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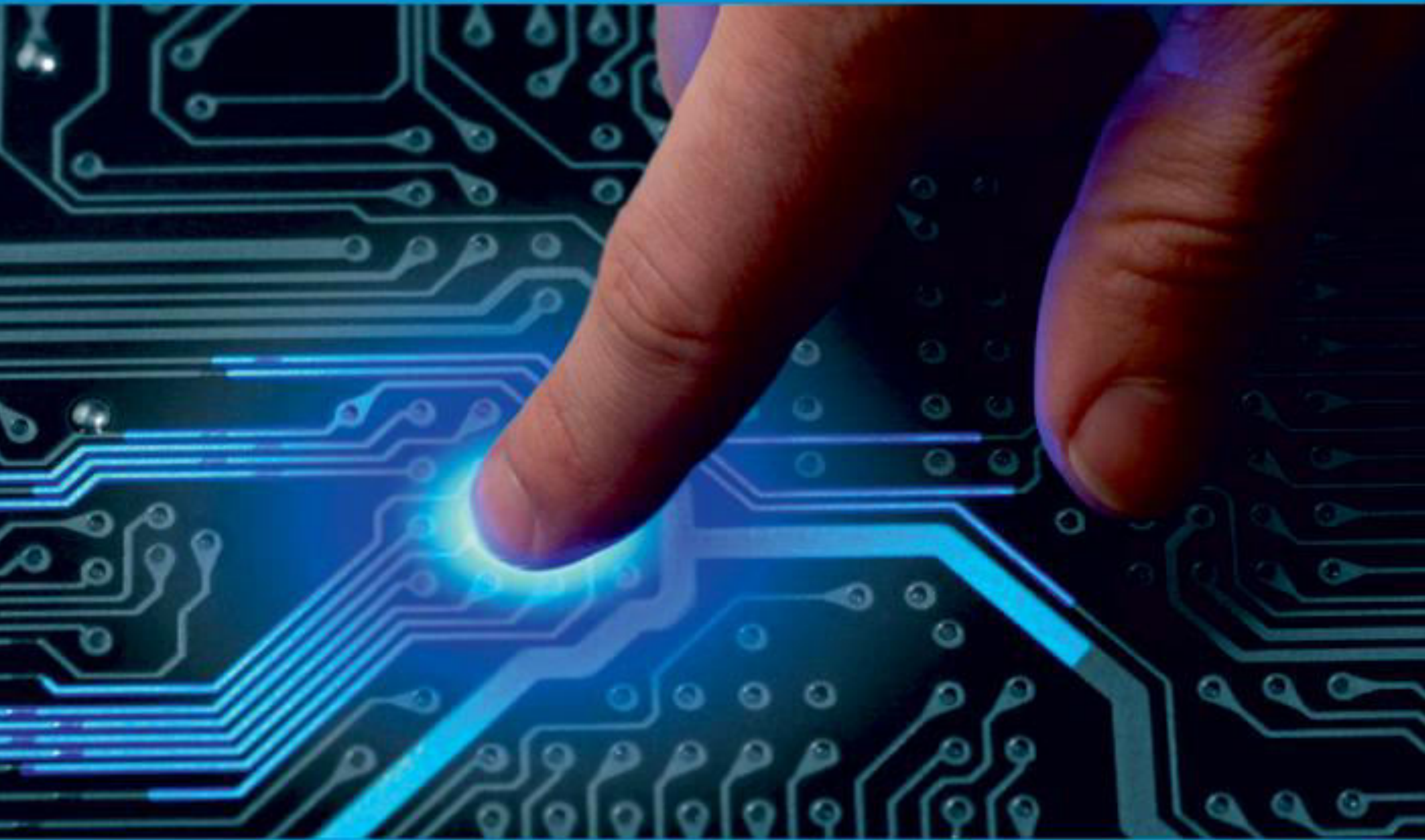

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Food Recognition using Incremental Extreme Learning Machines

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ABSTRACT: Deep learning has made image classification less difficult, and more extensive datasets and computer resources are now available. These days, the convolutional neural network is the most widely used and well-liked method for classifying images. A food dataset is used to classify images using a variety of transfer learning methods. Food is essential to human life because it gives us various nutrients. As a result, everyone needs to be mindful of their eating habits. For this reason, categorizing food is crucial to leading a healthier lifestyle. In this project, pre-trained models are employed instead of the more typical approach of creating a model from scratch, which reduces computing time and cost while improving results. For training and validation, the food dataset is divided into numerous classes, each containing a large number of photos. The provided food will be identified using these pretrained models, and based on the image's hue, the nutrient content will be estimated.

