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# Web application for commerce automated flowerpots

Diploma Project  
**Degree in Computer Engineering**

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# Abstract

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Nowadays, caring for a household plant is very responsible and time-consuming work for every person. For this purpose, it would be great if there were automated systems where the user can care remotely for his flower or public garden without worrying anymore. To solve this problem, systems like this were created that offer full automation and easy care for the plant. The next important step is these automated systems to be commerced somehow online. The E-commerce has grown as one of the most popular and easiest method of shopping these days. Creating a website that offers to purchase these newly created systems would contribute much of their dissemination and promotion.

The main goal of the present work was to create a prototype of a web application for commerce automated flowerpots. To develop the application, it was important to do a research about other applications that have similar idea to ours whereby it was easier to choose the functionalities that this application should possess. Due to this fact, the requirements of the application were described in the form of use case diagrams and through each one was described a separate functionality. After we had an idea about how the application would work, it was a turn to determine the application's design. For this purpose, was used the Three-Layer technology. Most of the functionalities that were chosen for this application as well as the design were implemented and for that purpose was used the MVC (Model-view-controller).

One of the main goals that has been achieved for this product is that the user can successfully purchase a product from the website and add it so he manage it through the application. Another important goal that was achieved is that application has very simple and easy to use interface which is also responsive so it can run on different devices. Most of the functionalities were achieved, but some of them are not fully implemented at this moment.

# Resumen

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Actualmente, el cuidado de plantas domésticas es una tarea que consume mucho tiempo y responsabilidad para cualquier persona. Por este motivo, sería interesante disponer de sistemas automáticos donde el usuario puede cuidar remotamente sus plantas, o en caso de un jardín público, sin tener que preocuparse. Para solucionar este problema, existen sistemas que ofrecen un total automatismo y cuidado fácil de las plantas. El siguiente paso importante es que estos sistemas automáticos puedan comercializarse por internet de algún modo. El comercio electrónico ha crecido recientemente como uno de los medios más populares y fáciles para comprar. La creación de una página web que ofrezca comprar estos sistemas novedosos contribuiría en gran medida a su divulgación y promoción.

El principal objetivo del presente trabajo es crear un prototipo de una aplicación web para comercializar macetas automáticas para plantas y flores. Para desarrollar esta aplicación, previamente se revisaron otras aplicaciones basadas en un concepto similar, lo cual facilitó la elección de funcionalidades que la aplicación debería tener. Así pues, los requisitos de la aplicación fueron descritos por medio de diagramas de caso de uso y para cada uno se describió una funcionalidad independiente. Una vez establecido cómo debería funcionar la aplicación, se realizó el diseño de la aplicación. Para ello, se usó la tecnología de Tres Capas. La mayoría de funcionalidades elegidas para esta aplicación así como el diseño se implementaron empleando el patrón de modelo-vista-controlador (MVC).

Uno de los principales objetivos que se ha conseguido para este producto es que el usuario puede comprar el producto con éxito del sitio web y añadirlo de modo que puede ser gestionado a través de la aplicación. Otro objetivo importante logrado es que la aplicación tiene una interfaz muy simple y fácil de usar, que también puede funcionar en distintos dispositivos. La mayoría de funcionalidades se han logrado, pero algunas de ellas no están totalmente implementadas por el momento.

# Table of Content

---

|   |    |
|---|----|
| 1. Introduction.....                                | 9  |
| 1.1 Environment and Motivation.....                 | 9  |
| 1.2 Project Objectives.....                         | 9  |
| 1.3 Structure of the document .....                 | 10 |
| 2. Environment .....                                | 11 |
| 2.1 Introduction .....                              | 11 |
| 2.2 System Similarities .....                       | 11 |
| 2.2.1 Edyn.....                                     | 11 |
| 2.2.2 PlantLink.....                                | 12 |
| 2.2.3 ParrotPot.....                                | 13 |
| 2.2.4 Grove.....                                    | 14 |
| 2.2.5 MINIGROW .....                                | 15 |
| 2.2.6 GreenIQ.....                                  | 16 |
| 2.4 Analysis.....                                   | 17 |
| 2.5 Synthesis.....                                  | 18 |
| 2.7 Conclusions.....                                | 19 |
| 3. Requirement Specification .....                  | 20 |
| 3.1 Introduction .....                              | 20 |
| 3.2 Use Cases .....                                 | 20 |
| 3.3 Tables of Functionalities.....                  | 29 |
| 3.4 Conclusions.....                                | 32 |
| 4. System Design .....                              | 33 |
| 4.1 Introduction .....                              | 33 |
| 4.2 Conceptual Specification .....                  | 33 |
| 4.3 Formal Specification.....                       | 34 |
| 4.3.1 Data Layer .....                              | 34 |
| 4.3.2 Business / Logical Layer .....                | 34 |
| 4.3.3 Presentation Layer .....                      | 50 |
| 4.4 Conclusions.....                                | 56 |
| 5. Implementation, implantation and evaluation..... | 57 |

|                                     |    |
|-------------------------------------|----|
| 5.1 Introduction .....              | 57 |
| 5.2 Implementation .....            | 57 |
| 5.2.1 Presentation Layer.....       | 57 |
| 5.2.2 Business/ Logical Layer ..... | 57 |
| 5.2.3 Data Layer .....              | 58 |
| 5.3 Integration .....               | 58 |
| 5.4 Evaluation.....                 | 58 |
| 6.Conclusions .....                 | 59 |
| 6.1 Level of completion.....        | 59 |
| 6.2 Resolved difficulties.....      | 59 |
| 6.3 Future Implementations.....     | 60 |
| 7. References .....                 | 61 |

# Illustrations

---

|   |    |
|---|----|
| Illustration 1: Interface of the Edyn Website.....                          | 11 |
| Illustration 2: Interface of the PlantLink Website.....                     | 12 |
| Illustration 3: Interface of the ParrotPot Website.....                     | 13 |
| Illustration 4: Interface of the Grove Website.....                         | 14 |
| Illustration 5: Interface of the MINIGROW Website.....                      | 15 |
| Illustration 6: Interface of the GreenIQ Website.....                       | 16 |
| Illustration 7: UC - The Two Types of Users.....                            | 20 |
| Illustration 8: UC - Register.....  | 21 |
| Illustration 9: UC – View Profile.....                                      | 22 |
| Illustration 10: UC – Manage Products.....                                  | 23 |
| Illustration 11: UC – View Product Data.....                                | 24 |
| Illustration 12: UC – Edit Product.....                                     | 25 |
| Illustration 13: UC – Manage Orders.....                                    | 26 |
| Illustration 14: UC - Manage Friends.....                                   | 27 |
| Illustration 15: UC - Access to Social Media.....                           | 28 |
| Illustration 16: Architecture of the System.....                            | 33 |
| Illustration 17: Sequence - Buy Product.....                                | 35 |
| Illustration 18: Sequence - Register.....                                   | 36 |
| Illustration 19: Sequence - View Profile.....                               | 37 |
| Illustration 20: Sequence - Edit Profile Info.....                          | 38 |
| Illustration 21: Sequence - Add Product.....                                | 39 |
| Illustration 22: Sequence - View Product Data.....                          | 40 |
| Illustration 23: Sequence - Edit Product.....                               | 41 |
| Illustration 24: Sequence - View Order.....                                 | 42 |
| Illustration 25: Sequence -Edit Order.....                                  | 43 |
| Illustration 26: Sequence - Return Order.....                               | 44 |
| Illustration 27: Sequence - Add Friend.....                                 | 45 |
| Illustration 28: Sequence - Send/Receive Message.....                       | 46 |
| Illustration 29: Sequence - Remove Friend.....                              | 47 |
| Illustration 30: Interface of the Website - User Profile.....               | 51 |
| Illustration 31: Interface of the Website - Profile Info.....               | 51 |
| Illustration 32: Interface of the Website - Manage Chombos.....             | 52 |
| Illustration 33: Interface of the Website - Register a Chombo.....          | 52 |
| Illustration 34: Interface of the Website - View Product Data.....          | 53 |
| Illustration 35: Interface of the Website - Edit Product.....               | 54 |
| Illustration 36: Interface of the Website - Buy Product.....                | 55 |
| Illustration 37: Interface of the Website - Customizable Purchase Form..... | 56 |

# Tables

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|  |    |
|--|----|
| Table 1: Features Comparison Table.....                | 17 |
| Table 2: Functionality - Buy Product.....              | 29 |
| Table 3: Functionality - Register .....                | 29 |
| Table 4: Functionality – View Profile .....            | 29 |
| Table 5: Functionality - Manage Products .....         | 30 |
| Table 6: Functionality - View Product Data.....        | 30 |
| Table 7: Functionality - Edit Product.....             | 30 |
| Table 8: Functionality - Manage Orders .....           | 31 |
| Table 9: Functionality - Manage Friends .....          | 31 |
| Table 10: Functionality - Access to Social Media ..... | 31 |
| Table 11: Function - Buy Product .....                 | 48 |
| Table 12: Function - Register .....                    | 48 |
| Table 13: Function - View Profile .....                | 48 |
| Table 14: Function - Manage Products .....             | 49 |
| Table 15: Function - View Product Data.....            | 49 |
| Table 16: Function - Manage Orders.....                | 49 |
| Table 17: Function - Manage Friends .....              | 50 |
| Table 18: Tests.....                                   | 58 |



# 1.Introduction

## 1.1 Environment and Motivation

At present, process automation systems in open environments, such as gardens or public spaces, are usually dedicated to basic tasks like irrigation control, and controlled by centralized units. However, thanks to the technological advances of recent years, it is possible to automate more processes, from the measurement of environmental variables (humidity, atmospheric pressure, etc.) and by means of a greater number of actuators (selective irrigation or environmental illumination).

Since a large number of sensors and actuators can be available in a garden or public space per plant, it is possible to distribute part of the automation and to provide the information of the sensors or the control of the actuators for the specific flowerpot to users who connect, via the Internet through computer or mobile device. However, there must be a way to commerce those automated flowerpots which are called “chombos”, so in order to accomplish this, it is necessary to be created a website dedicated to this. Nowadays the websites are one of the easiest ways to popularize a product and to commerce it.

## 1.2 Project Objectives

Before we start with describing the goals of the project, it is important to note that that this application is prototype and it’s not going to be fully implemented the way it will be designed.

One of the most important aspects to start with is that the project is oriented in creating a web application that is focused on managing all commercial transactions with chombos. The user should be able to purchase chombos and choose the type of sensors and actuators during the buying process that can be included in the package. Furthermore, the user must be able to add his product in his profile by using the product key provided by the manufacturer. Also, the user should be able to see orders historically or manage them during shipping by editing the order details, cancel it or return it.

Secondly the user will be able to see the data of the product or more precisely seeing the environmental measurements from the sensors historically depicted in the form of a chart. Also, the website will offer camera view for the chombo in “Real Time” (livestream of the flowerpot trough the camera) and map so that the user will be able to see the chombo location. Ditto, the owner of a product should be able to edit it by changing the description and give permissions to other users to view the product data. Also, the user will be able to manage friends by add friend, remove friend or simply send or receive a message.

Last, but not least, for the design of the website will be used the Three-Layer Architecture. Also, the design of the application will be responsive so it can be loaded on different devices. Of course, the web application must have very simple design so that the users can easily orientate when working with it.

### **1.3 Structure of the document**

This document is composed of 6 sections. The following are briefly described below:

The first section introduces the content of the project, its objectives and the environment in which it is carried out.

In the second section, a market study is carried out to obtain an overview of the similar websites and their characteristics. From there we choose the characteristics that our website should include.

The third section defines in a technical and more detailed way all aspects of the web application, as well as the overall description of the project as a whole.

The fourth section presents the design of the system, the distribution of all data and the form of interaction chosen.

The fifth section details the implementations that have been chosen according to the selected design.

Finally, the conclusions of this project are presented, the difficulties encountered and the solutions to them as well as the suggested future implementations which the application could have.

## 2. Environment

### 2.1 Introduction

Recently more and more devices like automated systems for caring about flowerpots or gardens are developed and alongside them there are websites that offer the users to purchase those systems. Some of these websites offer you a way to manage those products online.

In this section will be reviewed several systems that offer a similar characteristic like our system.

After this, an analysis will be made by which we will compare the functionalities between the systems. From there we choose the characteristics that our website should include.

Thereafter a synthesis will be revealed to describe in detail the chosen functionalities for the system and they will be arranged by priority. The technology that will be used for this project will be show below.

Lastly, the conclusions for this section will be also described below.

### 2.2 System Similarities

According to the committed research there are several systems that exist with functionalities like those that are desired for the realization of the project which as well as to decide what aspect can help this website application to stand out among the others.

#### 2.2.1 Edyn

Edyn is a smart garden system that monitors and tracks environmental conditions. Inserted in the soil, the Edyn Garden Sensor gathers and analyzes data about changing weather and soil conditions and sends this data via Wi-Fi.

The Edyn Web App is very good-looking website. On the first place, it has a scroller technology which is probably Parallax and very well intrigue the eye of the user. There is very useful information about how the sensor is working displayed with good animations which gives a clear idea of how it works. There are also pictures with information for the mobile app and can give tablature of the app's UI before you can access it. Of course, there are links to Google App Store where you can download the mobile application and also links to the social environment. There is also a buying system where you can purchase the sensor. One unique option in the website is that there is customer service chat where a person from the Edyn team can answer any question of the user. The Web App supports mobile version.

Source: <https://edyn.com/>

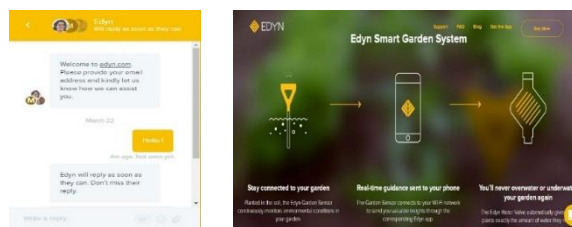


Illustration 1: Interface of the Edyn Website

## 2.2.2 PlantLink

PlantLink takes the guesswork out of watering your plants. By combining soil moisture sensors with an internet-connected wireless infrastructure, PlantLink generates automatic watering schedules using plant-specific algorithms. Simply place Links indoors or outdoors next to your house plants, in your garden or in your lawn, and never worry about incorrectly watering again.

The PlantLink Web App is also very similar in UI and functionalities with Edyn, but with little difference. It looks more well-arranged with a bit simpler design, but very readable and understandable from the user which also make very good attention itself. There is also a lot of useful information for the sensor. There are a few buttons in the header for buy system, story of the group and other and the same buttons are down in the footer so it can be comfortable for the user to have access to the buttons instead scrolling back to the header to click them. You can also subscribe by email so you can stay up to date for news. Also, there is a mobile app available for free download, from the Apple Store. The Web App supports mobile version.

Source: <http://myplantlink.com/>

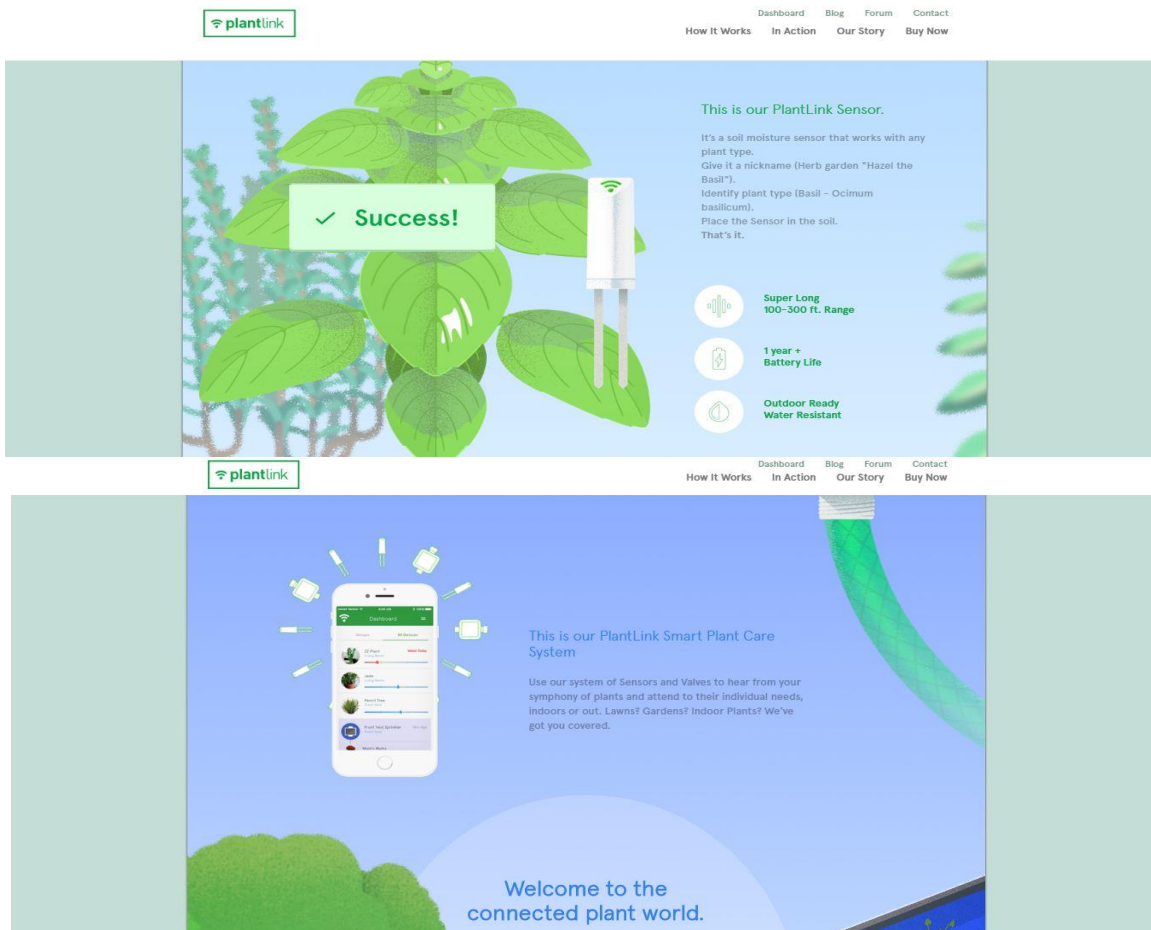


Illustration 2: Interface of the PlantLink Website

### 2.2.3 ParrotPot

Parrot Pot is a connected pot that helps you keep your plants healthy. It incorporates an intelligent watering system and four sensors that continuously analyze your plant's needs. The data collected by your Parrot connected object (Pot or Flower Power) are sent to your smartphone or tablet thanks to Bluetooth Low Energy wireless technology (Bluetooth v4.0).

The ParrotPot Web App doesn't have scroller like the previous two websites, but is also well-arranged. The ParrotPot is only one of the pages in the website. The website is called only Parrot and it offers other technologies like drones, minidrones, car kits, etc. On the right side of the page you have slide navigation to better and easy navigate through the slides or more precisely you can return on the slide you want without scrolling. On the right side of the website there are links to social environment which are also located on the footer. Down below when you scroll you can see technical parameters for the pot which is pretty important and kind of unique. You also have the opportunity to chat with the customer service which is located in the lower left side of the website. You have a lot of information for the pot and how it works and you have video tutorials included. The website also offers you to login/register where you have a personal account with many different options. This website also offers a mobile application which is free for download in the Google Play Store & Apple Store. The Web App supports mobile version.

