

Business Requirements Specification (BRS) document

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Contents

1. Introduction	3
1.1. Business purpose	3
1.2. Business scope.....	3
1.3. Business overview	4
1.4. Major stakeholders	4
2. Business management requirements	5
2.1. Business environment	5
2.2. Mission, goals, and objectives	5
2.3. Business model	6
2.4. Information environment	6
Project portfolio	6
Long-term system plan.....	7
Database configuration	7
3. Business operational requirements	8
3.1. Business processes	8
3.2. Business operational policies and rules.....	9
3.3. Business operational constraints.....	11
3.4. Business operational modes	11

3.5. Business operational quality	11
3.6. Business structure.....	12
4. Preliminary operational concept of proposed system.....	13
4.1. Preliminary operational concept.....	13
4.1.1. Operational policies and constraints	13
4.1.2. Description of the proposed system	14
4.1.3. Modes of system operation	16
4.1.4. User classes and other involved personnel.....	16
4.1.5. Support environment.....	18
4.2. Preliminary operational scenarios	19
5. Other preliminary life-cycle concepts	21
5.1. Preliminary acquisition concept.....	21
5.2. Preliminary deployment concept	21
5.3. Preliminary support concept.....	22
5.4. Preliminary retirement concept.....	22
6. Project constraints.....	22
7. Appendix.....	23
7.1. Acronyms and abbreviations.....	23

1. Introduction

1.1. Business purpose

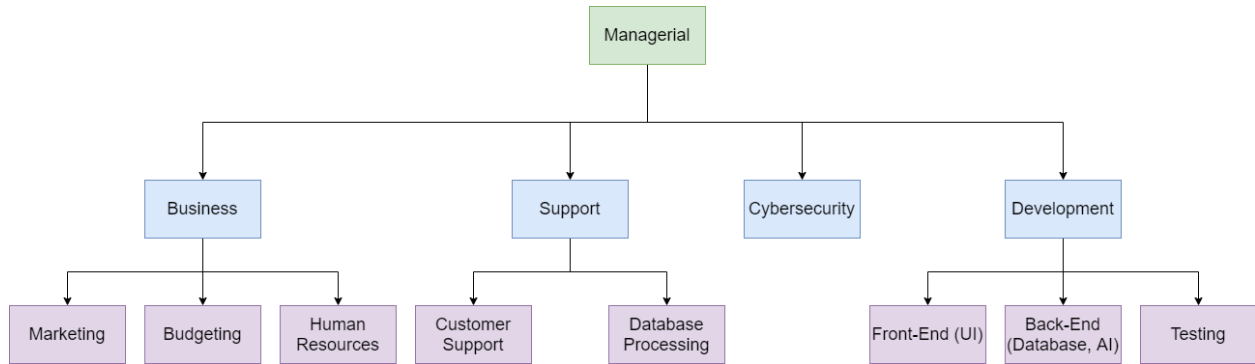
In a world where digital health monitoring has become prevalent, a business needs to remain competitive and set itself apart. Digital Health Inc. has noticed that despite having a significant share of the energy expenditure monitoring market, they have a big gap in the market of monitoring energy intake. Digital Health is looking for an application that can allow a user to easily log their energy intake daily. This application, along with their other energy intake/expenditure offerings, will then be able to be sold to users who are looking for a convenient, accurate suite of programs to improve health.

1.2. Business scope

Digital Health Inc. is a personal health monitoring company that is primarily involved with providing devices and services that allow individuals to measure their energy intake and view changes in their health. They are planning on selling a complete package of health care applications to various health clinics and doctors in order for them to be able to better assist their client with meeting their health goals.

Digital Health Inc. is trying to develop an application that is automatic and has high levels of accuracy. Specifically, they want the application to be able to calculate the number of calories and nutrition simply based on the picture taken by the user. They found that current offerings on the market such as MealSnap and Carbs&Cals did not meet these requirements, which presents an opportunity for Digital Health Inc. to create a compelling product.

1.3. Business overview



The above diagram depicts the major internal divisions and how they are related to each other. The managerial department will oversee all the departments. Some of the departments will also have sub-teams who will work closely together.