I. INTRODUCTION

Image classification has become easier thanks to research in computer vision and machine learning. There is the availability of a huge amount of data and computational resources. Techniques that can be used for image classification are KNN classifiers on local and global features used in [9], artificial neural networks, SVM, and random forest techniques to classify different classes using different sets of features. However, these methods fail when the dataset is huge. Because the convolutional neural network can be easily handled with large amounts of data and still provides high classification accuracy, it has gained attention in image classification recently. Therefore, food classification is an essential thing for a healthier lifestyle. The number of people across the world who are suffering from obesity is more than 10%. The rate of obesity has been increasing at an alarming rate over the past few years. In this growing digital world, it is very important to keep track of calorie intake in our food. As the world grows, problems like obesity and weight gain are also equally growing. It becomes inevitable to keep track of food intake. It becomes difficult to keep everything on track in a diary. Statistics show that 95% of people no longer follow any dietary plan, as these restrict them from consuming their day-to-day food. So, the primary cause of obesity is an imbalance of the amount of food intake and energy consumed by the individual, and a healthy meal is necessary. Thus, maintaining a healthy diet is an important goal for many people. The process of tracking the number of calories consumed can be very tedious, as it requires the user to keep a food journal and perform little messy calculations to estimate the number of calories consumed in every food item. Through this research, we try to classify Indian food images into their respective classes. The proposed software model uses machine learning as the base, which recognizes the food image that is uploaded as input by the user, processes the food image, recognizes it, and

estimates the calories from the predicted image. People record, upload, and share food images more willingly than ever on websites like Instagram, Facebook, etc. So, it is more convenient to locate more data (images and videos) related to food. Consequently, supporting users in diet management reduces the need for the manual paper approach. Food image recognition and calorie estimation can aid in diet management, food blogging, and recognizing Indian foods. The organization of the paper is as follows: the related works are presented in Section II. Section III deals with the proposed methodology, followed by the experimental results, conclusion, and future work in Sections IV and V, respectively. To overcome the manual labor and the erroneous data, various applications were developed to calculate the food intake. One of the latest technological advancements to overcome difficulties in taking pictures of food items is the development of a variety of e-health applications to calculate calories in food that use the concept of image