Source: <https://www.parrot.com/us/connected-garden/parrot-pot#parrot-pot>

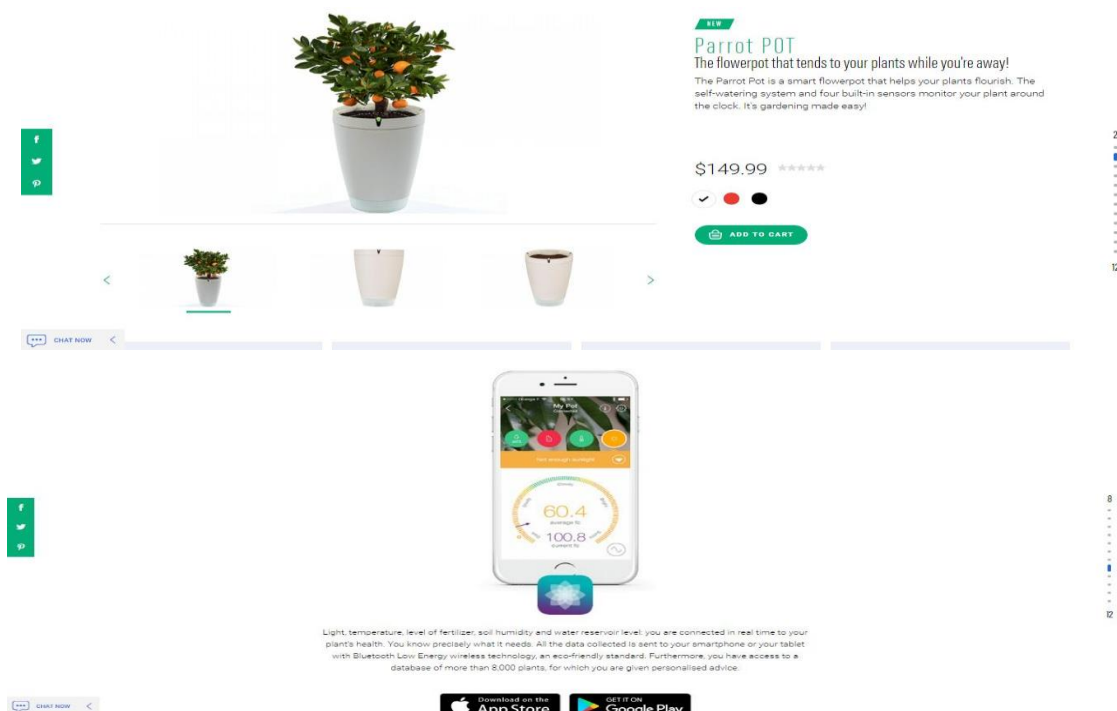


Illustration 3: Interface of the ParrotPot Website

## 2.2.4 Grove

The Grove Garden has been designed from the ground up for indoor gardening. From its beautiful, compact form with integrated storage and workspace to the intelligent lighting system that mimics daylight to its nearly silent water pump — all in a package no larger than a bookcase. It’s a delight for your eyes as well as your tastebuds. You may not realize it, but your Garden is a perfectly balanced ecosystem — you feed the fish, the fish feed the plants, and the plants feed you. The result is a garden that grows faster than an outdoor garden, uses only one-tenth of the water, and requires no dirt or weeding. All our products are hand-crafted in Massachusetts using an elegant and sustainably-sourced Moso amber bamboo. Only twenty percent of the crop is harvested each year, allowing time for the remaining bamboo to grow and refill small voids, resulting in net carbon sequestration.

The Grove Web App is very simply made. In the home screen, you can’t find much of an info, but you can find more in The Garden tab located close to the other tabs in the header. There you have useful information about the system including pictures. In these tabs, there are semi tabs where you can find technical parameters about the system which is very valuable for the user. You also have a market where you can purchase a system. Near the footer, you can find links to social environments and you can also have the privilege to sign up for newsletter. The website also offers mobile application for free download in the Apple Store. The Web App supports mobile version.

Source: <https://grovegrown.com/>

### Technical Specifications



| Physical           | Aquarium          | Growing           | Lighting          |
|--------------------|-------------------|-------------------|-------------------|
| Dimension          | 21" x 18"         | 6" x 6"           | 24" x 18" x 4"    |
| Weight             | 12.5 lbs (5.7 kg) | 1.5 lbs (0.7 kg)  | 2.5 lbs (1.1 kg)  |
| Material           | Stainless Steel   | Aluminum          | LED               |
| Power Source       | AC Power          | AC Power          | AC Power          |
| Water Capacity     | 20 Gallons (75L)  | 5 Gallons (19L)   | 5 Gallons (19L)   |
| Water Pump         | Yes               | Yes               | Yes               |
| Water Filter       | Yes               | Yes               | Yes               |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
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| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
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| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrate      | 0-1000            | 0-1000            | 0-1000            |
| Water Temperature  | 60-75°F (15-24°C) | 60-75°F (15-24°C) | 60-75°F (15-24°C) |
| Water pH           | 6.5-7.5           | 6.5-7.5           | 6.5-7.5           |
| Water TDS          | 0-1000            | 0-1000            | 0-1000            |
| Water Conductivity | 0-1000            | 0-1000            | 0-1000            |
| Water Salinity     | 0-1000            | 0-1000            | 0-1000            |
| Water Hardness     | 0-1000            | 0-1000            | 0-1000            |
| Water Alkalinity   | 0-1000            | 0-1000            | 0-1000            |
| Water Ammonia      | 0-1000            | 0-1000            | 0-1000            |
| Water Nitrite      | 0-1000            | 0-1000            | 0-1000            |
| Water Nit          |                   |                   |                   |

## 2.2.5 MINIGROW

MiniGrow is a unique small grow box, optimized to grow and flourish one single plant in a perfect environment. Pamper your plant with the help of hypermodern light- and computer technology and grow the best yield possible on a square foot. Designed to be small, MiniGrow fits in any interior. It is easy and enjoyable to grow your favorite plant in the smallest and best quality grow box available!

The MINIGROW Web App is too simple and not so good structured compared with the previous four websites. On the home page, you have some information for the system, but you don't have much wallpapers. Instead of this in the beginning of the page there is a slider with pictures and the user has the option to check more pictures if not satisfied. On the footer, there are again links to the social environments. In the header, you have more tabs. In the tab "We grow an Idea" you can find more detailed information about the system. In the other tab, you can find specifications of the system like the previous two websites. There is also a mobile app available for free download, but there is no link to the application. The Web App supports mobile version.

Source: <http://minigrow.net/>



### The Specifications

#### Exterior

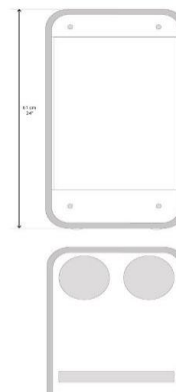
MiniGrow measures only 34\*37\*61cm (13.4\*14.6\*24") (w\*d\*h). The high quality, handbuild finish is a combination of Bamboo veneer and high-gloss white piano polish.

#### Front-panel

The fully removable frontdoor makes for easy access. Planting, watering, clipping, there are no obstacles to pamper your plant. At the same time, when closed, no light or odour can escape.

#### Light

MiniGrow's light engine and used spectrum is optimized to produce the best possible yield on a square foot. A solid 50W LED panel is based on the highest quality Cree X series and Osram LEDs, optimized for small and highly potent plants. Additional 10w side-lighting strips provide additional light-penetration in the shadow area of the plant.



**Illustration 5: Interface of the MINIGROW Website**

## 2.2.6 GreenIQ

GreenIQ Smart Garden Hub uses the most advanced Internet, cloud and mobile technologies to intelligently manage garden's irrigation and lighting scheduling. from anywhere, at any time. In a typical garden, the system can save up to 50% on your outdoor water bill.

The GreenIQ Web App is simple, but very affable for the user. In the home tab, you can find information about the hub, how to connect it through device, accessories for your smart garden and other. If you click on Smart Garden Hub It redirects you to other page with information only for the device. Below the first one there are four tabs (Overview, how it Works, Technology, Features). Each one of the tab display different useful information about the hub depends on the tab. Close to the footer you can find a buy now button which redirects you to new page where you can click from where you're purchasing a product depends on the country you are. On the footer, there are other useful tabs like about us or technical support, etc. You can also subscribe for newsletter and you can find links to social environments. You also have the privilege to use and mobile application. You can find the link to the app again in the footer. The Web App supports mobile version.

Source: <http://greeniq.co/>

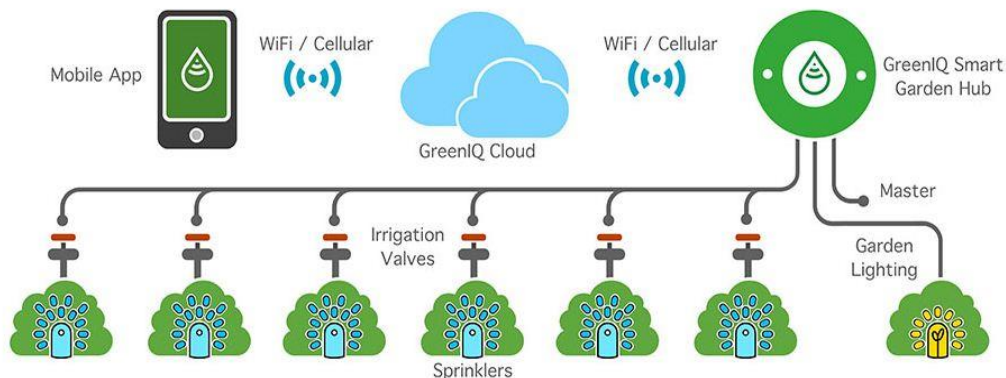
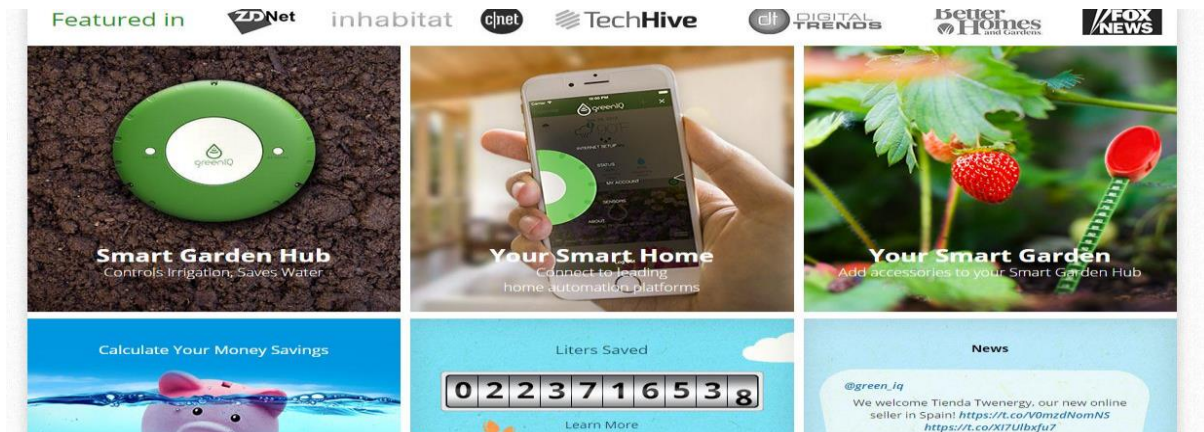


Illustration 6: Interface of the GreenIQ Website



## 2.4 Analysis

In this subchapter, we want to make a comparison of various features to get on the one hand the basic functions that the application should have, and on the other hand the characteristics that will make the application stand out among its competition. Below is a comparative table with different characteristics:

Legend:

**Scroll Tech** - Scroller Technology (i.e. Parallax) and/or Slide Navigation.

**Links Social** - Links to social environment like Facebook, Twitter, Instagram, etc.

**Links Mobile** – Link to the mobile application from Google Store or Apple Store

**Online Purch.** – Option to purchase online the technology that the website offers

**Cust. Supp.** – Customer Support where a person from the team can answer any question of the user.

**B&F Opt.** – Blog and Forum

**Email Subsc.** – Subscribe to Newsletters

**Video Tuts** – Video Tutorials explaining how the technology works

**User Acc.** – The user can register and login in the website

**Mobile Version** – Supporting of a mobile version when access through smartphone

**Hist. Data** – Option to track the environmental metrics about the plant/s of the user as history.

**ML Supp.** - Option of the website to support multiple languages.

| Websites  | Scroll Tech. | Links Social | Links Mobile | Online Purch. | Cust. Supp. | B&F Opt. | Email Subsc. | Video Tuts. | User Acc. | Mobile Version | Hist. Data | ML Supp. |
|-----------|--------------|--------------|--------------|---------------|-------------|----------|--------------|-------------|-----------|----------------|------------|----------|
| Edyn      | Yes          | Yes          | Yes          | Yes           | Yes         | Yes      | No           | No          | No        | Yes            | No         | No       |
| PlantLink | Yes          | No           | No           | Yes           | Yes         | Yes      | Yes          | No          | No        | Yes            | No         | No       |
| ParrotPot | Yes          | Yes          | Yes          | Yes           | Yes         | Yes      | Yes          | Yes         | Yes       | Yes            | No         | No       |
| Grove     | No           | Yes          | No           | Yes           | Yes         | Yes      | Yes          | No          | No        | Yes            | No         | No       |
| MINIGROW  | No           | Yes          | No           | No            | No          | Yes      | No           | No          | No        | Yes            | No         | No       |
| GreenIQ   | No           | Yes          | Yes          | Yes           | Yes         | Yes      | Yes          | No          | No        | Yes            | No         | No       |

**Table 1: Features Comparison Table**

## 2.5 Synthesis

Completing the analysis of the various existing websites, we proceed to summarize and extract the characteristics that are desired to be included in the website application. They are ordered by priority below, starting from the highest to the lowest priority.

- Char. № 1: Online Purchase – By “Online Purchase” it is meant that every user who has account will have the option to purchase a product from the website. During the purchase process, the user can customize the chosen combo and add more parts or just select the parts that are included in the packet. After this the user will be redirected to the payment process where able to choose different payment method like Visa, Master Card, American Express or a possibility to pay via electronic payment methods like PayPal, and ePay. Additionally, every user will have a purchase history with exact time and date.
- Char. № 2: User Account – By “User Account” it is meant that every user will have the option to register if he is new or login if he already has an account. The user will also have the option to login or register with Facebook and Google Plus. In the account, there will be personal details about the user, it will also show the plants that the user owns and the plants that the user don't own but have a permission access. For every combo there will be a product data (read Char. № 3: Product Data). It will also have orders tab where the user can see purchase history and also a friend's tab where the user can see his friends.
- Char. № 3: Product Data – By “Product Data” it is meant that it will represent all the information for the user's plant that is available. There will be available historical charts where the user can see historical charts for the plant measurements, a location of the product, camera and characteristics for the parts that are included for the specific combo.
- Char. № 4: Mobile App Links – By “Mobile App Links” it is meant that every user will have access to the mobile application thanks to the links that will redirect the user to Google Apps Store and Apple Store.
- Char. № 5: Social Links – By “Social Links” it is meant that every user will have the privilege to access the app's social pages like: Facebook, Twitter, Instagram and others for additional information for updates and other useful information.
- Char. № 6: Customer Support – By “Customer Support” it is meant that every user can ask their questions or report a problem through “Contact Us” option which sends an email to the support of the website.
- Char. № 7: Multilanguage Support – By “Multilanguage Support” it is meant that the website will have support of many different languages. How the website will be visualized depends on the language chosen.
- Char. № 8: Blog & Forum – “Blog & Forum” are other websites that are separated from each other and there is only link for each of them in our website so you access them. With both blogs and forums, you can post a comment and reply to other comments, thus developing discussions.

In both cases, you can leave comments which may or may not be moderated and you may have to identify yourself with a name and email address.

Below are several characteristics that are optional, but their including can enrich the functionality of the website and can bring additional user convenience.

- Char. № 9: Scroller Technology
- Char. № 10: Email Subscription
- Char. № 11: Video Tutorials
- Char. № 12: Mobile Version

The next step is to decide what technology is going to be used for developing the website application. The web server will support PHP 5.6, MySQL 5.6 and of course Firezilla Server. Optionally, an application development framework such as CodeIgniter can be used for faster developing.

## **2.7 Conclusions**

This section has reviewed the web applications for automated cultivation that exist in the market. Some of the several websites that were founded have quite nice functionalities, but still can be improved with additional functionalities like the historical data and user account option which will provide greater user usability.

The analysis that was made helped us to choose the best functionalities for the website which will make it more user-friendly and were ordered by priorities. The online purchase, the user profile and the product data functionalities are the most important of all functionalities and they are the main objectives of the project, and that have to be the main focus during the development. The other functionalities that are optional are also very good to implement like for example the “Email Subscription” for receiving newsletter through email about the website content activity. A functionality like “Scroller Technology” will be also good to implement, because it could easy attract the user’s eye with the better cosines that will pass to the website.

As for the technologies that are going to be used in order for this project to be carried out and also to partially fulfill the last objective are the PHP programming language with the Codeigniter framework.

### 3. Requirement Specification

#### 3.1 Introduction

In this section, the application's aspects are defined more technically and detailed by presenting the functionalities and requirements that define the project.

Firstly, the Use Case diagrams that describes the chosen functionalities above will be revealed below. Some nodes of specific diagrams will be examined in depth to depict the actions that would be available.

Secondly, after the Use Cases are revealed the functionalities in tabular type by each one of them which describes the priorities which they are going to have in the application.

Lastly, the conclusions for this section will be described below.

For the creation of this section, the IEE 830 standard has been chosen.

#### 3.2 Use Cases

The following UML diagrams describes the permissions which every type of user have when entering the website application. Every user has different permissions. There are two type of users that can connect in the system: Non-Registered User and the Registered User.

