Automated Alarm System

Monitoring Smart Home Security (Team 12)

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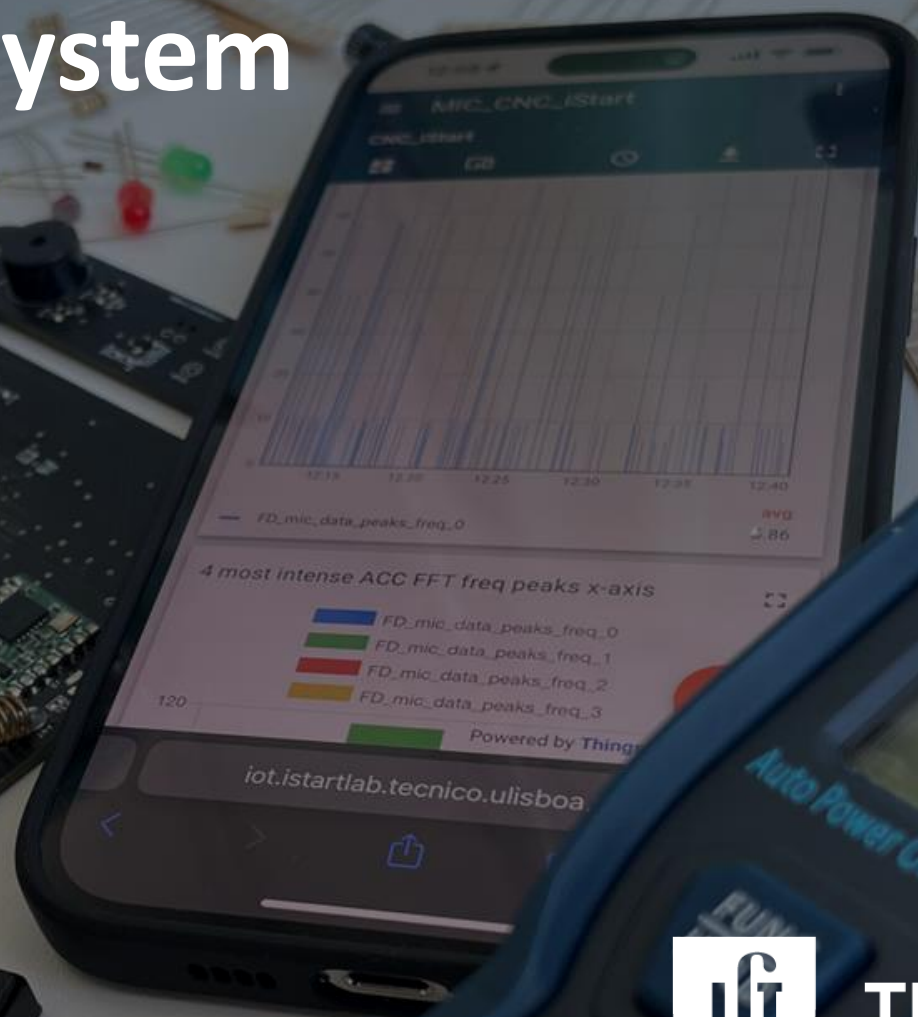
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TÉCNICO LISBOA

1. Advisors and Mentor

- Scientific Advisor: Prof. Luís M. Correia

- Scientific Co-advisor:

- Coordinator: Prof. Luís M. Correia

- Mentor:Prof. João Felício

2. Problem definition

Nowadays most alarm systems implemented in people's homes aren't totally automated, needing someone to manually enable or disable them. Our focus is to try to maximize the automation of the alarm installed in those places, specially in apartments , while simultaneously making it as robust and reliable as possible. To increase its authenticity, we are going to compare it to other alarm systems during the testing phase.

A restriction/disadvantage of an automated alarm system might be the cost of its components.

3. Solution beneficiaries

The segment of society who benefits from the alarm are mainly the owners of the buildings where it is installed, as well as their neighborhood.

