EatyBitties_Final Report

INTRODUCTION

Video Introduction: EattyBitties_FinalVideo.mp4

Abstract

In the 21st century, the availability of food options has significantly increased, making it challenging for individuals to monitor their food intake effectively. This trend has led to a growing number of people who are seeking to become more mindful of what they eat to maintain their health and well-being. Despite their best efforts, many of these health-conscious individuals struggle to maintain their new habits due to the arduous nature of their methods.

That's why, our team 'Tidbit' is offering an easy-to-use calorie-tracking mobile application. Now, users can capture their food pick and get notified about the nutritional data instantly.

Usability Problem

One challenge that health-conscious individuals often encounter is the difficulty of accurately assessing the nutritional value of foods they consume. Diet-conscious individuals may struggle to estimate the ingredients that make up certain foods, as well as to predict the overall calorie count. This can lead to a lack of confidence in the accuracy of their dietary tracking and may hinder their progress toward their health goals.

In modern times, individuals lead busy, structured lives, leaving them with little time to spare. As such, many opt to use mobile applications to help them stay mindful of their nutritional intake. However, even with the assistance of these apps, the daily task of inputting nutritional information requires a significant amount of effort and time from the individual.

*Diet-conscious individuals may **struggle to estimate the ingredients** that make up certain foods and **predict the overall calorie count.***

Related Work

As obesity rates are rising around the world and healthcare education is spreading widely, tracking calorie intake has attracted enormous attention from more and more people. Thus, there are an increasing number of solutions in the market that enable users to track their calorie intake. In this section, we will review some existing solutions available both in the market and in the literature.

1. **Existing Solutions**

   The early appearance of calorie tracking requires journaling, in which the users have to measure the portions of everything in the meal, calculate the calorie, and log it in a journal. This traditional way has inherent downsides as it requires a lot of work, and is hard to keep track in the journal. As we enter the digital era, there is rapid growth in the development of mobile applications, and companies start to see opportunities in releasing healthcare applications. Some notable examples of manual tracking apps are Calory, MyFitnessPal, and Lose It. They provide users with a comprehensive database of foods and nutritional information, allowing them to manually log their food intake and track their calories. These apps also offer features such as goal setting, progress tracking, and social support to help users achieve their health and fitness goals. However, these

applications usually hide useful features behind a paywall and suffer from inherent drawbacks such as being time-consuming and high levels of commitment from users.

Figure 1. “Calory” application

In recent years, with the emergence and innovations in state-of-the-art Artificial Intelligence models, companies and researchers are now focusing on their applications in the healthcare field. Some recent automated tracking tools are Cronometer, LogMeal API, and SmartPlate. Cronometer utilizes food's barcode and its enormous database to log users' calorie intake. LogMeal API and SmartPlate use image recognition technology to identify the type and amount of food on the plate and provide users with their calorie intake. Although these solutions have proven effective in tracking users' calorie intake, they still need some limitations. For instance, Cronometer does not provide much fitness information, LogMeal API requires a kiosk to measure the food's weight, and SmartPlate still has low accuracy.

Figure 2. LogMeal Kiosk

2. **Literature Review**

   The early research on the problem focuses on the benefits of tracking calorie intake, the challenges associated with it, and the literature survey on calorie-tracking solutions. Unsurprisingly, tracking calorie intake is an effective way to achieve weight loss goals. Burke et al. [1] showed that users with food-tracking journals lost more weight than those who did not. Evert et al. [2] found that tracking food intake resulted in better blood glucose and lower hemoglobin A1c levels. However, tracking calorie intake can be challenging due to the user's circumstances. Black et al. [3] showed that low-income individuals faced barriers to tracking their food intake, such as a lack of access to healthy foods and limited time for food preparation.

   In recent approaches related to tracking calorie intake, Machine Learning models are rising as a dominant force when it comes to computing the users' calorie intake efficiently. To automatically capture the foods' calories, image processing and recognition are required. Redmon et al. [5] transformed the computer vision field with their YOLO architecture innovation, which achieves state-of-the-art on both accuracy and efficiency, enabling the camera to recognize objects in real time. Pouladzadeh et al. [4] suggested an assistive calorie measurement system aimed at supporting patients and healthcare providers in managing health conditions related to diet. Amol et al. [6] proposed a web-based application for estimating fruit calories and improving individuals' utilization propensities for wellness.

Proposed Solution

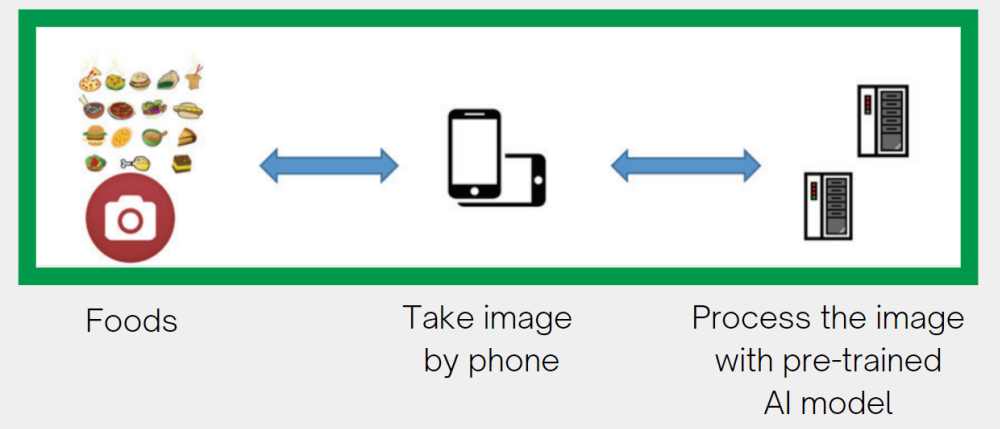


Figure 3. Application Framework

As we discussed in the previous section, the main usability problem of existing applications is having to manually enter the information about the meal and the calories of each food, and low accuracy. Therefore, in this section, we propose a mobile application that will detect the meal from an instantaneously captured picture and then estimate the calories of each item there using computer vision and machine learning techniques.

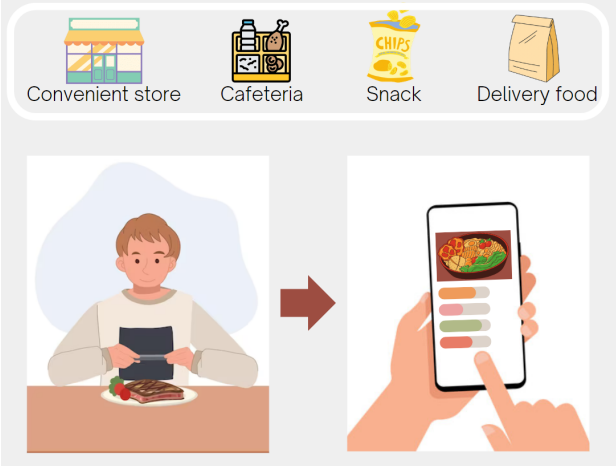


Figure 4. Usage scenario

The app should be user-friendly and provides a simple way for users to log their food and drinks by taking a photo of their meal or snack. The app will then use image recognition algorithms to identify the different types of foods and drinks, estimate their portion sizes, and provide an accurate calorie count. To accurately obtain food types and estimate the calories, we will utilize the state-of-the-art YOLO architecture, which can efficiently categorize objects in real-time, which boosts the response speed of our app.

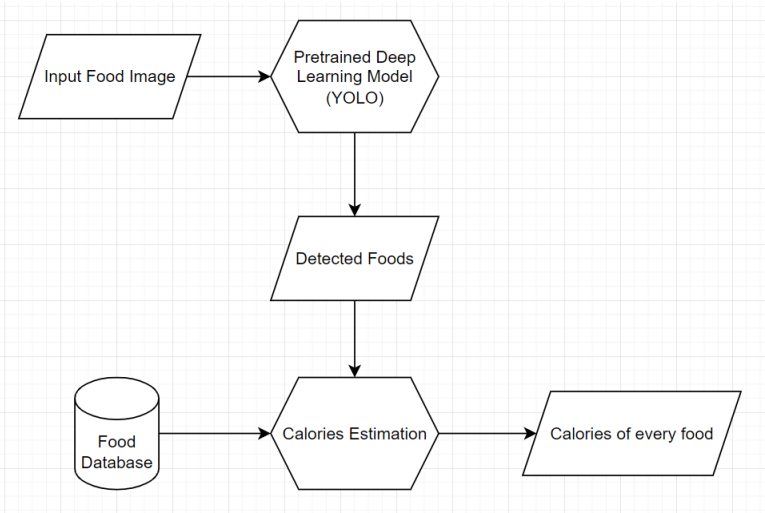


Figure 5. Flowchart of our Deep Learning Framework

To have a better understanding of our application workflow, please refer to Figure 5. Firstly, the user will take an image of the food, and it will be sent to the backend, which contains a pre-trained Deep Learning Model that will process that image and produce the annotated information about each type of food. Along with such information, we will make queries to a food database to estimate each food type's portion size. The result will then be sent back to the user's device, where it will be displayed along with the calorie count for each food item. The user can then review and confirm the accuracy of the information and make any necessary adjustments. Once the user has confirmed the information, the calorie count for each food item will be added to the user's daily intake summary. The user can review their daily summary at any time to see their total calorie intake for the day and track their progress toward their goals.

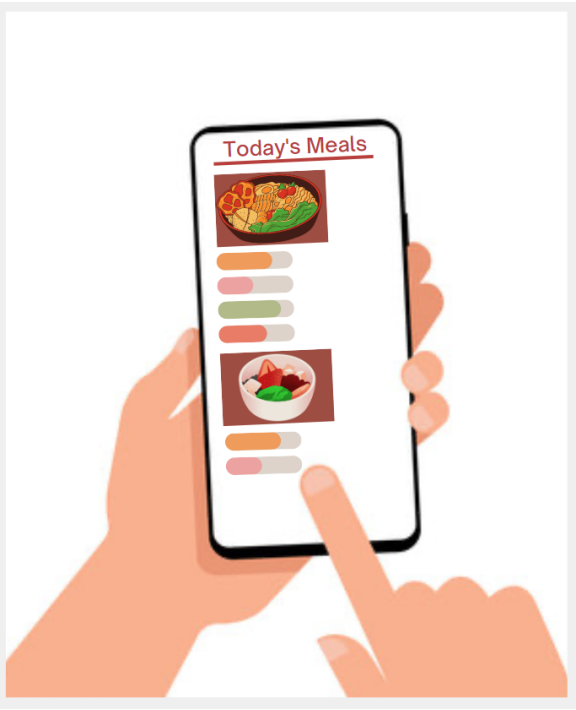


Figure 6. Food history in one day

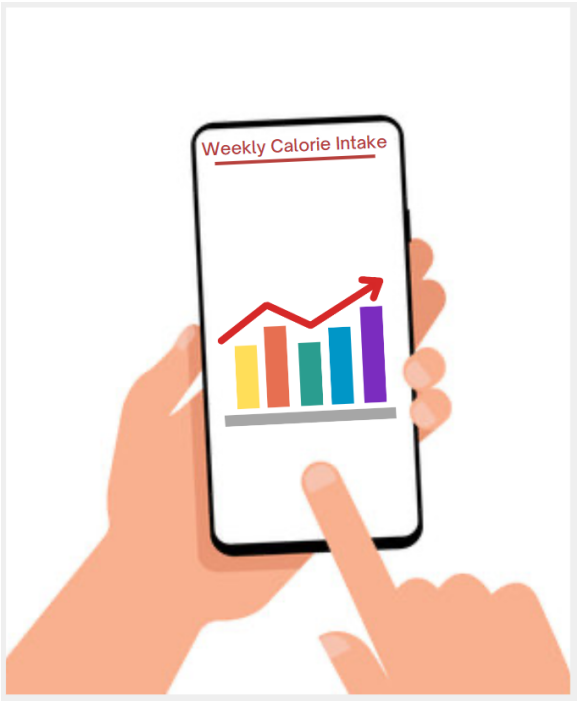


Figure 7. Weekly calorie intake

Overall, our application workflow is designed to provide a seamless, efficient, and accurate way for users to track their calorie intake and improve their health. By leveraging advanced technology and machine learning algorithms, we aim to deliver users the power to make informed and healthy food choices in a simple and accessible way.

ITERATION REPORT

Making a low-fidelity paper prototype for a mobile application is a crucial stage in the design process since it enables us to test and refine our design concepts and spot possible usability problems. It also allows us to quickly test and iterate on our design without investing too much time or resources. By making a physical prototype of the user interface of our application, we can simulate user interactions and get feedback on the usability through user surveys and interviews. It is an essential process in order to identify any design flaws and implement fixes early in the design process to improve user experience.

1. Pre-prototype: Target User Study

i. **Participants**

- A total of 61 participants from various countries and academic backgrounds at UNIST were surveyed.
- Countries represented: Korea, Kazakhstan, Vietnam, India, Indonesia, Turkey, Philippines, Dominican Republic, Turkmenistan
- Age range: 20-28 years old
- Gender: Not specified
- Academic backgrounds: Biomedical Engineering, Computer Science and Engineering, Materials Science and Engineering, Energy and Chemical Engineering, Business Administration, Mechanical Engineering, Biological Sciences, Urban and Environmental Engineering
- Year of study: Undergraduate and graduate students

ii. **Tasks**

- The participants were asked to complete a survey about their fitness goals, exercise habits, and tracking methods.
- The survey included questions about the following:
    - Their fitness goals
    - Their exercise habits
    - The methods they use to track their progress
    - The challenges they face in tracking their progress
    - The features they would like to see in a fitness-tracking app

iii. **Research Method**

- The survey was conducted using Google Forms.
- The survey was open for a period of two weeks.
- A total of 61 participants completed the survey.

iv. **Results**

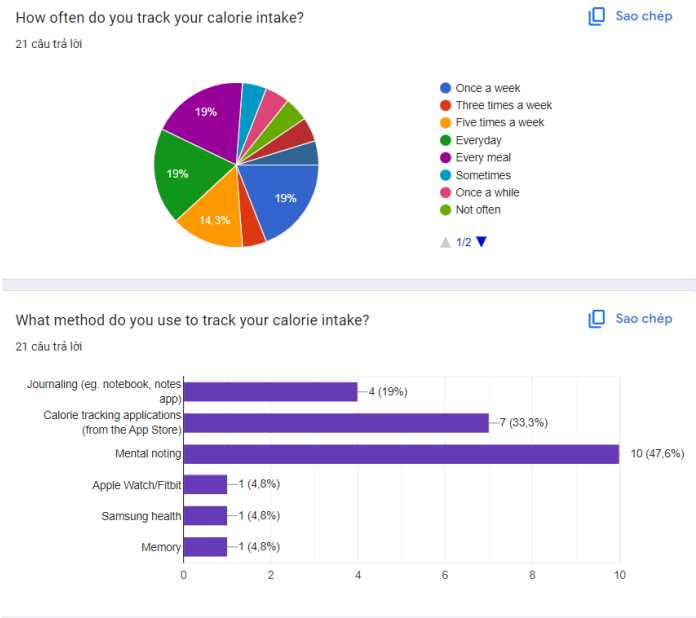


Figure 8. Target User Study Survey

The majority of participants expressed an interest in losing weight, lowering body fat, and building up muscle. Exercise/working out and calorie deficit/surplus were the most common methods used to achieve their fitness goals.

