International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 07 | July – 2025 DOI: 10.55041/ISJEM04858
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

Study and Analysis of Human Emotions Based on Consuming Food Using CNN Approach

K.TULASI KRISHNA KUMAR, GOLLU SAIKIRAN
Training & Placement Officer, Student Final Semester - MCA,
Master of Computer Applications,
Sanketika Vidya Parishad Engineering College, Vishakhapatnam, Andhra Pradesh, India.

Abstract:

In this project, we aim to use OpenCV, Python, HTML, and Flask to identify the facial expressions of customers while they are eating in restaurants. As food is a fundamental source of sustenance, it is essential to ensure customer satisfaction. With the help of this technology, machines can now understand the expressions and feelings of human beings. To tackle the issue of uncertainty in customer satisfaction, our project involves live prompting and a video uploading section, where the system verifies the expressions of customers while eating and predicts the probability of their satisfaction. To predict this, we used the CNN algorithm. This rating system provides valuable insights for restaurant owners to improve their offerings on a daily basis, which can lead to increased customer satisfaction and business growth. The system is designed to be non-intrusive and can function seamlessly in the restaurant environment without disturbing customers' dining experience. It leverages real-time video analysis and facial recognition techniques to continuously monitor emotional changes throughout the meal. Expressions such as happiness, disgust, surprise, and neutrality are mapped to a satisfaction index, which helps quantify the emotional response of each customer.

INDEX TERMS: Open CV, Python, Jupiter Notebook, Anaconda Navigator, Feedback System, Face Recognition, Emotion detection, Web Development, Database

1.Introduction

Food is one of the most essential resources for human survival. It is impossible for a person to live without consuming food in their daily life. With the vast variety of food items available today, people often prefer eating at restaurants or trying street food due to their busy schedules. These food outlets gradually become personal go-to places for many individuals. As a result, restaurant owners generate profits by serving different food items to meet customer demands. However, a major challenge arises when customers leave without providing any feedback on the food they consumed. Without clear feedback, it becomes difficult for restaurant owners to understand whether the food was satisfactory or not. This lack of insight leads to continued production of potentially unpopular or disliked dishes. By the end of the day, many restaurants end up discarding large quantities of leftover food, leading to significant food wastage. This not only affects the environment but also impacts the restaurant's efficiency and profitability. To address this challenge, our project introduces a smart solution that uses image processing and facial expression recognition to analyze the emotional response of customers while eating. A camera captures the customer's facial expressions in real-time, and our system classifies the emotions into categories such as happy, neutral, or dissatisfied. If the expression is positive, the restaurant can continue offering the same recipe with confidence. However, if the expression indicates dissatisfaction, the restaurant can take further action—either by modifying the recipe or removing the item from the menu. Over time, this system allows restaurants to fine-tune their offerings based on genuine, unbiased customer reactions. This intelligent feedback mechanism not only helps in reducing food wastage but also enhances the overall quality of food service. By integrating artificial intelligence and human emotion recognition, the project empowers restaurant owners to make data-driven decisions, optimize their menus, and improve customer satisfaction.

2. LITERATURE SURVEY

The integration of artificial intelligence in human emotion recognition has gained significant traction over the last decade. With the rise of machine learning and deep learning techniques, especially Convolutional Neural Networks (CNNs), the ability to analyze facial expressions with high accuracy has become a key area of interest across industries like healthcare, automotive, and now food services.

- Facial Emotion Recognition (FER) Systems

Previous studies have shown that facial expressions are one of the most accurate indicators of a person's emotional state [2]. Ekman and Friesen's work on the Facial Action Coding System (FACS) laid the foundation for emotion classification using facial features. Modern FER systems leverage CNNs for automated detection and classification of expressions such as happiness, sadness, anger, surprise, disgust, and neutrality.

- CNN for Image Classification

CNNs are highly effective for tasks involving image processing and classification due to their hierarchical learning structure [5]. Research by Alex Krizhevsky et al. (2012) on AlexNet demonstrated the capability of CNNs to outperform traditional algorithms in object recognition, laying the groundwork for emotion detection through facial image data. Similarly, models like VGGNet, ResNet, and MobileNet have further enhanced real-time performance and accuracy in emotion recognition.

