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General Introduction

Gardening have become a growing concern due to the movement of populations into more urban settings. One way to mitigate the increase in costs for cultivating plants and decrease the amount of energy expended on gardening is to grow plants locally.

Cultivating plants is usually a very time-consuming activity, to be done in a reasonable amount of time, it requires a large amount of human resource. Traditionally, all the steps were executed by humans. Nowadays, some systems use technology to reduce the number of workers or the time required to cultivate the plants.

The objective of this project is to develop and implement an automated garden monitoring system that can be scaled down to improve the conditions of indoor gardens as small as household garden boxes for garden enthusiasts or for scientific researchers or as big as greenhouses for the agriculture industry.

The User will dispose of a graphical interface which will allow him to interact with the system a database will allow him to remotely monitor the system status.

This report is divided into four chapters, the first chapter is dedicated to the bibliographical study, the second chapter is for the functional analysis and the technological choices, and the third chapter will describe the study and conception of our project and finally the fourth chapter is dedicated for its realization.

Chapter I Study of art

Introduction:

In this chapter we are going to start by laying the outlines of the project and present a bibliographical documentation for the main themes of our work.

1. Gardening:

1.1. Definition:

Gardening is a practice for growing and cultivating plants for different purposes such as growing fruits and vegetables for nutrients and conception, medicinal herbs for medicine and flowers for her appearances also for research purposes.

1.2. History:

Gardening is a derivative of farming and one of humanity's oldest practices its started since the prehistoric times by cultivating plants, fruits and vegetables from forests by the time forms of cultivating and growing plants started evolving according to the needs of man by the middle ages it started to get more and more organized and gardening for aesthetic purposes, and moving on other forms of gardening and farming appeared like , gardening for medicinal purpose and finally gardening for research purpose in the modern time. [1] Figure 1 represents breeding plants to cope with future climate change, as for Figure 2 it illustrate gardening during the middle ages

Figure 2 Gardening during the middle ages

Figure 1 Modern gardening

1.3. Types:

There are different types of gardening like:

- ➢ Residential gardening: it's the gardening that takes place near home or resident in a place called a garden, illustrated in Figure 3.
- ➢ Water gardening : growing plants and vegetables adopted to pools and water ponds (like rice)
- ➢ Organic gardening : it’s the type of growing that uses natural and sustainable methods to grow not genetically modified plants
- ➢ Indoor gardening: it's the type of gardening we are most concerned about it's the growing of plants inside a home like entitled indoors, and the objective of this project is to create a system that makes indoor gardening easier for researchers, illustrated in Figure 4.

Figure 3 Residential gardening

Figure 4 Indoor gardening

2. Automation

Our idea to facilitate the task of indoors gardening is by making the shores of gardening done automatically.

2.1. Definition

Automation or automatic control, is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Some processes have been completely automated. The biggest benefit of automation is that it saves labor; however, it is also used to save energy and materials and to improve quality, accuracy and precision.[2]

2.2.History

Control systems began by giving humans a way to apply general timing and have evolved through technology and innovation to being able to sense and act within cycles of time smaller (milliseconds) than human operators can perceive.

Although we consider industrial controls as part of factory processes since the mid 1800's, the early Greek and Arabic societies actually had some float-valve regulators in devices such as water clocks, oil lamps, wine dispensers and water tanks.

The earliest feedback control mechanism was the thermostat invented in 1620 by the Dutch scientist Cornelius Drebbel. Another control mechanism was used to tent the sails of windmills. It was patented by Edmund Lee in 1745 also in 1745, Jacques de Vaucanson invented the first automated loom.

The term automation was coined in the automobile industry about 1946 to describe the increased use of automatic devices and controls in mechanized production lines. The origin of the word is attributed to D.S. Harder, an engineering manager at the Ford Motor Company at the time.

Automation technology has matured to a point where a number of other technologies have developed from it and have achieved a recognition and status of their own. Robotics is one of these technologies; it is a specialized branch of automation in which the automated machine possesses certain anthropomorphic, or human like, characteristics.

Figure 5 represents a governor and a throttle valve which is one of the earliest feedback control mechanisms, Figure 6 represents a modern power plant control room.[3]

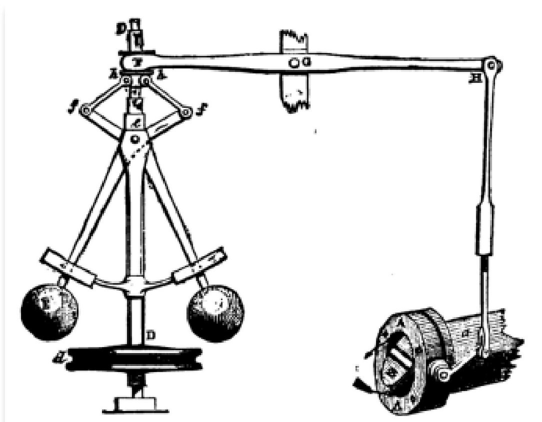

Figure 6 A governor and a throttle valve

Figure 5 Modern power plant control room

2.3.Feedback Control

Feedback Control is usually a continuous process and includes taking measurements with a sensor and making calculated adjustments via a controller to an output device to keep the measured variable within a set range. For instance, in a water heater, the sensor is the thermometer which measures the temperature of the water. The output of the thermometer is sent to the controller which compares the current temperature to the set point which is the desired temperature. Then, based on the difference between the current temperature and the set point a signal will be sent to the heaters to go on or off depending upon whether or not the water is hot enough.[2]
Figure 7 illustrate a simple control loop.

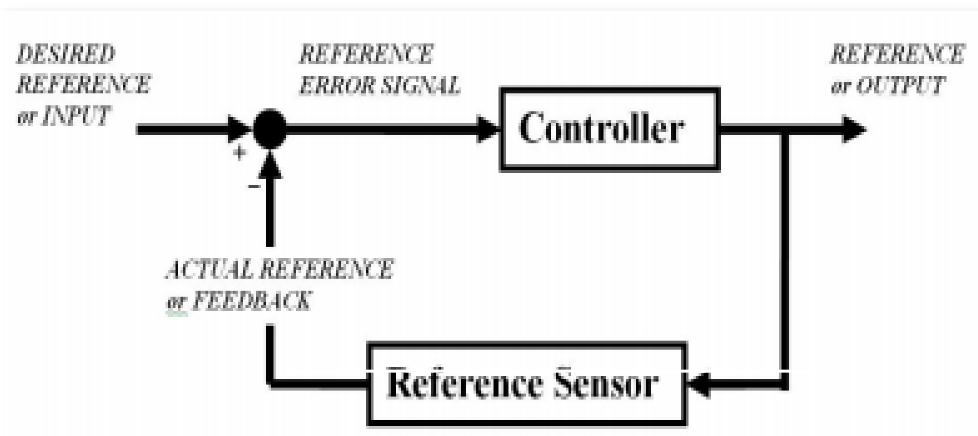

Figure 7 Simple control loop.

3. Graphical user interface:

One of the main elements of our project is the use of graphical user interface to monitor the system status and gives the user the ability to dynamically interact with the system.

3.1.Definition:

Graphical user interface or GUI is a notion in computer science, a graphic based user interface allows the user to control and manipulate the system through graphical icons and visual indicators instead of the usual text type command.

3.2.History:

The concept of GUI went through a lot of changes and evolutions in time starting by the creation of Text based hyperlinks manipulated by the mouse by researchers in Stanford research institute an example is shown in the figure below:

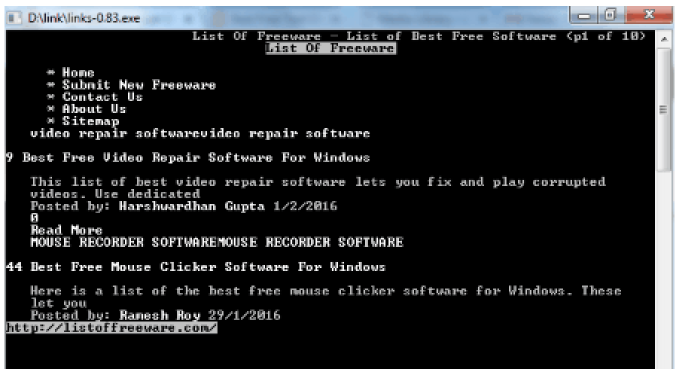

Figure 8 Text based hyperlinks

Later the concept was refined into the PARC user interface that introduced graphical elements such as windows menus, radio boxes, and checkboxes and later on icons an example of the PARC user interface is shown in this figure:

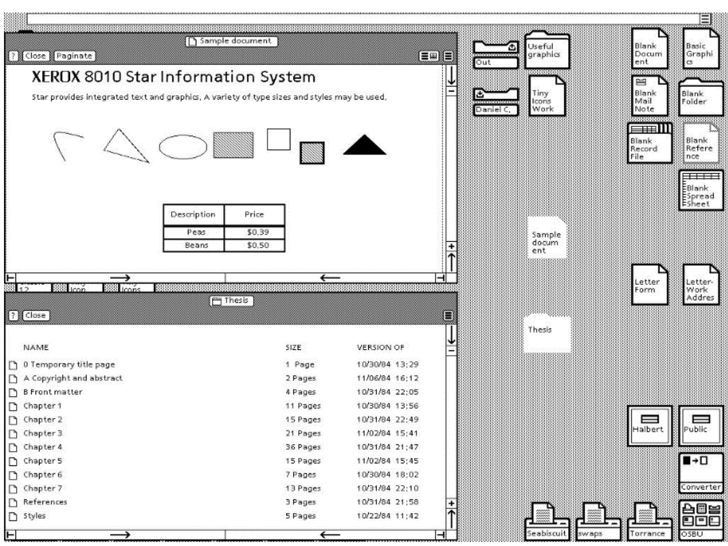

Figure 9 PARC user interface

due to its easy use the concept of GUI rose in popularity leading in the creation of a lot of types and products of GUI leading to it being used in many field and investing nearly every electronic based field , the operating system of pc's and smartphones are examples of a GUI.
With the variation of GUI either products or types there is also a variation on how to create them so what are the different methods to create a GUI. [4]

3.3. Creating a GUI:

The creation of a GUI is through programming or coding there are a lot of different and unique programming languages that can create a graphical user interface like:

C++ based GUI:

It's possible to code a GUI using C++ code using visual basic studio an example in the following figure:

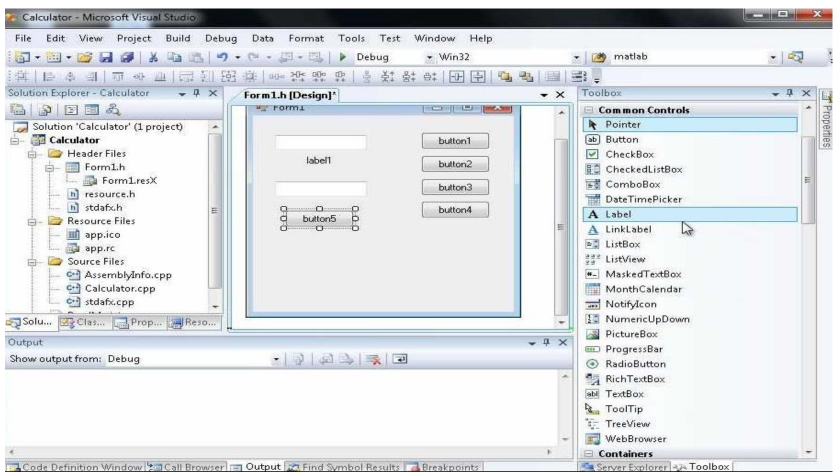

Figure 10 C++ based GUI

Java based GUI:

Java is an OOP an object oriented programming language so it's made for such a task the creation of a GUI again an example of such in the figure below:

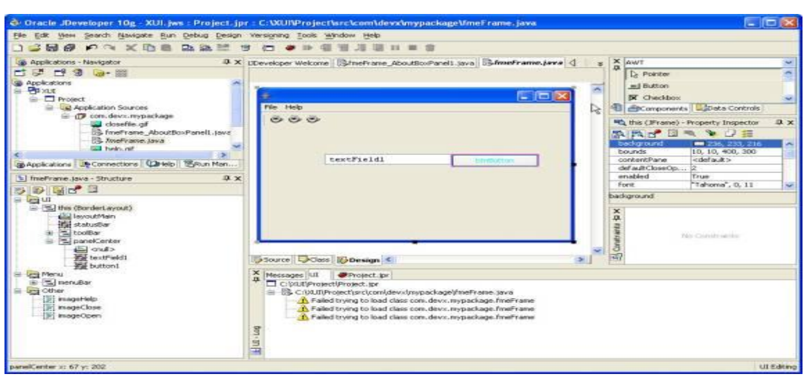

Figure 11 JavaScript based GUI

Python based GUI:

Same as the Java the python is a language specifically created to code graphical user interfaces and it exist a lot of frameworks that makes this possible like for example the PyGUI used this figure:

Figure 12 python based GUI

4. Internet of things:

Internet of things also known as IOT is the final part of the this bibliographical study it's the part about the connectivity of the project and saving the information/data let's start by the definition

4.1.Definition:

Internet of things or IOT is a new concept that means the interworking of physical devices and connecting machines into the internet making them accessible for anyone with internet connection and with access to the user interface, the IOT allows machines to be controlled and manipulated via internet also to see any new information saved in the web.

4.2.History:

The internet of things is a new concept it started with the creation of the internet even then the notion wasn’t existing with the rise of popularity of the internet and of its industrial applications, the application of the IOT started and the first ever connected machine was a modified coke machine in 1982, by 1999 the concept started getting momentum and started appearing in various applications.

The figure below illustrate the modified coke machine.

Figure 13 The modified coke machine

4.3. Applications:

In our days the IOT is applied nearly in every field due the dependency of information and speed to acquire information and data the IOT found its way into every field here some examples of it applications

- Environmental monitoring : the IOT application in the environment is through monitoring the environment and every changes , the climate change , animal movement using sensors , saving data and sharing it online into the respective servers .
- Energy management: managing the level of energy consumption using appropriate sensors and save the collected data online.
- Medical and healthcare: monitoring the state of patients and shares information with doctors and health care via internet.
- Building and home automation: automated smart homes that manages and save any change in the state of the home and domestic property and shares said information to the user online.

5. Project presentation

5.1. Context of the project

It is the study, design and realization of an automated garden that will allow the user to cultivate plants with ease.

This project is part of the electromechanical field and encompasses three main parts:

- Mechanical design part
- Electrical design part
- Computer programming part

5.2.Problematic

Cultivating plants is a very time-consuming activity, and usually all the steps are done by humans. Our need is to create an automated garden that will allow its user to cultivate plants with the minimum of effort.

5.3.Project specifications

The aim of our project is to create an automated connected garden that will allow the user to monitor his plants and set all the parameters.

Conclusion:

In this chapter we did a bibliographical research for the most important parts of our project for a better understanding of our need, now we move on to the functional analysis and technological choices.

Chapter II Functional analysis and technological choices

Introduction

The aim of this chapter is to study the project in a systematic way by analyzing the needs and the detailed operation of the system in order to satisfy the service functions. This will allow, by using the tools of decision-making aids, to choose the solution best suited to the functional specifications. There are several functional analysis tools to perform a detailed project study by defining the needs and technological solutions required. At first we are going to analyze the need

1. Analysis of the need

The analysis of the need is a very interesting step for the functional study because the production of any system or technical object comes as a result of a need satisfaction so that the product comes to fulfill the wish of the user, the need has to be clearly defined in advance.

In our case the need is to automatically control and monitor an interior garden through a user interface and a website for distance access.

To carry out this study, we must go through the following steps:

- ✓ Determine the need
- ✓ State the need
- ✓ Validate the need

1.1.Determine the need

We are going to determine our need through the DIAGRAM A-0, yet our system main function is to control and monitor the temperature ,the humidity , the luminosity and the irrigation of the interior garden , the user define these parameters and the system dynamically execute these commands.

The figure below illustrate the DIAGRAM A-0

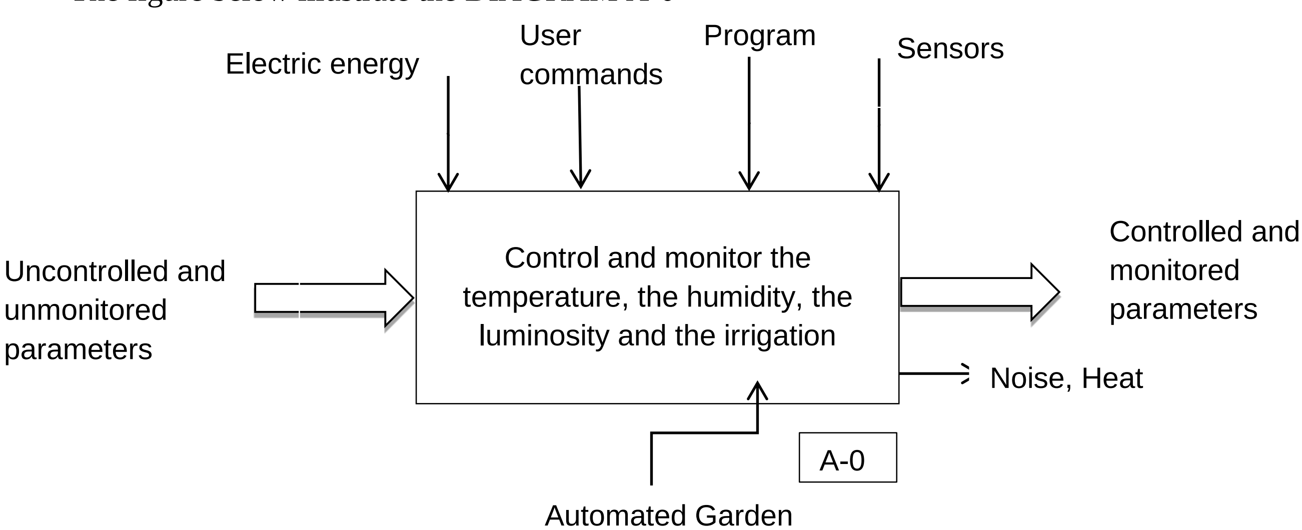

Figure 14 The DIAGRAM A-0

1.2.State the need

The definition of the need is the answer to the following questions:

- ✓ To whom (which) the product returns it service?
- ✓ On what (on that) does the product act?
- ✓ For what purpose does the product exist?

The Horned Beast tool below represent the state of our need

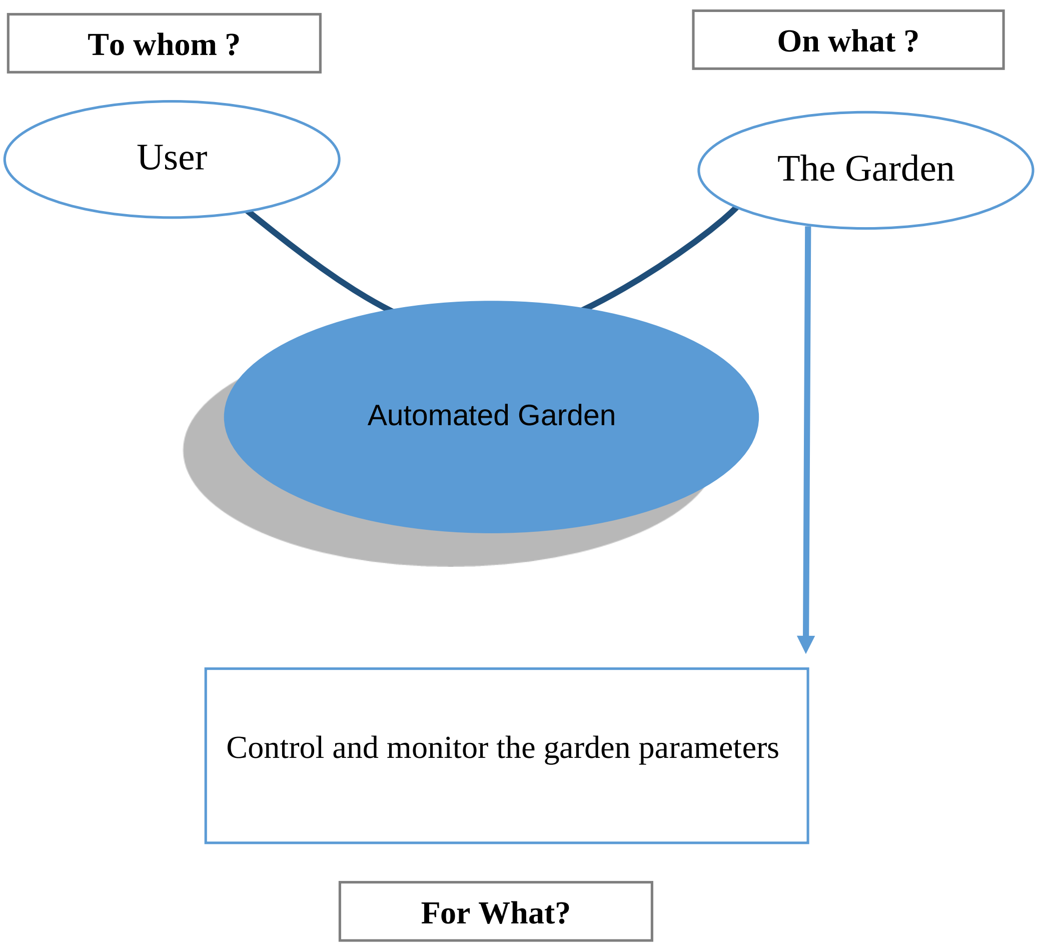

Figure 15 The Horned Beast tool

1.3.Validate the need

After defining the need, it is necessary to check its stability over time and ensure that it is validated for a sufficient period. There are 3 questions to ask and allows us to validate the need :