Calorie-tracking applications, mental noting, and journaling were the most common tracking methods used by participants. The most commonly tracked data were calorie intake and macronutrient intake.

The most common reason for tracking was to have a better understanding of their calorie intake and to ensure they were meeting their fitness goals. The most common barriers to tracking were lack of time and difficulty in finding accurate information about the food they consumed.

In terms of features, participants expressed interest in an app that could suggest healthy meals based on their fitness goals and dietary restrictions. They also expressed interest in a feature that could automatically detect the calories and macronutrients in their food.

Statistics

Percentage of participants interested in losing weight: 77%

Percentage of participants interested in building up muscle: 62%

Percentage of participants who use exercise/working out to achieve their fitness goals: 84%

Percentage of participants who use calorie tracking to achieve their fitness goals: 61%

Percentage of participants who track their calorie intake: 84%

Percentage of participants who track their macronutrient intake: 59%

Percentage of participants who find tracking difficult due to lack of time: 54%

Percentage of participants who find tracking difficult due to lack of accurate information: 39%

2. Prototype #1 Paper Prototype

a. **Design**

In order to make a low-fidelity paper prototype of the user interface, we used common supplies including paper, markers, tape, stickers, and colored pencils. Our key objective was to quickly repeat our user interface design and make changes to it without much difficulty when we found better approaches for the same design issues.

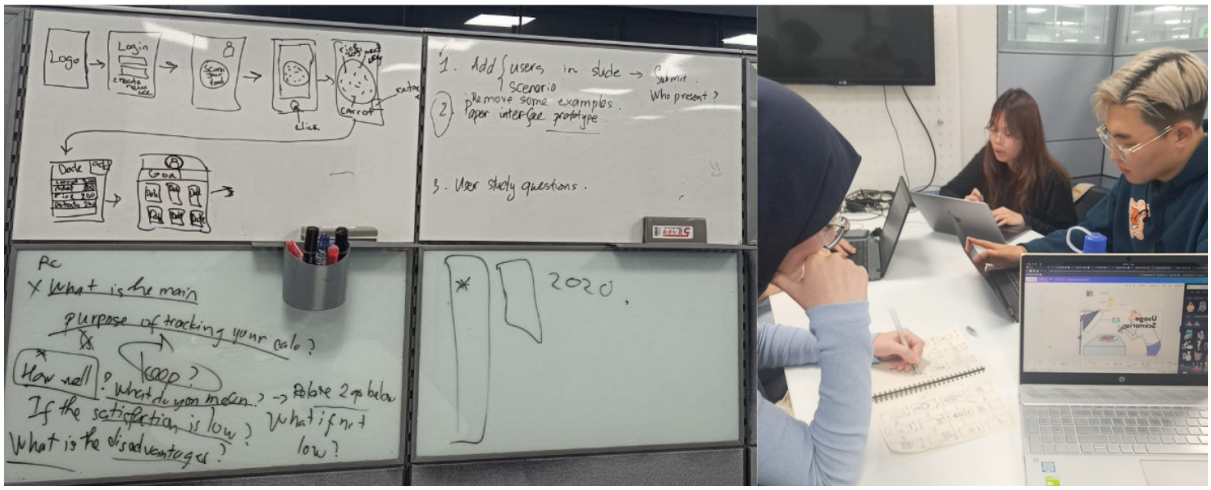


Figure 9. Scratching and meeting about our very first paper prototype

We initially spoke about our design approach as a team before getting started with actual materials. We identified the main features of our application and concentrated on how to display these features. We then discussed the number of screens required for each functionality. After identifying each screen we need in our application, we sorted them from the most important feature to the least important. According to the importance of these functions inside our application, we wanted to provide access to them concurrently.

Since food analysis from an instantly taken picture is our application's primary feature, we chose to make that feature the homepage for easier access. As it is the main reason why people will use our application, we did not want users to have to navigate through several screens in order to reach the appropriate screen.

Then we made the decision to add two primary navigation buttons to the top of the screen, one for the menu that shows the remaining features and the other for going back to the home page. For the menu, we decided to organize each element on the menu in accordance with the prior determination of importance. We used the whiteboard that was set up in the space where we had our group meetings throughout this process to communicate with each other about the specific design ideas we had. Additionally, we did several sketches before moving on to making a paper prototype.

We began sketching up each screen on sheets that we cut to the actual size of a typical phone once we had identified all the features on each of these pages, such as buttons, menus, and forms. To make this procedure easier, we made the drawings by hand rather than using computer tools. The designs we came up with for this prototype were as straightforward as feasible and contained just the features that were absolutely necessary to communicate the design concept. We did not use detailed designs for icons and graphs. However, we simply used colored markers to give the users a better understanding since the color choices are also a solution for some usability problems.

After completing sketching each screen, we lay them on a surface and went through different navigation scenarios to see which sequence was most practical. We taped the screens together in a horizontal line

once they had been arranged. To show the buttons that must be hit to advance to the screen that follows the current one, we used a little red arrow. We assigned numbers to buttons on screens where there are many button options in order to make it clearer which screen comes next. Then, we cut a phone frame out of paper and colored it with a black marker. After merging it with another piece of paper of the same size, we used it to pass through the screens we taped together.

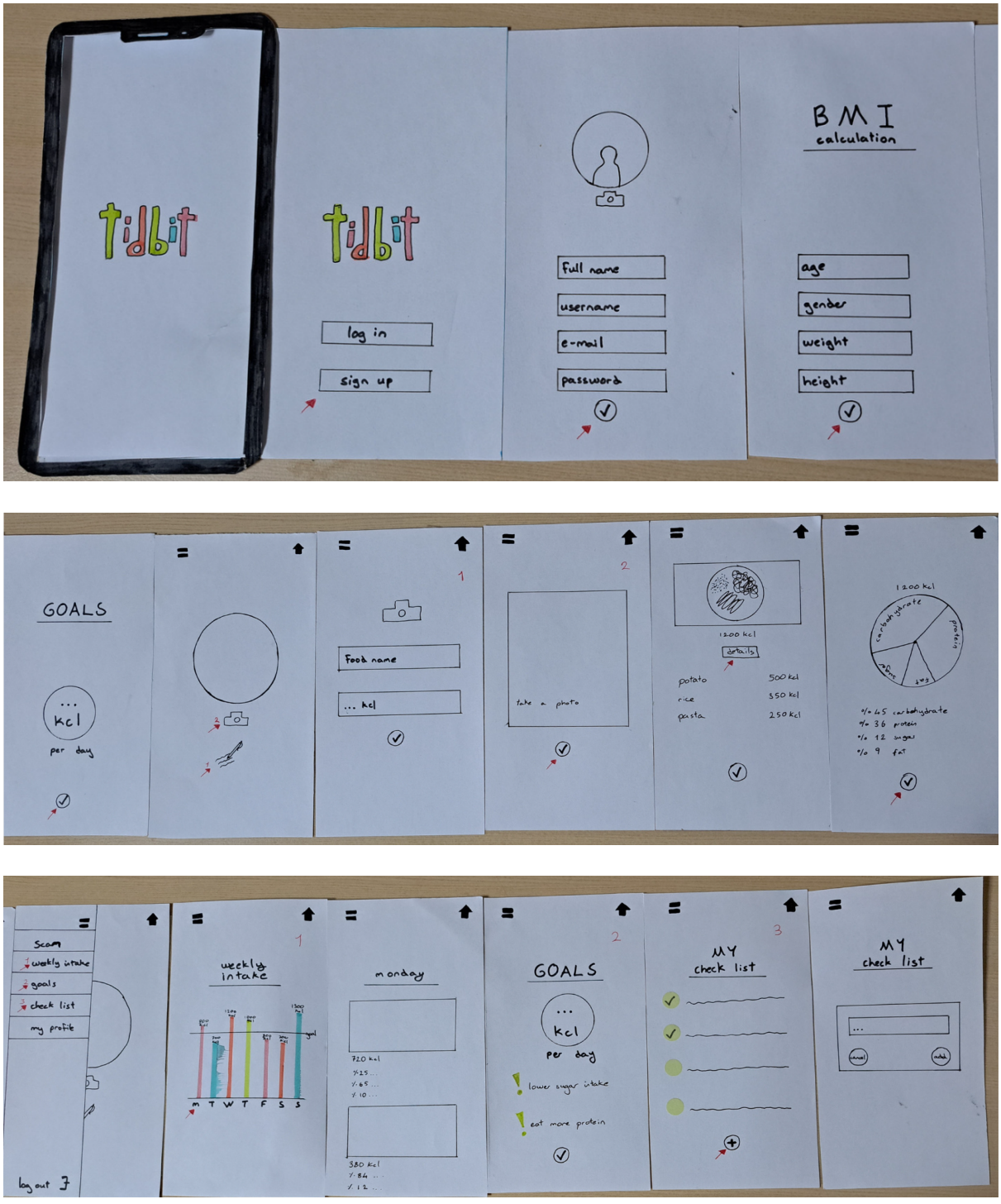


Figure 10. Overview of the first paper prototype

b. **Design Justification**

The information architecture of our calorie counting application has been thoughtfully designed to guide users through a seamless and intuitive journey. The flow of the application is structured to ensure users can efficiently track their daily calorie intake, monitor their progress, and receive personalized suggestions to achieve their health goals.

1. **Sign-Up**: The user journey begins on the main page, where new users can sign up for an account. The sign-up process includes filling out profile information, such as full name, username, email, and password.
2. **Health Information and Goal Setting**: After signing up, users are directed to provide additional health information, such as age, gender, weight, and height for the automatic body mass index (BMI) calculation. Following this, users are prompted to set their calorie intake goals for the day or a general target based on their preferences and objectives.
3. **Main page:** The big circle in the middle shows how many calories are left for a day. And right below that, there are 2 icons for calorie input. The icon in the top left corner shows the menu features and the one in the top right corner straightly returns to the Main Page when users are interacting with features on other pages.
4. **Calorie Input**: The user is then directed to a page where they can input their calorie intake. Our application offers two options for entering calories:
    a. **Food Image Recognition**: Users can take a picture of their food, and our embedded AI and database will analyze the image to provide details and a breakdown of the calories and macronutrients in the food.
    b. **Manual Input**: Alternatively, users can manually enter their calorie intake by typing in the relevant information.
5. **Weekly Intake**: After recording the calorie intake, users can navigate to the weekly intake screen. This screen provides a comprehensive overview of their calorie consumption for the week, allowing them to track their progress and identify any patterns or trends.
6. **Goals**: To further support users in achieving their health goals, the application suggests actions based on their calorie intake. These suggestions might include eating more protein, and reducing sugar intake.
7. **My checklists**: This feature is like a user's note. Users could add their own have-to-do things such as drinking more water, waking up at 8 am, go jogging for 30 minutes per day. Users can remind themselves by going to this feature.
8. **Profile Page**: Lastly, users can access their profile page, where they can view and update their personal information such as passwords, email addresses, and health information such as age, height, and weight.

The information architecture described above aims to create a logical and streamlined user experience, ensuring that users can easily navigate through the different stages of calorie tracking, receive personalized feedback, and stay motivated on their health journey.

c. **User Study**

i. **Participants:**

- 3 users who have health consciousness and many experiences using calorie tracking applications at UNIST.

ii. **Tasks:**

Our interview question set is as follows:

1. Can you tell me your first impression of the application?
2. What do you think the different buttons or actions on the screen do? Are they intuitive enough? Is there anything you would suggest to change?
3. Were there any parts of the paper prototype that confused you or were difficult to understand?
4. Can you suggest any changes or improvements to the design?
5. How would you rate the overall usability of the paper prototype on a scale of 1-10?
6. Is there anything you would have expected to see or be able to do that you can't find on the prototype?
7. Are there features that you think we should add after seeing this application?

iii. **Research Method**

- Semi-structured interview with the designated questions.
- A small interview session lasts for about 10 minutes for each user.
- The question set was created based on the paper prototype and we collected their opinions for further improvements to the next paper prototype.
- We asked for opinions on different functions, buttons, and actions on the screen, as well as suggestions for changes or improvements to the design.
- Users' answers were recorded by typing using a computer during the interview and analyzed right after the session ends.

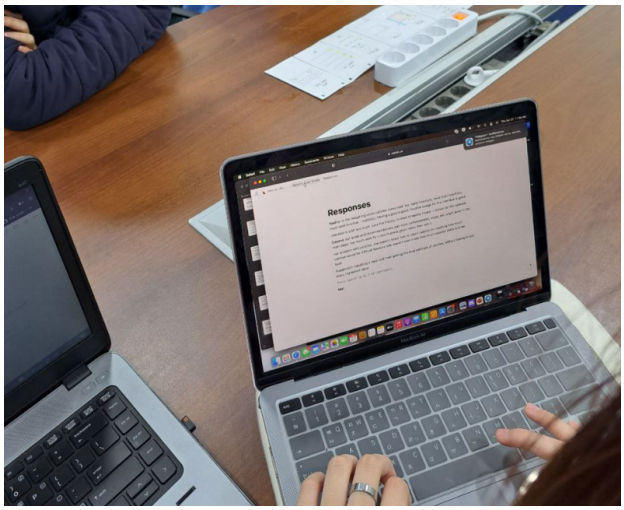


Figure 11. User Study with the first paper prototype

iv. **Results**

1. Overall design:

- A minimum and maximum score of 7 and 9 out of 10 were assigned to the usability overall respectively.
- Our paper prototype is simple, follows minimalism, and is relatively easy to understand its features.

- All participants liked the statistics function and having a specific goal.

2. Difficulties to understand features and buttons in paper prototype:

- The design was intuitive and easy to understand, but some buttons' placement was confusing.
- All 3 people said that adding food intake manually is confusing at first glance.
- One participant commented that the checklists feature is unnecessary.
- The return to the main page button is confusing, it is the “upload” button.

3. Some suggestions to change or improvement in the design:

- Allowing users to input their own goals.
- Showing recommendations of nutrients amount and goals on the main page of the app.
- 2 users proposed enhancing the food's health benefits material with more nutrient details, health advice, and justifications.
- Adding colors to the user interface that related to the health theme.
- People’s weights can vary every day so some people might want to recalculate them frequently.

4. Potential missing features or functionalities:

- Displaying calories consumed on the phone’s notification bar.
- One participant suggested incorporating technology to recommend food and adding health suggestions and detailed explanations for scientific terms like how much carbohydrates, protein, etc they should consume per day.
- 3 people suggested adding photo and grams input options and having a database to input the calories automatically instead of manually inputting them.

d. **Insights and Reflections**

The user interface (UI) design for Tidbit is currently in its early stages and should be considered a rough representation of our vision. Our intention is to continuously refine and enhance the UI to create a more polished and engaging experience for our users.

At this stage, the UI design is focused on providing a functional layout that allows users to easily track their daily calorie intake. However, we acknowledge that the design lacks the desired liveliness and fails to fully convey a sense of health or being healthy, which is a crucial aspect of our application's purpose.

Moving forward, we aim to incorporate vibrant and energetic visual elements that promote a positive and health-oriented atmosphere. This includes exploring color schemes that evoke feelings of vitality and well-being, as well as integrating relevant imagery such as fresh fruits, vegetables, and active individuals engaging in exercise.

We also plan to introduce interactive elements and animations that provide visual feedback to users, enhancing their engagement with the application. These additions will contribute to creating a more lively and dynamic UI that aligns with the overall goal of fostering a healthy lifestyle.