1.4. Major stakeholders

- Customers: this product is aimed to be convenient for both general and specialized consumers.
 - General users: people that will use this application to monitor their caloric intake due to overweightness or a want to stay fit.
 - Institutions and doctors: people or entities in the health care sector that will purchase the application to have a comprehensive view of their patients' eating habits so they may better assist their patients.
 - Competitive athletes and trainers: people that will use this application to closely monitor an athlete's intake of calories as well as relevant nutrients, and then either maintain or adjust their eating habits to stay at peak competitive form.
- Employees: refer to the people who work at Digital Health Inc. or will be hired once the development process begins to help the company meet its business and technical goals. Employees in the company can be divided into different departments, as described in the organization diagram.

2. Business management requirements

2.1. Business environment

Digital Health Inc. has a very high standard for their products and services because they seek an accuracy of almost 95% for their energy intake monitoring system. This shows that the company would require a solution that is of high quality. The lack of useful alternatives on the markets means that the company would need to be able to provide in-depth details of how they would want the final product to look like. This can be an issue if the people contributing to the requirements of the project are not well-versed in technology or are unable to come to conclusive decisions.

2.2. Mission, goals, and objectives

The goal of developing an energy intake monitoring system is for Digital Health Inc. to capture a large market share of the energy intake market. Due to there being no products on the market that have high amounts of accuracy when estimating a meal's weight, Digital Health Inc. has decided it will be the first of its kind and develop a highly accurate system that will precisely estimate the amount of food in a photo and generate an equally precise report displaying nutritional information of the food(s) in question. Having the most accurate application in the field of energy intake monitoring systems will ensure that Digital Health Inc. is a leader in the industry.

By creating an application that is better than its competitors in accuracy and feature set, it will also incentivize customers to exclusively use the Digital Health Inc. ecosystem of applications. The goal of developing this application is to not only to develop a strong standalone application, but also to introduce customers to applications also developed by the company. Customers will be more inclined to invest in exclusively using the entire suite of Digital Health Inc. products to have a more streamlined, user-friendly experience, and will lead to an increased number of users in all other previously existing applications.

2.3. Business model

The product that will be offered is an application to calculate the energy intake depending on different meals. The services offered by the product shall be the ability to take a photo of different meals and analyze all the types and amounts of the ingredients included, as well as calculate different nutritional and caloric information of all the ingredients combined.

The product shall be available globally with no geographical restrictions and will be available across all common mobile platforms such as Android and iOS with no platform restrictions. As this will be the leading application of its kind, it is expected that a majority of users who are interested in keeping records of their nutritional intake will use this application over its competitors.

The revenue model shall be based on a subscription system. The product will be available for free for the basic functionalities of taking a photo, analyzing ingredients and a basic report of the caloric content. Basic users will be presented with advertisements after they have made several actions, and these advertisements will contribute to the revenue of this application. In order to avoid advertisements, view more advanced reports containing information such as macronutrients and micronutrients of the meals, save reports locally on their device, and use a faster backend system to calculate the report, the user will need to pay a subscription fee monthly. These monthly subscription fees will be the majority source of revenue for the system.

2.4. Information environment

Project portfolio

The system will be storing information in several databases. One of two major databases will initially only contain an amalgamation of other commercially available food databases, which will be refined and added to once the system is deployed. The other major database will eventually contain user information such as name, e-mail, and payment information. Additionally, logs of data access and alteration, information on total application usage

such as total use time and total active users will also be stored for security and business purposes respectively.

The system's AI shall be responsible for processing the information from the food database. Once sufficiently trained, it will be able to identify different foods and their amounts based on a user-submitted photo to provide users with meaningful nutritional statistics when they generate a report.

Long-term system plan

The system is indeed to be in use long term and will be continually improved upon, due the nature of using an AI to generate reports. The AI shall improve its accuracy on recognizing foods and estimating amounts of each food as it is used and is fed more information by user submissions. It should also be noted that the AI shall be able to learn incrementally without having to re-train itself after a new food is added to the database.

Database configuration

Each of the databases will have multiple permission levels to prevent unwanted access or misuse by employees who are not privy to such information.

