"Recommendation system using location sensing (LBSN) and sentiment analysis"

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***Abstract**: Customer reviews have become increasingly important in digital marketing of products and services in the digital era. Sentiment analysis is a popular approach for analysing reviews that uses machine learning and natural language processing[2][3]. The proliferation of social networks has resulted in the establishment of a network based on geographic location. This aids in determining the user's location, which aids in the recommendation of location-based information [1][4]. The recommendation system is a method of connecting items or services to users and assisting them in confirming their decision [7][8]. This paper's main approach will be to look at both sentiment analysis and location-based social networks, as well as their many forms, to see how integrating the two can improve recommendation systems with a variety of applications.*

Keywords: Sentiment Analysis, Natural language Processing, Machine learning, location-based social network, recommendation system

1. Introduction

E-commerce and e-business are making great strides today, encouraging start-ups to run their businesses through applications. With this trend, application developers have a strong responsibility to provide comprehensive customer support and user-friendly tools such as recommendations and filters. From 2006 to 2009, Netflix sponsored the contest and offered the team a $ 1,000,000 grand prize. The award was able to obtain a dataset of over 100 million movie reviews provided and return recommendations that are 10% more accurate than the company's existing recommender systems[7][8]. These tools help users effectively select their preferences based on a variety of factors. In applications such as online transportation and hotel reservations, users always prefer a nearby location based on their situation. The main goal of our project is to provide a location-specific recommender system, analyse ratings and ratings together, and provide a clear view to customers [1][4]. The applicability of this system is demonstrated by an application for artists who find clients making money for their art. The purpose of this system is to use sentiment analysis using supervised machine learning and a location-based social network using the Google Maps application interface[1][4]. The location can be used as input when registering with the

application, or it can be changed later in the application interface. Emotion and rating analysis is averaged and the resulting score determines the ranking of each entity or customer [2][3].

2. Literature Survey

In this paper "Sentiment Analysis of Twitter Data" which is published by Sahar A. El Rahman; Feddah Alhumaidi AlOtaibi; Wejdan Abdullah AlShehri in the publication IEEE MAY 2019 follows the work as each tweet extracted classified based on its sentiment whether it is a positive, negative or neutral. Data were collected on two subjects McDonalds and KFC to show which restaurant has more popularity [1]. This paper "Movie Recommendation System Using Sentiment Analysis from Microblogging Data" published by Sudhanshu Kumar, Kanjar De, and Partha Pratim Roy in IEEE JUNE 2020 and their purpose is to use movie tweets is to understand the current trends, public sentiment, and user response of the movie. Experiments conducted on the public database have yielded promising results.[2]. The paper" Striking the Balance Between Novelty and Accuracy in Location-Based Recommendation System" published by Vivek Agrawal, ShivamSahu, Sneha Oommen, G. Ram Mohana Reddy in IEEE JANUARY 2020 in this paper the proposed algorithm provides users with a personalized ranked list of venues based on their past check-in data and social relationships, which is novel yet accurate at the same time.[3] .In this paper " Location Based Place Recommendation using Social Network" published by Ms. Priya Naik, Ms. Palak V. Desai, Ms. Supriya Patil In IEEE MARCH 2019 and their Point-of-interest(POI)recommendation assists users to search new locations as per their preferences or choices. In the recent study of location based social networks, influence factors are taken into consideration.[4]. This paper " Comprehensive Study on Sentiment Analysis: Types, Approaches, Recent Applications, Tools and APIs" published by Ms. Binju Saju, Ms. Siji Jose , Mr. Amal Antony In IEEE NOVEMBER 2020 The paper gives a detailed study of sentiment analysis. It explains the basics of sentiment analysis, its types, and different approaches of sentiment analysis. [5]. In this paper " Recommender Systems Challenges and Solutions Survey " published by Marwa Hussien Mohamed, Mohamed Helmy Khafagy , Mohamed Hasan Ibrahim in IEEE FEBRUARY 2019. This paper introduces a survey about recommendation systems, techniques, challenges the face recommender systems and lists some research papers that solve these challenges. [7]