- Real-Time Emotion Recognition

Real-time facial expression detection has been explored in various studies using datasets like FER-2013, CK+, and JAFFE. These works focus on real-time emotion detection from video feeds using lightweight CNN architectures suitable for deployment in real-world environments such as classrooms, automobiles, and public places.

- Emotion-Based Feedback Systems in Food Industry

While traditional feedback mechanisms (manual forms, ratings) have been prevalent in restaurants, recent studies have looked into the use of sentiment analysis from text or speech. However, facial expression analysis during or after food consumption remains a relatively unexplored domain [3]. Research by Zhou et al. (2018) proposed using AI-based emotion tracking in dining scenarios to monitor elderly care nutrition, suggesting similar potential in restaurants to analyze customer satisfaction.

- Food Wastage and Customer Satisfaction

Food wastage is a major concern in the hospitality sector. Studies by the Food and Agriculture Organization (FAO) show that up to one-third of all food produced is wasted. A contributing factor is the inability of food providers to gauge consumer preferences accurately. This project aims to bridge that gap by introducing a feedback mechanism based on customer emotions, helping restaurants adjust their menu dynamically based on emotional responses.

2.1 Challenges

- Real-Time Image Capture in Dynamic Environments

Capturing clear facial expressions while customers are eating can be difficult due to frequent movements, head rotation, partial face occlusion (e.g., by hands, utensils, or food), and changing lighting conditions in restaurants.

- Expression Variation While Eating

Unlike normal emotion datasets, facial expressions during eating may not be as expressive or easily distinguishable [8]. Subtle emotions like mild satisfaction or slight discomfort are harder to detect and require fine-grained classification.

- Limited and Unlabeled Dataset

There is a lack of publicly available datasets specifically focused on facial expressions while eating. This necessitates collecting custom datasets, which is time-consuming and may raise privacy concerns [1].

- Customer Privacy and Consent

Capturing and analyzing facial data in public or private dining areas raises ethical and legal issues [7]. Ensuring customer consent and handling data privacy (e.g., not storing or misusing facial data) is a major challenge.

- Accuracy of Emotion Classification

CNNs can misclassify emotions, especially when trained on generic datasets not suited for the specific context of eating. Improving accuracy in a noisy environment with real-world data remains a critical challenge.

- Integration with Restaurant Systems

Deploying the system in restaurants requires integration with existing digital infrastructure (e.g., POS systems or feedback dashboards) and real-time operation without affecting customer experience [10].

3. Proposed System

Facial expression recognition system: This system would use a CNN model trained on a dataset of facial expressions related to food consumption to identify and classify emotions such as enjoyment, disgust, or indifference [13]. The system would capture and analyze facial data from customers as they consume food, providing real-time feedback on their emotional response [18]. Customer feedback system: This system would integrate the facial expression recognition technology with a feedback mechanism, allowing customers to rate their food based on their emotional response. For example, the system could display a series of emojis or sliders representing different emotions, allowing customers to select their preferred response.

Analytics and reporting system: This system would collect and analyze data on customer emotions related to food consumption, providing insights into which food items are popular and which ones need improvement [4]. The system could generate reports and visualizations that show trends over time, allowing restaurant owners to make data-driven

decisions about their menu and marketing strategies. Menu optimization system: This system would use the data collected from the facial expression recognition technology to optimize the restaurant's menu, making changes based on customer preferences and emotional responses [19]. For example, the system could recommend new dishes or ingredients based on their popularity or adjust the pricing based on their emotional response.