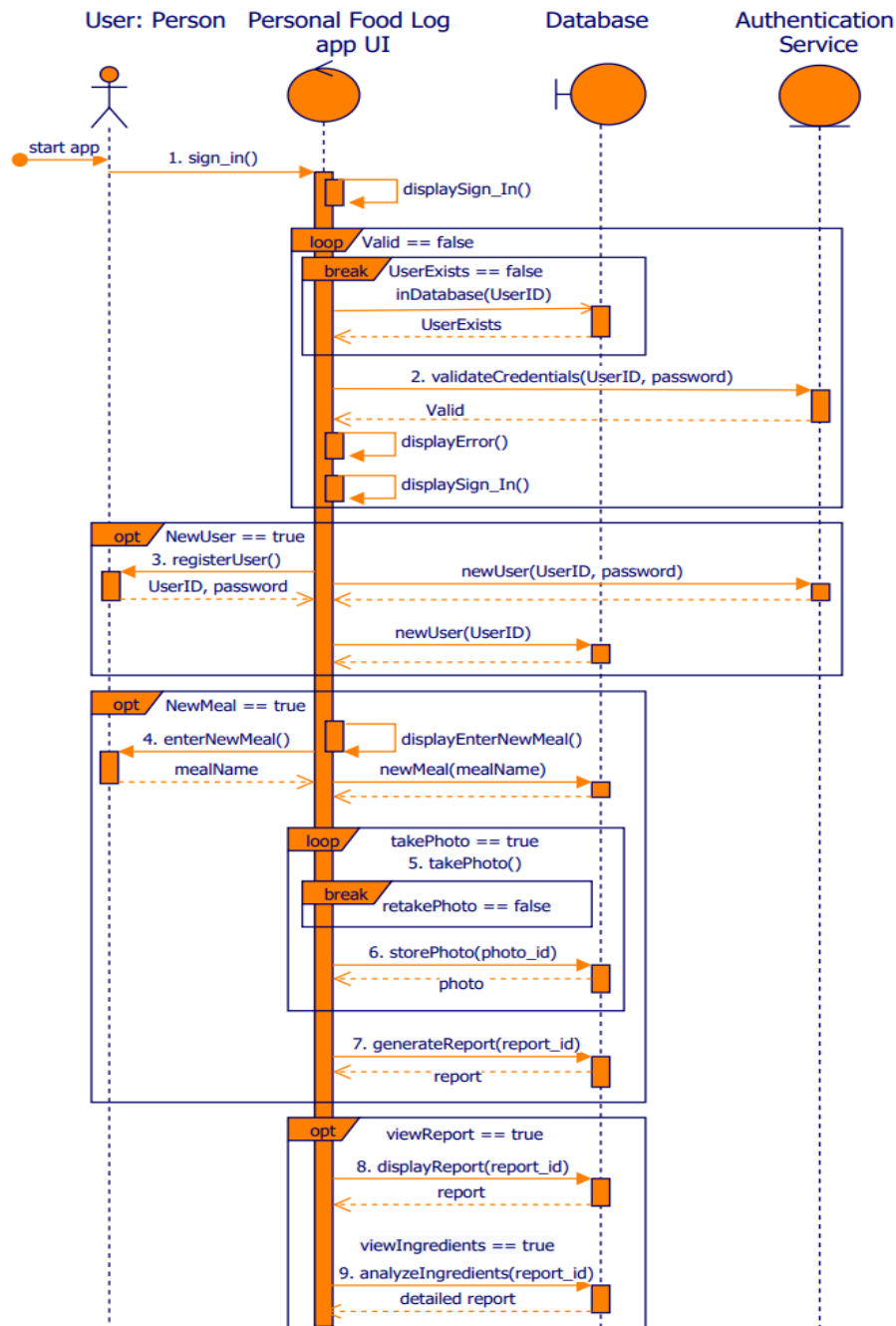
As the food database has the least confidential information, there will only be 3 types of permissions. Employees who are not directly working with the database will be given no access to either read from or write to the database, junior employees working on the system will be given ability to read but not write to the database, and senior employees will be given full access to the database.

The logs of database access and any information related to users will be much more protected. Only cybersecurity staff and executives will have any access to logs, to ensure information that could lead to attacks on the database is not leaked. Lastly, statistics on revenue, total user base, etc. will be distributed only amongst shareholders of Digital Health Inc.

3. Business operational requirements

3.1. Business processes

View the UML sequence diagram below for a high-level overview of the business processes in the context of both the user and system.



