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1. Introduction

Recommender Systems (RSs) are the software that learns about the interests of the users and provides recommendations that the user would find most useful [1]. The recommendation system is helpful for those people who are not good at comparing similar items provided by different websites. Most of the RSs are based on user ratings of the items [1]. Recommendation System is a current favourite topic among the researcher as there is ample information is available on the web for hotels, movies, books, jobs, music, video, and many more [1][10]. If we are planning for something, then it's human tendency that we first search on the web related to that and try to find out best option from the different available options for that item, for example, if we are planning a trip first, we will search for the hotel in that particular area and read review for some hotels and most likely based on the reviews we decide a hotel for a stay. So, to fulfill this need recommendation system comes in a picture.

Recommendation Systems play a major role by filtering the places which suit the user's interests and requirements [11]. It helps users to find out proper information about an item at the right time [2].Recommendation systems are developed mostly based on Collaborative filtering, Content-based filtering, Hybrid filtering and Knowledge-based filtering [2]. Below we have given a brief introduction on Collaborative and Content-based filtering methods:

- **Collaborative Filtering:** RSs based on this technique, suggests items based on how other similar users like that item. In a simple word, a collaborative filtering method filters the information about the user's interest by gathering information from other similar users [8].
- **Content-based filtering:** This method, also known as cognitive filtering. RSs based on the content-based filtering use the data provided by the user such as ratings or reviews of items; based on the review of an item user profile is generated, and then the item is recommended by RSs using user profile and item description [2][9][7].

So, overall, Recommender Systems uses different filtering methods to recommend the best items to the users. Currently, many recommender systems are based on content-based filtering. [3] Nowadays, with the advancement of technology, there are ample e-commerce websites that provide different options for similar items like electronic items at Amazon, hotel options at Trip advisor and many more. Data provided by online reviews is rich in information about user's preferences user likes and dislikes as well as provides the information about whether that item is good or not [4].

Here I implemented a hotel recommendation system which works on user reviews. This recommendation system gives recommendation based on similarity of user reviews.

How Content based filtering works in recommendation system?

- Content based filtering technique works on textual information. This recommendation system based on similarity of user reviews. For example, as you show in below figure user read one article from any website then based on that article this recommendation system suggest them most similar article.
- Content based filtering method also works on explicit and implicit data.
    a. Explicit data means ratings and textual reviews
    b. Implicit data means clicking on browser link

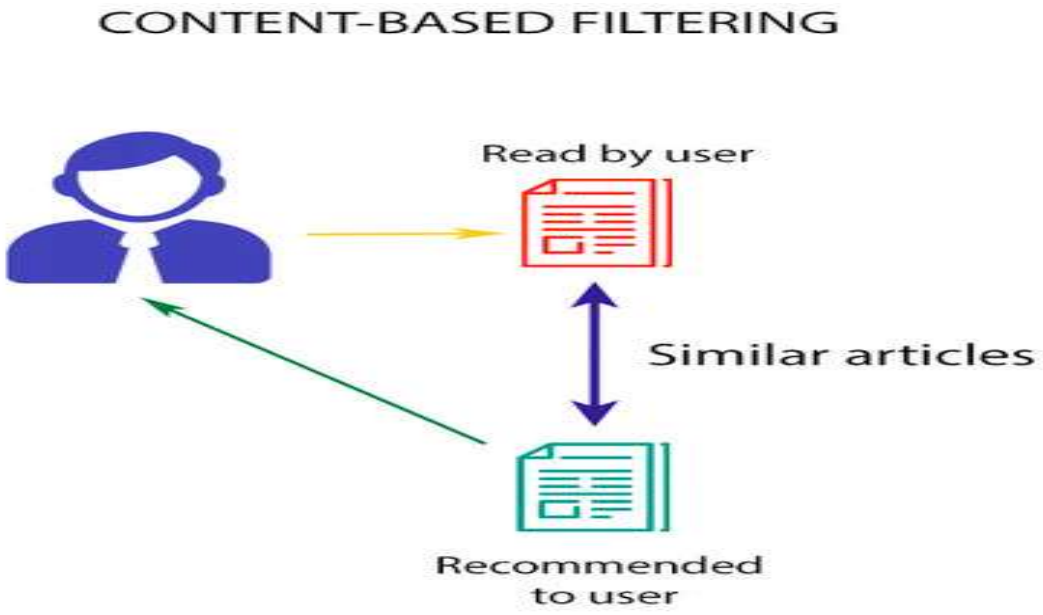


Fig 1. Content Based Filtering

2. Problem Statement

Currently, many existing hotel recommendation systems available in the market, but in that, we might be experiencing scalability and inefficiency problems while discovering and working with large-scale data. They have not considered the customer's various preferences and cannot meet the user's personalized requirements. In that system user is not the representative of the overall statistics. Even in the recent rating approaches allow users to specify their reviews but does not use this rating to discover recommendation. So, for the better hotel recommendation purpose, a review-based hotel recommendation system can work on those user reviews and suggest hotels based on a variety of input criteria [11].

Online reviews are generally available in both forms, such as rating and text-based comments about product/item/hotel. But, Most of the systems ask users to give the rating in low to large scale for the hotels and how they like their services and then compute overall rating for a hotel. Hotel recommendation system provide us logs of customer behavior. Which include which purpose they searched for. Our goal is to recommend hotels to users based on hotel properties, user behavior and users searches.

Existing System:

The existing system proposed by author used a collaborative filtering technique to give a recommendation to the user. In this existing hotel recommendation system, lots of information regarding client behaviour is given. These incorporate what the user is looking for and predict which kind of hotel a user is going to book. This system has its in-house algorithms to form a hotel cluster and this cluster works as good identifiers and it can suggest new hotels but it doesn't have past records of hotels and user reviews.

Drawbacks of the existing system:

- In this existing system, it doesn't store historical data of user reviews so, the system cannot suggest suitable hotels to the user.
- The system is using collaborative filtering, and it requires some minimum number of users to rate a new thing before that thing can be recommended.
- The existing system needs structured data, and it takes time.

3. Solution Overview

Our main goal is to recommend the most suitable hotels to a user based on the reviews provided for hotels. In general, our first step is to identify important information form the user's reviews because text-based comments contain many sentences. To build a recommender system first, we need data to play with it; for that, we will first find the user reviews from different hotel websites, which will be used later. Online reviews mostly consist of ratings of item/hotel, and textual comments [6], ratings provided by users are easy to process but text-based reviews are mostly in a natural language without any formation [3][6]. Customer writes their reviews on their own words based on what they experienced. While recommender systems need structured well-formed data to build a model and to provide proper recommendations, but textual reviews are very useful in order to build a better recommendation system. So, processing will be required to convert user's reviews to meaningful information i.e. unstructured data to useful data.

