IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

A Literature Survey on Recipe Generation From Food Images using AIML

Tejas D and Varun C M
Students, Department of Information Science and Engineering
Global Academy of Technology, Bangalore, India

Abstract: *The "Recipe Generation from Food Images" project introduces an innovative approach to culinary technology by leveraging deep learning techniques to automatically analyze food images and generate comprehensive cooking recipes. The system's key components include crafting catchy titles, compiling detailed ingredient lists, and outlining step-by-step cooking instructions. Targeting individuals intrigued by enticing food imagery but lacking the expertise or inspiration to recreate dishes, the project offers a user-friendly solution to bridge this gap. Ultimately, it aims to contribute to culinary technology by providing a valuable tool for cooking enthusiasts and researchers, catering to the evolving needs of contemporary culinary experiences. Through its utilization of advanced deep learning methodologies, the project seeks to democratize access to culinary knowledge and inspire creativity in the realm of home cooking.*

Keywords: Inverse Cooking ,Convolution Neural Network(CNN),Digital Image Processing

I. INTRODUCTION

In recent years, the intersection of technology and gastronomy has witnessed remarkable advancements, catering to the evolving demands of culinary enthusiasts and professionals alike. Among these innovations, the burgeoning field of computer vision and deep learning has opened avenues for trans-formative applications in the realm of food photography and recipe generation. With the widespread proliferation of social media platforms showcasing tantalizing food imagery, there exists a burgeoning desire among individuals to recreate these visually captivating dishes. However, the inherent challenge lies in deciphering the intricate composition of these culinary creations solely from images, as they often lack accompanying recipes or detailed preparation instructions. Addressing this gap, the "Reci Generation from Food Images" project emerges as a pioneering endeavor, seeking to harness the power of deep learning methodologies to automatically analyze food images and generate comprehensive cooking recipes. By leveraging sophisticated neural network architectures, this research endeavors to unravel the culinary narrative behind each visually enticing dish, providing users with not only a tantalizing visual feast but also the knowledge and inspiration to replicate these creations in their own kitchens. Through this exploration at the nexus of computer vision and culinary arts, the project aims to democratize access to culinary expertise, foster creativity in cooking, and pave the way for a new era of gastronomic exploration.

History: There are various projects and research initiatives aimed at generating recipes from food images using machine learning and computer vision techniques. Early Explorations (2010s):In the early 2010s, researchers began exploring the use of computer vision and machine learning for food recognition and recipe generation. Initial attempts focused on identifying ingredients and recognizing dishes from images.

Ingredient Recognition: Researchers worked on algorithms capable of recognizing individual ingredients within a food image. This involved training models to detect and classify different food items.

Recipe Retrieval Systems: Some projects aimed to build systems that could retrieve existing recipes based on a given food image. This involved matching the recognized ingredients to a database of recipes.

Advancements in Deep Learning: With the rise of deep learning and convolution neural networks (CNN's), there was a significant improvement in the accuracy of food image recognition systems.

Integration of Natural Language Processing (NLP): As projects evolved, there was a trend toward integrating natural language processing techniques to generate coherent and human-readable recipes.

Large-Scale Datasets: The availability of large-scale datasets containing food images and corresponding recipes played a crucial role in training more sophisticated models.

Attention Mechanisms: Attention mechanisms, which enable models to focus on specific parts of an image or sequence, were incorporated to enhance the quality of recipe generation by considering relevant details.

End-to-End Systems: Some projects aimed to create end-to-end systems capable of taking a food image as input and producing a complete recipe as output, encompassing both ingredient lists and preparation instructions.

User-Friendly Applications: Towards the later part of the 2010s, there was an emphasis on making these systems more user-friendly, with the potential for integration into cooking apps or smart kitchen devices.

Challenges and Future Directions: Challenges remained, including the ambiguity in food images, variations in cooking styles, and the need for more nuanced understanding of ingredient combinations. Future directions were likely to involve more sophisticated models, potentially incorporating multi-modal approaches that consider both images and textual information.

II. APPROACHES

2.1 Food Image Recognition

- Convolution Neural Networks (CNN's): CNN's are widely used for image recognition tasks, including identifying
- different food items within an image.
- Transfer Learning: Trained CNN models on large datasets can be fine-tuned for specific food recognition tasks,
- leveraging knowledge gained from other image classification tasks.

2.2 Ingredient Extraction

- Object Detection: Object detection models, such as CNN or YOLO, can be employed to not only recognize food items but also locate them in the image.
- Segmentation: Image segmentation techniques can be used to separate individual ingredients within the food image.

