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Prediction of Probable Allergens in Food Items Using Convolutional Neural Networks

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Abstract:- Food monitoring and nutritional analysis play a crucial role in addressing allergen-related health issues, and their importancecontinues to grow in our daily lives. In this study, we utilized a convolutional neural network (CNN) to recognize and analyze food images, assess the nutritional content of dishes, and provide information on potential allergens. Identifying food items from images poses a significant challenge due to the wide variety of foods available. To address this, we leveraged the Logmeal API, which utilizes CNN to identify various types of meals, their ingredients, and potential allergens.

Keywords:- *Convolutional Neural Network (CNN), Food Image Recognition, Convolution Layers, Nutrition,Logmeal API,Food Allergies*

I. INTRODUCTION

Today, individuals are increasingly conscious of their dietary choices as a means to prevent future or existing health issues. Precise evaluation of ingredients and calorie content is crucial for ensuring proper nutrient intake and mitigating the risk of allergies. The accurate categorization of food items holds significant importance in this regard. In recent years, extensive research has been dedicated to leveraging computer vision and artificial intelligence technologies for the analysis of food images and automated vision-based system for assessing traditional food involves four main steps: food identification, food type classification, weight assessment, and obtaining health information. Advancements in image processing, object recognition, machine learning, and deep learning, particularly convolutional neural networks (CNN), have significantly enhanced the accuracy of food recognition applications. Utilizing the Logmeal API, we classify food using CNN and store the data in FirebaseDB in JSON format for this project.

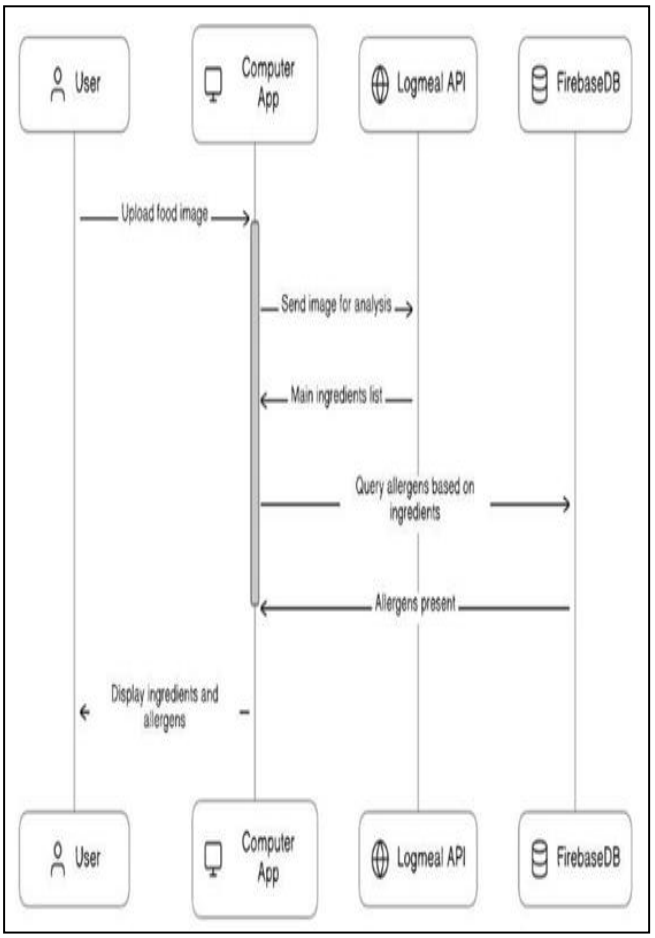

Fig 1: System Architecture

A. Related Work

In recent years, deep learning and convolutional neural networks (CNN) have been instrumental in advancing food-related methods. The abundance of food images accessible on the Internet, including platforms like Google image search, has facilitated the aggregation of extensive data for training deep learning models. Overcoming challenges unique to the culinary domain, such as variation and similarity between categories, necessitates the use of sophisticated and intelligent algorithms. This section provides a review of literature on food analysis, significant works on multimodal learning and food, and the application of these techniques within restaurant contexts.

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II. LITERATURE SURVEY

In [1], the survey lays the groundwork by providing essential information on food allergies. This may include coverage of topics such as allergens, immune responses, diagnostic methods, and management strategies. In [2] and [3], the paper concentrates on developing a framework that employs deep learning techniques to real-time estimate the nutritional value of food. It is likely to delve into the methodology, data sources, deep learning models used, and the accuracy of nutritional value estimation. In [4], the paper likely presents an innovative approach that combines fuzzy clustering and a Whale-based neural network for food recognition and calorie estimation in daily dietary assessment. In [5], the paper introduces a new dataset specifically tailored for foodrecognition tasks. The papers are likely to detail experiments using various recognition algorithms, as well as discussing the outcomes, challenges, and potential enhancements in food recognition technology. In [7][12], the paper describes thecreation of a real-time food recognition system meant for smartphones, possibly examining the system architecture, image processing techniques, machine learning models used, and real-world performance metrics. In [8], the paper concentrates on enhancing food recognition through the utilization of image augmentation techniques in combination with convolutional neural networks (CNNs), potentially covering different augmentation methods, CNN architectures, training procedures, and improvements in recognition accuracy.

III. MODULES

A. *Firebase Integration Module:*

The detection system relies on Firebase Realtime Database, which provides functions for accessing the entire website to retrieve allergen data. It also allows for the updating of allergen data with new information as required.