Text mining is used to convert unstructured data into meaningful data [6]. From the text-based reviews of users, we need to extract useful information, which involves sentiment

analysis of text and opinion mining. Sentiment analysis is one of the parts of Natural Language Processing (NLP). To fetch or extract emotions from the text, this analysis is being used. Probably after gathering sufficient data for our project, we will do sentiment analysis of the collected data using python, for that will use “NLTK” module of python, Scikit-learn library for this NLP method and predict whether customer is satisfied or not by that hotel based on review given by customer, which will be useful for extracting features and for recommendation modelling. Content based filtering technique used Tf-IDF. Term frequency- Inverse document frequency used to count the frequency of words in the document.

I developed a specialized recommender system for hotels and which will not only focus on various rating parameters but also considering text-based comments on the client’s reviews. Below figure shows that how content based filtering technique works to build recommendation system.

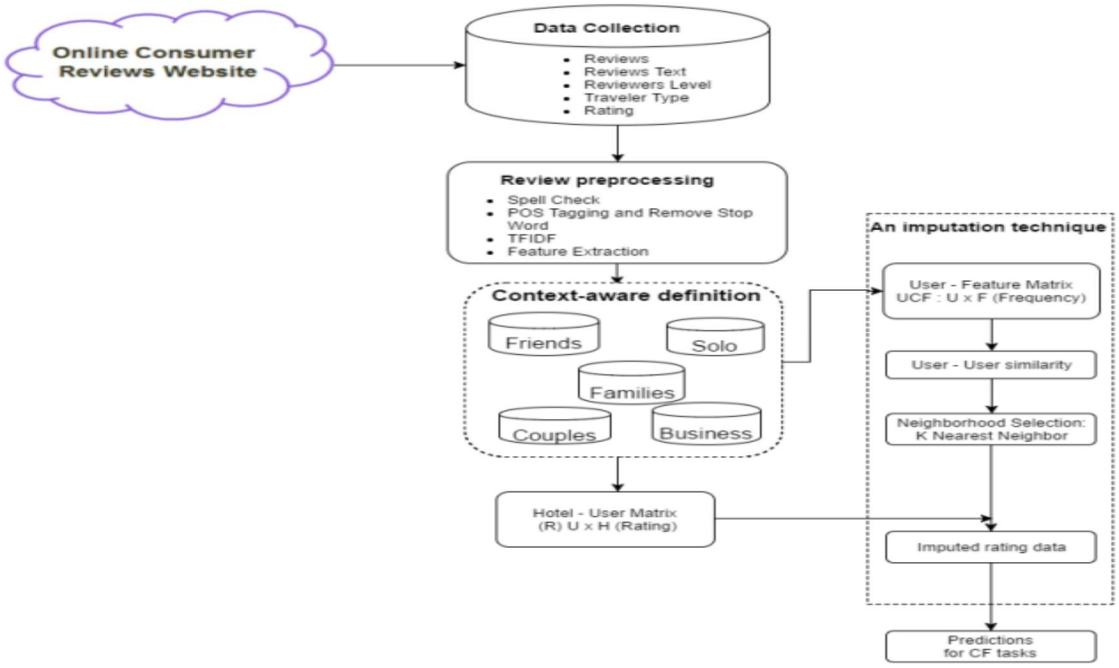
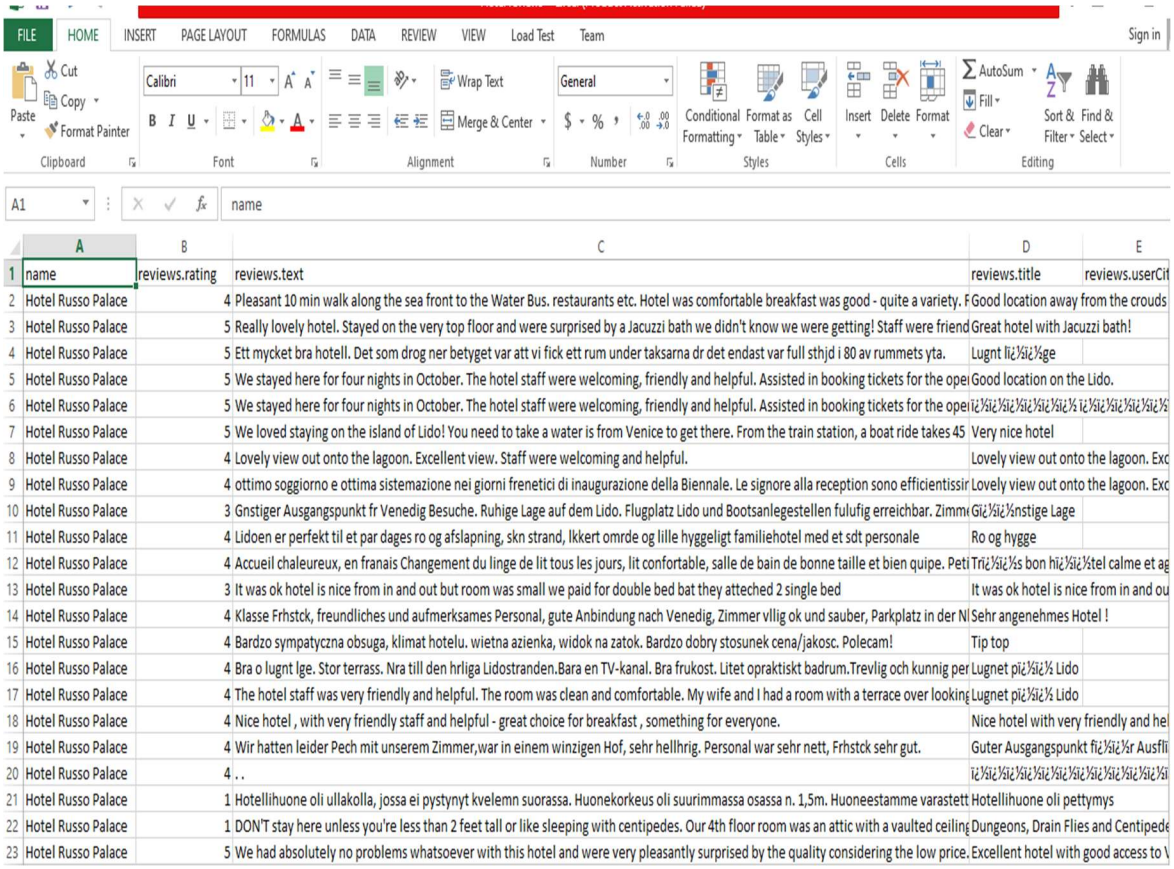


Fig. 2 Review based recommendation system work

4. Dataset

Here I used hotel reviews dataset from Kaggle. This data is provided hotel reviews by datafiniti’s business dataset. This dataset gives all information about hotel name, ratings, text reviews and customer details. This dataset is anonymized. In this dataset, I have information of 10000-35000 hotel reviews.