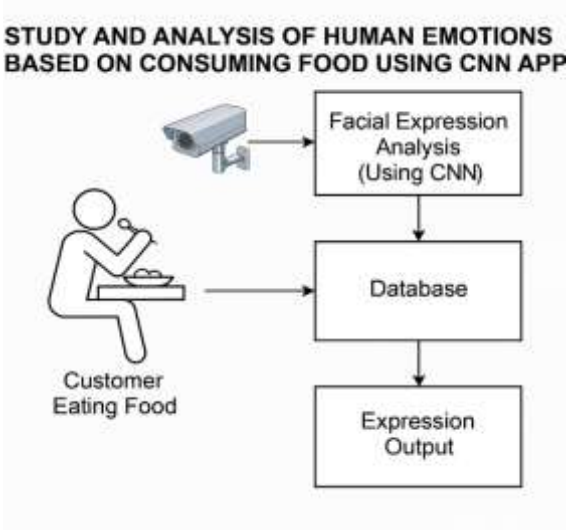


Fig:1 Proposed Diagram

3.1 Advantages

Improved customer experience: The facial expression recognition technology could provide real-time feedback on customer emotional responses to food [21], allowing restaurant owners to adjust their menu or service to better meet customer needs and preferences. This could lead to a more enjoyable and satisfying dining experience for customers. Data-driven decision-making: The analytics and reporting system could provide valuable insights into customer preferences and behavior, allowing restaurant owners to make data-driven decisions about their menu, marketing, and pricing strategies. This could lead to more effective and efficient use of resources and increased profitability [14]. Innovation and differentiation: The use of facial expression recognition technology in the context of food consumption is a novel and innovative approach that could differentiate the restaurant from competitors and attract new customers. This could increase the restaurant's visibility and reputation and lead to greater customer loyalty. Potential for scalability: Once the facial expression recognition system is developed and implemented [11], it could be scaled up to other restaurants or food service establishments. This could provide a new revenue stream for the business and increase the reach and impact of the technology.

3.2 CNN Algorithm :-

- A CNN (Convolutional Neural Network) model in facial expression recognition while eating food is a type of deep learning algorithm that is designed to analyze images or video frames of individuals eating food and recognize their facial expressions.
- The model consists of multiple layers of convolutional filters, which are applied to the input images to extract features relevant to facial expressions [20]. These features are then fed into a neural network that is trained to recognize different facial expressions associated with eating food, such as happiness, disgust, or sadness.
- To train the CNN model, a large dataset of images or video frames of individuals eating food with labeled facial expressions is required [16]. The model is then trained on this dataset using a process called backpropagation, where the network adjusts its internal parameters to minimize the difference between its predicted outputs and the true labels.
- Once the CNN model is trained, it can be used to analyze new images or video frames of individuals eating food and classify their facial expressions with a high degree of accuracy. This technology can have applications in fields such as market research, food psychology, and consumer behavior analysis [9].

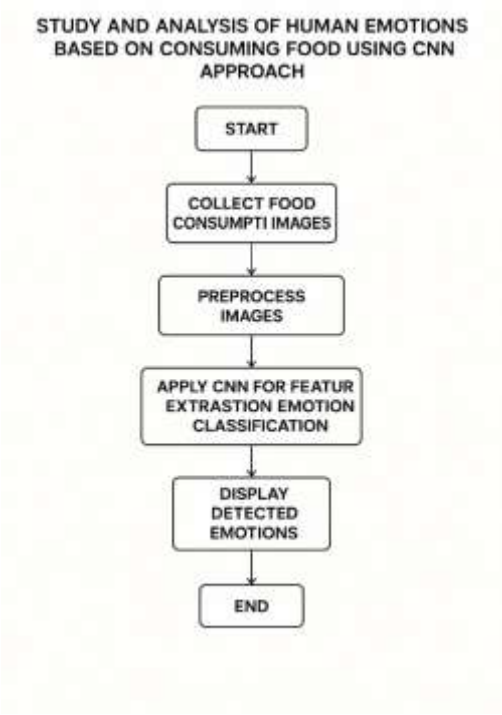


Fig:2 Algorithm

3.3 Architecture

Image/Video Acquisition Unit

- Cameras placed in dining areas capture real-time facial expressions of customers while eating.
- Ensures good lighting and angle for accurate detection.

Data Preprocessing Module

- Performs face detection (using OpenCV, MTCNN, etc.).
- Cropping, resizing, normalization of facial images for CNN input [6].