3. Prototype #2 Computer Prototype

a. **Design**

In this section, we will describe the design strategy used for Tidbit. Our proposed calorie counting application's design strategy incorporates both aesthetically pleasing and practical components, with the primary goal of developing a simple, straightforward user experience that is tailored to assist users in tracking their daily calorie intake. We drew a low-fide computer prototype with some changes to the paper one based on our insights after the user study.

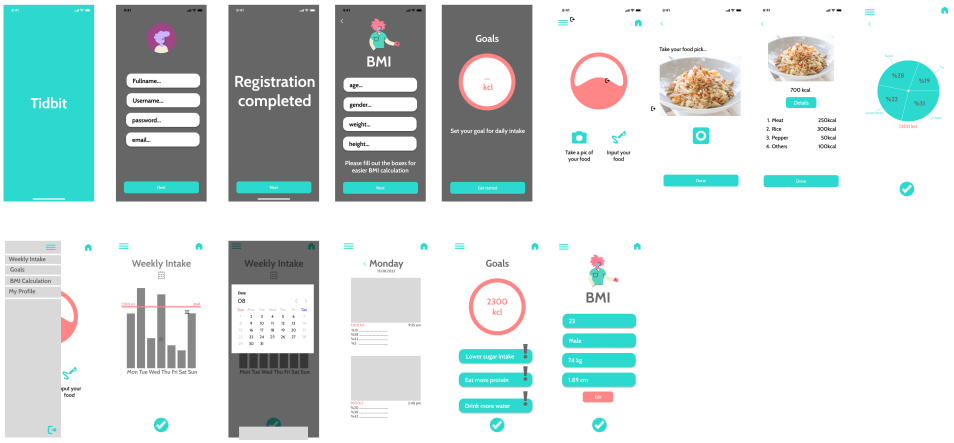


Figure 12. The overview of the first computer prototype

b. **Design Justification**

The design decisions made for Tidbit are driven by a user-centric approach, with a focus on creating an intuitive, visually engaging, and health-oriented user interface (UI). The following justifications explain why specific design choices were made:

- **User-Centric UI**: While our UI is currently in the rough sketch phase, the design concept revolves around utilizing graphs and visual elements to represent data in a more intuitive and meaningful way. By presenting information through visually appealing and easily understandable visualizations (making the calories left as the fluid wave in the big circle of the Main Page), we aim to enhance user comprehension and engagement with their calorie tracking and nutritional data.
- **Color Scheme and Health Association**: Although the specific color scheme has not been finalized, our design direction is to use colors that are commonly associated with health and well-being. By selecting colors (teal and orange, which are complementary colors) related to nature, freshness, and vitality, we aim to create a visual atmosphere that reinforces the application's purpose of promoting a healthy lifestyle. The color scheme will be carefully chosen to create a harmonious and visually appealing UI, while also ensuring that the text and data remain easily readable and accessible to users.
- **Flow of Screens**: The flow of screens within the application has been carefully planned to ensure a seamless and intuitive user experience. The progression from the main page to the sign-up page, profile information, health details, and goal setting allows users to provide essential information for accurate calorie tracking. The subsequent screens for calorie input, weekly intake overview, calendar, and personalized suggestions follow a logical sequence that aligns with users' needs and goals. This thoughtful screen flow enables users to navigate the application effortlessly and make the most of its features.

- **Adding titles for calorie input icons:** Only icons themselves sometimes make users confused, therefore, we added texts to guild users to choose the input method.
- **Switch My Checklists feature to BMI Calculation feature:** As observed from the user study, we concluded that the My Checklist feature is not that necessary. Since the weight of users could vary over time, they might need to recalculate BMI scores more often to decide their specific goals and the amount of calorie intake per day. Therefore, we added an option for users to update their BMI and removed the My Checklist feature.
- **Calendar and Historical Data**: Users can access a calendar function to view their calorie intake history from previous dates. This functionality enables users to review and compare their daily intake, facilitating self-reflection and informed decision-making.

These design choices aim to provide users with a clear and structured pathway to navigate through different stages of the calorie tracking process. By presenting screens in a coherent flow, users can easily comprehend the app's functionalities and transition smoothly between tasks. This intuitive screen flow reduces user confusion and enhances overall usability, contributing to a positive and engaging user experience.

The combination of a user-friendly UI, visually appealing data representations, readable font sizes, a health-associated color scheme, and a carefully planned screen flow all work together to create an application that is not only visually appealing but also highly functional and conducive to promoting a healthy lifestyle.

c. User Study

i. **Participants**

4 users care about their nutrients and health from different countries, genders, ages, and experiences using a calorie-tracking app (no one is in the group of users in the previous user study).

ii. **Tasks**

Users were asked to freely talk to each other about the usability and design of the computer prototype for a calorie-counting application. We asked them for opinions on different functions, buttons, and actions on the screen, as well as suggestions for changes or improvements to the design while they discover the user interface on Figma. Some shared potential missing features or functionalities that users would like to see added to the application.

iii. **Research Method**

- Constructive Interaction
- 2 people in each group, one with some experience with using some calorie-tracking applications before, and another does not have that kind of experience.
- A group will try to learn how to use the app interface together and talk to each other while they are interacting with the laptop.
- Each session takes 20 minutes.
- 1 of our team members works as an observer, taking note of what they are talking using paper and pencil.

iv. **Results**

1. Color scheme:

- Keeping minimalism is good, but the logo should stand out more.
- The background color when we set the highest brightness of the phone would be too bright and hurt the eyes.
- The movable flow of the big central icon on the main page would be more interesting.
- Adding colors (can also support those who have color blindness).

2. User information for BMI
    - Showing the reasons why we ask about personal information such as age, height, and weight.
3. Features
    - All users suggested a separate user guidance tour for users who try our app for the first time.
    - The name “Weekly Intake” feature is confusing —> “Daily Intake”
    - Some participants found the choosing feature in the statistics part confusing when they missed choosing the wrong day.
    - Adding an alert option to remind users time to eat/drink water or when they eat more nutrients than they should such as too much protein or fat.
    - Instead of having a Goals feature, put some nutrient suggestions on the main page, and change it whenever the user opens the app.
4. Suggested functions:
    - Instead of having all manual type input, having more constraints for the user input part (a drop-down menu for the ages, genders, and weights) would be better.
    - Asking for how often the user exercises.
    - Using BMI calculation to calculate some suggested calorie intakes and let users choose based on their goal (lose weight/gain weight and how much weight per week).
    - Some random facts pop up about health such as: Chicken skin is fat as fuck and egg has high protein.
    - Connect to an SNS account to share the app, the food that you ate, or when they reached their goals.

d. Insights and Reflections

We learned important lessons and had important realizations while we were developing our calorie-tracking application, Tidbit, and these things had a crucial impact on the design that we ultimately came up with. These observations were made as a result of user feedback, iterative design, and our user survey, which highlighted areas that needed enhancing and adjusting. The main conclusion and reflections are as follows:

1. **User Study Findings**: The user study provided valuable feedback regarding the application's visual appeal and cohesiveness. Participants emphasized the importance of a professional and polished look, indicating the need for a more cohesive color scheme, refined font choices, and improved iconography. These insights have underscored the significance of elevating the application's aesthetic elements to enhance user perception and engagement.

2. **Iterations and Continuous Improvement**: The design process and user study have highlighted the importance of iterations in refining and enhancing the application's design. We have realized that iterations allow us to incorporate user feedback, address usability concerns, and make iterative improvements. This realization has reinforced our commitment to an iterative design approach, where we continuously refine and evolve the application to better meet user needs and aspirations.
3. **Flow and Usability**: Participants expressed the importance of intuitive navigation and seamless transitions between screens. As a result, we recognize the significance of revisiting the flow of screens and refining the placement and prominence of icons to ensure a more intuitive user experience.
4. **Color Scheme and Font Choices**: Based on user study feedback, we have realized the need to revisit and carefully select a color scheme that aligns with health and well-being, evoking a sense of vitality and freshness. Additionally, font choices will be reconsidered to ensure optimal readability and a professional aesthetic that enhances the overall user experience.
5. **Design Cohesion and Professionalism**: Our reflections have highlighted the significance of a cohesive and professional design that instills user confidence and trust. We acknowledge the importance of considering the application as a holistic experience, where visual elements, font choices, color schemes, and iconography work together harmoniously to create a polished and professional interface.

These observations have been a great source of direction for our design approach, ensuring that we successfully address user needs and objectives. We hope to develop an application that not only offers customers great functionality but also delights them with its visual appeal and usability by incorporating user feedback and thinking back on our design decisions.

Moving forward, we will embrace the iterative nature of design and use user insights and feedback to motivate ongoing development. We are confident in our abilities to develop a calorie-counting application that effortlessly combines usability, user experience, and visual appeal by iteratively improving the design.

4. Prototype #3 Computer Prototype

1. Design

   Our mobile application Tidbit, encompasses a comprehensive range of 25 screens, each meticulously designed to serve a specific purpose and contribute to an enhanced user experience. The design choices made throughout the application, including screen layout, color selection, and navigation, have been carefully considered to ensure optimal usability, visual appeal, and effective communication of information to the users. By analyzing the needs and expectations of the target audience, we created an intuitive and user-friendly interface that facilitates seamless interaction and encourages users to achieve their calorie tracking and dietary goals effortlessly. Through a combination of thoughtful screen organization, aesthetically pleasing color schemes, and intuitive navigation options, the application provides a robust and enjoyable experience for users seeking to monitor and manage their calorie consumption effectively. We approached the creation of the mobile application with a thorough and iterative design process, ensuring that the final design met the needs and expectations of the users. To begin, the team conducted extensive research to understand the target audience's preferences, habits, and pain points related to calorie tracking and dietary management. Based on the research findings, we engaged in an ideation phase, brainstorming and generating multiple design concepts. They explored different layouts, color schemes, and navigational structures to create a visually appealing and intuitive user interface. The goal was to strike a balance

between aesthetics and usability, ensuring that users could easily navigate through the application and understand the information presented. After selecting the most promising design concepts, we moved on to the prototyping stage. Using Figma, we created each screen that illustrated the flow of the application and the visual representation of each screen. This allowed us to visualize the user journey and evaluate the effectiveness of the design in meeting the application's objectives.

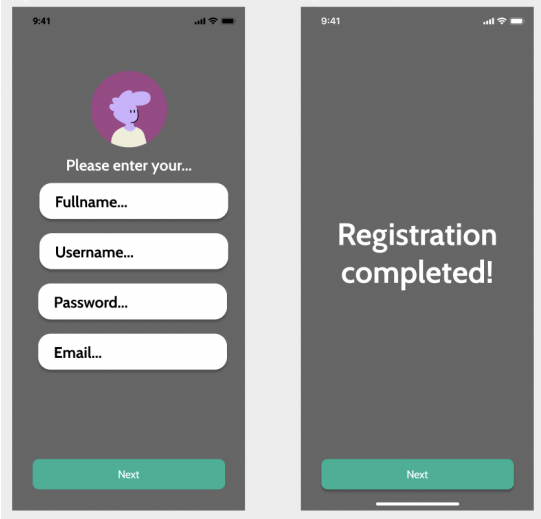
2. Design Justification

   The application predominantly uses green and pink colors throughout the screens. We chose these colors based on the following justifications:

   - Green: Green represents freshness, health, and vitality, aligning with the application's focus on calorie tracking and healthy eating habits. It evokes a sense of nature and well-being, fostering positive associations and user engagement.
   - Pink: Pink conveys a sense of care, nurturing, and positivity. It complements the green color and adds an element of warmth and friendliness to the application. The combination of green and pink creates a visually appealing and harmonious color scheme, enhancing the overall user experience.

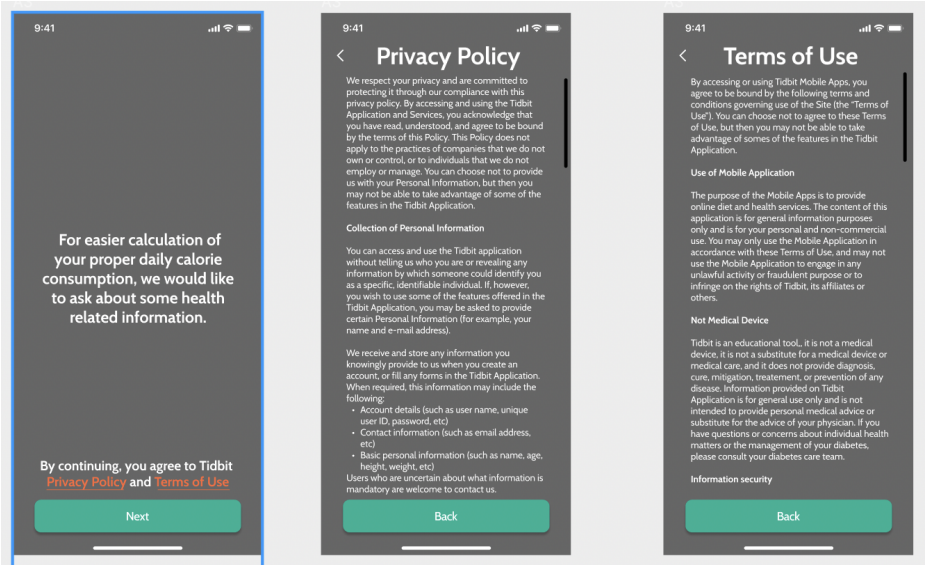
App Logo

The first screen displays the app logo, creating a visual identity for the application. The logo serves as an immediate visual cue for users as the term "tidbit" refers to a small, interesting piece of information or a delicious snack. In the context of our application, we choose the name "Tidbit" with the thought that it conveys the idea of providing users with bite-sized, valuable information about their food consumption. It suggests that the app will deliver concise and meaningful insights into users' calorie intake, helping them make informed decisions about their diet.



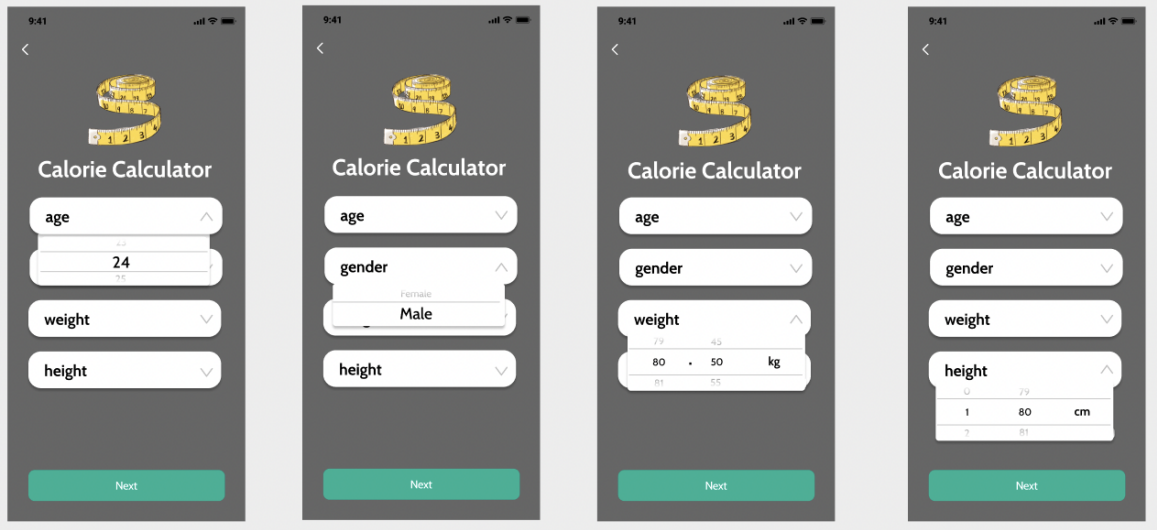
Sign-up

The sign-up page captures user information required for account creation. It follows a simple and intuitive layout, making it easy for users to provide the necessary information for account creation. Clear instructions asking for information such as “Fullname”, “Username”, “Password”, “Email” and well-designed input fields ensure a smooth and hassle-free sign-up process, contributing to a positive user experience. The next screen after Sign-up screen provides immediate feedback and confirmation to users upon successful sign-in. The prominent message reassures users that they have successfully accessed their account, instilling a sense of accomplishment and confidence in their interaction with the application.