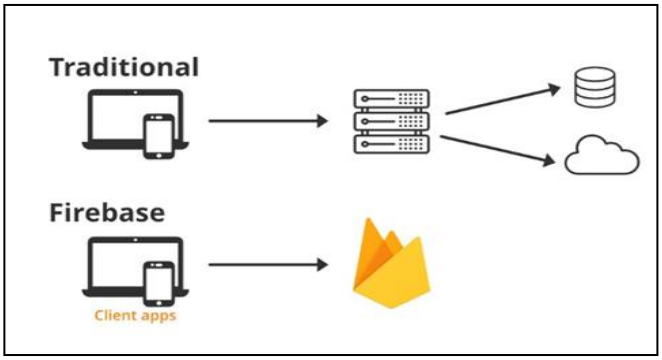

Fig 2: Fire Base DB

B. *Logmeal API Integration Module:*

The dataset comprises a variety of images featuring diverse food items from various cuisines, obtained from the Logmeal API for food recognition. Integration with the Logmeal API enables the retrieval of food ingredient details. The system includes functions to make HTTP requests to the Logmeal API, parse the API responses, and extract pertinent food ingredient information.

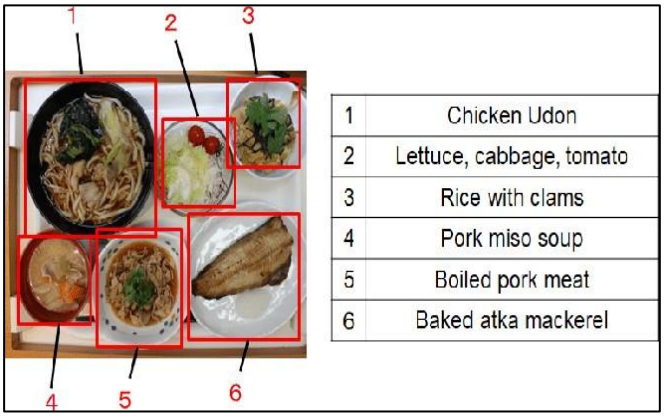

Fig 3: Food Recognition

C. *Allergen Detection Module*

This module uses data obtained from Firebase DB and Logmeal API to identify allergens in a specified food item. It involves comparing the ingredients of the food item with the allergen data stored in the Firebase database to detect any matches.

D. *User Interface Module:*

The user interface module manages the user interaction aspect of the project. It encompasses functions for capturing user input (food images) and presenting the allergen detection results to the user. React is utilized for the module to enhance the interface.

➢ *CNN Architecture*

The convolutional neural network comprises the input layer, hidden layer, and output layer. Within the CNN, the intermediary layer is referred to as the hidden layer. In CNNs, the input is in the form of a tensor: (number of inputs) x (input height) x (input width) x (input channel). Following traversal through the convolutional layer, the image is consolidated into afeature map known as the Activation Map, which is represented as: (Number of entries) x (height of feature map) x (width of feature map) x (feature map channel). The spiral layer may include pooling layers as well as general and global layers in convolutional networks. The subsequent layer of a single neuron comprises a group of neurons that aggregate the data outputs with the scale of the layer group. Known as the fully connected layer, it links each neuron in one layer to every neuron in the following layer, resembling the traditional multilayer perceptron (MLP) neural network.

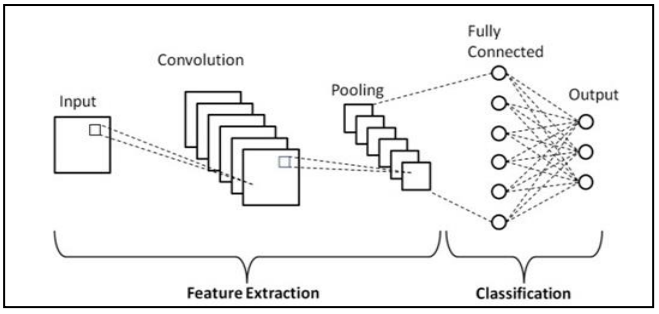

Fig 4: CNN Architecture

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➢ *Allergens Display:*

After completing the Deep Learning phase, the project enters the second phase, which involves displaying potential food allergies. This is achieved by utilizing FirebaseDB to update real-time collected data and data obtained from various internet sources in the form of a JSON file. Using JavaScript, the database is connected to the existing Logmeal API data. Inthe backend, a list of potential allergens and their corresponding ingredients and allergies is updated. This allows for the display and sorting of potential allergies related to specific food items based on their ingredients. The process of using FirebaseDB is as follows:

- Retrieve Data
- Initializing the Database
- Accessing Firebase Database
- Processing and Filtering Data
- Integration with Food Detection
- Displaying Possible Allergens

IV. RESULTS

We initiated our study by employing the CNN architecture to recognize food images and identify potential allergens presentin the food ingredients with the assistance of FirebaseDB and LogmealAPI. As previously stated, the dataset utilized in the project yields an impressive accuracy rate of 93%, delivering near-perfect results.

Fig 5: Output Design

V. CONCLUSION AND FUTURE ENHANCEMENTS

In this initiative, our aim was to detect food allergies by analyzing the ingredients using various Deep Learning algorithms. Leveraging Logmeal API and FirebaseDB, we have effectively launched a system focused on food allergens, which can benefit users seeking information about the food they consume. For future improvements, we can expand the database to identify a wider range of possible allergens. To consistently update and broaden the known allergen database to encompass a wide variety of allergens to adapt to new findings or advancements in allergen research. Also, to incorporate the application with wearable devices like smartwatches and trackers.

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