WEST UNIVERSITY OF TIMIŞOARA
FACULTY OF MATHEMATICS AND COMPUTER SCIENCE
BACHELOR STUDY PROGRAM: COMPUTER SCIENCE IN ENGLISH

BACHELOR THESIS

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GRADUATE:
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TIMIŞOARA
2025

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HomeSync

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Abstract

This thesis aims to develop and implement HomeSync, a home automation system that is modular in nature which gives the user power over their own environment. Integrated with a range of sensors and relays, the system allows for control to be over room temperature regulation, plant irrigation, garage door opening/closing and automatic ambient lighting using Raspberry Pi board as Controller. The architecture is designed to be both scalable and flexible, leaving ample room for future growth without limitation on additional functionalities. HomeSync uses a web interface together with mobile app for real time remote monitoring and control- making it an easy to use, and robust solution that appeals. Similarly, using software with integrated interfaces allows all devices in the home to be centrally managed, providing a simple and unified approach to controlling everything in the house.

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Chapter 1

Introduction

1.1 Motivation

Smart home technology is in vogue, and as such, there are certain solutions that may not be affordable or that may not be exhaustive enough for the personalised needs of the user at the moment. Most of the current home automation technologies, apart from being inconvenient, do not support the user in any way. Generally, these systems of home automation are suggested with technology gadgets that are supposed to be purchased by the users. These solutions do not allow the user to build the home of his or her choice because they force the user to work according to a preset framework. Such does not suit the objective of the Smart Home era of completely integrate able solutions.

Among the many factors that encouraged this undertaking was the need to provide an open-source and low cost solution where the users could automate any part of their home as necessary. The app developed in this thesis intends to use this approach in its development, as it is based on the concept of modularity and employs the functionality of various integrated development environments with the Raspberry Pi to provide a coherent system rather than a mere application. This supports the development of a technology that users can utilize in any location, including the bedroom, kitchen, living room, bathroom, and other areas of the home. Being able to view or manage the system remotely through a web browser or smart devices based application increases convenience and hassle-free monitoring thus an enhanced standard of living.

Chapter 2

State of the art

Over the past decade, there has been an emergent interest towards analyzing the application of smart house automation. This involves approaches in the design of such networks and the sensors and instruments incorporated in these systems discussing such issues as voltage trend in source of power and security. This survey shall also discuss closely related works and draw out ideas on related methodologies, recent technologies and creative solutions that can be of use in the development of HomeSync system.

First step is to search what has be done in field your thesis.

2.1 Resources

To understand the current state of the art in home automation systems, scientific articles were consulted from a range of online field, including:

Scientific articles can be found in different online database:

1. ACM Digital Library
2. Annual Reviews
3. IEEE Explore
4. JSTOR (social sciences, arts & humanities)
5. Science Direct
6. Springer Link
7. Wiley InterScience
8. SCOPUS
9. Google Scholar

The research papers and articles consulted can be grouped into several themes, including smart irrigation systems, remote access to smart home controls, security in automation systems, voice command integration, and energy efficiency in home management.

Identify communities on the topic (specific workshops on national and international conferences)

Some of the articles are accessible through university IP.

Some other thesis on the topic an be consulted: `oatd.org`, `openthesis.org`, etc.

2.2 Take notes

2.2.1 Smart Plant Watering System

Manisha Mayuree[MAA19], Priyanka Aishwarya, and Prof. Bagubali A developed a similar system, as described in their research paper. They utilized an Arduino Uno board in conjunction with a water level sensor, a GSM module (for internet connectivity), a moisture sensor, and a motor shield to power the water pump. Their system monitors environmental conditions such as soil moisture, temperature, and humidity to automate plant irrigation. Additionally, the paper mentions that the user is notified when the plant is being watered.

In my contribution, I aim to enhance this concept by integrating the ability to access the system through both a web browser and a mobile app. My model will also include an activity log to track water usage and monitor the tank's water level. Furthermore, I plan to expand upon their design by creating a modular system that supports multiple plants, addressing the limitation of single-purpose usability present in their example.

2.2.2 Cat feeder

A similar approach to an automatic feeding system was developed by Nenny Anggraini, Dzul Fadli Rahman, Luh Kesuma Wardhani, and Nashrul Hakiem, as described in their work Mobile Based Monitoring System for an Automatic Cat Feeder Using Raspberry Pi [PSM+22]. Their system utilized a Raspberry Pi 4 Model B in conjunction with a stepper motor and a webcam to enable remote control functionality. This system demonstrated the feasibility of automating pet feeding processes while providing real-time monitoring capabilities.

In my contribution, I aim to expand upon their approach by developing a fully automated and user-friendly feeding system. My design includes a food storage tank equipped with a servo motor to control the release of cat food into the feeding bowl. During the feeding process, an ultrasonic sensor and a webcam will monitor the cat's activity. The system will take a photograph and record a brief video while the cat is eating, followed by a final image once the cat leaves the feeding area. These features allow the owner to monitor the amount of food consumed. This approach ensures both convenience for the owner and comprehensive monitoring of the feeding process.