- ❖ **For what purpose?**
- ✓ Control and Monitor the garden's parameters
- ❖ **Why?**
- ✓ Allow the user to cultivate plants at home, control the cultivation parameters and reduce gardening labor
- ❖ **What could increase the need?**
- ✓ The need an automated home gardening.
- ❖ **What could eliminate the need?**
- ✓ The absence of home gardening.

➡ The need is validated, given the great necessity of this activity and the continuity of service

2. Feasibility study

2.1. Octopus diagram

It is important that the formulation of the function is independent of the solutions likely to be realized, one uses then the tool of the "octopus" because it presents itself as an excellent tool of representation of the functions and their relations with the object studied. Its main advantage is to present synthetically and in a convivial way what the literature describes in a very long document.

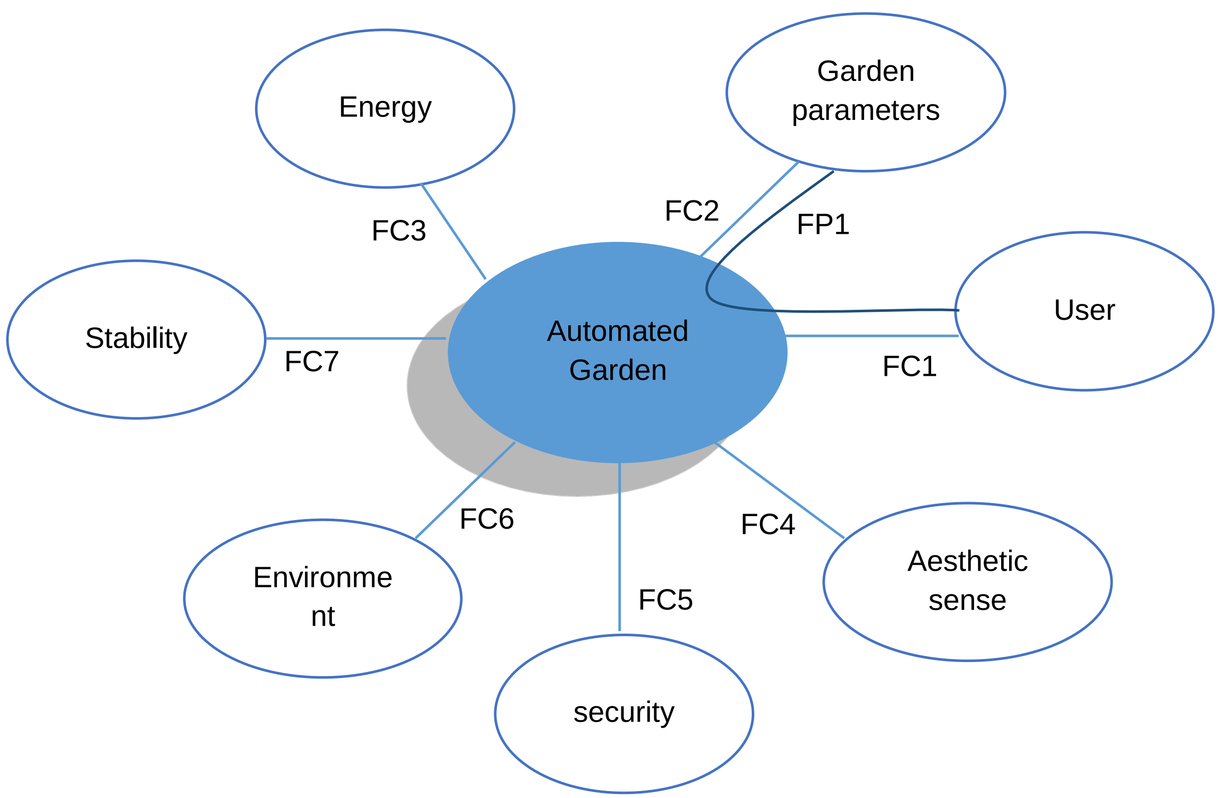

Figure 16 Octopus diagram

2.2. Service functions

- FP1: Allow the user to control the garden parameters.
- FC1: Be easy to operate.
- FC2: Be compatible with the garden.
- FC3: Operate with available energy.
- FC4: Pleasing to the eye (Aesthetics).
- FC5: Observe safety rules.
- FC6: Resist internal environment.
- FC7: Be stable on a plan.

2.3. Characterization of service functions

At first we present in the following tab Criteria for characterization of service functions

Flexibility	**Flexibility class**	**Flexibility level**
Nothing	F0	Imperative
Low	F1	Little negotiable
Good	F2	Negotiable
Strong	F3	Very Negotiable

The following tab present the description of the Octopus diagram

	Functions	Criteria of Appreciation	Flexibility
FP1	Allow the user to control the garden parameters.	-Precision.	-F0
FC1	Be easy to operate.	-The simplicity.	-F0
FC2	Be compatible with the garden	-Precision.	-F0
FC3	Operate with available energy	-Electricity.	-F1
FC4	Pleasing to the eye	-Form. -Color.	-F1
FC5	Observe safety rules	-Security.	-F1
FC6	Resist internal environment.	- Dust. -Corrosion.	-F2
FC7	Be stable on a plan.	-Stability.	-F1

2.4.Comparison of service functions “Cross- Sorting tool”:

After we characterized our functions we are going to compare them using the cross sorting tool

	FC1	FC2	FC3	FC4	FC5	FC6	FC7	Points
FP	FP(2)	FP(1)	FP(3)	FP(3)	FP(2)	FP(3)	FP(3)	17
	FC1	FC2(2)	FC1(2)	FC1(2)	FC1(2)	FC1(2)	FC1(2)	10
		FC2	FC2(3)	FC2(3)	FC2(2)	FC2(3)	FC2(2)	15
			FC3	FC3(2)	FC5(1)	FC3(2)	FC3(1)	5
				FC4	FC5(2)	FC4(2)	FC7(1)	2
					FC5	FC5(2)	FC5(1)	6
						FC6	FC7(2)	0
							FC7	3
						Total		58

Figure 17 the cross sorting tool

3. Internal Functional Analysis

3.1.SADT method

Top-down functional analysis using the SADT (Structural Analysis and Design Technique) method: Structured Systems Analysis and Modeling. The principle of the SADT method consists in using numbered boxes modeling the functions and arrows codifying the relations or the constraints between them. The representation model takes the form of Actogram (boxes), rectangles based on the activities or functions of the system.

