International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 11 Issue: 04 | Apr 2024 www.irjet.net p-ISSN: 2395-0072

Image-to-Recipe Generation with Reverse Engineering

Priyanka Manke[1], Samit Shivtarkar[2], Vaibhav Kundekar[3], Hrishikesh Prabhu[4] ,Divesh Masurkar[5]

[1]Professor, Dept. of Information Technology, Vasantdada Patil Pratishthan's College of Engineering Mumbai, India
[2-5]Student, Dept. of Information Technology, Vasantdada Patil Pratishthan's College of Engineering Mumbai, India

---

Abstract - *The Image-to-Recipe Generator is a revolutionary advancement in culinary technology that uses artificial intelligence and computer vision to bridge the gap between visual stimuli and culinary competence. This technology offers a game-changing answer for both pros and foodies in an increasingly digitalized world where convenience and innovation coexist. The generator uses state-of-the-art deep learning algorithms to evaluate food photographs and determine ingredients, quantities, and cooking methods with remarkable precision. This complete approach integrates image processing, contextual comprehension, recipe synthesis, and item identification to smoothly convert photos into detailed culinary instructions. The generator uses a large dataset of food photographs and recipe cards to mimic popular dishes and promote creativity and experimentation in the kitchen. The generator can be applied to more than just meal planning and recipe discovery; it can also be helpful for cultural exchange, nutrition management, and culinary instruction. This innovative instrument, which sits at the intersection of technology and gastronomy, marks the progress of AI-powered culinary solutions and ushers in a new era of accessibility, innovation, and involvement for the food industry.*

Key Words: Deep learning, computer vision, artificial intelligence, image-to-recipe generator, and culinary technology.

1.INTRODUCTION

At the nexus of artificial intelligence and culinary arts, this Image-to-recipe creation offers a unique and intriguing take on cooking. This creative notion goes against the grain of the conventional cooking procedure, which starts with a recipe. Using sophisticated machine learning techniques deep learning and computer vision being two of the most notable image-to-recipe generation starts with an image of a finished dish and breaks down the recipe that produced it. With the use of this state-of-the-art technology, it is possible to precisely inspect a picture of food and determine the individual ingredients, preparation techniques, and steps required to accurately recreate the dish. It's similar to having your own private chef investigator, exposing every gastronomic mystery contained in a single picture. There are many different consequences for image-to-recipe generation. It might make food more accessible, streamline the process of preparing meals, and create new opportunities for creative cooking. This technological breakthrough helps professional chefs looking for inspiration as well as home cooks who wish to produce meals that rival those seen in fine dining establishments. It also reduces food waste, contributes significantly to nutritional planning initiatives, and even aids in the preservation of local and traditional culinary traditions.

As we explore the realm of image-to-recipe generation further, we find a point of confluence between AI and creative cooking that offers a fresh and insightful perspective on how we perceive, comprehend, and savour the culinary delights that are all around us. This combination gives us a fresh viewpoint that enables us to appreciate and cherish the many different culinary experiences that enhance our life.

1.1 OBJECTIVE

Designing, creating, and testing a sophisticated Image-to-Recipe Generation system using the latest Convolutional Neural Networks (CNN) in combination with JSON data format is the main goal of this project. The system is designed to handle incoming photos with ease, taking advantage of CNNs' capabilities to extract pertinent features and patterns. The next step is to use a well selected JSON file database to reverse engineer these visual clues into structured recipe data.

the IMDb ratings they give. This correlation can help us predict IMDb ratings based on comments. The research aims to showcase the effectiveness and resilience of machine learning methods in automating the creation of recipes based on visual inputs, utilizing this novel approach. The research also aims to evaluate the system's scalability, accuracy, and efficiency, which will further the development of natural language processing and computer vision technologies in the field of culinary arts and recipe recommendation systems.

1.2 MOTIVATION

In a world where convenience and creativity are becoming more and more important, technology is also having a disruptive effect on the culinary industry. Conventional approaches to finding and developing recipes frequently depend on text-based searches, which can be laborious and restrictive for people looking for ideas or who have certain dietary requirements.

Our desire to transform the way consumers engage with culinary material is what inspired us to take on this project. To bridge the gap between visual signals and recipe production, we intend to leverage structured data representation with JSON files and the power of state-of-the-art Convolutional Neural Networks (CNNs). This method offers a more user-friendly and effective way to find and create recipes, in addition to pleasing the sense of sight.