	A	B	C	D	E
1	name	reviews.rating	reviews.text	reviews.title	reviews.userCit
2	Hotel Russo Palace	4	Pleasant 10 min walk along the sea front to the Water Bus. restaurants etc. Hotel was comfortable breakfast was good - quite a variety. F	Good location away from the crouds	
3	Hotel Russo Palace	5	Really lovely hotel. Stayed on the very top floor and were surprised by a Jacuzzi bath we didn't know we were getting! Staff were friend	Great hotel with Jacuzzi bath!	
4	Hotel Russo Palace	5	Ett mycket bra hotell. Det som drog ner betyget var att vi fick ett rum under taksarna dr det endast var full sthjd i 80 av rummets yta.	Lugnt li¿½i¿½ge	
5	Hotel Russo Palace	5	We stayed here for four nights in October. The hotel staff were welcoming, friendly and helpful. Assisted in booking tickets for the ope	Good location on the Lido.	
6	Hotel Russo Palace	5	We stayed here for four nights in October. The hotel staff were welcoming, friendly and helpful. Assisted in booking tickets for the ope	i¿½i¿½i¿½i¿½i¿½i¿½ i¿½i¿½i¿½i¿½i¿½	
7	Hotel Russo Palace	5	We loved staying on the island of Lido! You need to take a water is from Venice to get there. From the train station, a boat ride takes 45	Very nice hotel	
8	Hotel Russo Palace	4	Lovely view out onto the lagoon. Excellent view. Staff were welcoming and helpful.	Lovely view out onto the lagoon. Exc	
9	Hotel Russo Palace	4	ottimo soggiorno e ottima sistemazione nei giorni frenetici di inaugurazione della Biennale. Le signore alla reception sono efficientissir	Lovely view out onto the lagoon. Exc	
10	Hotel Russo Palace	3	Gnstiger Ausgangspunkt fr Venedig Besuche. Ruhige Lage auf dem Lido. Flugplatz Lido und Bootsanlegestellen fulufig erreichbar. Zimm	Gi¿½i¿½nstige Lage	
11	Hotel Russo Palace	4	Lidoen er perfekt til et par dages ro og afslapning, skn strand, Ikkert omrde og lille hyggeligt familiehotel med et sdt personale	Ro og hygge	
12	Hotel Russo Palace	4	Accueil chaleureux, en franais Changement du linge de lit tous les jours, lit confortable, salle de bain de bonne taille et bien quipe. Peti	Tri¿½i¿½s bon hi¿½i¿½tel calme et ag	
13	Hotel Russo Palace	3	It was ok hotel is nice from in and out but room was small we paid for double bed bat they atteched 2 single bed	It was ok hotel is nice from in and ou	
14	Hotel Russo Palace	4	Klasse Frhstck, freundliches und aufmerksames Personal, gute Anbindung nach Venedig, Zimmer vllig ok und sauber, Parkplatz in der N	Sehr angenehmes Hotel !	
15	Hotel Russo Palace	4	Bardzo sympatyczna obsuga, klimat hotelu. wietna azienka, widok na zatok. Bardzo dobry stosunek cena/jakosc. Polecam!	Tip top	
16	Hotel Russo Palace	4	Bra o lugnt lge. Stor terrass. Nra till den hrliga Lidostranden.Bara en TV-kanal. Bra frukost. Litet opraktiskt badrum.Trevlig och kunnig per	Lugnet pï¿½i¿½ Lido	
17	Hotel Russo Palace	4	The hotel staff was very friendly and helpful. The room was clean and comfortable. My wife and I had a room with a terrace over looking	Lugnet pï¿½i¿½ Lido	
18	Hotel Russo Palace	4	Nice hotel , with very friendly staff and helpful - great choice for breakfast , something for everyone.	Nice hotel with very friendly and hel	
19	Hotel Russo Palace	4	Wir hatten leider Pech mit unserem Zimmer,war in einem winzigen Hof, sehr hellhrig. Personal war sehr nett, Frhstck sehr gut.	Guter Ausgangspunkt fi¿½i¿½r Ausfli	
20	Hotel Russo Palace	4	. .	i¿½i¿½i¿½i¿½i¿½i¿½i¿½i¿½i¿½i¿½i¿½	
21	Hotel Russo Palace	1	Hotellihuone oli ullakolla, jossa ei pystynyt kvelemn suorassa. Huonekorkeus oli suurimmassa osassa n. 1,5m. Huoneestamme varastett	Hotellihuone oli pettymys	
22	Hotel Russo Palace	1	DON'T stay here unless you're less than 2 feet tall or like sleeping with centipedes. Our 4th floor room was an attic with a vaulted ceilin	Dungeons, Drain Flies and Centipede	
23	Hotel Russo Palace	5	We had absolutely no problems whatsoever with this hotel and were very pleasantly surprised by the quality considering the low price.	Excellent hotel with good access to V	

Fig. 3 Sample dataset (CSV Format)

5. Data Analytics Lifecycle

1. Data Gathering:

- This is the initial step for creating any recommendation system. Here I took the hotel user reviews dataset from the kaggle. In this dataset they provided information of hotel name, user ratings, user's textual rating, location. This dataset is a collection of user's reviews for various hotels of different cities worldwide.

Out[1]:

	reviews.rating	reviews.text	reviews.title
0	3	This hotel was nice and quiet. Did not know, there was train track near by. But it was only few ...	Best Western Plus Hotel
1	4	We stayed in the king suite with the separation between the bedroom and the living space. The so...	Clean rooms at solid rates in the heart of Carmel
2	3	Parking was horrible, somebody ran into my rental car while staying there. I didn't get to try t...	Business
3	5	Not cheap but excellent location. Price is somewhat standard for not hacing reservations. But ro...	Very good
4	2	If you get the room that they advertised on the website and for what you paid, you may be lucky....	Low chance to come back here

Fig.4 Dataset

2. **Data Pre-processing:**

- After gathering enough data our next step is to clean that data because online data are noisy. Online reviews are in user's natural language and this data are unstructured data. To convert this unstructured data into structured data we use NLTK (natural language toolkit) python library. We need to clean the user reviews by performing basic operation on that and which is part of NLP (Natural language processing).
- **NLP Pipeline:**

  Remove punctuation: For getting clean text without any punctuation such as '!', 'or', ',' ':' etc. I used regular expression python module.

  Tokenization: I used split function to fetch words from the text.

  Remove stop words: To remove the stop words from the text I used corpus from NLTK and it removes extra such as a, an, the etc. from hotel reviews.

  Stemming: After getting the clean data I lemmatize the word using the corpus word net from NLTK python.

