TunisianRepublic

Ministry of Higher Education

and Scientific Research

Higher School of Communication of Tunis

Scope Statement:
Smart Home Surveillance

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General Context

0.1 Introduction

As technology advances, everyday objects are becoming smarter and more connected through the Internet of Things (IoT). This shift is particularly evident in home security, where traditional surveillance systems are evolving to meet modern safety needs.

Smart home surveillance systems enhance security by utilizing advanced features like facial recognition and abnormal activity detection. These systems not only monitor your home but also provide real-time alerts and controls, making them a vital addition to any household.

This project focuses on creating a smart home surveillance system using a Raspberry Pi as the core device. It will include a camera module for facial recognition, allowing secure access to your home, and monitoring capabilities to detect unusual activities when no one is present. A Progressive Web Application (PWA) will enable users to manage and access the system remotely from their devices.

0.2 Objectives

The objectives of this project focus on creating a smart home surveillance system that is secure, scalable, energy-efficient, and user-friendly, integrating advanced features and real-time monitoring capabilities. These goals ensure a high level of security, usability, efficiency, and sustainability.

- **Develop a secure and privacy-focused smart home surveillance system**: Ensure data privacy and local processing for sensitive information.
- **Implement dual-mode operation with energy conservation**: Enable facial recognition for authorized access and anomaly detection when the home is vacant, prioritizing energy efficiency.
- **Create a scalable architecture integrating IoT edge devices, middleware, and cloud services**: Design a flexible system that supports IoT devices and cloud storage for efficient data handling.
- **Provide real-time monitoring and alerts through a responsive PWA interface**: Allow homeowners to manage and monitor their security system remotely from

any device.

0.3 Functionalities

The smart home surveillance system includes several key functionalities aimed at enhancing security and user experience:

- **Facial Recognition for Access Control**: The facial recognition system activates when the homeowner's device approaches the home, as determined by the PWA geolocation services. This enables secure and efficient access to the door based on proximity detection.
- **Abnormal Detection**: If the geolocation indicates that all authorized users are away from home (i.e., no registered devices are present), the abnormal detection mode activates. This mode monitors for unusual activity around the home and promptly sends alerts to the homeowner, ensuring heightened security.
- **Real-Time Monitoring and Alerts**: The system continuously monitors for potential security threats and is capable of sending immediate notifications to the homeowner regarding detected irregularities or suspicious activities, enabling quick responses.
- **Remote Access to Live Feeds**: Homeowners can remotely monitor their property through live camera feeds, allowing them to visually verify alerts or suspicious activities in real-time, facilitating timely interventions.
- **User Control and Status Updates**: Users can manually update their status or switch modes (e.g., set the system to "Home" or "Away") within the application, refining the system's responses based on their preferences.

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Components

Raspberry Pi 4

The **Raspberry Pi 4** is a powerful, compact microcomputer ideal for *IoT* and smart home projects. It features a **quad-core ARM Cortex-A72 processor** at 1.5 GHz and up to **8 GB of RAM**, providing the capability to run machine learning models and handle real-time tasks. Equipped with **USB 3.0 ports**, a **camera interface**, and built-in **Wi-Fi** and **Bluetooth**, it supports fast data transfer and easy integration with IoT devices. This makes it perfect for centralizing and managing smart home surveillance systems.

Camera

The camera should be a **high-resolution digital camera** compatible with the Raspberry Pi, capable of capturing clear images and videos for processing by machine learning models.

Lock Door

Electronic locks that are compatible with *IoT* projects and support remote control.

Relay Module

A relay is required to control high-power devices like locks. The **relay module** acts as a switch, allowing the Raspberry Pi to control the lock mechanism.

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Technologies

Technologies

In order to implement the different home automation functionalities into the mobile application, different technologies will be used to develop this app.

5.1 Back-end

- **MongoDB**: A NoSQL document-oriented database. MongoDB is used to store user data. It is practical and easy to use with Node.js.
- **MQTT**: A lightweight publish-subscribe network protocol used to communicate sensor-collected data to a cloud MQTT broker (Mosquitto).

5.2 Middleware

- **Jakarta EE**: Jakarta EE is a set of software components and APIs for developing specifically enterprise Java applications. These components are often referred to as specifications.
- **WildFly**: Formerly known as JBoss Application Server or JBoss, it is a free Java EE application server written in Java, released under the GNU LGPL license. Being written in Java, WildFly can be used on any operating system providing a Java virtual machine.
- **Mosquitto**: Mosquitto is a widely used MQTT broker, serving as an intermediary for efficient and reliable messaging between IoT devices and the back-end system.