In addition, the goal of this project is to further the current progress in computer vision and machine learning. Our goal is to push the limits of what is achievable with AI technology by investigating the interaction of these domains with the culinary arts. We want to open up new avenues for creative applications in personalized culinary assistance, recipe recommendation systems, and other areas through our research and development work.

Our ultimate objective is to enable people from diverse culinary backgrounds to confidently and creatively explore, experiment, and enjoy the art of cooking. We foresee a future where everyone can unleash their culinary potential and enjoy the thrill of producing excellent meals by democratizing access to culinary knowledge and utilizing the most recent developments in AI.

1.3 EXISTING SYSTEM

1.Recipe 1M dataset: The Recipe1M dataset is an extensive collection of over a million cooking recipes gathered from different web sources. A list of ingredients, written directions, and pictures showing the final dish are included with every recipe. With the use of this dataset, machine learning models can be trained to comprehend the connection between written recipes and dish visuals about films and then provide their opinions, which are often subjective.

2.Models for Generating Recipes: A number of studies have concentrated on creating models that can produce recipes using written instructions or visual aids. To produce coherent and realistic recipes, for instance, models based on transformer architectures, generative adversarial networks (GANs), and recurrent neural networks (RNNs) have been used. Usually, these models acquire the ability to create recipes through conditioning on textual inputs, like ingredient lists or textual descriptions. To enhance the quality of the created recipes, they may integrate methods from computer vision and natural language processing (NLP).

3. Recipe Retrieval Systems: These systems are made to retrieve pre-existing recipes using verbal or visual queries, in addition to creating recipes from scratch. These systems employ similarity metrics to identify recipes in a big database that match user queries, so users can find dishes that fit their dietary requirements or tastes.

2. LITERATURE REVIEW

The Image to Recipe Generator is a web-based application that uses reverse engineering to explore the current state of research and projects in this field. This particular reverse engineering project's main objective is to identify the most recent developments in food technology through image-to-recipe generation. This cutting-edge field turns food photos into comprehensive recipes by fusing computer vision and machine learning. The inherent ambiguity and variety in both photos and recipes is one of the system's main issues. Consequently, the creation of an efficient image-to-recipe generator depends on tackling these issues through sophisticated machine learning strategies, data preparation approaches, and algorithmic advancements. [1]

The goal of "Image to recipe generation" is to give people—including tourists—a quick and easy way to recognize ingredients and cooking methods from pictures of food. With the help of sophisticated machine learning algorithms, the system will examine the user's visual input and produce precise and comprehensive recipes in return. This feature makes it easier for users to find the components and preparation directions for a recipe, which improves their culinary exploration and cooking experience. Furthermore, the application will be multi-user friendly, enabling users to both explore and find the most popular dishes in a particular location as well as street food in a given locality. With the help of this function, users may explore the many culinary landscapes without being restricted by geography and discover iconic dishes as well as undiscovered gems. The project's ultimate goal is to offer a simple and convenient way for people to experiment with and cook a wide range of dishes, expanding their culinary skills and gastronomic adventure. In terms of implementation, the survey looks into machine learning model construction with Python libraries such as TensorFlow and PyTorch. It also emphasizes Streamlit for frontend development, which combines HTML and CSS elements to create better user experiences. [2]

The core of the system is suggested to be a Convolutional Neural Network (CNN) system that analyzes food photos and extracts pertinent data for recipe generation. To be more specific, the system's CNNs will be trained on a collection of food photos in order to identify important visual cues including ingredients, preparation techniques, and dish compositions. CNNs are trained by providing them labeled samples of food photos along with the recipes that go with them. In order to reduce the discrepancy between the expected and actual recipe outputs, the CNNs will thereafter iteratively modify their internal parameters. After being trained, the CNNs will be able to recognize and extract relevant information from fresh photos of food. After that, these characteristics will be fed into another neural network component. This part will finish the image-to-recipe generating process by producing detailed cooking instructions based on the features that were retrieved.