Anyone who owns a home and is concerned about its safety can benefit from this solution, increasing the reliability of its security. Neighbors of homes that have this solution implemented can also benefit from it, since better security in one home allows better alerts to be given to the neighboring homes.

4. Technological solution (I)

The technical solution for the given problem is the development of an automated alarm system through a central computation unit that supports incoming sensory inputs from a myriad of sensor types, such as through RFID-based sensors, motion sensors, and cameras. As such, the only fully-mandatory requirement in terms of hardware would be a central computer. Said central computer would run software that implements a solution incorporating input from several types of sensors, accounting for implementations where there are more/less sensors installed, and correspondingly adapting said solution. The amount and type of sensors implemented in each scenario can therefore be variable. A particular implementation might use a camera, to provide video to be processed in facial recognition/other video processing algorithms, a motion sensor to track people entering or leaving the house, and RFID technology for ease-of-use of the main users.

The system will also use an app that provides an easy way for users to manage their alarm system, providing information about suspicious activities as well as giving the user control over the system functionalities, such as disabling the alarm after they have been made aware of the possible threat at hand.

4. Technological solution (II)
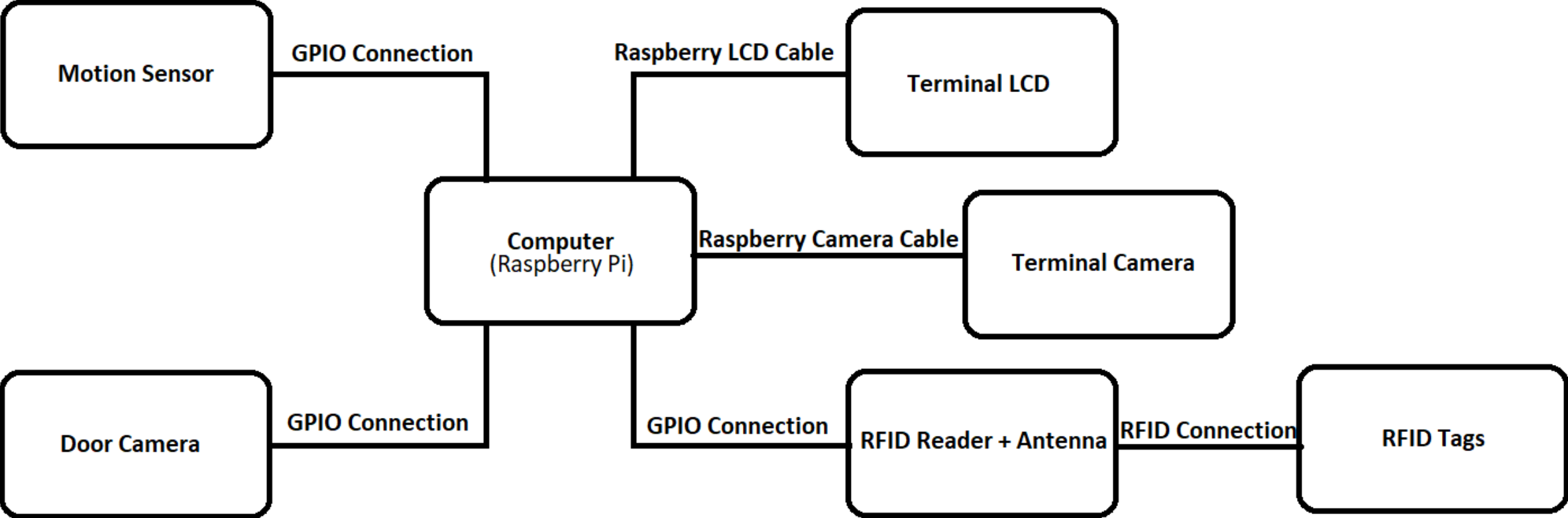
5. Competitors and previous work

Existing alarms end up not being completely automated resulting in the need to manually operate them. Some companies that sell these products are Securitas, Ring, Prosegur, etc.