2.3 Data Preprocessing

- Normalization: Ensuring that images are standardized in terms of lighting, orientation, and resolution.
- Augmentation: Introducing variations in training data through techniques like rotation, scaling, and flipping to improve model generalization.

2.4 Recipe Database Integration

- Database Matching: After identifying ingredients, systems may retrieve matching recipes from a database, aligning recognized ingredients with existing recipes.

2.5 Natural Language Processing (NLP)

- Sequence-to-Sequence Models: Using architectures like recurrent neural networks (RNN's) or transformers to generate textual sequences representing recipes.
- Attention Mechanisms: Enhancing the model's ability to focus on specific parts of the image or important ingredients while generating recipe instructions.

2.6 End-to-End Models

- Combined Approaches: Some models attempt to generate recipes directly from food images without relying on separate steps for ingredient recognition and recipe retrieval.

2.7 Evaluation Metrics

- BLEU Score: Commonly used to measure the similarity between generated recipes and reference recipes.
- ROUGE Score: Evaluating the overlap of n-grams between generated and reference recipes.
- Perplexity: Assessing the language model's performance in generating coherent and fluent text.

2.8 User Interaction

- User Preferences: Incorporating user preferences or dietary restrictions into the recipe generation process.
- Feedback Mechanisms: Systems that allow users to provide feedback on generated recipes for continuous improvement.

2.9 Multi-Modal Approaches

- Combining Text and Image Information: Integrating information from both textual recipes and food images to enhance the model's understanding.

2.10 Fine-Tuning and Adaptability:

- Continuous Learning: Updating models with new data to adapt to evolving culinary trends and user preferences.

III. ARCHITECTURE

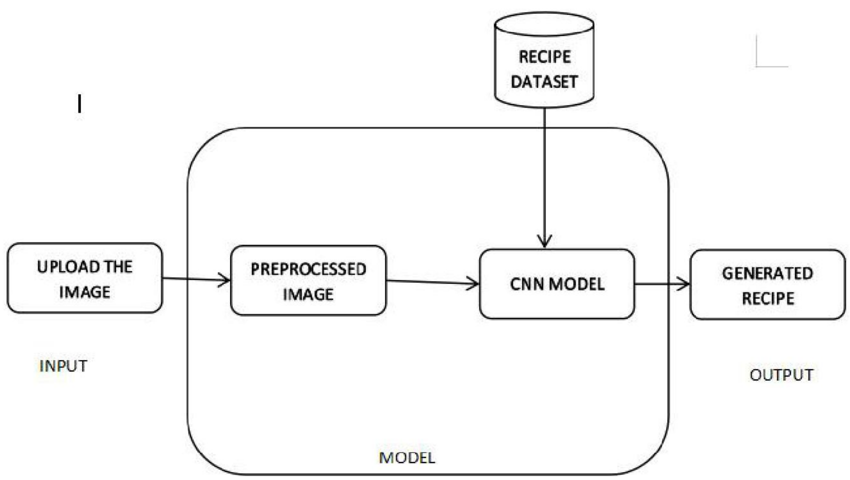

Fig. 1 Data flow representation

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 1, February 2024

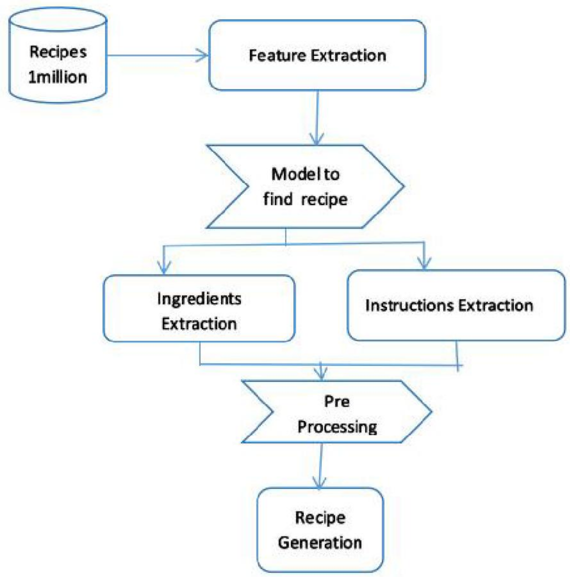

Fig. 2 Architecture for Recipe Generation

The architecture for the "Recipe Generation from Food Images" project involves a multi-stage pipeline that integrates computer vision, deep learning, and natural language processing components. The overview of the architecture follows:

3.1 Input Data Processing:

- Food Image Input: The system takes food images as input, which are pre-processed to standardize dimensions, enhance contrast, and remove noise.
- Textual Metadata: Additional textual metadata, such as captions or tags associated with the food images, may also be incorporated into the input data for improved recipe generation.