CNN-Based Emotion Detection Engine

- Input: Preprocessed facial images.
- Architecture: Convolutional layers, pooling layers, activation functions (ReLU), fully connected layers.
- Output: Facial feature maps used for emotion recognition.

Feature Extraction Layer

- Extracts emotional features like eyebrow movement, eye openness, lip curvature, etc.
- Encodes expressions into meaningful patterns [17].

Emotion Classification Unit

- Uses Softmax or SVM classifier to categorize emotions (Happy, Sad, Angry, Disgusted, etc.)
- Can use pretrained models like VGGFace, FER2013 fine-tuned for your dataset.

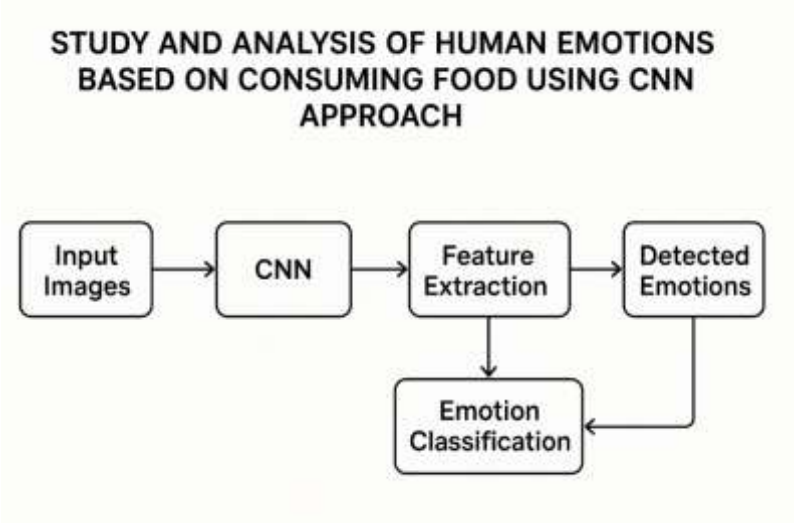


Fig:3 System Architecture

International Scientific Journal of Engineering and Management (ISJEM) ISSN: 2583-6129
Volume: 04 Issue: 07 | July – 2025 DOI: 10.55041/ISJEM04858
An International Scholarly || Multidisciplinary || Open Access || Indexing in all major Database & Metadata

4. Input

In today's world, customer satisfaction plays a crucial role in the food industry [12]. Understanding how customers emotionally respond to food can help improve food quality and service. This project focuses on analyzing facial expressions of individuals while eating, using computer vision and deep learning techniques. By capturing real-time images or videos of customers consuming food, the system aims to detect and classify emotional responses [15]. A Convolutional Neural Network (CNN) is employed to analyze facial features and predict emotions such as happiness, sadness, surprise, or disgust.

Home page :