2.3 Gaps in Current Systems

The existing solutions found in the previously described research papers could be improoved by centralising everything together.

2.3.1 Proposed System Overview

The proposed system, HomeSync, addresses these gaps by offering a modular, open-source home automation platform. It integrates functionalities such as plant watering system and food dispenser into a single cohesive system managed through a web interface and mobile app.

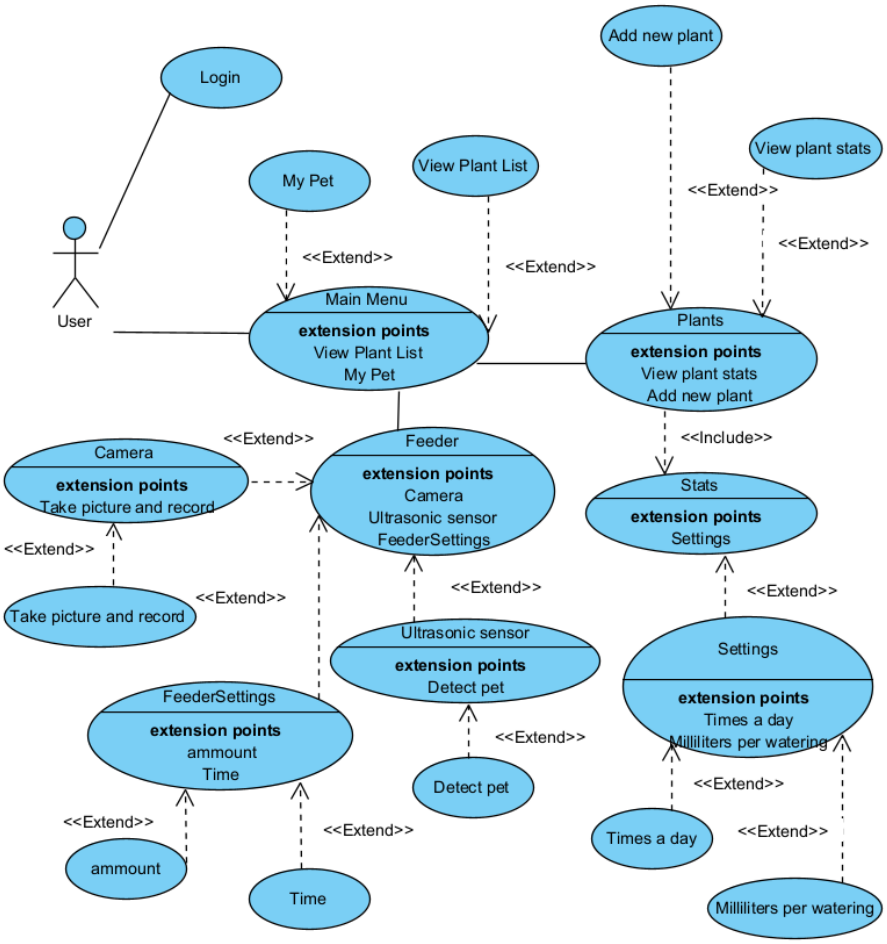
For each read paper try to note information, so you can use later:

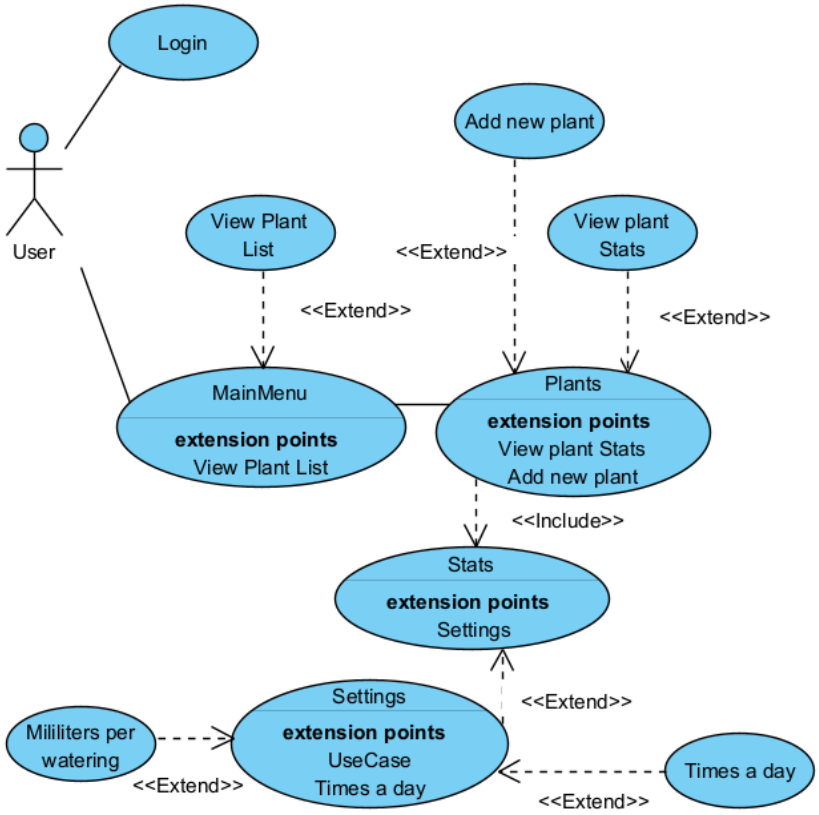
- resource author;
- resource name (article title, book title, ...);
- subject: what is the paper aim;
- addressed problem ;
- methods/methodology used to solve the problem;
- used algorithms;
- test data (e.g. benchmarks, real cases).