3.2. Business operational policies and rules

1. Sign in:
 - 1.1. Start condition: The user will select the 'sign in' prompt to trigger this process.
 - 1.2. Branch conditions: If the user selects the 'return' prompt, they will be sent back to the home screen.
 - 1.3. End condition: The user's credentials will be validated against the system (2) which will then display either an error or a sign-in message.
2. Validate credentials:
 - 2.1. Start condition: This process is triggered after the user enters their credentials and selects the sign-in prompt.
 - 2.2. End condition: Both the userID and password will be checked against the system.
3. Register user:
 - 3.1. Start condition: The user will select the 'register user' prompt to trigger this process.
 - 3.2. Branch conditions: If the user selects the 'return' prompt, they will be sent back to the home screen.
 - 3.3. End condition: The user will enter their desired username and password, and then become a registered user after selecting the 'register user' prompt again.
4. Enter new meal:
 - 4.1. Start condition: The user must be registered and signed in to their account and then select the 'enter new meal prompt' to trigger this process
 - 4.2. Branch conditions: If the user selects the 'cancel' prompt, they will be sent back to the home screen. If the user selects 'take photo' (5), they will have the option to take a photo from their mobile phone of the food item.
 - 4.3. End condition: After entering the meal name and photo, a report will be generated (7).
5. Take photo:

- 5.1. Start condition: Following from (4.1) the user must then select the 'take photo' prompt after they have entered the meal name.
 - 5.2. Branch conditions: If the user selects the 'retake photo' prompt, this process will be repeated from the start.
 - 5.3. End condition: After the user confirms that they are satisfied with the photo they took, this process will end.
6. Store photo:
 - 6.1. Start condition: Following from termination of (5), this process will then be triggered.
 - 6.2. End condition: After (5.3) a loading icon will appear which indicates processing and storage of the user's selected photo. After the loading icon disappears, the process is completed.
7. Generate report:
 - 7.1. Start condition: Following from termination of (6), this process will then be triggered.
 - 7.2. Branch condition: The user can select the 'retake photo' prompt again to return to (5) if they wish.
 - 7.3. End condition: After the user selects the 'generate report' prompt, a message will appear indicating that report was generated and then the process will end.
8. Display report:
 - 8.1. Start condition: The user must be logged in and either select the 'view previous reports' prompt or just finished generating a new report following (7) to trigger this process.
 - 8.2. End condition: Once the start condition is met, the report is displayed to the user and the process is finished.
9. Analyze ingredients:
 - 9.1. Start condition: Following termination of (8), this process will be triggered if the user selects the 'view ingredients' prompt.
 - 9.2. End condition: Once the start condition is met, the detailed report is displayed to the user and the process is finished.

3.3. Business operational constraints

Digital Health Inc. has established several business constraints that the application must fulfill. First, the application should meet or exceed the 94.11% accuracy that the research on a deep learning food processing system was able to achieve. At the very least, the system should be the most accurate application of its type. Due to this, the system shall utilize a highly scalable artificial intelligence to analyze foods. The AI shall take advantage of existing commercially available food databases to train it to accurately detect foods. Lastly, the system shall use Amazon Web Services (AWS) to store and process user submitted photos, as Digital Health has previously established infrastructure that uses AWS.

3.4. Business operational modes

In the unexpected event of a system failure, the application will enter a manual mode where users are informed that they can still create new meals with photos. However, they will be notified that these photos will be automatically stored and their ingredients will be analyzed after the system is back online. They will receive a notification when their newly created meals are eventually processed. Additionally, users will still be capable of viewing and editing meals that have been locally downloaded within their application.

3.5. Business operational quality

Sign in quality:

- Ensure that the quality of this business operation is on par concerning the sign-in features of other existing applications.
- This implies that triggering this operation is both intuitive and reliable.

Validate credentials quality:

- Ensure that credentials validation is nearly 100% accurate with high urgency for spotting and fixing mistakes.

Register user quality:

- Ensure users can register accounts with ease and relatively quickly compared to other application with registration features.

Enter new meal:

- Ensure the process of entering new meals is simple with minimal delay from system responses.

Take photo:

- Ensure there are no breaches in the user's privacy with high urgency for any security breaches associated with this process.

Store photo:

- Ensure that stored photos are not altered from their original quality and that they can be quickly accessed when the user desires.