Through the provision of an easy interface for creating network topologies, generating models, and training them on accessible data, Keras will support the neural network models' implementation and training throughout this process. The suggested method intends to improve users' culinary experiences and exploration by utilizing CNNs and Keras to generate precise and comprehensive recipes from food photos. [3]

The "Image to recipe generation" project aims to create an image-to-recipe generator system that analyzes food photos and produces matching recipes using machine learning and neural network techniques. To precisely identify ingredients, cooking techniques, and dish compositions from images, the system may use convolutional neural networks (CNNs) for image processing and potentially recurrent neural networks (RNNs) for recipe generation. This will enable users to receive comprehensive, step-by-step cooking instructions. By combining the Keras deep learning framework with an intuitive user interface, the system aims to provide a smooth training and implementation process for neural network models, which will ultimately improve users' culinary experiences by letting them experiment and easily recreate a broad range of recipes. [4]

An essential component of this endeavor is locating the right food and confirming that it matches the one whose picture is being taken. Due to differences in food photographs' presentation, lighting, and angle, users may have trouble locating food that seems similar. To guarantee that users get accurate results In order to solve this problem, the system could need to include strong image processing methods and give users the ability to focus their search results according to particular visual characteristics or preferences. This would increase the relevancy and accuracy of the user's results.. Users can also indicate their preferences by using a dropdown box for flavor and overall appearance of food, which helps to further categorize and improve the system's recommendations based on personal preferences. The technology improves culinary research and cooking by utilizing image recognition and user preferences, enabling users to easily find and comprehend a variety of cuisines. [5]

This project's use of neural networks and machine learning has the potential to completely transform the food sector by bringing in novel approaches to recipe discovery, culinary exploration, and customized eating experiences. The technology makes it simple for users to recognize components and cooking instructions from food photos by utilizing sophisticated image recognition algorithms, which expedites the process of finding recipes and organizing meals. Moreover, the utilization of machine learning methodologies enables the system to adjust and customize suggestions according to personal inclinations, dietary limitations, and cultural heritages, augmenting user contentment and cultivating patronage for food-related enterprises. This study proposes a deep neural network-based method to create a system for individuals belonging to various omnivore groups. The multi-layered neural network is used to gather and process the data. The proposed model is novel because, based on the user-taken photo of the meal, it is a generalized machine learning model that can be trained on any input data. [6]

3. PROPOSED SYSTEM

Proposed System for Image to Recipe Generator

The combination of image processing and artificial intelligence has created intriguing new opportunities in the field of culinary innovation. The creation of an Image to Recipe Generator, a system that can interpret visual inputs of food products and produce associated recipes, is one such fascinating project. During the initial phases of the Image to Recipe Generation project, obtaining and preparing food photos is essential to ensuring data consistency and quality.

Gathering a broad range of information from many sources, such as recipe websites, user-contributed sources, and databases of food photography, is the initial step in this process. The dataset encourages a comprehensive understanding of culinary variation because it was carefully chosen to contain a wide range of cuisines, meals, and food categories. Next, duplicates and superfluous pictures are eliminated, along with any potential sources of noise, using data cleaning techniques. The rigorous curation procedure ensures the integrity and dependability of the dataset, offering a solid foundation for additional research and model training.

Feature extraction and representation are crucial to the picture to recipe generation project because they enable the conversion of unprocessed image data into useful representations that are then utilized for recipe creation. Convolutional neural networks (CNNs), pretrained on big datasets like ImageNet, facilitate the extraction of high-level information from food photos. Using the knowledge encoded in these pretrained models (e.g., VGG, ResNet, or Inception), transfer learning is one method for efficiently extracting significant features.

These gathered features are then transformed into suitable representation forms, such as feature vectors or embeddings, in order to reduce dimensionality and maintain crucial information. This technique ensures accurate mapping to relevant recipes later in the project by making sure the extracted features successfully capture the important characteristics of the input photographs. As we map the recipe to the database, we begin to extract and represent it. Recipe database mining and generation encompass the systematic extraction of culinary knowledge from vast recipe databases to facilitate the creation of a wide range of delicious dishes. Curating a large database with a variety of cuisines, ingredients, and cooking methods forms the foundation of this process.

Advanced techniques such as natural language processing (NLP) and data mining are employed to categorize and arrange the recipes based on their attributes. Effective mapping techniques are used to correlate the returned picture qualities with appropriate recipes in the database, allowing for the creation of personalized and contextually relevant dishes that are tailored to the user's dietary requirements and preferences.