For a git resource or an existing application:

- URL;
- application features;
- used technologies.

2.4 Use Case Diagram




Login
Add new plant
User
View Plant List
<<Extend>>
View plant Stats
<<Extend>>
<<Extend>>
MainMenu
extension points
View Plant List
Plants
extension points
View plant Stats
Add new plant
<<Include>>
Stats
extension points
Settings
Settings
extension points
UseCase
Times a day
<<Extend>>
Mililiters per watering
<<Extend>>
Times a day
<<Extend>>

Chapter 3

Some Latex Statements

In this chapter are presented some useful latex statements in thesis written part.

3.1 Enumeration usage

Enumeration with numeric label:

1. Option 1
2. Option 2
3. Option 3

Enumeration without label:

- Option 1
- Option 2
- Option 3

3.2 If you need to add: definitions, theorems, ...

Definition 3.2.1. ...

Theorem 3.2.1. ...

Proof. ... □

Remark 3.2.1. ...

Example 3.2.1. ...

3.3 References

The bibliography has to be referenced in thesis content using cite (e.g. [**?**]).

3.4 Using figures

Each figure has to have a caption that is a suggestive description of what the picture represents (e.g. Figure 3.1).

Figure 3.1: FMI logo scaled at 25% of text width

3.5 Algorithm pseudo-code

Pseudo-code is a formal way to describe an algorithm, is more clear than a textual description ore code (e.g. Algorithn 1).

Algorithm 1 An algorithm with caption

Require: $n \geq 0$
Ensure: $y = x^n$
1: $y \leftarrow 1$
2: $X \leftarrow x$
3: $N \leftarrow n$
4: **while** $N \neq 0$ **do**
5: **if** N is even **then**
6: $X \leftarrow X \times X$
7: $N \leftarrow \frac{N}{2}$ ▷ This is a comment
8: **else if** N is odd **then**
9: $y \leftarrow y \times X$
10: $N \leftarrow N - 1$
11: **end if**
12: **end while**

3.6 Plan

3.7 Adding code

If it necessary to add some code from the application, do not use print-screens, use listing (e.g. listing 3.1).

Listing 3.1: Un exemplu de cod python

```
1 import numpy as np
```

```
2
3  def incmatrix(genl1,genl2):
4      m = len(genl1)
5      n = len(genl2)
6      M = None #to become the incidence matrix
7      VT = np.zeros((n*m,1), int)  #dummy variable
8
9      #compute the bitwise xor matrix
10     M1 = bitxormatrix(genl1)
11     M2 = np.triu(bitxormatrix(genl2),1)
12
13     for i in range(m-1):
14         for j in range(i+1, m):
15             [r,c] = np.where(M2 == M1[i,j])
16             for k in range(len(r)):
17                 VT[(i)*n + r[k]] = 1;
18                 VT[(i)*n + c[k]] = 1;
19                 VT[(j)*n + r[k]] = 1;
20                 VT[(j)*n + c[k]] = 1;
21
22                 if M is None:
23                     M = np.copy(VT)
24                 else:
25                     M = np.concatenate((M, VT), 1)
26
27                 VT = np.zeros((n*m,1), int)
28
29     return M
```

3.8 Tablels

A simple example of an table (see Table 3.1).

Stopping criteria	**Alg.1**	**Alg.2**	**Alg.3**
MSQ	0.97	0.8	00.60
R2	0.77	0.78	0.54

Table 3.1: Algorithm comparison

For more details regarding how to create a table use the following reference `https://www.overleaf.com/learn/latex/Tables`.

Bibliography

[MAA19] Manisha Mayuree, Priyanka Aishwarya, and Bagubali Annasamy. Automatic plant watering system. In *Proceedings of the ViTECoN 2019*, pages 1–3, 03 2019.

[PSM+22] Heshan Padmasiri, Jithmi Shashirangana, Dulani Meedeniya, Omer Rana, and Charith Perera. Automated license plate recognition for resource-constrained environments. *Sensors*, 22:1434, 02 2022.