Out[11]:

	reviews.rating	reviews.text	reviews.title	reviews.text_clean	reviews.text_clean_tokenized	reviews.text_no_sw
0	3	This hotel was nice and quiet. Did not know, there was train track near by. But it was only few ...	Best Western Plus Hotel	This hotel was nice and quiet Did not know there was train track near by But it was only few tra...	[this, hotel, was, nice, and, quiet, did, not, know, there, was, train, track, near, by, but, it...	[hotel, nice, quiet, know, train, track, near, train, passed, stay, best, western, changed, hote...
1	4	We stayed in the king suite with the separation between the bedroom and the living space. The so...	Clean rooms at solid rates in the heart of Carmel	We stayed in the king suite with the separation between the bedroom and the living space The sof...	[we, stayed, in, the, king, suite, with, the, separation, between, the, bedroom, and, the, livin...	[stayed, king, suite, separation, bedroom, living, space, sofa, bed, wasnt, good, back, discomfo...
2	3	Parking was horrible, somebody ran into my rental car while staying there. I didn't get to try t...	Business	Parking was horrible somebody ran into my rental car while staying there I didnt get to try the ...	[parking, was, horrible, somebody, ran, into, my, rental, car, while, staying, there, i, didnt, ...	[parking, horrible, somebody, ran, rental, car, staying, didnt, get, try, breakfast, business, r...
3	5	Not cheap but excellent location. Price is somewhat standard for not hacing reservations. But ro...	Very good	Not cheap but excellent location Price is somewhat standard for not hacing reservations But room...	[not, cheap, but, excellent, location, price, is, somewhat, standard, for, not, hacing, reservat...	[cheap, excellent, location, price, somewhat, standard, hacing, reservations, room, nice, clean,...
4	2	If you get the room that they advertised on the website and for what you paid, you may be lucky....	Low chance to come back here	If you get the room that they advertised on the website and for what you paid you may be luckyIf...	[if, you, get, the, room, that, they, advertised, on, the, website, and, for, what, you, paid, y...	[get, room, advertised, website, paid, may, luckyif, stay, many, days, give, good, roomsnobody, ...

Fig.5 Clean data (CSV file)

- Next process in data preprocessing is **feature engineering.** Feature engineering is the process of fetching features from the raw text and these features can be used in machine learning to improve the accuracy and performance [15].

Fig. 6. Word cloud of hotel reviews

- **Vectorization:** To find the relevant word from the text we perform vectorization on text data. For build content based recommendation system I used TF-IDF techniques. Term-frequency Inverse document frequency mostly used in information retrieval. TF-IDF mostly used to count the weight of each word and which identify the importance of that word in the data [16]. Equation for measure TF-IDF is:

  TF-IDF = Term Frequency (TF) * Inverse Document Frequency (IDF)

Out[28]:

	10	2	50	AC	And	Best	But	Carmel	Did	Everything	...	wasnt	water	website	week	withir
0	0.000000	0.000000	0.000000	0.000000	0.000000	0.221077	0.187936	0.000000	0.221077	0.000000	...	0.000000	0.000000	0.000000	0.000000	0.000000
1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.170103	0.000000	0.000000	0.000000	0.170103
2	0.000000	0.000000	0.000000	0.000000	0.184577	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.000000	0.000000
3	0.000000	0.000000	0.000000	0.179094	0.000000	0.000000	0.152246	0.179094	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.000000	0.000000
4	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.159316	0.000000	0.000000
5	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.179123	0.000000	0.000000	0.000000
6	0.167328	0.334656	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.167328	...	0.000000	0.000000	0.000000	0.000000	0.000000
7	0.000000	0.000000	0.206007	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.206007	0.000000
8	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.000000	0.000000
9	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	...	0.000000	0.000000	0.000000	0.000000	0.000000

10 rows x 214 columns

Fig.7 TF-IDF Vecterzation

- **Sentimental analysis:** In data processing task, I performed sentimental analysis on the hotel user reviews to find the positive and negative reviews.

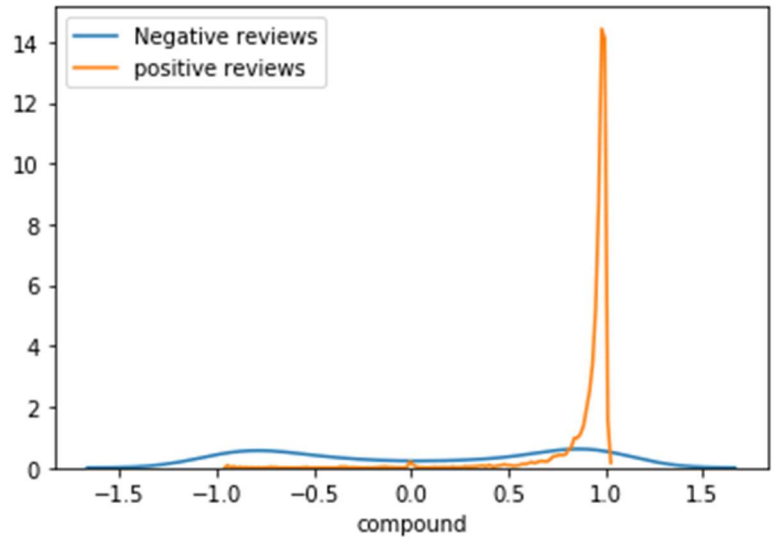


Fig .8 Visualization of sentimental analysis

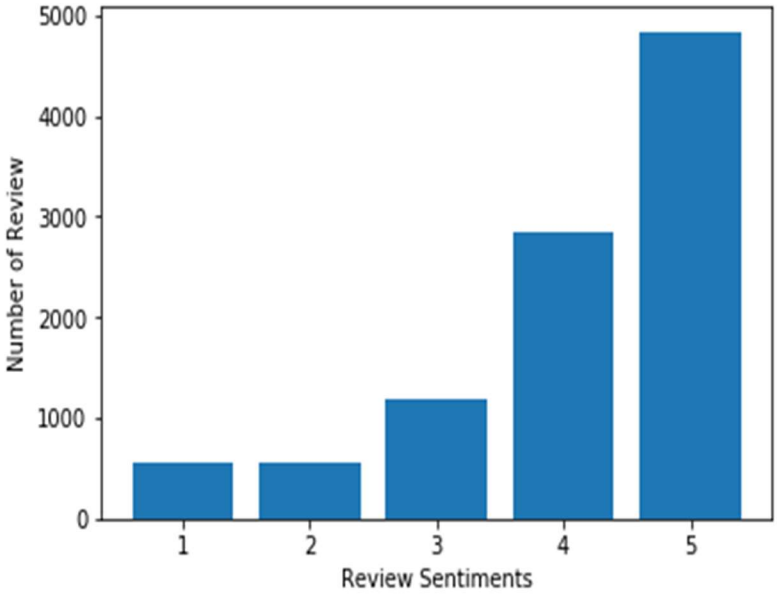


Fig.9 Visualization of Ratings

3. Model planning and model building:

To build any recommendation engine model planning and model building is important. It is a part of machine learning.

