Hazard Analysis
Utrition

Team 16, Durum Wheat Semolina
Alexander Moica
Yasmine Jolly
Jeffrey Wang
Jack Theriault
Catherine Chen
Justina Srebrnjak

Table 1: Revision History

Date	**Developer(s)**	**Change**
October 19, 2022	All	Initial Version
April 4, 2023	All	Revision 1 Changes

Contents

List of Tables

1 Introduction

This document discusses the hazards associated with Utrition. In the context of Utrition, hazards are defined to be a set of circumstances that prevent the expected use of the system, leading to an error state. The document will communicate the scope, boundaries and assumptions made when completing the hazard analysis, and provide a list of identified hazards. In addition, it will mention recommended actions to mitigate and circumvent hazards encountered while using the system.

2 Scope and Purpose of Hazard Analysis

The purpose of conducting a hazard analysis is to document the system conditions, that along with conditions in the environment, can cause harm or damage. Documentation for how to control or mitigate these conditions will also be included. The scope of this hazard analysis will span from the time the user inputs a food item into Utrition to the time when the nutritional data results of their input are displayed, including the pre-processing, processing, API request, and data representation steps.

3 System Boundaries and Components

The system boundaries for this hazard analysis will include the device that the application is installed on as well as the components of the application itself. These components consist of text upload, voice upload, voice-to-text translation, image upload, image pre-processing, image processing & identification, API request calling, data logging, data log access, user settings saving, user settings access, data calculations, and data display components.

3.1 Text Upload

This component allows an textual input to be uploaded by the user and relayed to the API request calling component.

3.2 Voice Upload

This component allows an audio recording to be uploaded by the user and relayed to the voice-to-text translation component.

3.3 Voice-to-Text Translation

This component an audio recording and converts it to text. This text is relayed to the API request calling component.

3.4 Image Upload

This component allows an image to be uploaded by the user and relayed to the pre-processing component.

3.5 Image Pre-Processing

This component takes an uploaded image and applies the algorithms needed to convert the raw image data into a format that can be used by a machine learning image model.

3.6 Image Processing & Identification

This component is where the machine learning model analyzes the pre-processed image to identify the food displayed by comparing it to the images it was exposed to during its supervised learning.

3.7 API Request Calling

This component allows the application to interface with the Nutritionix API to access nutritional data on a given food.

3.8 Data Logging

This component logs past uses of the application by the identified food and the date it was consumed.

3.9 Data Log Access

This component returns the recorded logs of past uses of the application. These logs include past food items consumed by the user.

3.10 User Settings Saving

This component will save user settings that are relevant for BMI and recommended calories calculations.

3.11 User Settings Access

This component returns the saved user settings which can be used in required calculations.

3.12 Data Calculations

This component calculates all the required values needed when displaying the user's data. This includes calories consumed per day, BMI, and recommended calories.

3.13 Data Display

This component displays data visually for the user to see, either in textual or graphical formats.

4 Critical Assumptions

In this Hazard Analysis, two assumptions are made. Firstly, the user will not be intentionally trying to cause errors in Utrition. Secondly, the user is assumed to have sufficient storage space to download and run the application.

5 Failure Mode and Effect Analysis

Failure Mode and Effects Analysis

System: Utrition
Subsystem: N/A
Phase/Mode: System Requirements

Design Function	Failure Modes	Causes of Failure	Effects of Failure	Detection	Recommended Actions	SR	Ref
Text Upload	Text is uploaded with no food items	Users upload text that does not contain any food items	No nutrional data output	NULL response from API call	Provide error message that informs the user that their text did not contain any food items	SR1	H1-1
Voice Upload	Unable to identify speech	User's surroundings are too loud for device to identify speech	No audio detected	None	Provide feedback on what system has identified	SR2	H2-1
	Audio is uploaded with no food items	Users upload audio (i.e. speech) that does not contain any food items	Same as H1-1	Same as H1-1	Provide error message that informs the user that their audio did not contain any food items	SR3	H2-2
Voice-to-Text Translation	Unable to translate sounds into text	User's audio input contained sounds that did not correlate to words	No voice-to-text input created	Same as H2-1	Same as H2-1	SR2	H3-1
	Speech is translated to wrong words	System identifies user's speech to be different from what was actually said	Incorrect text generated	Same as H2-1	Same as H2-1	SR2	H3-2
Image Upload	Image of incorrect type inputted	Users attempt to upload a file of an unsupported type	No image uploaded	Upload error will occur	Provide error message that informs the user that only file types of type .png, .jpg, and .jpeg can be uploaded	SR4	H4-1
	Image size inputted is too large	Image file from user is too large to be uploaded and stored	Same as H4-1	Same as H4-1	Provide error message that inputted file is too large	SR5	H4-2
	User tries to upload more than 1 image at once	User attempts to upload more than 1 image	Same as H4-1	Same as H4-1	Only allow the user to select one file from their device to upload	SR6	H4-3