3. Design Methodology

This system uses user and customer locations to provide recommendations or search results to users[8][11]. The system also provides a detailed sentiment analysis of reviews and averages them in ratings to provide scores that help user's better rate customer service. Location specificity is provided using a location-based social network (LBSN) that uses Haversine formulas for distance calculations [6]. Sentiment analysis of reviews is performed using supervised machine learning techniques using IMDB datasets. The sentiment analysis score is then evaluated and averaged, allowing for a better analysis of the user's evaluation of the customer.[2][3][12]

3.1. Design Methodology for Sentiment Analysis

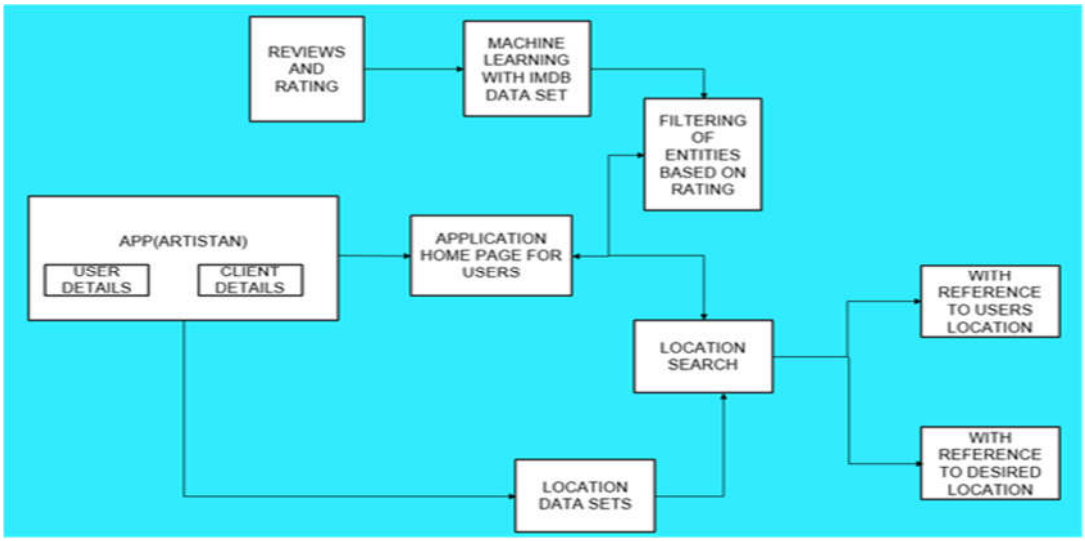

Figure 1. Flow chart of Design Methodology for Sentiment Analysis

The system will be demonstrated using an application that binds all artists of different art movements.When the application home page is displayed, there is a search bar that allows users to search for artists based on artist category and provide recommendations based on score and location. There are two options for location search.

i. . Refer to User's Location Here, the user keeps his location data as a reference point.
ii. Browse to the desired location here, users can enter the desired location to find nearby businesses and customers.

Users can also search based on the artist's score as rated from the sentiment analysis of reviews averaged by rating.