Here I used naive Bayes classifier machine learning algorithm to recommend hotel based on user reviews. For model building we have to divide our data into two parts train and test and based on that data we perform testing. In the machine learning context, Naïve's Bayes Classifier is a probabilistic classifier based on Bayes' theorem that constructs a classification model out of training data. [13]This classifier learns to classify the reviews to positive or negative using the supervised learning mechanism. The learning process starts by feeding in sample data that aids the classifier to construct a model to classify these reviews [13].

```
                precision    recall  f1-score   support

             1       0.70      0.41      0.52       103
             2       0.38      0.03      0.05       111
             3       0.33      0.20      0.25       261
             4       0.47      0.46      0.47       587
             5       0.69      0.88      0.77       938

    accuracy                           0.60      2000
   macro avg       0.51      0.40      0.41      2000
weighted avg       0.56      0.60      0.56      2000

Confusion Matrix:
 [[ 42   1  38  15   7]
 [ 13   3  50  34  11]
 [  1   1  53 151  55]
 [  1   2  14 272 298]
 [  3   1   4 105 825]]

Accuracy:  0.5975
```

Fig.11 Test Data model

```
              precision    recall  f1-score   support

           1       0.92      0.72      0.81       464
           2       0.98      0.37      0.53       443
           3       0.73      0.54      0.63       929
           4       0.73      0.73      0.73      2262
           5       0.82      0.95      0.88      3902

    accuracy                           0.80      8000
   macro avg       0.84      0.66      0.72      8000
weighted avg       0.80      0.80      0.79      8000

Confusion Matrix:
 [[ 334    0   60   48   22]
 [  13  162  106  114   48]
 [   3    0  506  287  133]
 [   4    1    8 1647  602]
 [   8    2    9  162 3721]]
```

Fig.12 Train Data model

4. Test Analysis:

In this I analyzed how accurately this system recommend hotel to user based on their reviews. The proposed system analyzed the various performance analysis metrics such as Precision, Recall and Accuracy.

Precision = True Positive\True Positive + False Positive

Recall = True Positive\True Positive + False Negative

Accuracy = No. of Reviews correctly classified\Total no. of Reviews

	precision	recall	f1-score	support
negative	0.92	0.08	0.15	685
neutral	0.91	0.12	0.21	180
positive	0.92	1.00	0.96	9135
accuracy			0.92	10000
macro avg	0.92	0.40	0.44	10000
weighted avg	0.92	0.92	0.89	10000

Out[68]:

	Predicted positive	Predicted negative	Predicted neutral
Actual positive	54	1	630
Actual Negavtive	1	21	158
Actual neutral	4	1	9130

Fig.13 Final Result

6. Tools

- To building this hotel recommendation engine I used various tools. I used Asp.net for my web application.

7. Timeline

This is the timeline of our project. This is the most important section for any project. Before starting actual coding and designing developer have to make timeline for the project and how they will complete that project.