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II. LITERATURE SURVEY

The following are the main ideas from the body of research on food recognition and associated difficulties: Unrestricted Ongoing Education: Food recognition systems have to learn new classes gradually over time in real-world circumstances. These systems, in contrast to fixed datasets, must adjust to changing food categories without retaining large amounts of exemplar photos, which would complicate the model and cause data security issues. Web-Based Education for Adjustment: Online learning strategies are critical to addressing differences in the current images of the classroom. By using these techniques, the model can dynamically adapt to variations in the look and context of the food. Overview of the Literature: A wide range of techniques, from basic Euclidean distances to complex spatial pyramid convolutional neural networks, are used in the literature on food recognition. Scholars have investigated diverse methodologies to enhance precision and resilience. Research Omissions and Additions: There are still gaps in the current approaches, despite improvements. By utilizing relief F for feature selection, transfer learning, and an innovative adaptive reduced class incremental kernel extreme learning machine (ARCIKELM), the suggested system seeks to close these gaps. Manpreetkour Basantsinghe [5] suggested an algorithm that uses form, color, and texture as the main determinants of fruit identification and calorie estimation. The area and the fruits are recognized by the histogram of gradients and GLCM with neighborhood binary pattern algorithms for texture segmentation scheme; the major and minor axes are computed using shape features to obtain a more precise calorie estimate. Using the nutritional look-up table, the characteristics are given to a multi-SVM classifier for increased accuracy. Using a Samsung Grand Prime cell phone, five types of fruit photos with a resolution of 3264x1836 pixels were taken for the dataset. The preprocessing processes that need to be completed include filtering, scaling to 256x256, converting RGB to grayscale, and equalizing the adaptive histogram. One distinctive descriptor that is utilized for object detection is the histogram of oriented gradients, or HOG. An appropriate segmentation strategy is employed in order to obtain the correct features. A model that focuses on estimating the quantity of calories in food items by simply utilizing their image as input using SVM was proposed by Hemraj Raikwar et al. [6]. The suggested model uses a few image processing approaches, then extracts features. The dataset was created by the authors, who subsequently processed it in accordance with the feature extraction procedure after applying it to various image processing techniques. Following the extraction of features from each image, the support vector machine (SVM) classifier is used to categorize the images into the many classes that the learning method specifies. The model consists of multiple intermediary tasks, including: a. extracting the image's feature vector; b. identifying the food item in the image; and c. forecasting the food item's calorie content. The Pittsburgh Fast Food Image Dataset (PFID) and nutrition's calorie information are included in the dataset. It uses background subtraction for pre-processing in order to eliminate noise and extraneous data. Google Net [7] is the codename for the deep convolutional neural architecture known as Inception, which was created by Szegedy et al. Using 1×1, 3×3, and 5×5 convolutions inside of a single network module, the inception module's goal is to operate as a multi-stage function extractor. The output of this module is then provided as input to the network's next layer. It achieved first place in the ImageNet Large Scale Visual Recognition Challenge 2014 (ILSVRC14) with good detection and classification scores. For vision networks and covering the predicted result with dense, easily accessible components, it was suggested by [7]. Modest profits were observed in relation to the other reference networks after a little module adjustment. In the paper, a classifier

has been constructed using Inception V3, the most recent version. An autonomous food detection system that can identify and detect different types of Indian food was proposed by Patanjali C. et al. [9]. The suggested food identification system is designed to be able to categorize Indian food items using the SVM and KNN classification models, two distinct models. The suggested method makes advantage of elements that blend color and shape. An analysis is conducted to compare the effectiveness of the two classification models. Food density tables, color, shape recognition in image processing, and SVM and KNN classification have all been taken into consideration as parameters. The feature vector that was taken from the sample photos is included in the data set. They have taken into consideration about 200 image samples, both of individual food items and crowded food. For these 200 examples, they took into account two combined features, using 80% of the photos as the training set and 20% as the testing set.

III. SYSTEM DESIGN & MODELING

3.1 Proposed system

A novel approach is introduced for food image classification based on popular convolutional neural network (CNN) features. In this method, CNNs automatically extract features, learn from them, and perform classification. Unlike other

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image classification algorithms, CNNs require minimal preprocessing. They learn traditionally hand-engineered filters, which offers a significant advantage by eliminating the need for prior knowledge and manual feature design.

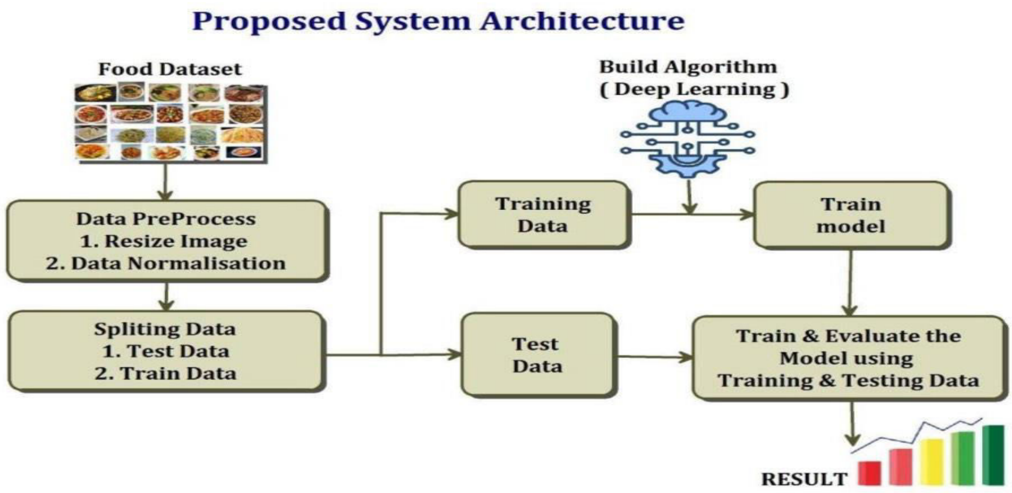

Fig 3.1: Proposed System Architecture

3.2 USECASE DIAGRAMS

A Usecase is a collection of hypothetical situations that explain how a source and a target interact. The relationship between actors and use cases is depicted is a usecase diagram. Actor and usecases are the two primary part of usecases diagram.The usecases diagram are displayed in the picture below.

