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# APPETITE RECOMMENDATION SYSTEM THROUGH EMOTIONS

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## ABSTRACT

By Utilizing machine learning algorithms, our project presents an innovative approach to predict food choices based on user mood. The system employs the k-means clustering algorithm, an unsupervised learning technique, to create distinct clusters representing moods such as sad, happy, and stressed. Training our system with different data sets, including facial expressions, food reviews, and restaurant information, optimizes the efficiency of mood-based food predictions. The user-friendly interface of our system offers two mood selection options. Users can manually choose their current mood from predefined categories and the other one is by using webcam-based mood detection, where the system captures and analyzes user emotion expressions to predict food choices. The program's front end is designed with Bootstrap, while the back end is implemented using Python and the Flask framework. To enhance the accuracy of food predictions based on user mood, the system integrates facial expression recognition technology. The primary objective of our project is to provide users with user-friendly interaction that makes them helpful while decision-making. Anticipating a 70-plus accuracy rate, this innovation demonstrates the system's commitment to leveraging advanced technologies for mood-based recommendation precision. Our project is of personalized recommendation systems, leveraging advanced technologies to enhance user satisfaction in the realm of food choices based on their current mood. The combination of machine learning algorithms, a user-friendly interface, and innovative features positions your project as a pioneering effort in this domain.

**Keywords: -**

K-Means Clustering, Sentiment Analysis, Facial Emotion Recognition, Convolution Neural Network (CNN), NLTK.

## 1. INTRODUCTION

India is one of the most diverse countries in the world, and the food habits of the people vary according to their cultures and geographical location. Food is fundamental to human existence, influencing various aspects of physical health, mental well-being, and societal connections. Food has the power to influence moods and emotions. Certain foods can trigger the release of neurotransmitters that affect feelings of happiness and relaxation. The impact of food on mood is a complex interplay between the nutrients. Food is

more important in life and there is a variety of dishes that people can choose. So, when people would like to eat, it is difficult to decide which foods to eat each meal of the day. Especially those who with the different mindset and mood. This is the reason that we do research projects by research groups to develop recommendations based on moods. Applying the system recommended in combined with data mining by analyzing data from storage to the satisfaction of food and eating habits.

Recommended systems help users make informed decisions by collecting information about their preferences in a variety of areas. The choice of restaurant among numerous and unknown selections is one of the important uses of the recommended systems, especially for tourists and travelers. The system provides the food recommendation not only on the basis of the ratings of a restaurant, but it also includes the user's reviews as sentiments that helps a user to select the food according to their mood and taste rather than the general trend of area.

### 1.1 RESEARCH PROBLEM

The goal of the study is to use machine learning to create a meal suggestion system based on mood. The primary objective is to design a user interface that allows users to select their current mood from predefined categories, enabling the system to provide personalized meal suggestions that align with their emotional state. In addition, it places a strong emphasis on developing a user- friendly interface that will allow users to express their emotions and obtain aesthetically appealing meal ideas, improving their whole dining experience. By using facial expression recognition technology our system can predict food choices based on user current mood.

### 1.2 OBJECTIVE AND GOALS

Our project holds Customized Recommendations. It includes recommending food based on mood that adds a personal touch to user experiences. And also, when food choices align with the user's mood, there is a higher likelihood of satisfaction. There is a well-established connection between mood and food preferences. Certain foods are known to have mood altering effects. In some cases, like feeling stress or some other specific moods, individuals often prefer comfort foods. Recommending such foods can contribute to stress relief and provide a sense of comfort. Mood-based food recommendations can encourage users to explore a variety of cuisines and dishes. In a competitive landscape, our system that recommends food based on mood stands out as innovative and forward-thinking. This unique feature can be a competitive advantage, attracting users seeking a more personalized and emotional experience**.**

A recommendation system examines vast amounts of user data and determines preferences based on the user's stated or inferred preferences, interests, or behaviors. The time and cost savings in implementing a recommendation system are appreciated by both users and service providers. These improve decision-making quality and reduce associated transaction costs when shopping online. Library recommendation systems assist readers by allowing them to search outside of library search. E-commerce increases sales by suggesting products based on consumer searches. The food industry benefits from recommendation systems that provide intelligent systems that help consumers choose what to eat based on factors such as seasonality, customer age, mood, experience level, and a restaurant's current sales. You can receive available discounts etc. Applying a recommendation system to this situation is a promising approach to taking care of issues like these. The proposed system is built on highly accurate models, Users can choose from a wide range of moods and get restaurant recommendations by selecting mood, Innovative face recognition.