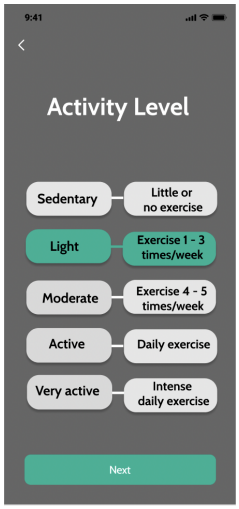
Terms of Use and Privacy Policy

These pages present the terms of use and privacy policy that users must agree to. By transparently displaying the terms and privacy policy, users are informed about the application's policies, establishing trust and compliance with legal requirements.



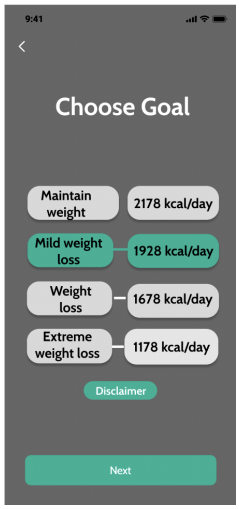
Calorie Calculator

These screens collect user information such as age, gender, weight, height, and activity level for BMI calculation and goal setting. Gathering this information enables personalized calorie intake recommendations, making the application more tailored to the user's needs and promoting effective calorie tracking.



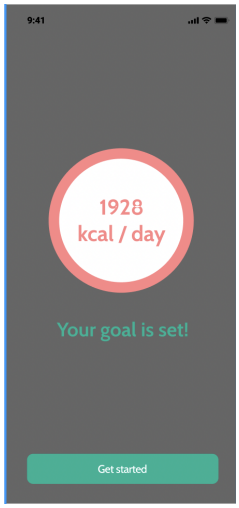
Activity Level

Users select their activity level from options like sedentary, light, moderate, active, and very active. The activity level selection screen offers clear options for users to choose from, accompanied by brief descriptions that clarify each level. This design choice simplifies the decision-making process for users. Selecting the activity level allows the application to provide accurate calorie intake recommendations based on the user's lifestyle, facilitating goal setting and healthy eating habits.



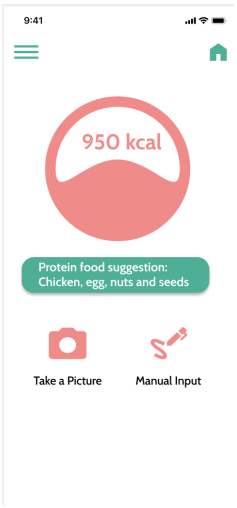
Calorie Intake Goal

Users choose their desired calorie intake goal, such as maintaining weight, mild weight loss, weight loss, or extreme weight loss. The goal selection screen presents different calorie intake options aligned with specific weight management goals. By providing informative descriptions and displaying relevant calorie intake values, users can easily choose a goal that suits their needs and preferences, enhancing the application's usability.



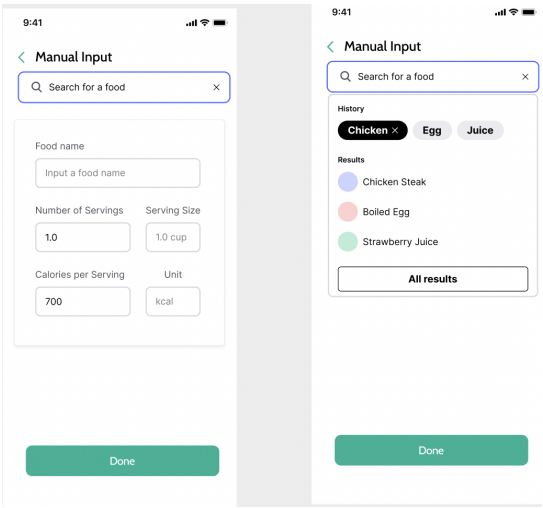
Goal Confirmation

This screen confirms the user's selected calorie intake goal, providing clarity and reassurance. The concise message and clear display of the chosen goal help users stay motivated and focused on their objective, creating a positive user experience.



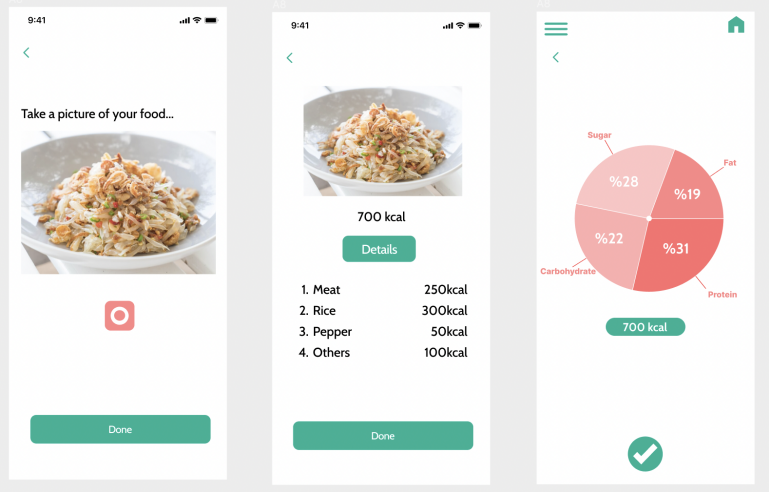
Main Page

The main page offers an at-a-glance overview of the user's calorie consumption for the day. Presenting a visual representation of calorie consumption allows users to track their progress easily. The icons in shape of a pencil and a camera for manual input and image capture offer convenient and efficient methods for recording calorie intake. The design of the main page is user friendly since it allows users to have access to the main feature of the app without much effort.



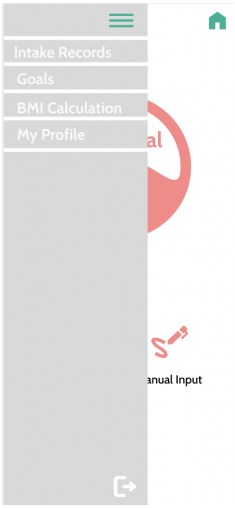
Manual Input

These screens enable users to manually enter food information in two ways. One is entering all the information including name, serving size, calories per serving, and unit manually. the other one is searching for that specific food using the search bar. The search bar and history display enhance usability and improve user experience. Providing a manual input option ensures flexibility for users who may encounter food items not easily captured by the image recognition feature.



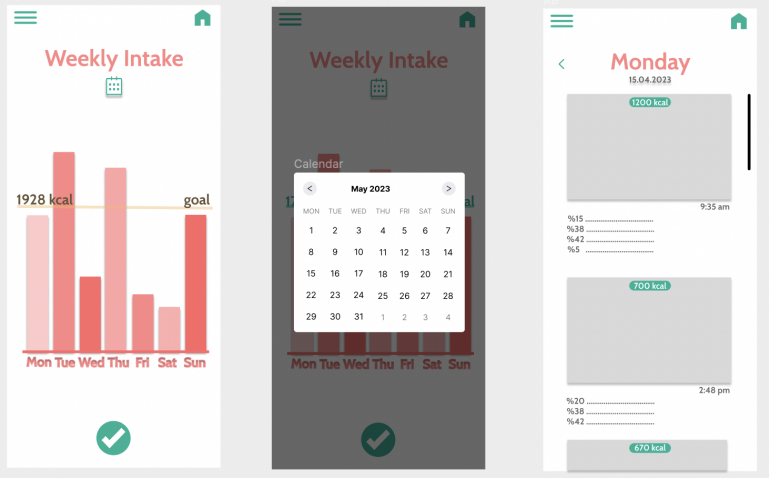
Food Image Capture

These screens guide users through taking a picture of their food, displaying the captured image and the corresponding total calories and individual food item details. The image capture feature enhances user convenience and automates the calorie counting process, making it more efficient and user-friendly. After taking the picture, the screen displays the image as well as related information such as the overall calorie information and detailed calorie information for each food that is recognized in the image. The “Details” button allows users to learn more about the nutritional information of what they are consuming. The screen presents a pie chart depicting the nutritional breakdown of the food, including sugar, fat, carbohydrate, and protein percentages. The pie chart makes it easy for users to analyze the data by showing the percentage they cover in that specific meal. Visualizing the nutritional composition helps users make informed dietary choices and promotes a balanced intake of essential nutrients.



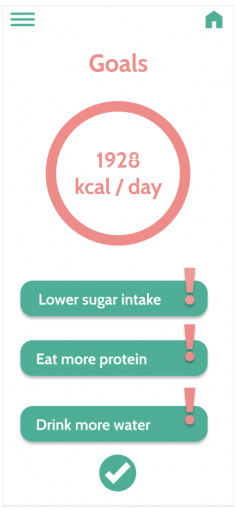
Side Menu

This screen displays a side menu with options such as Intake Records, Goals, BMI Calculation, and My Profile. The side menu offers intuitive navigation, allowing users to access different features and information easily.



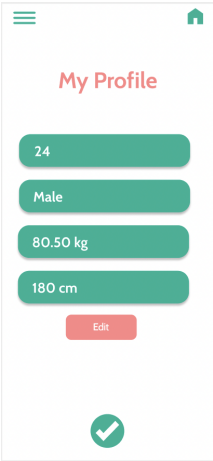
Intake Records

These screens show a line chart illustrating daily calorie consumption for the week, along with a line representing the user's goal intake. The line over the line chart, which represents the goal set by the user, makes it easier for users to see if they are over or under the calorie consumption of their chosen goal for that specific day of the week. Clicking the calendar icon reveals a yearly calendar. Visualizing weekly intake and displaying a calendar enable users to track their progress over time, providing insights into their eating patterns and adherence to their calorie goals. If the user selects a specific date, the next screen displays all food images captured on a selected day, along with corresponding calorie and food information. By presenting a chronological gallery of food images, users can review their past dietary choices and assess their calorie intake habits effectively.



Goals

This screen shows the user's set goal and provides recommendations based on their food consumption such as “Lower sugar intake.” or “Eat more protein”. Offering personalized recommendations based on food consumption encourages users to make healthier choices and supports their weight management journey.



My Profile

This screen displays the user's profile information and allows for editing. Providing a dedicated profile screen allows users to review and update their personal information easily, ensuring accurate goal setting and personalized recommendations.

3. User Study

   a. Participants

      26 students from UNIST who are well-acquainted with mobile apps designed to manage calorie intake and/or individuals who strive to achieve a healthy state and desired physical appearance.

      To ensure diverse perspectives, our participant pool will consist of:

      - An equal number of male and female participants (13 each)
      - 18 individuals with prior experience using calorie tracking apps, while the remaining 8 have never used them
      - 20 individuals who seek to gain or lose weight, and 6 individuals who aim to maintain their weight while carefully controlling their nutrition intake.

   b. Tasks

      Every user was asked to do the below tasks in order:

      - Looking at the Figma UX/UI interface frames and interacting with Figma by clicking on the buttons just like using a mobile application on the given laptop (which is our group member’s laptop)
      - Figuring out Tidbit’s functionalities on their own, and trying to learn how to use the Tidbit app on their own.
      - After 5 minutes of exploring the UX/UI interfaces, users were asked to complete a 5-minute short survey about their feeling about Tidbit’s user interface which consists of 17 closed-end questions. The survey aimed to assess users' perceptions of various design aspects and features of the interface. The survey utilized a scale of 1 to 10, with 1 being the lowest and 10 being the highest rating.

   c. Research Method

      To conduct our quantitative user study, we have implemented the following approach:

- A quantitative method to gather a comprehensive overview of user perceptions regarding our app's interface. This study serves as an extension of previous user studies, allowing us to implement necessary edits and enhancements. We prioritize collecting feedback from a diverse range of users, regardless of their gender, objectives, or prior experience with calorie-tracking apps.
- User and Observer Setup: Each user is assigned one observer from our team. The observer's role is to closely observe the user's interaction with our app's interface.
- User Experience: During a session, each user is provided with a laptop displaying our app's design on Figma and then they were asked to complete the survey. The session duration for each user is set at 10 minutes.
- Observer's Role: The assigned observer takes detailed notes on any aspects that might confuse the user while they interact with the laptop. Additionally, there is an optional task: the observer engages with the user, inquiring about their feelings and gathering feedback once the user finishes everything.
- Parallel Experiment: To optimize time efficiency, we conduct the experiment simultaneously in five separate rooms.

d. Results

This report presents the findings and analysis of a survey conducted to gather feedback on Tidbit's user interface. Additionally, qualitative feedback regarding colors, words, and functions used in the interface was obtained from five participants. The following sections provide a summary of the survey questions, the mean responses, and key insights derived from the data.

Survey Questions and Mean Responses:

Interface visuals:

1. visually appealing
   Mean Response: 77.69
2. How appropriate do you find the colors used in Tidbit's user interface for a calorie-tracking application?
   Mean Response: 70.00
3. How well do you feel the color scheme in Tidbit's user interface harmonizes and contributes to a pleasant visual experience?
   Mean Response: 71.54
4. How appropriate do you find the font size used in Tidbit's user interface for readability and ease of use?
   Mean Response: 88.46

Intuitive:

1. How clear and understandable are the icons used in Tidbit's user interface?
   Mean Response: 83.08
2. visual element consistency (e.g., buttons, icons, graphical elements)
   Mean Response: 83.85

3. How easy is it to navigate through different sections of Tidbit's user interface?
   Mean Response: 83.08
4. How easily can you discover and understand the key features of Tidbit's user interface?
   Mean Response: 84.62

Learnability:

1. How clear and understandable is the information presented in Tidbit's user interface?
   Mean Response: 84.62
2. How efficiently can you perform tasks and actions within Tidbit's user interface?
   Mean Response: 83.85

Satisfaction:

1. How satisfied are you with the amount of flexibility and customization options provided in Tidbit's user interface?
   Mean Response: 77.69
2. How satisfied are you with your overall user experience using Tidbit's user interface?
   Mean Response: 80.77
3. How likely are you to recommend Tidbit's user interface to others?
   Mean Response: 78.46

Importance:

1. How valuable do you find the feature that allows you to get calorie information by taking a picture of the food/dish you're eating?
   Mean Response: 83.85
2. How important is the ability to access your eating history and review what you ate on any specific date in Tidbit's user interface?
   Mean Response: 85.38
3. How useful do you find the option to create a profile in Tidbit's user interface, where you can provide relevant information about yourself?
   Mean Response: 89.23
4. How necessary do you think it is to have the ability to manually input your food information without using the image capture option in Tidbit's user interface?
   Mean Response: 89.23

Qualitative Feedback:
Two participants provided qualitative feedback regarding the colors and words used in Tidbit's user interface. One participant mentioned that the colors and words that have been used to guide users could be improved. Another participant specifically noted that the shade of green and orange seemed off. One participant said that there should be a choice in calorie assumption for those who want to keep the same weight/ want to gain weight.