Generate report:

- Ensure generated report is easily interpretable with clean formatting.
- Set a high level of urgency for maintaining high report accuracy.

Display report:

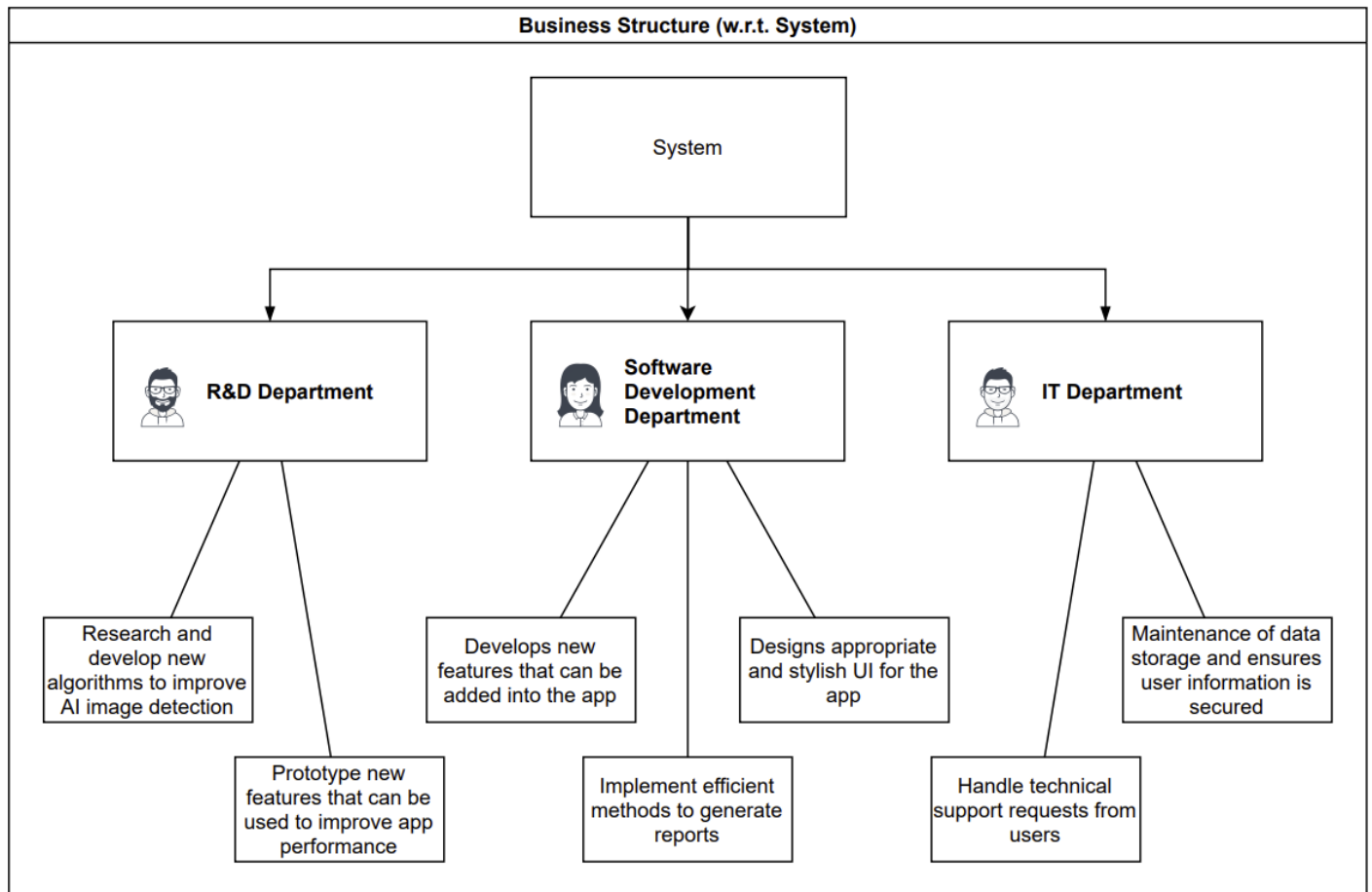
- Ensure reports are displayed upon user's request with minimal delay.