## 2. LITERATURE SURVEY

Mood-based food recommendation systems use machine learning techniques to suggest foods and recipes based on a user's emotional state and mood. This approach combines the fields of machine learning, natural language processing, and K-means clustering to provide personalized and contextual food recommendations. A literature review focusing on the major research papers and approaches in the field of mood-based food recommendation using machine learning: -

Food Recommendation System using Neural Collaborative Filtering and Sentiment Analysis.On the validation dataset, the model achieves 78% accuracy. Provides a way to improve restaurant reviews using ratings and comments. The authors of this work are Tinku Singh et al. [16] This he proposed in 2017. The proposed techniques include sentiment analysis and neural collaborative filtering (NCF). India is one of the most diverse countries in the world, and people's dietary habits vary depending on their culture and geographical location. With the spread of the Internet, various companies are now offering grocery delivery services. People can easily order food online that suits their tastes and budget. Billionaires are investing money in India's food industry. It contributes significantly to the Indian economy with its high growth rate and high profits. It has a 32% share in the Indian market. The revenue of the Indian online grocery industry in 2020 was $1.0196 billion, and the number of users was 203.6 million.

Recommendation of Diet Using Hybrid Collaborative Filtering Learning Methods proposed by the authors of this work are Samikshal et al[10]. It was proposed in the year 2020. The description of the proposed algorithm is K-Nearest Neighbor Collaborative Filtering. KNN Basic achieved an accuracy of 97, ALS's KNN achieved an accuracy of 98, and SGD's KNN achieved an accuracy of 99. The proposed diet and exercise recommendation framework suggests a balanced diet for thyroid patients. Ensure food intake that contains the nutrients necessary for thyroid disease. In this paper, we apply a collaborative K-nearest neighbor filtering model using different similarity measures. Two hybrid learning methods were evaluated in this work. ANN with Alternating Least Squares: KNN-ALS and ANN with Stochastic Gradient Decent: KNN-SGD. In the experimental settings, the mean absolute error (MAE) and root mean square error (RMSE) values were used to analyze and evaluate the performance of all algorithms.

Food Recommendation System Using Machine Learning proposed by the authors are Jayashree et al [12] . It was proposed in the year 2020. It is proposed in the year 2020. Description of the proposed algorithm is a technique for collaborative filtering of results. Use reviews to narrow down the best restaurants for you. However, there is no mention of the accuracy rate. While traditional recommendation systems recommend products based on a single criterion, hotel meal pricing considers different criteria for each product. Although rating systems for food recommendation systems have shown promising accuracy, the approaches they use require many previous users to rate items based on specific criteria. This article introduces a food recommendation rating scale recommendation system to select the most suitable hotel in a city according to user preferences and other users' reviews. To determine hotel food ratings based on previous users, a variety of natural language processing approaches are used on a hotel with 4,444 food reviews to create a database of user items and characteristics.

The paper “Restaurant Food Recommendation System via a Transformer-based Deep Learning Model” by Xinwei et al [ 3] published in 2022. Descriptions of proposed algorithms are Deep learning, Food recommendation, Transformer. The proposed system has demonstrated its effectiveness in ranking food dishes with any combination and unseen food dishes through extensive experiments on our self-constructed dataset. These are the results obtained by the author. The accuracy is not provided. Food recommendation

system has proven as an effective technology to provide guidance on dietary choices, and this is especially important for patients suffering from chronic diseases. Unlike other multimedia recommendations, such as books and movies, the food recommendation task is highly dependent on the context at the moment, since users' food preference can be highly dynamic over time. For example, individuals tend to eat more calories earlier in the day and eat a little less at dinner. However, there are still limited research works trying to incorporate both current context and nutritional knowledge for food recommendation. Thus, a novel restaurant food recommendation system is proposed in this paper to recommend food dishes to users according to their special nutritional needs. Our proposed system utilizes Optical Character Recognition (OCR) technology and a transformer-based deep learning model, Learning to Rank (LTR) model, to conduct food recommendation.

Restaurant recommender system based on sentiment analysis by the authors are Elham, et al [8] proposed in 2021. The description of the proposed algorithm is Natural Language Processing (NLP). The results showed that the proposed system could provide the user with an accuracy of 92.8% in his Top5 mode. The proposed content-based recommendation system analyzes the content of users' comments and recommends restaurants based on preferences and menu similarities extracted from users' comments. Additionally, the system provides restaurants with similar menus based on the user's past selections. This type of recommendation is leveraged in collaborative filtering systems between elements. Therefore, the proposed system is a hybrid filter system.

The study “Optimal Facial Feature Based Emotional Recognition Using Deep Learning Algorithm” is proposed by Tarun et al [5], 2022. The description of the proposed algorithm is the use of convolutional neural networks and deep learning algorithms. Facial features are used for emotion recognition. The results obtained by the authors compared with current methods show that the convolutional neural network improves the accuracy and classification method. When we compare our proposed strategy with the current approach, the results are better. The model's ability appears to meet the challenge of requiring facial expression recognition at these resolutions. Therefore, this article uses kernel filters to minimize the bounds of the dimensional space. Facial features are one of the important techniques in emotion recognition, and this paper implements feature extraction using holistic approaches, hybrid approaches, geometric approaches, and template-based techniques. Feature extraction techniques are the next level of preprocessing techniques. As a result, the convolutional neural network receives the output when the feature extraction process is completed. The output continues as the above feature extraction techniques provide an improved CNN model of facial expressions.