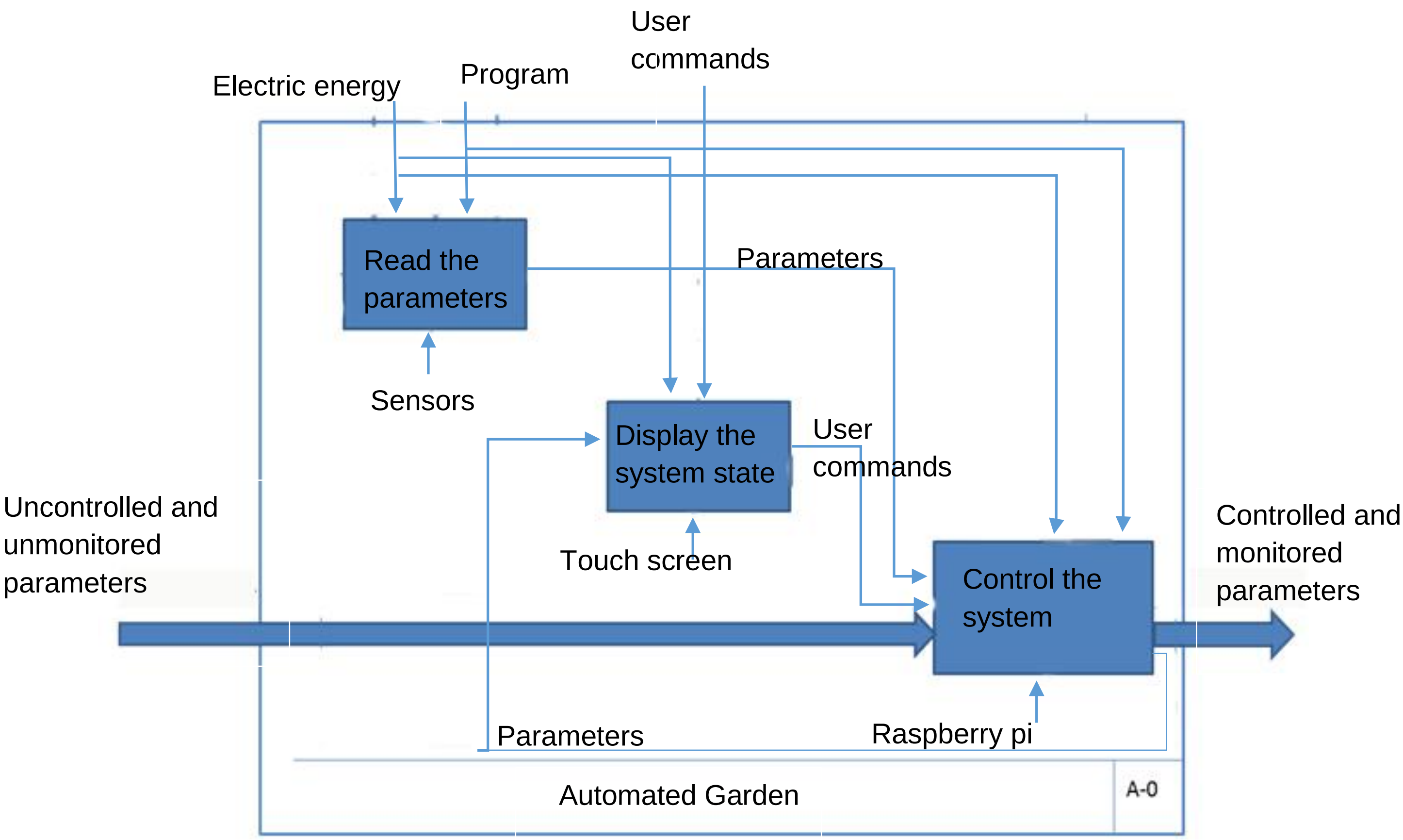

Figure 18 SADT Level A0 Diagram

3.2.FAST Method

The FAST diagram (Function Analysis Technical System) presents a rigorous translation of each of the service functions into technical functions, then materially into constructive solutions. The FAST diagram is constructed from left to right, in a logic of why to how. Thanks to its technical and scientific culture, the designer develops the service functions of the product in technical functions. He chooses solutions to finally build the product. The FAST diagram then constitutes a set of essential data allowing to have a good knowledge of a complex product and thus to be able to improve the proposed solution

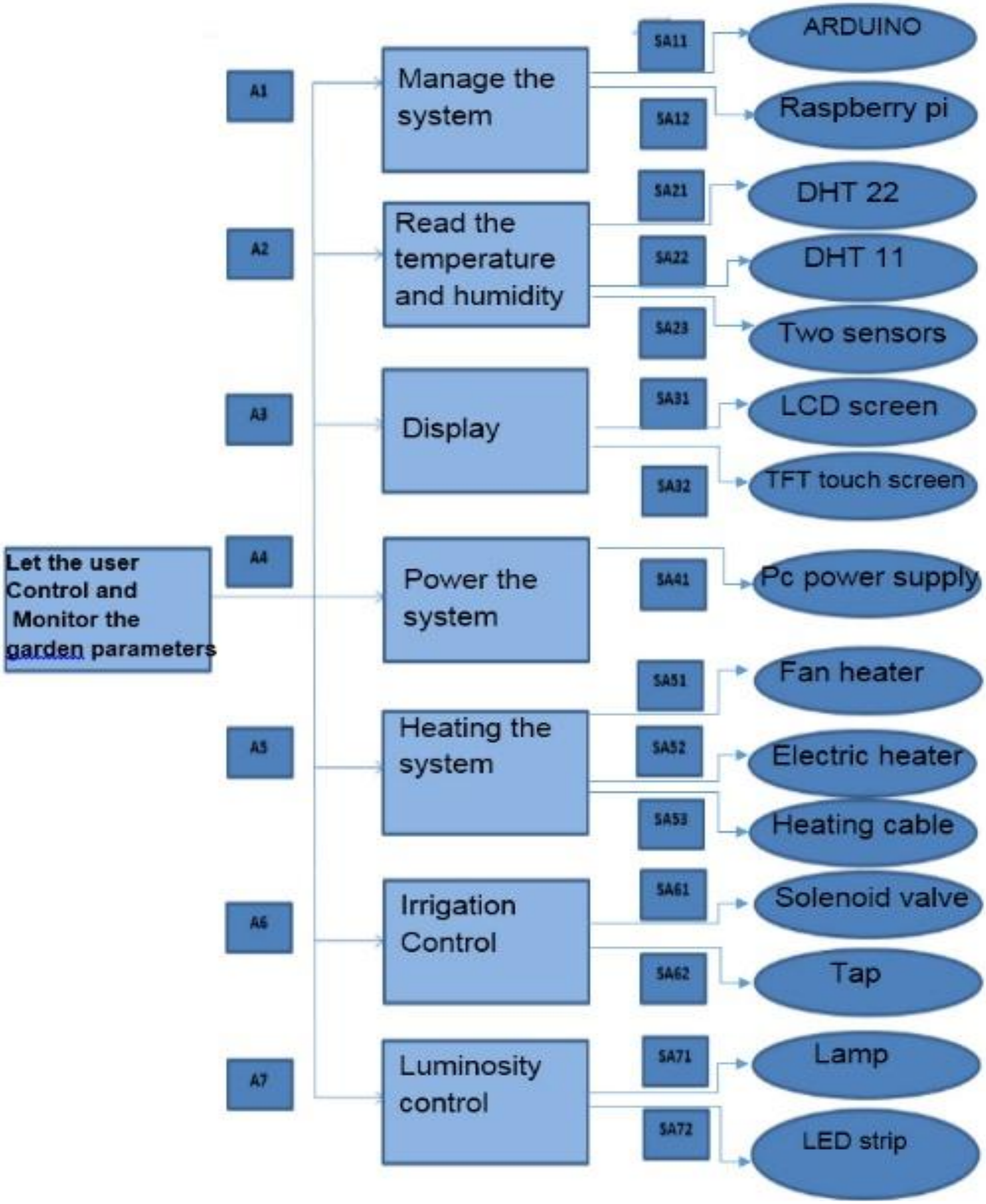

Figure 19 The FAST diagram

➢ **Weighted vote:**

According to the FAST diagram a weighted vote of the solutions to be adopted for the design is carried out, it is noted that the vote was carried out in order to satisfy the following criteria:

• Means of realization.

• The cost of realization.

• Standard elements.

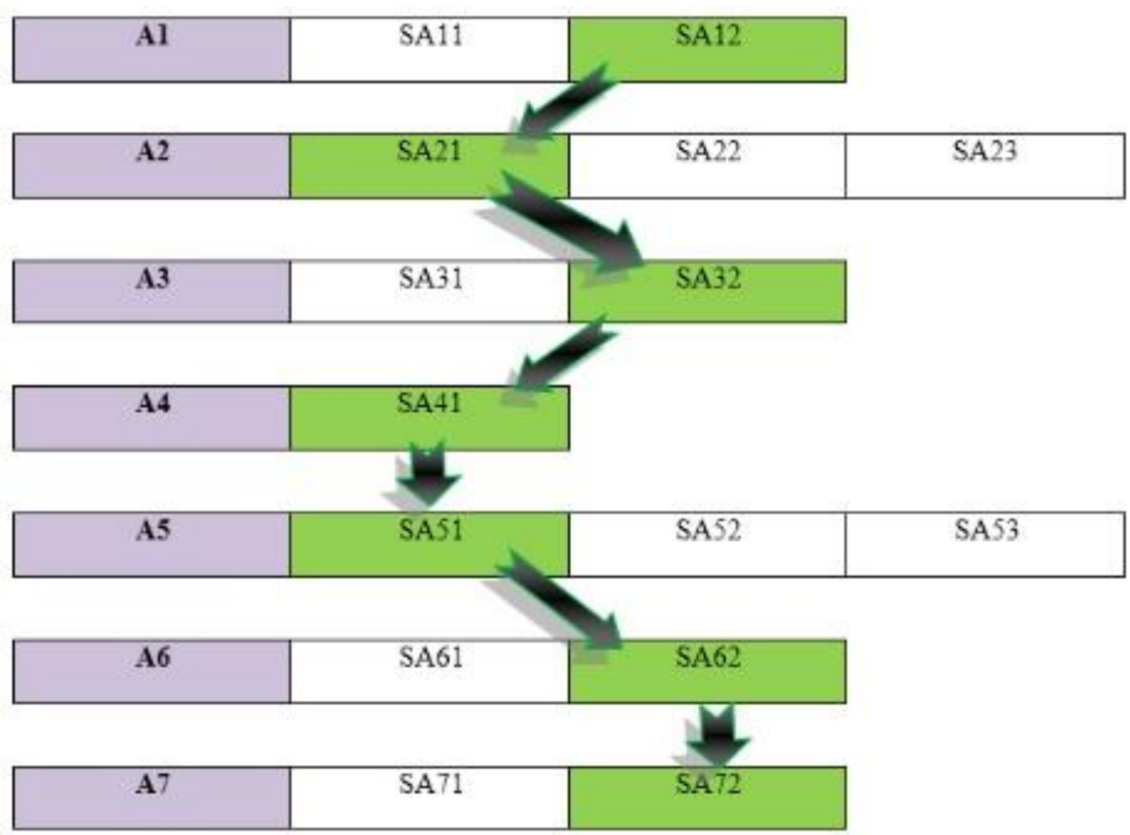

Figure 20 Chosen solutions

➢ **The solution adopted is: SA12 + SA21 + SA32 +SA41 + SA51 + SA62 + SA72**

Conclusion

In this chapter we have carried out a systematic study of the system based on the functional analysis that will be needed in the next chapter which will be dedicated to a study and design of our system

Chapter III Study and Design

Introduction

In this chapter we are going to study the different components of the system and explain our choices, then we are going to present the system's design.

1. Study

This part is divided into three sections, electric, mechanic and program development in each section we are going to explain our choices.

1.1.Electric study

1.1.1. Components choice

- **The Raspberry pi**

The Raspberry Pi is a series of credit card-sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and developing countries. The original model got way more popular than anticipated, outside of the target market; enthusiasts use it for various uses, such as robotics.

We have chosen the Raspberry pi to be the brain of our system , first because it will allow us to easily add a touch screen for the user interface , also it's easy to connect it to the internet because it contain an integrated Wi-Fi model , Finally because of its ability to execute many task in the same time .

The figure below illustrate the Raspberry pi 3, the one we used in our project.

