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# Nutr.io - Multi-platform application for diabetics' nutritional choices

## **Beta release**

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# Abstract

The idea that every field of study can be digitalized in order to ease monotonous tasks is continuously growing in the modern world. Our project aims to tackle the field of Type 1 diabetes, given its growing prevalence in the world.

One of those monotonous tasks is the count and measurement of carbohydrates in meals used to administer the correspondent amount of insulin, along with their blood levels, to maintain a healthy lifestyle. A task that heavily relies on having access to food databases and realize of how many portions a meal has - usually by using a digital balance or doing estimations.

Eating in restaurants is the perfect example that showcases a gap in this field, that our project, Nutr.io, aims to fill. Most nutritional applications do not provide data for restaurants' meals, such as MyFitnessPal, nor does the user bring his digital balance from home - resulting in a faulty carbohydrate count and therefore the administration of an incorrect insulin dose.

The main goal of this project is to design a system that offers a way to facilitate difficult carbohydrate measurement situations, like in restaurants. To that end, a system that stores meals' nutritional information will be developed, where users can use and calibrate its data with their feedback.



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# Chapter 1

## Introduction

This document is related to the project's beta release, mentioning all progress made up to this date.

The report will also state the issues encountered during this time period, mentioning the decisions the group made to solve them. This might also include changes in the initial plan, that the group found relevant for the project's progress efficiency.

The diagrams and schemas developed for this project are shown when approaching the respective topic, however there is an appendix which contains additional information about the project, having references pointing to it when necessary.



## Chapter 2

# Project development

### 2.1 Roadmap

According to the proposed plan, the group managed to accomplish a more complete Android application that can make requests to the server and use its information to display lists, detailed views and calculate user's insulin values as store local cache such as user profiles and search history.

The HTTP server also had great progress, having now most of its planned features working and properly tested. In order to make this possible, the database suffered some changes that will be detailed later in this report.

However, as it will be detailed in the next section, the group faced some issues that caused delays and made the web browser application development not possible in this delivery, mainly due to API withdrawals and data models changes.

### 2.2 Issues encountered and updates

This section describes the issues found and the decisions made to overcome them during development.

#### 2.2.1 Relational database

The group had to redesign the database's models multiple times again, due to the previously mentioned API withdrawals and other encountered incoherences.

#### 2.2.2 Food API's

Throughout development and with some research, the group concluded that no meal API exists that provides accurate nutritional - either for a recipe/meal or a base ingredient, such as rice.

This conclusion came from investigating three possible API's: Edamam, Nutrionix and Spoonacular; and comparing their provided nutritional values with corresponding values obtained from certified sources for Portugal. The results can be found in [Appendix D - API nutritional accuracy

sheet].

The group assumes that this inaccuracy is due to the fact that mentioned API's automatically calculate a recipe's carbohydrates from its ingredients without taking into consideration the cooking process, meaning, 100g of raw rice does not have the same carbohydrates as 100g of cooked rice.

Another assumption is that there is no international standard for nutritional values, meaning that the same meal (and its ingredients nutritional composition) can have different carbohydrates between Portugal and the United States of America.

As a result, the group no longer relies on food API's and as such, inserts curated meals and ingredients in the project's database. This comes with the limitation that certain ingredients might have been missed, meaning that a user might not be able to create their desired meals.

### **2.2.3 Android client**

The Android application's development progressed normally but it had to be put on hold sometimes, because of HTTP server's endpoints' completion, in which the application depends strongly. A major DTO and model restructure had also to be made inside the mobile application in order to meet with the current HTTP responses.

## **2.3 Roadmap updates**

Given that the previously mentioned issues, the group agrees that every mandatory requirement made in the initial draft and rectified in the previous progress report can still be implemented until the project's final release, such as the web client application.

However the group will have to remove some optional features so the main ones can be delivered whole.

## Chapter 3

# Results

This chapter shows what has been achieved and developed to this date.

Overall, every initial mandatory goal stated in the project's proposal was met, with two key exceptions: a missing browser-based client and a missing authentication system. This was due to an ambitious number of mandatory requirements and encountered difficulties mentioned previously in the progress report.

However, the first optional objective was fulfilled. Meaning that a community based contribution system which allows users to create restaurants, meals and to vote on said submissions is present in the Beta phase.

### 3.1 Relational database

As a result of multiples redesigns, here is the database's conceptual model.