Feedback Based Food Recommendation Systems Using Hybrid Deep Learning suggested by Manoj [1] in 2023.Convolutional neural networks outperform traditional recommendation systems in understanding users' moods and considering similarities between people and food. The accuracy of the algorithm was 70%. The recommendation system is powered by a hybrid deep learning algorithm that takes into account user preferences and personalization issues. In this work, we use content and collaborative filtering on different datasets and user profiles at different stages. The dataset was collected and analyzed specifically for this article. To evaluate performance, the dataset was split into test and training data, and a series of machine learning algorithms were run through their respective paces. Customer preferences are used to specifically instruct the algorithm to suggest restaurants and cuisines. Price, volume ratings, location, and other factors were considered when creating the proposal.

Gowroju et al.[21-25] experimented on various deep learning techniques to evaluate the performance of prediction using various optimizers. The UNet model using Adam optimizer has performed with good prediction for predicting thn age of the person using Iris biometric.In recent advancements in biometric applications, three distinct papers contribute significantly to age prediction utilizing iris and pupil images. The first paper introduces a pioneering approach by employing a deep neural network (DNN) based on the UNet architecture for age group prediction from pupil images, achieving notable accuracy on benchmark datasets (MMU, CASIA, UBIRIS). The second paper proposes an intelligent system for pupil detection, showcasing remarkable accuracy even on small datasets and under challenging low illumination conditions, outperforming existing state-of-the-art systems across multiple datasets, including CASIA, UBIRIS, MMU, random datasets, and live video recordings. The third paper provides a comprehensive review of traditional and machine learning algorithms for age prediction from iris images, emphasizing the importance of security and privacy in iris-based age prediction systems.The reviewed papers demonstrate innovative approaches to age prediction using ocular features, emphasizing the effectiveness of deep learning methods in segmentation and detection. These studies underscore the importance of system security and individual privacy in the evolving landscape of biometric technology

## 3. PROPOSED SYSTEM: -

Our suggested technique offers a thorough method for improving client happiness and making individualized food recommendations. By using two different bulk datasets to train our model, we ensure accurate predictions for the application. Our intuitive interface gives customers the ability to choose moods from a list, giving the experience a more unique feel. Notably, we've incorporated direct links to well-known food delivery apps like Swiggy and Zomato, speeding up the process from choosing a mood to placing orders. Our approach incorporates a sophisticated sentiment analysis procedure, in contrast to the previous research article, which lacks information on the sentiment analysis methodology and lessens the impact of tailored recommendations. We've used AI-driven systems to their full capacity to create a tool that makes it easier for people to make decisions. Leveraging the power of facial emotion recognition technology, we will enable users to receive food recommendations based on their current emotional state.

### 3. 1 METHODOLOGY: -

In our project the user interface for the mood-based food prediction system is designed to be simple and easy to use. Firstly, giving choice to users to select their current mood either by a manual process or by selecting a web camera option. Upon manual option it will be redirected to another end point where we will recommend to users the restaurants in a particular city. The restaurants are aggregated based on the rating. If you select any of the 9 moods, then the model will process it and display the food that most people eat in that mood. And it will show you the restaurants that have the best rating for those types of foods.

We will classify the restaurants based on reviews, locations, and cuisines using K-Means Clustering. For each mood option, K-Means Clustering is crucial in grouping similar establishments. For our study, we used the "Zomato.csv" file from Kaggle, which contains data on food reviews. The restaurants are grouped together based on their reviews using the K-Means Clustering method and the Zomato Dataset. In order to determine the best foods to advise in light of the input mood, the predict food choices algorithm employs sentiment analysis. It makes use of a database of hundreds of review files for meals. We are making use of a different dataset, the mood "food choices" dataset.

Using sentiment analysis and NLTK, this database is utilized to train a model that uses mood to predict food decisions. After processing the input mood that the user picked, we will finally forecast the food. Then, based on the cuisine that our model suggests, we will display the restaurant in that city. If a user chooses the web camera option to show their feelings about their meal selections. It involves a database called "facial

expression" that uses a convolution neural network (CNN) and large samples to determine our face expression. In our study, CNN is primarily employed for image recognition based on face expression. It makes the most precise predictions regarding food choices after analyzing the image.

In our project, we are using two main machine learning algorithms they are

### 3.1.1 K-Means clustering

An overview of the study methodologies and strategies used in the examination of New Delhi's restaurant statistics, food preferences, and geographic clusters is given in this section along with the libraries and tools utilized for data processing and visualization are also highlighted. It also provides bespoke tools designed to locate the best restaurants and analyze comfort foods based on mood. The primary source of data for this research was a CSV file named "zomato.csv." This data set comprised the locations, ratings, and cuisines of the restaurants. In order to focus on a specific area, the data was filtered so that it only included restaurants located in New Delhi. Additionally, invalid data points—such as those with latitude and longitude values of zero—were removed. The analysis did not include 'Not rated' entries that had the 'Rating text' label attached. This phase aimed to ensure that only establishments with ratings were included. The 'Cuisines' parameter was used to tally the number of cuisines that each restaurant serves to build the 'fusion_num' feature. A comprehensive analysis of the cuisines was conducted, which entailed counting the occurrences of each cuisine.