Table 2: FMEA Table Part 1

Failure Mode and Effects Analysis

System: Utrition
Subsystem: N/A
Phase/Mode: System Requirements

Design Function	Failure Modes	Causes of Failure	Effects of Failure	Detection	Recommended Actions	SR	Ref
Image Processing & Identification	Food from image is incorrectly identified	a. Poor image quality	a. System will process the incorrectly identified food item	a. User will file a report to the development team with the image that was incorrectly identified	a. If the machine learning model is not confident in result, the system will suggest the user upload another image	SR7	H5-1
		b. Machine learning model has not been trained to identify inputted food item	b. Same as H5-1a	b. Same as H5-1a	b. Same as H5-1a		
		c. Machine learning model accuracy is low	c. Same as H5-1a	c. Same as H5-1a	c. Same as H5-1a		
	No food is identified in the image	Same as H5-1	No food item will be identified and the system will not be able to proceed	The food identification machine learning process will return an error to the system	Display error message detailing that system could not identify a food item in the uploaded image	SR7	H5-2

Table 3: FMEA Table Part 2

Failure Mode and Effects Analysis

System: Utrition
Subsystem: N/A
Phase/Mode: System Requirements

Design Function	Failure Modes	Causes of Failure	Effects of Failure	Detection	Recommended Actions	SR	Ref
API Request Calling	API call fails unexpectedly	a. Internet connection error	a. System will not return nutritional data for a food item	a. The API response will be verified by the system. The system will detect if the response is an error	a. Display error message detailing a system error due to poor internet connection	SR8	H6-1
		b. Too many requests sent to API causing throttling limit to be reached	b. Same as H6-1a	b. Same as H6-1a	b. Display error message detailing a system error due to too many requests being sent		
		c. API outage is in progress	c. Same as H6-1a	c. Same as H6-1a	c. Display error message detailing a system error due to inability to obtain food information		
	API does not contain nutrition facts for a food item	Food item is not found in API database	Same as H6-1a	The API response will be verified by the system and will detect if the response is empty	Display error message detailing that the food data could not be fetched	SR9	H6-2
Data Log Access	User past data is unavailable	There are no entries of past food inputs given by the user	System will not output any past input data	No result will be returned for past food inputs	Display error message explaining that there are no past food inputs	SR10	H7-1
	User past data is deleted	a. The data was not successfully stored within the CSV file	a. System will not output any of the user's information	a. Nothing will be output after user requests past data	a. Display error message saying that the user's past data has been deleted	SR11	H7-2
		b. The user's past data was deleted unintentionally	b. Same as H7-2a	b. Same as H7-2a	b. Same as H7-2a		

Table 4: FMEA Table Part 3

Failure Mode and Effects Analysis System: Utrition Subsystem: N/A Phase/Mode: System Requirements							
Design Function	**Failure Modes**	**Causes of Failure**	**Effects of Failure**	**Detection**	**Recommended Actions**	**SR**	**Ref**
User Settings Access	User settings are unavailable	a. The settings were not successfully stored within the JSON file b. The user's past data was deleted unintentionally	a. System will output NULL values for all settings b. Same as H8-1a	a. Requested user settings does not return anything b. Same as H8-1a	a. Display NULL values in settings so the user knows that they need to resubmit their settings b. Same as H8-1a	SR12	H8-1
Data Calculations	Calculations are incorrect	a. No past food item data exists for the required calculations b. No user settings exist for the required calculations	a. System will output NULL values for required calculation b. Same as H9-1a	a. Access past food input data will return NULL b. Access user settings will return NULL	a. Do not display output for calculation b. Same as H9-1a	SR13	H9-1
Data Display	Graph cannot be generated	a. Not enough past information from user b. Graphing code package fails to create graph image	a. No graph is displayed to the user b. Same as H10-1a	a. There is no information available in user's past data b. Image file is not created	a. Display error message stating there is not enough data to create the graph b. Display error message that graph image failed to be created	SR14	H10-1
	Past data cannot be displayed	No past food item data exists	System will output NULL values for data value	Access past food input data will return NULL	Do not display output for past data	SR15	H10-2