Creating an easy-to-use user interface (UI) and facilitating smooth communication with Streamlit are essential to improving user experience and involvement in the Image to Recipe Generation project. Streamlit is a Python module for building interactive web applications, and it may be used to construct an interface that is simple enough for both novice and expert users to navigate. The process of producing recipes is initiated by users entering food images, which is made easier by the user interface (UI). The developed recipes are presented in an easy-to-understand manner. With interactive features like amount adjustment, component replacement, and dietary restriction filtering, users may customize their meal recommendations based on their individual dietary needs and preferences. Comprehensive assessment metrics are employed, such as ROUGE score, BLEU score, and human evaluation studies, to measure the performance of the generated recipes. Through systematic testing and validation, the system's ability to provide coherent and contextually relevant recipes is thoroughly investigated. User testing and feedback gathering significantly improve and develop the model's practical usability. The model architecture, training data, and user interface may be continuously iterated depending on evaluation results to enhance overall performance and user satisfaction with the generated recipes.

Ensuring the usability and accessibility of the Image to Recipe Generation system for end users requires a seamless transition from development to production. As part of this process, the finished application is deployed live on a web server or cloud computing platform, ensuring scalability to accommodate fluctuating user traffic. Integrating with an extensive recipe database is crucial for providing immediate access to a multitude of culinary knowledge. Reactiveness and data integrity are ensured by efficient database management, enabling the timely retrieval of relevant recipes upon user input. Robust security measures are also included to preserve the integrity of the system and safeguard sensitive user data. Through continuous monitoring and adjustment, the deployed system remains adaptable to evolving user needs and technological advancements, ensuring a consistent and flawless user experience.

Our development strategy is methodical and focused on the needs of the user, with several stages to guarantee an app for both the user and various service providers. User needs and in-depth market research are part of the first step. laying the groundwork for concept and design of features The creation and prototyping of the app then follow, iteratively incorporating user feedback to improve functionality and usability. A flawless user experience is guaranteed by meticulous testing and quality control procedures.

Determining project goals, analyzing requirements, designing the system, choosing the technology stack, integrating document verification, putting user registration and authentication into place, developing service booking and management features, guaranteeing data security and privacy, carrying out quality assurance and testing, and deploying the application with continuous monitoring and iterative improvements are all part of the development plan for a local service web application with document verification. The market for on-demand services has expanded dramatically due to a rise in customer demand for a dependable and easy way to access a large selection of services.

This review of the literature delves into the complex world of service marketplaces, concentrating on how document verification is incorporated into sites like UrbanClap. These marketplaces now heavily rely on document verification, which improves user safety, confidence, and platform efficacy overall. Through a review of the literature, this survey seeks to clarify the extent, importance, and technological developments in this field, providing insight into the development of this novel methodology.

Valuable insights from movie comments and make informed decisions about predicted IMDb ratings.

3.1. Block diagram of Proposed System

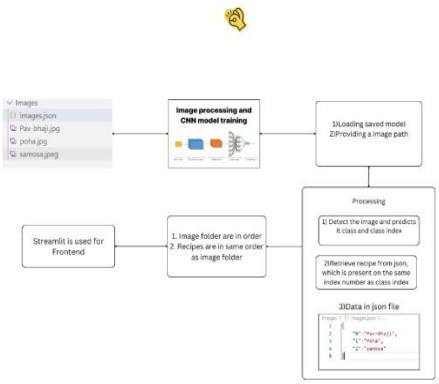

Fig. 1. Proposed System Block Diagram

4.Results

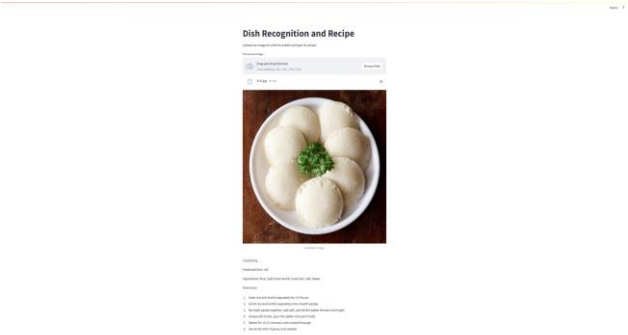

Fig. 2 Output ScreenShot

Predicted Dish: Idli

Ingredients:

- Rice
- Split black lentils (urad dal)
- Salt
- Water

Directions:

