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AI Smart Software for Food Industry

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Abstract : This project aims to develop a software system based on existing knowledge of Artificial Intelligence which will eliminate the need of human employees for taking orders at food industry. This will eliminate human limitations and errors. The proposed software will do so by giving recommendations for food items based on identity and emotion of the person.

Our project plans to incorporate this research to increase sales of food industry. In this project we will implement facial emotion recognition in order to suggest and recommend a personalized menu or food items using a food recommendation model. It will give the suggestions and recommendations according to the emotion of the user and the data regarding to which previous users of the same emotion have ordered. This increases the chances of the customer to order more food and be satisfied with the menu and visit again, hence increasing sales. The emotion recognition will be done using the Facial Emotion Recognition library in python and recommendation will be done using recommender system. There are a lot of applications where websites collect data from their users and use that data to predict the likes and dislikes of their users. This allows them to recommend the content that they like. Recommender systems are a way of suggesting or similar items and ideas to a user's specific way of thinking.

IndexTerms – Facial Emotion Recognition, Recommendation Model.

I. INTRODUCTION

In our daily life, we knowingly or unknowingly carry out different types of Facial Expressions. These movements convey the emotional state of humans. We can judge the mood and mental state of the next person by his Facial Expression. Emotion is one of the very few words in the English language that do not have a concrete definition and it is understandable. It is abstract. Yet, almost every decision we have ever made in our lives is driven by emotion. Facial emotions are important factors in human communication that help us understand the intentions of others. Marketing research has proven that predicting sentiments correctly can be a huge source of growth for businesses.

Traditionally, people had to make calls to place orders or drive to the restaurants for a take-out. Sometimes, placing an order on the phone means that there could be mistakes in order. Clearly, these aren't really the best solutions to order food from restaurants especially for people with busy lifestyles. While a few months ago, minimizing human contact during restaurant transactions was merely a preference, the COVID-19 pandemic has elevated that preference into a priority. During COVID-19, minimal contact helps protect customers, employees, and the public at large from the spread of the virus.

The project is undertaken to incorporate "AI technology in food industry", making the process simpler. The loop of what to eat and what not to eat and then ending up choosing the regular cuisine is so much annoying. So it basically deals with recommending meals based on your eating preferences and let you explore something different. The food industry is largely dependent on the data about flavor combination, customer's cuisine choices and combinations that people frequently reorder. This kind of information allows company to launch innovative products in the market and help generate revenue. The food industry is known for its limitless choices of spices, flavors and ingredients and hence recipes can be twisted in unbelievable ways. It is rather challenging to settle on what precisely customers want. But Artificial Intelligence can help with this process, where it can tell food companies to what to output based on customers preferences. For recognizing the emotion, we will make use of Facial Expression Recognizer(FER) Library of Python and for person identification we will use mobile numbers as ID's.

II. RELATED WORK

A solution is given by Castrograph AI, it predicts the flavours and preferences of customers at the pre-production stage. AI for food understands the human perception of flavour and preferences, dividing users into different demographic groups and modeling their preference behaviour or predicting what they want, even before they do.[1]

Developing an expert system for diet recommendation - Menu construction is an important task for institutions that need to plan menus within certain constraints. There is also a personal need for professional menu construction by clients or patients who should eat according to a planned diet. For menu construction and dietary analysis, there are several approaches (e.g., linear programming, genetic algorithms, rule-based expert systems, etc.) and commercial IT systems. They have proposed a case-based approach for diet recommendation. Based on this approach, they constructed an expert system which is intended to be employed in a health record management system. Their approach is based on ripple down rules (RDR), however a special representation is also needed for patient attributes and rule actions.[2]

According to different surveys, verbal components convey one-third of human communication, and nonverbal components convey two-thirds. Among several nonverbal components, by carrying emotional meaning, facial expressions are one of the main information channels in interpersonal communication. Therefore, it is natural that research of facial emotion has been gaining lot of attention over the past decades with applications not only in the perceptual and cognitive sciences, but also in affective computing and computer animations.

Also, conventional FER approaches are described along with a summary of the representative categories of FER systems and their main algorithms. Deep-learning based FER approaches using deep networks enabling “end-to-end” learning are then presented. The review also focuses on an up-to-date hybrid deep-learning approach combining a convolutional neural network (CNN) for the spatial features of an individual frame and long short-term memory (LSTM) for temporal features of consecutive frames.

Types of Recommendation System that exists already,

Collaborative Filtering - Collaborative Filtering recommends items based on similarity measures between users and/or items. The basic assumption behind the algorithm is that users with similar interests have common preferences.