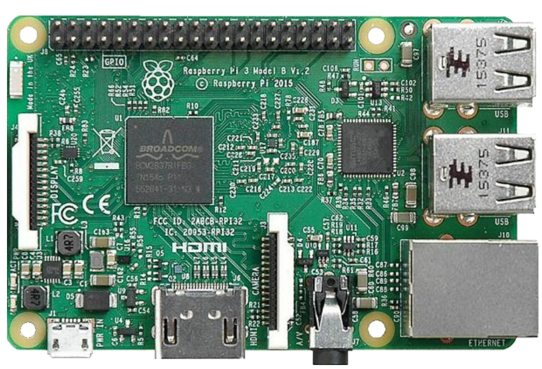

Figure 21 Raspberry pi 3

➢ The touch screen

The 7" Touchscreen Monitor for Raspberry Pi gives users the ability to create all-in-one, integrated projects such as tablets, infotainment systems and embedded projects. The 800 x 480 display connects via an adapter board which handles power and signal conversion. Only two connections to the Pi are required; power from the Pi's GPIO port and a ribbon cable that connects to the DSI port present on all Raspberry Pi's. Touchscreen drivers with support for 10-finger touch and an on-screen keyboard.

The figure below illustrate the touch screen we used for the user interface.

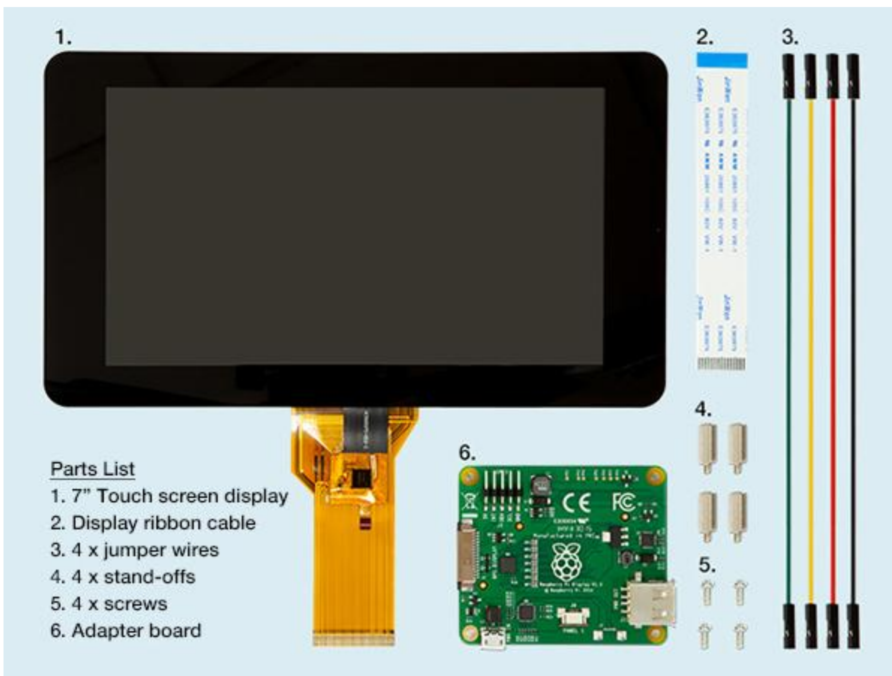

Figure 22 The 7" Touchscreen Monitor

➢ The DHT 22 sensor

The DHT22 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air.

We have chosen the DHT 22 sensor first because it's a digital sensor so we can connect it easily to the raspberry pi, also it will allow us to read the temperature and humidity simultaneously.

Below the illustration of the DHT 22

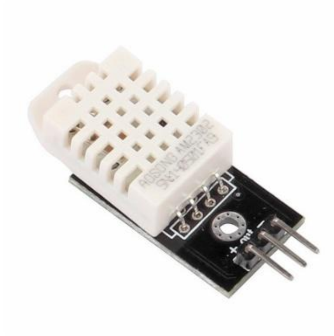

Figure 23 DHT 22 sensor

- **The luminosity sensors (LDR)**

A photo resistor (or light-dependent resistor, LDR, or photocell) is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

Below the illustration of an LDR

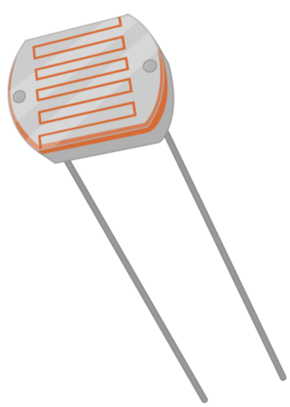

Figure 24 Light-dependent resistor

- **Fan**

  We have chosen to use an electric fan to cool our system and help control the humidity The figure below illustrate the fan.

Figure 25 The fan

- **The led strip**

  We agreed to use a led strip to control the luminosity of our system.

Figure 26 Led strip

- **Heater fan**

  A fan heater is a heater that works by using a fan to pass air over a heat source (e.g. a heating element). This heats up the air, which then leaves the heater, warming up the surrounding room. They can heat an enclosed space such as a room faster than a heater without fan.

  We adopted this solution because it will allows us to heat our system more effectively.

  A heater fan is illustrated in the figure below.

Figure 27 Heater fan

- Pc power supply

  We used a pc power supply because it supplies a 5v and a 12v which will allow us to power the raspberry pi and the led strip, the other components are powered directly from the mains 220v.

  Below an illustration of the power supply.

Figure 28 Pc power supply

1.1.2. Financial study

We have visited some component suppliers to assume the total cost of the electric components of our project.

The bill are included in the annex 1, the approximate cost of the electric components will be about 400dt.

1.2.Mechanical study

1.2.1. Material choice

We studied the choice of the material we are going to use to build our project chassis, and we agreed to use aluminum because it is remarkable for its low density and its ability to resist corrosion, also using aluminum profiles will help us to make a strong stable chassis. The figure below illustrate an aluminum profiles.

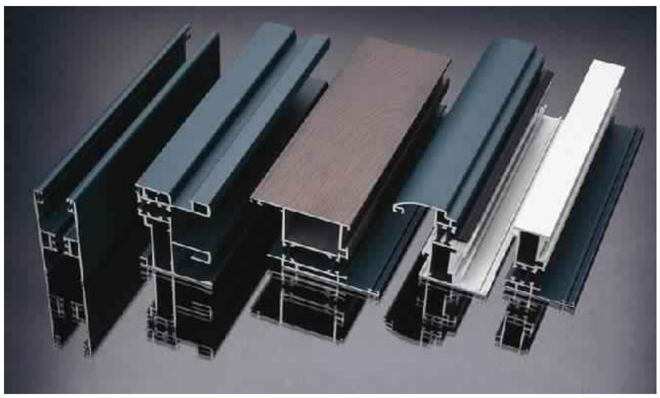

Figure 29 Aluminium profiles

We agreed also to use Plexiglas as lining of our chassis, because its light weighted and resistant, also from an esthetic point of view the combination of Plexiglas and aluminum would give an eye pleasing project. Below an illustration of the Plexiglas.

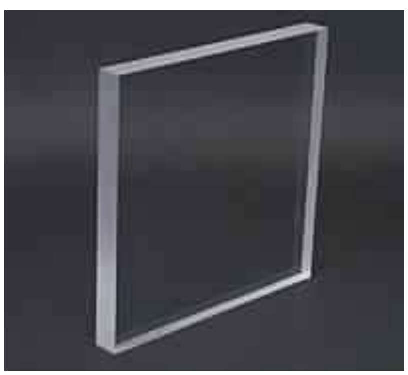

Figure 30 Plexiglass

1.2.2. Financial study

To have an idea about the cost of our project chassis and have an acknowledgment of the material available on the market, we visited some aluminum and Plexiglas suppliers and that helped us to come up with new ideas for the design of our project and improve our first design so after many discussions with the suppliers we agreed on a final design, for that we took a bill which is included in annex 2, the cost of the mechanical build will be about 600dt.

1.3.Program development

1.3.1. Programming language choice

To develop our program we have chosen Python which is a widely used high-level, general-purpose, interpreted, dynamic programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

Python supports multiple programming paradigms, including object-oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library.

Below an illustration of the python symbol.

Figure 31 Python symbol

1.3.2. Graphical user interface development tool

To develop the user interface we have chosen to use Qt is a cross-platform application framework that is widely used for developing application software that can be run on various software and hardware platforms with little or no change in the underlying codebase.

To implement our GUI in the raspberry pi we had to use PyQt which is one of the two most popular Python bindings for the Qt cross-platform GUI/XML/SQL C++ framework PyQt developed by Riverbank Computing Limited.

The figures below illustrate Qt designer .

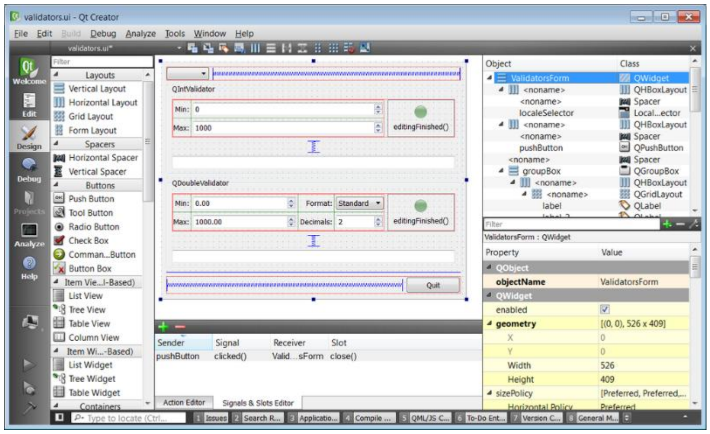

Figure 32 Qt designer

1.3.3. The web interface

We decided to build our own LAMP web server on the raspberry pi. That will allow the user to monitor the garden status from distance.

LAMP is an archetypal model of web service stacks, named as an acronym of the names of its original four open-source components: the Linux operating system, the Apache HTTP Server, the MySQL relational database management system (RDBMS), and the PHP programming language. The LAMP components are largely interchangeable and not limited to the original selection. As a solution stack, LAMP is suitable for building dynamic web sites and web applications.

The role of LAMP's web server has been traditionally supplied by Apache, and has since included other web servers such as Nginx.

MySQL's original role as the LAMP's relational database management system (RDBMS) has since been alternately provisioned by other RDBMSs such as MariaDB or PostgreSQL, or even NoSQL databases such as MongoDB.