Table 5: FMEA Table Part 4

Failure Mode and Effects Analysis

System: Utrition
Subsystem: N/A
Phase/Mode: System Requirements

Design Function	Failure Modes	Causes of Failure	Effects of Failure	Detection	Recommended Actions	SR	Ref
General System	Device loses internet connection	a. Internet connection used by device is too weak	a. Unable to access nutrition facts for food items	a. API calls will fail	a. Display error message that informs the user that they must be connected to an internet connection to use the system	SR16	H11-1
		b. Internet shutdown on connected network	b. Same as H11-1a	b. Same as H11-1a	b. Same as H11-1a		
	System closes unexpectedly	a. Host device shuts down (loses power)	a. Loss of recently inputted data	a. Device screen will turn black	a. System should save data with each new input to minimize lost data	SR17	H11-2
		b. Internal error occurs	b. Same as H11-2a	b. Application will become unresponsive	b. Same as H11-2a		

Table 6: FMEA Table Part 5

6 Safety and Security Requirements

6.1 Safety Requirements

SR1. Utrition will return an error message when the user uploads text that does not contain any food items.
Rationale: Utrition should not crash by improper user input. Users should have an opportunity to upload new text.
Associated Hazards: H1-1.

SR2. Utrition will provide the user with constant feedback regarding what the system could pick up from audio input.
Rationale: Utrition should notify the user if their audio input cannot be deciphered or has been deciphered incorrectly.
Associated Hazards: H2-1, H3-1, H3-2.

SR3. Utrition will return an error message when the user uploads audio that does not contain any food items.
Rationale: Utrition should not crash by improper user input. Users should have an opportunity to upload new audio.
Associated Hazards: H2-2.

SR4. Utrition will return an error message when the user uploads an abnormal image format that is not .png, .jpg, or .jpeg.
Rationale: Utrition should not crash by improper user input. Users should have an opportunity to upload a new file of an appropriate format.
Associated Hazards: H4-1.

SR5. Utrition will return an error message when the user uploads an image file that exceeds the maximum size.
Rationale: Utrition should not crash by improper user input. Users should have an opportunity to upload a new file of an appropriate size.
Associated Hazards: H4-2.

SR6. Utrition will return an error message when the user uploads more than three images at once.
Rationale: Utrition should not crash by improper user input. Users should have an opportunity to upload three or fewer images to the system.
Associated Hazards: H4-3.

SR7. Utrition will prompt the user if food identification cannot be completed successfully. The user will be notified on the type of error that occurs.
Rationale: Food identification may fail due to a variety of reasons, and the user should be notified so they may attempt to find a workaround for the issue.
Associated Hazards: H5-1. H5-2.

SR8. Utrition will return an error message if the request to retrieve nutritional information cannot be completed successfully.
Rationale: Information retrieval requests may fail due to a variety of reasons, and the user should be notified of the reason why the service could not be completed as expected.
Associated Hazards: H6-1.

SR9. Utrition will return an error message if the nutritional information of a specific item cannot be found.
Rationale: The user should be notified if the nutritional data of their food item cannot be fetched.
Associated Hazards: H6-2.

SR10. Utrition will return an error message if the user's past nutritional logs cannot be found.
Rationale: The user should be notified if their nutritional data of past meals cannot be found.
Associated Hazards: H7-1.

SR11. Utrition will return an error message if the user's past nutritional logs have been deleted.
Rationale: The user should be notified if their nutritional data of past meals are no longer saved in the system.
Associated Hazards: H7-2.

SR12. Utrition will return NULL values if the user's settings cannot be found.
Rationale: The user should be notified if their settings cannot be found.
Associated Hazards: H8-1.

SR13. Utrition will not display data calculations if there is no past food item inputs or user settings.
Rationale: The user will see that there is no data to do calculations for.
Associated Hazards: H9-1.

SR14. Utrition will prompt the user if past nutritional trends cannot be displayed successfully. The user will be notified on the type of error that occurs.
Rationale: Failure to display past nutritional trends may fail due to a variety of reasons. The user should be made aware of the issue, and the underlying cause behind it.
Associated Hazards: H10-1.

SR15. Utrition will not display data if there is no past food item inputs or user settings.
Rationale: The user will see that there is no data to be displayed.
Associated Hazards: H10-2.

SR16. Utrition will prompt the user if their device is not connected to the internet when attempting to access the system.
Rationale: The user should be notified if they are unable to connect to the system so they may apply a fix to the issue.
Associated Hazards: H11-1.

6.2 Security Requirements

SR17. Utrition will periodically save user's data during use.
Rationale: In the event of unexpected shutdown, the user should not lose all information from the last session. Periodically saving user information will allow users to continue from their last step in the event of an unexpected shutdown.
Associated Hazards: H11-2.

7 Roadmap

Durum Wheat Semolina is planning to implement SR1-SR17 during Utrition's capstone timeline. All requirements are easy to implement and do not provide much strain to the system. They exist to guide the user through Utrition, and to aid Utrition in being an easy-to-understand application.