EMOQ-Emotion Based Food Recommendations System

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Abstract — Emotions affect our everyday decision, our motivation to do things, our relationships, and as well as the food we eat and vice versa. Emotion sensing and machine learning technology have had many advancements in recent years which have made it possible to apply emotion detection in various fields of life. One such application of emotion recognition is in the food recommendation system for accurate and appropriate food selection by the user. Food is a complex mixture of chemicals that interact with multiple physiological systems in our body including the brain which is responsible for what we feel, think and do. In this project, we aim at building an emotion-based food recommendation system that would sense the core emotions of a person and after considering the current state of the user, such as being stressed, bored, etc., give appropriate food recommendations based on the current mood of the person.

Keywords — Emotion Recognition, Food recommendation system, Food-Mood, Machine learning, Deep face, Streamlit, Pandas

I. INTRODUCTION

One of the fundamental aspects of human beings is the ability to feel things and have emotions.

Emotions affect one's life more than one may realize. Emotions affect our everyday decision, our motivation to do things, our relationships, and so much more. Human emotions are the state brought on by the neurophysiological and hormonal changes that are associated with feelings, pleasure/ displeasure, thoughts, and our behavior. Human emotions can be classified as fear, disgust, anger, surprise, sad, happiness, and neutral which can be called the core emotions as all other emotions are subsets of these emotions, such as cheerfulness being a variation of happiness, contempt being a variation of disgust, etc can be categorized under this umbrella of emotions. These emotions affect our facial expressions and these changes are very subtle. Emotions mostly affect the mouth and eyes. The Facial muscle movements and contortions are very minute and detecting these differences can be very challenging as even the slightest change in expression can result in a different emotion.

With the rising advancements in machine learning technology, reading the emotions of a person has become easier than ever. There are pre-built libraries now which can detect the core emotions. Therefore, with the rising advancements in emotion recognition technology, there is also a rising advancement in the application of these techniques. As emotions affect almost every aspect of our life there are various applications for this technology. One such application is in the recommendation of the food we eat. There is no doubt that our mood affects the food we eat and vice versa is also true. For example, when we are stressed or upset we tend to eat a particular comfort food even though we may not be actually hungry, this kind of hunger is known as emotional hunger.

From a biochemical standpoint, food is a complex mixture of chemicals that interact with multiple physiological systems in our body including the brain which is responsible for what we feel, think and do. As mentioned above, It is well known that many people have their "comfort food" when they are feeling moody. There are studies that show, that food like chocolate and coffee greatly affect mood by increasing positive feelings and relieving fatigue, fruits like bananas are responsible for the release of serotonin which makes us feel "happy". As we can see that our emotions are related to the various chemicals such as caffeine and serotonin which are present in the food. Although we can determine a healthy diet to enhance our mood, as human beings we do not eat healthy food all the time. We generally have "cravings" to eat something while we are either doing something or just feeling a certain way. These cravings are related to emotional hunger. Emotion-sensing technology can help us in determining the best food for our emotional hunger. It is not possible to determine the food just based on the core emotions such as happiness, sadness, fear, etc. but we can increase the accuracy of recommendations by detecting these core emotions and combining them with the emotional state of a person at that time to give out the accurate food recommendation to enhance the mood.

In this project, we are going to build an emotion-based food recommendation system that would sense the core emotions of a person and after considering the current state of the user give appropriate food recommendations based on the current mood of the person.

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II. LITERATURE REVIEW

To design an Emotion-based Food recommendations system, we were bound to research various project papers on an existing system. The relationship between mood and food is still being researched and there are only research papers and initial attempts at building a mood-based food recommendation system. One of the recent applications of emotion-sensing in food recommendations is the "Mood Based Food Recommendation System"[1] which is a website designed where the user gets personalized food recommendations. The user selects their current mood out of the options provided. Based on given inputs the website recommends food items to the user. Another recent research was done in "AIoT Application For Food Recommendation based On human analysis"[2] by using IoT and AI. In this project, AI cameras and IoT devices are used to detect the emotions of the user and recommend food based on the core emotions of the user. Another variation in mood-based food recommendations is the "Restaurant recommender system based on sentiment analysis"[3] which recommends nearby restaurants to the user based on sentiment analysis. They use a semantic approach to cluster the name of foods extracted from users' comments and analyze their sentiments about them. After the sentiment analysis, a nearby restaurant based on their comments is recommended. "A recipe recommendation system that considers user's mood"[4] is another approach to relating food with mood. It is a recipe recommender that suggests homemade food to the user. Another variation of a food mood recommender includes the "Mood food recommender"[5] which recommends three comfort foods to the user based on the user's current mood. The system uses a survey dataset of comfort foods and comfort food reasons along with NLP to recommend the food. "Moodie Foodie"[6] is a web application that recommends food based on core emotions and also provides features for sellers to sell food on the website. The user has to select one of the core emotions based on his current mood and then a list of predefined food items is presented to the user.

