

Preliminary Bachelor's Degree Final Project

IoT Solution for Home Food Management



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Contents

Introduction	3
Objectives and Scope of Application	3
Project Description.....	4
Methodology and Work Plan	5
Resources	6
Bibliography	6

Introduction

The Internet of Things (IoT) technology is no longer just a fancy innovation. It's becoming a familiar presence in countless homes, manifesting in various ingenious forms. Among the realms that stand to gain significantly from these IoT solutions is home food management. In a world increasingly attuned to sustainability and efficiency, having tools that help minimize food wastage and optimize usage has become paramount.

In this initial project phase, we propose crafting a prototype for an IoT solution aimed at making home food management a more seamless and efficient process. Our vision is for this prototype to integrate diverse functionalities, turning the ordinary task of managing food at home into a more automated and optimized experience. Picture it as akin to how a Chromecast transforms a regular TV into something resembling a Smart TV.

The core objective of this prototype is to grant typical refrigerators the capabilities of a smart fridge and then take it a step further. By implementing this solution, our aim is to empower users to effortlessly monitor their food consumption, strategically plan purchases and meals for optimal utilization, ultimately saving both time and money. And, of course, contributing to a more sustainable world.

This isn't a one-size-fits-all solution; rather, it's scalable. Whether you're in a cozy home or overseeing a sprawling residence or even managing a bustling catering or restaurant business, this solution is designed to adapt and enhance.

Objectives and Scope of Application

The primary objective of this project is the design and development of a prototype for a food management system in a refrigerator.

As specific objectives, this project will:

- The development of a specific application for use in the prototype. This application aims to manage the logging of food input and extraction from the refrigerator. Additionally, it will serve as a platform to launch recipe queries, featuring an interface tailored for each process.
- Utilize a relational database to store the list of foods.
- Develop a mobile app to check the refrigerator inventory and receive alerts.
- Configure a Cloud Computing server to execute and manage requests launched from the aforementioned applications. This server will also be responsible for querying the employed database.

Project Description

The prototype will be implemented using a Raspberry Pi or a similar alternative (specific model to be determined). This device will run the application and control the hardware responsible for barcode recognition. This setup will enable functionalities such as:

- 1) Keep an inventory of the products available in the refrigerator by scanning their barcode. Utilize Open Food Facts, an open and collaborative database with nearly 3 million records, to identify the product and its characteristics.
- 2) Implement a system of alerts that notifies when the expiration date of any of the products is approaching. For this prototype, the expiration date will be entered manually through a user interface designed to be as simple and intuitive as possible.
- 3) Develop a method to generate QR codes that replace traditional barcodes and include more information about each product, including the expiration date. *
- 4) Demonstrate how to implement RFID technology to store all this information and, additionally, utilize it as an alarm system. *
- 5) Assistance for efficiently managing food purchases, leveraging existing product stocks, and the user's purchase history (frequency of replenishment or depletion for each product).
- 6) Section to record when a specific product has run out, featuring a user-friendly interface to ensure a quick and easy process.
- 7) Timers and step-by-step guided recipes for cooking.
- 8) Recipe suggestions based on the available products or highlighting which ones are missing for a specific recipe.
- 9) Explore the possibility of integrating the system with a voice assistant such as Alexa or Siri.

*(Points 3 and 4 will be developed as business ideas without being implemented in the prototype). **

Methodology and Work Plan

Para cada una de las funcionalidades anteriores se seguirá el siguiente plan de trabajo. De esta forma se aplica una metodología iterativa e incremental, obteniendo pequeños procesos For each of the aforementioned functionalities, the following work plan will be followed. This approach applies an iterative and incremental methodology, obtaining small functional and tested processes. This helps prevent errors from necessitating extensive changes in later stages, as would occur with a waterfall methodology applied to the entire project at once.

ETAPA							
Requirements Analysis							
Prototype Design							
Prototype Development							
Component Integration							
Developed Software integration							
Testing							
Documentation							

1. **Requirements Analysis:** Study of the requirements to be met, functionalities to implement, and definition of necessary materials and components.
2. **Prototype Design:** Choose technologies, development environments, protocols, database models, and platforms that the prototype will utilize. Search for APIs or existing external tools that can enhance its functionalities. (Potential use of the trendy ChatGPT API that could significantly improve the performance of some prototype features.) Design the architecture to implement all the elements and establish their interconnections. Select external hardware and study optimal integration of the previously chosen components.
3. **Prototype Development:** Software development, creation of the database, and establishment of connections between different employed technologies. Assembly of the hardware
4. **Component Integration:** External sensors/scanners that enable obtaining information about the foods will be integrated into the prototype.
5. **Developed Software Integration:** Once the physical components are assembled and the software portion is developed, both parts will be integrated.

Testing and Validation: Tests will be conducted to verify the functionality of the prototype with all possible use cases, subjecting it to anomalous or unlikely situations, and studying its response. This process validates its functionalities or addresses potential flaws.

(I am quite interested in Test-Driven Development practices and am currently learning about them, so I would like to apply them in this development.)

Improvements and Updates (after completing all the previous steps for each functionality): Based on the results obtained in the previous section for each feature, we'll make enhancements to the prototype and keep it up-to-date according to market needs and feedback from potential pilot users. We want to ensure it stays current and remains valuable for those using it.

Resources

The necessary resources for carrying out this project include:

- Infrastructure: a suitable space for designing and developing the project, equipped with a stable and high-quality Internet connection.
- Essential components and hardware for assembling the prototype.
- Software and its development to implement control and management.
- Cloud platform for storing, processing, and managing all collected data.
- A minimum of funding to acquire the necessary components and possibly utilize some external services or tools.

Bibliography

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