CSCE 5430 SOFTWARE ENGINEERING

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Image Based Food Size and Calorie Estimation

Using CNN Classifier

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Revision History:

|  |  |  |  |
| --- | --- | --- | --- |
| Date | Description | Author | Comments |
| 09/28/2020 | Initial version | Abhinav Mamidipelly | First revision of requirements |
| 10/02/2020 | Final Version | Harsha Vardhan Reddy Goli | Final revision of requirements |

**Members Contribution Table**

|  |  |  |
| --- | --- | --- |
| Member name | Contribution description | Overall Contribution (%) |
| Abhinav Mamidipelly | Introduction, Structure of the Application | 25 |
| Harsha Vardhan Reddy Goli | System Requirements (Functional, Non-Functional and Interfaces) | 25 |
| Prakyath Reddy Kandimalla | Development Phases | 25 |
| Udhaya Kumar Gutta | Checking the overall flow of the document | 25 |

# Introduction

In the current generation, obesity is a significant health issue in the United States of America. It causes numerous health issues like diabetes, stroke high blood pressure, and it may lead to many cancers related problems. The main reason for obesity is the increased consumption of food and calories. To overcome obesity, people need to calculate calories before taking it. But for calculating the calories of the food, we need to know food details what we are taking and calories information, but this is tough in practice because of many cultures and food habits. The United States of America is a large country with many cultures, each culture has their unique food habits, and food items will be there. Collecting the calories information of all these types of food is very tough. So, we are trying to develop an application that identifies the food name from the image to retrieve the calories of the food based on the amount we are consuming. For this, we are using the CNN model for prediction of food name from the image.

## Project Purpose

The primary purpose of developing this application is to know the details of the food we are taking; most of the time, we depend on the outside food due to our modern lifestyle. In the present situation, we are eating different types of food, those we don’t know the exact details of the food item like ingredients, calories, etc. We need to know about the calories we are taking even we don’t know about the name of the food item. So, we are trying to develop an application which is an initial step to start an application which tells you about the food item details.

## Document conventions

This document contents are based on SRS conventions. The font used in this document is Times New Roman, Throughout the document the font size is 14 for Titles in bold and 12 for sub section in bold and the content in normal font. The document also has different images which are mentioned in the table of contents which explains about the project as labeled.

## Intended Audience and Reading Suggestion

The SRS document is intended for developers, stake holders, testers. Users are encouraged to view any section they want. We have briefed each part of the document here.

The sections are introduction, structure of the application, system features, functional requirements, implementation plan, references. These again have sub sections in it. this way it'll be easy for people to understand it. people in the sense developers, testers etc.

## Scope

We have minimal applications like the caloriecontrol.org web app to know the calories of a food item. But these services are minimal and not user friendly. Suppose we know about the calories of food; we need to know about the food's necessary information like name of food and ingredients of the food. But we require an application that will make user friendly by uploading the food image it will give the calories of the food item.

## References

1. <https://caloriecontrol.org>
2. <https://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm>
3. <https://www.tutorialspoint.com/pyqt/index.htm>
4. <https://www.tutorialspoint.com/python/index.htm>
5. <https://en.wikipedia.org/wiki/Obesity_in_the_United_States>

# Overall description of the application

Food calorie estimation identifies the food name and calories from the user inputs of food image and weight of the food that we are taking. The main reason for developing this application is that everyone gets to know how many calories we are taking from food; this process will help us overcome obesity. People should need to know the calories of food before it takes. The current few applications provide information on the food's calories by giving the name of the food, etc. but this process is not a user friendly.

Deep Learning is a part of the Artificial Intelligence used to build neural model features to predict the data from the unstructured data. In this model, we are using CNN (Convolutional Neural Networks) to predict the food item from the image. Based on the food name from the picture, we calculate the calories of the food item. For this, we are preparing a desktop application by using Python, PyQt5, and MySQL concepts.

A picture containing graphical user interface

Description automatically generated

*Functional Flow Diagram*

Graphical user interface

Description automatically generated

Figure 1: Structure of the system

In our system architecture, we have two major modules, i.e., admin and users. Whenever user or admin wants to use the application, they should run our desktop application by clicking or running our application's main program. After running the application, the user interface (admin or users), and then login into their portals using the application's login option, user interface actors can perform their specified functionality and store or retrieve data from the database.

## Product Perspective

Image based Food size and Calorie Estimation desktop application can be accessed by both admin and users. The exact usage of the application is through image recognition to get the clear picture of the food item and calorie estimation of the desired food item that is given by the user. The application is a general usage i.e., with the help of the user login and password s/he can login to the application and by searching the food item, they can get the expected results on the screen. In our desktop application, the first one is Machine Learning, collection of the input data. But here we can also provide unstructured and unlabeled data like images, text, etc. In the second step, we can combine the Feature Extraction and Classification algorithm. For object identification we are using CNN Classifier.