Site Securitas : https://www.securitasdirect.pt

Site Prosegur : https://alarmes.prosegur.pt

Site Ring : https://eu.ring.com/

Alarms systems that also use RFID technology:

-TV-401, TUYA (TRUVISION)

- NVS-A6WG-U1, TUYA : https://www.nivianhome.com/pt/produto/nvs-a6wg-u1/

6. Solution requirements (I)

Our solution must be robust enough to accurately function in both the most common scenarios and in scenarios where more creative ways to have unauthorized access to the home are attempted. As such, the following parameters must be met:

- **Performance** - The solution must reliably keep track at all times of who is present inside the home, monitoring entrances and exits with high accuracy. The video-processing algorithms used should therefore also work with high accuracy. The system response time should be fast enough to ensure timely alerts, ideally instantaneous.

- **Usability** - The system interface should be user-friendly for easy setup and management.

- **Reliability** - The video-processing algorithms used in the system should operate reliably under various lighting conditions and camera angles.

- **Security** - All data pertaining to users must be securely stored and encrypted, as to preserve privacy. The system must have mechanisms to prevent tampering or hacking.

- **Compatibility** - Ideally, the system should be compatible with most common home security infrastructures and be able to integrate with existing home automation systems, when such an interface is possible.

- **Scalability** - The solution must scale well, in the sense that it must work accurately in both small and large homes. It must also provide a reliable solution, even if with variable levels of accuracy, when implemented with less/more sensory components.

6. Solution requirements (II)

The cameras that are going to be used for the facial recognition should have a minimum resolution of 1080p, a frame rate of at least 30fps and a sensor adaptable to various lighting conditions.

The RFID technology cover frequency ranges from 860 to 960 MHz (UHF). The tags should be able to receive data within 2 meters and be small enough to be easily transportable (0.8 mm).

The most suitable central computation unit for the system is a raspberry pi that coordinates the synchronization between tasks that it has to perform. It should also be able to support inputs from various sources.
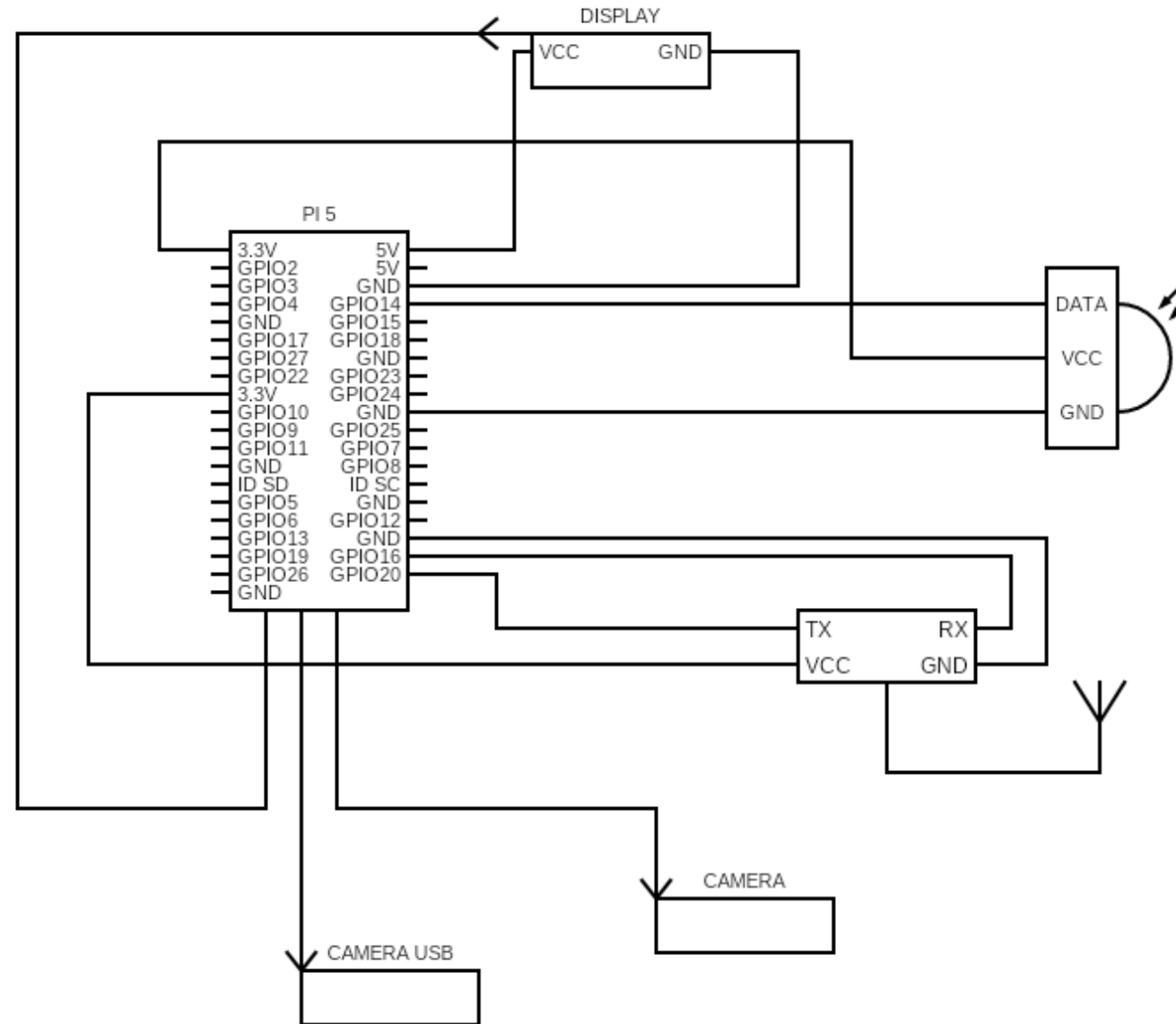
7. Technical challenges