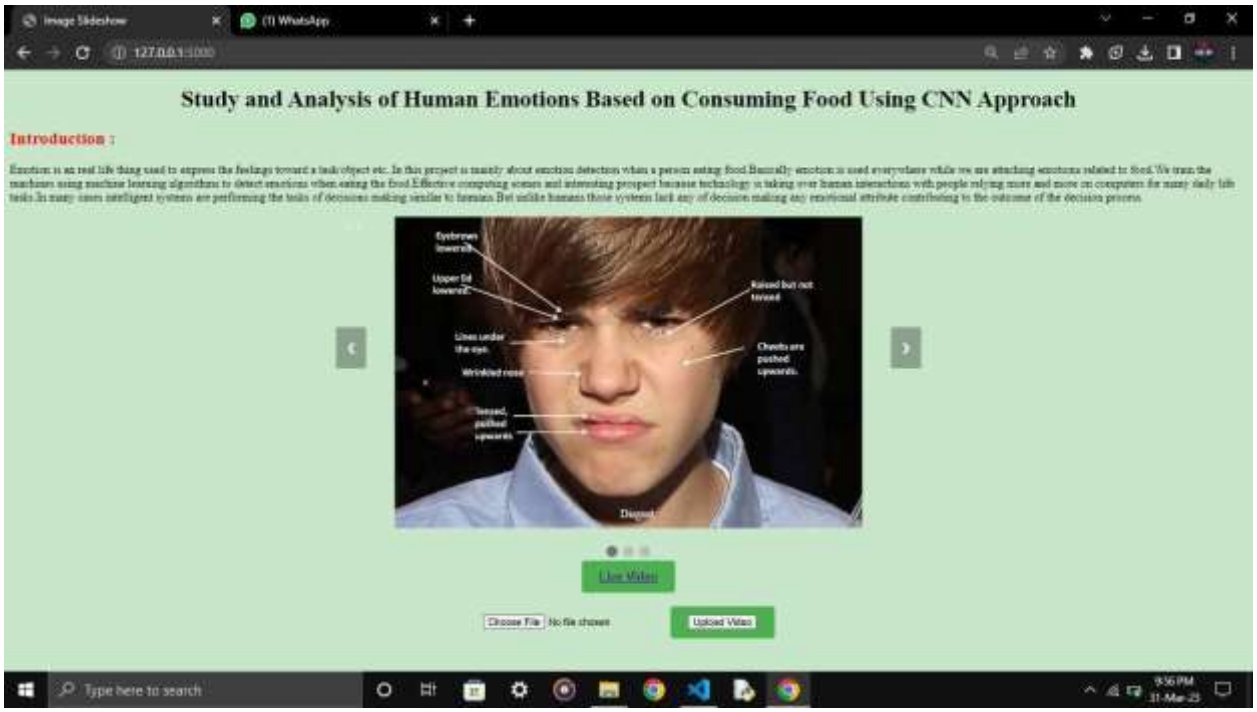


Fig. Home page consists of two options like live video or upload a video.

Result in Live prompting in neutral:

