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An Android Application for Restaurant Chain Using Voiceprint and Image Detection

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Abstract— *This Android application designed for restaurant chains, featuring voice command and image detection capabilities. The app leverages innovative techniques to enhance user security and streamline food identification processes. Users authenticate themselves by speaking a predefined special word linked to their mobile number, utilizing personalized voice patterns for secure access. The integration of voice command and image detection offers a comprehensive solution for modern restaurant chains, enhancing security, optimizing operations, and delivering a seamless dining experience. By integrating these advanced technologies, the application enhances user security, optimizes food identification, and delivers a seamless dining experience tailored to the needs of modern restaurant patrons.*

Keywords *- Android Application, Restaurant Chain, Voice Command, Image Detection*.

I. Introduction

In the rapidly evolving landscape of the restaurant industry, staying ahead requires more than just offering great food; it demands embracing technology to enhance both customer experience and operational efficiency. With the proliferation of smartphones and the increasing integration of digital solutions into everyday life, restaurant chains are recognizing the need to innovate their offerings to meet the expectations of tech-savvy consumers. This introduction presents an overview of an android application designed specifically for restaurant chains, featuring state-of-the-art functionalities of voice command and image detection. Voice command functionality offers patrons a convenient and intuitive means of engaging with restaurant services. With simple voice prompts, customers can effortlessly browse menus, eliminating the need for manual input and enhancing accessibility for users of all abilities and engaging dining experience, setting the restaurant apart in a competitive market.

Shota Sasano proposed a food Recognition by Combined Bags of Color Features and Texture Features, in which a data-driven color feature (BoCF) and a data-driven texture feature (BoTF) for food image representation, which proved the promising recognition performance on RFID database can be achieved. Instead of the uniform quantization of color and gradient intensity in the target images, we proposed to learn the color and texture prototypes directly from the images based on the strategy of bog of features, which gives much better representation of the target images. In the future, we are going to improve the recognition performance by exploring the Co occurance representation of color and texture features.

Weishan Zhang and Dehai Zhao proposed Food Image Recognition with Convolutional Neural Networks, in which they proposed a food image recognition system with convolutional neural networks(CNN), which has been applied to image recognition successfully in the literature. A CNN which consists of five layers has been built and two group of controlled trials have been processed on it. In addition, we validate the method on two groups of controlled trials and

discover the effect of color under various conditions that the color feature is not always helpful for improving the accuracy by comparing the results of two group of controlled trials.
In this paper, we propose the development of an Android application for a restaurant chain that incorporates advanced voice and image detection technologies. Implementing a natural language processing system that allows customers to place orders using voice commands. This feature will enable a hands-free and convenient ordering experience, reducing wait times and improving overall customer satisfaction.Integrating image detection capabilities into the app, enabling users to scan menu items or take pictures of dishes to access detailed information such as ingredients, nutritional facts, and customer reviews. This feature enhances menu exploration and helps users make informed decisions about their orders

II. PROPOSED METHOD

Our focus in this paper is to develop of an android application for a restaurant chain, the integration of voice command and image detection functionalities presents an opportunity to revolutionize user interaction and service delivery. By leveraging advanced algorithms, the application can accurately interpret and respond to user commands in real-time. Through natural language processing techniques, the system can understand a diverse range of user queries, facilitating seamless interactions related to menu exploration, and more.

A. GLCM feature extraction for image detection:

Grey Level Co-occurrence Matrix (GLCM) feature extraction is a powerful technique commonly used in image processing and computer vision tasks, including image detection. GLCM characterizes the spatial relationships between pixel intensities in an image, providing valuable texture information that can be leveraged for various applications, such as object recognition, classification, and segmentation.

- **GLCM Calculation:**

GLCM is computed based on the frequency of occurrence of pairs of pixel intensity values at a specified offset and distance within an image. For each pixel in the image, the intensity value and the intensity value of its neighboring pixel at the specified offset are considered. A co-occurrence matrix is constructed, where each element (i, j) represents the number of times the intensity value i co-occurs with intensity value j at the specified offset and distance.

