Food insights and analysis based recommendation using convolutional neural network method

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***Abstract*— This paper describes a system for recognizing meals, extracting ingredients, and suggesting recipes for an individual. Many of us are forced to eat diet food based on ingredient characteristics due to our busy lifestyle and inconsistent eating habits. It is tough to request that the chef prepare a variety of recipes in accordance with the diet plan. Many recipes can be found on a variety of recipe websites, encouraging the chef to cook in their own kitchen without understanding the diet ingredient proportions or side effects. Furthermore, compiling a list of all recipes involving a specific item is still a difficult task. This paper presents a method for obtaining all of the recipe's information.**

Keywords—Machine Learning, Image Processing, Convolutional Neural Network, Food Detection

I. INTRODUCTION

Any substance ingested to give nutritional support for a living being is referred to as food. Food is usually made up of carbohydrates, fats, proteins, vitamins, and minerals and is derived from plants, animals, or fungi. To give energy, preserve life, or encourage growth, an organism consumes a material that is digested by the organism's cells.

Because of the enormous variety of ingredients, foods, and personal tastes, food selection is a significant part of our everyday activities. Choosing the right food at the right time appears to be a difficult task for many people.There are so many options, choosing food is a daily chore. We can't tell how anything is made merely by looking at it. However, with the aid of image processing, we could accomplish something that humans couldn't. People are still oblivious to the nutritional worth, advantages, and disadvantages of their food choices in healthcare decision-making.

Food has a calorie nevertheless, in most meals, the consumer has no idea how many calories are in the food being provided. It is necessary to identify food. In a food picture, there are usually multiple varieties of food served, and it is possible to tell what food is served from just one picture. Food selection is essential for specific purposes, such as a diet grading system, to prevent obesity, diabetes and others. Food references can be found through the food classification. Image classification is a challenge because the food image dataset is not linear; for example, There is a food which has more similarities in look and taste, which is not the same, and there is also a food with another food which has similarities in types and forms of food.

II. LITERATURE REVIEW

A. Diabetes and Correlated Dietary Habits

Diabetes is a long-term health condition that affects how your body converts food into energy [4]. The majority of the food you eat is converted into sugar (also known as glucose) and released into your bloodstream. When your blood sugar rises, your pancreas sends a signal to release insulin. Having too much glucose in your blood can lead to health problems over time. Although there is no cure for diabetes, you can take steps to manage it and stay healthy.

Diabetes is classified into several types. Diabetes is classified into three types: type 1, type 2, and gestational diabetes. Type 1 diabetes is typically diagnosed in children and young adults. Because type 1 diabetes can be passed down through families (Genetics). If you are 45 or older, between the ages of 19 and 44, overweight or obese, and have one or more other diabetes risk factors, or a woman who has had gestational diabetes, experts recommend routine testing for type 2 diabetes. Although type 2 diabetes most commonly affects adults, it can also affect children. Experts advise testing children aged 10 to 18 who are overweight or obese and have at least two other risk factors for diabetes.

Glycemic Index (GI) plays a major part in food. Balancing high and low GI foods is one way to manage diabetes through dietary changes [1]. Foods with a high GI raise blood sugar levels more than foods with a low GI. Limit your intake of high GI foods and pair them with sources of protein or healthy fat to reduce the impact on blood sugar and keep you feeling fuller for longer.

Green = Go
Low GI (55 or less) Choose Most Often

Yellow = Caution
Medium GI (56 to 69) Choose Less Often

Red = Stop and think
High GI (70 or more) Choose Least Often

Foods in the high GI category can be swapped with foods in the medium and/or low GI category to lower GI.