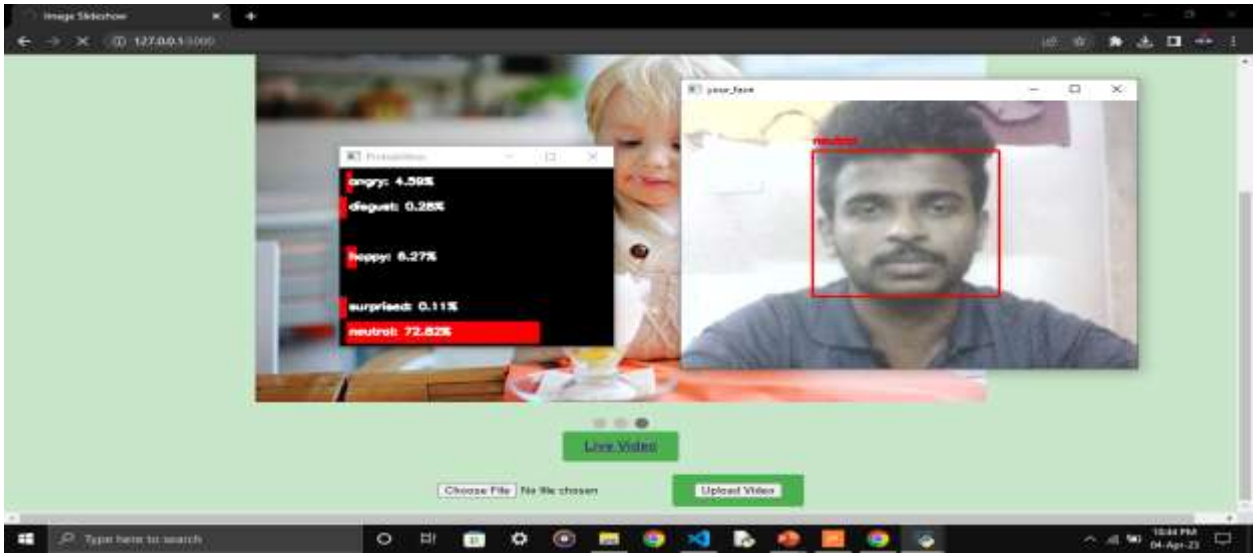
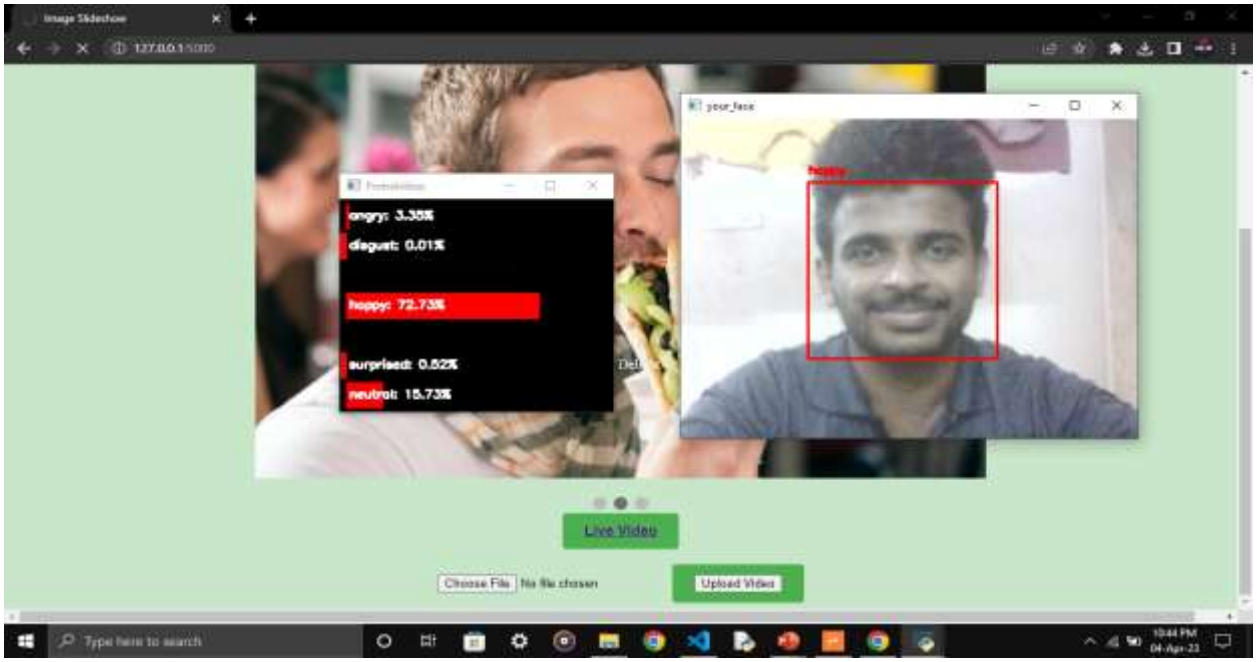


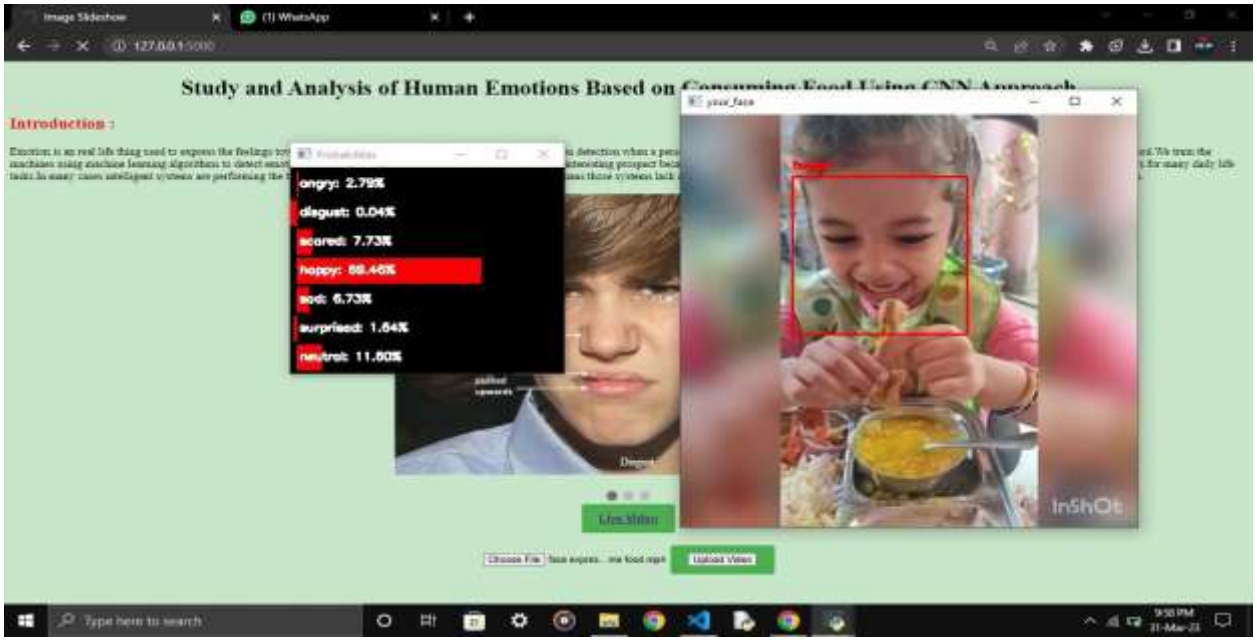
Fig. Using webcam we can upload a live video with duration of 30 sec. So that it will be redirected to the next page.