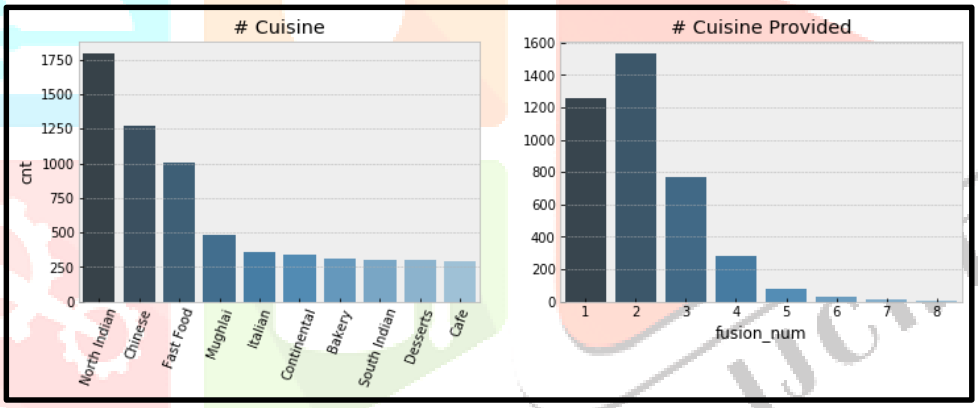


Fig. 1: Figure showing the cuisine in New Delhi

The restaurant sites were analyzed using K-Means clustering to understand the geographical distribution of the eateries. This clustering led to the creation of seven distinct location clusters. By displaying the clustered sites on a scatter plot, restaurant clusters in New Delhi were found. Pandas and other statistical analysis tools are used for data manipulation and filtering. Additionally, combine Seaborn with Matplotlib for data visualization, including bar and scatter graphs. K-Means clustering is used to categorize restaurant locations based on latitude and longitude. A novel capability was developed to identify comfort foods associated with a specific feeling. This program parsed and analyzed comfort food data from a to return the best comfort meals for a given mood.

### 3. 1.2 Convolutional Neural Network (CNN): -

Convolutional Neural Network (CNN) is a type of deep learning algorithm that is particularly suited for image recognition and processing tasks. CNNs are often used to analyze visual data. CNNs are inspired by the visual processing that occurs in the human brain. Convolutional neural networks (CNNs) can also be used to recognize facial expressions. This is a common approach for image classification tasks such as emotion recognition. A dataset of facial expressions is collected and preprocessed, and each image is labeled with the corresponding emotion developed a CNN architecture that can learn to recognize emotions from images. This

architecture often includes convolutional layers for feature extraction, pooling layers for downsampling, fully connected layers for classification, and activation functions such as ReLU. We trained the model using the prepared dataset. This includes forward and backward passes, updating weights, and optimizing to minimize the loss function. Evaluate model performance on validation or test datasets and measure emotion prediction accuracy. Given a new image, load the pretrained model, make predictions, and return the predicted sentiment labels.

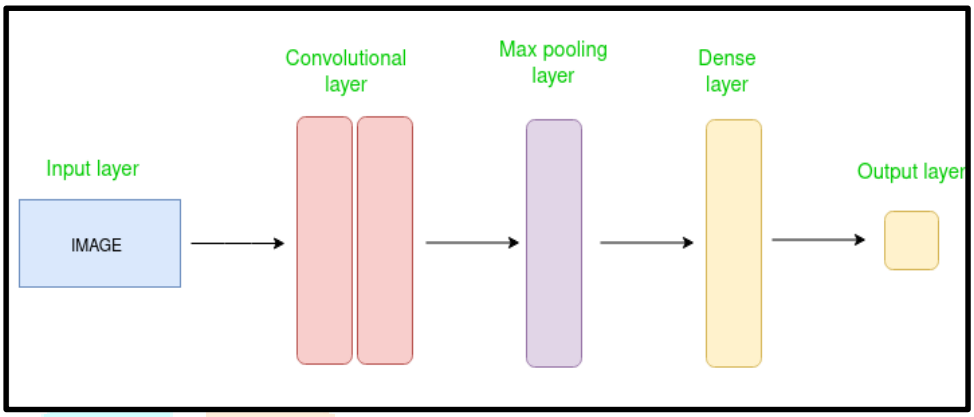


Fig.2 : Architecture of CNN

### 3. 1. 3 NLTK and Sentiment Analysis: -

NLTK, or the Natural Language Toolkit, is a powerful Python library for working with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources, such as WordNet. Additionally, NLTK includes a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and more. Sentiment Analysis is the process of analyzing digital text to determine whether the emotional tone of the message is positive, negative, or neutral.. Sentiment analysis, also known as opinion mining, is a natural language processing (NLP) task that determines the mood or emotion expressed within text. The purpose is to understand whether the opinions expressed are positive, negative, or neutral. Sentiment analysis can be applied to a variety of areas, including customer feedback analysis, social media monitoring, and product reviews.