Content-Based Recommendation - It is supervised machine learning used to induce a classifier to discriminate between interesting and uninteresting items for the user.

Collaborative Filtering - Collaborative filtering is based on the idea that similar people (based on the data) generally tend to like similar things. It predicts which item a user will like based on the item preferences of other similar users. Collaborative filtering uses a user-item matrix to generate recommendations. This matrix contains the values that indicate a user's preference towards a given item. These values can represent either explicit feedback (direct user ratings) or implicit feedback (indirect user behavior such as listening, purchasing, watching).

A brief review of publicly available evaluation metrics is given, and a comparison with benchmark results, which are a standard for a quantitative comparison of FER researches, is described. This review can serve as a brief guidebook to newcomers in the field of FER, providing basic knowledge and a general understanding of the latest state-of-the-art studies, as well as to experienced researchers looking for productive directions for future work.

Facial emotion recognition (FER) is an important topic in the fields of computer vision and artificial intelligence owing to its significant academic and commercial potential. Although FER can be conducted using multiple sensors, we will focus on studies that exclusively use facial images, because visual expressions are one of the main information channels in interpersonal communication.

The food industry has already invested heavily in automation, with far-reaching benefits across multiple levels of production. Processors are under constant pressure to produce food in greater amounts and variety, and it's no secret that automated processes can perform tasks faster and more accurately than their manual counterparts. Moreover, food safety concerns are greater than ever following the pandemic, and minimizing human contact and human error in processing can have substantial benefits for food hygiene. It's important to note that automation isn't solely about digitalizing individual processes. Connecting all automated processes across the entire company creates an integrated, centralized approach. Process or machine-level automation certainly yields benefits, but connecting all those processes amplifies those benefits to boost production, streamline processing to reduce waste, and ultimately support a better way of working.

Artificial Intelligence in Food Safety

Due to the sterile nature of robots, it is widely acceptable in food processing industries. However, the maintenance of an AI-based system is simple and easy [2, 49]. According to the report published by Technavio, the implementation of robots in food processing industries will lift up by 30% and also fulfill the government's demands. There are also some new revolutionary inventions by using artificial intelligence in food safety approaches that are anticipated to become well-known soon. They have the major objective to plummeting the frequency of food-borne diseases.

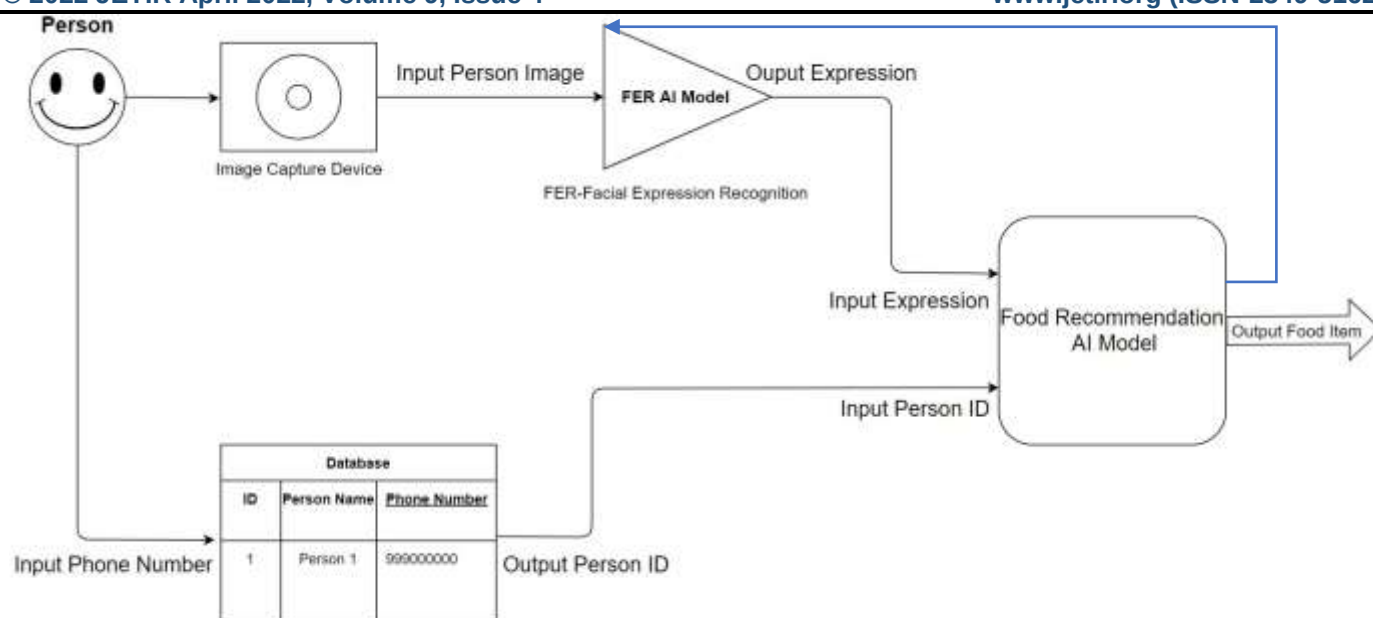
As it is in many industries, artificial intelligence (AI) is making huge waves in the world of food and beverage. More and more organizations within the industry are recognizing the potential of AI to drive greater efficiency and profits, reduce wastage and provide protection against supply chain disruptions. It's all part of what is known as Industry 4.0 - the growing emergence of smart technology like AI in traditional industries like food and beverage. By "AI" we are simply referring to machinery and technologies used to carry out complex tasks that previously required human thought to complete. AI in the food industry comprises a number of technologies, from robotics to machine learning.