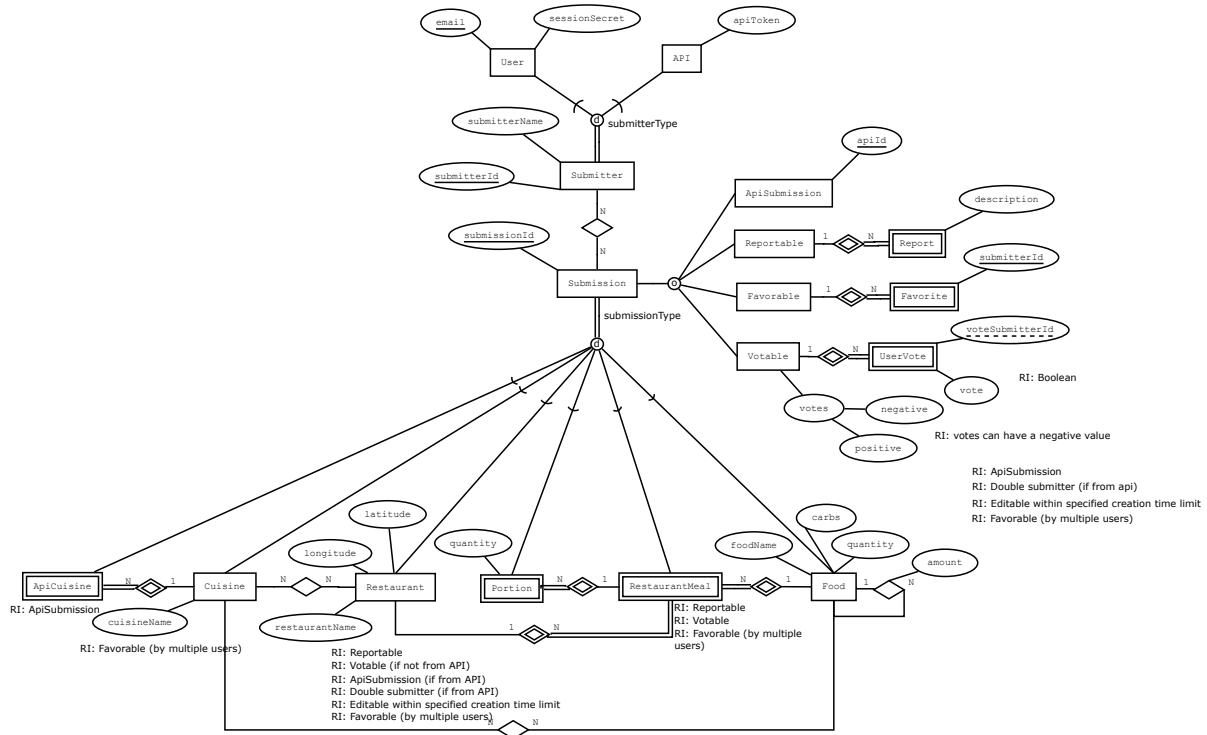


Figure 3.1: Database conceptual model

The database's relational model is present inside this report's appendix [Appendix B - Database relational model].

In the relational model there are tables which are not specified in the conceptual model. These are a product from associations between entities which will simplify queries' complexity.

Now the submission can fall into 4 categories: ApiSubmission, Reportable, Favorable and Votable, in order to distinguish between submissions that are from the user or from APIs and to separate which ones can be reportable, favorable and votable by the user.

The cuisine entity has now an associated entity called ApiCuisine, to save cuisine information provided by the Here API.

Meals and ingredients were now condensed into one entity called food - now each meal can have meals inside it that can also be considered ingredients in other contexts.

Therefore each meal possesses nutritional information, which is essential to the user especially to the insulin calculations. That information is composed by 'carbs' - meal's carbohydrates; and quantity - meal's quantity.

## 3.2 HTTP server

Given that some mandatory goals were not met, the server endpoints appendix was changed [Appendix C - Endpoints' table] in order to be consistent with said goals.

Seeing as user authentication was not implemented, but some endpoints require a submitter, a placeholder form of authentication was created which relies on query parameter '?submitter=submitterId' being given.

Every 'POST' or 'PUT' endpoint requires authentication.

## 3.3 Geolocation

Given how all clients rely on obtaining nearby restaurants, there was a need to implement a geolocation function in the project's design.