Figure #

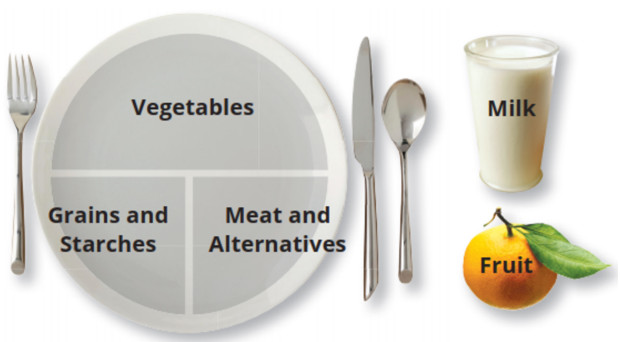
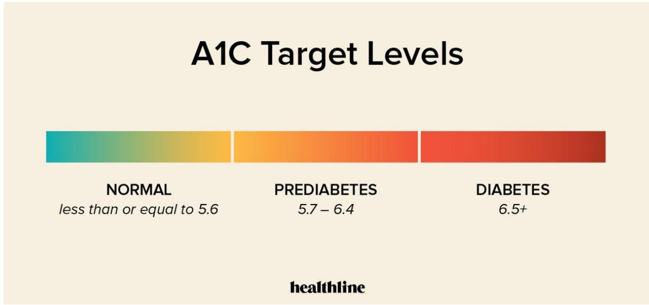


Figure # Indicate the plate method using a standard dinner plate. Source : www.diabetes.ca/mealplanning

The Plate Technique. To control your portion sizes, use a standard dinner plate and this model.

The A1C test, also known as the hemoglobin A1C or HbA1c test, is a straightforward blood test that measures your average blood sugar levels over the previous three months. It is one of the most commonly used tests for diagnosing prediabetes and diabetes, as well as the primary test for assisting you and your health care team in managing your diabetes. Higher A1C levels have been linked to diabetes complications, so achieving and maintaining your personal A1C goal is critical if you have diabetes.



According to the International Diabetes Federation (IDF), the prevalence of diabetes among adults in Sri Lanka is 8.5 percent. Diabetes affects one in every twelve adults in the country, a total of 1.16 million people.

People with diabetes can manage their blood sugar levels by eating certain foods and avoiding others. A diet high in vegetables, fruits, and lean proteins can provide significant health benefits. Blood sugar levels can be raised by both sugary and starchy carbohydrates. However, in the right amounts, these foods can contribute to a well-balanced diet. Many factors, including a person's activity level and medications, such as insulin, can influence the appropriate amount and type of carbohydrates.

B. Identify the Food and predict the ingredients and how it was cooked

Food is essential for human survival. It not only provides us with energy, but it also has a significant impact on our culture and identity [10]. As the old saying goes, we are what we eat, and food-related activities such as cooking, eating, and talking about it occupy a significant portion of our daily life. In the digital age, food culture has expanded quicker than ever, with many people sharing images of their meals on social media [11]. On Instagram, a search for #food returns at least 300 million results, while a search for #foodie returns at least 100 million, illustrating the indisputable centrality of food in our culture. Additionally, eating patterns and cooking customs have evolved over time. Food used to be mostly prepared at home, but nowadays we consume a lot of food that has been prepared for us (e.g. takeaways, catering and restaurants). As a result, particular information about prepared foods is hard to come by, making it impossible to know exactly what we're eating. As a result, we believe that inverse cooking systems are required, which can infer components and cooking directions from a prepared meal.

In the last few years, visual recognition tasks such as natural picture classification, object identification, and semantic segmentation have witnessed tremendous progress [12]. Food identification, on the other hand, has more challenges than natural picture interpretation since food and its components have a lot of intraclass variability and go through a lot of deformations during the cooking process. Ingredients are typically disguised in cooked foods and come in a range of colors, sizes, and textures. Advanced reasoning and prior knowledge are also required for visual ingredient recognition (e.g. cake will likely contain sugar and not salt, while croissant will presumably include butter). As a result, food identification forces current computer vision systems to think beyond the apparent in order to generate high-quality structured food preparation descriptions. Previous attempts to better understand food have focused on food categorization. On the other hand, a system for comprehensive visual food recognition should be able to recognize not only the type of meal or its ingredients, but also the method by which it is produced. The picture-to-recipe problem has traditionally been treated as a retrieval job [3], in which a recipe is extracted from a fixed dataset using an embedding space image similarity score. The size and variety of the dataset, as well as the quality of the learned embedding, all have an impact on the system's effectiveness. These techniques fail when the static dataset lacks a matching formula for the picture query, which is unsurprising. To go over the dataset restrictions of retrieval systems, the image-to-recipe problem could be rewritten as a conditional generation problem. As a result, in this work, we present a system for creating a cooking recipe from an image, replete with a title, ingredients, and cooking instructions. Cooking instructions are generated by first guessing ingredients from an image and then applying conditions to the image and the components. To the best of our knowledge, our system is the first of its kind to generate cooking recipes directly from food images. The task of creating instructions is stated as a sequence generation problem involving two modalities: an image and its expected parts. The problem of predicting ingredients is formulated as a set prediction based on their underlying structure. The topic of whether order matters is revisited because we don't penalize for prediction order when modeling ingredient dependencies. We tested our strategy on the Recipe1M dataset [13], which contains photographs, ingredients, and cooking directions, and found it to be effective. We show that our inverse cooking system beats previously introduced image-to-recipe retrieval approaches by a significant margin in a human evaluation study. Furthermore, we demonstrate that food image-to-ingredient prediction is a difficult problem for humans to solve with a limited amount of images, and that our method can overcome this challenge.