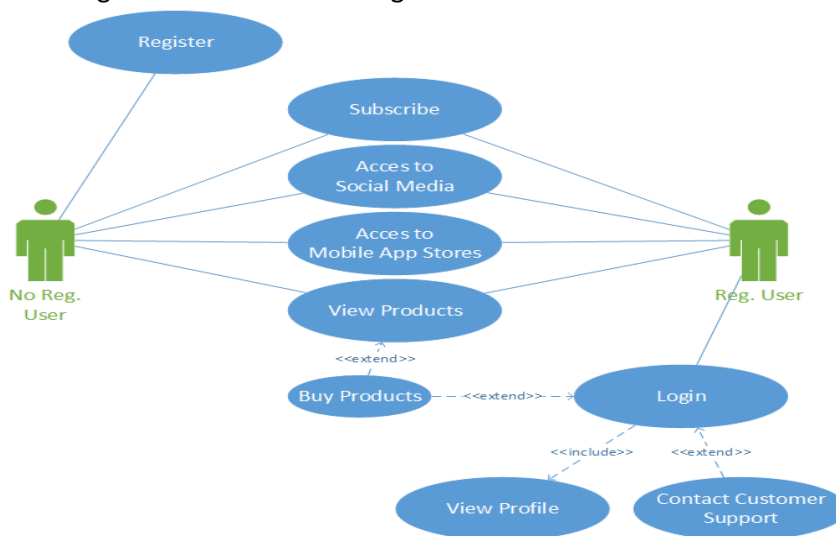
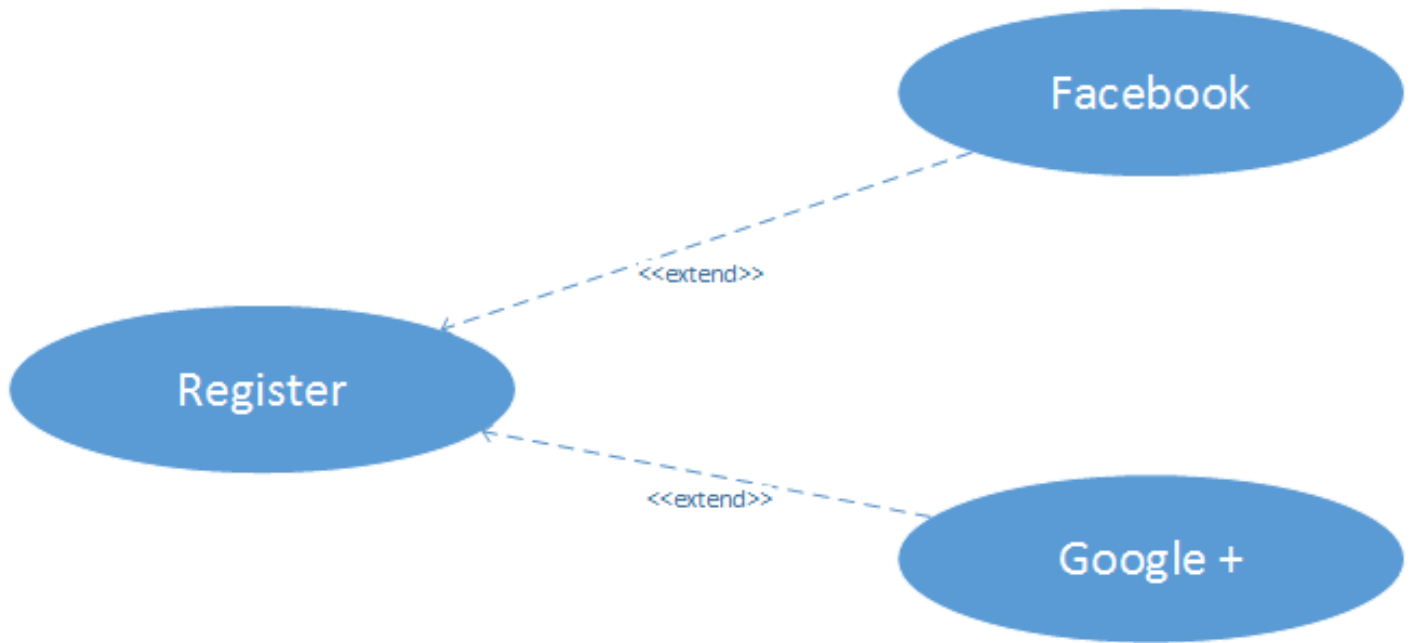


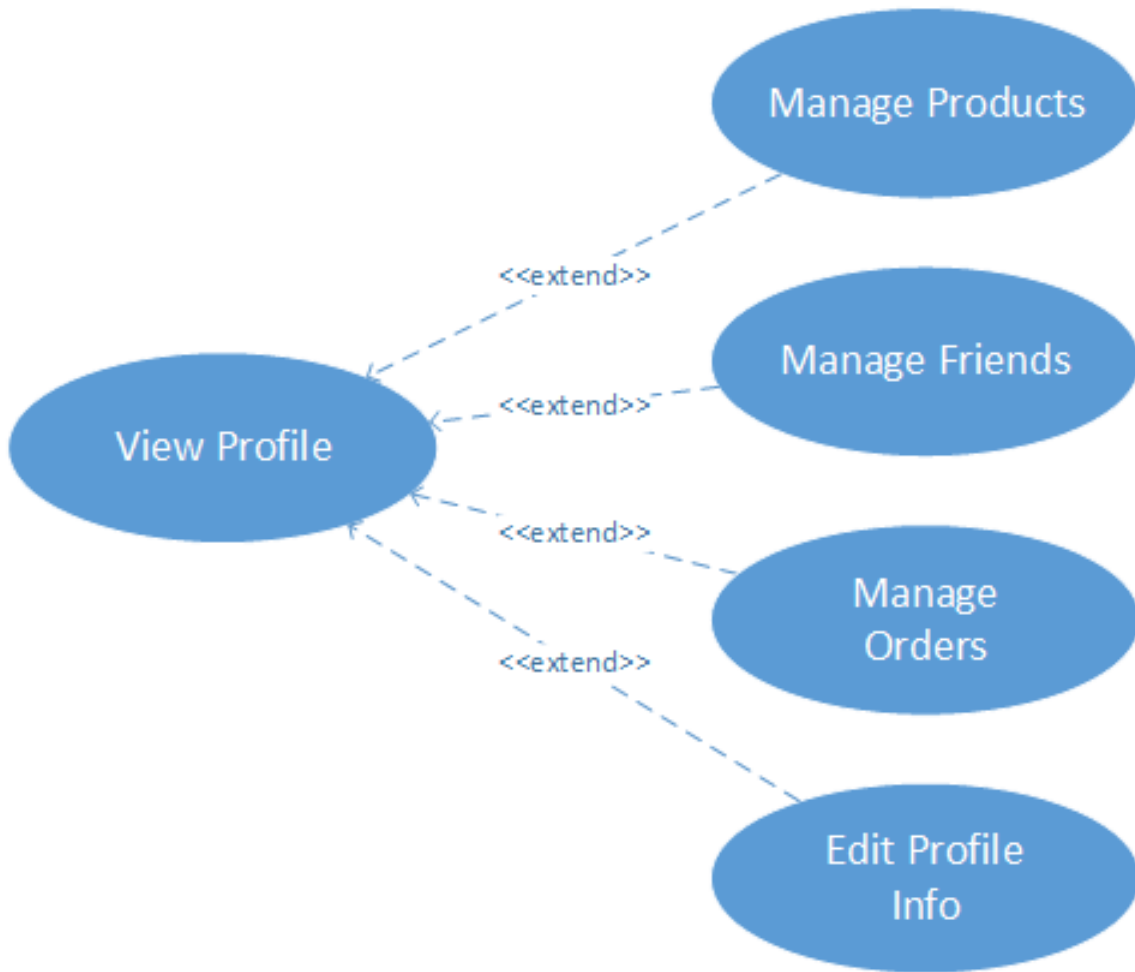
Illustration 7: UC - The Two Types of Users

**UC\_00: The Two Types of Users.** In this first Use-Case diagram are showed the two types of users who has different options. Both users can access social media sites, the mobile app store, the store page and also can subscribe. The Non-Registered user can also see all products that the website can offer and for further options he must register. The registered user except that he can have access to everything that the other user has can also buy products from the website. Then he can customize the product parts during purchase process. Also, there is a chance to contact to the customer support, but only if you are registered otherwise it will redirect you to the register page. The registered user can also have access to his personal profile page. More details for View Profile are shown in another UML's below.



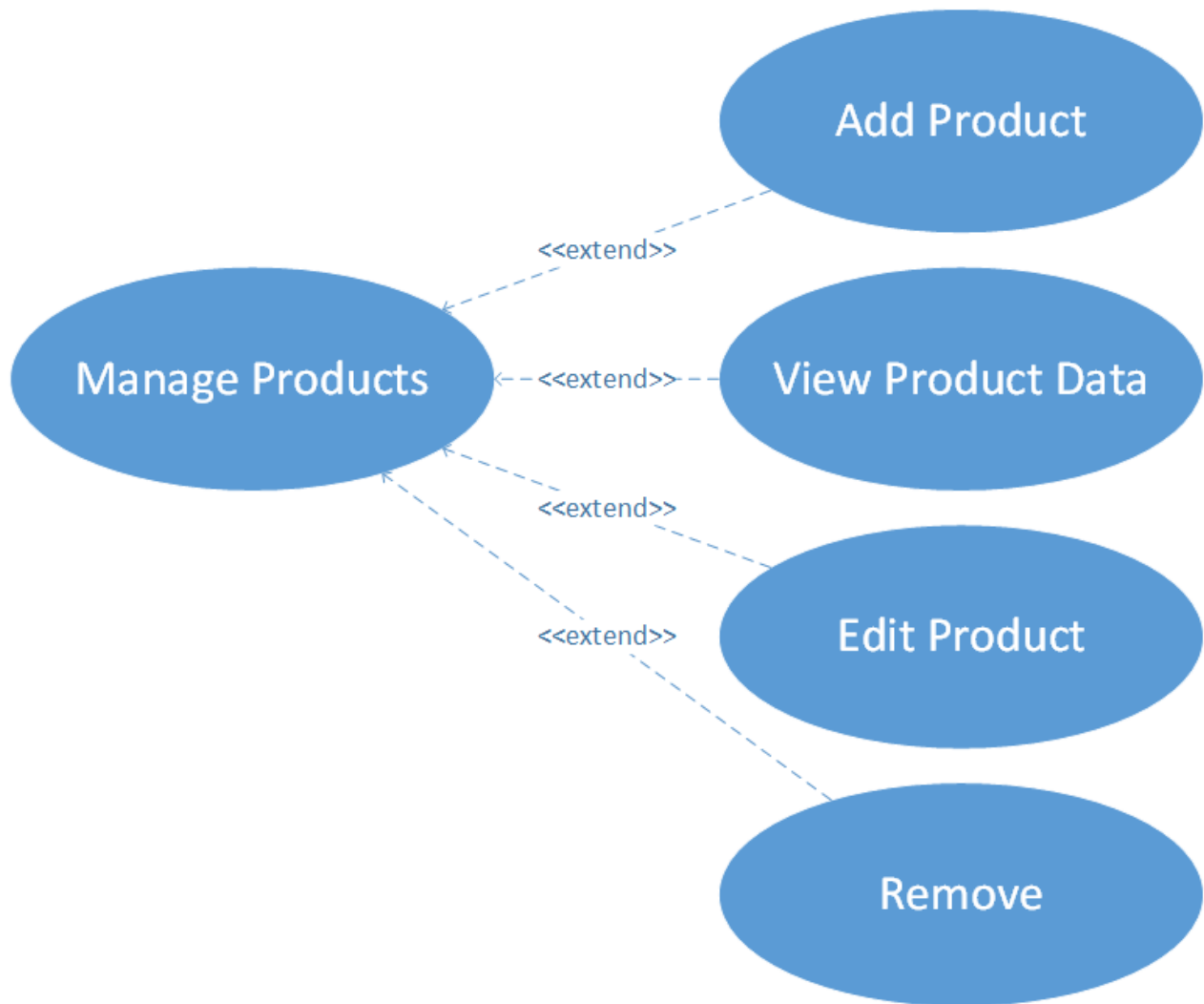
**Illustration 8: UC - Register**

**UC\_01: Register.** This diagram describes the different types of registration methods that the non-registered user can use. You can register through the website policy using your email and password. The other two ways are to link a Facebook or Google + Accounts if available for better utility.



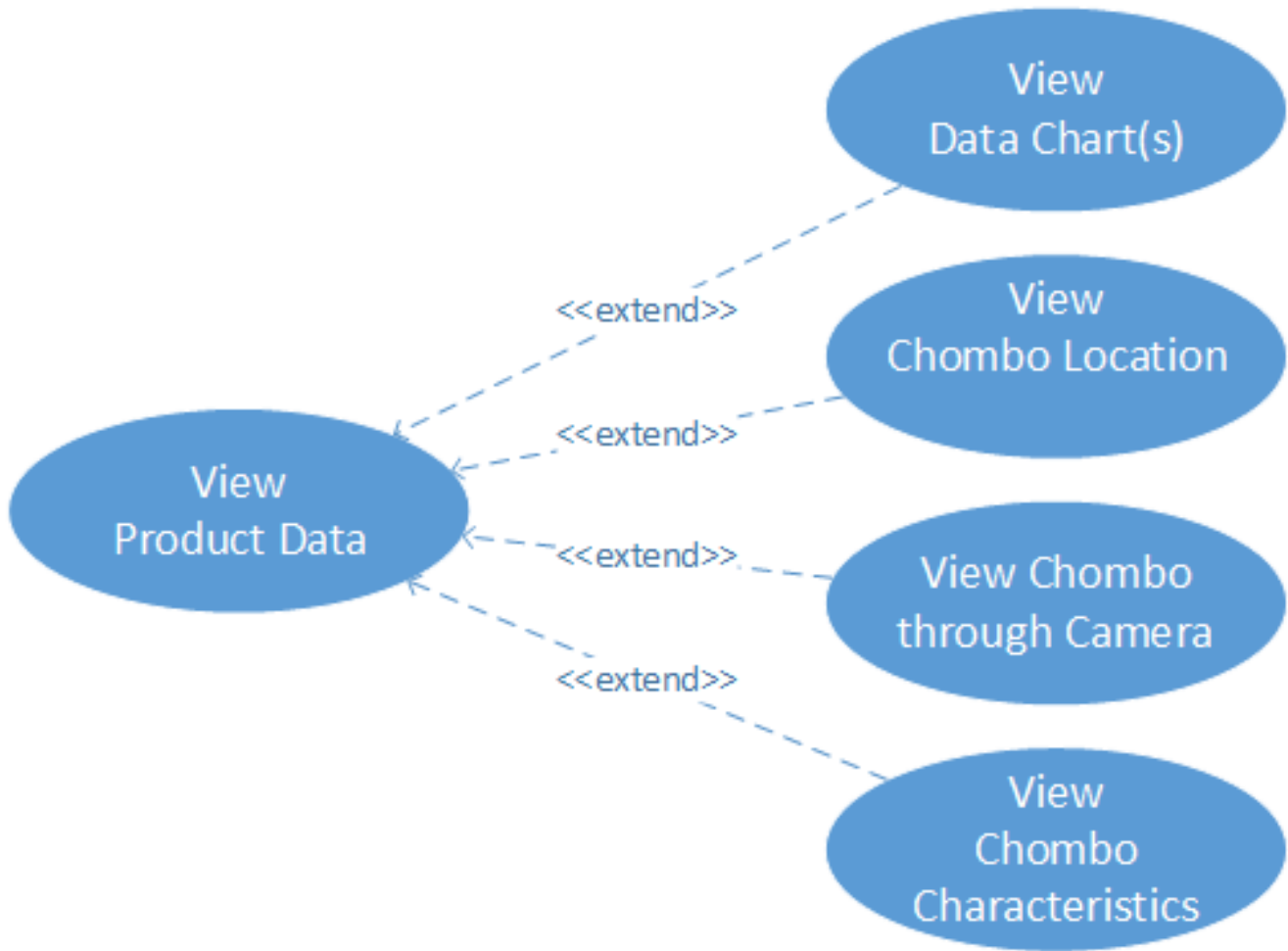
**Illustration 9: UC – View Profile**

**UC\_02: View Profile.** This diagram is referring to all the options available when the user is registered and the moment when he is logging in the website. Every time when you log in it automatically show you your profile page where you have different other semi options. The user can check his profile info and edit it anytime he wants. Also, it's possible to manage the products that the user has or don't have but have access to. Also, the user has access to orders tab where he can see all his orders and friends tab where he can have access to his friends. More details for the semi functionalities that were described above will be shown in another UML's below.



**Illustration 10: UC – Manage Products**

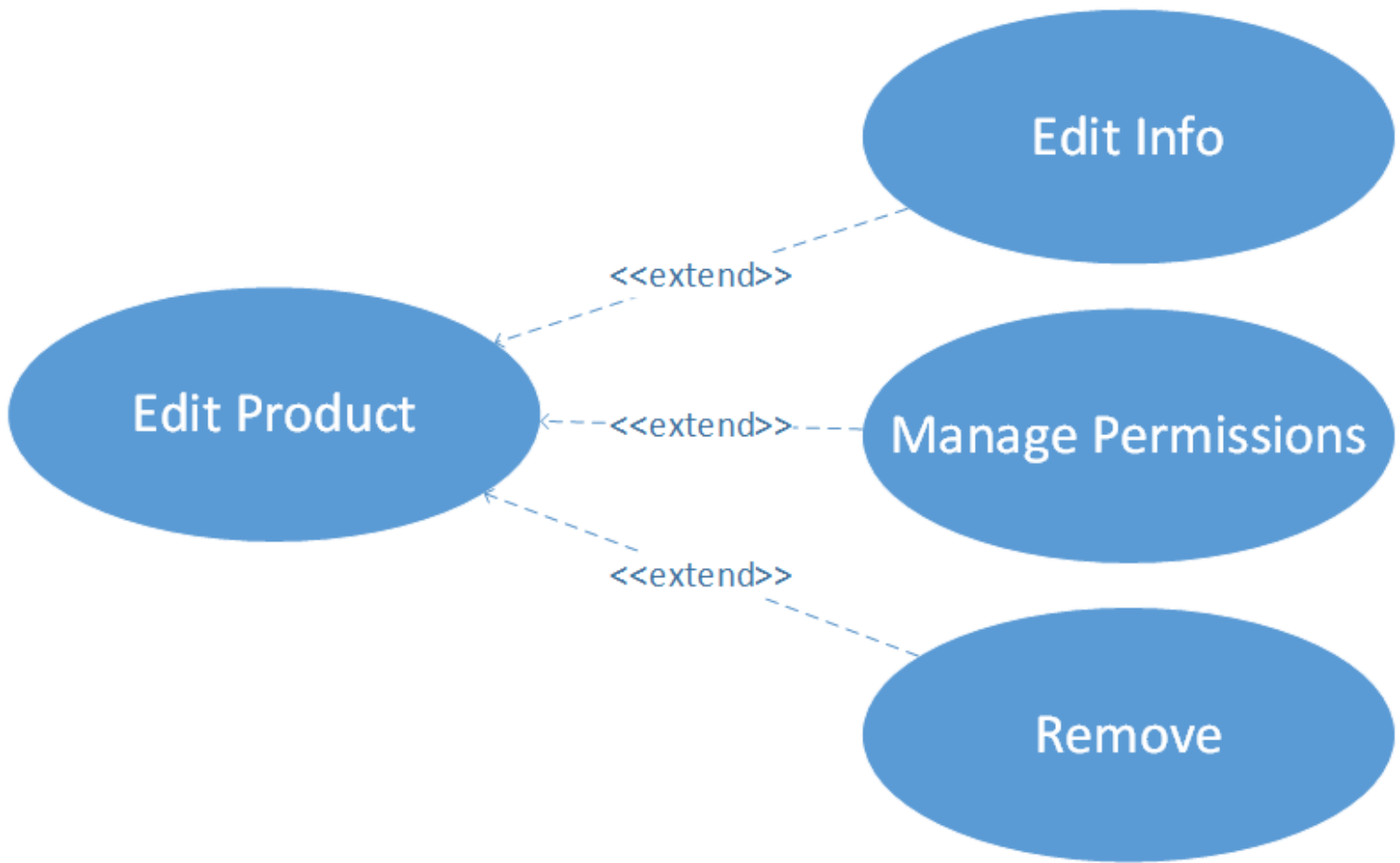
**UC\_03: Manage Products.** This diagram describes the options available for managing one chombo or certain amounts of chombos from the user. The user has the option to easy add a new product which means adding the product ID for the purchase. Also, the user can edit only his chombo/s. For every chombo there is also a product data available. The user can also remove the chombo if no longer desire to use it. To add it again in his profile he must use the product key. More information for product data and Edit Product will be shown in a UML's below.