Initial research showcased two possible solutions: Haversine distances and cartesian distances, where the latter returns a highly imprecise distances. As such, Haversine was selected.

The next step was to choose which system filters nearby restaurants: database or HTTP server. After some discussion, the group decided that database was the best option for two reasons:

- Given the large amount of existing restaurants, sending such data from the database to the HTTP server so that it could filter it would occupy too much memory;
- PostgreSQL already supplies extensions that add support for location queries, namely PostGIS.

## 3.4 Android application

As mentioned in the progress report, the group managed to implement in the mobile application a fragment that displays a map with a list of restaurants nearby the user.

The user can also search for restaurants, meals and cuisines providing the associated name or identifier.

The core feature of the application was also finished during this time period - the insulin calculator. This feature calculates how many insulin doses should be injected in order to maintain the blood glucose levels stabilized according to the user's planned glucose objective for that period of the day.

The blood glucose objective is set inside the user's profile, by creating multiples insulin profiles, each one has a limited time period to give the user freedom to map its own insulin routine throughout the day.

This is due to the fact that user's insulin sensitivity factor varies along the day, so the user has the ability to specify its own values in order to the calculator





## **Chapter 4**

# **Appendices**

This chapter displays all the appendices referenced in this report.

Appendix A - Initial plan



Figure 1: Initial plan accorded in the project's proposal

## Appendix B - Database relational model

- **Submitter**

- Attributes: submitterId, submitterName, submitterType
- Primary Key(s): submitterId
- Foreign Key(s): -
- Not null: submitterName, submitterType

- **User**

- Attributes: submitterId, email, sessionSecret, creationDate
- Primary Key(s): submitterId, email
- Foreign Key(s): submitterId references Submitter(submitterId)
- Not null: sessionSecret

- **API**

- Attributes: submitterId, apiToken
- Primary Key(s): submitterId
- Foreign Key(s): submitterId references Submitter(submitterId)
- Not null: apiToken

- **Submission**

- Attributes: submissionId, submissionType, submissionDate
- Primary Key(s): submissionId
- Not null: submissionType

- **ApiSubmission**

- Attributes: submissionId, apild
- Primary Key(s): submissionId, apild
- Foreign Key(s): submissionId references Submission(submissionId)
- Not null: submissionType

- **SubmissionSubmitter**

- Attributes: submissionId, submitterId
- Primary Key(s): submissionId, submitterId
- Foreign Key(s):
  - \* submissionId references Submission(submissionId)
  - \* submitterId references Submitter(submitterId)
- Not null: submitterId

- **SubmissionContract**

- Attributes: submissionId, submissionContract
- Primary Key(s): submissionId, submissionContract

- **Report**

- Attributes: submissionId, submitterId, description
- Primary Key(s): submissionId, submitterId
- Foreign Key(s):
  - \* submissionId references Submission(submissionId)
  - \* submitterId references Submitter(submitterId)
- Not null: description

- **Votes**

- Attributes: submissionId, positiveCount, negativeCount
- Primary Key(s): submissionId
- Foreign Key(s): submissionId references Submission(submissionId)
- Not null: submissionType

- **UserVote**

- Attributes: submissionId, voteSubmitterId, vote
- Primary Key(s): submissionId, voteSubmitterId
- Foreign Key(s):
  - \* submissionId references Submission(submissionId)
  - \* voteSubmitterId references Submitter(submitterId)

- **Restaurant**

- Attributes: submissionId, restaurantName, latitude, longitude
- Primary Key(s): submissionId
- Foreign Key(s): submissionId references Submission(submissionId)
- Not null: restaurantName

- **Cuisine**

- Attributes: submissionId, cuisineName
- Primary Key(s): cuisineName

- **ApiCuisine**

- Attributes: submissionId, cuisineSubmissionId
- Primary Key(s): cuisineName
- Foreign Key(s):
  - \* submissionId references Submission(submissionId)
  - \* cuisineSubmissionId references Cuisine(submissionId)

- **Meal**

- Attributes: submissionId, mealName, carbs, quantity, unit
- Primary Key(s): submissionId
- Foreign Key(s): submissionId references Submission(submissionId)
- Not null: mealName

- **RestaurantMeal**

- Attributes: submissionId, restaurantSubmissionId, mealSubmissionId
- Primary Key(s): submissionId, restaurantSubmissionId, mealSubmissionId
- Foreign Key(s):
  - \* restaurantSubmissionId references Restaurant(submissionId)
  - \* mealSubmissionId references Meal(submissionId)