## Product Features

Graphical user interface, application, Teams

Description automatically generated

*Fig 3. Class Diagram*

### Admin login:

Login page of Admin, to this page admin, can navigate by **Homepage > Admin** option. For Admin, there is no need for the register; the user id and password are fixed in the database at a time manually. After entering the user id and password admin need to click on the ‘Login’button. The next action method will connect to the database and verifies user id and password; if given login data is valid, then Admin will get the admin home page window.

### Dataset Upload:

In this feature, the admin will upload the dataset, after selecting the dataset file, you should click on the ‘Upload’ button for raising action. In this action, the dataset will store in the database. After uploading the dataset admin will get an alert box of conformation.

### View Dataset:

In this feature after clicking on the “Click to View” button admin can see the dataset of food name and calories per gram in tabular structure.

### Update Calorie Dataset:

Here the admin can update the food items and calorie per grams which are taken from the outside source. So, if we want to add a new food item to the dataset this feature helps admin to update the dataset.

### User Signup:

For User login, the user should register with his/her details like name, email, etc. on this page. After entering all the details, the user needs to click on the ‘Signup’button. The next action method will connect to the database and store these details into the database. After completion of this user will get an alert of confirmation.

### User Login:

After Signup user can get his own credentials, After the registration process, the user can log in for accessing the user portal with email and password. After entering the email and password, the user needs to click on the ‘Login’ button; the login action program will connect to the database and verify the user id and password. Users will navigate to the user's home after successful login action.

### Image Upload:

After logging into the application, the user can have a feature to upload a food item s/he desires to see the information of that picture.

### Give Grams Information:

In this feature, after uploading the image, simultaneously the user needs to give the additional information about the food. Here, it is number of grams of the food. So that our desktop application can calculate the calories of the food.

### Train Dataset:

We maintain the food calorie per gram in database. We will be training few food items dataset with CNN algorithm. This dataset consists of 101 food item images each food item categories consists of more than 1000 images; we’ll train the dataset with neural network and get the result.

## User classes and Characteristics:

### Admin:

Admin plays a prominent role in our application. Admin is responsible for maintaining the data of food categories image dataset and training images for prediction at the user side functionalities. Admin also uploads the calorie dataset into the database of food items. This dataset includes the name of the food and calorie of food items as per a gram. Admin needs to maintain the application with a user-friendly and accurate prediction of food images and calories estimation.

### User:

The user is an end-user of our application. To login to the user portal, the user can register from our application, and based on the registration login details; they can log in to our application. The user portal user can upload a food item image, and s/he should enter the size of the food in grams. The application will predict the food name from the image and collect the calorie data from the database based on food name and return food and calorie information based on size to the user.

### Run Application:

To start any desktop application, we should create/run the primary or initial program of application. To start the main program, we have many procedures like beginning the main program from the command prompt or starting the application by clicking on an executable file. In a python programming language, by default, every python program works as an executable file. So, by clicking on the main program or python file, we can have our application interface.

### Functionality Programs

After converting the PyQt design form, we need to build all user interface files' functionality action. Based on every design form component, we need to develop the business logic. For example, In Qt designer, we build an interface of the registration page. But the business logic of the registration page is collecting the field's data and store into the database in a suitable table. We assign a functionality program for the 'Register' button and create a data connection and store it using the SQL query. Based on the functionality programs, every business logic and flow of the application will navigate. Based on user inputs on interface functionality, code will execute. According to the requirements, functionality programs will connect to the database for storing and retrieving the data.

### Database

A database is nothing but software that provides security for unauthorized access to data and data manipulations using RDBMS concepts. Application data will store in the database for permanent storage and retrieve data by using programmatically. The database server works based on RDBMS concepts, which means the software's operations are processed based on SQL queries. Using SQL queries, we can store, retrieve, update, delete, and so many functions.

## Design and Implementation Constraints:

The Major challenge we'll be facing with our project is training the CNN. We need to provide it with large amounts of data. One more challenge is accuracy and to overcome this we'll add as many filters as possible and make sure that every pattern and textures are recognized accurately and produce accurate end result. We also have one more thing going against us i.e. this is solely a desktop application, so the reach is limited. We'll try to bring this application to other platform, but we might not have enough resources to do so.

## Assumptions and Dependencies

The Following assumptions are made based on Image Based Food Size and Calorie Estimation. The User needs to upload the picture of the food item via the desktop application

The User needs to specific the quantity in grams and the CNN which we trained will detect the food item then returns number of calories.