**Illustration 11: UC – View Product Data**

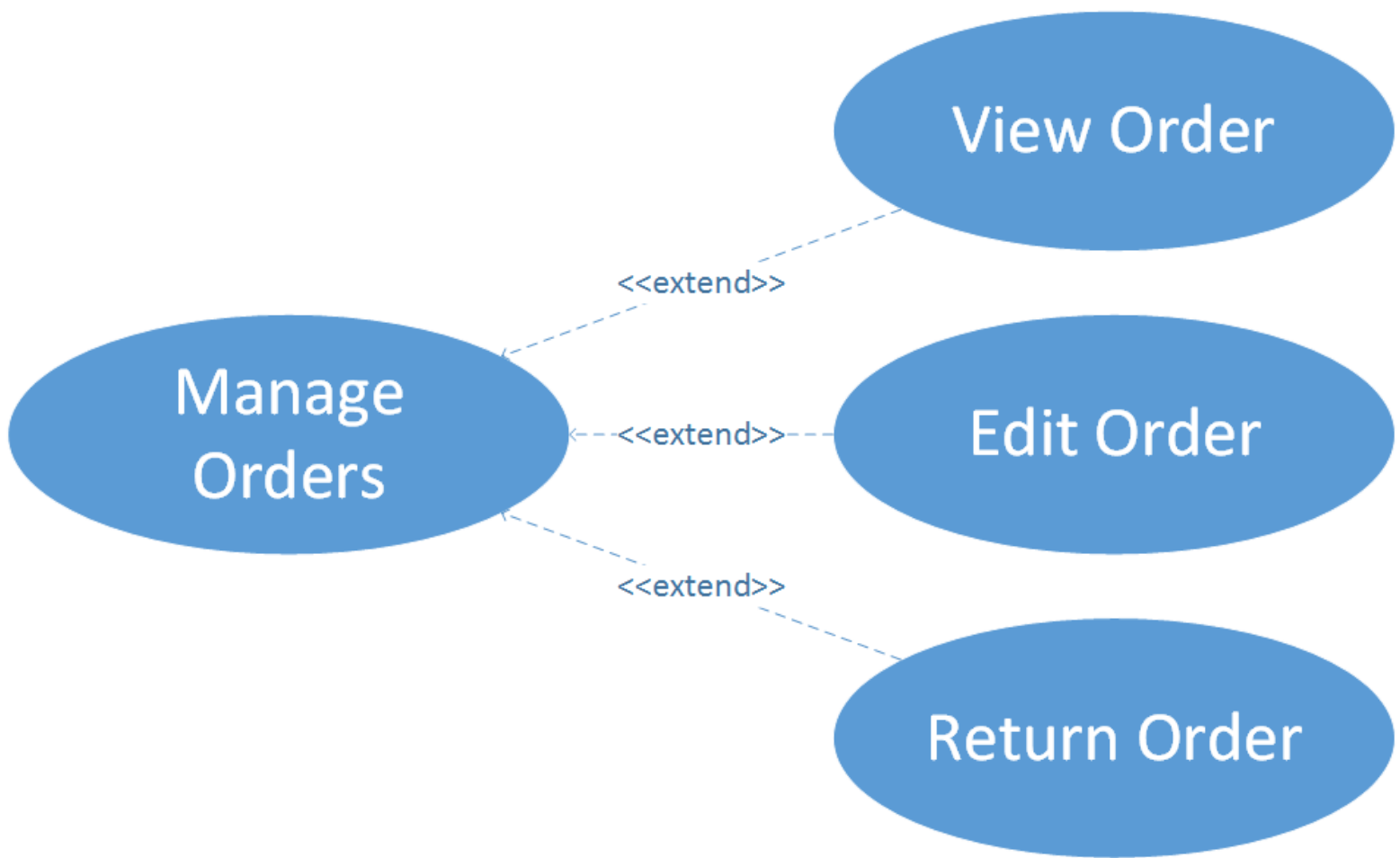
**UC\_04: View Product Data.** This diagram is referring to all the data available when the user enters his personal chombo or somebody else’s chombo that he has access to. There will be four tabs that the user can enter. The user can see historical data charts depending on the specific sensors that the certain chombo has or for example: humidity chart, light chart or pollution chart and other. On the next tab, the user can track the chombo location using the Google Map. On the third tab, the user can see the chombo through camera which can help to easy track the plant growth process. And on last place there will be characteristics for the chombo’s sensors which can show the values of a specific sensor more clearly and of course will give better tablature.





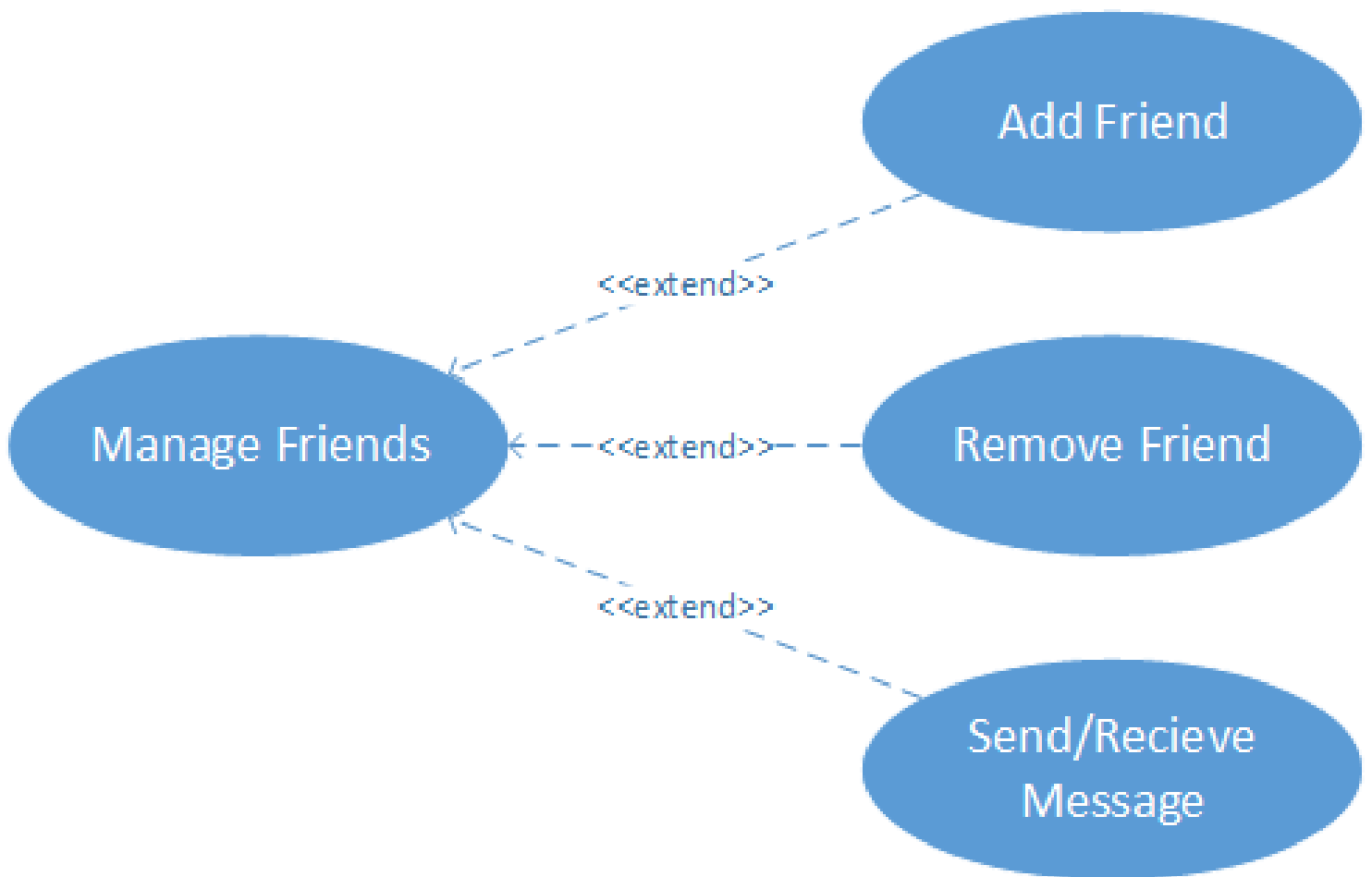
**Illustration 12: UC – Edit Product**

**UC\_05: Edit Product.** The user can edit the title of the chombo, write some description for the chombo, change the status of the chombo and can also set the permissions of a chombo for a public or a specific user from his friend list. The friend of the user can have certain permission which depends on the access level that is given to him. Also, if the user doesn't want to use the chombo anymore he can remove it.



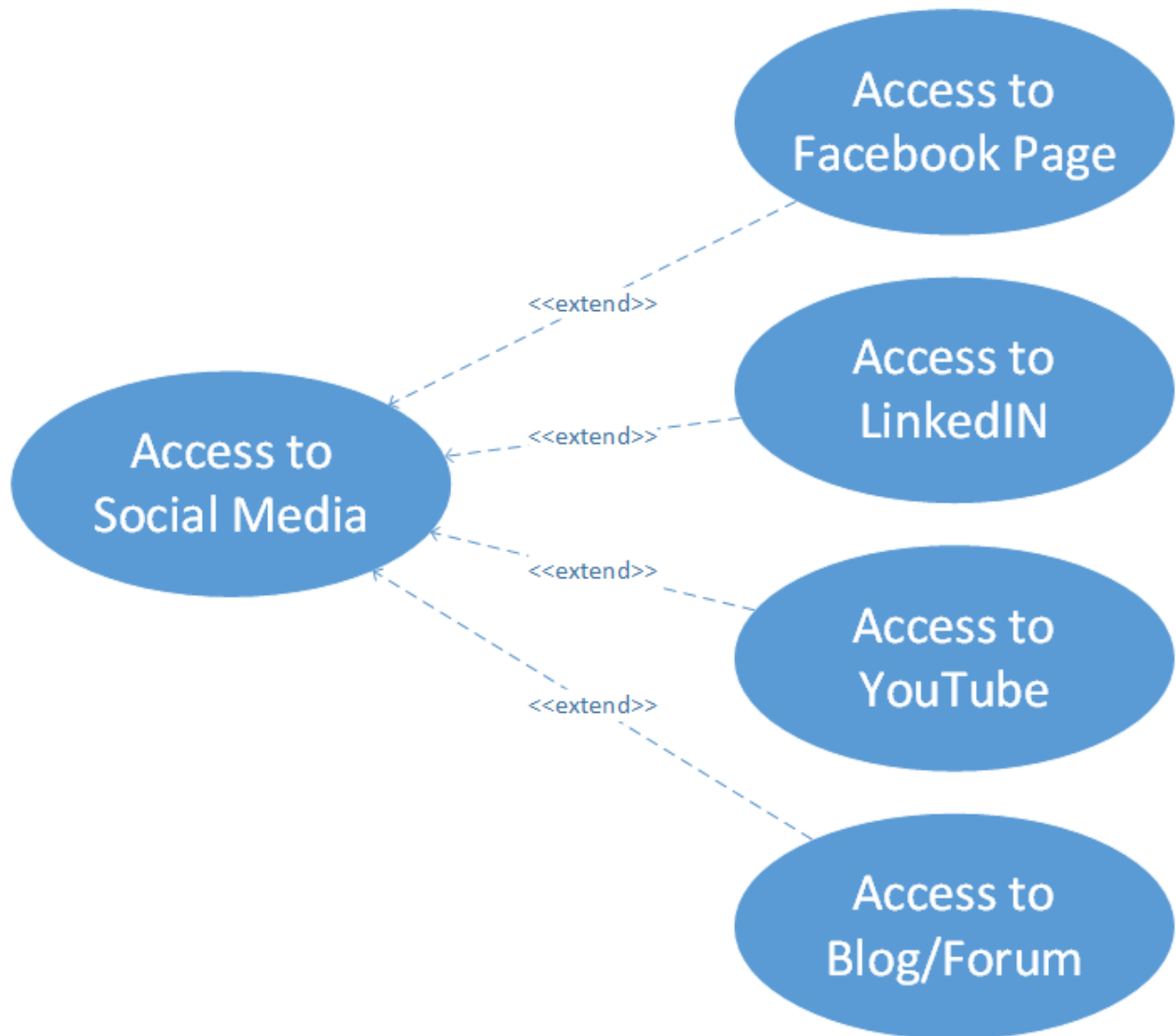
**Illustration 13: UC – Manage Orders**

**UC\_06: Manage Orders.** This diagram describes the order options in the order tab. Firstly the user can view only his own order history. Also, can return his order if the product is defective and is still under warranty, otherwise this option will not be available. Also, the order can be edited and then the user can change some details or just cancel the order which of course depends on the status of the order.



**Illustration 14: UC - Manage Friends**

**UC\_07: Manage Friends.** This diagram describes the different functionalities of the friends tab. The user can add new friend by email. Can also edit the friend's name or remove the friend if the user doesn't want to be in his friend's list anymore. Also, there is an option to send message to every friend or receive message from him which helps for better communication between two users.



**Illustration 15: UC - Access to Social Media**

**UC\_08: Access to Social Media.** This diagram defines the accesses that a user can have to different social media websites. The user can access to Facebook, LinkedIn or to the Blog/Forum for more information about the product or just finding new friends with the same interests or access to YouTube for video guides of how to use the product properly.

### 3.3 Tables of Functionalities

After describing and detailing the use cases, it is necessary to describe which functionalities the application should fulfill. The following is a series of tables that describe what each functionality consists of and the priority of each:

|                         |  |
|-------------------------|--|
| Number of Functionality | UC_00  |
| Name                    | The Two Types of Users / <b>Buy Product</b>  |
| Description             | The registered user must have the option to buy a product and customize the product parts during purchase process.               |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional |

**Table 2: Functionality - Buy Product**

|                         |   |
|-------------------------|---|
| Number of Functionality | UC_01   |
| Name                    | Register  |
| Description             | On the moment when the user wants to register in the website, is good to have the option to do it Except through the policy of the website, but also by linking accounts of social environments such as Facebook and Google + |
| Priority                | <input type="checkbox"/> High/Essential <input checked="" type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional  |

**Table 3: Functionality - Register**

|                         |  |
|-------------------------|--|
| Number of Functionality | UC_02  |
| Name                    | View Profile   |
| Description             | On the moment, when the user enters his profile he must have the option to manage friends, orders and products and the opportunity to edit his personal information. |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional                                     |

**Table 4: Functionality – View Profile**

|                         |   |
|-------------------------|---|
| Number of Functionality | UC_03   |
| Name                    | Manage Products   |
| Description             | The user must have the option to manage products considering add a product to the account, edit an owned product, access its data or remove it. |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional                |

**Table 5: Functionality - Manage Products**

|                         |   |
|-------------------------|---|
| Number of Functionality | UC_04   |
| Name                    | View Product Data   |
| Description             | On the moment, when the user clicks on a chombo that it's owned or chombo that he accesses to, must redirect to page with the data of the product. There the user can see data charts for specific sensors that a certain chombo have, location of the chombo in map, camera to see the chombo live and characteristics for the sensors that the chombo owns. |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional  |

**Table 6: Functionality - View Product Data**

|                         |   |
|-------------------------|---|
| Number of Functionality | UC_05   |
| Name                    | Edit Product  |
| Description             | On the moment, when the user edits an owned chombo should be able to edit the chombo's info like title, description, also should be able to change status of chombo and change permissions or just remove the chombo. |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional  |

**Table 7: Functionality - Edit Product**

|                         |  |
|-------------------------|--|
| Number of Functionality | UC_06  |
| Name                    | Manager Orders   |
| Description             | As soon as the user clicks on the Orders tab, you must have the option of seeing an order, editing it, canceling it, and changing the details or being able to bring it back before the expiration date. |
| Priority                | <input checked="" type="checkbox"/> High/Essential <input type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional   |

**Table 8: Functionality - Manage Orders**

|                         |  |
|-------------------------|--|
| Number of Functionality | UC_07  |
| Name                    | Manager Friends  |
| Description             | As soon as the user clicks on a friend's tab, he must have the option to add a friend, edit an existing friend, for example, change friend's name, send a message to the friend or simply delete the friend from the list. |
| Priority                | <input type="checkbox"/> High/Essential <input checked="" type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional   |

**Table 9: Functionality - Manage Friends**

|                         |  |
|-------------------------|--|
| Number of Functionality | UC_08  |
| Name                    | Access to Social Media   |
| Description             | The user can have the option to have access to the social media pages of the website like Facebook, LinkedIn, Blog/ Forum and YouTube for additional guides. |
| Priority                | <input type="checkbox"/> High/Essential <input checked="" type="checkbox"/> Medium/Desired <input type="checkbox"/> Low/Optional                             |

**Table 10: Functionality - Access to Social Media**

### **3.4 Conclusions**

This section has reviewed in depth the functionalities and their priorities in the application. The diagrams were described stepwise, starting from the first moment when the registered user enter the website – login and goes inward the system. Also, each one of the nodes that are connected to the view profile are analyzed in depth. There is also revealed the other type of user: the non-registered one and the accesses that are available for him before he registers. This whole depth analysis helps us to easy construct our developing plan when building the application later.

After this, the functionalities were fetched from above and were given to them level of priorities. The buying process is the key aspect of this project so it has the highest priority. A functionality that is connected to this one is the Manage Orders functionality which also has the high. The other functionalities should be implemented after this one depending on their priority. As shown there is no low priority, but this doesn't mean that all of the functionalities will be fully developed on the first version of the web application.



## 4. System Design

### 4.1 Introduction

From the last two sections, we clearly understood what the website is for and the functionalities that are good to be implemented giving us an idea of how the application should work.

The next section is to determine what can be the design of the website in visual and technical aspect. One of the most important purposes that is directly connected with the visual of the website is that the application must have a responsive design. This would definitely provide great convenience for the user, because it can be opened from many different devices. The other very important thing is to have very simple and clear design so it can be easy to use by the user which will definitely attract the attention otherwise it will lead only to dissatisfaction.

Thereafter the conceptual specification reveals the architecture of the whole system and depict how it works. This project is part of this whole “Chombo” system and every specific part of this system is developed by other students.

After this, in the formal specification is defined the design of the project, which uses the three-layer architecture (data, business and presentation layer).

### 4.2 Conceptual Specification

In this section, we will conceptually introduce the structure that forms the whole system. The system has deliberative control that make up the communication between the server and the pots, as well as the pots with each other. The function of this project is to contribute with an intelligent control layer (supervision by the user).