Analyze ingredients:

- Ensure all ingredients in a meal are picked up with a very high level of urgency for maintaining accurate results.
- This process should also be done relatively quickly with minimal interaction from the user side.

3.6. Business structure

Below is a high-level overview of a proposed business structure between different departments regarding the system functionality of the app. Responsibility for the business operations will be split between these departments:



4. Preliminary operational concept of proposed system

4.1. Preliminary operational concept

4.1.1. Operational policies and constraints

The system should operate at all times, as mealtimes differ all over the world due to time zones. Therefore, when purchasing servers, there needs to be multiple servers for computation and data storage available so that traffic can be redirected somewhere else if one of the servers is down.

As there will be multiple servers, possibly in different geographical locations, there needs to be personnel on or near the site to each of the server locations so that upkeep and maintenance can be done. There needs to be at least one person stationed at each server. If purchasing servers, the computer hardware purchased should be server specific.

4.1.2. Description of the proposed system

The system shall be operational in all mobile operating systems such as Android and iOS. The major system elements are the UI, database, and authentication service. Data needed for the system to function such as user credentials and nutritional information for different food items will be stored in the database. Authentication service will be required for the users to log onto the system, and UI will be required for the users to generate, navigate through and read the nutritional report.

The proposed system will allow the users to create an account and authenticate themselves. Once an account is created and the user has logged in, the user can take a photo of their meals to analyze ingredients and caloric content. This information can be viewed in an easily readable report. Should they choose to sign up for a paid subscriptions service, the user will have access to more comprehensive reports that will show macronutrients and micronutrients and can also view past reports created.

The process model of the system from the user's perspective can be seen in section 4.1 of this document.

The main budget for the system would be primarily coming from subscription fee revenue from users. The possible operational risk factors might be if there are not enough users subscribing to the system for the revenue to cover any costs associated with the system such as server maintenance costs.

The system will be available at all times. As the AI of the system will continue evolving from past data, the correctness and reliability will improve as more users utilize the

system. The system was developed with future possible changes in mind. Therefore, the structure of the system is expendable and flexible by design, and both code and data store easily maintainable.

The system will perform at a good speed by responding to requests for meal analysis quickly. The AI will use multiple optimization algorithms for better responding and calculation speed. As well, information from the analysis by the AI will also be cached in the database for future usage, which will also cut down the performance time. Though personal network connection will determine some of the throughputs of the application's communication with the server, the system will also divide any incoming and outgoing communication into smaller packets to reduce latency and optimize throughput. The server of the system can always support a high volume of work from applications all over the globe by having multiple servers and splitting the workload.

The user will need to agree for the application to share some information from the user with some third party when signing up for the user account. The user will also have to manually give the application to access camera functionality. All information collected from the user will be stored in a physically and virtually secured data store. The system will only share the information that the user has agreed to be shared, with the third party that the user has agreed to be shared with. If there are any changes to the information being shared or the party the information is shared with, the user will be notified and required to agree to the updated terms to be able to continue using the user account.

In case of emergency when one server fails, all the communication will be redirected to other servers. If all servers fail in the worst-case scenario, The users will still be able to take a photo of their meals and manually input the ingredients. The user's inputs will be automatically saved, and when the servers are online, the meals will be automatically analyzed again and user notified. Past meals and reports locally downloaded onto their device will still be available for viewing through the application.

4.1.3. Modes of system operation

In a regular mode, the user will have access to any application functions available to their account, such as taking a photo of meals, analyzing ingredients, analyzing and viewing caloric content in a report, viewing current and past reports, signing up for the subscription service and signing out of the system.

In premium mode, the system will operate at a faster speed for premium registered users who are paying a monthly/yearly subscription to the application. Additional system features include locally storing data, more specific and detailed reports including information such as micronutrients and macronutrients, report customizability, etc.

If a server fails, the system will still operate in regular mode though the traffic will be redirected to other servers while the failed server is being fixed. This may cause a slight delay to the users though it should not be noticeable.

If all servers fail in the worst-case scenario, the system will operate in a manual mode. The users will still be able to take a photo of their meals and manually input the ingredients and weights. Though the analysis function will not be available at that time, the user will be notified that their photos will be automatically stored and meals analyzed when the system is back online. When the servers are back online and meals processed, the users will be notified. Furthermore, the users will still be able to view past meals and reports locally downloaded within the application on their device if they are premium users.