3.2 Image Analysis Module:

- Convolutional Neural Networks (CNN's): Pre-trained CNN models are used to extract high-level features from the input food images. These features capture visual elements such as ingredients, cooking utensils, and presentation styles.
- Attention Mechanisms: Attention mechanisms are applied to focus on salient regions of the images, enhancing the model's ability to identify relevant visual information for recipe generation.

3.3 Text Generation Module:

- Recurrent Neural Networks (RNN's): The extracted visual features are passed through an RNN-based text generation model, which sequentially generates the textual components of the recipes, including ingredient lists and cooking instructions.
- Attention Mechanisms: Attention mechanisms are employed to attend to important visual features while generating each step of the recipe, ensuring coherence and relevance.

3.4 Recipe Fusion and Refinement:

- Fusion of Visual and Textual Information: The generated textual components are combined with the visual features extracted from the food images to create comprehensive cooking recipes.
- Refinement Mechanisms: Post-processing techniques, such as language model fine-tuning or recipe coherence checks, may be applied to refine the generated recipes and ensure their quality and coherence.

3.5 Output Generation:

- Final Recipe Output: The refined cooking recipes are presented as the output of the system, typically in a human readable format such as structured text or multimedia presentations.
- User Interaction: Optionally, the system may incorporate user feedback mechanisms to allow users to interactively refine or customize the generated recipes based on their preferences or dietary restrictions.

3.6 Evaluation and Iteration:

- Evaluation Metrics: Various evaluation metrics, including ingredient prediction accuracy, recipe coherence, and human judgment of recipe quality, are employed to assess the performance of the system.
- Iterative Improvement: Based on the evaluation results and user feedback, the system undergoes iterative refinement and improvement to enhance its accuracy, usability, and overall performance.

IV. LITERATURE SURVEY

[1]. "Recipe Generation from Food Images using Deep Learning" by Srinivasamoorthy et al.(2022) provides a comprehensive overview of the application of deep learning techniques in analyzing food images. The paper discusses the challenges specific to food image analysis, such as variations in appearance and intra-class differences.

[2].Salvador, Amaia, Michal Drozdzal, Xavier Giró-i-Nieto, and Adriana Romero. "Inverse cooking: Recipe generation from food images." In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition introduces a novel approach that combines deep learning and natural language processing (NLP) techniques to generate recipes from food images. The paper proposes a method where convolutional neural networks (CNNs) extract features from images, which are then processed by recurrent neural networks (RNNs) or other NLP models to generate corresponding textual recipes.

[3] "Food Image Analysis and Recipe Generation: A Review" by L. Gao et al. (2020), provides a thorough examination of the intersection between food image analysis and recipe generation. It delves into the techniques, datasets, challenges, and opportunities in these domains. The review covers a range of topics including food recognition, ingredient detection, recipe recommendation, and automatic recipe generation using methods such as deep learning.

[4] "Recipe Generation from Food Images: A Deep Learning Approach" by M. Han et al. (2020). presents a novel method using deep learning techniques to automatically generate recipes from food images. The paper introduces the problem of recipe generation from images, discuss related work, describe the proposed deep learning architecture, detail the dataset used for training, explain the training procedure, evaluate the model's performance using appropriate metrics, and discuss the results.

[5] "Recipe Generation from Food Images using Attention-based Neural Networks" by D. Chaudhary et al. (2020). explores the use of attention-based neural networks for generating recipes from food images. The paper is expected to introduce the problem of recipe generation from images.

[6] "Cooking with AI: A Survey on Recipe Generation using Deep Learning" by S. Sankar et al.(2021), it discuss applications of recipe generation in areas such as culinary creativity, meal planning, and personalized cooking assistance.

[7] "Inverse Cooking Recipe Generation from Food Images" by B. Ujwala et al.(2023),. An inverse cooking system that generates cooking recipes from food images is developed using Convolutional Neural Network (CNN). The system utilizes a unique architecture to predict ingredients and their dependencies without imposing any order. It then generates cooking instructions by simultaneously considering the image and inferred ingredients.

V. APPLICATION

1. Cooking Assistance: Assist home cooks by generating recipes based on the ingredients and cooking methods visible in a food image. Provide step-by-step instructions and cooking tips for users.
2. Dietary Planning: Generate recipes tailored to specific dietary preferences or restrictions based on the visual analysis of food images. Provide nutritional information and suggest alternatives to meet specific dietary goals.