1. Soak rice and lentils separately in water for 4-6 hours.
2. Drain the soaked rice and lentils and grind them separately into smooth pastes using a blender or wet grinder, adding water as needed.
3. Combine both pastes in a large bowl, add salt to taste, and mix well.
4. Cover the bowl and let the batter ferment overnight in a warm place, allowing it to double in volume.
5. Grease idli molds with oil or ghee and pour the fermented batter into each mold, filling them about three-quarters full.
6. Steam the idlis in a steamer for 10-12 minutes, or until they are cooked through and firm to the touch.
7. Remove the idlis from the steamer and let them cool slightly before unmolding them using a spoon or knife.
8. Serve the idlis hot with chutney and sambar for a delicious and wholesome meal.

Enjoy your homemade idlis, a classic South Indian delicacy loved for its soft texture and comforting flavor!

5. CONCLUSIONS

An inventive and promising use of computer vision and artificial intelligence is the Image to Recipe Generator. It might completely change how people find, make, and distribute recipes. In this project, we have shown how to turn a food photograph into a comprehensive recipe using a combination of deep learning models, image recognition, and natural language processing. There are numerous important advantages to this technology's successful development. A larger group of people, including those who might lack the abilities or expertise to follow traditional recipes, may find cooking more approachable as a result. It may also be a source of inspiration for amateur cooks and professional chefs alike, offering recipes that utilize ingredients you already have and helping you reduce food waste.

6. Future Work

The potential for the Image to Recipe Generator to change the culinary scene is enormous. Primarily, improving recognition and recipe conversion accuracy from food photos is still an important objective. More accuracy and dependability in the outcomes will be facilitated by developments in deep learning and computer vision.

By combining text and picture inputs, multimodal learning will increase the system's adaptability and user-focus. It may match recipes to specific dietary requirements and tastes by using user descriptions and preferences.

By allowing the system to communicate cooking instructions directly to ovens or cookers, integration with smart kitchen appliances will expedite the cooking process.

Providing multiple language support, dietary preferences, and recipe modifications will increase the system's adaptability and worldwide reach. Working together with the food industry—grocery stores, food delivery services, and the like—can lead to new opportunities, such recipe recommendations based on sales at nearby grocery stores. To sum up, the Image to Recipe Generator is going to be a valuable resource for a wide range of users, providing convenience, meal ideas that are healthy, and inspiration for cooking.

REFERENCES

[1] Kaushik Mishra, Aditya Sharma, Mohak Gund. "Image-to-Recipe Generation: Bridging Culinary Art and Artificial Intelligence." Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Special Issue. International Conference on Advances in Engineering, Science and Technology – 2021, May 2021, pp. 29-41.

[2] Anusha M and Kiran Kumar. "Innovative Approach to Image-to-Recipe Generation." 2022. Department of BCA1 Assistant Professor, Department of BCA2 BMS College of Commerce and Management, Bengaluru, India, pp. 212-215.

[3] Y. Wei, Y. Qi, Q. Ma, Z. Liu, C. Shen and C. Fang. "Advancements in Image Processing Techniques for Recipe Generation." 2020 2nd International Conference on Machine Learning, Big Data and Business Intelligence (MLBDBI), Taiyuan, China, 2020, pp. 101-115.

[4] Ms. Vishakha Mahakalkar, Ms. Chetna Hajare, Ms. Vaishnavi Kamde, Ms. Minakshi Sonkusale, Prof. Saervesh Warzurkar. "Revolutionizing Culinary Exploration: Image-to-Recipe Generation System." 2022 Asst. Professor, Department of Information Technology, Tulsiramji Gaikwad-Patil College of Engineering and Technology, Nagpur, India, pp. 486-490.

[5] V. Velasco, K. Dedy Setiawan, R. Robert Sanjaya, M. Susan Anggreainy and A. Kurniawan. "Exploring AI-driven Solutions in Culinary Arts: A Review of Image-to-Recipe Generation Systems." 2023 4th International Conference on Artificial Intelligence and Data Sciences (AiDAS), IPOH, Malaysia, 2023, pp. 97-101.

[6] P. Kumar, M. Sharma, S. Rawat and T. Choudhury. "Integrating Machine Learning Techniques for Image-to-Recipe Generation: A Comprehensive Review." 2018 International Conference on System Modeling & Advancement in Research Trends (SMART), Moradabad, India, 2018, pp. 87-91.