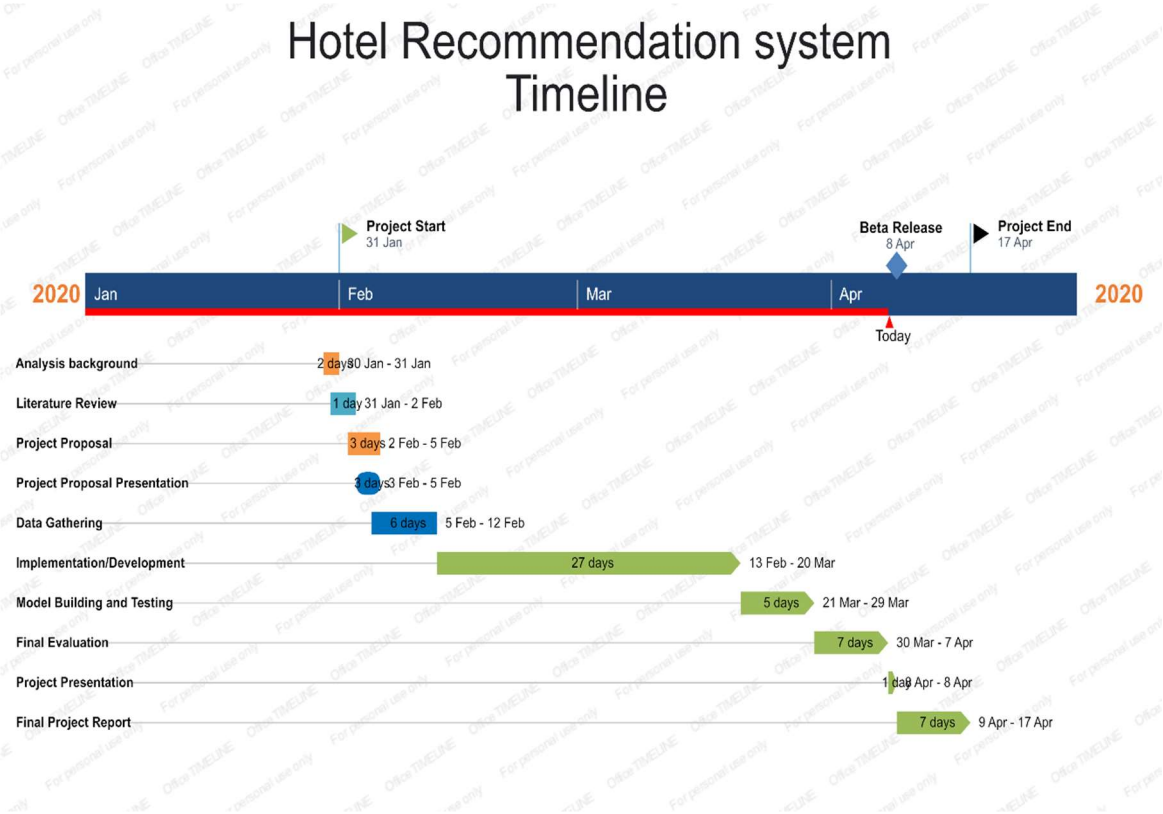


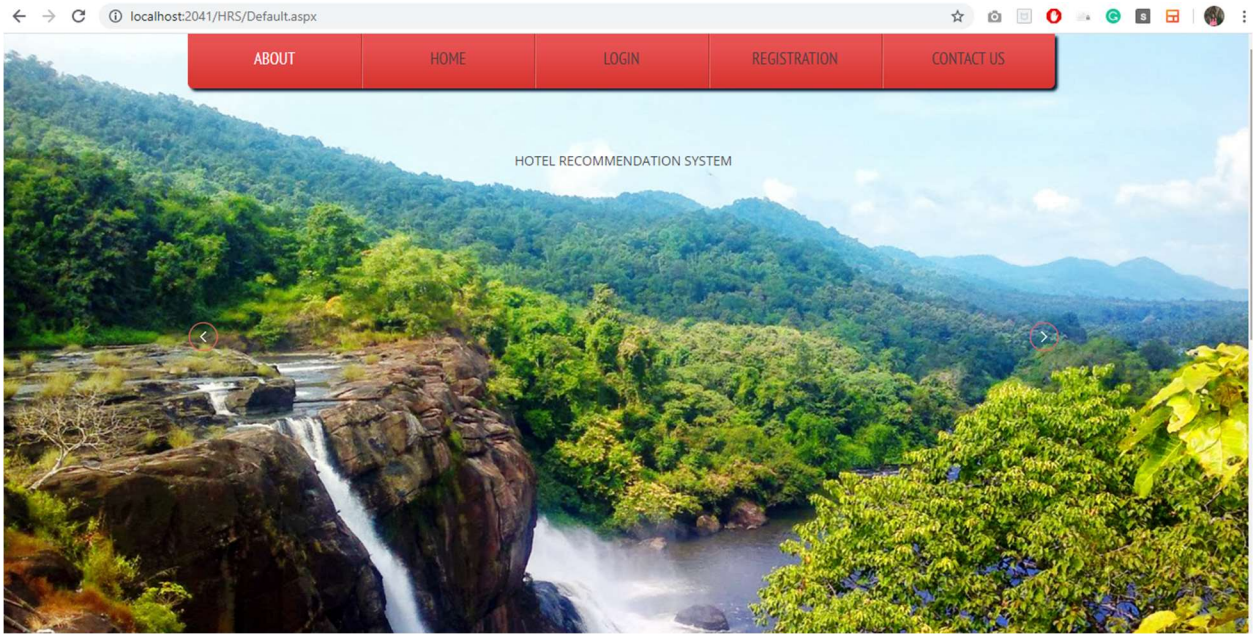
Fig.7. Gantt chart

8. Conclusion

Our system suggesting hotel based on textual rating and simple star/numeric ratings. I have collected hotel reviews dataset and get different feature to build system model using ML algorithm and feature matrix. For this, used NLP library which converted user language reviews to machine language. Finally, to recommend hotel actual recommendations machine learning algorithm used, get user preferences for different input criteria and provides different recommendations.

9. Screenshots of Hotel Recommendation system web app

1.



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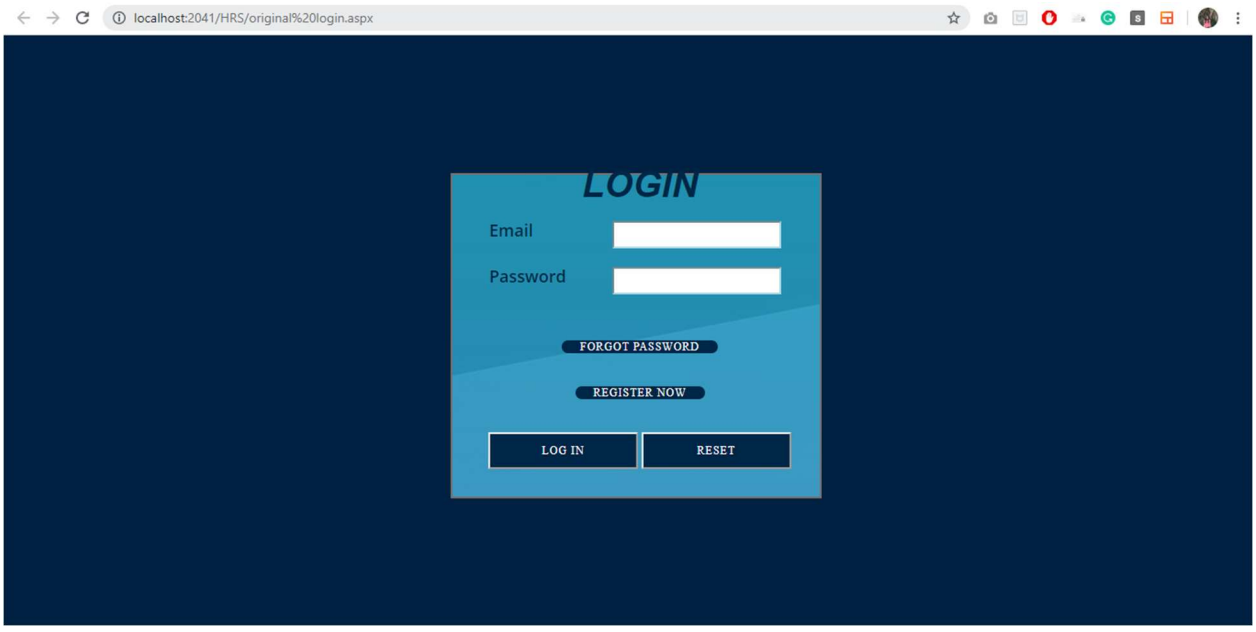
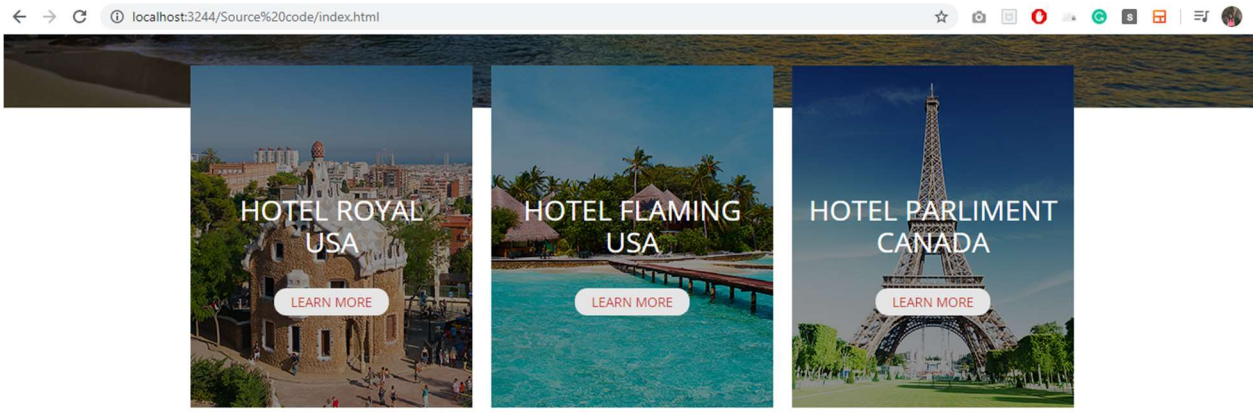
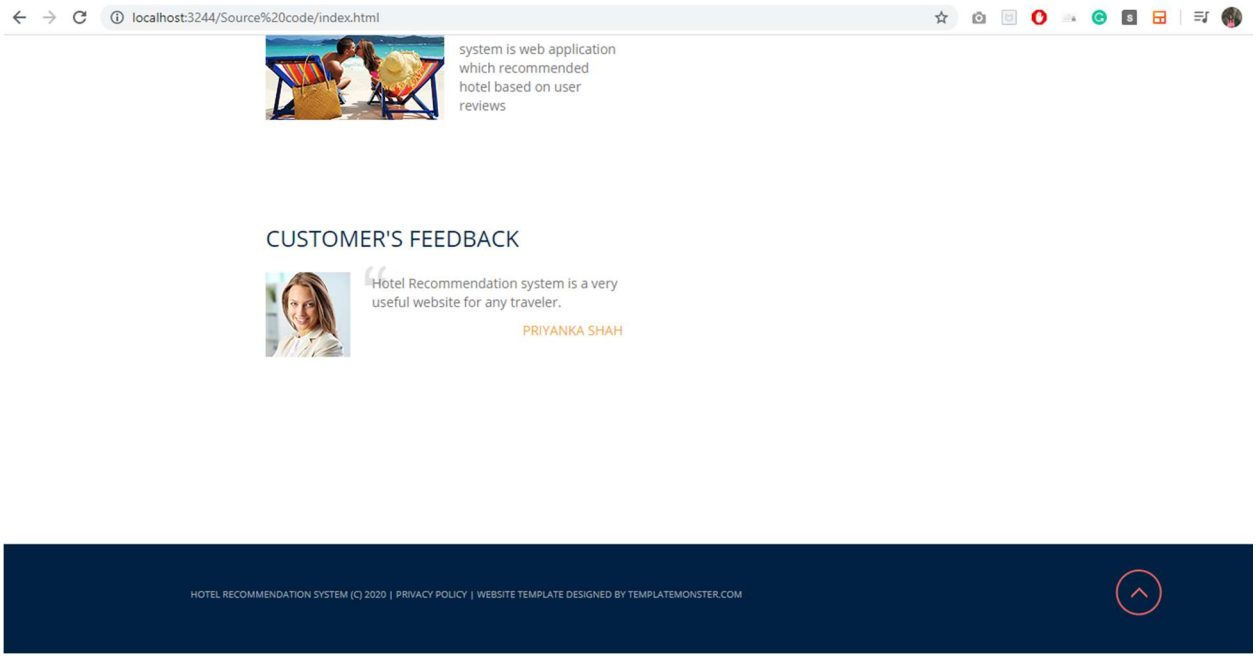