PHP's role as the LAMP's application programming language has also been performed by other languages such as Perl and Python.

PHP is a server-side scripting language designed for web development but also used as a general-purpose programming language.

Since its creation, the LAMP model has been adapted to other componentry, though typically consisting of free and open-source software. For example, an equivalent installation on the Microsoft Windows family of operating systems is known as WAMP. Below an illustration of the Lamp model.

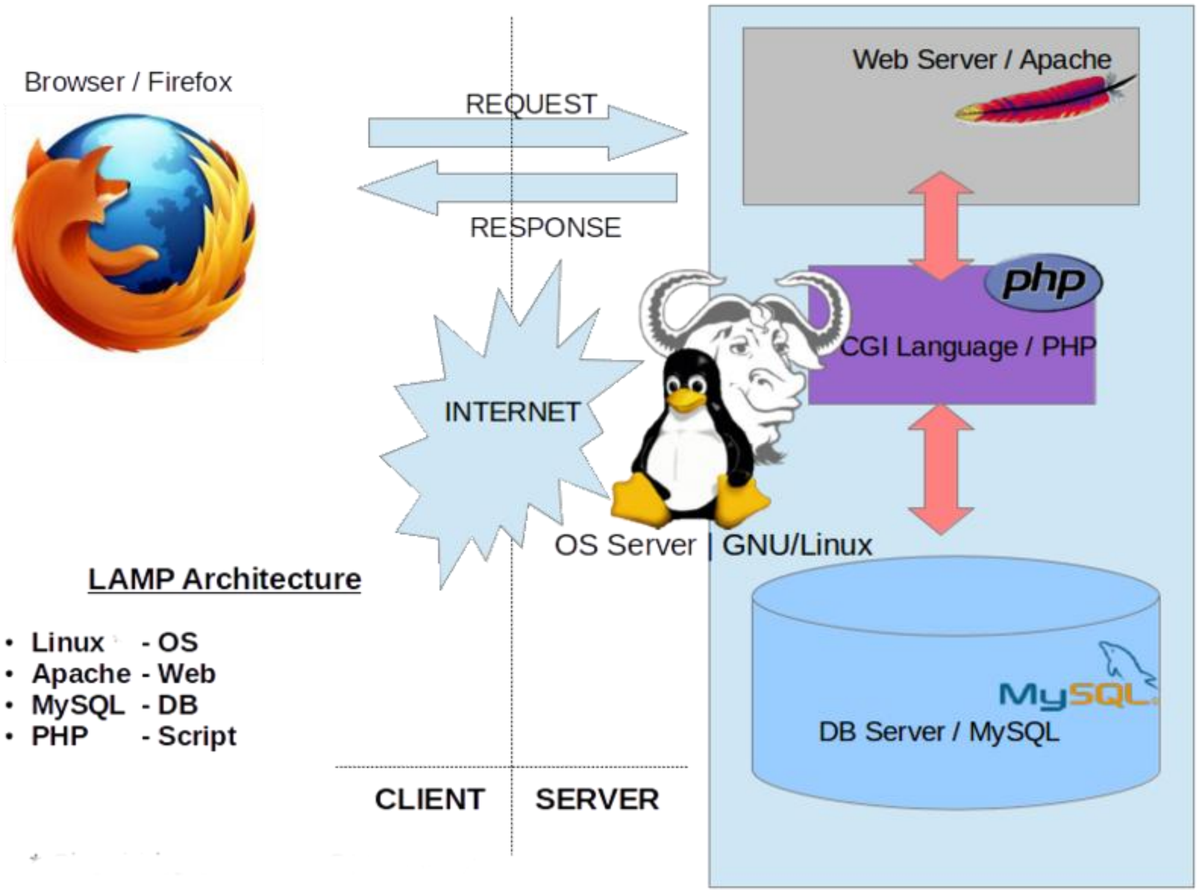

Figure 33 LAMP architecture

2. Design

In this section we are going to demonstrate the Design of the different parts of our project, it will be divided into three sections electrical, mechanical and program development.

2.1. Electrical design

In this part we are going to explain how we will connect the sensors to the raspberry pi and the different boards we designed for our project.

2.1.1. Sensors connections

➢ **DHT 22 sensor**

Using Fritzing to illustrate and simulate our sensors, we obtained the following figures, The figure below illustrate how the DHT 22 will be connected to the raspberry pi.

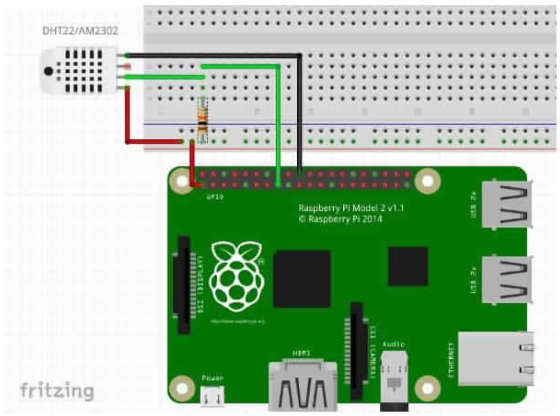

Figure 34 DHT 22 connection

➢ **LDR connection**

The figure below illustrate how the LDR will be connected to the raspberry pi.

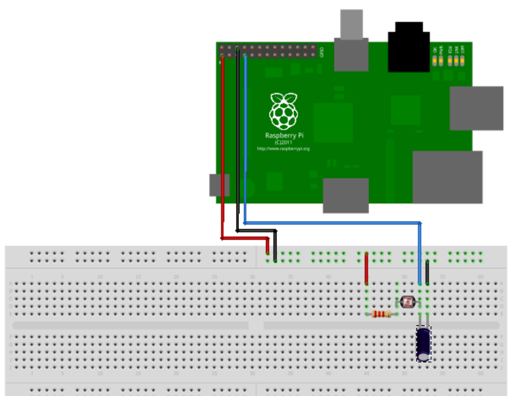

Figure 35 LDR connection

2.1.2. Boards design

To easily connect the different parts of our electrical system we have designed three boards the first is designed to distribute power to the different components, the second board is designed

to connect the LDR sensors to the raspberry pi as for the third board it's designed to let us connect the different sensors to the raspberry pi via screw pin headers.
We designed a board containing 5 solid state relays, which will allow us to control the heater and the fan via a PWM signal.

- **LDR board**

  Using Altuim designer and Eagle designer we designed our boards.
  The figure below illustrate the LDR board