5.3 Front-end

  - **PWA**: Progressive Web Applications are web applications that leverage service workers, manifests, and other web-platform characteristics along with progressive enhancement to provide users with a native app-like experience.

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Architecture

In this project, Cloud of Things technologies will be used. Therefore, the middleware server, the database and the MQTT Broker will all be hosted on cloud.

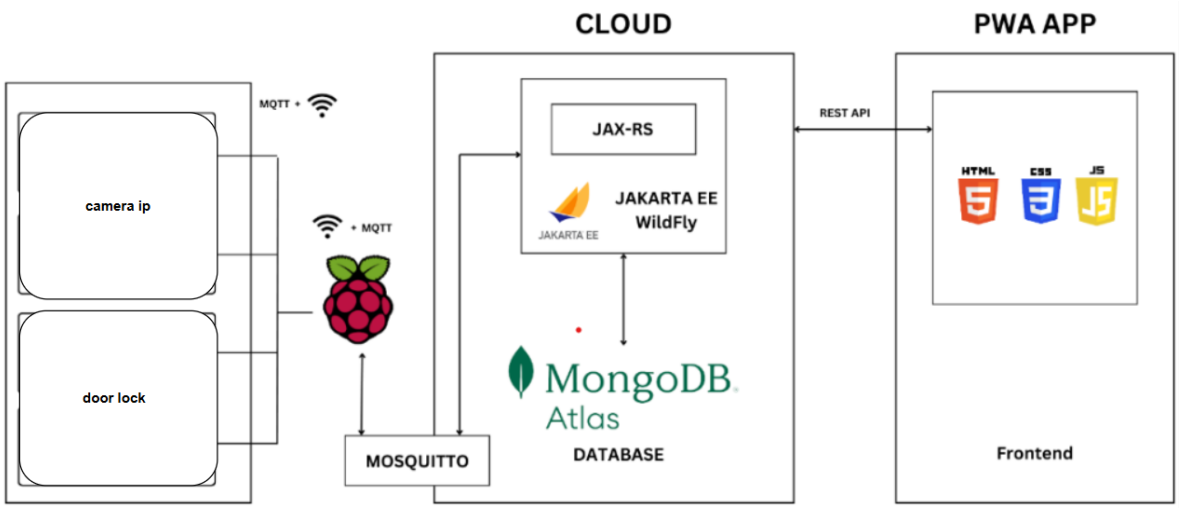

Figure 4.1: project architecture

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Timeline & Tasks

This timeline outlines the critical tasks and milestones for the development and implementation of the smart home surveillance system. Utilizing a Gantt chart template, we will visually represent the sequence of activities required to complete the project effectively. Each phase of the project, from initial planning and system architecture design to sensor integration, software development, and final testing, is carefully scheduled to ensure a structured approach. This timeline will serve as a roadmap, helping to track progress, allocate resources efficiently, and ensure timely completion of deliverables.