A recommendation system that considers the nutritional information and user preferences[7] has also been developed by R. Y. Toledo. We further studied recommendation systems that have been developed[8]. From the above literature survey, we decided to not just be limited to core emotions for recommending food but also consider the current state of the user and use a combination of both to recommend the food items.

III. METHODOLOGY

A. Theory

1.DeepFace

DeepFace[9] is facial recognition and facial analysis library in python. It was created by the AI research group at Facebook in 2014. Besides its facial analysis module, it also covers age, gender, and race recognition. This module is mainly based on TensorFlow and Keras libraries in python which provide an interface for the artificial neural networks. Facial emotion recognition consists of four different stages: detect, align, represent and classify. For the detection of a face in a frame, we have to use the Haar cascade algorithm with the help of Open-CV. Open-CV is a computer vision library in python.

DeepFace deploys a 9-layer CNN(Convolutional neural network) which maps the image with more than 120 million connection densities and was trained for over 4 million images uploaded on Facebook by people. The model reached over 97.35 ± 0.25 % accuracy for emotion and face recognition. Thus it predicts more accurately than humans. DeepFace library is divided into four modules; 2-D alignment, 3-D alignment, Frontalization, and Neural Network. The 2-D alignment detects 6 fiducial points on the detected face and identifies the center of the eye, the tip of the nose, and the mouth. These points are now wrapped into another image since 2-D alignment fails to do rotations. Thus here we use 3-D alignment. In 3-D alignment, we detect 67 fiducial points; these points help to improve the rotations. The neural network is a sequence of layers that are arranged as a convolutional layer - max-pooling - convolutional layer - 3 locally connected layers - fully connected layer. The input is an RGB image of the face, scaled to the resolution 152 X 152, and the output is a real vector of dimension 4096, being the feature vector of the face image. The accurate and precise results are obtained from this light-weighted machine learning model

2. Streamlit is an open-source python framework used for building web apps where Machine learning and Data Science models can be deployed. Streamlit allows you to make an app by writing python code. We can create very appealing user interfaces for our models using streamlit. With only a few lines of code, one can create stunning-looking web apps.

B. Method

1. Dataset-Defining a relationship between mood and food is the other main half of our project. There is a data set on Kaggle under the Mood Food Recommender[10] project in which the author conducted a survey on food and people's behavior and mood. This CSV file has over 125 responses collected from different people and also collected their responses regarding favorite food, comfort food, etc. More so we also conducted a survey through google form in which we collected over 110 responses. In this survey, we collected information regarding their favorite food. Also, what would they prefer to eat when they are happy, sad, or angry? Even though all of this seems enough, this data wasn't arranged and organized in a proper manner. Proper validation is required where a person's mood and their current state of mind are related to the suggestion which will boost them up. Thus a properly validated dataset from over 2-3 different surveys and researching through the internet we mapped a few different kinds of food for different mental

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states.

	Hunger	Bored	Tired	Relaxed	Lazy	Work-mode	Try something New
Happy	Comfort Food	Carrots, Snap-Pea	Oatmeal, Apples, I	Pizza, Chocolate, Ic	Carrots, Snap-	Nuts and dried foc	French Toast Stuffe
Sad	Comfort Food	Choco-chips, Fruit	Banana, Yogurt,	Chocolate, Cashews, I	Choco-chips, I	Greek Yogurt, Chc	Banana-Nutella Cre
Neutral	Comfort Food	Light popcorn, Chi	Chocolate, Eggs, I	Ice cream, Chocolat	Light popcorn,	Nuts and dried foc	Eggs Diablo, Eggs
Anger	Comfort Food	Eggs, Almonds, Fi	Banana, Apple,	Chocolates, Chocolate	Banana, Apple,	Chocolates, Cho	Chocolate-Coconut
Comfort food							
Biryani							
Chicken wings							
chicken nuggets							
Pizza							
Burger							
Chicken biryani							
Pani Puri							
Ice cream							
Sandwich							
Dabeli							
Shev puri							

Fig. 1. Validated data set of core emotions, state of mind, and food.

2. Algorithm- The algorithm that we used for face detection during a live video frame is the Haar Cascade algorithm. Paul Viola and Michael Jones came up with the Haar Cascade algorithm which is one of the foremost powerful and oldest algorithms ever. Haar Cascade is an object detection algorithm that detects objects during a real-time frame or a picture. This algorithm uses edge or line detection features provided in the paper "Rapid Object Detection using a Boosted Cascade of Simple Features" published in 2001[9]. Haar cascade is a machine learning-based approach where an image is classified as a positive or negative image and can be used to train the classifier. Positive images contain the object we want to identify and negative images contain everything except our object. The model created from this training to detect faces in an image or real-time video is obtainable at the OpenCV GitHub repository. This repository contains the models stored in XML files which can be accessed with the OpenCV methods. These include models for face detection, eye detection, upper body, lower body detection, etc. The algorithm can be described in four stages

- Calculating haar features
- Creating integral images
- Using Ada boost
- Implementation of cascade classifiers

Each pixel is given a relative value between 0 and 1, where 0 is for the smallest amount of intense pixel and 1 for the darkest pixel. Then three different features are accustomed for calculating the summation of the pixels in the darker and lighter area.

