PROPOSAL

of the Diploma Project entitled (working title(s)):

DIET4Elders: a Service Oriented Architecture for the Prevention and Self-Management of Malnutrition

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# Project Purpose and Objectives

The purpose of our project is to design an application that will provide nutrition care for older people on a daily basis. The application will take into account the user’s preferences, allergies and, depending on the health of the user, the doctor’s prescription. The application will use menus generated by local food providers.

Our main objectives are:

* Design a model of the nutrition process by using ontologies
* Map real data onto the ontology model to provide solid test data for the algorithm
* Design an optimized hybrid algorithm that will generate daily menus for the older people
* Link the generated menu with local food providers

# Project Description

It is estimated that in Europe more than 15% of the population is affected by poor nutrition and malnutrition cause by the problems of ageing such as decrease in sensitivity, poor dental health, lack of transportation, physical difficulty, forgetfulness and other issues.

DIET4Elders is a project that addresses that problem by providing a nutrition care system. It is an aid for preventing malnutrition and it offers an automated carer that is present 24/7, making it easier for them to continue their daily life activities without having to worry about achieving the daily recommended dose of nutrients, or worry about having meals that are not medically recommended or contain ingredients the user is allergic to.

From the technical point of view, the project will consist of a model that is based on ontology concepts. The ontology will be populated by using the nutrients’ and weights’ data provided by the National Nutrient Database[[1]](#footnote-1) from the United States Department of Agriculture.

Based on the model, the application will have an algorithm that will generate food menus for a day that are provided by local food vendors. The ontology will be populated with many recipes that have at least one food vendor and can be recipes of starter, main or desert dishes.

The algorithm will need to be an optimization algorithm that, by repeated combination of dishes based on a mathematical model, will result in local optimal solutions. The fitness of a daily menu is computed by extracting the nutrients of each recipe, computing an error margin by comparing the real value with the expected value. The expected value of each nutrient (protein, vitamins etc) will be provided by specialized sources based on gender, weight, age and medical condition.

The menus will also take into account user preferences as well as provide diversity in order to avoid generating similar dishes in consecutive days or so. The carer will be able to specify the doctors prescription and edit system settings.

# Related Work

The main focus of this application is the hybrid algorithm that will be used to generate daily menus. The algorithm will be a nature inspired algorithm, to be more precise, it is the mathematical model of bee behavior. The algorithm will shape the cyclic process of **honey bee mating**, thus it is where its name is derived from.

Honey Bee Mating Optimization (HBMO) is a meta-heuristic algorithm and has been used for search and as an optimization tool in various problem domains including science, commerce and engineering. “The honey-bees mating process may also be considered as a typical swarm-based approach to optimization, in which the search algorithm is inspired by the process of real honey-bees mating”[[2]](#footnote-2).

Direct-search and gradient-based search are two methods of traditional optimization. In direct-search methods, only the objective function and constraint values are used to guide the search strategy, whereas gradient-based methods use the ﬁrst and/or second-order derivatives of the objective function and/or constraints to guide the search process. Since derivative information is not used, direct-search methods usually require many function evaluations for convergence. For the same reason, they can also be applied to a variety of problems without a major change in the algorithm.

Modeling the behavior of social insects, such as ants and bees, and using these models for search and problem-solving are the context of the emerging area of swarm intelligence. Ant colony is a typical successful swarm-based approach to optimization, where the search algorithm is inspired by the behavior of real ants. Ant colony algorithms as evolutionary optimization algorithms were ﬁrst proposed by Dorigo (1992) and Dorigo et al. (1996) as a multi-agent approach to different combinatorial optimization problems like the traveling salesman problem and the quadratic assignment problem.

Honey-bees mating may also be considered as a typical swarm-based approach to optimization, in which the search algorithm is inspired by the process of mating in real honey-bees. The behavior of honey-bees is the interaction of their genetic potentiality, ecological and physiological environments, and the social conditions of the colony, as well as various prior and ongoing interactions.

# Necessary Resources

Our system has mainly software dependencies:

* The implementation will be done in **Java** programming language
* We need an open source ontology editor and a knowledge acquisition system in order to work with our ontology (chose **Protégé)**
* We need a relational DBMS to handle relational part of schema and from which we can import nutrition data into our ontology as well as food providers etc (choose **Mysql**)
* We need an open source semantic web framework for Java (chose **Jena)**

We also need an extensive dataset:

* For the nutritive value of basic food the database from the Nutrient Data Lab of the National Agricultural Library

The user needs:

* Any machine running an OS supporting JVM
* Internet connection

# Expected Results

# Project Timeline

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| --- | --- | --- | --- | --- |
| Week | Period | Research | Implementation | Writing |
| 1 - 8 | 3 nov – 23 dec | Bibliography Study | Comparison & Tests | Weekly short reports |
| 9 - 13 | 5 jan – 6 feb | - (session) - | - (session) - | - (session) - |
| 14 - 15 | 9 feb – 20 feb | Bibliography Study | Comparison & Tests | Weekly short reports |
| 16 | 23 feb – 28 feb | Related Work Research | Comparison & Tests | Weekly short reports |
| 17 | 1 mar – 6 mar |  | Full Flow Conceptualization | Detailed Component Overview |
| 18 | 9 mar - 15 mar |  | Implementing the data model |  |
| 19 | 16mar -21 mar |  | Implementing HBMO simple version |  |
| 20 | 23mar –26mar |  | Adding the recipes |  |
| 21 | 29 mar - 4apr |  | Creating the database |  |
| 22 | 5apr - 11apr |  | Assessing the simple version | Introduction |
| 23 | 12apr – 18apr |  | Adding more heuristics to HBMO | Bibliographic study |
| 24 | 19apr – 25apr |  | Flow Integration | Analysis & design |
| 25 | 26 apr – 2 may |  | Flow Integration |  |
| 26 | 3may – 9may |  | Implementation stabilization | Implementation |
| 27 | 10may -16may |  | Fine Tuning & Testing |  |
| 28 - 29 | 17may -27may |  | Performance & scalability | Tests & conclusions |
| 30-31 | 2jun-8june | - (session) - | - (session) - | - (session) - |
| 32-33 | 9june-24june |  | Final tests and demo | Improve & Finalize doc |

# Table of Contents

For the table of contents, please see the [Tiberiu\_Boros\_contents\_bibliography.pdf](Tiberiu_Boros_contents_bibliography.docx) attached document.

# Bibliography

For the bibliography, please see the [Tiberiu\_Boros\_contents\_bibliography.pdf](Tiberiu_Boros_contents_bibliography.docx#Bibliography) attached document.

# Glossary

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| Term | Definition |
| HBMO | Honey Bee Mating Optimization bio-inspired algorithm |
| Jena | Framework API to interact with ontologies in Java |
| Protégé | **Protégé** is a free, open source [ontology](http://en.wikipedia.org/wiki/Ontology_(computer_science)) editor and a [knowledge acquisition](http://en.wikipedia.org/wiki/Knowledge_management) system. |
| Mysql | Mysql is a [relational database management system](http://en.wikipedia.org/wiki/Relational_database_management_system) |

1. National Nutrient Database - http://ndb.nal.usda.gov/ndb/search [↑](#footnote-ref-1)
2. Honey-Bees Mating Optimization (HBMO) Algorithm: A New Heuristic Approach for Water Resources Optimization [↑](#footnote-ref-2)