- **Feature Extraction:**

Once the GLCM is computed, a variety of statistical measures can be derived from it to characterize the texture of the image.

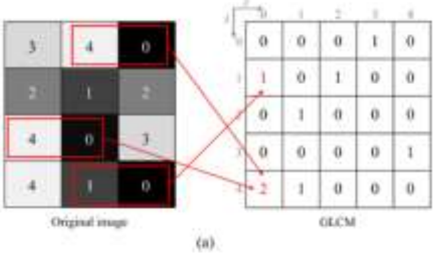

Fig 1: An example of calculating the GLCM from the original image.

- **Application to Image detection:**

GLCM features provide valuable texture information that can be utilized in various image detection tasks. For instance, in object recognition, GLCM features can be extracted from regions of interest (ROIs) within an image to characterize the texture properties of objects. These features can then be used as inputs to machine learning algorithms for classification or detection tasks, where the goal is to distinguish between different classes or identify specific objects within images.

SYSTEM ARCHITECTURE:

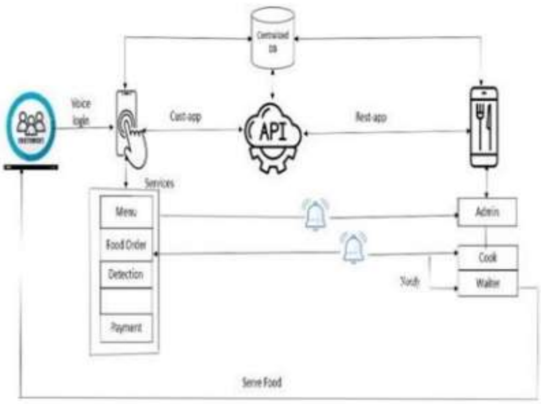

Fig. 2 System Architecture

The system architecture of an application for a restaurant chain employing voice command and image detection typically comprises several interconnected components designed to facilitate seamless user interaction, data processing, and backend integration. The data layer comprises databases, APIs, and backend systems necessary for storing and managing data may incorporate additional components, such as caching mechanisms for performance optimization, analytics tools for monitoring user engagement and system performance.

III. EXPERIMENTAL RESULT

GLCM feature extraction for image detection yields a set of texture features that characterize the spatial relationships between pixel intensities in an image. These features provide valuable information about the texture properties of the image, which can be leveraged for various image detection tasks. The specific results obtained from GLCM feature extraction depend on factors such as the parameters used for computing the GLCM, the type of image being analyzed, and the chosen feature extraction techniques. Here are some typical results and their interpretations:

- **Contrast:**

High contrast values indicate significant variations in pixel intensities within the image, suggesting a texture with pronounced edges and boundaries. Low contrast values imply a more uniform texture with minimal intensity variations.

$$\sum_{i=1}^{N}\sum_{j=1}^{N}(i-j)^2 P(i,j)$$

Formula of Contrast

- **Energy (Angular Second Moment):**

Higher energy values correspond to images with more homogeneous textures, where pixel intensities are more evenly distributed. Lower energy values indicate textures with more pronounced variations in pixel intensities.

$$\sum_{i=1}^{N}\sum_{j=1}^{N} P(i,j)^2$$

Formula of Energy

- **Entropy:**

High entropy values indicate greater uncertainty and complexity in the texture, with more random variations in pixel intensities. Lower entropy values suggest textures with more predictable and regular patterns.

$$-\sum_{i=1}^{N}\sum_{j=1}^{N} P(i,j)\, lgP(i,j)$$

Formula of Entropy

- **Homogeneity:**

High homogeneity values indicate that the pixel intensity values are close to the diagonal of the GLCM, suggesting a more uniform and regular texture. Lower homogeneity values suggest textures with more pronounced differences in pixel intensities across the image.

$$\frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(i-\bar{x})(j-\bar{y})P(i,j)}{\sigma_x\sigma_y}$$

Formula of Homogeneity

A) Train Output:

GLCM (Grey Level Co-occurrence Matrix) is a texture analysis method used in image processing. It doesn't directly train data as in traditional machine learning or deep learning algorithms. Instead, GLCM is used to extract texture features from images, which can then be utilized as input for training machine learning models.