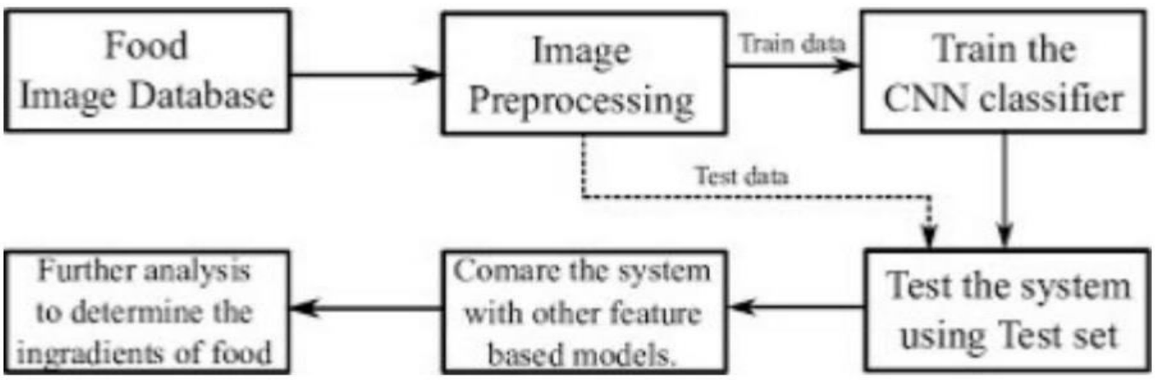

Fig 3.2:
Use Case Diagram

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3.3 FLOW CHART

The designed multiple-dish food recognition model is detailed and explained in this section. Three types of meals—single-dish, mixed-dish, and multiple-dish—were considered as input. These inputs were divided, labelled, trained, evaluated, and tested. The overall workflow of the proposed model is shown in the figure.