4. Insights and Reflections

The survey results provide valuable insights into users' perceptions of Tidbit's user interface. We have some key insights as the following:

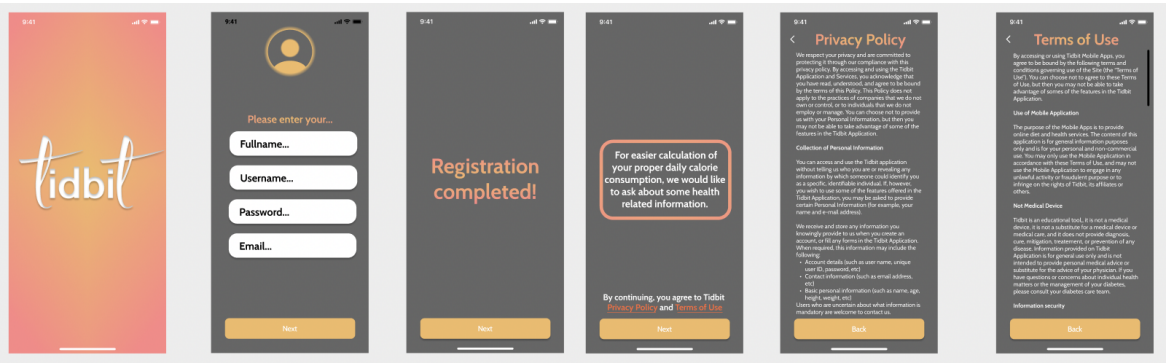
- The overall design of Tidbit's user interface received a relatively positive mean rating, indicating that it is visually appealing to users.
- The appropriateness of the color scheme and the colors used in the interface received moderately positive mean ratings, suggesting the potential for improvement.
- The font size, icon clarity, and consistency of visual elements throughout the interface were perceived favorably by users.
- Users found navigation, discoverability of key features, and the clarity of the information presented to be satisfactory.
- The interface's responsiveness and the feature that allows calorie information retrieval through picture-taking received generally positive mean ratings.
- Flexibility and customization options, overall user satisfaction, and the likelihood of recommending the interface received slightly lower mean ratings, indicating areas for improvement.
- Qualitative feedback highlighted the need for improvement in color selection and language usage in the interface.
- More screens regarding choosing users' purpose (maintain weight/ loose weight/ gain weight)

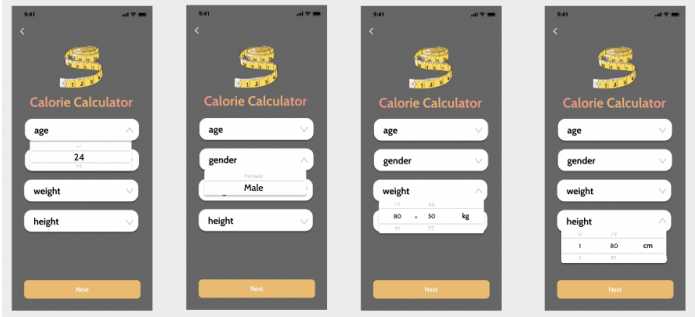
By addressing these areas, Tidbit can enhance the visual appeal, usability, and overall user experience of its interface.

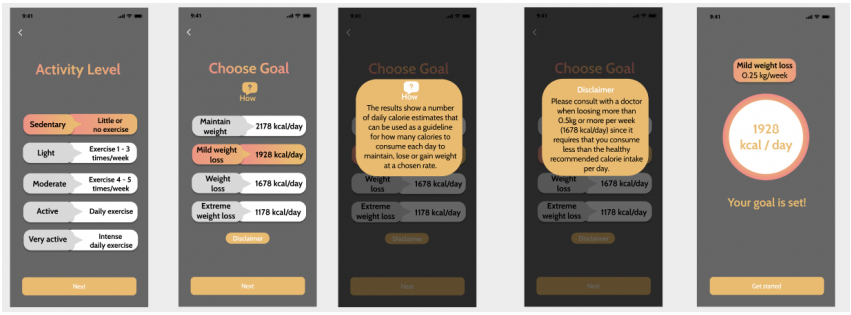
Through this user study, we observed how users interacted with the prototype and collected valuable feedback on the design's strengths and areas for improvement. This feedback was crucial in identifying usability issues, refining the layout, and addressing any concerns raised by the users.

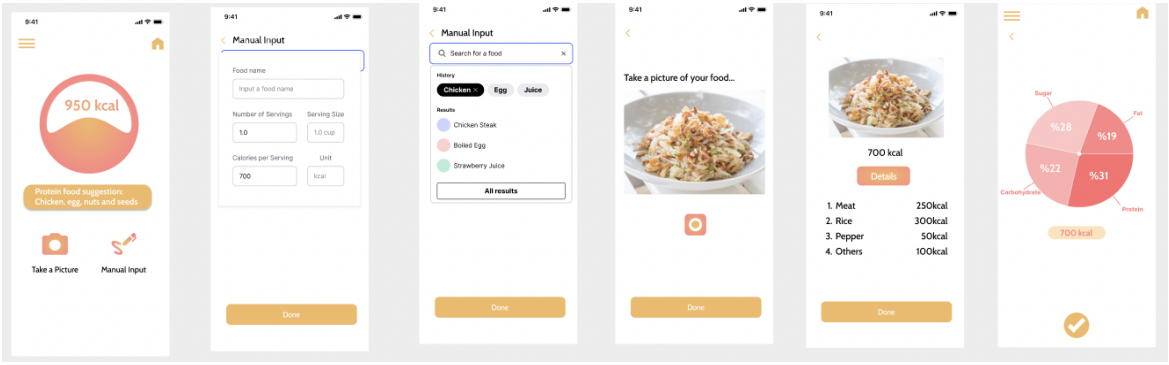
Iterating on the feedback received, we refined the prototype and made necessary adjustments to the screen layouts, color selection, and navigation. We paid close attention to the clarity and simplicity of the design, ensuring that users could easily understand the purpose of each screen and perform desired actions without confusion or frustration. We also made color adjustments and add additional screens for clarification to some already existing screen as these were the main feedback that is received from the users.

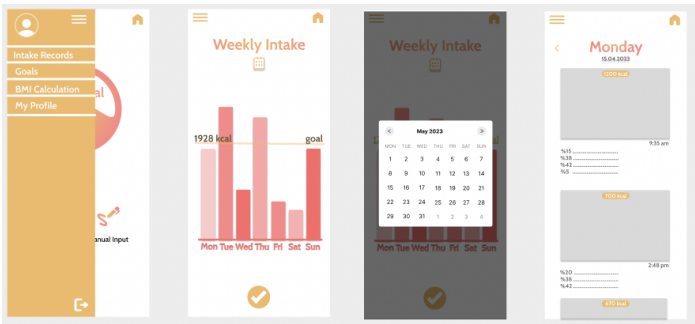
The Design After the Adjustments Based on User Feedback:

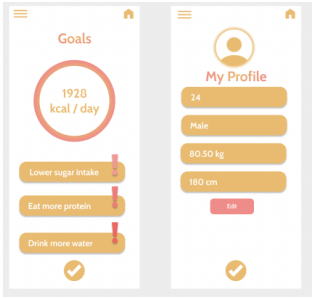



Calorie Calculator
age
24
weight
height
Next
Calorie Calculator
age
gender
Male
height
Next
Calorie Calculator
age
gender
weight
80
50
kg
Next
Calorie Calculator
age
gender
weight
height
1
80
cm
Next


Activity Level
Sedentary
Little or no exercise
Light
Exercise 1 - 3 times/week
Moderate
Exercise 4 - 5 times/week
Active
Daily exercise
Very active
Intense daily exercise
Next
Choose Goal
How
Maintain weight
2178 kcal/day
Mild weight loss
1928 kcal/day
Weight loss
1678 kcal/day
Extreme weight loss
1178 kcal/day
Disclaimer
Next
Choose Goal
How
The results show a number of daily calorie estimates that can be used as a guideline for how many calories to consume each day to maintain, lose or gain weight at a chosen rate.
Weight loss
1678 kcal/day
Extreme weight loss
1178 kcal/day
Choose Goal
Disclaimer
Please consult with a doctor when loosing more than 0.5kg or more per week (1678 kcal/day) since it requires that you consume less than the healthy recommended calorie intake per day.
Weight loss
1678 kcal/day
Extreme weight loss
1178 kcal/day
Mild weight loss
0.25 kg/week
1928
kcal / day
Your goal is set!
Get started

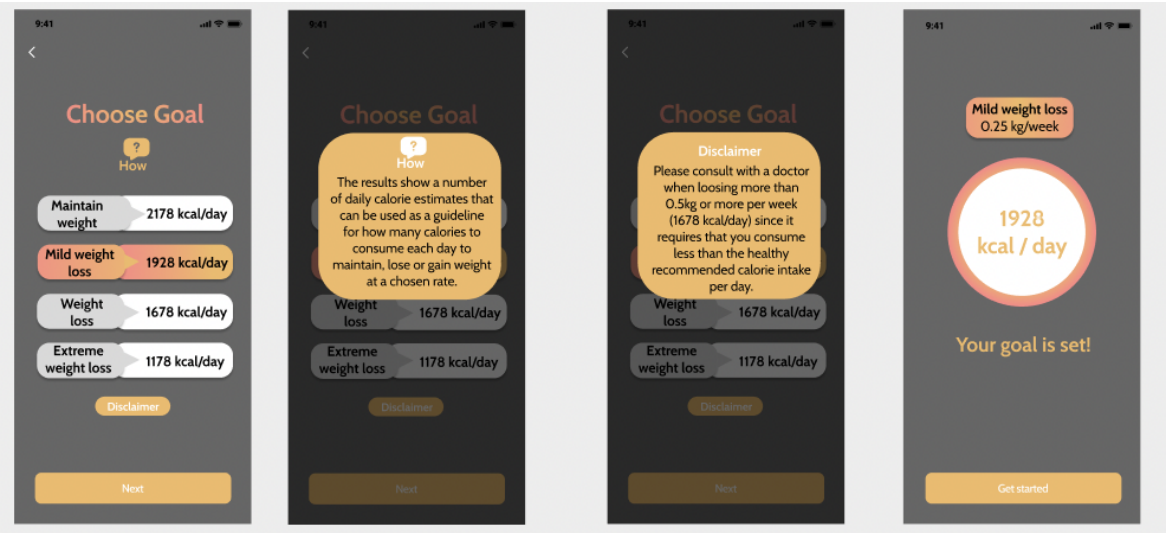

950 kcal
Protein food suggestion:
Chicken, egg, nuts and seeds
Take a Picture
Manual Input
Manual Input
Food name
Input a food name
Number of Servings
Serving Size
1.0
1.0 cup
Calories per Serving
Unit
700
kcal
Done
Manual Input
Search for a food
History
Chicken
Egg
Juice
Results
Chicken Steak
Boiled Egg
Strawberry Juice
All results
Done
Take a picture of your food...
Done
700 kcal
Details
1. Meat 250kcal
2. Rice 300kcal
3. Pepper 50kcal
4. Others 100kcal
Done
Sugar
Fat
Carbohydrate
Protein
%28
%19
%22
%31
700 kcal


Intake Records
Goals
BMI Calculation
My Profile
Weekly Intake
1928 kcal
goal
Mon Tue Wed Thu Fri Sat Sun
Weekly Intake
May 2023
Mon Tue Wed Thu Fri Sat Sun
Monday
15.04.2023


Goals
1928
kcal / day
Lower sugar intake
Eat more protein
Drink more water
My Profile
24
Male
80.50 kg
180 cm
Edit

Based on the user study feedback indicating a dislike for the current color scheme, we thought that a change to an orange-pink color palette could be a suitable alternative. The change to an orange-pink color combination can establish a stronger connection between the app's visual elements and its core purpose, which is calorie consumption calculation. Orange is commonly associated with energy, vitality, and enthusiasm, while pink conveys warmth and approachability. By incorporating these colors, the app's visual identity can align more closely with the concept of monitoring and managing calorie intake, creating a more cohesive and purposeful user experience. Orange, being a warm and vibrant color, has the potential to evoke a sense of appetite and energy. In the context of our calorie counting application, this color choice can subtly influence users to engage with the app and maintain an enthusiastic attitude towards tracking their calorie consumption. The addition of pink can complement the orange hue, adding a touch of friendliness and softness to the overall visual experience.

Additionally, based on the user feedback, we added extra screens for the clarification of choosing a calorie consumption goal.



Choose Goal

The "Choose Goal" screen plays a crucial role in guiding users through the goal selection process, providing them with necessary information to make an informed decision. To enhance the user experience and ensure clarity, the design incorporates two additional elements: the "How?" button and the "Disclaimer" button. If the user clicks “How?” button, a bubble pops up and the disclaimer shows instructions about the information displayed on the “Choose Goal” screen. Users can gain a deeper understanding of the goal options available and the factors they should consider when making their selection. If the user clicks “Disclaimer”, a disclaimer bubble pops up, providing essential guidance and highlighting factors that warrant their attention. This proactive approach ensures that users are well-informed about the potential challenges and considerations associated with choosing the "Extreme Weight Loss" goal. By providing these disclaimers, the design fosters user awareness and promotes responsible decision-making. Finally, goal confirmation screen additionally displays detailed information about the chosen option.

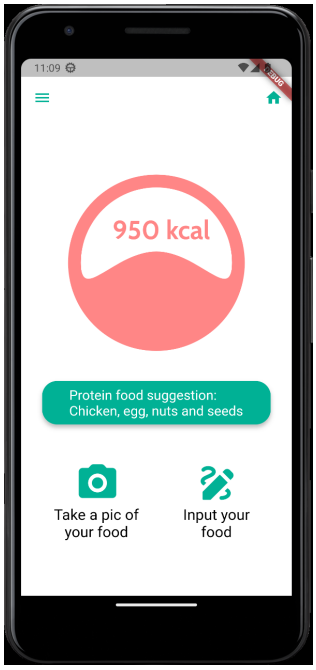
5. Prototype #4 Hi-Fi Prototype

1. Design
   In this prototype, we maintained the overall user interface design from the low-fidelity computer

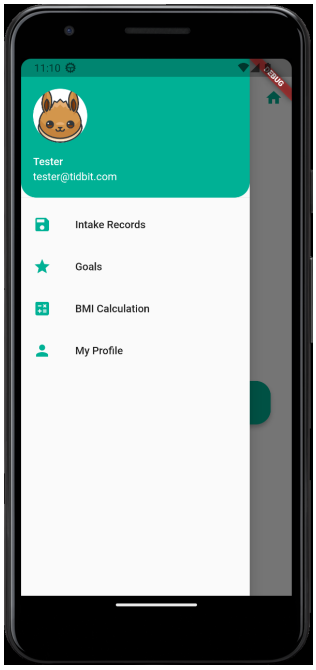
prototype, incorporating the modifications suggested by the previous user study. Along with the implementation of our application's user interface, we will also introduce the use of a Deep Learning model in detecting food and calories.

a. Frontend Implementation

We developed an Android application using the Flutter framework. The final prototype encompassed the majority of the important features, and we utilized the **Figma to Code** plugin [7] to assist us in the implementation process. To begin with, let's discuss the home page, which closely resembled the design from Figma, with minor modifications made to the icons on the buttons. Additionally, we successfully incorporated a user profile header into the application's menu, utilizing the **UserAccountsDrawerHeader** widget, and included icons for each option within the menu.

