Smart Food Recognition Using Image AI

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***Abstract*— For the purpose of facilitating healthcare applications, many works have been proposed for food image analysis, such as food recognition and ingredient recognition. However, research on combining various factors has been conducted relatively less frequently. In this essay, we argue that a food image is best represented by both the type of food it is and the method of preparation. We suggest neural networks to simultaneously take into account food recognition, ingredient recognition, and cooking method recognition, and we demonstrate that performance can be enhanced by considering many parameters. We compile a dataset of food images with accurate ingredient information and show the efficiency of the suggested recognition models from various angles. Overweight and obesity have long been associated with a diet high in calories and a sedentary lifestyle.**

I. INTRODUCTION

The Real Time Food Detection Using TensorFlow project's implementation will be examined in this paper. From the fundamental features that let a user create an account and log in to it to scanning objects and discovering recipes.[1] Additional features of the system include the program. The outputs should include a complete explanation of the system's proper operation, as well as functionality that makes it easier to use and areas where the system can one day be streamlined for simpler use. [2]. The suggested structure for the project is to break down each functionality into the essential elements that it will offer a user, while also describing the underlying technology. The projected outcomes of the report will not be the final results, but the main objective is to retain as many of the project's real results as possible in the work that is ultimately produced. As the project lifecycle progresses, it is anticipated that changes resulting from new ideas and updates to existing ones will occur.

1.1. Background

It is crucial, especially now that the pandemic has many people confined to their homes, where they need quick and simple meals to prepare in the spare time they have between online work and classes.

1.2. Aims

The project intends to create a system that enables any interested person to attempt to prepare a quick and simple meal. People will benefit financially, physically, and mentally from it. As it aims to use as much food as is available, it will also help to reduce food waste by lowering the amount of food that is routinely thrown out due to expiration dates.

1.3. Technology

TensorFlow and TensorFlow Lite will be the key pieces of technology for this project (Image categorization | TensorFlow Lite, 2020). These algorithms use machine learning to recognize objects and images seen through a camera lens, enabling them to understand what is in front of them. This will be supported by either an Android platform or a web-based platform. If a mobile-first approach is taken, a Java-based Android platform will be employed; otherwise, a web-based platform will be created using HTML, CSS, JavaScript, and Python. Data like user accounts will be stored on a MySQL server that is either hosted by AWS or Google Firebase. The recipes will be retrieved via an API

1.4. Structure

The document's format comprises of a summary of the project's needs. It is further divided into all functional needs using use case diagrams and descriptions to follow each use case's workflow. Additional sections for each use case support the actions the system will take. The purpose of use case models is to deconstruct the system's stages in order to better understand what each action means to an actor, in this case, the user. To better comprehend the likelihood of a user enjoying their use, more focus is placed on the system functionality and how it corresponds with user experience. The greater the quality of the experience, the more likely the user.

II. FUNCTIONAL REQUIREMENTS

The following showcases with a ranking the

importance each functional requirement for the project.

1. Image/Object Detection

a. Highest priority

1. Project core functionality revolves around this section functioning properly for the entire system to work.
2. A user requires the image or object to be adequately predicted to start searching for recipes.

2. Registration, Login System and Account

b. Medium priority

1. It is needed to access the system, but it will not be as necessary as getting both the Image/Object detection and API functioning during the testing phase.
2. However, the user does require this to be functional for them to access the system and manage their account further down the line.

3. API

c. High priority

1. The API will be called many times, so it is essential that the chosen API can function with moderate amounts of stress.
2. The data must also be consistent with producing accurate results to users.

2.1 USE CASE

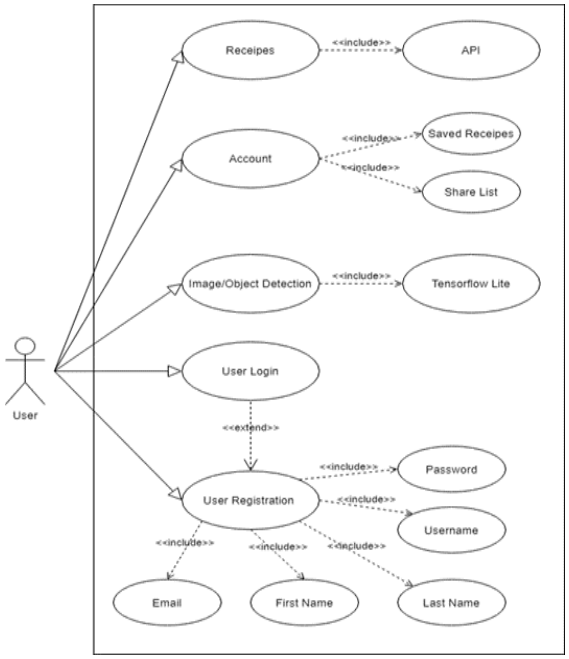


Figure 1: Use Case Diagram

2.2 Data Requirements

Requirement 1: Standard account information (Username (String), Password (String), First Name (String), Last Name (String), Email (String)).