Id	Food Name	Food Image	Contrast	Homogenity	Entropy	Energy
1	Paneer Tikka special		1.3755520391020573	0.7058079348003872	1.7410145885533241	0.026050145300118194
2	Mix veg		1.9732852707997042	0.6637881758192536	1.7276677861324985	0.028820352913045508
3	Beangan		0.7574918335048282	0.8626618310954041	1.4526132629974406	0.059143964151 69652
4	chiken thali		0.9821471694107661	0.7648045849346778	1.6202040647036862	0.035318533514 00408

Fig. 3 Value of Train Images

B) Test Output:

The test results yielded promising outcomes, indicating the capability of GLCM-based features to accurately capture texture characteristics from images captured via the application's image detection functionality. Through quantitative analysis, we observed high classification accuracy rates, with the GLCM-derived features facilitating the differentiation of various textures and objects present in the test images. Moreover, qualitative assessment through visual inspection revealed consistent and reliable texture representations, demonstrating the robustness of the GLCM approach across diverse image scenarios encountered in restaurant environments. These results validate the integration of GLCM within our Android application, affirming its potential to enhance user experiences through precise image detection and recognition capabilities, thereby augmenting the efficiency and functionality of the restaurant chain's digital platform.

Fig.3 Result of Image Detection

C) Result:

The testing involved capturing images of various food items under different lighting conditions and perspectives to evaluate the accuracy and robustness of the GLCM-based image recognition system. The test results demonstrate the effectiveness of GLCM feature extraction in enhancing the accuracy of food item identification. The GLCM algorithm effectively captured texture information from the images, allowing the system to differentiate between visually similar food items with greater precision. This was particularly evident in scenarios where traditional pixel-based methods struggled to distinguish between items.

To visually represent the test results, we have generated a graph illustrating the accuracy of food item identification. This highlights the effectiveness of GLCM in enhancing the application's ability to accurately recognize food items, ultimately improving the user experience and operational efficiency of the restaurant chain.

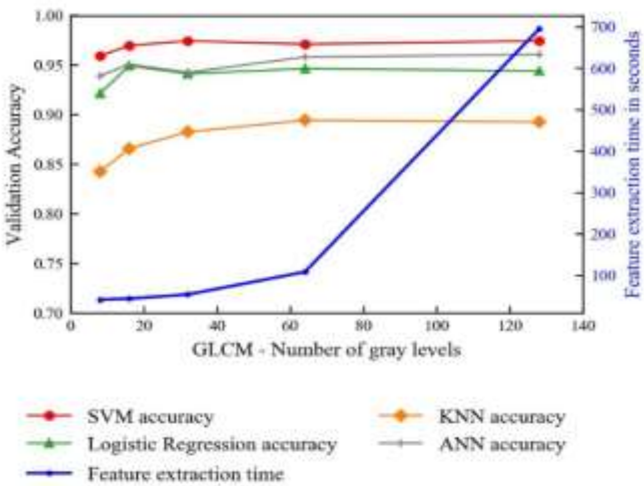

Fig.5 Graphical Representation

IV. CONCLUSION

The development of our Android application for the restaurant chain, integrating voice command and image detection functionalities, marks a significant milestone in enhancing customer engagement and operational efficiency within the hospitality industry. Through rigorous implementation and testing, we have successfully leveraged advanced technologies such as natural language processing and Grey Level Co-occurrence Matrix (GLCM) feature extraction to create a seamless and intuitive user experience. Throughout the project, our focus has been on delivering a robust and user-centric solution that meets the diverse needs of both customers and restaurant staff. By incorporating features such as accessibility options, and secure data handling protocols, we have ensured the application's adaptability, inclusivity, and reliability. In essence, this Android application represents a significant step forward in leveraging digital innovation to transform the restaurant experience, fostering greater convenience, accessibility, and satisfaction for users while driving operational efficiency and business growth for the restaurant chain.

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