# System Features

System features describe of an application or software features, dataflow, and behavior of user/admin etc. Requirements for functional software assist you capture the user’s behavior.

## HOMEPAGE

|  |  |
| --- | --- |
| 3.1.1 | The face of our desktop application shows a picture of the food calorie estimation |
| 3.1.2 | A navigation bar which contains Admin sign in, User sign in, User signup on the top of the application |
| 3.1.3 | A small introduction text box in front of the home page just to give an overview of what the desktop applications does. |

## Admin

|  |  |
| --- | --- |
| 3.2.1 | Admin is the main user of the application. Homepage > Admin |
| 3.2.2 | In the admin sign in with username there is a password the specific password for admin is saved in database. Admin should login for authentication when s/he wants to access admin portal. |
| 3.2.3 | A login button and a validation are set to the login if the user credentials are wrong you can see the error in logging into application. |
| 3.2.4 | A view dataset which is used to view the uploaded dataset mostly the dataset consists of the food title and calories per gram to calculate the intake of the respective food. For verification purpose admin can view the calories dataset from the admin portal.  Homepage > Admin > Login > Admin Homepage > View > Click on ‘Click to View |
| 3.2.5 | The dataset can be updated only by admin if the new food item is trained the calories can be updated in the dataset. |
| 3.2.5 | An upload dataset is to upload the updated or new dataset there is a text box where we can paste the path of dataset in the device and the upload button to upload an updated dataset. For trained images, the admin needs to maintain the calorie's grams' data to calculate the user side's calorie prediction.  Homepage > Admin > Login > Admin Homepage > Dataset Upload. |

## User

|  |  |
| --- | --- |
| 3.3.1 | User login page is the first face of the page what a user sees. The user needs enter login credentials if he already signed up and there is validation setup if user enters wrong username or password shows an error message login failed. To get the into login page user show navigate through Homepage > User |
| 3.3.2 | User password has set of validation regulations which are password should contain a special character, alphabet and the number and minimum of 8 digits. |
| 3.3.3 | If user is new to the application one should sign up by navigating to Homepage from there to sign up there are few details to be entered in the signup form. |
| 3.3.4 | A set of details should be entered to sign up which are name, email, contact number, address, password these are to be entered in the respective textboxes and a signup button these credentials are then saved in database. |
| 3.3.5 | The user enters into the main interface after login he will be uploading the image by giving the path of the food item that he needs to calculate. |
| 3.3.6 | In the detection function, the user must provide two input data, namely the food image and number grams of the food. The application will predict the name of the food and calculate calories. |

# External Interface Requirements

## User interface

The project we are build is the desktop application it is basically a software which can be installed on a single computer (laptop or desktop) and can be used to perform specific tasks. User interfaces of desktop applications are simple and powerful. User interfaces of our application, helping actors to achieve their functionality goals directly. For our application, we used the PyQt toolkit for building user interfaces of the application. For designing PyQt user interfaces, we need to follow two steps.

* Design frontend form with QT designer software. After designing the layout, we can save it into the ‘.ui’ file format.
* Covert frontend form into python code by using the public (Python User Interface Compiler). It is a compiler of PyQt for the conversion of the ‘.ui’ file to the ‘.py’ file.

## Hardware interface

Since our application is desktop applications it needs the basic hardware requirement a power supply and an internet connection to download the images and a desktop or a laptop to get a user experience.

## Software Interfaces

For our application, we developed a software interface application only. It allows connecting with both admin and users. And it’s completely individual, there is no need of communication of multiple users. We used MySQL database for our application and used python coding language. For front end design, we have used PyQt tools to create desktop applications.

The software requirements used in our desktop application are.

* Operating system: Windows, MacOS
* Database: MySQL
* Tools Required: PyQt, Pyuic5, and TensorFlow,
* Technologies used:
  + Front end: PyQt
  + Language: Python

# Other Non-Functional Requirements:

## Performance Requirements:

Our application has high performance as we train data with lots of images. Calorie calculation is fast and depends upon the execution time. As we use more filters in CNN classifier, we will get the accurate results and the image resolution is high. The application will not get breakdown as long everything is running in the background.

## Security Requirements:

Protects the user login credentials and the signup information. Only admin has the access to read and maintain the data, can update the food items and update the dataset whenever required.