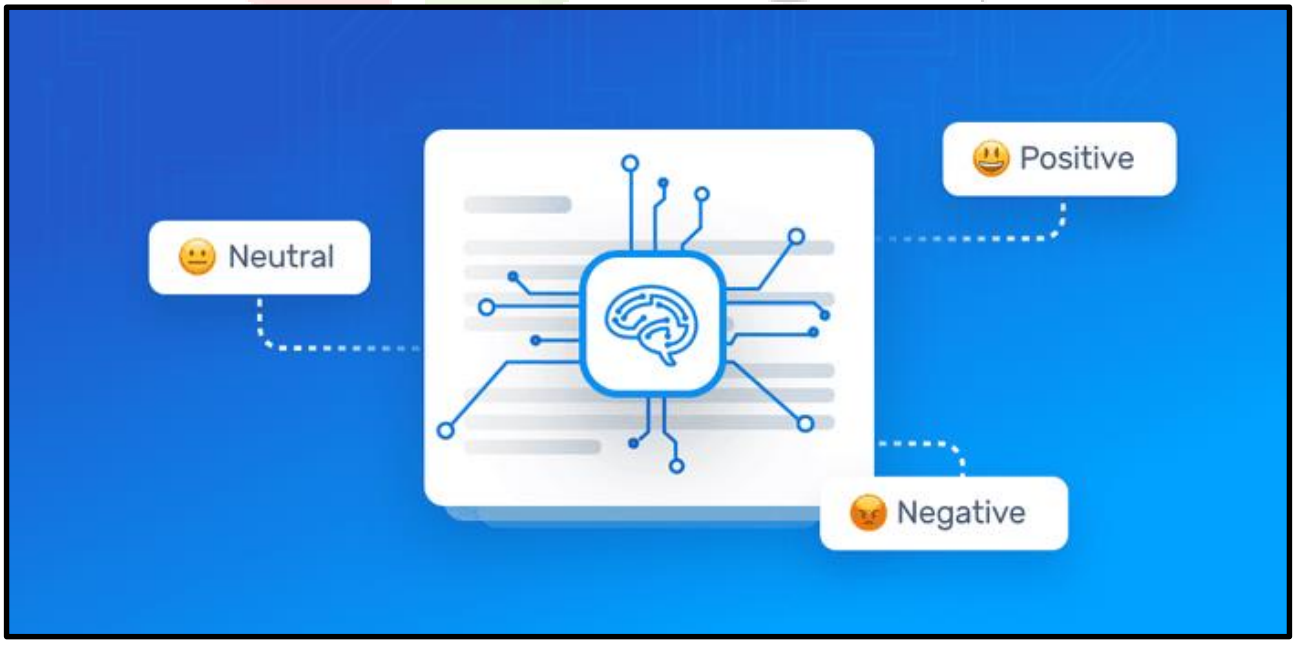


Fig : 3 Figure displaying Sentiment Analysis

### 3.2 SYSTEM ARCHITECTURE: -

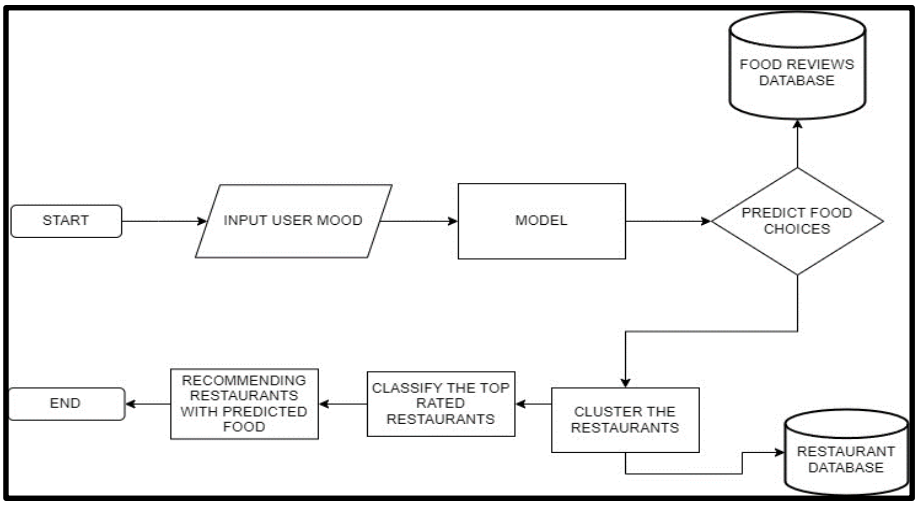


Fig. 4 : System Architecture of the Proposed System

The mood input module serves as the initial interaction point between the user and the system. Users can manually input their emotional state by choosing from a selection of emotions or allow the system to automatically capture their emotions through facial expressions using a camera. In the last case, the the records and analyzes the user's facial expressions, aligning them with a database of recognized expressions linked to different emotions such as joy, sadness, anger, or surprise. This stage aims to precisely determine the user's emotional state at the moment of interaction. Following the facial expression analysis, the system employs an emotion prediction model based on machine learning. The model process gathers the emotional data gained from the user, aiming to identify patterns in facial expressions and predict the user's emotional state, which could range from happiness to sorrow or anger.