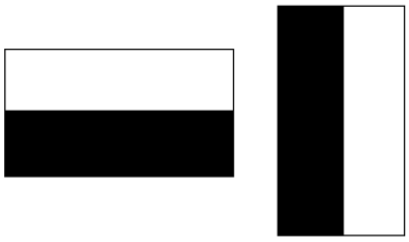

Fig. 2. (a) Edge feature

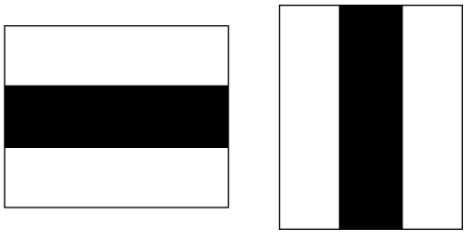

Fig. 3. (b) Line Feature

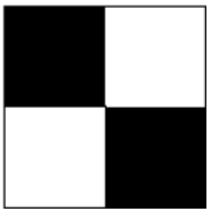

Fig. 4. (c) Four-rectangle features

The haar feature continuously travels from top left to bottom right. Haar cascade features: Fig. 2. shows the Edge feature which is answerable for searching for finding out the lighter and darker regions along the edge, and FIg. 3. (b) Line features compare adjacent rectangular regions with darker and lighter pixels, lastly, Fig. 4. (c) Four-rectangle feature is employed for comparison along the diagonal. For a larger image, it will be crucial to determine these features. This is where the role of integral images comes into play as the number of operations is reduced using the integral image. So, instead of calculating for each and every pixel, the entire image is divided into rectangular fields and then each feature is passed over the field to calculate the Haar feature. Now if the rectangular field contains the least amount of haar feature then it would be inefficient to use it as a classifier, here the Adaboost training plays a major role. Adaboost helps to choose the best feature and trains the classifier. Weak learners are trained using boosting, which allows for a highly accurate classifier from the mean prediction of all weak learners. Based on this prediction, the classifier either decides to point to an object that was found (positive) or travel to the following region (negative). Stages are designed to reject negative samples as fast as possible because a majority of the windows don't contain anything of interest.

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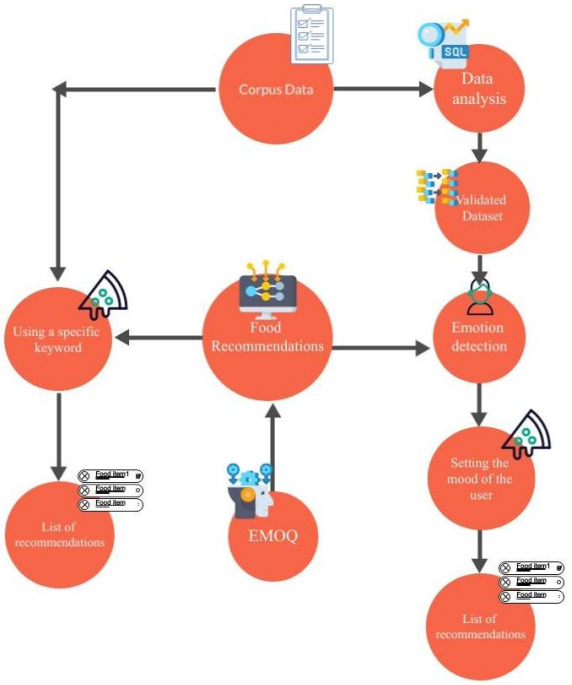

Fig. 5. System architecture and flow of logic

C. Testing

DeepFace doesn't give precise results as expected and also it is limited to 7 emotions: happy, neutral, sad, anger, disgust, fear, and surprise. So for recommending food accurately, we added another parameter, that is the state of mind of the user, which the user can select from the available options. Using emotion and state of mind as two parameters we were able to improve the accuracy of our recommendations.