- **Favorite**

- Attributes: submissionId, submitterId
- Primary Key(s): submissionId, submitterId
- Foreign Key(s): submissionId references Submission(submissionId)

- **Portion**

- Attributes: submissionId, restaurantMealSubmissionId, quantity
- Primary Key(s): submissionId
- Foreign Key(s): submissionId references Submission(submissionId)
- Not null: quantity

- **MealIngredient**

- Attributes: restaurantSubmissionId, ingredientSubmissionId, quantity
- Primary Key(s): restaurantSubmissionId, ingredientSubmissionId
- Foreign Key(s):
  - \* mealSubmissionId references Meal(submissionId)
  - \* ingredientSubmissionId references Ingredient(submissionId)

- **RestaurantCuisine**

- Attributes: restaurantSubmissionId, cuisineName
- Primary Key(s): restaurantSubmissionId, cuisineName
- Foreign Key(s):
  - \* restaurantSubmissionId references Restaurant(submissionId)
  - \* cuisineName references Cuisine(cuisineName)

- **MealCuisine**

- Attributes: mealSubmissionId, cuisineName
- Primary Key(s): mealSubmissionId, cuisineName
- Foreign Key(s):
  - \* mealSubmissionId references Meal(submissionId)
  - \* cuisineName references Cuisine(cuisineName)

## Appendix C - Endpoints' table

Method	Path	Query String	Body parameters	Description
GET	\restaurant	float latitude, float longitude, optional String name, optional int radius, optional String name		Search for restaurants and their cuisines, based on location or named search
GET	\restaurant\restaurantId			Obtain specific restaurant's full information by given restaurantId
GET	\restaurant\restaurantId\meal			Obtain all suggest and user inserted restaurant meals for given restaurant
GET	\restaurant\restaurantId\meal\mealId	int skip, int count		Obtain specific restaurant meal for given restaurantId and mealId
GET	\cuisines	optional int skip, optional int limit		List possible cuisines
GET	\ingredients	optional int skip, optional int limit		Get all possible ingredients
GET	\meal	optional string[] mealTypes, optional int skip, optional int count, optional string[] cuisines		Get all suggested meals
GET	\meal\mealId			Obtain specific meal's full information by given mealId
POST	\restaurant		RestaurantInput	Create a new restaurant around given geolocation
POST	\meal		MealInput	Create a user meal with at least one ingredient
POST	\restaurant\restaurantId\meal\mealId		PortionInput	Insert a new portion for given restaurant meal
PUT	\restaurant\restaurantId\vote		VoteInput	Add or update your vote on a user restaurant
PUT	\restaurant\restaurantId\mealId		VoteInput	Add or update your vote on a restaurant meal created by an user
PUT	\restaurant\restaurantId\meal		RestaurantMealInput	Creates a restaurant meal from given user meal
DELETE	\restaurant\restaurantId			Delete user created restaurant
DELETE	\restaurant\restaurantId\vote			Delete user's vote on an user's restaurant
DELETE	\restaurant\restaurantId\meal\mealId			Delete user's portion submission for given restaurant meal
DELETE	\restaurant\restaurantId\meal\mealId\portion			Delete user's restaurant's meal portion
DELETE	\restaurant\restaurantId\meal\mealId\vote			Delete user's restaurant's meal vote
DELETE	\meal\mealId			Delete an user created meal, along with any associations with a restaurant the meal might have

## Appendix D - API nutritional accuracy sheet

Meal string displays the query String used to search in respective API		
Meal (always 100g)	APDP Values	Edamam
	Carbs	Value
Green peas	8	14
Broad bean (favas)	7	11
cooked red kidney beans	14	22
cooked chickpeas	17	27
Soybeans, mature cooked, boiled, without salt	6	9/30
Lupine (tremoço)	7	9
Corn bread	37	43
Wheat bread	57	48
Cooked Rice (simple)	28	28
Tomato Rice	19	18
Roasted Potato (assado)	24	17
potatoes, boiled, cooked in skin, flesh	19	20
potatoes, boiled, cooked in skin, skin	19	17
sweet potato, cooked, boiled, without skin	~17	17
French fries	28	23
Mashed potato	17	16
Pizza	24	29
Chicken rice	25	12
Baked Fish and Rice	15	8
Octopus rice	10	no result

Figure 2: API nutritional accuracy sheet