Once the emotional state is determined, the the utilizes a K-means algorithm to categorize the user's emotions and recommends meals that best suit that particular emotional state. The meal recommendations draw from a comprehensive meal review database containing information about various foods, their ingredients, and their associations with specific emotions. For instance, someone someone feeling sad might be suggested comfort food, while someone experiencing user experiencing happiness might receive recommendations for light and refreshing options.

After identifying suitable meals, the system proceeds to cluster restaurants that offer the recommended foods, considering the user's culinary preferences, location, and other dietary considerations such as vegetarian or vegan options. This system aims to provide a personalized dining experience based on the user's emotional state and food preferences.

To further enhance the dining experience, the the evaluates and selects top-rated restaurants from the pool of possibilities. This decision-making process may take into account factors such as customer reviews, ratings, and other relevant considerations to ensure a high-quality and satisfying dining experience tailored to the user's mood and culinary preferences.

## 4. RESULTS

In this work, we developed an emotion-driven restaurant suggestion online application that provides users with real-time face emotion detection in addition to manual mood selection. The application's goal was to offer individualized restaurant recommendations depending on the feelings and mood of the user.

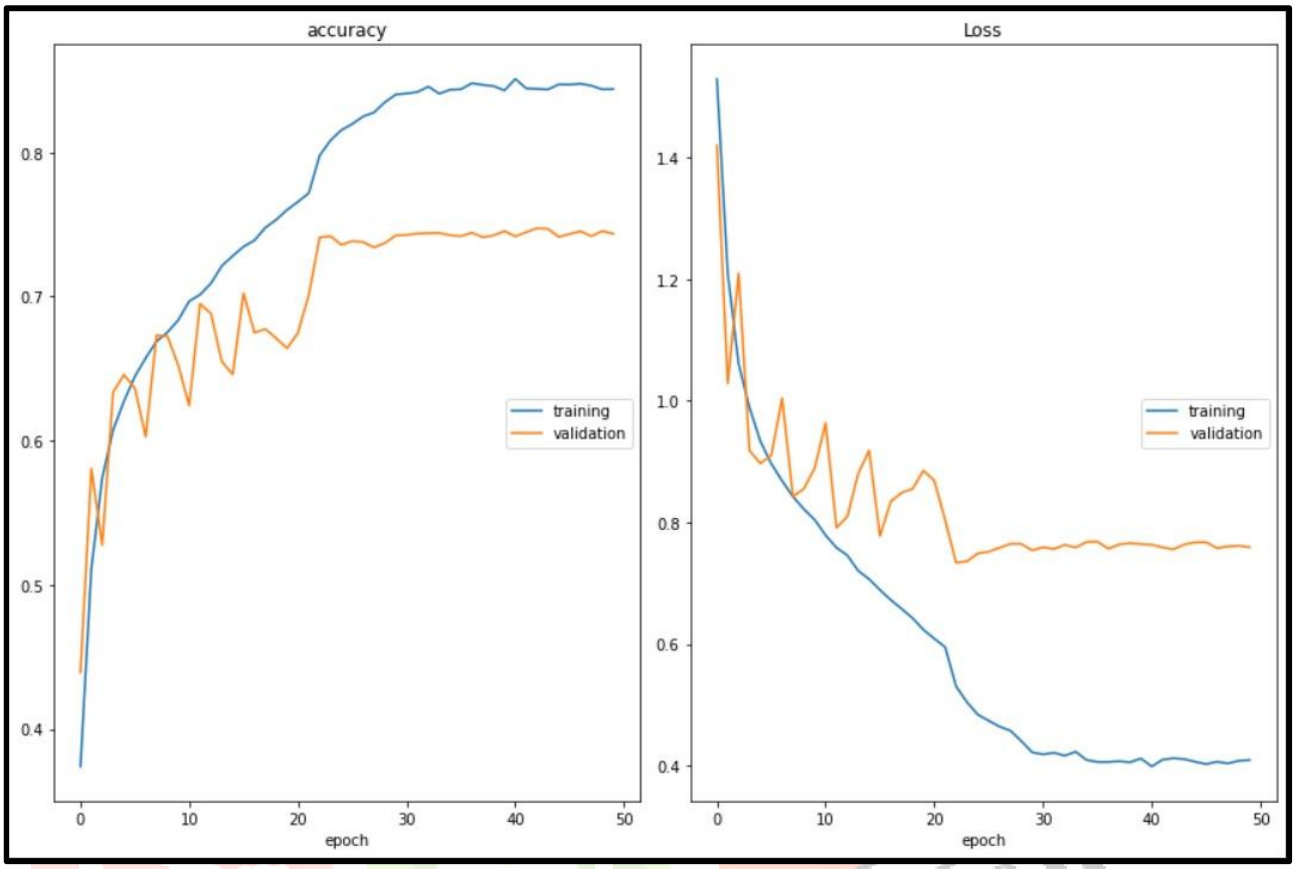


Fig:5 Figure showing the training model's accuracy and loss

The provided figure illustrates the training model's accuracy and loss, key metrics in evaluating the system's performance. The accuracy trend reflects the model's ability to predict user emotions, with a rising curve indicating improved precision. Concurrently, the loss curve gauges dissimilarity between predicted and actual emotions, highlighting the model's learning progress. This visual representation offers insights into the convergence of the training process, guiding adjustments for enhanced performance. The dynamic interplay of accuracy and loss underscores the system's continual refinement, ensuring effective facial expression analysis and precise meal recommendations based on the user's emotional state.