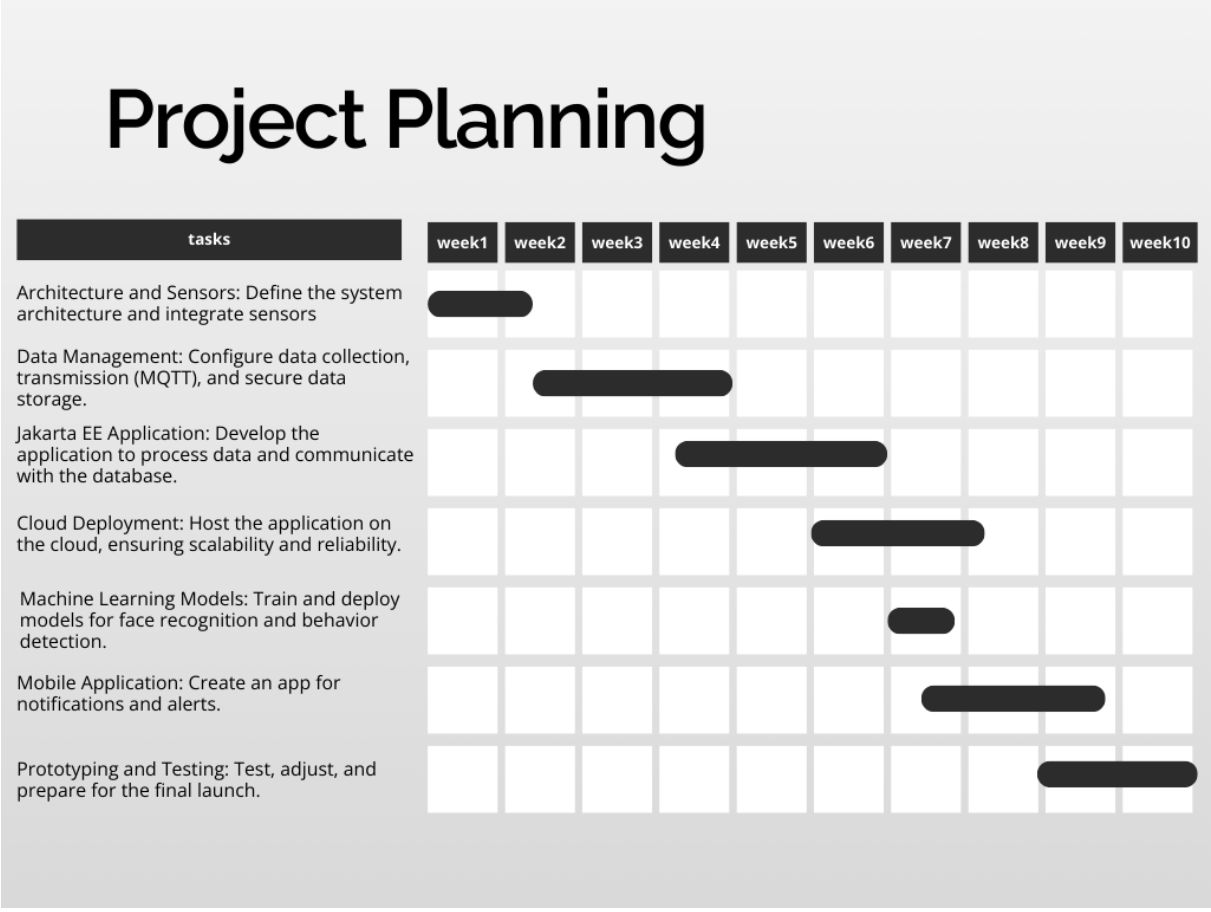

Figure 5.1: Project Timeline

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Deliverables

At the conclusion of the project, the following deliverables will be provided:

- A smart home surveillance application that detects abnormal behavior and recognizes authorized individuals.
- Source code for various components of the surveillance system available on GitHub.
- A design document outlining the application architecture and functionalities through various diagrams.
- A prototype or simulation demonstrating the functionalities of the surveillance system.
- A comprehensive report detailing the system's design, implementation, and operational guidelines, along with a demonstration video.

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Assumptions Constraints

1 Assumptions

The following assumptions have been made regarding the users and system requirements:

- **User Familiarity:** Users are expected to have basic technological skills to interact with the application and hardware.
- **Internet Connectivity:** Users should have stable internet access for optimal cloud functionality and real-time data transmission.
- **User Privacy Awareness:** Users are expected to consent to data collection practices regarding video and behavioral data.

2 Constraints

The project is subject to the following constraints:

- **Budget Limitations:** Project budget constraints may limit hardware and software choices.
- **Technical Limitations:** Edge device processing power may limit the complexity of algorithms for behavior detection and facial recognition.
- **Timeframe:** A defined project timeline may restrict the scope of features that can be implemented.