3.1.1. Mathematical Model of algorithm AWD-LSTM:

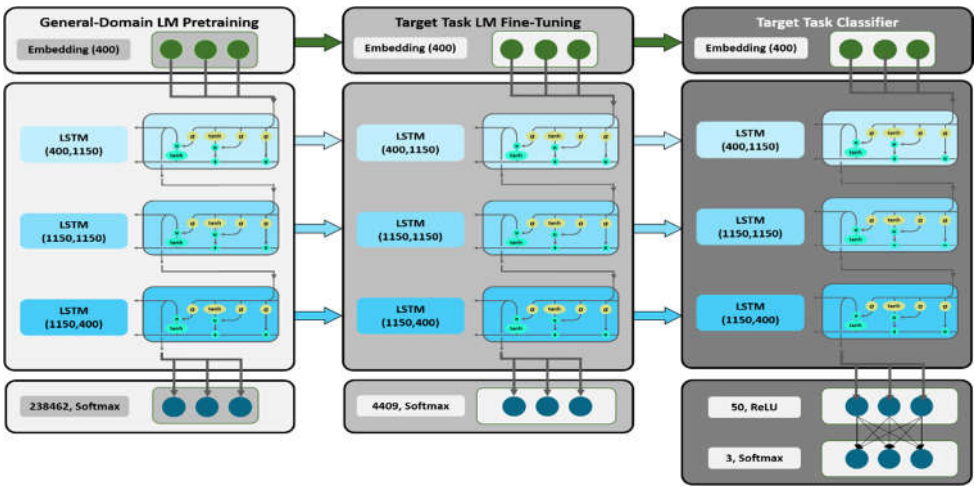

Figure 2. Mathematical model of AWD-LSTM

AWD-LSTM is NT-ASGD (Non-monotonically Triggered ASGD), is an averaged random probability distribution technique gradient descent technique. Weight-Dropped LSTM. It uses Drop Connect and the average random gradient descent method, in addition to other regularization strategies. Due to the memory element existing in this recurrent neural network (RNN) we choose this algorithm.[10][13]

LSTM equations:

$i_t = \sigma(W^i xt + U^i ht-1)$

$ft = \sigma(W^f xt + U^f ht-1)$

$o_t = \sigma(W^o xt + U^o ht-1)$

$c\tilde{}t = \tanh(W^c xt + U^c ht-1)$

$c_t = i_t \odot c\tilde{}_t + f_t \odot +\tilde{}c_t-1$

$h_t = o_t \odot \tanh(c_t)$

where [Wi , Wf , Wo , Ui , Uf , Uo] are weight matrices, x_t is the vector input to the time step t, h_t is the current exposed hidden state, c_t is the memory cell state, and $\odot$ is element-wise multiplication.

The following is implementation of AWD-LSTM in the recommendation system**:**

```
from fastai.text.all import *

dls = TextDataLoaders.from_folder(untar_data(URLs.IMDB), valid='test')
learn = text_classifier_learner(dls, AWD_LSTM, drop_mult=0.5, metrics=accuracy)
```

Fig 3 Implementation of AWD-LSTM in the recommendation system

3.2 Design Methodology for review score

- First we create a supervised machine learning algorithm using the IMDB data set (sentiment analysis of reviews) and train the model.
- We run this model with the reviews given by user and generate the score of entity.
- The sentiment analysis approach used is automatic approach.
- The type of sentiment analysis used is standard sentiment analysis.
- Sentiment analysis result is as follows:

Percentage	Sentiment	Equivalent score (Es)
90	NEGATIVE	0.5
80	NEGATIVE	1
70	NEGATIVE	1.5
60	NEGATIVE	2
50	NEUTRAL	2.5
60	POSITIVE	3
70	POSITIVE	3.5
80	POSITIVE	4
90	POSITIVE	4.5
100	POSITIVE	5

Figure 4.Review Score

The Es as per the above table is averaged with average star rating to get score with the formula:

ENTITY_SCORE= (STAR RATING+ES)/2

4. Design Methodology for Location Based Social Network (LBSN)

- Locations are recorded by creating a location-based social network (LBSN)[9].
- Records of received user and customer data are marked.
- The location is determined using Haversine formulas.
- If you have two different values of latitude and longitude from two different points on the earth, you can easily calculate the great circle distance (the shortest distance between two points on the surface of the sphere) using Haversine's equation[6].