4.1.4. User classes and other involved personnel

Organizational structure

The organizational structure of the user classes falls into two groups: the intended end-user of the system and the development and maintenance team of the system. The user of the system falls under two categories: subscribed users and unsubscribed users. The development and maintenance team can be divided into UI developers, AI developers, Database Administrators, and the Server Maintenance team.

Profiles of user classes

- User of application
 - Unsubscribed Users: any person can make an account and use the system. These users can sign in, take a photo of their meals, request reports where the ingredients, caloric content, and nutritional information of a food are analyzed, and view reports of past meals. Unsubscribed users can also upgrade their user plan.
 - Subscribed Users: will have access to all features that unsubscribed users have in addition to also seeing more extensive nutritional information, locally storing data, and customizing reports. They can also cancel their subscription at the end of a billing payment cycle should they choose to at any time.
- Software Development Department: The software developers will design, develop and maintain the UI of the system. They will also continuously update UI and the features of the application according to user requests. The software developers must be certified software engineers.
- Research & Development Team: The R&D Team will build and train AI as well as continuously verify results from AI. They will also update the AI's algorithms to be more efficient and re-train the AI in case of inaccurate results reported. The developers of R&D Team must have an appropriate minimum of one year's experience in Artificial Intelligence.
- IT Department: divided into help desk employees, database administrators, and server maintenance team.
 - Help Desk: will answer technical support questions from the users as well as re-directing any tickets raised by the users regarding UI, database or connection related issues to appropriate departments so that the issue can be solved.
 - Database Administrators: will build databases, input and classify data and continuously maintain the database of the system. The DBAs must have at least one year of database experience.

- Server Maintenance Team: The server maintenance team must maintain servers and live near the site to provide support in case of server failure. The server maintenance team must have at least one year in server systems and have certified education in networking.

Interactions among user classes

- UI developers will work closely with R&D Team and Database Administrators to make sure the UI fits their needs.
- The Server Maintenance team will work closely with R&D Team and Database Administrators to make sure the servers purchased and maintained will fit the needs of database and artificial intelligence needs.
- AI Developers and Database Administrators will work closely together so AI Developers can make sure the AI is training and outputting correct results into the database.
- UI developers will work closely with end-users to make sure the UI fits their needs and convenience.
- Help Desk Workers will work closely with end-users to make sure that the user receives appropriate technical support.

Other involved personnel

- The company of Digital Health Inc. is one of the involved user classes.

4.1.5. Support environment

The system will have a team of AI specialists to do maintenance and debugging for the system AI. The system will also have a team of database administrators to do maintenance on the database and the data. Each server will also have a server maintenance team who will regularly maintain and update the servers. Finally, there will be a small team of developers who will answer any help tickets from the users, and do any UI-related updates requested by the users.

Each server will be offline for maintenance every two weeks for three hours. Each server will go through maintenance at a different day so that the traffic could be redirected to other servers, with at least a day in between in case the previous maintenance caused any issues. This maintenance will be done by the server team.

Similarly, the database will go through maintenance every week to make sure all the data is correctly stored and processed, and to make any updates if there are any issues or needed extra fields. All the distributed database systems will be updated so that the data is in sync. This maintenance will be completed by the database administrator team.

The AI team will continue to provide training data to the AI to improve its accuracy, as well as fix any cases where there were any issues reported of the AI's inaccuracy by updating the source code, the database classifications or additional training. The AI will be maintained continuously, though changes will only be deployed every two weeks except for any emergency cases.

If any hardware such as servers fail, it will be repaired if possible and replaced promptly if not. The hardware will go through an inspection every six months and if there is any hardware that needs to be replaced or repaired, it will be done in a timely fashion to reduce any possible future bugs or downtime.