C. Food recommendation system.

Generally in a recommendation system there are three types of techniques are used extensively for filtering.

- Content Based Filtering.
- Collaborating Filtering.
- Demographic Filtering

The content based filtering technique uses similarities in features to make decisions. For instance, text recommendation systems which are used in the newsgroup system use the words of their texts as features. This content-based recommender learns from the characteristics of the objects that the user has rated, a profile of user interest, known as "item-to-item correlation," and derives the type of user profile. The collaborative filtering technique uses similarities between users and items simultaneously to make recommendation decisions. The main characteristic of this model is that it allows generating recommendations based on a combination of ideas from the contributions of many other users. Instead of filtering items by content, make recommendations based on like-minded users' reviews. Finally in demographic filtering it aims to classify the user based on personal characteristics and make recommendations based on demographic classes. For our research demographic filtering technique would be helpful rather than the other two techniques which are CBF and CF because this technique doesn't require collecting complex data like user activities and doesn't have to suffer from high computational power issues. Adding to that content filtering technique also often suffer from a main problem: Cold start issues: Needs bulky data from already created systems in order to provide precise recommendation.

III. METHODOLOGY

A. Image Classification using CNN

Foods have many characteristics to classify and the classification method can use existing methods in machine vision.Convolutional Neural Network (CNN) is a food detecting approach that has a good level of accuracy [17]. CNN can recognize any food in an image with multiple sorts of meals, and it can also be used to classify dishes or determine what food is offered.CNN is a very efficient neural network class for image classification and object detection. Classification of the Food dataset using CNN achieved an accuracy of 92.86.

CNN is a refinement of an Artificial Neural Network (ANN) that uses high precision to classify images, segment images, and extract features. The food detection system uses the Convolutional Neural Network (CNN) classification to represent advanced stages of knowledge by identifying what food is in one frame of the picture taken. This system is used in our application for food analysis and insights in order to maintain track of user food intake habits and provide advice or suggestions based on their medical condition.

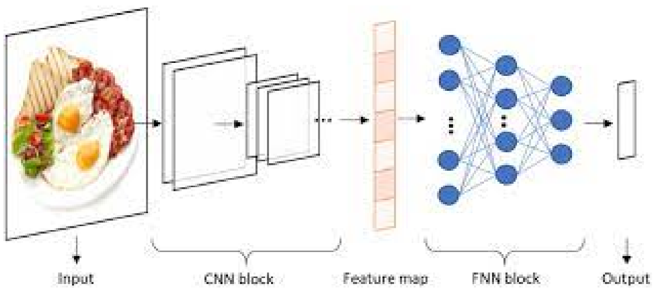


Figure # Convolutional Neural Networks works on food classification.