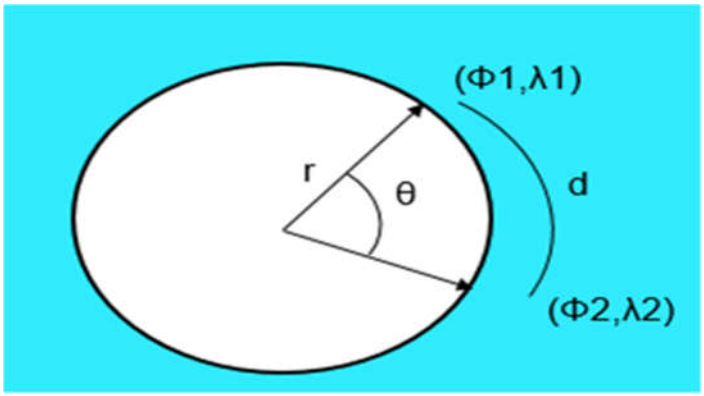

Figure 5. Haversine Formula

The Haversine formula calculates the shortest distance between two points on a sphere using their latitudes and longitudes measured along the surface. It is important for use in navigation. The haversine can be expressed in trigonometric function as:

$$\text{haversine}(\theta) = \sin^2(\theta/2) \quad (1)$$

The haversine of the central angle θ (which is d/r) is calculated by the following formula:

$$\text{haversine}(d/r)=\text{haversine}(\varphi_2-\varphi_1)+\cos\varphi_1 x\cos\varphi_2\ \text{haversine}(\lambda_2-\lambda_1) \quad (2)$$

Where r is the radius of earth (6371 km), d is the distance between two points, Φ1, Φ2 is the latitude of the two points and λ1, λ2 is the longitude of the two points respectively.

Solving d by applying the inverse haversine or by using the inverse sine function, we get: (h=hav (θ))

$$d= r*\text{hav}^{-1}(h)=2r\sin^{-1}(\sqrt{h}) \quad (3)$$

5. Results

5.1 Results for sentiment analysis

By using sentiment analysis we predict the review of the artists provided by the users and we categorize them as positive and negative.

5.1.1 Positive Results :

Figure 6. Positive result of sentiment analysis

Figure 7. Positive result of sentiment analysis

5.1.2 Negative Results :

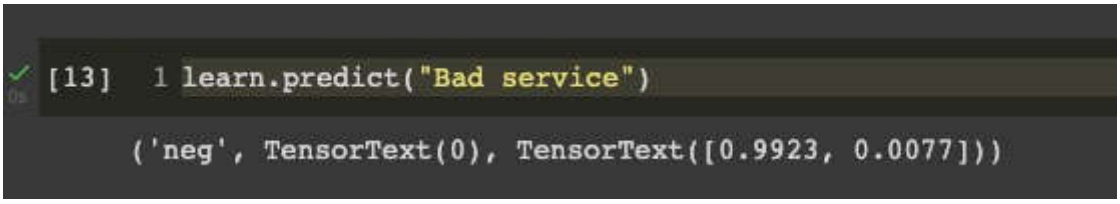

Figure 8. Positive result of sentiment analysis

5.2 LOCATION BASED SOCIAL NETWORK (LBSN)

The below picture shows how haversine formula is executed to track location of specific user:

```
from math import radians, cos, sin, asin, sqrt


def haversine(lon1, lat1, lon2, lat2):
    """
    Calculate the great circle distance in kilometers between two points
    on the earth (specified in decimal degrees)
    """
    # convert decimal degrees to radians
    lon1, lat1, lon2, lat2 = map(radians, [lon1, lat1, lon2, lat2])

    # haversine formula
    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) * sin(dlon/2)**2
    c = 2 * asin(sqrt(a))
    # Radius of earth in kilometers. Use 3956 for miles. Determines return value units.
    r = 6371
    return c * r
```

Figure 9. Positive result of sentiment analysis

6. Conclusion

Therefore, by using LBSN and sentiment analysis together, you can build a powerful search and recommendation system that allows users to find the preferences they need. This ultimately helps users get site-specific results and also provides them with the information they need about customer service reliability. LBSN is very effective in assisting location-based recommendations by showing the shortest distance from a customer's available unit. Sentiment analysis can provide inferences about authenticating reviews, ensuring that customers receive information about quality service.

7. References

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