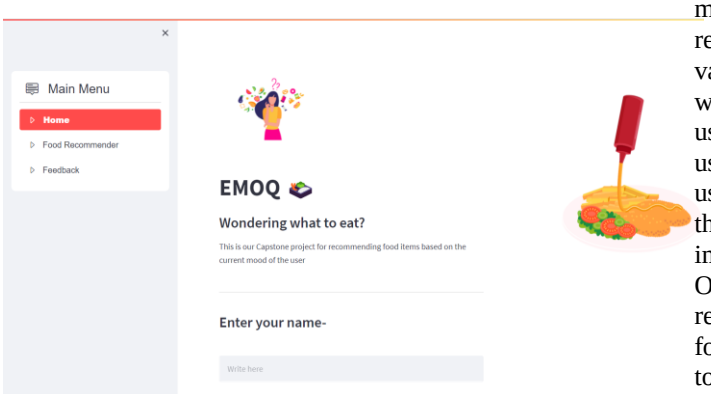

Fig. 6. Home page of "EMOQ" web app

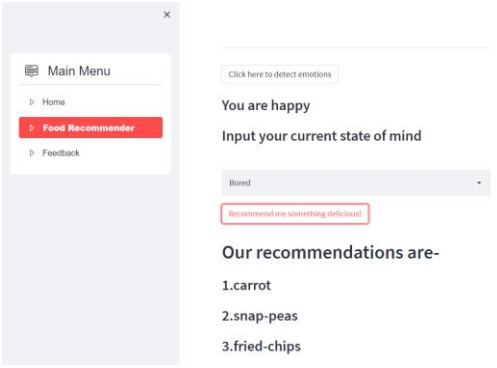

Fig. 7. Food recommender page

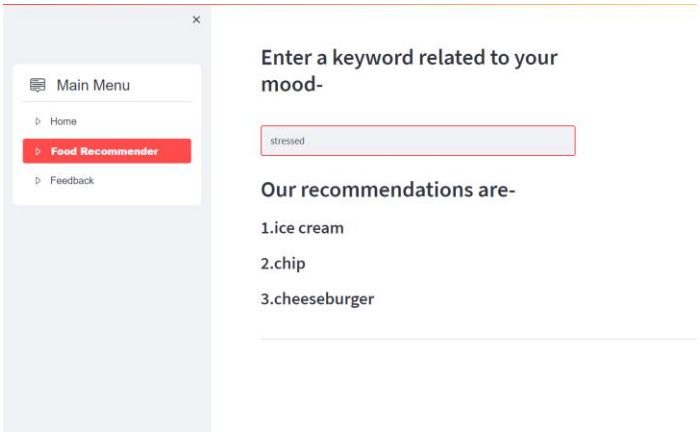

Fig. 8. Food recommendation through keywords

IV. Results and Discussions

Our web application is able to detect the emotions of the user using the Deep face model and we consider the current mental state of the user for better accuracy with food recommendations. These recommendations are based on the validated dataset we created for this project. Apart from this, we have also added a method to input certain keywords from users about their current mood and recommend food items using the Kaggle dataset for a wide scope of moods. The user can also provide feedback regarding his experience with the recommendation system which can then be used to improve the recommendations.

Our web app can be loaded with the dataset of a particular restaurant, through which the user can get recommendations for that particular restaurant. A similar application would be to deploy it in an online food ordering service application but to achieve accuracy with recommendations when we are dealing with multiple restaurants, an ever-changing menu, and a wide variety of customers we need a very large dataset that has been validated.

Nutrition being one of the most influential factors on our health, small changes also make a huge impact. With the increasing number of options available on the menu, it is not possible to take them all into account. The only way to traverse through all the options available and choose the best-suited nutrition is to use a recommendation system.

Recommendation systems have changed the way products or websites interact with users and have allowed businesses to

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increase their sales and profits based on the information they gather on every customer. Building an accurate food recommendation system will revolutionize the food industry for the better. The mood is one of the many factors we need to consider while building a food recommendation system. Our project is still far from being the most accurate recommendation system as we were working with a limited dataset. To further develop this model we will need to increase the amount of data that we input and validate the data for accuracy.

V. FUTURE SCOPE

Smart-Waiter -

Recommendation systems have an impact on the consumer's intentions and decision-making process. This is especially true in a restaurant where the customer has trouble selecting from a vast menu and would prefer to have some kind of usual food instead of trying something new. A smart waiter with emotion-sensing capabilities would be able to recommend food based on the customer's current mood along with a few other parameters. Emotion-sensing ability also enables a robot to act more humanely through the use of machine learning and artificial intelligence. It could give the customer a more personalized experience in the restaurant. The smart-waiter could also take feedback from the customer and improve its services accordingly.

Technological expansion of mood-based food recommendation systems includes an increase in the accuracy of the recommendation and an increase in the variety of the recommended food.

VI. CONCLUSION

A mood-based food recommendation system using pandas and Deepface has been developed. Food recommendation systems are receiving increasing attention due to their relevance in the modern world for a healthy lifestyle. Our system detects core emotions and then takes inputs about the current state of the user to recommend the food. This project is still in the initial stages of development in mood-based food recommendations and it will advance further along with emotion detection technology and research being made on the relationship between food and mood.

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