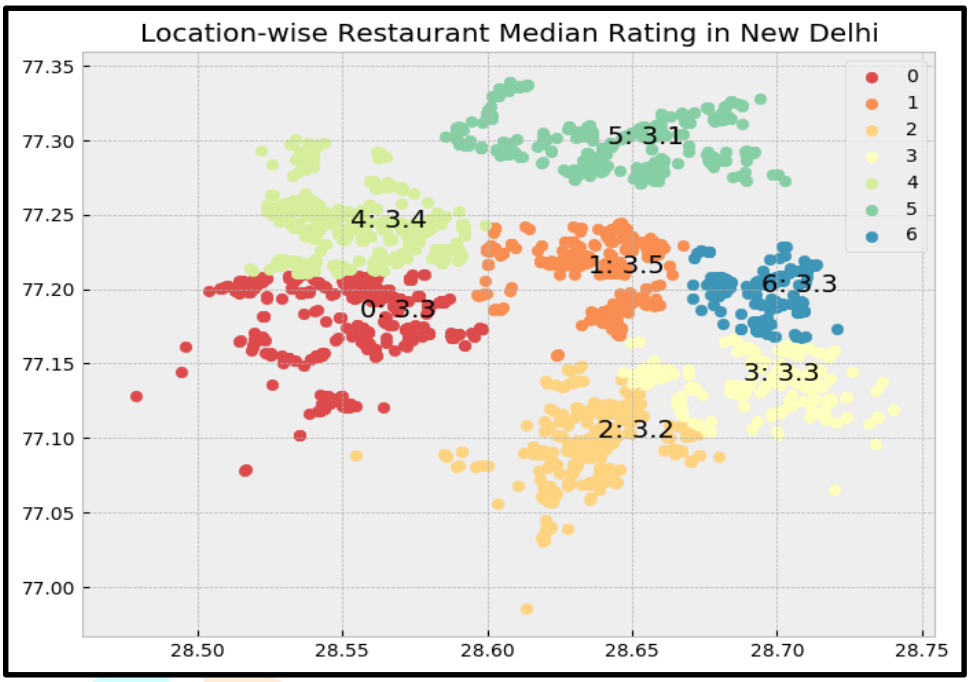


Fig. 6 : Figure showing Location wise restaurant median rating in New Delhi

The figure showcasing "Location-Wise Restaurant Median Rating in New Delhi" visually reflects the spatial distribution of restaurant ratings across different areas of the city. It consists of a color-coded map of New Delhi, with each region indicating its corresponding minute restaurant rating. The league provides clarity on the rating scale, enhancing enhancing comprehension. By employing distinct markers for individual restaurants, the the figure succinctly conveys valuable information about the regional dining experiences in various locations within New Delhi, offering a quick and insightful overview of the city's culinary landscape.

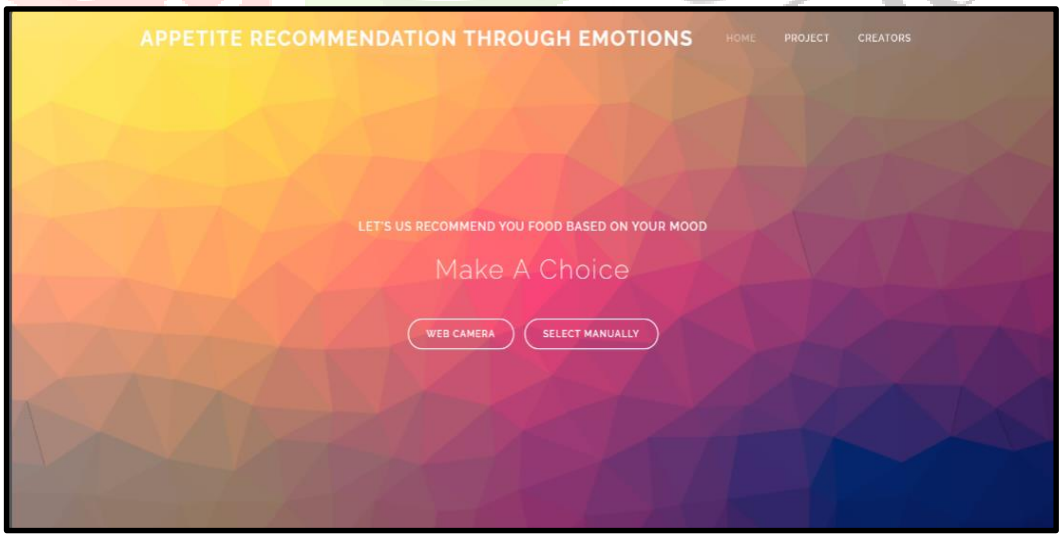


Fig. 7: Figure displaying Home page

Participants might choose from nine distinct moods while using the manual mood selection tool. The following emotions were among them: "Happy," "Sad," "Laziness," "Angry," "Stress," "Hungry," "Boredom," "Cold Weather," and "Watching TV." The technology allowed users to identify their mood and then suggested eateries based on that selection. The manual mood selection features results demonstrated that participants

thought the restaurant selections made sense and matched the emotions they had chosen. This tool improved users' dining experiences by giving them a carefully chosen list of selections.

