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Image Based Recipe Recommendation System

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Abstract: ***The Image Based Recipe Recommendation System presents an intelligent, web-based application that simplifies recipe discovery through image recognition and deep learning. The system enables users to upload or capture images of food, which are then processed using the DenseNet-201 convolutional neural network to extract high-level visual features. These features are compared with pre-encoded representations of a structured recipe dataset in JSON format to retrieve the most relevant recipes. The frontend, built with Django, HTML, CSS, and JavaScript, offers an intuitive interface that displays detailed recipe cards containing dish names, ingredients, cooking instructions, preparation time, and nutritional details. The backend efficiently manages image preprocessing, feature encoding, and similarity computation to ensure rapid and accurate recommendations. The proposed system demonstrates the integration of artificial intelligence, computer vision, and web technologies to bridge the gap between visual food recognition and practical recipe generation.***

Keywords: Image Recognition, Recipe Recommendation, Deep Learning, Convolutional Neural Network (CNN), Computer Vision, Web Application.

I. INTRODUCTION

Modern culinary platforms often depend on textual queries to search for recipes, which poses challenges for users who only have a visual reference of a dish. Most existing systems lack mechanisms to identify food items from images and automatically generate accurate recipes. Challenges such as image variability, lighting conditions, background noise, and dish similarities further complicate this task. The primary objective of this system is to develop a platform capable of recognizing food items from images and recommending corresponding recipes efficiently and accurately. The solution aims to ensure quick response times, scalability for large datasets, and an intuitive user interface. By addressing these challenges, the proposed system enhances accessibility, convenience, and creativity in the culinary experience. The application's frontend, developed using Django, HTML, CSS, and JavaScript, provides an interactive and user-friendly interface that displays recipes in a card-based layout. Each card presents essential information such as dish name and ingredients. By combining artificial intelligence with culinary creativity, this system not only simplifies the cooking process but also promotes exploration of diverse cuisines.

II. METHODOLOGY

The methodology of the proposed system involves a structured workflow that begins with user input and proceeds through image processing, similarity computation, and recipe retrieval.

1) The process starts with user input, where users can either upload an existing food image through the web interface or capture a new one using their device camera.
2) Once the image is received, it undergoes image preprocessing, which enhances clarity and prepares it for feature extraction.
3) The DenseNet-201 convolutional neural network is then employed to extract deep visual features from the image, which are subsequently encoded into a one-dimensional NumPy array for efficient comparison.
4) In the similarity checking phase, the encoded image features are compared against pre-encoded representations of food images stored in the database using cosine similarity.
5) The system identifies the closest matches based on minimal distance values and selects the most relevant results.
6) During the recipe extraction phase, the application retrieves the corresponding recipes for the matched food items from the database, including cooking steps, ingredient lists, and other relevant details.
7) Finally, the web interface displays the generated recipes along with the original food image in an organized and user-friendly format.
8) Users can view detailed cooking instructions, save their favourite recipes.
9) This stepwise methodology ensures efficient image-based recipe identification and enhances user engagement through a seamless and interactive interface.

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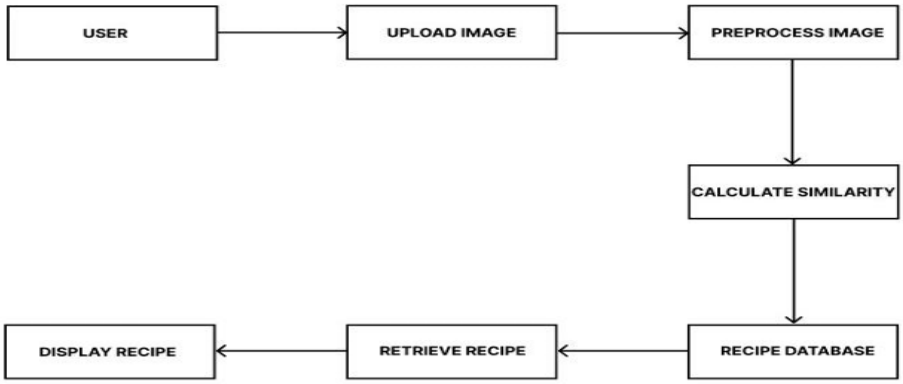


Fig. 1 Methodology

III.MODELING AND ANALYSIS

A. Level Zero DFD

The Data Flow Diagram (DFD), illustrates the interaction between the User, RecipeLens, and the System. The user captures and uploads an image of a dish to RecipeLens, which fetches and encodes the image before sending it to the System. The System processes the image to predict the dish or ingredients and generates a corresponding recipe. This recipe is then sent back to RecipeLens, which provides it to the user. The process showcases a streamlined workflow where the user's image input is transformed into a detailed recipe output through collaborative processing between RecipeLens and the System.