Here are five ways AI is transforming the food and beverage industry for the better:

- Developing New Recipes Guided By Consumer Trends
- Better Supply Chain Management
- A More Efficient Cleaning Process
- More Hygienic Production Lines
- Food Sorting
- Food Business is also Embracing AI
- Kiosks
- Apps and Chatbots
- Robot
- Recommendation Engines
- Food Safety
- Best Quality Cleanliness

III. RESEARCH METHODOLOGY

1. For recognizing the emotion, we will make use of Facial Expression Recognizer (FER) an existing Library which is developed by Justin Shenk. This Library requires OpenCV ≥ 3.2 and Tensorflow $\geq 1.7.0$ dependencies installed in the system. Faces are detected using OpenCV's Haar Cascade classifier.
2. Detector returns a list containing the Ordered dictionary of bounding box notations where the face is detected and all the 7 emotions in decimals values from 0 to 1.
3. The FER contains the Keras model built with convolutional neural networks and weights saved in HDF5 model.
4. Then the output will be fed as input to a Content-Based Recommendation System. Content-Based systems recommends items to the customer similar to previously high-rated items by the customer. It uses the features and properties of the item. From these properties, it can calculate the similarity between the items.
5. Here the user profiling is done by taking basic information such as name and mobile number as input and stored in a database.
6. A feedback is also given from the output of recommendation model to FER to improve learning, accuracy & precision of the overall model.



Emotion Recognition

Emotion recognition is the use of computers to detect human faces and analyze the characteristics of the performance information. The machine realizes the purpose of human beings' recognition and understanding of emotional expression. From the point of view of the expression recognition process, emotion recognition can be divided into three main steps, namely, the detection and position of the face, the feature extraction of the expression, and the classification of the expression.

Face Detection and Positioning

The detection and localization of facial images is the first step in facial expression recognition. The content of this step is to find the correct position of the face from the acquired image or image sequence. Webcam access is permitted to detect face of the customer on the system.

Extraction of Facial Features

An important part of the facial expression recognition process is facial expression feature extraction, and its main function is to extract information features that can characterize human facial expressions. Then, customer's image will be captured on the system, FER will extract facial features for that customer and will analyze it for further processing. When a person's facial expression changes, important information features will be extracted from the deformation process of the face and accordingly the output of the system will vary.

Facial Expression Classification

Expression classification analyzes the relationship between expression functions and assigns them to corresponding categories. Like, analyzing the emotion (using FER) and recommending a food item for the customer for that emotion and also simultaneously keeping track of what other customers ordered based on similar emotion (as input to the system) and utilizing the complete information for making decision of recommending food items, it helps the system to improve performance & accuracy. Next, the method based on neural network is used. The neural network is composed of various parallel units. The change of expression drives the change of the neural network. The output node of the neural network corresponds to 10 general basic corresponding points. The output node connects multiple processing neurons to form the entire neural network structure. Artificial neural networks can learn repeatedly and obtain invisible effects from the corresponding point rules. After feature extraction, according to the performance classification method of artificial neural network, an extremely obvious expression classification effect can be obtained.

IV. CONCLUSION

When talking about the food industry, technology isn't usually the first thing that comes to mind. But nowadays, technology in the food industry is an essential factor. We have proposed a working model of AI Smart Software using emotion recognition, face recognition & recommendation model technologies. The proposed model will be helpful in predicting output i.e giving food recommendations after analyzing emotions from the captured image of a person.

The implementation of AI Smart Software in food industry is already moving to a new level, enabling fewer human errors and less waste of abundant products, lowering cost for storage/delivery and transportation and creating happier customers, quicker service and more personalized orders.

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