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Business Study

1 Business Model Canvas (BMC)

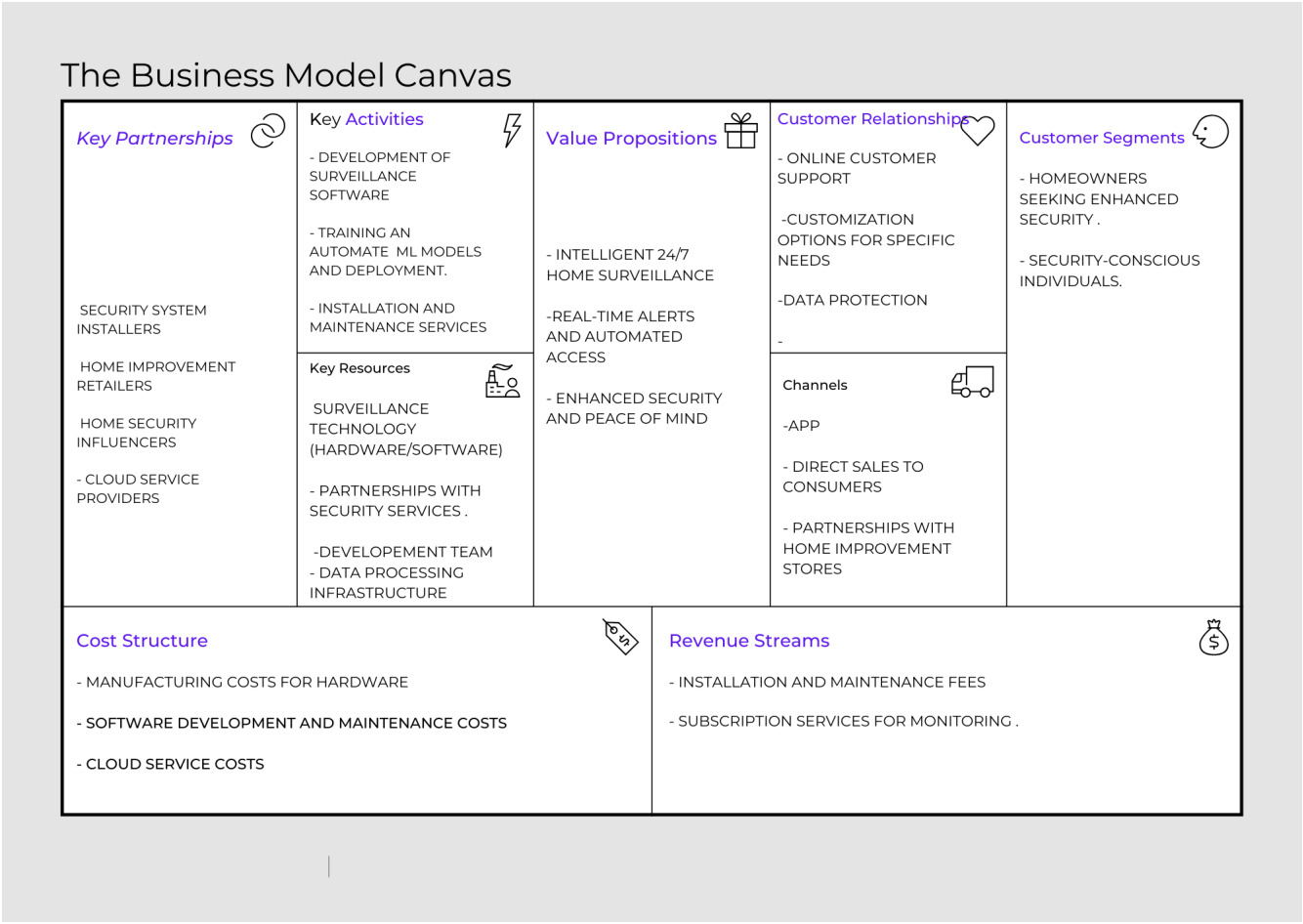

Figure 8.1: Smart Home Surveillance System Business Model Canvas

- **Value Propositions:** 24/7 monitoring, real-time alerts, and automated door unlocking for enhanced security.
- **Customer Segments:** Homeowners and organizations prioritizing safety.
- **Revenue Streams:** Sales of surveillance hardware, software subscriptions.
- **Key Partnerships:** Collaborations with security service providers and technology distributors.

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Marketing Study

1 SWOT Analysis

SWOT analysis is a strategic planning tool used to identify and evaluate the Strengths, Weaknesses, Opportunities, and Threats related to a project or business.