Result in Live prompting in Happy:

ISSN: 2583-6129
DOI: 10.55041/ISJEM04858



Result after uploading video:



CONCLUSION

Emotion detection using CNN provides an effective and non-intrusive way to evaluate customer satisfaction during food consumption. The project successfully demonstrates how deep learning techniques can be used to analyze facial expressions and classify emotional responses in real time. By correlating food items with customer emotions, this system enables data-driven decisions in menu design and service improvement. The use of CNN ensures high accuracy and reliability in extracting complex facial features associated with different emotions. This system can be a valuable tool in the hospitality and food service industry to personalize experiences and boost customer engagement. The captured emotional data can also be used for future research, including behavioral studies and food psychology. Overall, the system bridges the gap between artificial intelligence and human behavior, opening new possibilities for emotion-aware smart applications. Additionally, the system offers a scalable solution that can be integrated into existing restaurant infrastructures without disrupting operations. The model's adaptability allows it to improve over time with more data, ensuring continuous enhancement of prediction accuracy and emotional insights. This emotion-based feedback mechanism can also aid chefs and nutritionists in crafting meals that cater not only to taste but also to emotional well-being[21].

FEATURE SCOPE

In addition to facial expression recognition, you could also incorporate other modalities such as voice recognition, body language, or physiological signals such as heart rate or skin conductance. This could provide a more comprehensive analysis of customer emotions and feedback. The system could be customized for individual customers based on their previous dining experiences and feedback. This could allow for more personalized recommendations and better customer satisfaction. Incorporating multi-modal emotion recognition not only enhances the system's robustness but also reduces the chances of misclassification by relying on multiple input sources. Personalized emotional profiling based on dining history can transform the dining experience, making it more interactive and emotionally adaptive to individual preferences. Integration with restaurant management systems enables real-time analytics, helping staff respond proactively to negative emotions or dissatisfaction. The fusion of emotional data with inventory insights could help restaurants predict demand trends, reduce food waste, and streamline kitchen operations.

ACKNOWLEDGEMENT

Kandhati Tulasi Krishna Kumar Nainar: Training & Placement Officer with 15 years' experience in training & placing the students into IT, ITES & Core profiles & trained more than 9,700 UG, PG candidates & trained more than 450 faculty through FDPs. Authored various books for the benefit of the diploma, pharmacy, engineering & pure science graduating students. He is a Certified Campus Recruitment Trainer from JNTUA, did his Master of Technology degree in CSE from VTA and in process of his Doctoral research. He is a professional in Pro-E, CNC certified by CITD He is recognized as an editorial member of IJIT (International Journal for Information Technology & member in IAAC, IEEE, MISTE, IAENG, ISOC, ISQEM, and SDIWC. He published 6 books, 60 articles in various international journals on Databases, Software Engineering, Human Resource Management and Campus Recruitment & Training.