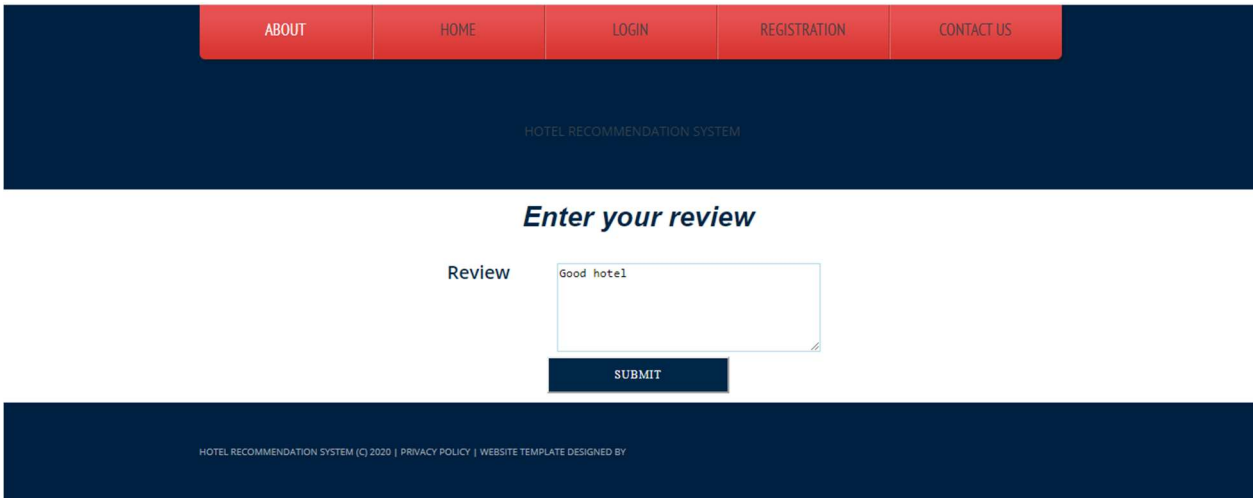
3.


localhost:3244/Source%20code/index.html
HOTEL ROYAL
USA
LEARN MORE
HOTEL FLAMING
USA
LEARN MORE
HOTEL PARLIMENT
CANADA
LEARN MORE
WELCOME
Hotel recommendation
system is web application
which recommended
hotel based on user

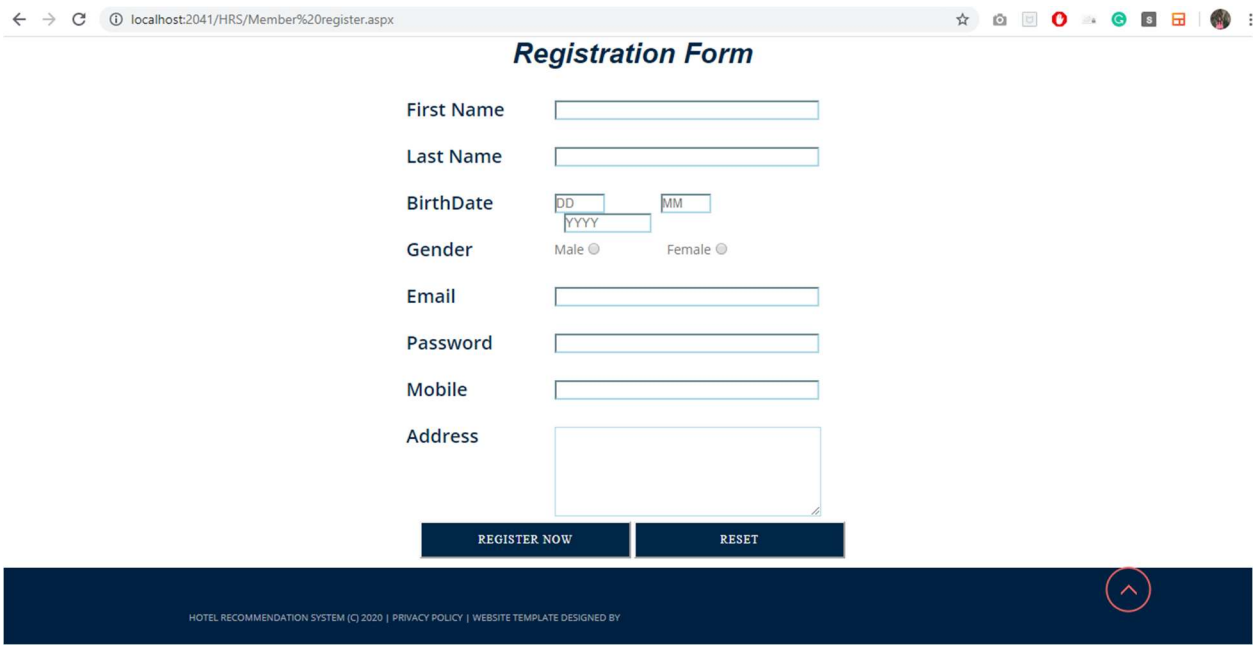
4.


localhost:3244/Source%20code/index.html
system is web application
which recommended
hotel based on user
reviews
CUSTOMER'S FEEDBACK
Hotel Recommendation system is a very
useful website for any traveler.
PRIYANKA SHAH
HOTEL RECOMMENDATION SYSTEM (C) 2020 | PRIVACY POLICY | WEBSITE TEMPLATE DESIGNED BY TEMPLATEMONSTER.COM

5.