4.2. Preliminary operational scenarios

1. Enter new meal:
 - 1.1. Start condition: The user must be registered and signed in to their account and then select the 'enter new meal prompt' to trigger this process
 - 1.2. Branch conditions: If the user selects the 'cancel' prompt, they will be sent back to the home screen. If the user selects take photo (2), they will have the option to take a photo from their mobile phone of the food item.
 - 1.3. End condition: After entering the meal name and photo, a report will be generated (2).
2. Take photo:

- 2.1. Start condition: Following from (1.1) the user must then select the 'take photo' prompt after they have entered the meal name.
 - 2.2. Branch conditions: If the user selects the 'retake photo' prompt, this process will be repeated from the start.
 - 2.3. End condition: After the user confirms that they are satisfied with the photo they took, this process will end.
3. Store photo:
 - 3.1. Start condition: Following from termination of (2), this process will then be triggered.
 - 3.2. End condition: After (2.3) a loading icon will appear which indicates processing and storage of the user's selected photo. After the loading icon disappears, the process is completed.
4. Generate report:
 - 4.1. Start condition: Following from termination of (3), this process will then be triggered.
 - 4.2. Branch condition: The user can select the 'retake photo' prompt again to return to (2) if they wish.
 - 4.3. End condition: After the user selects the 'generate report' prompt, a message will appear indicating that report was generated and then the process will end.
5. Display report:
 - 5.1. Start condition: The user must be logged in and either select the 'view previous reports' prompt or just finished generating a new report following (4) to trigger this process.
 - 5.2. End condition: Once the start condition is met, the report is displayed to the user and the process is finished.
6. Analyze ingredients:
 - 6.1. Start condition: Following termination of (5), this process will be triggered if the user selects the 'view ingredients' prompt.
 - 6.2. End condition: Once the start condition is met, the detailed report is displayed to the user and the process is finished.

5. Other preliminary life-cycle concepts

5.1. Preliminary acquisition concept

The system acquisition will begin with the hiring of a development team, who will work alongside the business team to determine the specifics of the requirements. This will be followed by interviews with relevant stakeholders about the vision of the system to further narrow down the specifications. Digital Health Inc. will have a major part in this preliminary discussion, and the software will begin development once agreements have been made.

The software system will feature a robust AI image processing module that can accurately determine the weight and density of various ingredients based on an image provided by the user. This will then be translated through real-time conversion to a report that contains nutritional information such as caloric content and macro and micronutrient specifics. The information on individual ingredients will be stored using Amazon Cloud Services to line up with Digital Health Inc.'s pre-existing infrastructure.

Prototypes will be unveiled to Digital Health Inc. in regular intervals to ensure the product is being developed following the requirement specifications.

5.2. Preliminary deployment concept

The system will be deployed once all major development has been completed to the satisfaction of major stakeholders and will be released on both Android and Apple iOS platforms through the Google Play Store and Apple App Store, respectively. Varying subscription models will be offered to users that will provide varying levels of speed and functionality. Users will be able to use the application for free but will be offered the option to upgrade their plan to remove advertisements and have access to more detailed reports and the ability to save reports locally.

5.3. Preliminary support concept

The system will be supported after deployment by constant updates to further improve functionality and fix bugs. This will require further development and testing work to be done. Additionally, user submissions may need to be scanned for correctness before it is added to the image recognition database, so a team will need to be assembled to ensure the database is using accurate nutrition and volume measurements. They will be responsible for reviewing user submissions and reports, and adding or removing database entries respectively as necessary.

5.4. Preliminary retirement concept

When the system is retired, any user information that is unrelated to user submissions will be safely deleted to avoid the leak of any sensitive information. This will include payment methods, emails, passwords, and other personal data. The database of food nutritional information may be compiled and sold for commercial use to other companies after the retirement of the application.

6. Project constraints

Time and cost constraints are present for this project. Deadlines will be established at the beginning of the project development phase once requirements and a timeline have been established. Deliverables will be presented to stakeholders at the end of each phase's deadline for review, and changes will be made according to feedback for review in the next iteration deadline. This is closely linked to the cost constraints of the project, as the size of the development team will be proportional to the budget given to the development team after initial planning.

A major functional constraint that this project will face is the visual detection of foods. To have an effective detection system, robust image processing, and machine learning modules must be developed so that the application can find distinct foods, and correctly identify their volume and weight based on an AI that is trained on existing databases as

well as user submissions. Should the development of the image processing and detection module not go smoothly, it is unlikely that the project as a whole will be able to be completed within cost and schedule.

7. Appendix

7.1. Acronyms and abbreviations

- BRS: Business Requirements Specification
- UML: Unified Modeling Language
- UI: User Interface
- AI: Artificial Intelligence