge-based filtering, and hybrid methods. These methods can help overcome some of the challenges associated with decision-making in the era of big data, such as dealing with large amounts of data, lack of knowledge about alternatives, and timing.

In the tourism sector, recommender systems have been widely used to provide personalized guides to tourists. These systems use various techniques to filter information and suggest relevant services and products based on the tourist's context, such as time, location, budget, and weather conditions. They also use an enormous dataset of options, locations, cultural heritage points of interest, hotels, attractions, etc. to cover the users' interest, preferences, and needs. However, due to the diversity in tourists' profiles and the variety of services available, the recommendation process can be quite challenging, leading to a significant amount of research on developing viable solutions.

Defuzzifier:

Defuzzification is the conversion of a fuzzy quantity to a precise value. In this method, the resultant membership functions are developed by considering the union of the output of each rule, which means that the overlapping area of fuzzy output set is counted as one, providing more result.

4. Dataset Used

We used the following dataset of Jaipur, Rajasthan present in Kaggle: https://www.kaggle.com/datasets/ishikajohari/jaipur-attractions-and-hotels

5. Conclusion

The proposed approach for assessing e-tourist attractiveness of countries as tourist destinations uses data obtained from popular travel and tourism websites such as Skyscanner.net, Booking.com, Airbnb.com, and Tripadvisor.com, as well as data obtained from the Google search engine through requests related to transport, tourism, and entertainment infrastructures. This data is collected using an automated web scraping software. The approach uses indicators such as the availability of information, the number of positive reviews and ratings, the prices of accommodation and travel, and the overall popularity of the destination. These indicators are then processed using the theory of fuzzy sets and fuzzy inference systems, and a hierarchical system is built to aggregate and fuzzify the inputs. The rule base is developed by experts in travel and tourism, and simplified and reduced for more effective data processing. The e-tourist attractiveness of a number of countries is determined by analyzing the results and these values can be used as quantitative indicators of competitiveness in the global e- travel and tourism market. Our model has attained an accuracy of approximately 80.5% in suggesting relevant tourist spots to users.

This approach uses a hierarchical system to aggregate and fuzzify the inputs. The inputs are fuzzified and aggregated into complex indicators of transport, tourism, and entertainment infrastructure using the union of fuzzy sets at the upper level. Mamdani fuzzy inference is carried out using the rule base developed by experts in travel and tourism domain at the lower level. The fuzzy rule base was also formed by experts and was further simplified and reduced to improve the effectiveness of data processing. To ensure the adequacy of the simplification, the values of the output parameters were calculated from both the simplified and initial rule bases, and the results were compared. This allows for a thorough analysis of the results and determination of the e-tourist attractiveness of a number of countries as tourist destinations.

A software was developed using HTML, CSS and Django has been developed using the above discussed approach. The e-tourist attractiveness values can be used as a benchmark for assessing a country's competitiveness in the e-travel and tourism market. Additionally, the proposed approach provides a decision support system that can be used by governments, tourism boards, and travel companies to improve the competitiveness of their respective countries in the global market. The system can also be used by travelers and tourists to make more informed decisions about choosing a destination based on the availability of information on the web.

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