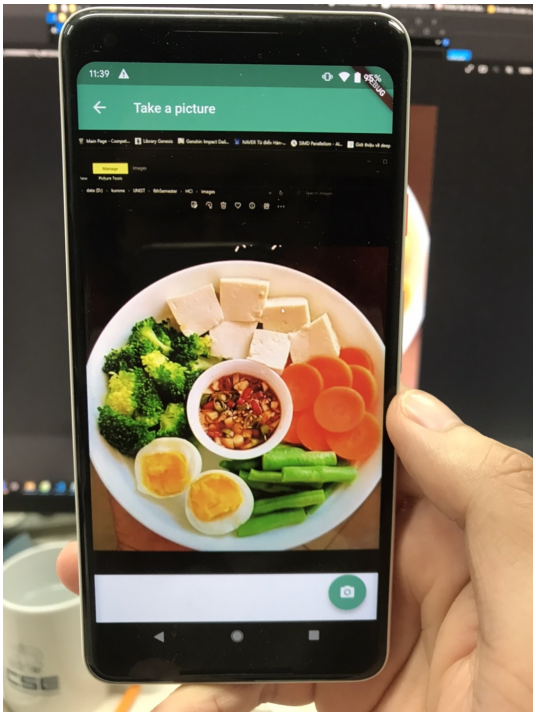


Home page

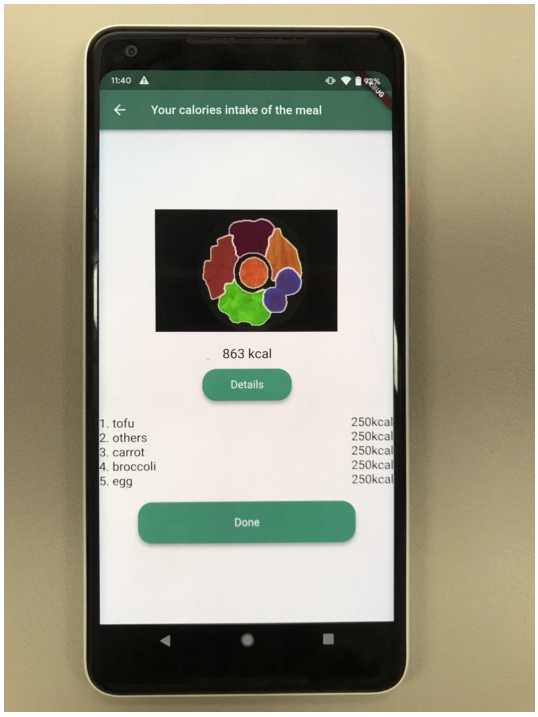


Application's Menu

The next UI component we implemented was taking a picture of the food by utilizing Flutter's camera plugin [8]. We also slightly modified the layout by introducing the app bar on top of the screen and moving the camera button to the lower right corner of the phone. It can easily detect the food but note that the displayed calories were probably incorrect due to not having connected to a food database.



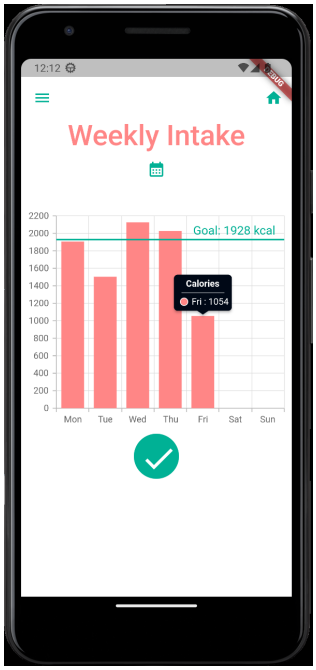
Taking a picture of the food



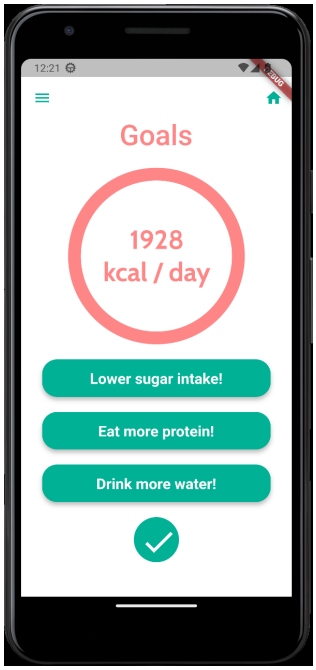
Food detection results

The next implemented feature was the Intake Records of the user. The bar chart was created by the use of a powerful visualization plugin, namely **syncfusion_flutter_charts** [9]. The green horizontal line is the goal set by the user when registering to our system. The user can also interact with it by tapping each bar to view a tooltip that provides detailed information about how many calories they have consumed during the chosen day.

One of the last UI components left to be implemented was the display of the user's daily goal. This was done simply by utilizing the **ListView** widget to display the suggestions from our system. The number of calories would be generated based on the user's registration profile.

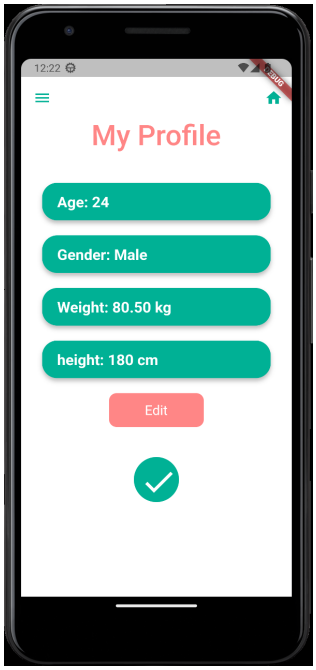


Intake Records



User's daily goal

Last but not certainly not least, the user's profile page was also implemented quite quickly as the page just consists of simple information from the user.



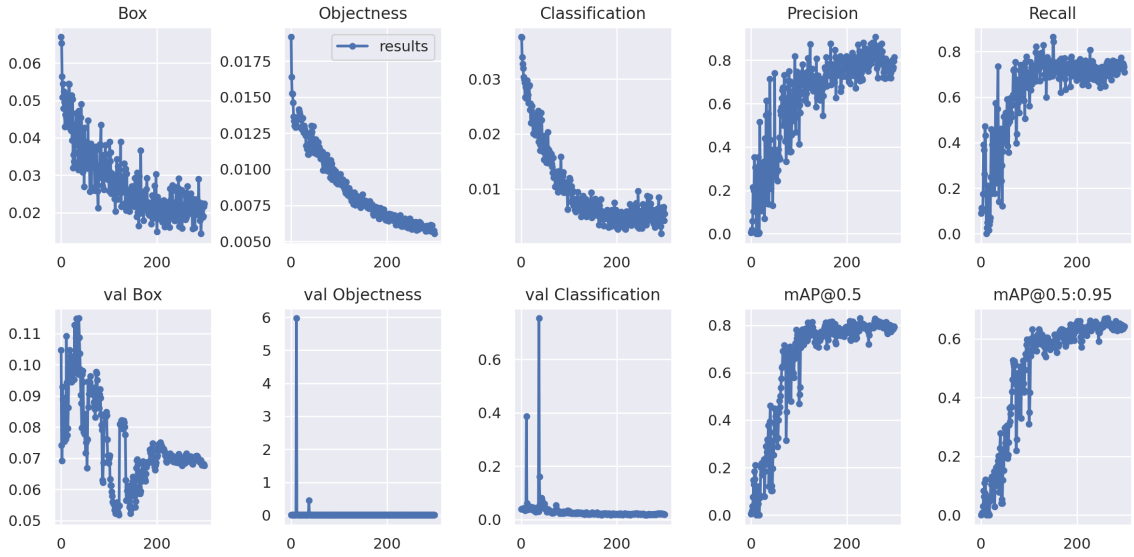
My Profile Page

b. Backend Implementation

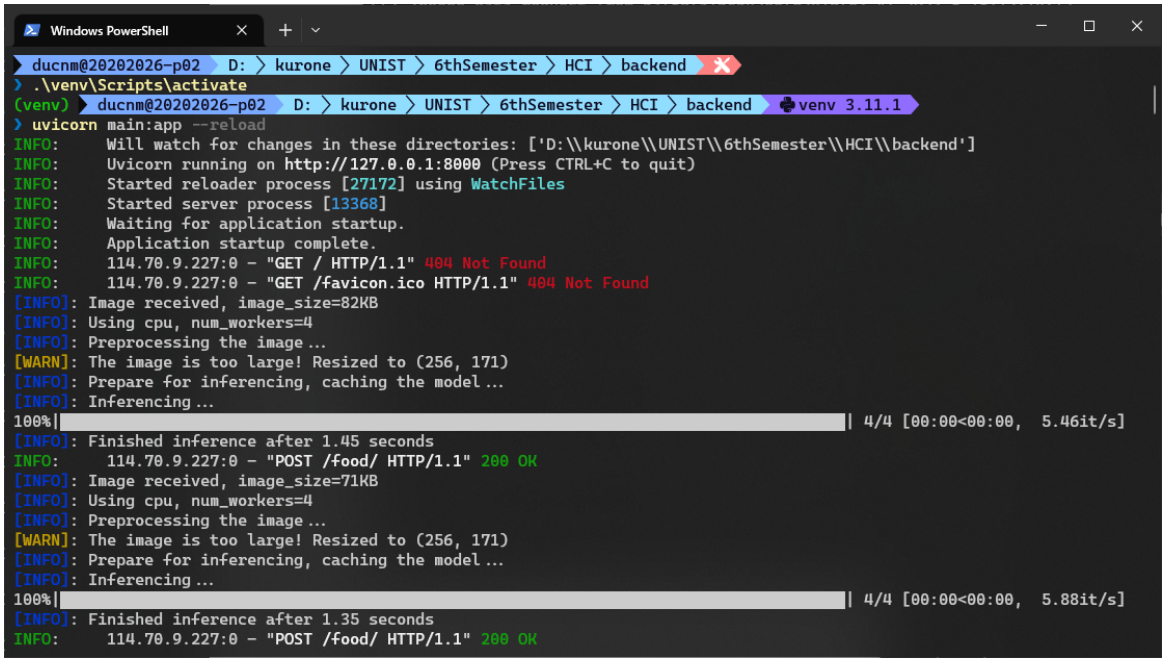
The main innovation in our product is the integration of Artificial Intelligence, hence, a backend server was needed to handle complex computations to automatically recognize and calculate the calories from the user's taken image. To achieve this, we used Python and FastAPI package [10]

to quickly set up the API. The overall flow of the system is the same as in the Proposed Solution section.

To incorporate the proposed Deep Learning model into our application, we decided to fine-tune the YOLOv7 architecture from Wang, et. al. [11] on the FoodSeg103 data set [12]. Please refer to the following figure for detailed training results. Our backend system takes 1.4 seconds on average to process the user's input. To deploy our system, we used ngrok [13].



Training results



Backend server using FastAPI

2. Design Justification

The feedback we received from participants in the previous user study highlighted the effectiveness of the layout and the intuitiveness of the interaction elements. Therefore, we decided to preserve the

core design principles while making minor adjustments to enhance the user experience when implementing the high-fidelity prototype.

We chose Flutter to implement our application because it provided us with a rich set of pre-built UI components and widgets, allowing us to create a visually appealing and consistent user interface across different devices and screen sizes. The framework's extensive widget library offered us flexibility in designing interactive elements, such as buttons, text fields, and navigation menus, ensuring a smooth and intuitive user experience. Also, Flutter is a cross-platform framework developed by Google, hence, we can easily deploy our application to the iOS platform (if needed) with minimal modification of our codebase.

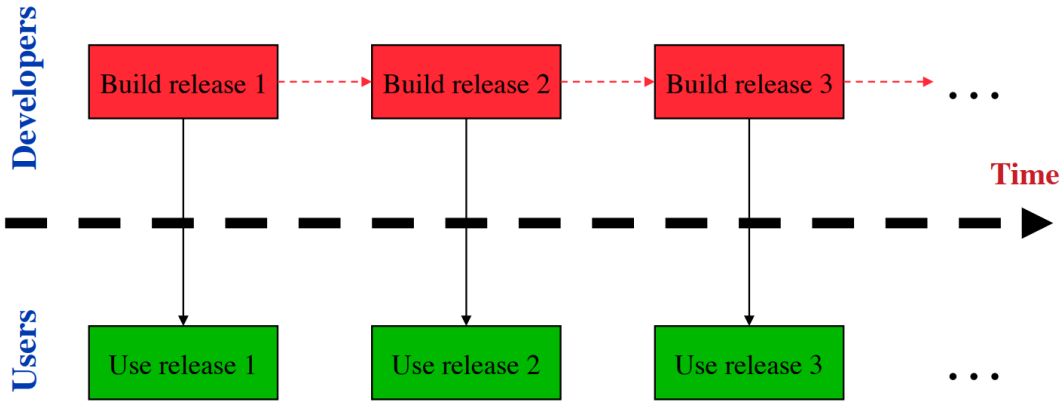
In the overall high-fi design of our application, we encountered a challenge with the buttons' icons due to limitations in Flutter's assets library. Specifically, some of the icons utilized in the previous prototyping stage on Figma were not available within Flutter's default icon set. We tried our best to find the best-fitted icons to replace those in Figma to ensure a cohesive and visually appealing user interface.

In the application's menu, we maintained a design that closely resembled the one in Figma but incorporated a user profile header in the application's menu and icons for each option to enhance the menu's visual appeal and usability. We did this because human visual perception is much better at recognizing visual cues such as shapes and colors. Therefore, we added those icons to further improve the overall user experience and learnability.

To visualize the user's intake data in an informative and visually appealing manner, we incorporated a powerful visualization plugin called **syncfusion_flutter_charts** [9]. This plugin had more than 2.5 thousand likes on Flutter’s package manager page, and provided us with a wide range of customizable chart types and options, allowing us to quickly create a dynamic and interactive bar chart.

It is important to note that the resulting image, after taking a picture of food, undergoes segmentation into different categories of foods with different colors. By assigning different colors for each type (qualitative color scheme) of food rather than boxes, we utilize human great visual perception to classify different items as colors have a high ranking in the visual perception hierarchy for categorical attributes [15]. This segmentation process significantly enhances the interpretability of our product, ultimately earning the trust of our customers. By categorizing the different foods within the image, users can easily understand and analyze their dietary choices. This transparency and clarity in presenting the segmented categories instill confidence in our customers, as they can trust the accuracy and reliability of our application's food recognition capabilities.

During the development process, it is crucial to gather feedback from targeted users at an early stage. By doing so, we can identify potential issues, gather valuable insights, and make necessary improvements before releasing the full version of the application. Therefore, to develop our product, we decided to follow the Phased Software Development Process as it promotes modularity, allowing early feedback and frequent releases and updates [14]. In this development process, we don’t release the full version right away but ensure the application is stable, secure, and performs optimally, which explains some features that exist in Figma but do not in our current state of the product.