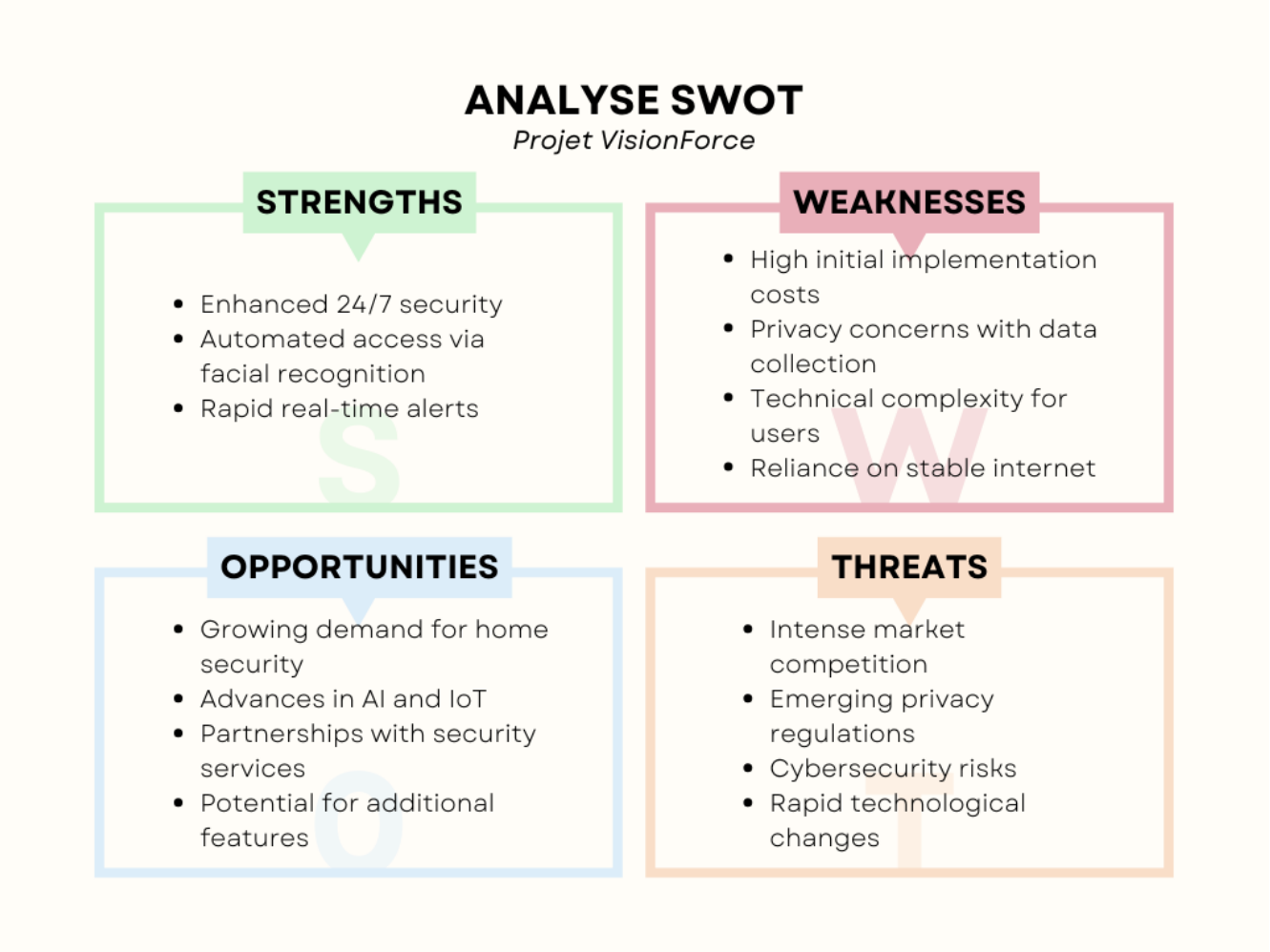

Figure 9.1: SWOT study

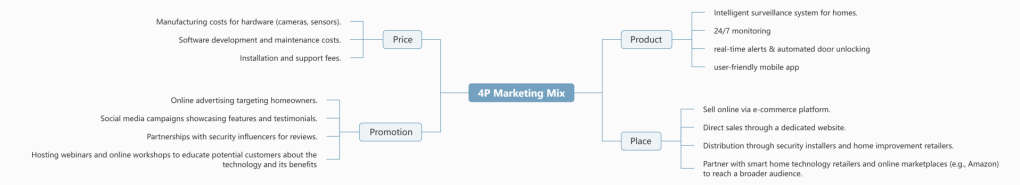

Figure 9.2: 4C Model of Smart Home Surveillance

2 4C Model of Smart Home Surveillance System

- **Customer:** Provides a crucial real-time surveillance service to meet the safety needs of homeowners.
- **Costs:** The system is designed to lower security-related expenses for residents by enhancing preventative measures.
- **Communication:** Facilitates direct interaction with users for immediate alerts and feedback on system performance.
- **Convenience:** Ensures easy access to the mobile application and installation of hardware components through local retailers.