3. Restaurant Menu Enhancement: Enhance restaurant menus by automatically generating detailed descriptions and recipes for each dish. Allow customers to access detailed information about the ingredients and preparation methods of a dish by scanning a menu item.
4. Food Blogging and Content Creation: Aid food bloggers and content creators by suggesting recipes and cooking instructions for the dishes they photograph. Provide content suggestions based on trending or popular recipes in the given cuisine.
5. Education and Skill Development: Serve as an educational tool to help users learn about various cuisines, cooking techniques, and ingredient combinations. Provide interactive cooking lessons by analyzing user-submitted food images and offering guidance.
6. Meal Planning and Grocery Shopping: Assist users in planning meals by generating recipes based on available ingredients or preferences. Generate shopping lists based on the recipes to streamline the grocery shopping process.
7. Culinary Innovation: Encourage culinary innovation by suggesting creative and unique recipes based on a combination of traditional and unconventional ingredients. Support chefs and culinary enthusiasts in experimenting with new flavor combinations and techniques.
8. Health and Wellness Apps: Integrate with health and wellness apps to offer personalized recipe recommendations aligned with users' health goals. Provide meal plans that align with specific health conditions or fitness objectives.
9. Smart Kitchen Appliances Integration: Integrate with smart kitchen appliances to provide automated cooking instructions. Enable users to control cooking devices based on the generated recipes.
10. Cultural Exploration: Facilitate cultural exploration by suggesting recipes from various cuisines around the world based on the visual analysis of food images. Include background information on the cultural significance of certain dishes.

VI. CONCLUSION

In conclusion, a recipe generation system from food images holds significant potential across various domains, offering innovative solutions and enhancing user experiences. The applications span from assisting home cooks with personalized recipes to revolutionizing restaurant menus and contributing to educational and wellness initiatives. The system's adaptability and integration capabilities with existing platforms are crucial for its success in the dynamic and ever-evolving culinary landscape.

As technology continues to advance, this project not only addresses immediate needs such as cooking assistance and dietary planning but also fosters culinary exploration, creativity, and cultural appreciation. The combination of visual analysis, artificial intelligence, and machine learning opens up avenues for personalized, efficient, and engaging experiences in the realm of cooking, nutrition, and food-related content creation.

To maximize the impact of the system, collaboration with various stakeholders, including culinary experts, nutritionists, and technology partners, is recommended. Continuous refinement based on user feedback, emerging culinary trends, and advancements in technology will ensure the system remains relevant and valuable over time. As the project unfolds, it has the potential to contribute to the evolution of how we approach cooking, meal planning, and culinary exploration, ultimately making a positive impact on individuals' lives and the broader food industry.

REFERENCES

[1] "Recipe Generation from Food Images using Deep Learning and NLP" by Y. Liu et al. (2019).

[2] Salvador, Amaia, Michal Drozdzal, Xavier Giró-i-Nieto, and Adriana Romero. "Inverse cooking: Recipe generation from food images." In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, pp. 10453-10462. 2019.

[3] "Deep Learning for Food Image Analysis: A Review" by M. Raza et al. (2020)

[4] Pan, Siyuan, Ling Dai, Xuhong Hou, Huating Li, and Bin Sheng. "Chefgan: Food image generation from recipes." In Proceedings of the 28th ACM International Conference on Multimedia, pp. 4244-4252. 2020.

[5] "Food Image Analysis and Recipe Generation: A Review" by L. Gao et al. (2020).

[6] "Recipe Generation from Food Images: A Deep Learning Approach" by M. Han et al. (2020).
[7] "Recipe Generation from Food Images using Attention-based Neural Networks" by D. Chaudhary et al. (2020).
[8] “Cooking with AI: A Survey on Recipe Generation using Deep Learning" by S. Sankar et al.(2021).
[9] "Food Image Analysis: A Review of Recent Advances and Challenges" by K. Zhang et al. (2021)
[10] "Recipe Generation from Food Images: A Survey" by R. Varshney et al. (2021).
[11] Zhang, Mengyang, Guohui Tian, Ying Zhang, and Peng Duan. "Reinforcement learning for logic recipe generation: Bridging gaps from images to plans." IEEE Transactions on Multimedia 24 (2021): 352-365
[12] “Recipe Generation from Food Images using Deep Learning” by Srinivasamoorthy et al.(2022)
[13]“Inverse Cooking Recipe Generation from Food Images” by B. Ujwala et al.(2023).