Phased Software Development Process [14]

For the backend server, we utilized FastAPI, a high-performance web framework for building APIs with Python. FastAPI offers a range of features that enable fast, easy, efficient, and scalable development [10], making it an ideal choice for our application. With FastAPI, we were able to create a robust and reliable backend that could handle incoming requests, process data, and provide responses in a fast and efficient manner. Furthermore, the choice of ngrok [13] to deploy our server is simple: a free domain that can be accessed outside of our LAN network.

In terms of the Deep Learning model, we employed the YOLOv7 architecture [11] (recently accepted as a conference paper at CVPR), a state-of-the-art object detection model known for its superior accuracy and speed in real-time image analysis tasks. It can do the inference at real-time speed on GPU, and also relatively fast on just a single CPU. By training the model on the FoodSeg103 data set [12], we enabled it to detect and identify different food items within images captured by the application. The utilization of YOLOv7's advanced algorithms and neural network architecture [11] ensured accurate and real-time food recognition, enhancing the overall functionality and user experience of our application.

Github: https://github.com/kurone02/tidbit

3. User Study
    a. Participants

        5 UNIST students are part of our target user group but had no prior exposure to our product through previous user studies. 2 of them are third-year design students with expertise in color schemes and product presentation, providing valuable insights into the design aspects.

    b. Tasks

        There are 3 different kinds of tasks in our last user study.

        1. Interaction with Hi-Fi prototype:

        - Start to learn how to use: Navigate to different pages of the app
        - Check your profile
        - Check your health goals
        - Take an image of food and see the results
        - Check your intake record

2. Constructive feedback for 3 opened-end questions:

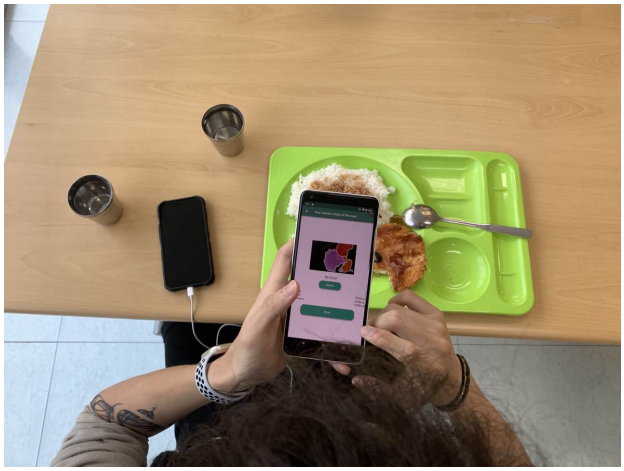
After finishing all of the interaction tasks, users were asked to give us 3 positive feedback (what they like), 3 negative feedback (what they wish), and how they think Tidbit could be improved (what if).

3. Satisfaction survey:

Finally, users were asked to complete a long survey about their satisfaction after their meal.

c. Research Method

We combined both quantitative and qualitative methods for a comprehensive user study. The environment of this study is in the UNIST cafeteria at lunchtime, where users can have a sense of the usage scenario of our application and they can try our app in real life with real cafeteria food.



Users are interacting with Tidbit Hi-Fi prototype.

In each session:

- 1 user - 1 observer at a time
- 15 - 20 minutes of interaction with the application
- Survey follow up
- Each user was asked to finish the tasks in order as we mentioned in the previous part.

1. Interaction with Hi-Fi prototype: Quantitative method

   The observer's role is to measure the time required for users to perform each task and record the number of errors that the user got during the execution task. The purpose of asking users to perform the first task with the high-fidelity prototype is to evaluate its effectiveness and efficiency based on several metrics:

   Effectiveness:

   - Time to learn and use: The duration required for users to understand the given scenarios and begin performing the tasks.
   - Image entry time: The time is taken to enter the necessary data for task execution.

- Tasks time: The duration users take to successfully complete the assigned tasks.

Efficiency:

- Number of errors: The count of mistakes made by users during task execution.
- Completion rate: The percentage of participants who accurately complete each task and achieve its objective.

By measuring these metrics, we can assess the effectiveness and efficiency of the high-fidelity prototype, identify any potential usability issues, and make appropriate improvements to enhance the overall user experience.

2. Constructive Feedback Task: Qualitative Method (Interviews)

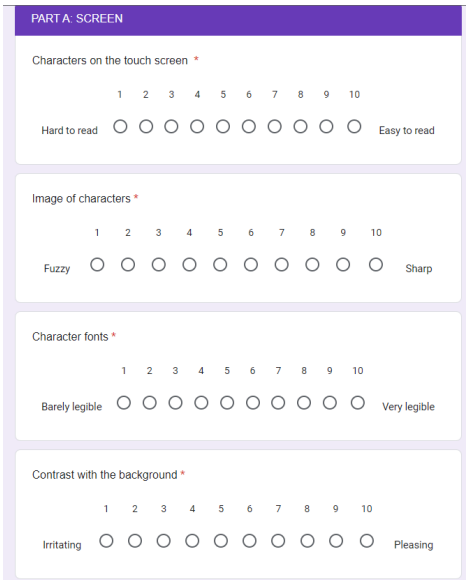
   For this task, we interview users after they have used the system.

   One of our team members takes note of their comments using pen and paper.

3. Satisfaction Survey: Quantitative Method

   We leverage a famous standard user questionnaire called QUIS 7.0 questionnaires [16] (Questionnaire of User Interface Satisfaction). We choose some appropriate questions with a rating scale of 10 points to create a long survey with 34 closed-end questions divided into 4 parts:

   - Visual appearance
   - Intuitiveness
   - Learnability
   - System capability



Satisfaction survey based on QUIS 7.0

d. Results

   i. Time consumption for an inexperience user to do these tasks as below:

Task \ Time (in seconds)	User 1	User 2	User 3	User 4	User 5
Learning time	182	183	165	140	175
Check profile	10	8	9	7	11

Task \ Time (in seconds)	User 1	User 2	User 3	User 4	User 5
Check health goals	9	9	8	6	8
Take an image of food and check the results	21	17	19	22	24
Check intake record	14	13	16	10	18
Number of errors	1	0	0	0	1
Completion rate	100%	100%	100%	100%	100%

Both User 1 and User 5 encountered an error while checking their profiles in the application. They expected to be prompted to capture an image of food first but were directed to other functionalities. This misalignment caused confusion and frustration for both users. To address this issue, it is important to align the application's flow with users' expectations and incorporate visual cues to guide them appropriately. Conducting usability testing and gathering user feedback can help improve the user experience.

2. **Statistics of the survey:**

We classified our questions into four main categories:

- Visual appearance
- Intuitiveness
- Learnability
- System capability

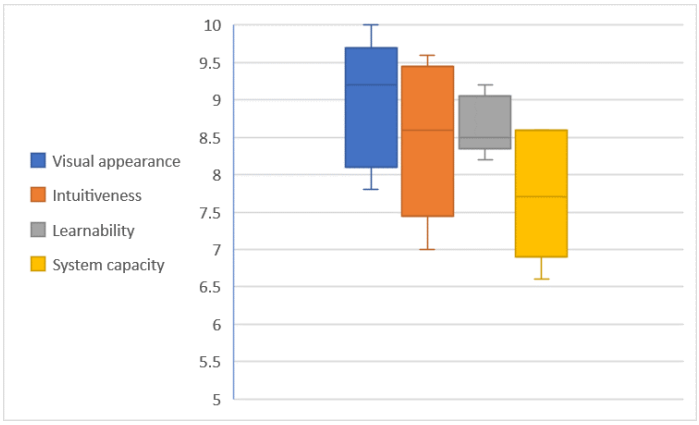
According to the findings from the survey evaluation, the overall performance of our application received a rating of more than 8.5 out of 10, indicating a positive reception. Notably, the visual appearance of the application was rated the highest among the evaluated components. Participants expressed that the application's interface is intuitive and easy to learn. However, the evaluation of the system capacity did not receive as high of a rating compared to the other aspects.

It is important to acknowledge that this evaluation was conducted on the initial design of our application. Despite the relatively lower rating for the system capacity, we interpret the overall evaluation as indicative of high satisfaction. This implies that the application has successfully met the expectations and needs of the participants in terms of its visual appearance and user-friendliness.

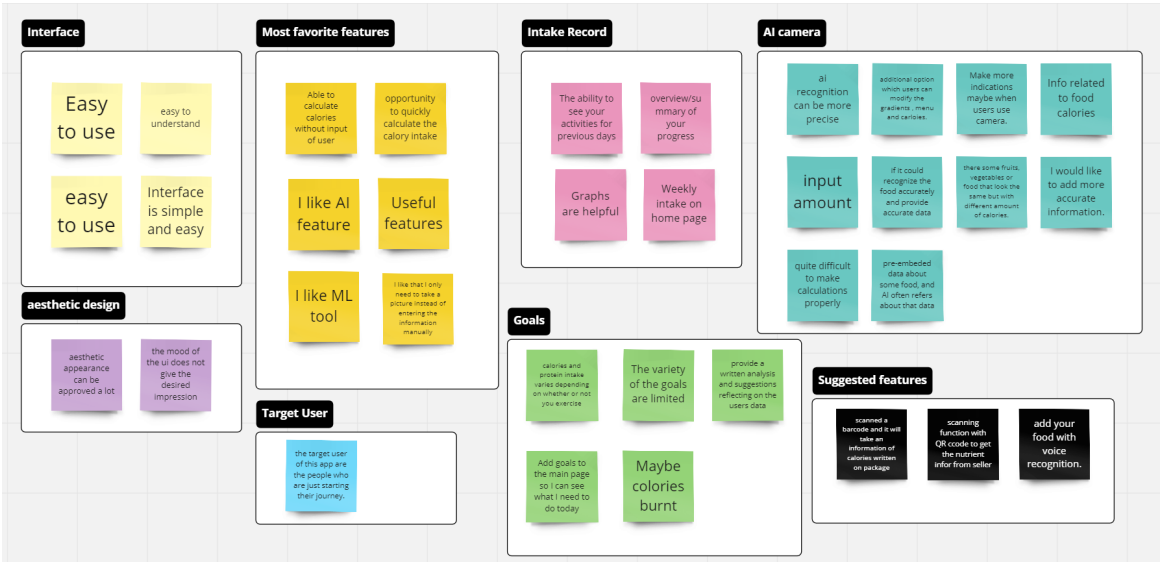
The positive evaluation of the visual appearance suggests that the design elements, such as the layout, color scheme, and graphics, effectively appealed to the participants' aesthetic sensibilities. The intuitive nature of the application interface implies that users were able to easily navigate and interact with the various features and functions of the application. This ease of use likely contributed to participants' perception of the application as being user-friendly and accessible.

On the other hand, the relatively lower evaluation of the system capacity highlights an area where improvements may be necessary. It is essential to investigate the specific concerns or limitations raised by participants in order to gain a deeper understanding of their expectations regarding the application's capabilities. This evaluation outcome can serve as valuable feedback for further

development and refinement of the application to enhance its performance and address any identified shortcomings.



3. This is the affinity diagram analysis of users' feedback for 3 constructive questions.



Affinity Diagram Analysis of users' feedback.

4. Insights and Reflections

   The AI system's performance in the user study was below expectations due to the limited representation of Korean foods in the training data set, which primarily consisted of Western foods. This disparity became apparent during the field study conducted in the cafeteria, where Korean foods were more prevalent. Consequently, the system's accuracy suffered. To address this issue and better serve the targeted users at UNIST, we aim to expand the training data set to include a wider range of Korean foods. This expansion will enhance the system's ability to accurately recognize and record Korean food items, improving its overall performance and catering to the specific needs of UNIST users.

   Additionally, the lower system capacity score can be attributed to certain buttons within the application that were not fully functional during the evaluation due to time constraints. This limitation affected the participants' ability to fully explore and utilize certain features, thereby impacting their assessment of the system's capacity. It is important to acknowledge that the time constraint was a contributing factor and that the incomplete functionality of these buttons may have hindered participants' perception of

the system's capabilities. Moving forward, allocating sufficient time for thorough testing and ensuring the full functionality of all buttons will be crucial in providing a more accurate evaluation of the system's capacity.

INDIVIDUAL REFLECTION

1. Badraa BatUlzii (20202010)

Contribution

Within our group, we prioritized effective workload distribution by leveraging each person's individual strengths and weaknesses. As someone who feels comfortable with ideation and design, I played a critical role in supporting our team in a variety of ways, including:

- Facilitating brainstorming sessions to generate new ideas
- Maintaining a positive and motivated team environment
- Creating written and visual reports that effectively communicated our progress and findings
- Strategizing and planning our team's workload to maximize efficiency
- Building both the survey and computer prototype for our project
- Managing project logistics, from scheduling meetings to coordinating with external partners

Throughout the project's duration, I remained an active and dedicated contributor, constantly seeking new ways to add value to our team's efforts.

Teamwork discussion

In the beginning of the semester, we had many different unique ideas. We were heavily involved in our discussion and listened each other with empathy and compassion, not judging anyone’s opinion wrong or right. I think that helped us to choose our final idea smoothly.

After gaining a clear direction, our team consistently looked for ways to improve the application usefulness for its users. We had numerous both face-to-face and online discussions for making our prototypes and design. To make the prototypes and our final product, we continuously integrated surveying or user experiment multiple times. As a team, we efficiently managed our time and expertise to scale our progress.

Individual reflection

My involvement in this project not only expanded my knowledge of the Human-Computer Interaction (HCI) field but also highlighted the immense power of teamwork. Initially, the task of creating a user-friendly application within a single semester seemed like a formidable challenge. However, as we embarked on this collaborative journey, I witnessed the incredible synergy that emerges when individual efforts merge into a cohesive whole.

Engaging in this project enabled me to develop both technical skills in design and implementation and communication abilities. Interacting with team members and stakeholders allowed me to refine my interpersonal skills, understanding the significance of effective communication in bridging gaps and

fostering productive collaborations. The project served as a real-world laboratory where I honed my abilities to convey ideas, actively listen, and integrate feedback from diverse perspectives.

Through this experience, I gained an appreciation for the fundamental pillars of HCI: communication, collaboration, consistency, and hard work. While technical proficiency contributes to success in the project, our team put our efforts and worked cohesively towards a shared objective. Witnessing the impact of effective teamwork firsthand reinforced the importance of clear communication channels, maintaining consistent progress, and valuing the contributions of every team member.

As we completed the project, I couldn't help but feel a sense of pride in our achievements. The knowledge and skills I acquired throughout this experience have equipped me with a solid foundation for future endeavors in HCI. I am confident that the lessons learned, particularly in the realms of teamwork and effective communication, will serve as valuable assets in my professional growth and enable me to navigate future HCI projects with increased confidence and proficiency

2. Funda Hatice Oztoklu (20202028)

Throughout the entire app development project, I actively participated and made significant contributions to various stages, aiming to enhance my collaboration, teamwork, and technical skills, particularly in addressing usability problems. My primary areas of contribution included UI design, paper and computer prototyping, filming the video showcase, and delivering the project presentation. This project provided me with a valuable opportunity to apply my skills and learnings in a practical setting while working closely with a team.