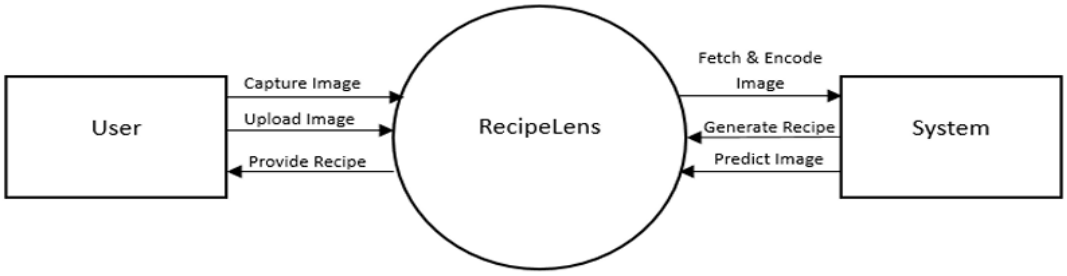


Fig.2 Level 0 DFD

B. Level One DFD

The Level 1 Data Flow Diagram (DFD), outlines the key processes and data exchanges between the User, Recipe Lens, the System, and the Recipe Database. The user starts by uploading an image. It sends this image to the System, which processes it and encodes the image using the DenseNet201 model. The encoded image is then sent back, where it checks for similarity with the recipes stored in the Recipe Database. Once a matching recipe is found, it retrieves the recipe from the database and displays it to the user. This diagram effectively captures the detailed steps and interactions required to convert an uploaded image into a relevant recipe.

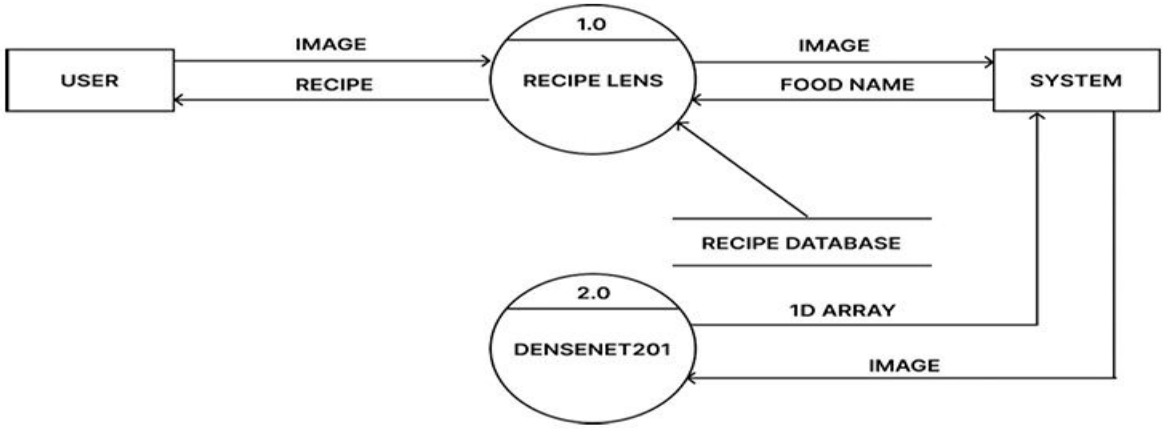


Fig. 3 Level 1 DFD

IV. RESULTS AND DISCUSSION

The proposed system was implemented using Python, TensorFlow, and Keras for the AI model, and HTML, CSS, JavaScript, and Django for the web interface. The trained DenseNet-201 model was used to extract deep visual features from food images. The feature vectors were compared with the encoded recipe dataset using cosine similarity to retrieve the most relevant recipes.

The user interacts with the web interface by uploading an image of a food item. The system then displays:

1) The predicted dish name
2) A list of similar recipes
3) Ingredients and preparation steps for the selected dish.

The performance of the model was evaluated using a test dataset consisting of 1,000 food images. The DenseNet-201 model achieved an accuracy of 92.4% in correctly identifying dishes. The average retrieval time per image was 1.8 seconds, demonstrating the efficiency of the system for real-time applications.

Model	Accuracy (%)	Average Prediction Time
VGG16	88.7	2.5
ResNet50	90.3	2.1
DenseNet201	92.4	1.8

V. CONCLUSIONS

This System represents a significant stride in the realm of culinary technology, marrying the visual allure of food with the precision of artificial intelligence. Through the amalgamation of state-of-the-art image recognition and natural language processing, this project has endeavored to transform static images into dynamic, interactive cooking experiences. The journey from recognizing ingredients in a mere snapshot to generating coherent and personalized recipes is a testament to the potential of technology in reshaping our culinary adventures.