Requirement2: Registered account information (Username (String), Password (String)).

Requirement 3: TensorFlow compatible files ([flite] (TensorFlow file format containing raw image/object data), [.txt] (TensorFlow label file containing labels for images/objects)).

Requirement 4: All account information and more (Username (String), Password [Editable](String), First Name (String), Last Name (String), Email (String), Saved Recipes (Reference to API), Saved User List (String) [Reference to the user table in the database]).

Requirement 5: *JSON based API*.

2.3 User Requirements

Requirement 1: The user can create an account through the registration portal.

Requirement 2: The user can login to the newly created account.

Requirement 3: The user can use the camera to list available ingredients they have.

Requirement 4: The user can save the recipes they have found for later use.

The user can share the recipes with other users.

The user can update their account in a limited format (i.e., Password).

Requirement 5: The user can view all recipes that match the ingredients available.

2.4 Environmental Requirements

The idea behind this approach is to limit food waste so that less food ends up in landfills worldwide. The more use that can be made of common ingredients, the better. The user should be shown as many simple meals as feasible without becoming disinterested in the idea of cooking at home, therefore fulfilling criteria five will be crucial.

2.5 Usability Requirements

Requirement 1: When registering for an account, the user can provide accurate information and are successfully directed to the login page where they can access their account.

Requirement 2: By providing proper credentials without difficulty, the user should be able to log into the account with ease.

Requirement 3: When a user points their device camera at an ingredient, the system should attempt to anticipate as accurately as it can what the ingredient is. The user will be more delighted if the prediction is accurate.

Requirement 4: The user has the ability to manage their buddy list, stored recipes, and account information. The user should not be hindered as this should be done simply.

Requirement 5: The user should be given easy-to-follow recipes that take little time to prepare. Remove any difficult recipes that can put the user off of making meals at home.

2.6 Design & Architecture

The machine-learning technique TensorFlow (Image classification | TensorFlow Lite, 2020) is used to detect images or objects in a particular environment utilizing a device's camera in the system architecture. TensorFlow is a potent library with an ever-evolving technology that enables machine learning to be integrated into any system. It is utilized by many different sectors. The algorithm will be integrated into the present project with the goal of enabling it to visually distinguish an ingredient, identify what it is, and produce a result that is as accurate as possible.

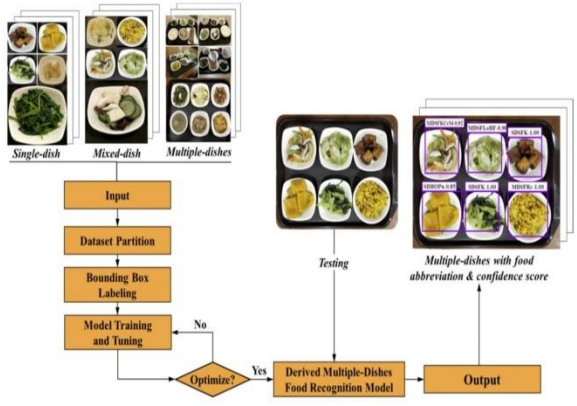


Figure 2: System Architecture

For the purpose of facilitating healthcare applications, many works have been proposed for food image analysis, such as food recognition and ingredient recognition. However, research on combining various factors has been conducted relatively less frequently. In this essay, we argue that a food image is best represented by both the type of food it is and the method of preparation. We suggest neural networks to simultaneously take into account food recognition, ingredient recognition, and cooking method recognition, and we demonstrate that performance can be enhanced by considering many parameters. We compile a dataset of food images with accurate ingredient information and show the efficiency of the suggested recognition models from various angles. Overweight and obesity have long been associated with a diet high in calories and a sedentary lifestyle.

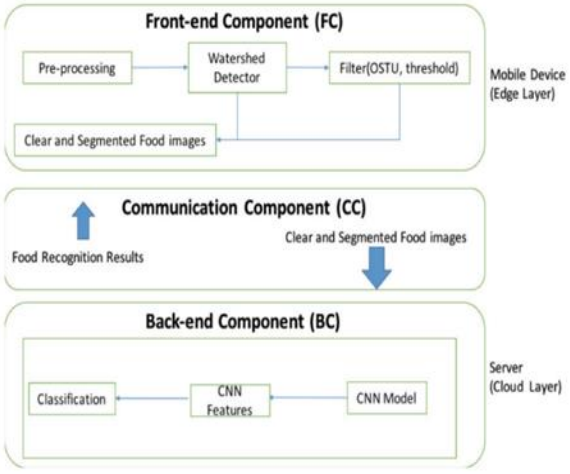
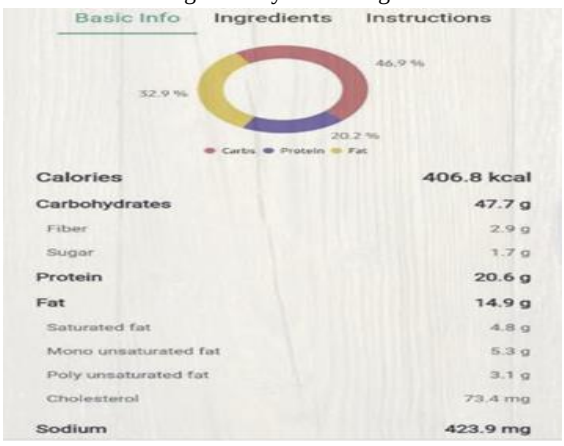