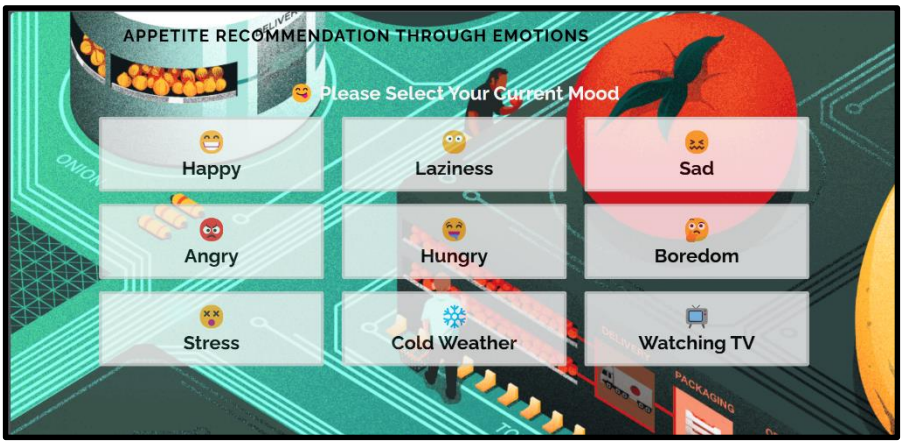


Fig. 8 : Figure showing Manually Choosing Your Mood

Real-time camera input was used by the face emotion identification tool to record users' emotions and facial expressions. Many emotions were recognized by the system, such as "Happiness," "Sadness," "Surprise," and "Anger." The facial expression detection feature's outcomes showed how well the program could recognize and react to users' emotions. Customers said that the restaurants that were suggested to them improved their eating selections and matched their emotional context. After choosing your preferred mood by clicking on any card, a different page where we will provide you with recommendations for restaurants in that specific city. Based on the pricing and rating for each cuisine, the restaurants are combined.


Fig. 9 : Figure showing Facial Emotion Detection

The facial emotion detection figure depicts a systematic process beginning with the mood input module, allowing users to manually input emotions or enabling automatic facial expression capture through a camera. Subsequently, the the analyzes facial expressions, employing an emotion prediction model based on machine learning. The predicted emotional state is then utilized by a K-means algorithm to recommend suitable food choices. Further, the the creates restaurants based on the user's culinary preferences and emotional state. This visual reflection succinctly illustrates the seamless flow from emotional input to personalized restaurant recommendations, providing an intuitive understanding of the facial emotion detection system.

## 5. CONCLUSION

The study report describes the effective use of an online application that makes restaurant recommendations based on mood and emotion. Users can have a more engaging and individualized dining experience with both manual mood setting and real-time facial emotion detection.

To sum up, the appetite recommendation through emotions initiative offers customized food recommendations based on user moods to improve the dining experience. To build a reliable and user-friendly system, a variety of technologies and development techniques were used throughout the process. The project effectively detects the user's mood manually or through facial expressions and matches it with appropriate meal alternatives by utilizing machine learning algorithms, sentiment analysis techniques, and data processing.

Python libraries with effective machine learning, data processing, and visualization capabilities, including Word Cloud, NumPy, Matplotlib, Pandas, and scikit-learn, were used in the project's implementation. We were able to manage big datasets, get significant insights, and produce aesthetically pleasing data visualizations thanks to these technologies.

## 6. FUTURE SCOPE:

The accuracy and personalization of the recommendations can be enhanced by integrating increasingly sophisticated machine learning algorithms, to start. Deep learning, natural language processing, and sentiment analysis are a few techniques that can offer more in-depth understanding of user preferences and moods, resulting in recommendations that are more specifically catered to.

Furthermore, by adding current user experiences and viewpoints, the recommendation system can be improved by combining user reviews and feedback. Over time, this can assist in improving the suggestions and adjusting to the unique interests of each user. Extending the recommendation system's reach to incorporate additional variables like dietary constraints, cultural preferences, or health concerns is another possible improvement. This would enable recommendations to be more varied and tailored to meet the needs of a larger spectrum of users. Lastly, combining the recommendation system with other platforms or services—like restaurant reservation platforms or food delivery apps—can improve user convenience and offer a smooth user experience. All things considered, these improvements have the potential to improve your mood-based meal suggestion project's efficacy and user satisfaction even further.

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