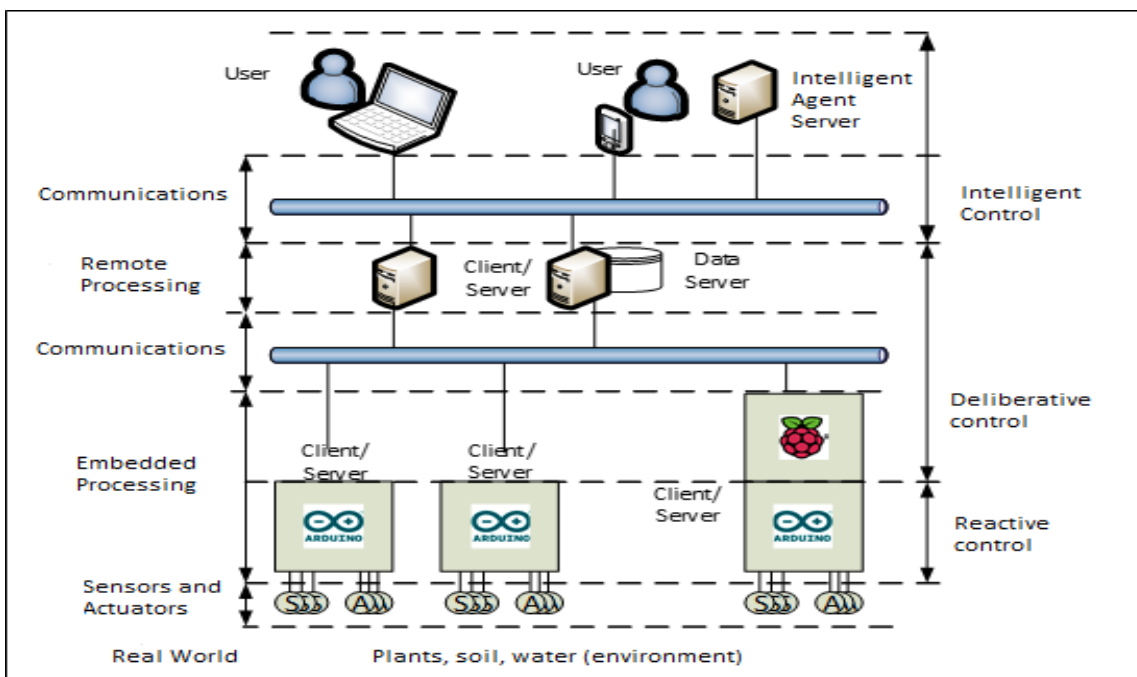


Illustration 16: Architecture of the System

In the illustration above is shown the structure of the whole system that this project takes part of. At the bottom part are depicted the chombos that are connected in the system. Each of them has a series of sensors and actuators that are connected to them. Every time when there is change in the chombo behavior by variation in the environmental values (humidity, light, pollution) measured from the sensors or change in the state of the actions (watering, illumination, movement) from the actuators, all this data is being sent to the servers. After the data is received, it can be easily accessed by the user. The part of our project is the communication between the user who is using the computer and the servers or more precisely the upper left side that is illustrated in the picture.

As mentioned above, this project is part of the "Chombo system" and every part of the project is developed separately by different students. The idea of this project is offered from the teachers in UPV.

### **4.3 Formal Specification**

For the overall design of the application has been chosen the Three-Layer Architecture. This software is divided into 3 different layers: Data layer, Business Layer and Presentation. Each layer is developed and maintained as an independent layer. To make a good design you must carefully define each of the layers. In this case the most important layer is the business layer, but that does not mean that the others should be left out. Each layer of the architecture is detailed below.

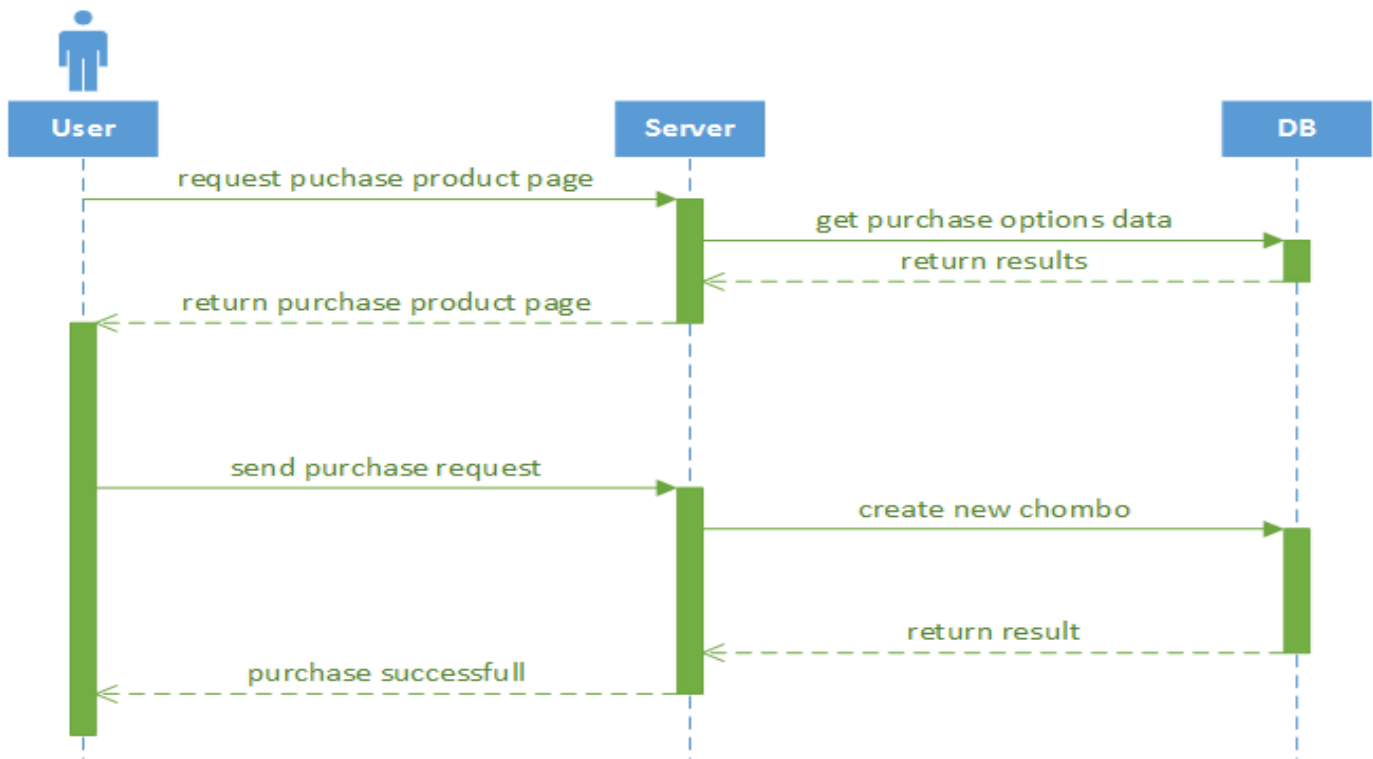
#### **4.3.1 Data Layer**

This tier consists of database servers. It can be accessed through the business layer and on occasion by presentation layer. Here the information must be stored and retrieved. This layer should keep data neutral and independent from application servers or business logic. Data maintenance should be maintained with backup and recovered. Access to compilation of queries should be optimized, with indexing or replication of tables. Giving data, its own layer also improves scalability and performance.

#### **4.3.2 Business / Logical Layer**

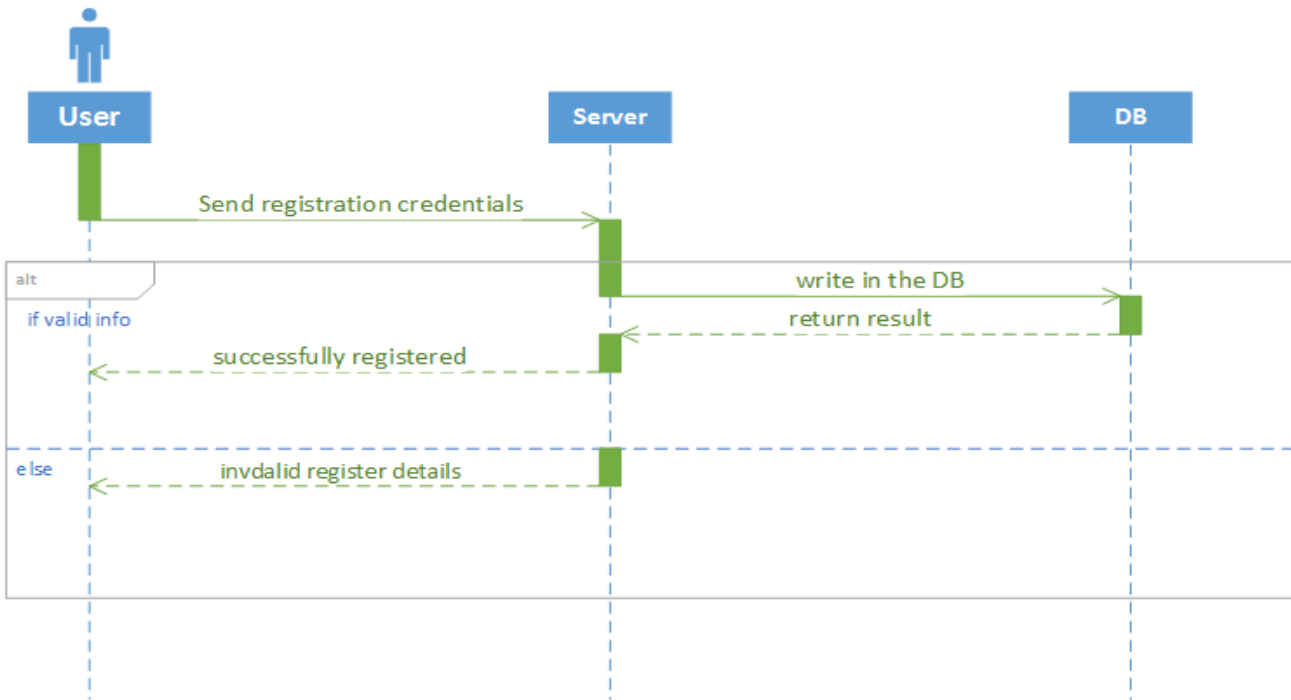
The most important thing in the web application is to offer the user the opportunity to purchase a product and manage it. The store page can offer the user a choice between variety of products. When the user decides to purchase a product, he have the option to customize it to his likings. After the product is delivered the user can register it in his profile. There can manage the chombo by editing its details or change its permissions. The user can also view the chombo's personal product data like sensor data, position, camera or characteristics.

The following sequence diagrams represent the workflow of some of the main functionalities of the web application.



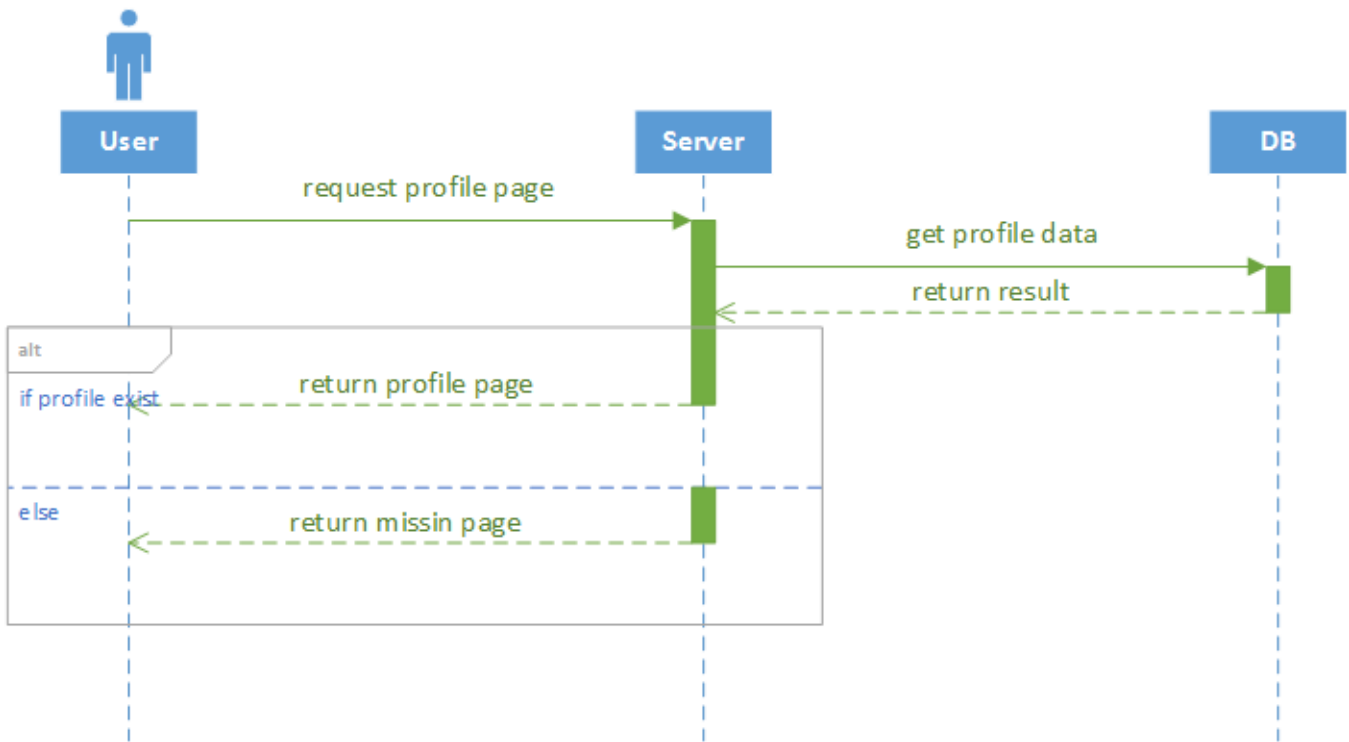
**Illustration 17: Sequence - Buy Product**

This diagram reviews the purchase product functionality. When the user enters purchase product page he sends a request to the server. Then the server send request to the database to get the purchase options data. The database returns a result and then the server returns the page to the user. After this when the user fills all the customizations and wants to submit he send a purchase request. The process is the same as the last one, but this time the server returns a message that the payment is successful. It's important to know that unregistered/unlogged users are not allowed to access the purchase process page.



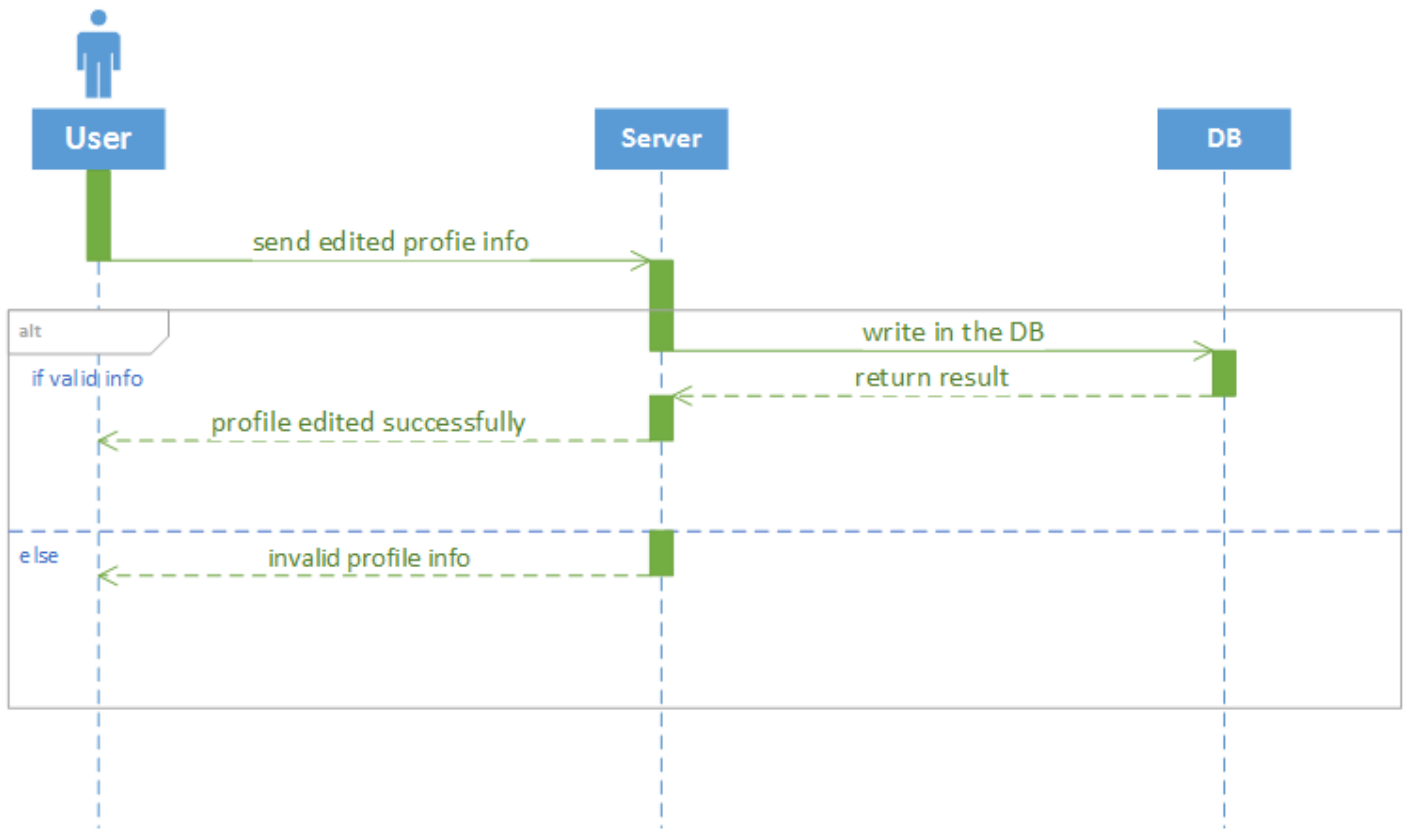
**Illustration 18: Sequence - Register**

This first diagram reviews the register function. There are two cases. For the first case if the information is valid - every time when the user fills the register form and submit it he sends the credentials to the server. Then the server sends the data in the database. Then it sends back a result to the database and the server returns a message to the user that he is successfully registered. In the other case if the user input invalid information that is required or the username already exist the server sends back message to the user that the details are invalid and he's not able to register.



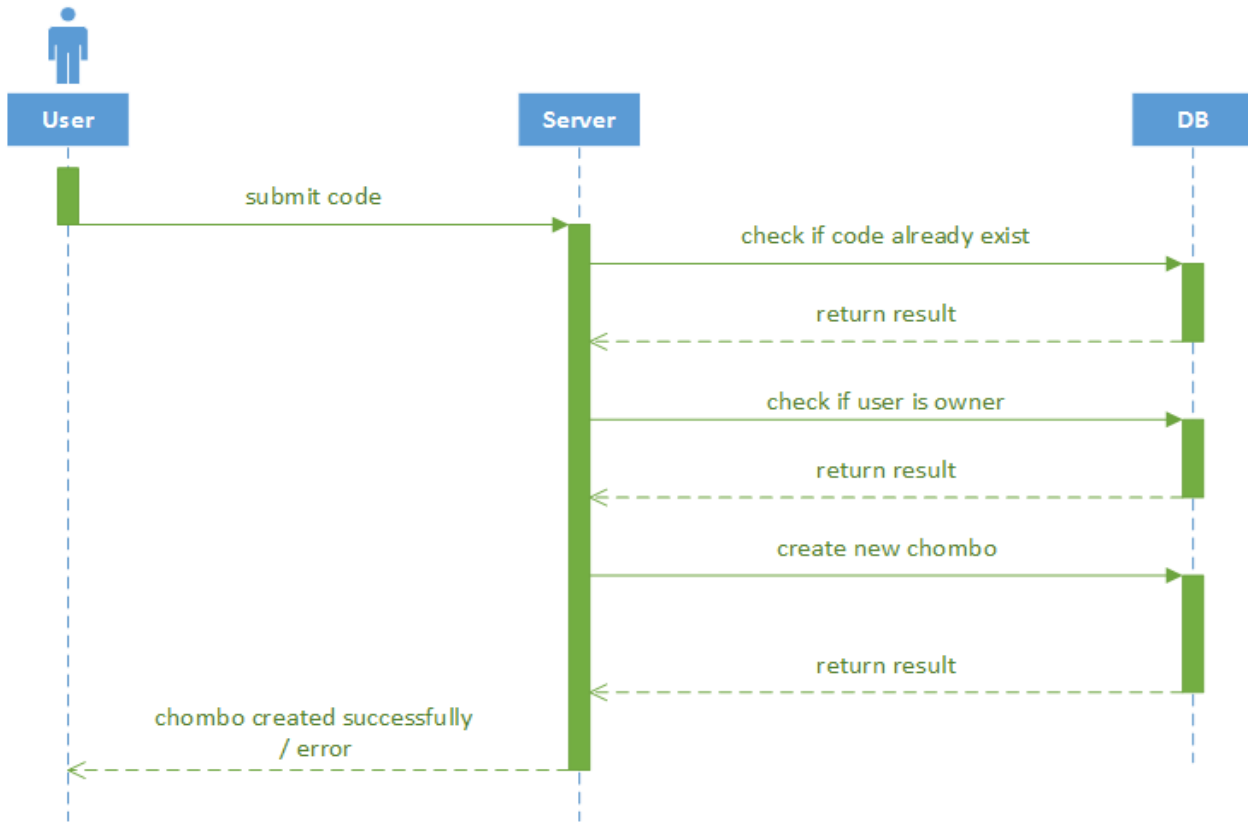
**Illustration 19: Sequence - View Profile**

This diagram reviews the view profile function. When the user enters in a friend’s profile he sends a request to the server. Then the server makes a request to the database which checks for the profile data. Then the database returns result. After this there are two cases. If the profile exist the server returns the profile page to the user. If not, then it returns an error that say that the page is missing.