## Software Quality Attributes:

* Usability: It is very simple and user-friendly to use, it has very straight forward options for both admin and users. For the users it is easy to signup with the basic info and can easily fill up and get an account created. Even we can upload the image with a single click on the upload image button and can enter the grams of data in a textbox which helps in getting the accurate result. For the admins it easy to update, upload, and view the data whenever required.
* Accuracy: As we know that CNN is good at filtering the images will be training a food item with lot of images into it. If the image of the user matches with that of the image in the database, we can have an accuracy of nearly 97%.
* Other Features: As we are at present training only few food items, we can add more food items as it is more scalable. Our application is available anytime as it is a desktop application, we can access it whenever the user wants.
* Feedback: We are open to the ideas of the users and will be taking the necessary feedback and will be updating the application based on the inputs from the user.

# DEVELOPMENT Phases:

Our application will be developed in three phases

**Development Phase 1: (10/02/2020) to (10/14/2020)**

As already requirement gathering is done. In this stage, designing the requirements, database schema design and front-end design will be done. In requirement gathering we observed many applications which has disadvantages while providing calorie information. In our current application we analyze and detection food calories which is user friendly, user need to know calories of the food by uploading of an image. We design admin and user functionalities which are explained in functional requirement section. Database Schema creation includes creation of tables for admin, user and dataset. The application design is also implemented in this phase.

**Development Phase 2: (10/15/2020) to (10/28/2020)**

In this development phase we will be implementing admin login page, user login page and signup page, dataset uploading page of admin, view option for admin. We test these individual modules after completion of business logic with data verify in the database with different input data. We develop full functional code implantation of a few admins and user functionalities, as mentioned in the functional requirement section.

**Development Phase 3: (10/29/2020) to (11/16/2020)**

In the third development phase the implementation of training of food images and predictions with multiple photos. We verify all the module's performance, which are mentioned in the requirements. After completion of implementation, we check with various tests and numerous data. If any errors occur, we fix those errors and test it again. After selecting all the individual modules, errors need to be rectified and run the full project demo multiple times to make it ready for the final project demonstration.

# Appendix A: Glossary

CNN- Convolutional Neural Network: This is a deep learning algorithm

Tensor Flow: It is an open source math library used in Machine Learning applications like Neural Networks.

PyQt: It is a Graphical User Interface used for front end development

Pyuic5: It is a tool used to convert .ui file to .py file.

MySQL: It is a structured query language, used to manage data in Relational Database.

Tools: PyQt, Pyuic5, MySQL, Tensor Flow

# Appendix B: Analysis Models

Data Flow diagram:

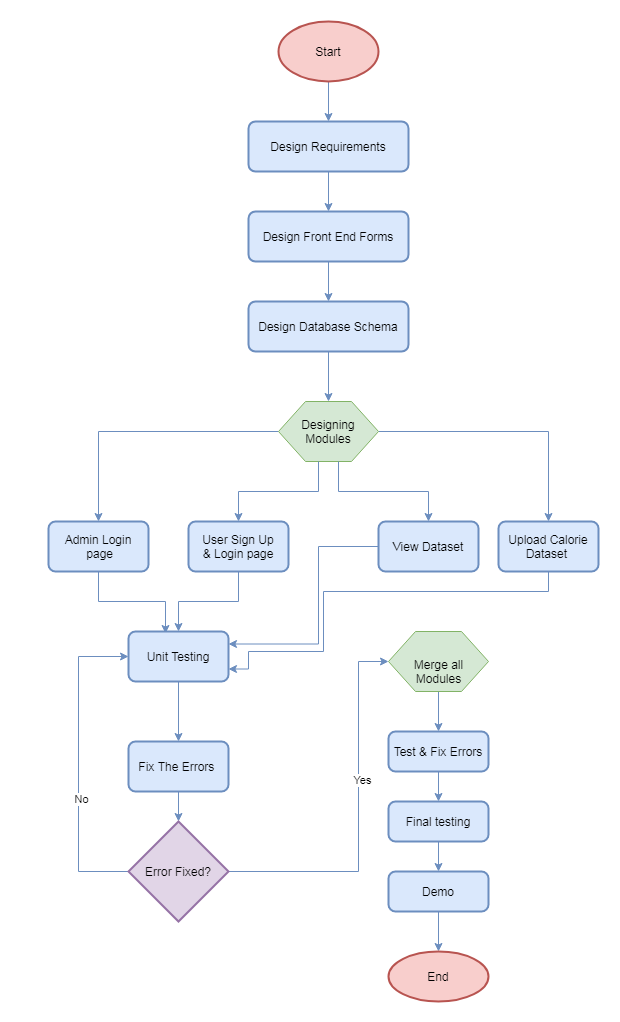


Figure 2: Process flow of the system

# Appendix C: Issues List:

We currently don’t have any issues and if we face any issues in future, we'll update it.

We also have some pending features we didn’t add for now once we’re done with those, we'll update this.

For now, we're not facing any issues.