ABOUT
HOME
LOGIN
REGISTRATION
CONTACT US
HOTEL RECOMMENDATION SYSTEM
Enter your review
Review
Good hotel
SUBMIT
HOTEL RECOMMENDATION SYSTEM (C) 2020 | PRIVACY POLICY | WEBSITE TEMPLATE DESIGNED BY

6.


localhost:2041/HRS/Member%20register.aspx
Registration Form
First Name
Last Name
BirthDate
DD
MM
YYYY
Gender
Male
Female
Email
Password
Mobile
Address
REGISTER NOW
RESET
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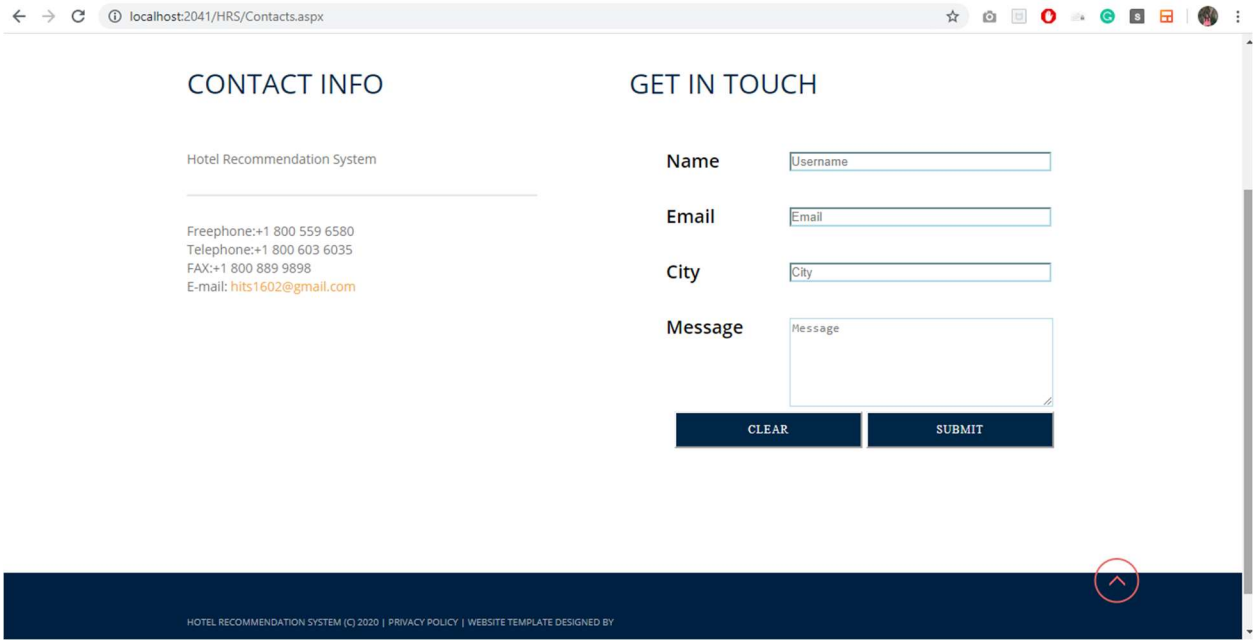
7.


localhost:2041/HRS/Contacts.aspx
CONTACT INFO
Hotel Recommendation System
Freephone:+1 800 559 6580
Telephone:+1 800 603 6035
FAX:+1 800 889 9898
E-mail: hits1602@gmail.com
GET IN TOUCH
Name
Username
Email
Email
City
City
Message
Message
CLEAR
SUBMIT
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References:

[1] S. Kaur, R. K. Challa, N. Kumar, S. Solanki, S. Sharma and K. Kaur, “Recommendation generation using typicality based collaborative filtering,” 20177th International Conference on Cloud Computing, Data Science & Engineering - Confluence, Noida, 2017, pp. 210-215.ng”.

[2] Ruihai Dong, Barry Smyth, “User-based Opinion-based Recommendation”, Proceedings of the Twenty-Sixth International Joint Conference on Artificial Intelligence (IJCAI-17), 2017.

[3] Dong, Ruihai, Smyth, Barry, “From More-Like-This to Better-Than-This: Hotel Recommendations from User Generated Reviews”, 2017, pp. 309-310.

[4] H. Qin, X. Ye, Y. Zhao and X. Cai, "Hotel Classification Based on Online Review Data," *2018 14th International Conference on Natural Computation, Fuzzy Systems and Knowledge Discovery (ICNC-FSKD)*, Huangshan, China, 2018, pp. 264-270.

[5] Shubhangi Dhanokar, Komal Patole, Poonam Kure Chaitrali Konde, "Hotel Recommendation based on User Preferences Analysis", International Research Journal of Engineering and Technology (IRJET), vol.4, 2017

[6] Personalized hotel recommendation based on social networks, available: https://pdfs.semanticscholar.org/7b8f/305115732f728fa7ad58108334f5d11bf1b8.pdf

[7] Engines, B. (2020). Beginners Guide to learn about Content Based Recommender Engine. Retrieved 14 April 2020, from https://www.analyticsvidhya.com/blog/2015/08/beginners-guide-learn-content-based-recommender-systems/

[8] Collaborative filtering, available: https://en.wikipedia.org/wiki/Collaborative_filtering

[9] Content based filtering, available: http://recommender-systems.org/content-based-filtering/

[10] Introduction to recommender system, available:

https://towardsdatascience.com/introduction-to-recommender-systems-6c66cf15ada

[11] Y. Sharma, J. Bhatt and R. Magon, "A Multi-criteria Review-Based Hotel Recommendation System," 2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing, Liverpool, 2015, pp. 687-691.

[12] Recommendation-system, available: https://www.yash.com/blog/recommendation-system/

[13] I.V., Shravan. (2016). Sentiment Analysis in Python using NLTK. OSFY - OpensourceForYou.