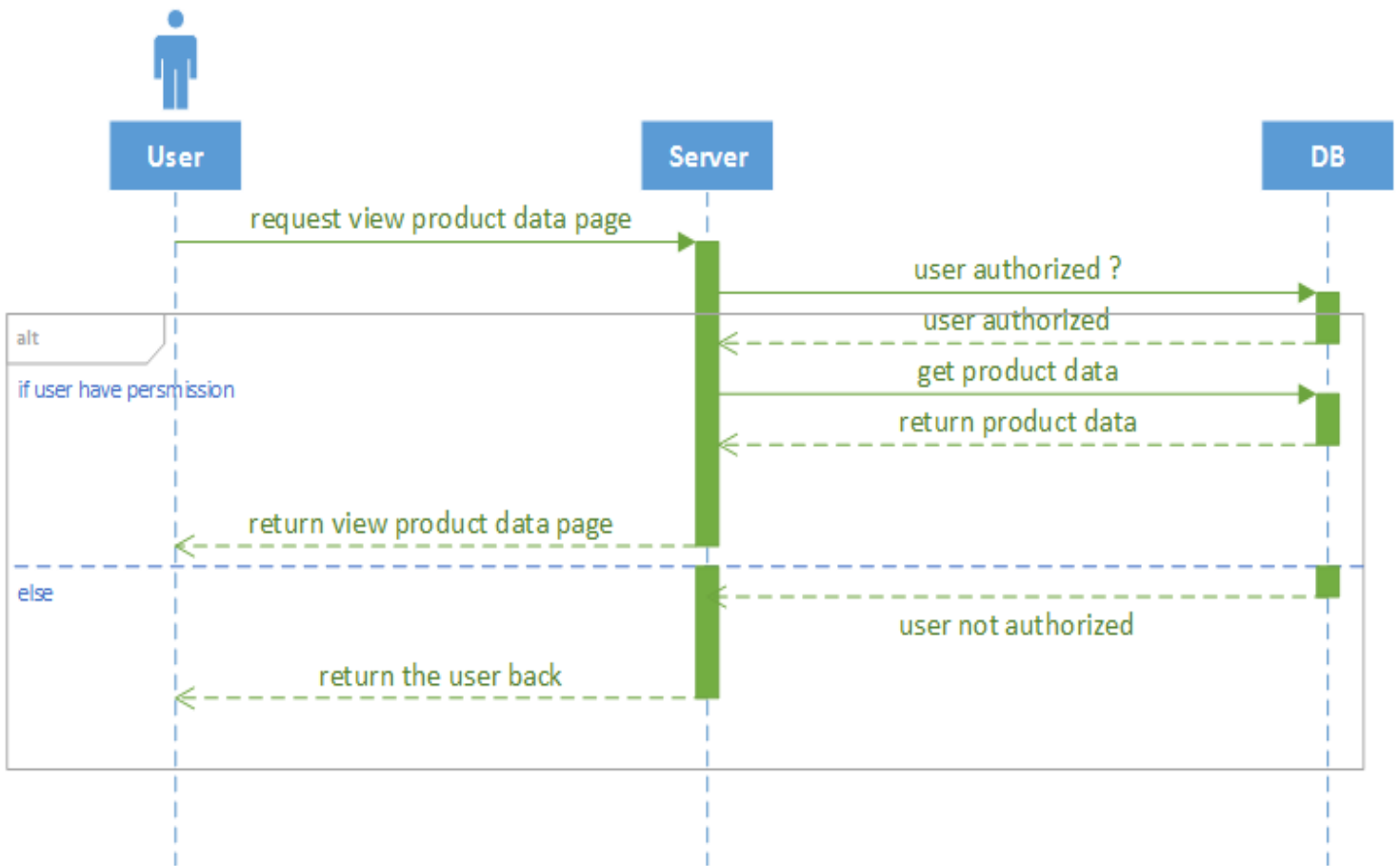
**Illustration 20: Sequence - Edit Profile Info**

This diagram reviews the view profile edit function. When the user edits his profile info he sends a request to the server. Then the server sends a request to write the changes in the database. Then the database returns the result. After this there are two cases. If the profile info is valid the server sends a message to the user that profile is edited successfully. If not, the server sends a message to the user that says the profile info is not valid.



**Illustration 21: Sequence - Add Product**

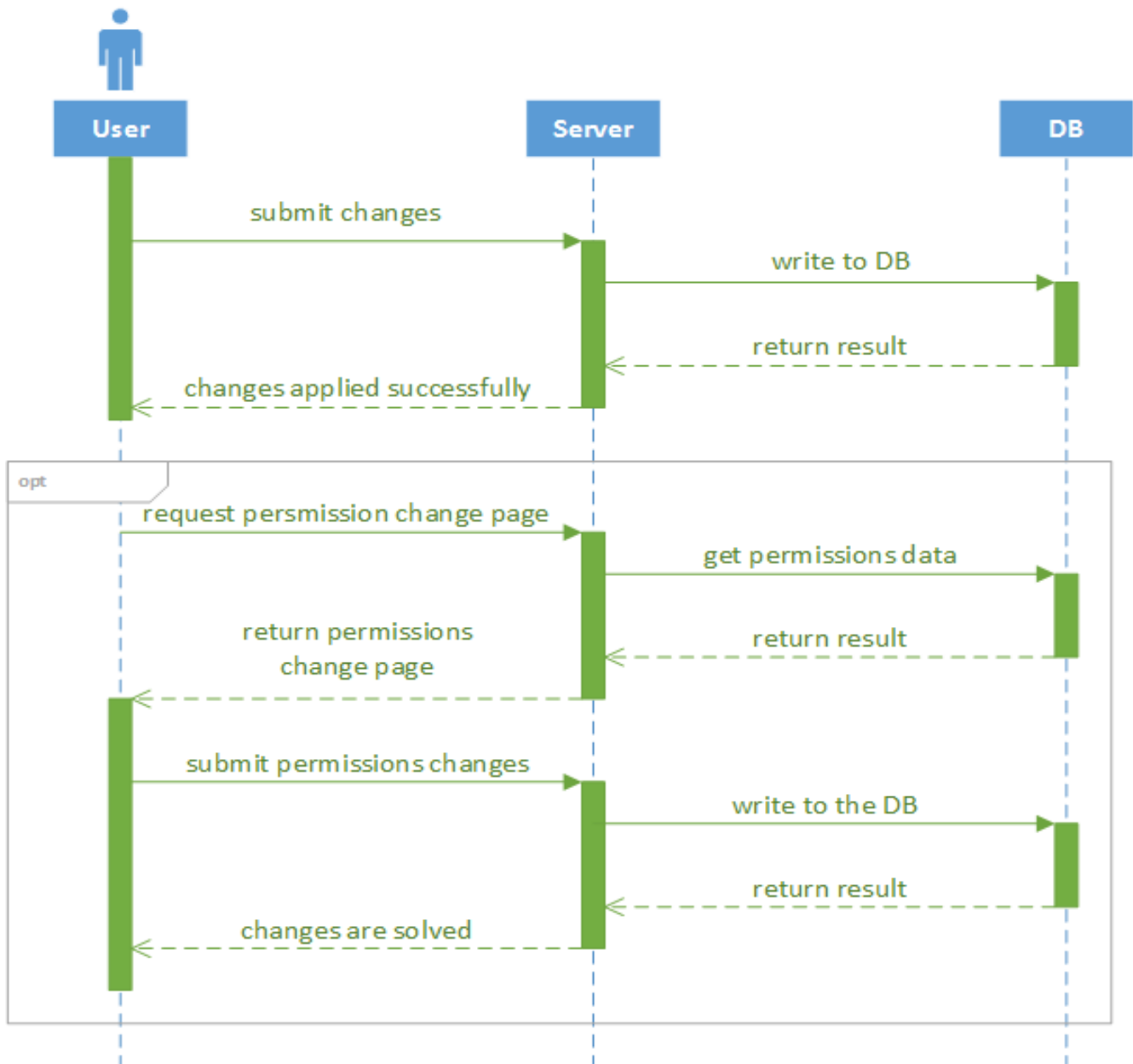
This diagram is associated with the managing of a products or more precisely add a product. After the user has bought the chombo and he got the key, he adds it to his profile. When he submits it, he sends request to the server. Then the server makes a request to the database which checks if this code already exists. If the code didn't exist then the user is redirected back to his profile page. If exist then send a result to the server. Then the server makes a new request which checks if the user is the owner of this code. If owner, then return result to the server. Then the server sends a new and final request to create new chombo. The database return result to the server and the server send a message to the user that the chombo is added successfully.



**Illustration 22: Sequence - View Product Data**

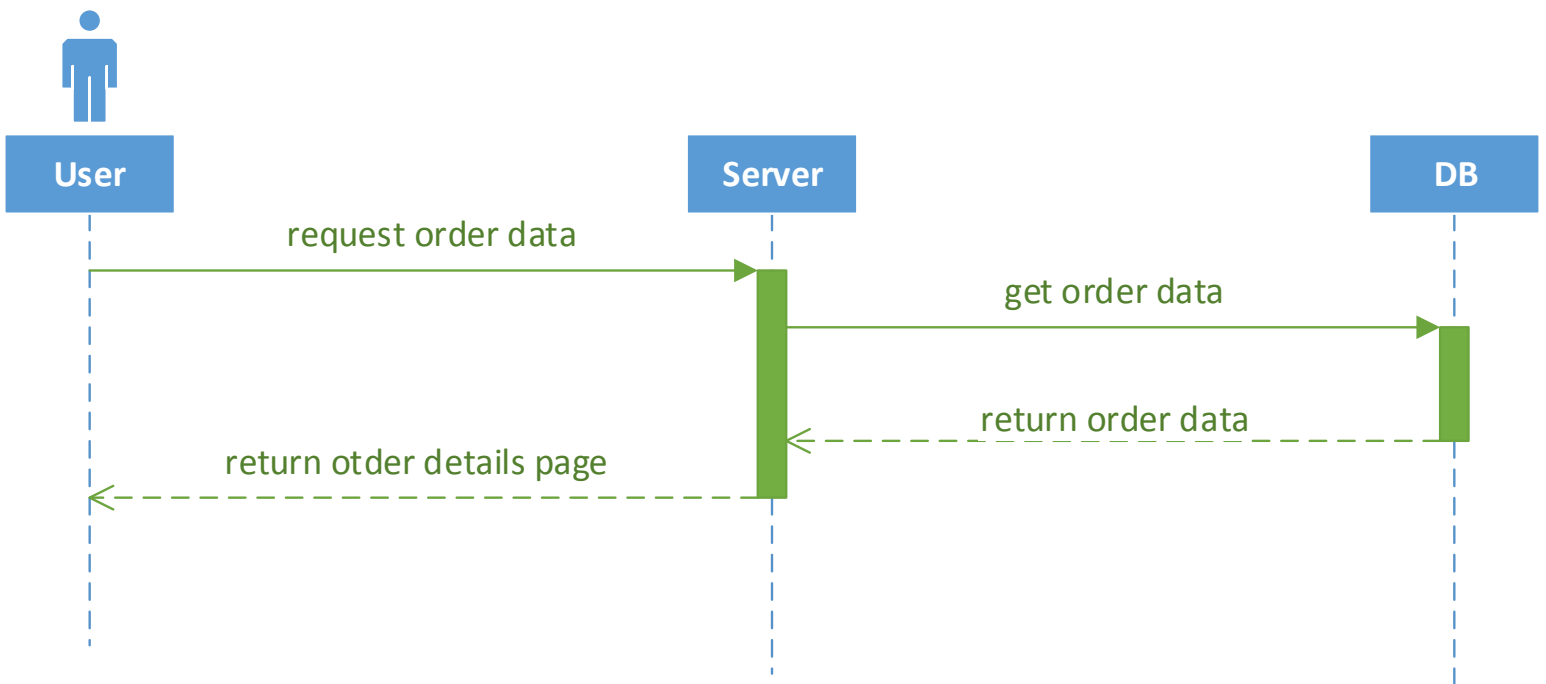
This diagram is associated with the managing of a products or more precisely view product data for a product. When the user enters the product data page he sends a request to the server. Then the server makes request to the database which checks if the user is authorized to view the data. This check is general which means that it doesn't matter if the user is owner or not an owner. There are two cases. If the user is authorized the database returns a result to the server. Then the server makes a new request to the get the product data for the combo. The database returns result to the server and the server sends back the page of the product. If the user is not authorized, he is returned to the previous page.





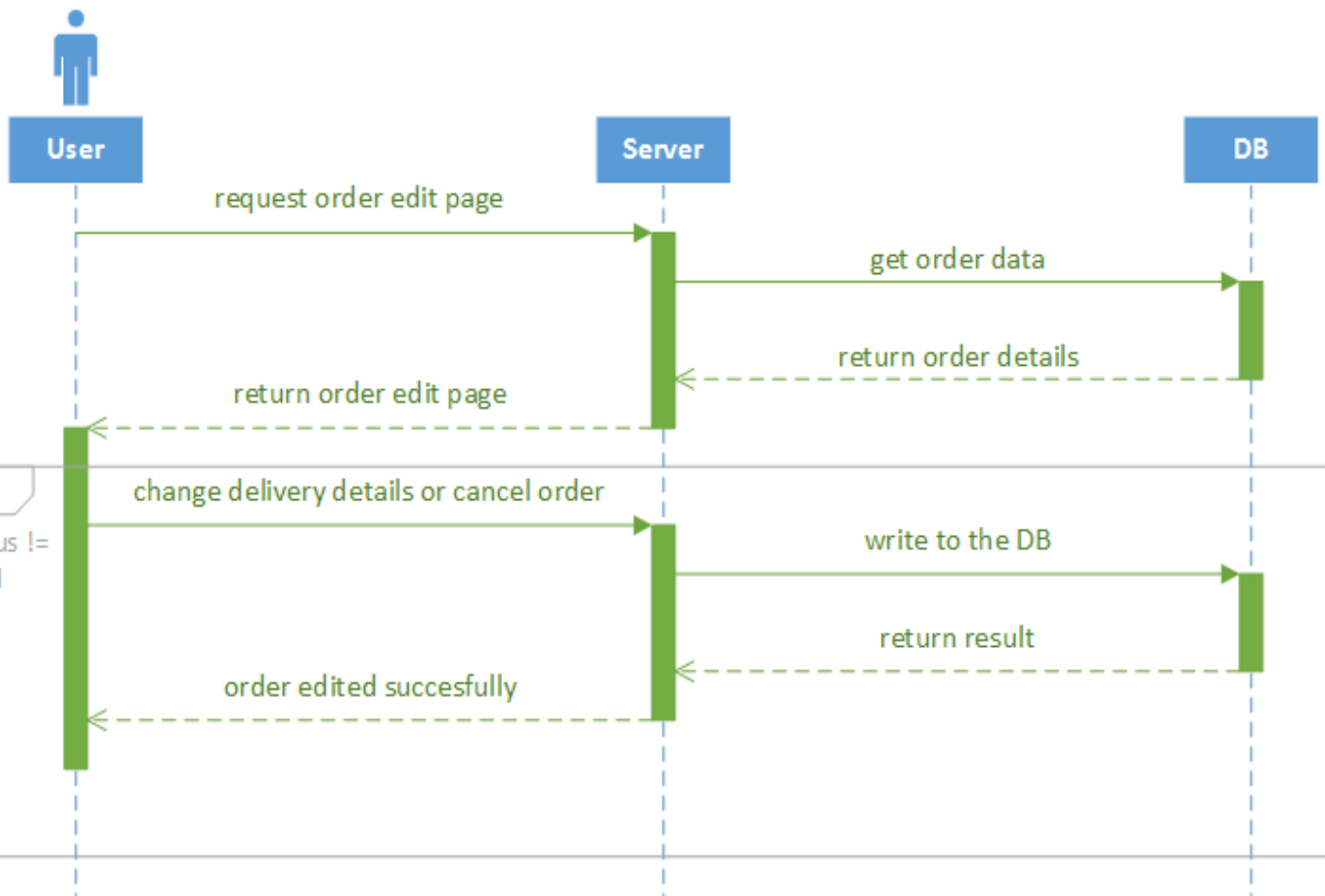
**Illustration 23: Sequence - Edit Product**

This diagram is associated with the managing of a products or more precisely edit a product. When the user edits some information of the chombo he sends a request to the server. Then the server sends request to write the changes in the database and then the result is returned. The server sends a message to the user that the changes are successfully applied. An optional case is if the user wants to change the permission of the chombo when he edits it. A request is again sent to the server. Then the server makes request to get the permissions data. The database sends results back and the server send the permission change page. If the user submits the permission changes they process the same way as the edit process.