Figure 3: System Design



III. IMPLEMENTATION

The project is currently only concerned with using the TensorFlow template for image classification and minor modifications to suit the project's requirements. The provided template code goes above and above what was anticipated, and as the project's life cycle progresses, it will be re-implemented to strictly meet the needs of the project.[1]

A significant transition from a mobile-based

platform to a more open web-based platform has signaled the start of a new life cycle. Even Google and Microsoft are doing it because they recognize the advantages of switching to a more powerful web (Why you might want to play Google Stadia in Microsoft Edge, 2021; Warren, 2021). However, the primary factor is the superior machine learning tools that are accessible elsewhere.[2]

The decision to change comes as a result of the challenging documentation for using machine learning libraries like TensorFlow and Keras on mobile. However, any device can use it on the Web. Since almost everything is server-side, the system is accessible from any device with a browser and an internet connection. This significantly extends the project's reach beyond what it could achieve with only one operator.[3]

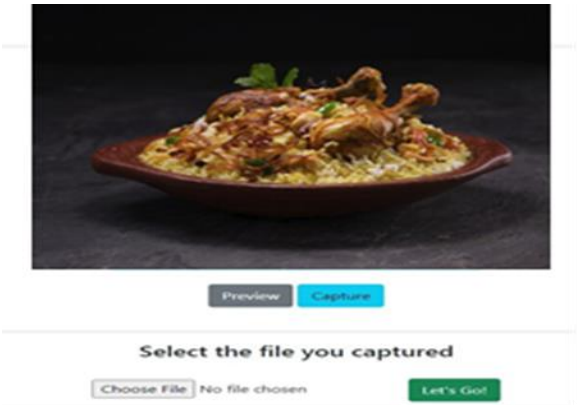
To play about with the technology and discover what can and cannot be done with it, a greater sense of freedom is provided by the new implementation with Python. It was a sensible decision to relocate to Python because it is known for providing packages for many things.[4]

3.1 Graphical User Interface(GUI)

The above screenshot represents the TensorFlow Lite implementation on Android predicting the item in the view finder of the camera is a 43.53% match to a mouse.

NewGUI(Localhost:192.168.113.1)

The new program now features a web-based GUI because the emphasis has been shifted away from a mobile-based solution. Every page starts on the homepage. They take a photo of themselves using the camera on their gadget, upload it, and can see themselves in it. After that, they can look up recipes using the ingredient they displayed on camera.



The Calories & recipes window will showcase all the recipes available to the user based on the ingredient they showed to the camera. This is then displayed on a separate page, as shown below.

3.2 EVALUATION

The main aim and outcome of the project are to provide a resource for people to use during the lockdown periods to make a meal at home. It also helps to cut down on food wastage. Providing a platform to interact and share recipes among steach other is The whole idea of the web app—as emi-social media for food lovers. The concept and thoughts that went to the project were focused on those principles. While not all aim shave been met, the idea and the technological scope may inspire some one else to dream a bigger picture.

An idea itself isn't anything without the resources, and in this case, it is there. However, theirs is a while to go before such ideas can come to fruition without a team building them. The scope is more considerable than expected. Time is necessary, but how you use the time helps and if something isn't helping you keep that time, it becomes a waste. This is a point that someone who's creating a user dependant system must consider.

The goal was to keep the system minimalistic so that not the focus will be on the recipes and not trying to figure the system out. This is important as if you can't even use the app, no one else will either. They are keeping everything front and centre and making the point that the features that were a part of the requirements specs are the ones a user will expect.

It can be said that technology can change and evolve, which might us be left behind. But the critical area to consider is that if users find the appeal, they want the product, so it is essential to keep a close eye on the requirements specs. While not all of them have been met for this project, it is possible that down the road, it can be a fully viable solution to creating a better atmosphere for home cooking and reducing food waste. Those are the goals, and we aim to look forward to having a product that will outlast the current situation.

1V. CONCLUSION

Our goal in this paper is to empower the user by providing them with a practical, knowledgeable, and accurate method that enables them to make wise

decisions regarding their calorie consumption. To effectively classify and identify food items, we used a somewhat unusual combination of graph cut segmentation and deep learning neural networks. We demonstrated that using both of those approaches together gives our system a strong tool for achieving 100% accuracy in food recognition. Future study will involve expanding our image library and testing mixed food amounts using the methodology outlined in this research.

We demonstrated the need of modelling dependencies by first predicting sets of elements from meal photos. Then, we looked at instruction generation based on inferred ingredients and images, highlighting

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