During our initial meetings, we collectively identified and discussed a wide range of usability problems. After coming up with various different ideas for the project, we narrowed our scope to the theme of healthy lifestyle. While discussing several ideas, I proposed the idea of developing an app that instantly displays calorie information based on pictures of meals. We had some conflicts on choosing the final idea as everyone were enthusiastic about several ideas. Then we decided to take my idea as a basis and improved it thoroughly through the whole process as a team. We discussed different ideas on how to design the user interface of the app together.

One significant aspect of my contribution was the UI design. As a team, we engaged in extensive discussions to generate ideas and solutions for the app's interface. I came up with important features of our app such as viewing weekly intake and displaying detailed information about nutrition values and percentages of the food. Taking charge of the final design for the initial paper prototype, I diligently incorporated and synthesized various inputs from my teammates, aiming to create a cohesive and user-friendly design. This process allowed me to gain a deep understanding of the intricacies involved in UI design. By meticulously sketching each screen by hand, I envisioned the user's journey through the app and anticipated potential challenges and opportunities for improvement.

I actively participated in both paper and computer prototyping. Working closely with the team, I contributed to translating our ideas into tangible prototypes, which enabled us to simulate and evaluate the user experience. By engaging in iterative prototyping, we iteratively refined our designs, addressing usability issues and ensuring a seamless user interaction.

Through this hands-on experience, I gained valuable skills in using Figma for UI design. It was also interesting to see the results of user studies and participate in conducting interviews with users. During in-person interviews, I observed how participants interacted with our prototypes and took notes on areas we could improve based on their feedback. This process not only improved my technical skills but also taught me the importance of iteratively refining designs based on user input.

When discussing the UI design within our team and finalizing the app's look, including screen layouts, colors, and instructions, we were all satisfied with the outcome. However, when we received negative

feedback regarding these aspects, it made me realize the importance of considering user feedback in the design process. I made final design adjustments after our third and fourth user studies, which focused on the app's UI and overall user experience. Conducting multiple user studies and incorporating their feedback into the UI design were the highlights of this project for me, as they allowed me to experience the process of creating a product that meets user needs.
Another significant role I took on was filming the video showcase for our mobile app. Crafting the video helped me improve my storytelling skills as I learned how to structure it to effectively communicate the app's features and benefits, engaging the audience and generating interest. It was also interesting to see a demonstration of how people would use our application in a real life setting, giving me a sense of accomplishment knowing that we had created something useful for people.
Additionally, I had the responsibility of presenting our idea to the class, which provided an excellent opportunity to enhance my communication skills. Preparing and delivering the presentation enabled me to effectively convey our idea to others in a clear and concise manner. I learned to structure the content in a logical sequence, highlighting the key aspects of our app and its value proposition. Through this experience, I gained confidence in public speaking and learned to engage the audience by articulating complex concepts in a way that was easily understandable. It also allowed me to receive valuable feedback and questions from my peers, further refining my ability to communicate and advocate for our project effectively.
Overall, taking Human-Computer Interaction (HCI) course has been a rewarding experience that has enriched my understanding and skills in designing user-centered digital interfaces and improve my teamwork skills. Throughout the course, I gained a deep appreciation for the importance of considering the needs and experiences of users in the design process. I learned various methods and techniques for conducting user research, creating prototypes, and evaluating usability. The approach of the course which emphasis on fostering a learning-centered environment rather than a memorization-based environment encouraged me to actively engage with the material, think critically, and apply my knowledge to practical situations through the project process.This approach not only helped me grasp the course content effectively but also instilled a passion for continuous learning and exploration in the subject. Additionally, the project we worked on served as a practical application of the knowledge gained in the course, allowing me to further develop my abilities in UI design, prototyping, and user testing. I particularly enjoyed this course because it provided a holistic perspective on designing interactive systems, emphasizing the significance of empathy, usability, and iterative design. It sparked my enthusiasm for creating user-friendly experiences and motivated me to pursue further studies and projects in the field of HCI.

3. Gail Rayla Emanuelle Parayno (20202029)

Contribution

To begin, during our initial team meeting, I proposed the concept of developing an alarm application paired with a vibrating ring or bracelet, addressing the personal struggle of relying solely on phone alarms. This idea appealed to me because existing solutions like the Apple Watch can be bulky and uncomfortable during sleep. Despite facing challenges in reaching a consensus due to strong-minded individuals within the team, we eventually agreed upon developing the calorie tracking application named Tidbit.

Following the selection of our project topic, I took on the responsibility of conducting extensive research on existing applications and related literature, examining over ten mobile and web applications as well as relevant technologies. This research allowed us to differentiate our solution and identify areas for

improvement. Additionally, I actively contributed to the creation of the presentation files for our pre-proposal and proposal presentation.

To ensure efficient organization and easy access to project information, I proposed the creation of a centralized Notion page before commencing our user studies. This implementation facilitated streamlined collaboration, providing a centralized space for all relevant materials.

During the subsequent user study phase, I assumed an integral role in designing and formulating the questions and activities for the interviewees. Leveraging my prior experience in conducting user studies, I developed a comprehensive Google Form survey and sought input from my team to refine the questions for clarity, relevance, and avoiding redundancy. Distributing the survey to individuals from diverse backgrounds yielded 61 responses. I meticulously analyzed the collected data, providing a concise report as presented in the First User Study section of the interim report. Furthermore, I conducted statistical analysis to enhance our understanding of the gathered data.

Subsequently, our team created a low-fidelity paper prototype, and once again, I played a pivotal role in formulating interview questions for users testing the prototype. During the testing session, I actively participated alongside the team, transcribing and documenting the interviewees' responses in real-time.

After the submission of the half report, I took on the responsibility of analyzing the data from the last user study I had conducted. This analysis provided valuable insights that directed subsequent iterations and improvements.

Additionally, I assumed a primary role in creating the project video, a crucial element of our final report. Collaborating closely with my team members, we engaged in a collective brainstorming session to visualize how the video would unfold and effectively convey the essence of our project. Drawing from our shared expertise and insights, we carefully crafted a compelling script that captured the key features, benefits, and unique aspects of our application.

In order to ensure a cohesive and visually appealing video, I took charge of outlining specific scenes and shots that would best illustrate the functionality and user experience of our application. Guided by my deep understanding of the project, I worked closely with the team to describe the desired visuals, actions, and transitions within each scene, providing detailed directions to the filming team.

During the filming process, I assumed the role of a director, overseeing the execution of each scene to ensure alignment with our vision. With meticulous attention to detail, I supervised the filming, offering guidance and clarifications when needed, and ensuring that the scenes were accurately captured to reflect the intended user experience and functionality of our application.

As the video began to take shape, I transitioned into the editing phase, harnessing my creative skills and technical expertise to weave together the captured footage into a cohesive and visually captivating narrative. Carefully considering the criteria for the video, I meticulously curated each element, from the selection of fonts and graphics to the choice of background music. I worked tirelessly to strike the right balance between informative content, aesthetics, and a seamless flow of information, ensuring that the video effectively engaged viewers and showcased the unique features and benefits

of our application.

Throughout the editing process, I paid careful attention to the pacing, rhythm, and timing of the video, ensuring that it conveyed a sense of professionalism, clarity, and coherence. By thoughtfully arranging the clips and integrating smooth transitions, I aimed to create a visually appealing and immersive experience for the viewers, enhancing their understanding and engagement with our project.

Teamwork Discussion

Throughout the project, our team encountered challenges, particularly during the initial idea selection phase, where disagreements and tensions arose due to the presence of strong-minded individuals within the group. However, through effective communication, compromise, and collaboration, we overcame these hurdles and reached a consensus. By actively listening to each other, considering different perspectives, and finding common ground, we maintained a positive team dynamic and achieved our common goals. This experience taught me the importance of respectful communication, open-mindedness, and collaboration in ensuring the success of team projects.

Individual Reflections

My participation in this project has provided me with valuable insights into the user-centered design process. From the initial brainstorming to the final video creation, I have learned the significance of placing the user at the forefront of the design process. Conducting user studies, analyzing data, and incorporating feedback have deepened my understanding of user needs, preferences, and pain points. This experience has reinforced the importance of empathy, iterative design, and continuous improvement in creating user-friendly and effective solutions. I have also developed essential skills in project management, collaboration, and effective communication, which will undoubtedly benefit me in future endeavors.

4. Thu Phuong Nguyen (20202027)

1. Contribution:

   Throughout the entire process, I took the initiative to organize regular weekly meetings with the group members. These meetings allowed us to come together more frequently to discuss the necessary steps, address any problems we encountered, assign specific tasks to each person, and set manageable deadlines. This approach ensured that everyone worked effectively as a team, avoiding the situation of rushing to complete everything just before the deadline.

   Furthermore, I took on the responsibility of planning and conducting user studies in an appropriate manner. To ensure this, I extensively studied the professor's lectures on conducting comprehensive user studies. Most of the user studies were carried out by me, and for qualitative studies, I objectively analyzed user feedback using Affinity Diagram immediately after the interviews were completed for the paper prototype and for our last user prototype. This allowed me to summarize information accurately and comprehensively, avoiding any loss of important insights and enabling the team to prepare for the subsequent steps efficiently.

   In addition, I actively participated in the design process of the third computer prototype. I collaborated with the team to determine suitable colors and function names based on user feedback. I incorporated frames for estimating the correct calorie amounts during user sign-up, implemented necessary constraints to avoid irrelevant information in the database, and focused on enhancing user convenience. I also suggested including sections for the Privacy Policy and Terms of Use to prioritize the respectful collection of users' personal information, acknowledging it as a fundamental human right.

   During the video recording phase, my friends and I brainstormed ideas for the script, proposed a simple scenario, and outlined the flows and usage environment of our product. By utilizing voice-over narration, we aimed to provide viewers with a professional and engaging experience. Additionally, we filmed according to the agreed-upon script, preparing for the subsequent editing stage.

2. Teamwork discussion:

In reflecting on our team's dynamics, we can identify both aspects that worked well and areas that presented challenges. Overcoming these hurdles required effective teamwork and communication. Furthermore, these experiences taught us valuable lessons about teamwork that we can apply to future projects.

1. Strengths:

- Regular meetings: Holding weekly meetings allowed us to maintain consistent communication and collaboration, ensuring that everyone was on the same page regarding project progress and tasks.
- Task assignment: Allocating specific responsibilities to each team member ensured a clear division of work and accountability.
- Learning from lectures: Actively engaging with lectures and applying the knowledge gained helped us conduct user studies and design the interface more effectively.

2. Challenges:

- Communication challenges: In situations where communication became difficult due to conflicting schedules when we cannot have a meeting with all 5 members together, we established alternative communication channels which are Notion and SNS to ensure effective information sharing.
- Managing disagreements: At the very first stage, when we have to come up with an idea, most of the ideas we have already exist in the commercial, which made us cannot find out a possible topic. At that time we encouraged constructive dialogue, encouraging open discussions, and considering diverse opinions enriched our decision-making process and led to better outcomes.
- Balancing workload: As workload distribution occasionally posed challenges, especially during the exam period, we regularly supported one another by offering assistance and redistributing tasks when necessary.

3. Lessons learned for future teamwork:

- Flexibility and adaptability: Being flexible and adaptable to changing circumstances and individual preferences fosters a more harmonious and efficient team dynamic.
- Effective communication: Prioritizing open and transparent communication ensures that everyone is informed, understands their roles, and can collaborate smoothly.
- Proactive problem-solving: Encouraging a proactive approach to problem-solving enables the team to address challenges efficiently, minimizing potential disruptions to the project's progress.

3. Individual Reflections:

The following are my key insights about the user-centered design process:

- Value of user studies: User studies have become a crucial element, in providing unbiased feedback. Direct encounters with users allowed for a deeper comprehension of their preferences and habits, transcending the constraints of straightforward scoring or quick surveys. We learned that our personal judgments of what is good or best might not coincide with user perceptions. Users might give surprising criticism, highlighting how crucial it is to rely on unbiased user input.
- We placed a strong emphasis on user-centered design after realizing that it is an iterative process that involves user surveys and prototyping. Comparatively to depending simply on internal

brainstorming, collaborative efforts and varied perspectives led to the discovery of beneficial innovations.

- We realized the importance of giving feature additions and deletions serious thought. We gained knowledge about how to evaluate features' necessity, weigh alternatives, and foresee future user annoyance.
- Participating in the user-centered design process inspired us to think creatively and from new angles. We began analyzing current goods critically, considering design options, and nurturing a drive to develop original, user-centered solutions.

5. Nguyen Minh Duc (20202026)

1. Contribution:
    - Suggesting the use of AI techniques in food detection.
    - Participating in researching existing solutions.
    - Fine-tuning the YOLOv7 model on the data set.
    - Implementation of FastAPI server and integration of the Deep Learning model.
    - Implementation of the high-fidelity prototype with Flutter.
    - Modification of the application’s icon in the high-fidelity prototype.
    - Selection of food segmentation color scheme.
    - Participated in brainstorming video showcase ideas.

    Most of my contributions were on the technical side of the product.
2. Teamwork discussion:

    All of our team members already knew each other before forming the team, which created a positive foundation for communication and collaboration, hence, there were virtually no challenges in understanding and connecting with one another. As we formed the team, we were quite excited to work together to produce a great HCI product. All of our members finished their designated tasks on time, and everyone contributed their own expertise on different aspects of our project since we have members with different backgrounds (designers, sports players, developers, and analysts). However, we were not that good when it came to time management as most of the work was finished moments before the deadline. The job was eventually done but I think that we could have done it better and finished everything in a more reasonable time interval. Also, meeting scheduling was a big problem in our group as most of our schedules conflicted with each other and it was hard to have a meeting with full members, which meant that we mainly communicate through our Telegram group chat.

    As for the hurdles in teamwork, I was already accustomed to teamworking so there were no real difficulties in working with each other as everyone did their part and came together to merge everyone’s ideas.

    As for the lessons learned, it is true that I have all of the tasks done, but in a very rushed manner. So I think that I should manage my time better to not be an obstacle to the entire team’s progress in the future.
3. Individual Reflections:

During the project, I could see the importance of prototyping and user studies. These two aspects played a critical role in shaping our final product and ensuring its alignment with user needs and preferences. Prototyping allowed us to quickly transform our ideas into tangible representations that users could interact with and provide feedback on. By creating low-fidelity prototypes early on, we were able to gather valuable insights and iterate our designs based on user feedback. Prototyping enabled us to visualize the user experience, test different design approaches, and identify potential usability issues or areas of improvement. Additionally, user studies were equally vital in our project. Through user research and testing, we had the opportunity to directly engage with our target users, and understand their behaviors and preferences. Most of the time, we thought that our proposed UI was the best and it consisted of everything that the user needs, however, when we actually carried out the study, a lot of problems arose from interviews with users. By involving users throughout the design process, we gained valuable insights into their needs, validated design decisions, and received feedback that guided us toward creating a more user-centered product.

Moreover, I could really feel that iteration is one of the keys to refine our product for a better user experience. This iterative cycle of designing, testing, and gathering user feedback allows for constant improvement and increases the probability that the final product will align with user expectations and goals.

Lastly, this project provided me with the opportunity to apply Deep Learning techniques to a real-life application for the first time. It was an exciting and rewarding experience to explore the realm of Deep Learning and witness its potential in solving practical problems. By incorporating Deep Learning algorithms and models into our application, I was able to leverage the power of neural networks to enhance the accuracy and functionality of our product. This hands-on experience not only expanded my technical skills but also deepened my understanding of the capabilities and challenges associated with implementing Deep Learning in real-world scenarios, especially in a user centered design setting.

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