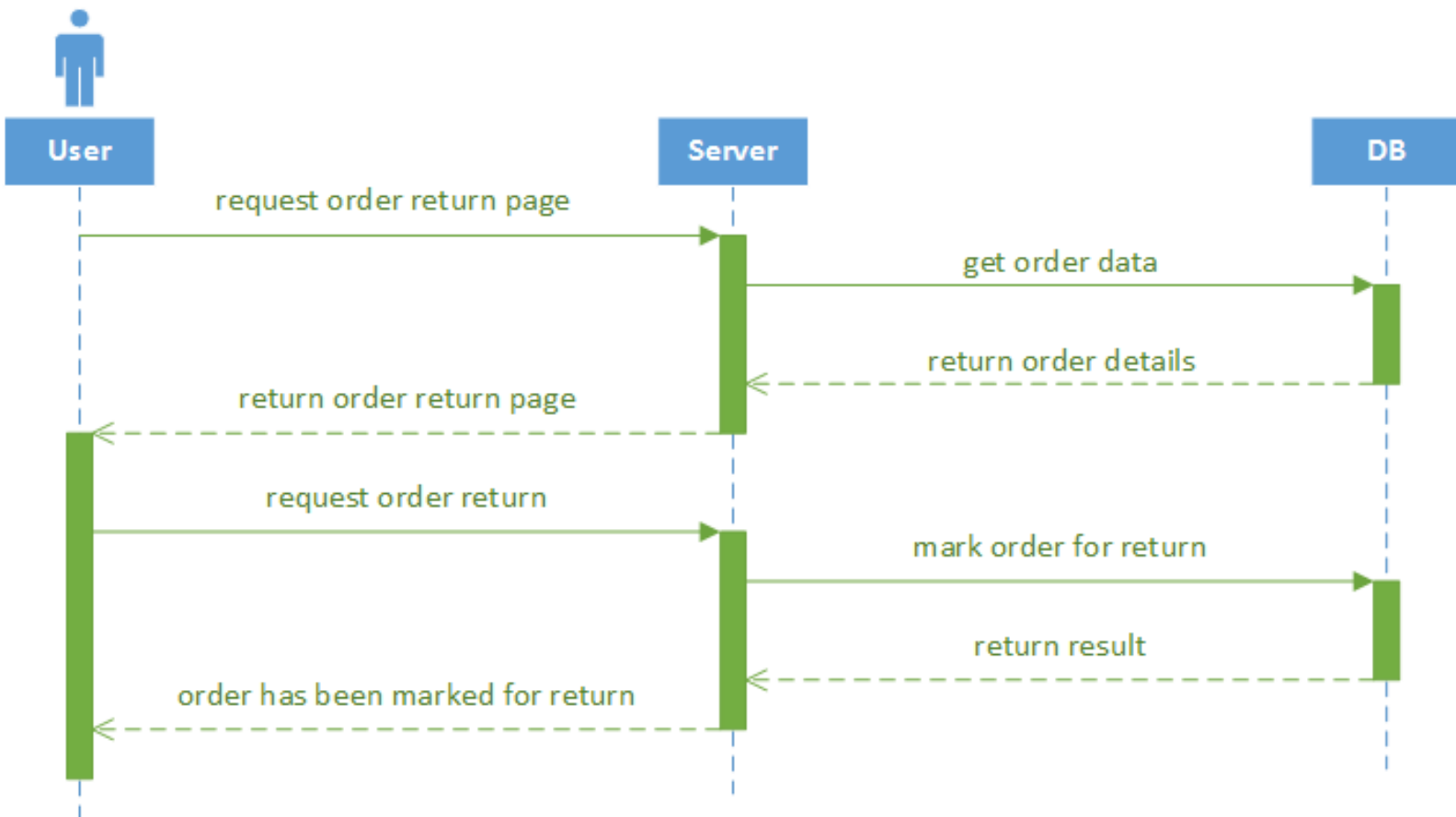
**Illustration 24: Sequence - View Order**

This diagram is associated with the managing of orders or more precisely view a specific order. When the user wants to view his order, he send a request to the server. Then the server makes a request to the database to get the order data. Then the database returns the order data and then the server sends the order details page to the user.



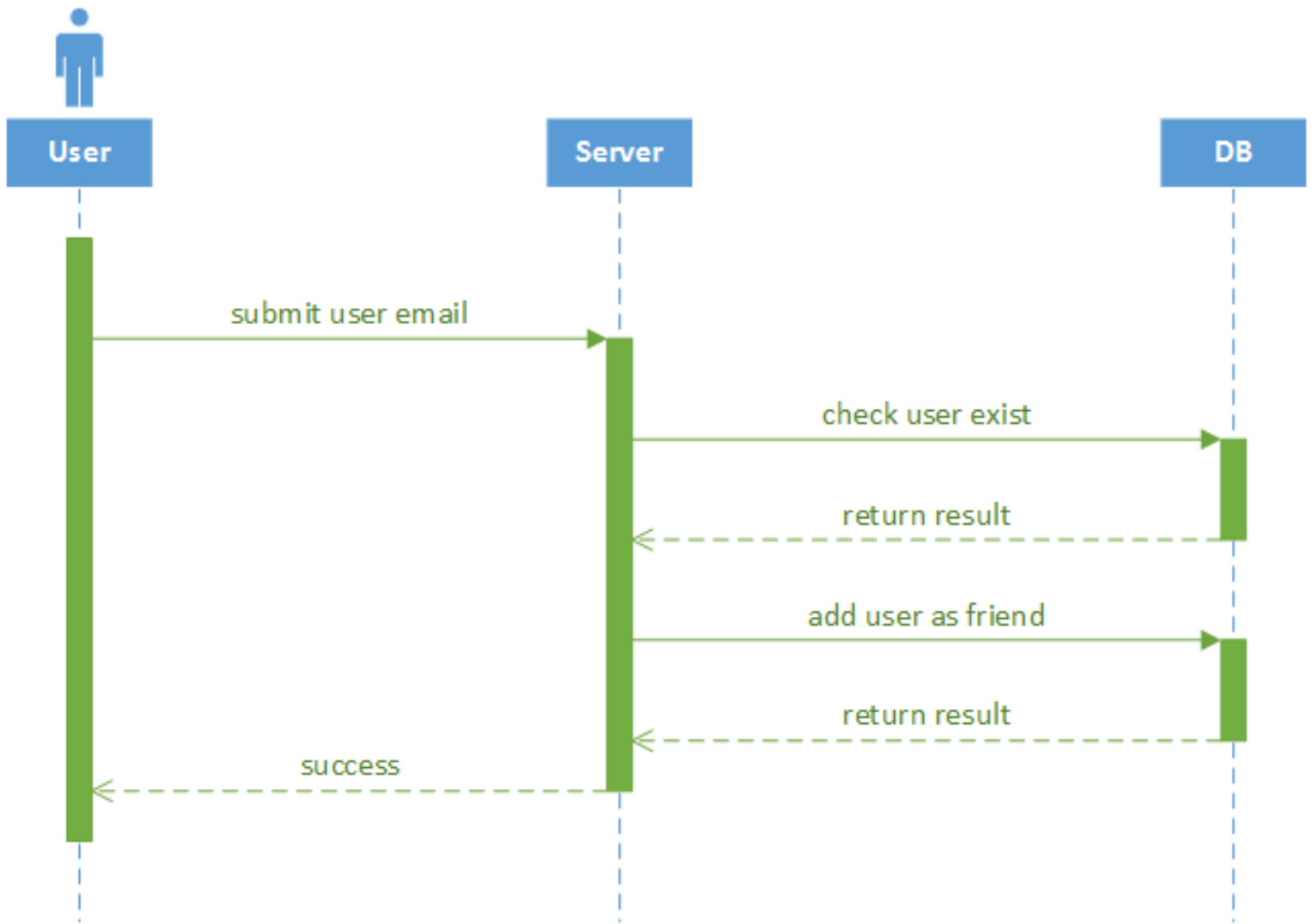
**Illustration 25: Sequence -Edit Order**

This diagram is associated with the managing of orders or more precisely edit an order. When the user enters the edit order page he sends a request to the server. Then the server makes a request to get the order data. The database returns the details of the order and the server sends the order edit page to the user. There is an optional case if the user wants to change delivery details or cancel an order. If the user submits the changes they process the same way as the edit process. Is important to know that this case can be active only if the order status is not completed.



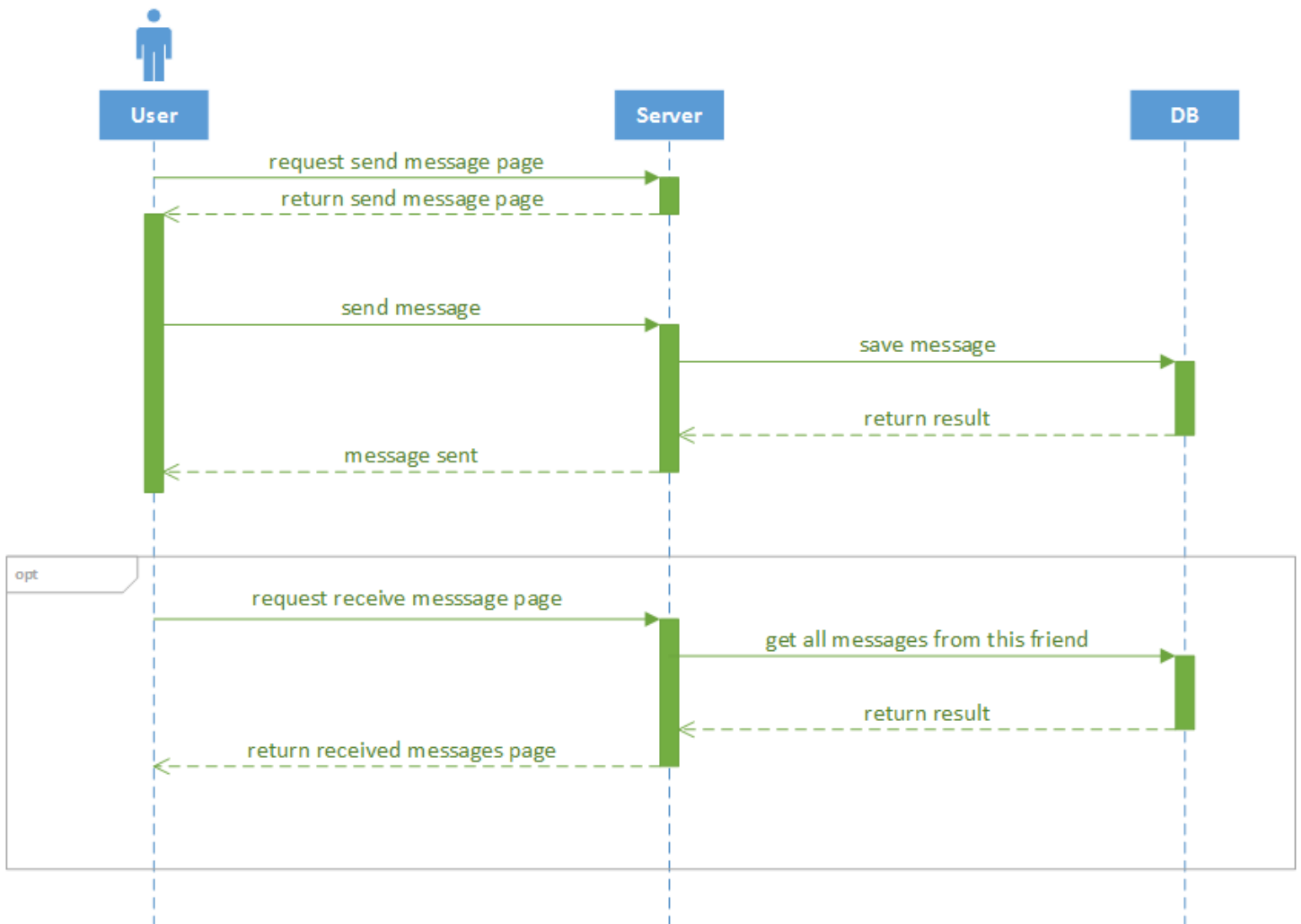
**Illustration 26: Sequence - Return Order**

This diagram is associated with the managing of orders or more precisely return an order. When the user enters the return order page he sends a request to the server. Then the server makes a request to get the order data. The database returns the details of the order and the server sends the order return page to the user. After this the user sends a request for order return to the server. The process the same as the previous process, but this time the server returns a message to the user that order is successfully marked for return.



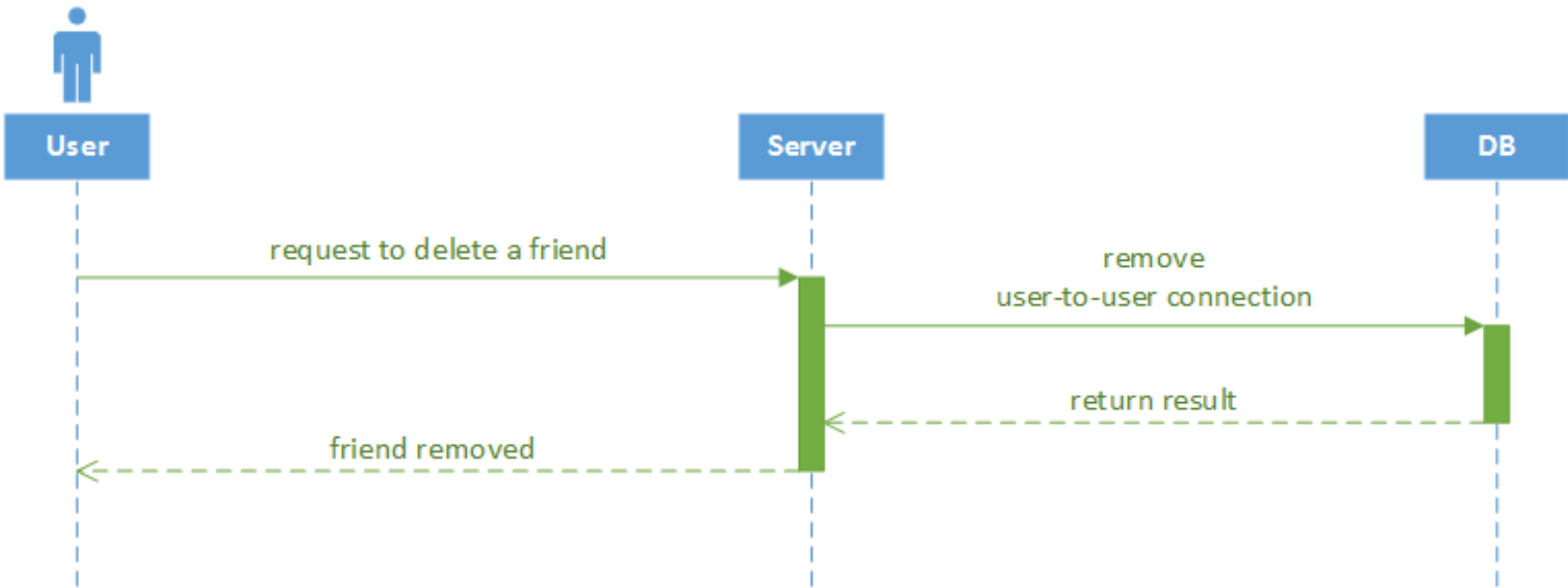
**Illustration 27: Sequence - Add Friend**

This diagram is associated with the friend managing or more precisely adding a friend. When the user wants to add a friend via email he sends a request to server. Then the server a request that checks if the user exist. If yes, then send back a result to the server. Then the server makes a new request to the database to add the founded user as friend. The database again sends back a result and the server send message to the user that the user is successfully added as friend.



**Illustration 28: Sequence - Send/Receive Message**

This diagram is associated with the friend managing or more precisely sending or receiving message to/from user. When the user wants to enter the send message page he sends a request to the server and the server returns the page to the user. Then when the user wants to send a message he sends a request to the server. After that the server send request to the database to save the message. The database returns the result and the server send back a message to the user that the message has been send successfully. An option case is when the user wants to enter the page for the received messages. The process is the same as the previous, but this time the server sends to the user the received messages page.



**Illustration 29: Sequence - Remove Friend**

This diagram is associated with the friend managing or more precisely removing friend from friend list. When the user wants to remove a friend, he sends a request to the server. Then the server send request to the database to remove the user-to-user connection. After this the database sends result and the server sends a message to the user that the friend is removed.

All the functions derived from the sequence diagrams described above are detailed below.

| Name   | Buy Product                                     |        | Number          | Func_00 |
|--|---|--------|-----------------|---------|
| Input  | Process   | Output | Actors          |         |
| User_id<br>Item_id<br>[sensors]<br>[actuators]<br>[customizations] | Test if the user can buy and customize product. | YES    | Registered User |         |

**Table 11: Function - Buy Product**

| Name  | Register                                     |        | Number            | Func_01 |
|---|--|--------|-------------------|---------|
| Input   | Process                                      | Output | Actors            |         |
| Firstname<br>Lastname<br>Username<br>Email<br>Confirm email<br>Password<br>Confirm password | Test if the user can register in the system. | YES    | Unregistered User |         |

**Table 12: Function - Register**

| Name  | View Profile                               |        | Number            | Func_02 |
|---|--|--------|-------------------|---------|
| Input   | Process                                    | Output | Actors            |         |
| User_id   | Test if the user can view profile info     | YES    | Owner             |         |
|   |  | YES    | Registered User   |         |
|   |  | NO     | Unregistered User |         |
| Firstname<br>Lastname<br>Email<br>Confirm email<br>Password<br>Confirm password | Test if the user can edit his profile info | NO     | Registered User   |         |

**Table 13: Function - View Profile**



| Name   | Manage Products                     |                                   | Number                 | Func_03 |
|--|-------------------------------------|-----------------------------------|------------------------|---------|
| Input  | Process                             | Output                            | Actors                 |         |
| Product_key                                  | Test if the user can add product    | YES                               | Owner                  |         |
|  |                                     | NO (the key belongs to the owner) | User that is not Owner |         |
| Product_id<br>Title<br>active<br>description | Test if the user can edit a product | YES                               | Owner                  |         |

**Table 14: Function - Manage Products**

| Name       | View Product Data                          |        | Number            | Func_04 |
|------------|--|--------|-------------------|---------|
| Input      | Process                                    | Output | Actors            |         |
| Product_id | Test if the user can see the product data. | YES    | Owner             |         |
|            |  | YES    | Authorized User   |         |
|            |  | NO     | Unauthorized User |         |

**Table 15: Function - View Product Data**

| Name   | Manage Orders                               |        | Number | Func_05 |
|--|---|--------|--------|---------|
| Input  | Process                                     | Output | Actors |         |
| Order_id   | Test if the user can view his order details | NO     | Owner  |         |
| Firstname<br>Lastname<br>Address<br>Phone number | Test if the user can edit his order         | NO     | Owner  |         |
| Order_id   | Test if the user can return his order       | NO     | Owner  |         |

**Table 16: Function - Manage Orders**

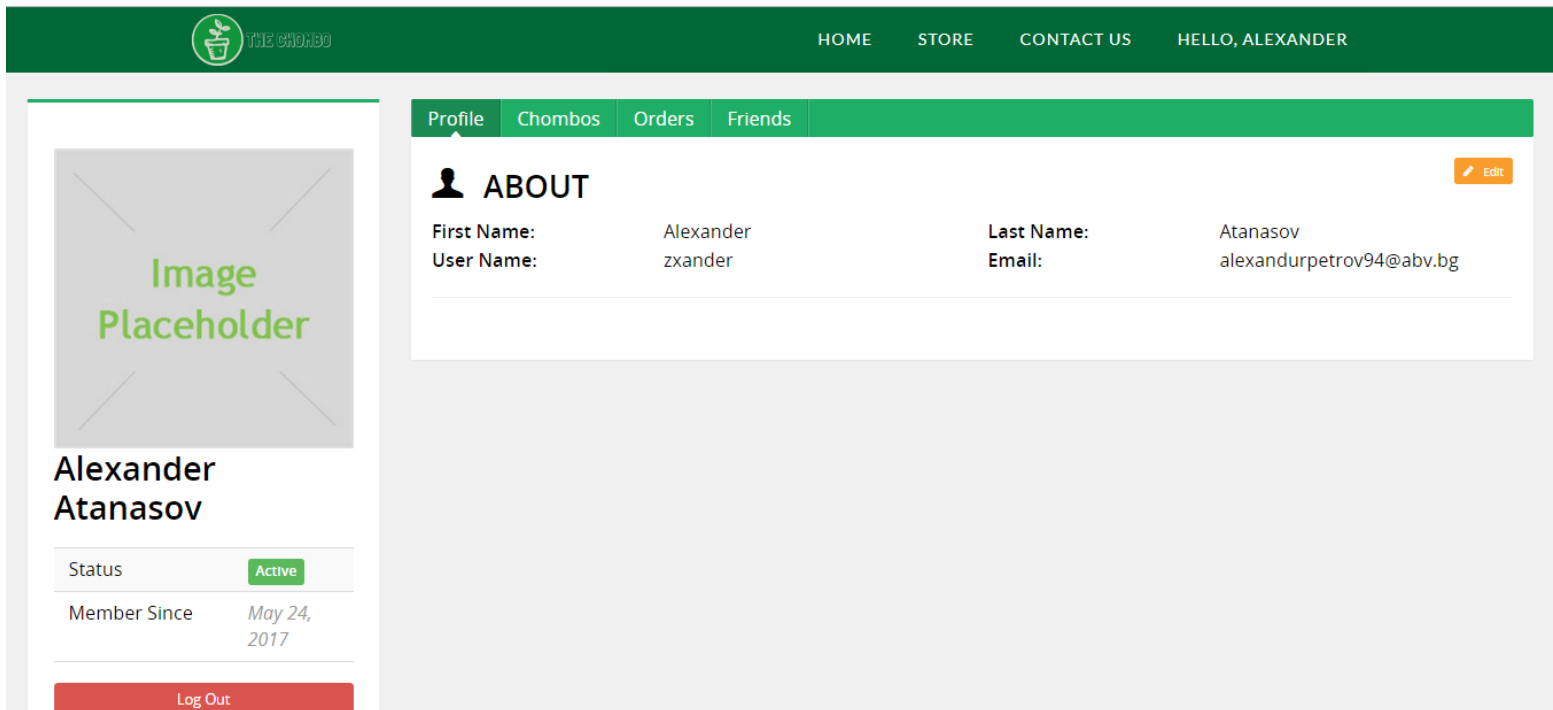
| Name               | Manage Friends                                 | Number | Func_06 |
|--------------------|--|--------|---------|
| Input              | Process  | Output | Actors  |
| email              | Test if the user can add a friend              | NO     | User    |
| user_id<br>message | Test if the user can send or receive a message | NO     | User    |
| User_id            | Test if the user can remove a friend           | NO     | User    |