B. Food deduction

Our approach introduces a new method for creating recipes straight from food images that, in the opinion of humans, delivers more interesting recipes than retrieval-based strategies. In terms of ingredient prediction, our technique outperforms prior baselines when tested on the large-scale Recipe1M dataset. We hope to be able to enable meal preparation access simply uploading a snapshot of food. Our image-to-recipe technology translates a food photo into a recipe that includes a title, ingredients, and cooking directions. Pretraining an image encoder and an ingredients decoder, which predict a set of ingredients based on visual features extracted from the input image and ingredient co-occurrences, is the first step in our solution. After that, the ingredient encoder and instruction decoder are trained, which create titles and instructions by feeding visual clues from the image and expected ingredients into a state-of-the-art sequence construction model. Food recognition puts current computer vision systems to the test because it asks them to look beyond the obvious. Visual ingredient prediction, when compared to normal picture perception, requires higher-level thinking and prior knowledge (e.g., that croissants likely contain butter). Food components have a lot of intra-class variability, heavy deformations occur during cooking, and pieces are frequently occluded in a cooked dish, all of which contribute to the complexity. Our strategy is the first step toward a deeper knowledge of food. The results of our research will be an Android app with three key capabilities or subsystems. Image processing, machine learning, optimization, and visualization technologies were used to create my component.

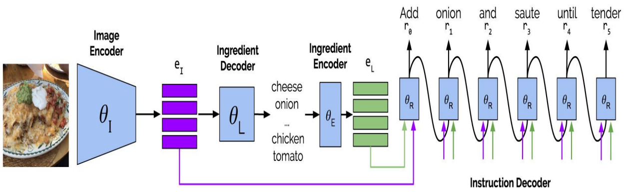


Figure 4: Recipe generation model.

C. Providing Recommendations

The proposed system will predict the best recipe recommendation based on user preferences. First, the system will ask the user to provide his/her demographic related data when registering [Rate your cooking skill level: Low, Medium, High, Physical activity…]. With provided data, a personalized user model would be created by using the Demographic Filtering technique. Demographic Filtering (DF) Technique uses the demographic data of a user to determine which recipe may be appropriate for the food recipe recommendation. Meanwhile, the dataset of the recipe would be refined using sentimental analysis with positively commented recipes having positive score and the negatively commented recipes getting negative score. This will allow the system to redirect the low skilled user to the positively rated recipes and direct the highly skilled user to try all kinds of recipes. The recipe which was shown to the user would not be shown when he/she's visiting the app next time

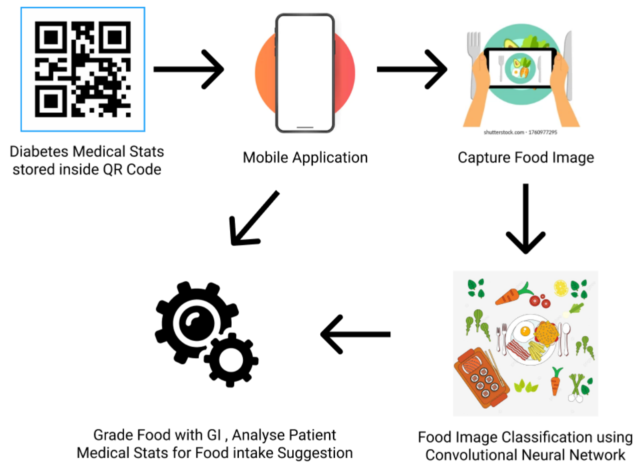


Figure # Single component which involves food classification and recommendation for diabetes patients.

This is a specific component in which a diabetic patient can feed their medical statistical report into the application and then receive food recommendations via image processing. The graded output is provided in order to gain a clear understanding of the patients' food habits and to inform them of the range of foods with the help of the individual Glycemic Index. that they are permitted to consume for any of their meals. When making recommendations, their sleeping and eating habits will be properly considered. This will function as a personal caretaker.

IV. RESULT & ANALYSIS

Pandas and Sklearn are data analysis and manipulation technologies. Matplotlib and Seaborn are used for graph and visualization, and Convolutional neural networks, Keras, and OpenCV are used for image processing tasks.

V. LIMITATION & FUTURE WORKS

More work on hyperparameters and model aspects such as which layers to freeze versus make trainable during transfer learning would be done in the future. Due to limited computing resources and time, most model implementation decisions were made by examining model convergence and relative metrics from training versus validation, but an exhaustive hyperparameter search would have been a more empirical approach. Another option is to train models to recognize images within a subset of food (e.g., fruits, noodles, pastries), because many of the model's errors are caused by confusing similar food items.

VI. CONCLUSION

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