Gollu Saikiran is pursuing his final semester MCA in Sanketika Vidya Parishad Engineering College, accredited with A grade by NAAC, affiliated by Andhra University and approved by AICTE. With interest in Artificial intelligence K.Bhargavi has taken up his PG project on STUDY AND ANALYSIS OF HUMAN EMOTIONS BASED ON CONSUMING FOOD USING CNN APPROACH and published the paper in connection to the project under the guidance of Kandhati Tulasi Krishna Kumar Nainar, Assistant Professor, Training & Placement Officer, SVPEC.

REFERENCES

[1] Human Behavior Understanding in Big Multimedia Data Using CNN based Facial Expression
https://link.springer.com/article/10.1007/s11036-019-01366-9
[2] Analysis of facial emotion expression in eating occasions using deep learning
https://link.springer.com/article/10.1007/s11042-023-15008-6
[3] Human-Behavior-Based Personalized Meal Recommendation and Menu Planning Social System
https://ieeexplore.ieee.org/abstract/document/9942937
[4] Automatic food detection in egocentric images using artificial intelligence technology
https://www.cambridge.org/core/journals/public-health-nutrition/article/automatic-food-detection-in-egocentric-images-using-artificial-intelligence-technology/CAE3262B945CC45E4B14C06C83A68F42
[5] Comparison Analysis of LSTM and CNN Variants with Embedding Word Methods for Sentiment Analysis on Food Consumption Behavior
https://link.springer.com/chapter/10.1007/978-981-99-0405-1_14
[6] Recognizing Emotions Evoked by Music Using CNN-LSTM Networks on EEG Signals
https://ieeexplore.ieee.org/abstract/document/9148598
[7] Understanding Deep Learning Techniques for Recognition of Human Emotions Using Facial Expressions: A Comprehensive Survey
https://ieeexplore.ieee.org/abstract/document/10041168
[8] Efficient extraction of deep image features using convolutional neural network (CNN) for applications in detecting and analysing complex food matrices
https://www.sciencedirect.com/science/article/abs/pii/S0924224421003022
[9] Deep Food: Food Image Analysis and Dietary Assessment via Deep Model

https://ieeexplore.ieee.org/abstract/document/8998172
[10] Sentiment analysis from Bangladeshi food delivery startup based on user reviews using machine learning and deep learning
https://beei.org/index.php/EEI/article/view/4135
[11] Human activity classification based on sound recognition and residual convolutional neural network
https://www.sciencedirect.com/science/article/abs/pii/S0926580519307563
[12] Neural Control of Appetite and Food Choices in the Context of Food Safety
https://link.springer.com/chapter/10.1007/978-3-031-94582-3_4
[13] When Machine Learning and Deep Learning Come to the Big Data in Food Chemistry
https://pubs.acs.org/doi/full/10.1021/acsomega.2c07722
[14] Where and What Am I Eating? Image-Based Food Menu Recognition
https://link.springer.com/chapter/10.1007/978-3-030-11024-6_45
[15] Explainable automated recognition of emotional states from canine facial expressions: the case of positive anticipation and frustration
https://www.nature.com/articles/s41598-022-27079-w
[16] Prediction of the Age and Gender Based on Human Face Images Based on Deep Learning Algorithm
https://onlinelibrary.wiley.com/doi/full/10.1155/2022/1413597
[17] The People Moods Analysing Using Tweets Data on Primary Things with the Help of Advanced Techniques
https://ieeexplore.ieee.org/abstract/document/10516073
[18] Food image classification and image retrieval based on visual features and machine learning
https://link.springer.com/article/10.1007/s00530-020-00673-6
[19] Recognition of food type and calorie estimation using neural network
https://link.springer.com/article/10.1007/s11227-021-03622-w
[20] Food Image Recognition and Calorie Prediction Using Faster R-CNN and Mask R-CNN
https://ieeexplore.ieee.org/abstract/document/10335053
[21] Accurate Emotion Recognition Utilizing Extracted EEG Sources as Graph Neural Network Nodes
https://link.springer.com/article/10.1007/s12559-022-10077-5