**Table 17: Function - Manage Friends**

### 4.3.3 Presentation Layer

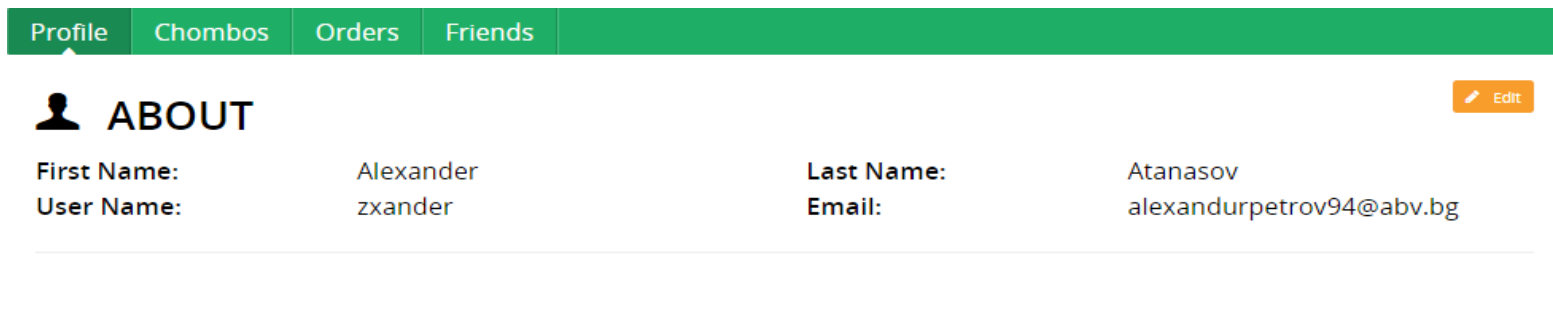
This layer includes the preliminary designs of the application. It is important to make a good design that meets certain conditions. The application should be easy to use for the user. It should also display all the necessary information for the user. Therefore, an application with a simple and ordered structure must be designed.

Below are the designs of each of the interfaces that a user can find in the application, and which function fulfills each of its elements.



**Illustration 30: Interface of the Website - User Profile**

This illustration shows the profile of the user when he is logged in the system. There are four tabs. Each of the tabs represent various functionalities. Every tab is dynamic which means that when the user clicks it doesn't redirect him to other page but on the same page only with different content. More about every tab is illustrated below.



**Illustration 31: Interface of the Website - Profile Info**

This illustration represents the first tab in the profile: the profile info. This is a public which means that every other user can see it. The user of the profile can edit his information and change everything that is included in the about tab except the username, because it's used to log into the system and it's unique.

| # | Name           | Title         | Access Level | Status | Owner           | Actions |
|---|----------------|---------------|--------------|--------|-----------------|---------|
| 1 | large_chombo3  | Large Chombo  | Regular      |        | You             |         |
| 2 | medium_chombo2 | Medium Chombo | Regular      |        | Viktor Jordanov |         |

**Illustration 32: Interface of the Website - Manage Chombos**

This illustration represents the second tab in the profile: chombos. This is a public which means that every other user can see it. The user of the profile can see chombos and manage them. As seen in the illustration

there are two chombos in this case. The owner of the first chombo is you and owner of the other chombo is another user that has given permissions to you to monitor it. When you click the name of the of the chombo it redirects you to another page where you can see the data of the product. Also, if you're owner of the chombo you can edit it. On the top right is located a register new chombo button. More for the chombo register, product data and chombo edit is illustrated in another picture below.

**Registering new Chombo**

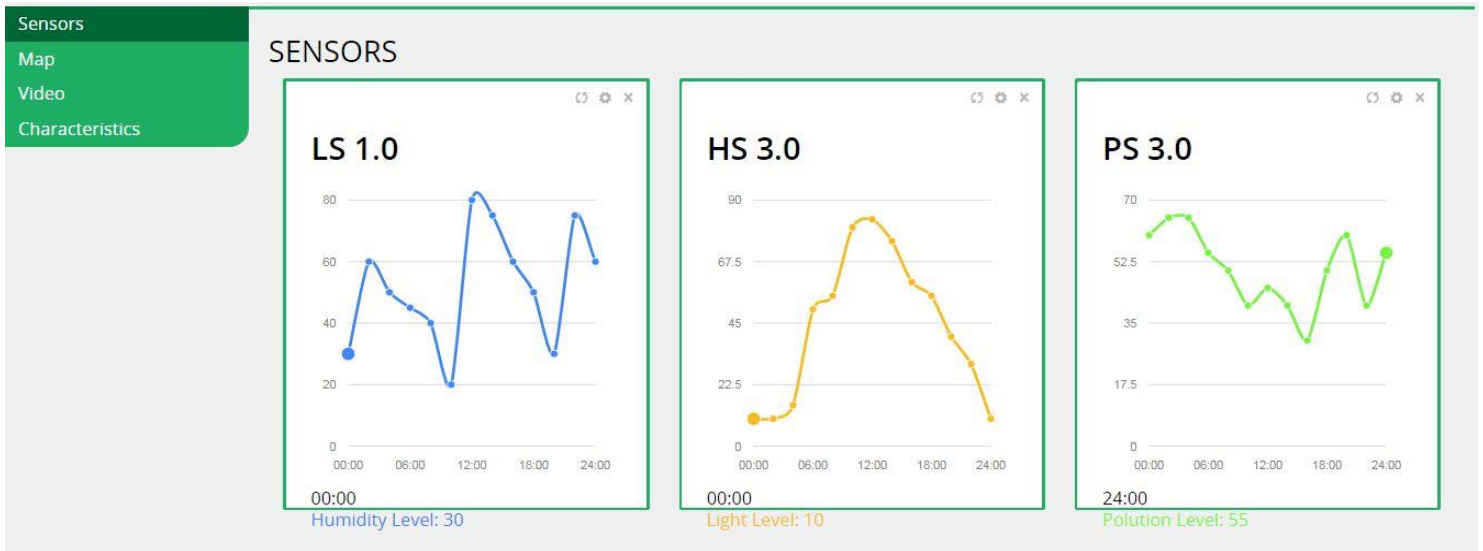
Here you can register your Chombo. To do so, you must first find the it's registration code inside the package. It will be located on the back of the User manual. Just type the code bellow and you should be able to see it listed in your list of chombos. If you encounter any problems, please contact customer support as soon as possible!

Code

**REGISTER**

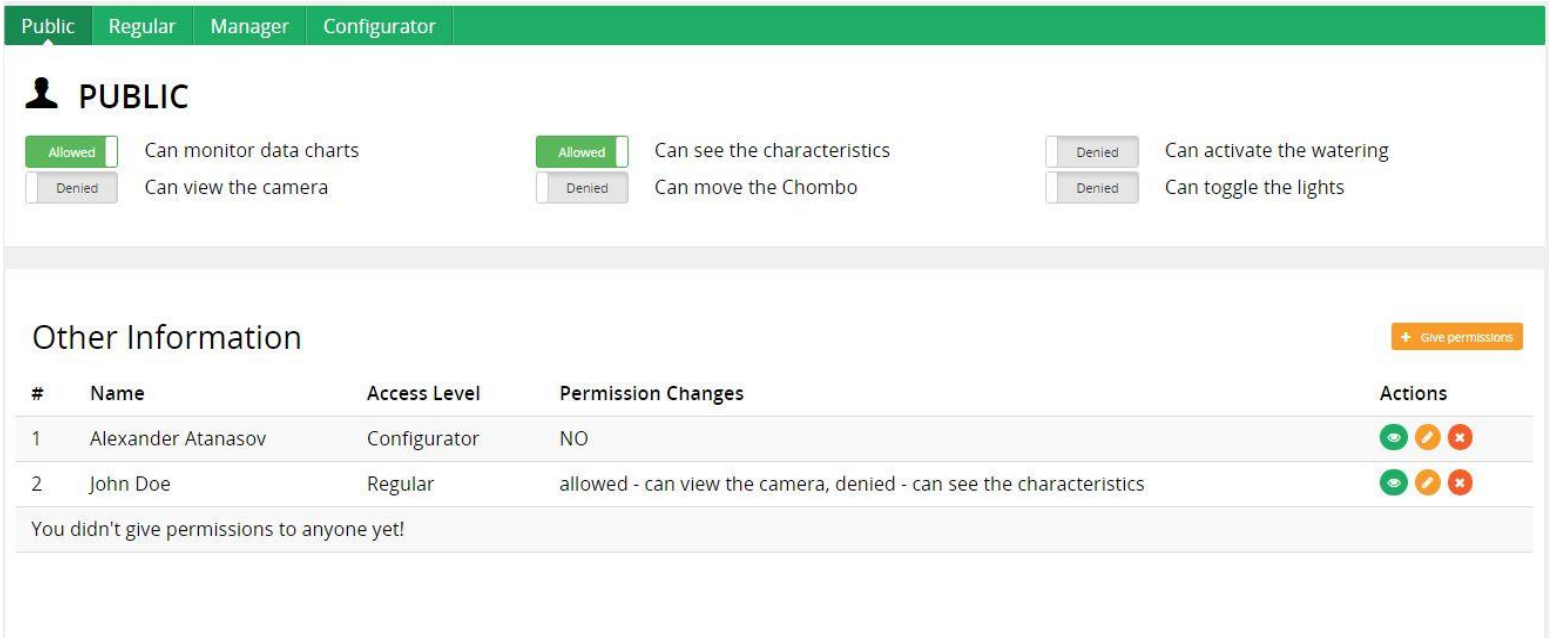
**Illustration 33: Interface of the Website - Register a Chombo**

This illustration represents the moment when the user clicks the button register new chombo that is illustrated above. After the user receive the code for the chombo he must register it here in order to see it in the chombo tab. The code is unique and only the owner that has received it can register it.



**Illustration 34: Interface of the Website - View Product Data**

This illustration represents the moment when the user clicks on the combo name. Then he is redirected to its product data. As illustrated there are four tabs. The tab sensors show the sensors data activity represent in the form of real time charts that refresh every once a day or more precisely to what was the activity from the last day. Also, there is map tab where the user can see the location of the chombo on Google map, Video tab where the user can see the chombo behavior live on camera and one last place the characteristics for the chombo that shows all the sensors and actuators and their values.



**Illustration 35: Interface of the Website - Edit Product**

This illustration represents the moment when the user wants to edit his personal chombo. There are four different tabs that represent the access levels. Below the user can give permissions to user that are in the friend list. After the user setup, the permission for the user he chose, above can allow or forbid what permissions the user can according to his access level. Also, the user can change the description and title and also change the status of a chombo, but this edit is not illustrated on this picture.



# Small Chombo

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Product images



Price: \$300



Share This:

**Illustration 36: Interface of the Website - Buy Product**

This illustration represents the moment when the user enters the store and click on a product from the list. It sends the user to this page where he can see more information for the chombo, more pictures or can buy it when click the buy now button. Also, there are a social media share buttons. More for the buy method is illustrated in another picture below.



## Humidity Sensors

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- HS 1.0
- HS 2.0
- HS 3.0



## Light Sensors

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**Illustration 37: Interface of the Website - Customizable Purchase Form**

This illustration shows the moment when the user clicks on buy now button that has been shown above. The user must fill a custom product form in order to choose some specific parts for the chombo for his personal likings. On the different steps trough, out the process the user can choose different parts and customizations. Finally, the form is submitted and the product is bought.

## 4.4 Conclusions

In this section was reviewed the whole design of the application.

Firstly, it has been opted for a 3-layer architecture that covers the needs of this part of the system. Using this architecture provides great flexibility and scalability to the website. The layers are explained in detail and they define how the system should work.

The overall appearance of the application has been designed in the presentation layer. It aims to achieve an application with a user-friendly interface but complete at the same time and offering all the required functionality. It is an intuitive and functional design. With this design has managed to avoid a saturation of information and at the same time maintains an order in the distribution of information and convey to the user a sense of comfort.



## **5. Implementation, implantation and evaluation**

### **5.1 Introduction**

This section will detail the way in which the functionalities described in the previous section have been implemented. This describes the structure that has been followed to develop the entire application.

It also describes the implementation process by the user and then describes the evaluations that have been made to ensure the correct operation of all use cases.

### **5.2 Implementation**

This section will explain the details of the implementation. It starts with the presentation layer because in this case it is the most important layer, since it is the one that is in direct contact with the user and must be done in detail.

#### **5.2.1 Presentation Layer**

In order to implement this layer, first must define which are the main pages of the web application and make a good design. The overall design of the pages is shown in the previous section above with detailed description for every page. The most important pages are the store, purchase process and profile page, because the web application is commercially orientated. The main purpose of the application is to give the user the opportunity to purchase the products and to manage them from his profile page.

Another key aspect of the overall design of the application is that is made to be responsive in order to run on different devices. Only some parts are yet to be developed responsively. It is important to note that only certain pages on the website are fully functional, but others are just mockups and are yet to be developed in future.

#### **5.2.2 Business/ Logical Layer**

In this layer, the most important functionalities such as Buy Product, View Profile, Manage Products, Manage Orders and others are already described above. For the saving of the data it is going to make use of the MySQL database configured on the server. The application uses the MVC(Model-View-Control) architecture.

For the creation of the business layer has been used the CodeIgniter Framework for easier and faster development. Also, the IDE which was used for the whole developing was Sublime Text 3. Of course there are also many other IDE's which can be used, but this is formal and rather relies on personal preferences.

### 5.2.3 Data Layer

This layer is oriented to the saving of the information. In this case, most of the information is contained in the database on the server and retrieved from there. However, there is an important element in the application that guarantees us to collect the correct information at all times.

For the communication between the server and the database are used PHP model classes. The model classes use queries to manage the database. This way the information in the database can be send to the presentation layer in order to be seen by the user in various forms. The classes also provide security from malicious behavior which is very important. In some case some of the information is stored in cookies or cache.

## 5.3 Integration

Since it is a web application, it must be uploaded on a web server which is configured to use PHP 5.6.3 and MySQL 5.6.X. After this the database scheme must be imported and filled with the needed data store items, sensors, actuators, etc. After this is finished the only thing left is the domain so It can be accessed.

## 5.4 Evaluation

Once the implementation is complete, and even during the implementation, all necessary evaluations are made on the application to ensure that it is working correctly. Below in the table are described the successful tests of some functionalities. Those functionalities can be fully implemented, because they are running successfully.

| Tests | Coverage | Result  |
|-------|----------|---|
| Test1 |          | If the user is registered he can enter the purchase process page and buy a product. |
| Test2 |          | If the user enters valid register details then he can register in the system.       |
| Test3 |          | If the user is logged he can view his or any profile page.                          |
| Test4 |          | If the user purchases a chombo successfully he can add the product to his list.     |
| Test5 |          | If the user is authorized he can view the product data.                             |

Table 18: Tests

## **6. Conclusions**

Finally, this section is aiming to show what functionalities are achieved to be fully developed so far. It also will be showed what difficulties have been encountered throughout the development of the project, and what decisions have been taken to resolve them. There is also a small introduction to possible improvements or additions that may appear in later years, since other students of the university have shown interest in improving and/or expanding each of the parts that make up the system.

### **6.1 Level of completion**

The main objective of the project was to create a prototype of a web application that focuses on managing all commercial transactions with chombos using PHP. A lot of functionalities were chosen to be integrated in the application to achieve greater user usability, but only few of them were managed to be fully functional. The user can login successfully in the website with your name and password. Now, when the user is logged he can successfully enter in the store and buy a product by customizing it during the purchase. Afterwards, he can register the code of the product in his profile and manage the chombo by editing its detail info or change permissions or access level. Also, if you are owner of a chombo or just have permissions to other friend chombos you can access the product data and see the data charts, live streaming through camera or the exact chombo location. The rest of the functionalities can be only seen visually in the website, but unfortunately, they are not functional at the moment.

For the overall design of the project was used the Three-Layer Architecture. Unlike that, for the implementation of the project was used MVC (Model-View-Controller).

Besides all this, for the visual aspect of the application was achieved to have very simple and easy to use design and to be responsively (to be able to run on different devices).

### **6.2 Resolved difficulties**

Since the whole project that the current work takes part of is done by multiple students, the cooperation and the development of the project together is a very difficult task. It also can lead to slowing the progress for some of the members. To solve this, I have decided to cooperate mostly with the colleague that is developing the mobile application for monitoring the chombos, who is using the same database and similar functionalities as in my project.

The other difficulty was the more time that was needed for developing of the project. In order to save more time, develop most of the functionalities of the product I use the CodeIgniter framework for easy and flexible programming and for the templates of the website was used Vendoird template that uses the latest Bootstrap library in order to achieve simple and beautiful design and most importantly to be responsive in order to run on different devices.

## 6.3 Future Implementations

After describing the totality of the project, future implementations are presented that can be carried out by other students interested in its continuity.

Firstly, there can be added new user called Admin that will have different privileges from the normal user. The admin will be able to change website content like product names, product prices, add or remove discounts, answer to customers if they have any questions or problem and other.

Another functionality that will be good to add is user review for products. This way the users can express their opinion which can help to improve or popularize the products.

All the other functionalities that are not functional at the moment could be finished which will slightly improve the user interface.

All these proposals are available to students who are interested in expanding and / or improving this project.

## 7. References

VENDROID TEMPLATES

<http://www.venmond.com/demo/vendroid/>

CODEPEN

<https://codepen.io/>

CSS TRICKS

<https://css-tricks.com/>

PHP MANUAL

<http://php.net/>

CODEIGNITER FRAMEWORK

<https://codeigniter.com>

STACKOVERFLOW

<https://stackoverflow.com>

MICROSOFT DEVELOPER NETWORK

<https://msdn.microsoft.com>

LOGO MAKER

<https://logomakr.com/>