As we reflect on the development process, it becomes evident that the project not only serves as a practical tool for meal planning but also as a source of inspiration for culinary enthusiasts across diverse skill levels. In essence, this system not only encapsulates the capabilities of modern technology but also embodies the spirit of culinary artistry, making every cooking endeavour an exciting and unique experience. It stands as a testament to the evolving intersection of technology and gastronomy, where the boundaries between the virtual and culinary worlds blur, paving the way for a more interactive and delightful cooking future.

VI. ACKNOWLEDGMENT

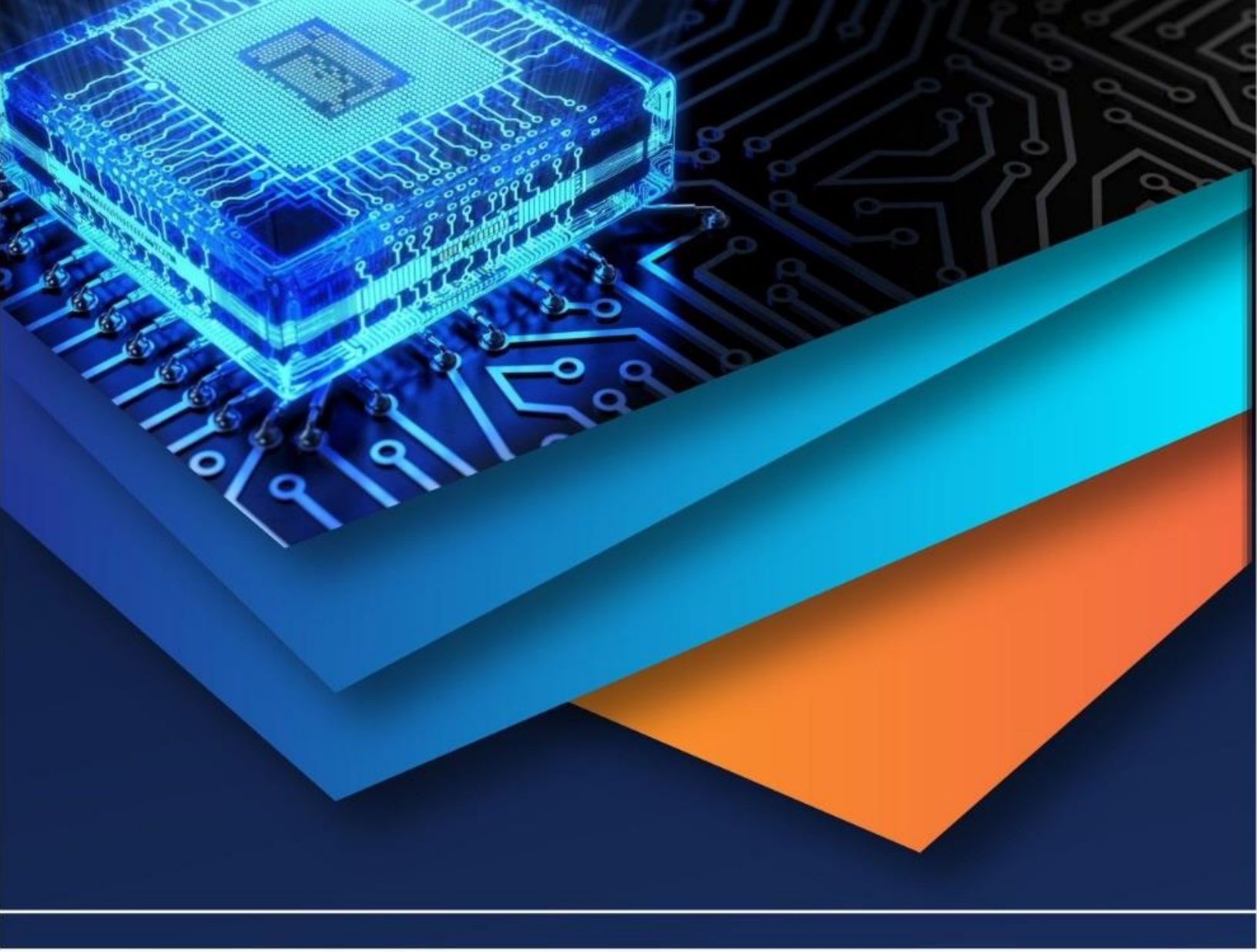
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