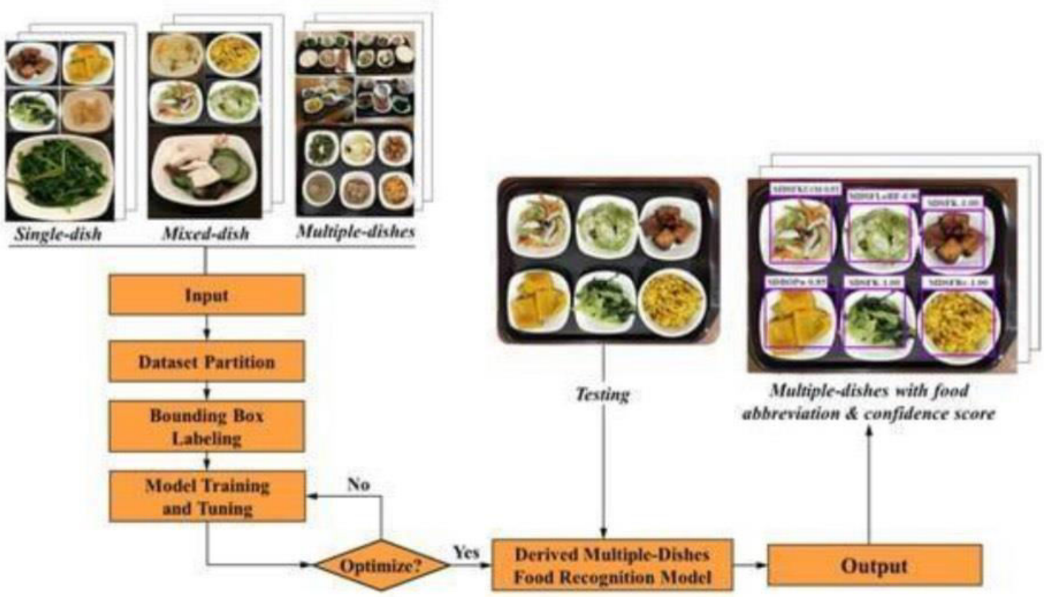

Fig 3.3: Flow chart

IV. RESULTS

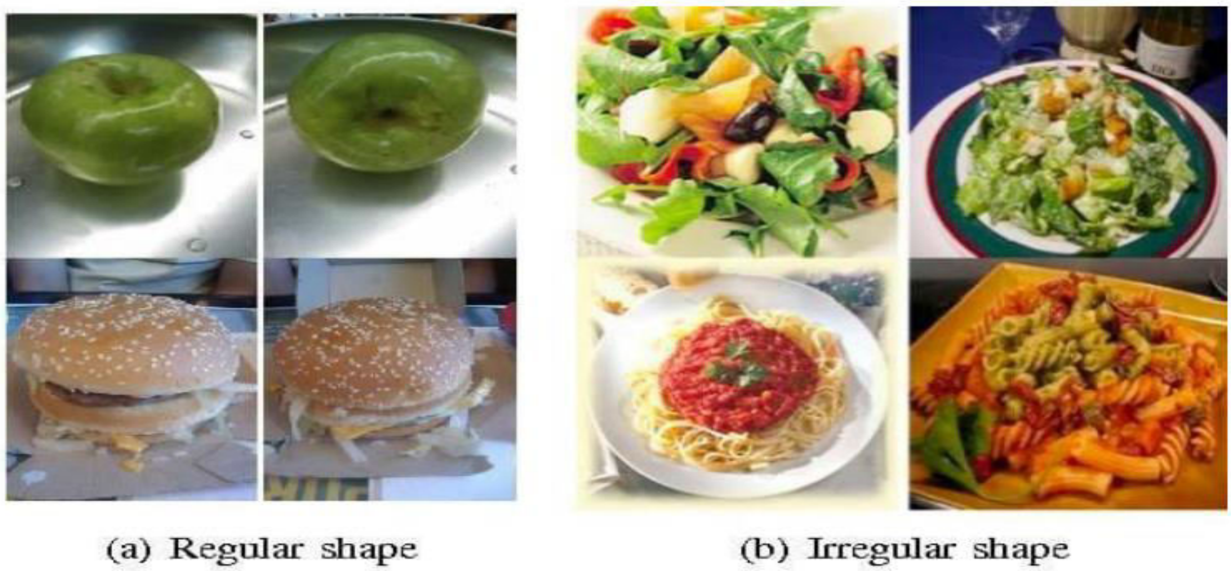

Fig 4.1: Food Detection

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Fig 4.2: Detection of Pizza

Fig 4.3: Detection of Cake

V. CONCLUSION

The food recognition system utilizing Incremental Extreme Learning Machines shows significant potential in improving the accuracy and efficiency of food identification. Its incremental learning feature enables the system to adapt to new data, enhancing its performance over time without the need for extensive retraining. This is especially beneficial in environments where new food items or variations are regularly introduced. Implementing these enhancements would make the food recognition system more robust, versatile, and valuable for a range of applications, from personal health to the food industry. For future enhancements, several avenues could be explored to refine the system: Integration of Deep Learning Features: Merging I-ELM with deep learning, such as CNNs, could enhance the processing of complex images and improve accuracy. Enhanced Dataset: Expanding the dataset to include a broader range of foods could improve the system's robustness and generalizability. Real-time Processing: Optimizing for real-

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time processing on mobile and edge computing platforms could increase practical usability. User Feedback Mechanism: A feedback loop for users to correct errors would promote continuous learning and system reliability. Cross-Domain Adaptation: Methods for recognizing food in various conditions would increase the system's versatility. AR Integration: AR technology could provide interactive experiences by displaying nutritional information on recognized foods. Nutritional Analysis: Adding nutritional analysis could offer insights for dietary management and 42 health conditions. Multimodal Data Integration: Using image data alongside other data types, like text or sensor data, could improve accuracy and provide a fuller understanding of foods.

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