Bachelor's Degree in Electronic, Telecommunications and Computers Engineering

P16: Home Energy Management System

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INTRODUCTION

In the current context of seeking sustainable and efficient solutions in the energy sector, European energy cooperatives promote efficiency by implementing innovative systems. Our project introduces a smart home open-source system with sensors to track energy use, empowering users to make informed choices and reduce waste and costs.

OBJECTIVES

- Implementation of an open-source solution;
- Implementation of an embedded circuit;
- Retrieve data using sensors and MCU;
- Deliver data to a Raspberry Pi 4;
- Home Assistant installed on a Raspberry Pi 4;
- Usage of the Home Assistant interface to make decisions.

PROPOSED SOLUTION

After researching candidate components to use in this project, the proposed solution is the system shown in the figure below.

From right to left, an ESP32 is connected to sensors, such as a temperature and humidity sensor, a light sensor and a current sensor.

These sensors make measurements and send them to the ESP32, then send this data to a Raspberry Pi 4, running the Home Assistant application.

The user accesses the client interface of the application where he can see these measurements and take the actions, or program automation. This is done by sending the command from the Home Assistant to a (solid-state) relay, connected to the ESP32 and making it possible to control the said home appliance.

DEVELOPMENTS

As for developments, the ESP32 was already implemented and tested with the temperature and humidity sensor. The light sensor was tested, as well as the current sensor, the PZEM-004T. The relay was also tested and connected to the ESP32. The system was successful in taking these measurements and sending them via a console. Additionally, the Home Assistant application was successfully tested on the Raspberry Pi 4.

CONCLUSION & FUTURE WORK

This project initiated a survey of the required hardware specifications and defined specific milestones to achieve the goal. As for future work, there needs to be a study on the MQTT protocol to support the connection between the ESP32 and the Raspberry Pi 4 running the Home Assistant application. The system then needs to be tested to verify the connectivity and communication between the server and each component.

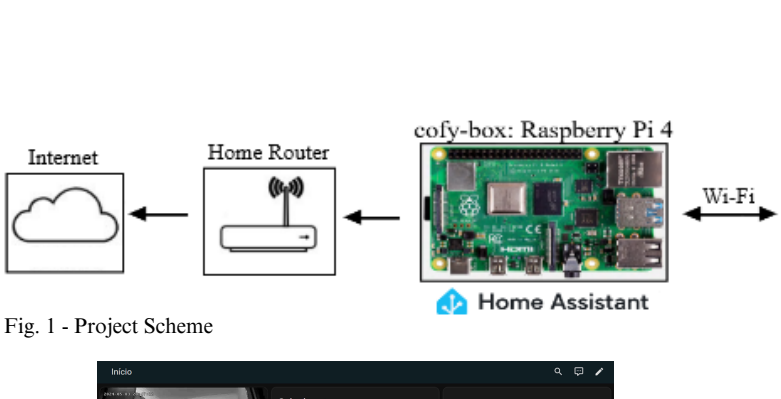

Fig. 1 - Project Scheme

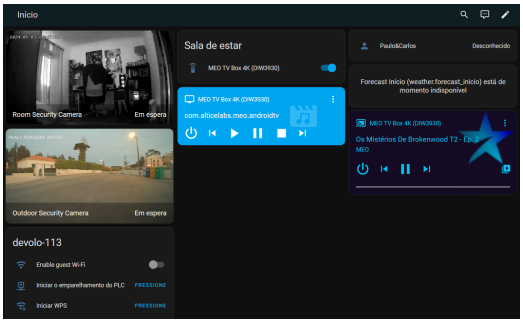

Fig. 2 - Home Assistant Demo

Tasks\Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Task 1 - Literature Review														
Task 2 - Outline and Evaluation of Candidate Solutions														
Task 3 - Definition of the Selected Solution														
Task 4 - Intermediate Report														
Task 5 - Implementation of the Selected Solution														
Task 6 - Presentation of the First Demo														
Task 7 - Testing of All Sensors														
Task 8 - Internet Connection Between Server and Cofy-Cookies														
Task 9 - Result Analysis														
Task 10 - Final Report														

Fig. 3 - Task Schedule