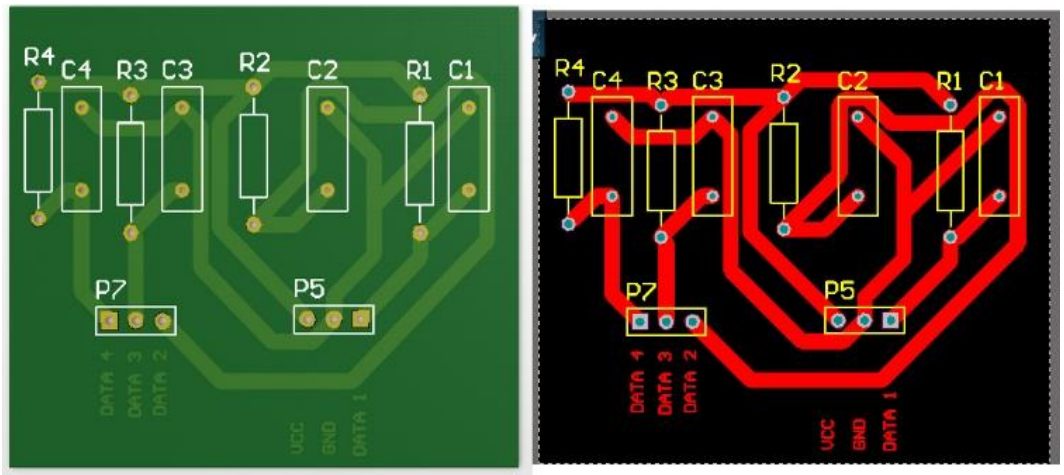

Figure 36 LDR board

- **Alimentation board**

  The figure below illustrate the Alimentation board

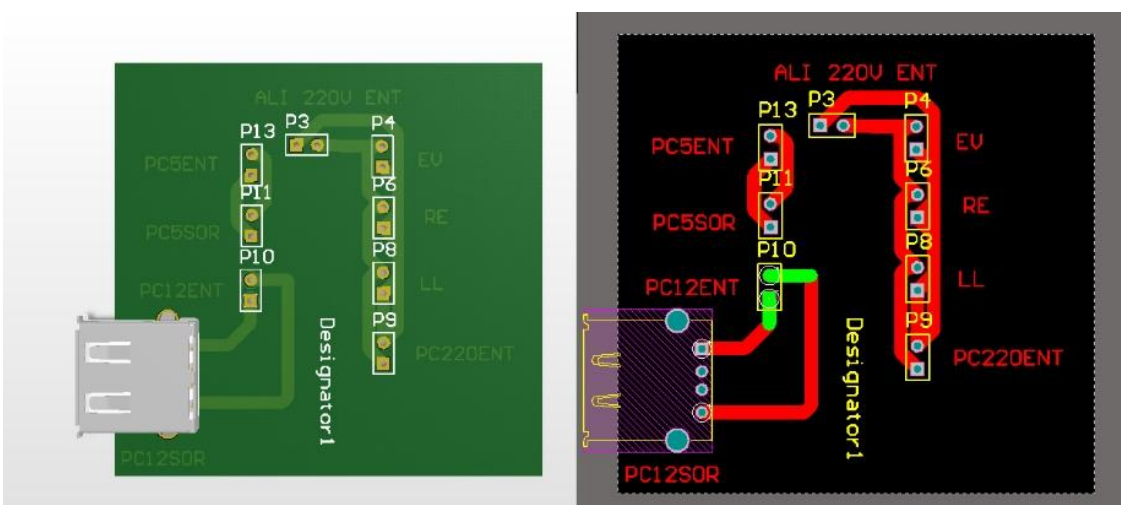

Figure 37 Alimentation board

- **Solid state relay board**

  The figure below illustrate the SSR board

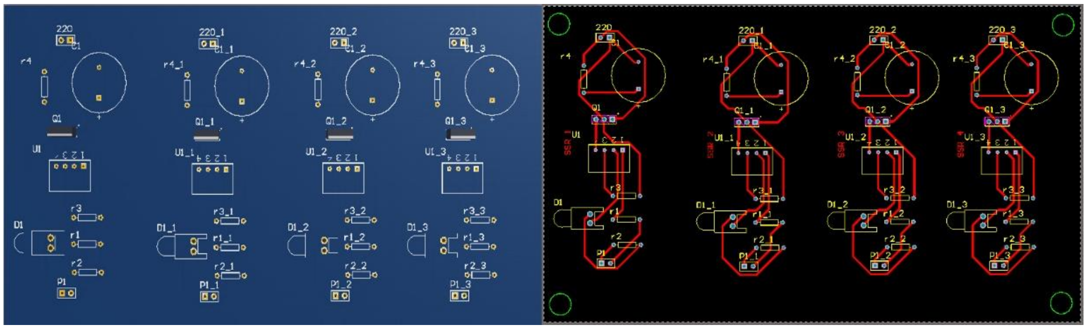

Figure 38 Solid state relay board

- **The Raspberry pi connection board**

  The figure below illustrate the Raspberry pi connection board

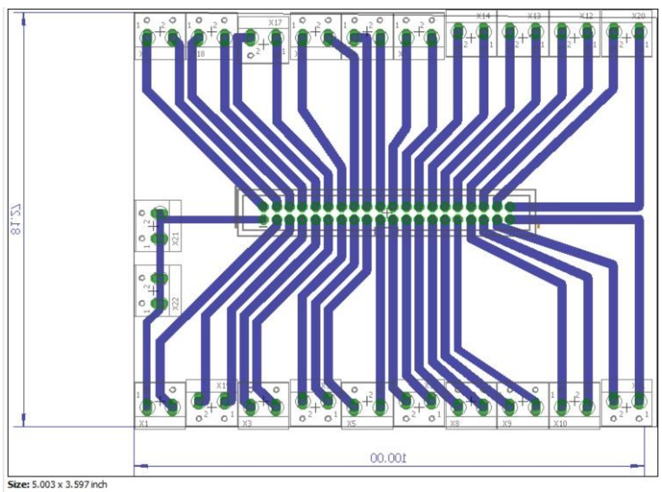

Figure 39 Raspberry pi connection board

2.2.Mechanical design

The mechanical design of our project went through many stages, at first we discussed the dimensions of the build and the look and we agreed at a first design shown below
All these designs were made using SOLIDWORKS.

Figure 40 First design

After visiting the suppliers and discussing the available products on the market, we came up with a new conception shown in the illustration below, based on the supplier's available aluminum profiles, and the Plexiglas available on the market.

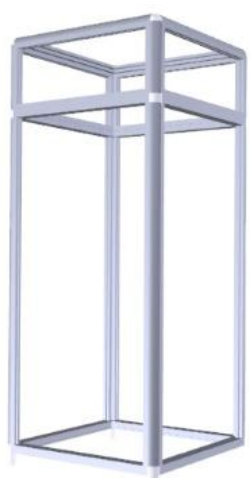

Figure 41 The second design

Then after some discussions we agreed on the final design shown below.

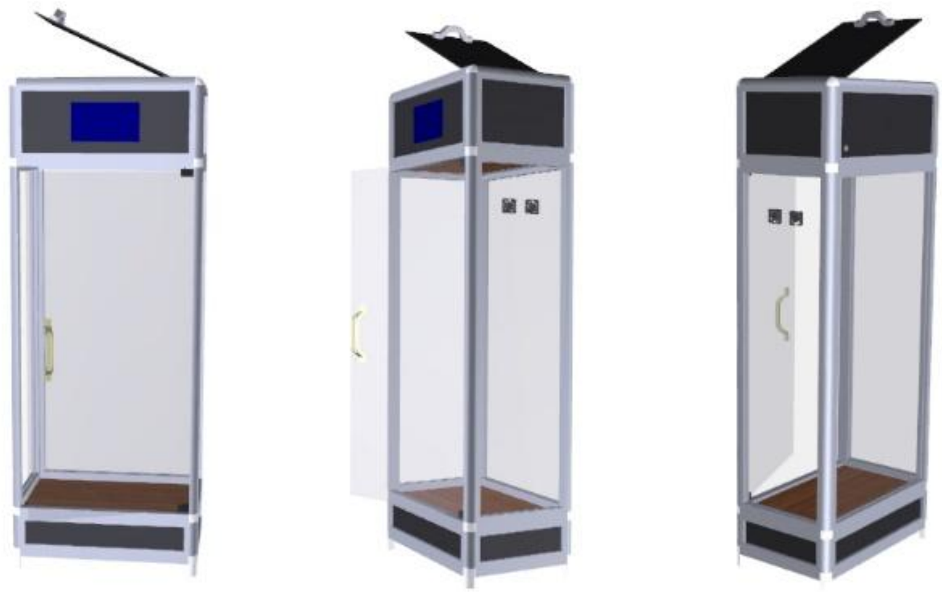

Figure 42 The final design

The top is designed to host all the electrical components, the middle is for the plans and in the bottom we are going to install a water tank.

2.3.Program design

The program of our system is divided into two major parts, the controlling interface, and the web server

- **The controlling interface**

The figure below illustrate the function principle of the controlling interface

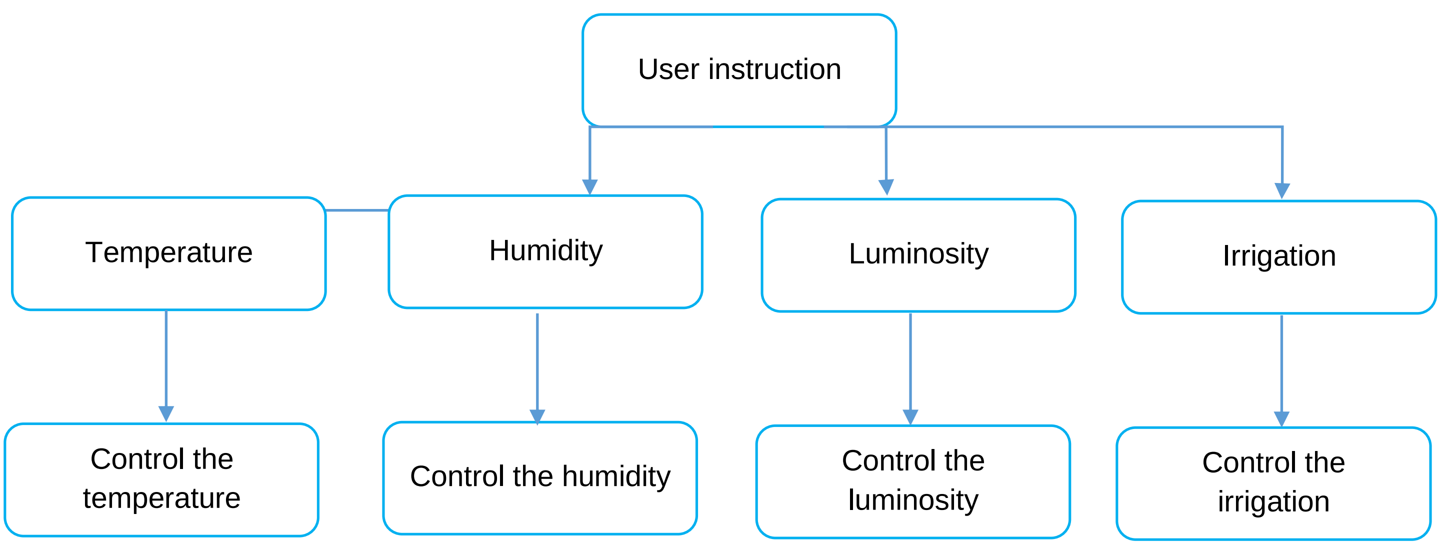

Figure 43 The function principle of the controlling interface

- **The web server**

The figure below illustrate the function principle of the web server.

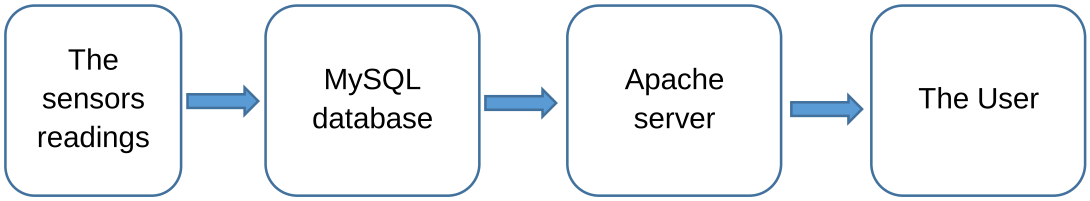

Figure 44 The principle of the web server

Conclusion

We detailed in this chapter the different stages we went through to design our project, so after this study we move on to the last chapter which will be dedicated to the realization of our project.

Chapter IV Realization

Introduction

In this chapter we are going to illustrate the realization of our project, this chapter is divided into four parts , first we are going to describe the program development and the user interface realization , then mechanical realization after that the electrical, and finally the assembly.

1. The program development

The program development went through many stages from learning the python language to designing the user interface and testing the different components, the illustration below show the user interface and the development framework.

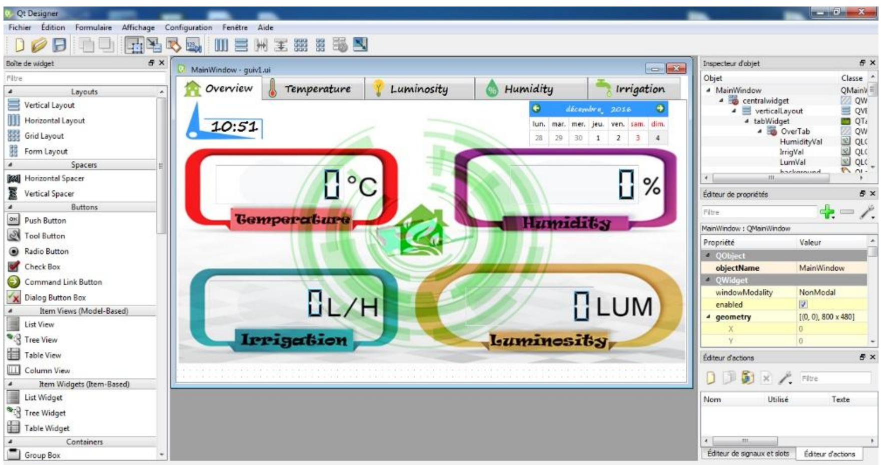

Figure 45 The user interface development

The figure below illustrates Pycharm IDE, which we used to develop our main program .