The main challenges of our solution revolve around guaranteeing that the detection mechanism that keeps track of entrances and exits in the home is reliable. Capable intruders might be knowledgeable enough to avoid detection by the motion sensor. Windows or entrances left open might also tamper with said tracking.

The RFID technology can also be viewed as a challenge considering the small distance the antenna can transmit data to the reader/tag. The cameras using the facial recognition technology might not work properly due to ethnicity issues, misidentifying people of color as well as some marginalized groups.

Other technical challenges might emerge along the way of our development.

8. Partners

So far, we have not partnered up with any companies.

Some companies in the home security area or others that operate with the mentioned technologies could provide us with equipment and/or important feedback.

9. Testing and validation metrics

Testing our system will include the regulation of the sensors and the testing of the facial recognition algorithm to ensure its' consistency. The sensor should also be prepared/tested in case there is no Wi-Fi/energy.

Validation metrics:

- Facial Recognition : accuracy and speed of the system, measuring the percentage of correctly identified individuals and how long that recognition takes. The camera's resolution and overall performance can also be considered as a metric.

- RFID Technology : evaluate the response time it takes for the system to grant access after the authentication, the distance between the antenna and the tag and the frequencies used.

- Motion Sensor: the sensitivity of the sensor to detect unauthorized movement without generating false alarms.

10. Division of labor (I)

Miguel Neves	João Saraiva	Gonçalo Amaral
Team Communication, Organization and Leadership	**Software developer**	**Software developer**
Hardware development	Facial recognition	Facial recognition
Prototype Presentation (PPT)	System Tests	Logistics
Data Organizer	Prototype Presentation (Video)	Prototype Presentation (Poster)

11. Division of labor (II)

Pedro Paiva	Francisco Carmo	Francisco Henriques
Webpage Manager	**Hardware developer - Camera**	**Hardware developer - Sensor**
Hardware development	RFID Implementation	Software – Motion Sensor
Webpage Creation	System Tests	System Tests
Prototype presentation (Poster)	Prototype presentation (Video)	Prototype presentation (PPT)

12. Schedule

Diagrama de Gantt