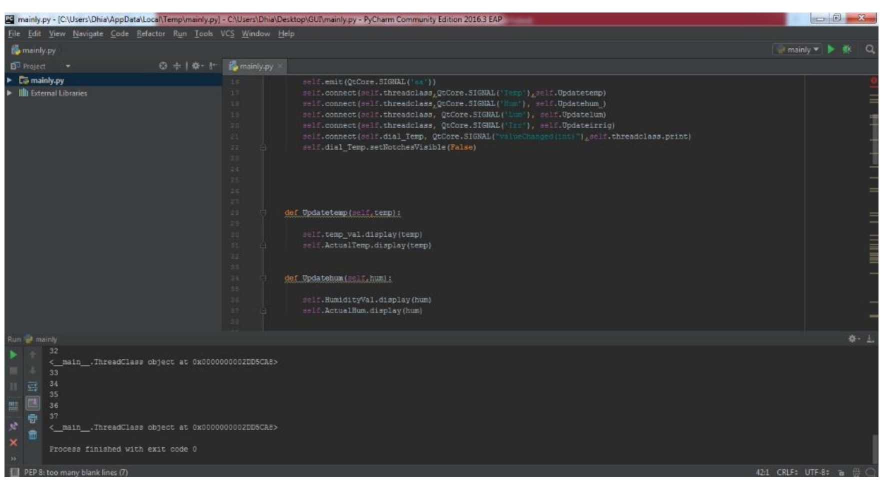

Figure 46 The main program development

After developing our main application we had to develop the web application wich will allow the user to remotely monitor the system.

The illustration below show the development of our web server.

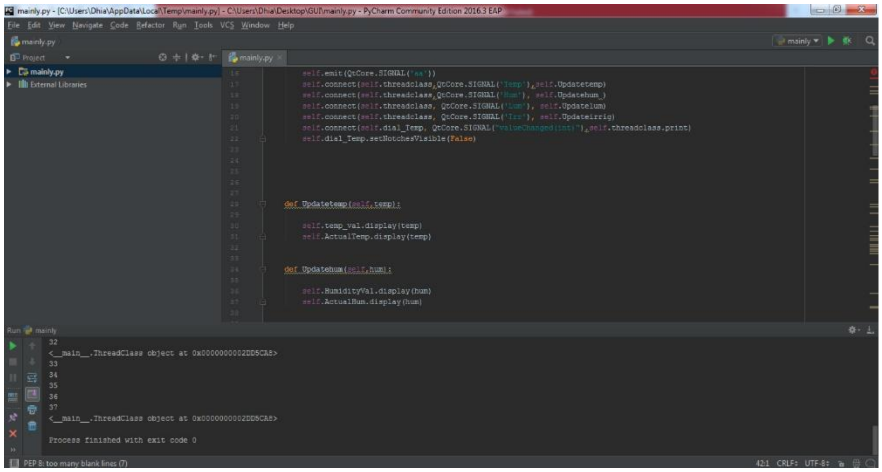

Figure 47 Web development

2. Electrical realization

After designing our boards we had to print them and then solder the components on them, the figures below illustrates the printed boards then the boards with the components.

Figure 48 The printed boards

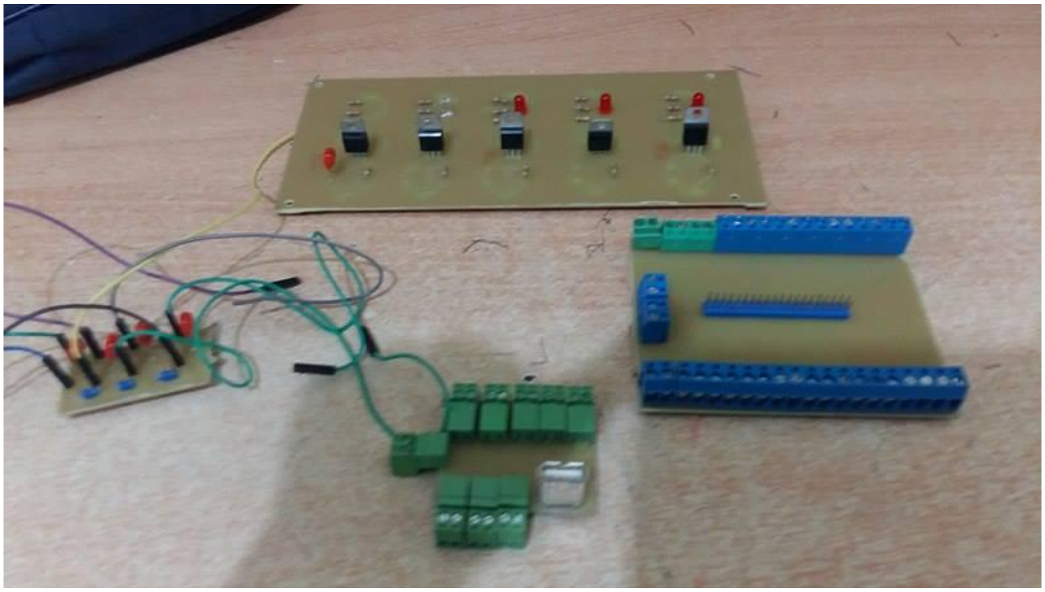

Figure 49 The boards after soldering the components

We connected the raspberry pi to the touch screen, which will allow the user to interact with our system the figure below illustrate the raspberry with the touch screen.

Figure 50 The raspberry pi connected to the touch screen

3. Mechanical realization

Due to financial problems we had to use an old build and adapt it to our need.

In the figure below we illustrate the old build on which we are going to operate after we did some modifications and painting.

Figure 51 The old build

General conclusion

Nowadays technology has become a very important factor in our lives, by making hard and repetitive tasks more and easier to do. The main idea of our project is to combine three aspects of technology which are automation, internet and user interfaces and implementing them into an old human task, gardening, to make it a lot easier to perform, and give the user the ability to monitor his garden without being physically present.

The development of our project went through many steps. First we started by a bibliographical study to better understand the different parts of our work and have a clear idea about the history and the new development of each field involved in our project .Then we moved on to the study of need and functions analysis to know exactly our need and define the functions of our project, In the next part we carried out a study to choose the components of our system, first we did a research to find out which components will fit best our system. Then we have chosen our system's parts based on the market availability and on a financial study, after choosing the components of our project, we moved to the last theory part of our work which is the design.
The last part of our work was the realization, in which we applied all the theory work done before, and brought our project to reality.

This project is a combination of many technological aspects, and its main aim is to let the user easily cultivate and monitor plants, yet this actual version of the project could be enhanced by adding more sensors and equipping the system with a camera to broadcast a live feed of the garden letting the user to view his plants from distance.

Bibliography

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Annex

Annex 1

SEBCOM

Société Electro-Benrour com
17, Avenue Ahmed Khabthani
[illegible]

MF : 1260369/B/A/M/000
RIB : BTK 20-008-0502219900072-11

Numéro	Date	N° télécopie client
DE016787	04/10/16	70 685 464
Référence		N° intracom. client
		000823/C/P/M/000

ESPRIT

Z.I. Chotrana II B.P.160
Pôle Technologique- LA GAZELLE
2083 TUNIS

Devis

Référence	Désignation	Qté	Px unitaire	Remise	Montant HT	#
RASP13	Carte raspberry Pi 3	1	138,831		138,831	V01
ARDTFT7	Ecran TFT 7 pouces	1	199,153		199,153	V01
ARD0026	DHT22 capteur d'humidité et température	1	13,983		13,983	V01
LDR7-MM	Photo résistance	4	0,847		3,390	V01
5050-4LED/BL	Module 4 Led Blanc	1	32,203		32,203	V01
VT_YSF8026	Ventilateur 220V/0.07A	2	7,203		14,407	V01

Code	Base	Taux	Taxe	Total HT	Escompte	TIMBRE	Total TTC	Acompte	NET A PAYER
V01	402,967	18,00%	72,533	403,467	0,000	0,500	476,000	0,000	476,000
Total	402,967		72,533						

Conditions de règlement : le 04/10/16 ESPECE

Téléphone : 71 702 283
Télécopie : 70 731 616
Courriel : sseebcom@gmail.com
Site :

Annex 2

STE PORSA SYSTEME

www.porsa-tunisie.com
ROUTE DE RAOUED KM 1.5
2080 ARIANA
B.P 179
Mat.fiscal: TVA0040666K A M 000
R.C 880025

Téléphone : 71762424-71757868
Télécopie : 71762054
Site web:www.porsa-tunisie.com

9998AG
ESPRIT

TEL 94961790
FAX
Mat.fiscal:

Devis

NUMERO	DATE	REFERENCE
D1601588	09/11/16	

Référence	Désignation	Qté	Px unitaire	Remise	Montant HT	TVA
VITRINE	VITRINE ALU BLANC, CONNECT BLANC H:1M30 XL:50CMXP:30CM AVEC ROULETTES SANS REMPLISSAGE	1,00	483,000		483,000	18

DELAIS: JOURS DATE COMMANDE FERME.

AVANCE: 50 % POUR COMMANDE FERME.

SOLDE A L'ENLEVEMENT.

VALIDITE DE L'OFFRE 30 JOURS

Montant Brut	Code	Base	Taux	Montant
483,000	FOD	483,000	1,00%	4,830
	TVA	487,830	18,00%	87,809
	Timbre	0,000		0,500
		Total		93,139

Total HT	Total TTC
483,000	576,139

Arrêtée le Présent devis à la somme de:

Cinq cent soixante seize Dinars cent trente neuf Millimes

PORSA TUNISIE Route de Raoued - Ariana Tél: 71 762 424 / 71 757 868 Fax: 71 762 054

Conditions de règlement :	576,139	09/11/16

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Toute marchandise enlevée n'est , ni reprise, ni échangée