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OPTION: NETWORKS AND DISTRIBUTED SYSTEMS

SUBJECT

Smart homes : Reinventing Real Estate Management with Security and Control

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Abstract

This project aims to design an innovative system integrating automated real estate allocation, remote procedure tracking, and home automation within the context of the Internet of Things (IoT) applied to smart homes. The main objective is to optimize the real estate allocation process by automating complex procedures while offering remote monitoring and intelligent control of properties. This system will explore advanced IoT technologies to create a comprehensive solution that meets the evolving needs of the real estate sector, thereby enhancing operational efficiency and user experience. This project will contribute to the future of the real estate industry by introducing innovative methods of property allocation and intelligent management.

Keywords

Automated Real Estate Allocation, Remote Procedure Tracking, Home Automation, Internet of Things (IoT), Smart Homes, Operational Efficiency, User Experience, Intelligent Management, Property Allocation, Real Estate Sector.

ملخص

هذا المشروع يهدف إلى تصميم نظام مبتكر يتكامل فيه التخصيص التلقائي للعقارات وتتبع الإجراءات عن بعد وأتمتة المنازل في سياق إنترنت الأشياء (IoT) المطبق على المنازل الذكية. الهدف الرئيسي هو تحسين عملية تخصيص العقارات من خلال أتمتة الإجراءات المعقدة مع تقديم مراقبة عن بعد والتحكم الذكي في الممتلكات. سيستكشف هذا النظام تقنيات إنترنت الأشياء المتقدمة لإنشاء حل شامل يلبي احتياجات قطاع العقارات المتطورة، مما يعزز الكفاءة التشغيلية وتجربة المستخدم. سيساهم هذا المشروع في مستقبل صناعة العقارات من خلال تقديم طرق مبتكرة لتخصيص العقارات والإدارة الذكية.

الكلمات المفتاحية

تخصيص العقارات تلقائياً، تتبع الإجراءات عن بُعد، أتمتة المنازل، إنترنت الأشياء (IoT)، المنازل الذكية، كفاءة التشغيل، تجربة المستخدم، إدارة ذكية، تخصيص العقارات، قطاع العقارات.

Résumé

Ce projet vise à concevoir un système novateur intégrant l'allocation automatisée d'immobiliers, le suivi des procédures à distance et la gestion domotique dans le contexte de l'Internet des Objets (IoT) appliqué aux maisons intelligentes. L'objectif principal est d'optimiser le processus d'allocation des biens immobiliers en automatisant les procédures complexes tout en offrant un suivi à distance et un contrôle intelligent des propriétés. Ce système explorera les technologies avancées de l'IoT pour créer une solution complète qui répond aux besoins évolutifs du secteur immobilier, améliorant ainsi l'efficacité opérationnelle et l'expérience des utilisateurs. Ce projet contribuera à l'avenir de l'industrie immobilière en introduisant des méthodes innovantes d'allocation et de gestion intelligente des propriétés.

Mots clés

Allocation automatisée d'immobiliers, Suivi des procédures à distance, Gestion domotique, Internet des Objets (IoT), Maisons intelligentes, Efficacité opérationnelle, Expérience utilisateur, Gestion intelligente, Allocation des propriétés, Secteur immobilier.

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General Introduction

Context

In the dynamic landscape of Algerian real estate, the integration of cutting-edge technologies has emerged as a transformative force, promising to redefine how properties are managed, operated, and experienced. Algeria, with its rich architectural heritage and diverse real estate market encompassing residential, commercial, and industrial properties, stands poised to benefit significantly from innovative technological interventions. By leveraging technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data analytics, and Blockchain, the project aims to revolutionize property management practices across the country.

Problématique

Despite its potential, the Algerian real estate sector faces longstanding challenges that hinder its growth and efficiency. Operational inefficiencies, sustainability concerns, and tenant dissatisfaction are prevalent issues. The traditional methods of property renting and management, such as relying on phone calls for reservations and property viewings, are fraught with uncertainties. Tenants often face issues with unreliable rental reservations, with landlords frequently changing their minds or becoming unreachable. This leads to a lack of trust and a frustrating experience for tenants. On the other hand, landlords waste a significant amount of time contacting tenants, waiting for their arrival, handing over keys, and showing the property. The absence of advanced digital solutions contributes to these inefficiencies, preventing the sector from reaching its full potential.

Solution

Our project aims to harness the power of advanced digital solutions to address these challenges and transform the Algerian real estate sector. By adopting smart real estate solutions, the project aims to streamline operations and enhance efficiency, aligning with Algeria's commitment to sustainability goals. Intelligent building management systems and data-driven insights will optimize resource utilization, reduce energy consumption, and

minimize environmental impact. Additionally, the project aims to enhance the security, comfort, and overall experience of occupants and property stakeholders. By implementing seamless connectivity, predictive maintenance capabilities, and transparent transaction processes, the project seeks to foster a conducive environment for growth and innovation. This comprehensive approach will reduce the time and effort landlords spend on property management tasks and provide tenants with a reliable and efficient renting experience. By driving efficiency, sustainability, and enhanced user experiences, this project represents a pivotal step towards modernizing the real estate sector and setting a benchmark for smart city initiatives in Algeria.

Project Structure

This thesis is divided into four chapters:

- **First chapter:** Discusses IoT technology, its protocols, and its application in real estate management.
- **Second chapter:** Presents a general view about the state of the art, including the problem statement, proposed solution, objectives, different protocols, and similar projects.
- **Third chapter:** Focuses on the conception of our system, including the use of UML modeling.
- **Fourth chapter:** Covers the implementation of our application, development environment.
- **Annex:** a project guide for our startup project .

Chapter 1

Internet Of Things

1.1 Introduction

The Internet of Things (IoT) refers to a network of physical objects equipped with sensors, software, and communication technologies, enabling them to collect and exchange data. Throughout this chapter, we will explore the fundamentals of IoT, its operational mechanisms, its diverse applications, and its implications across various fields.

1.2 Definition of the Internet of Things

The Internet of Things (IoT) is a network of physical objects—such as devices, instruments, vehicles, and buildings—embedded with electronics, software, sensors, and connectivity. This integration allows these objects to collect and exchange data, enabling remote sensing and control. The concept dates back to 1982 with the first internet-connected appliance, a Coke machine at Carnegie Mellon University. Kevin Ashton coined the term "the Internet of Things" to describe this system of interconnected objects.

IoT's key feature is its ability to operate autonomously, without human intervention. Although still developing, IoT has early applications in healthcare, transportation, and automotive industries. Current advancements focus on integrating sensor-equipped objects into the Internet infrastructure.

Challenges in IoT include infrastructure development, communication protocols, interface standardization, and security measures. This paper aims to provide an overview of IoT, covering its fundamental concepts, architecture, terminology, and services.

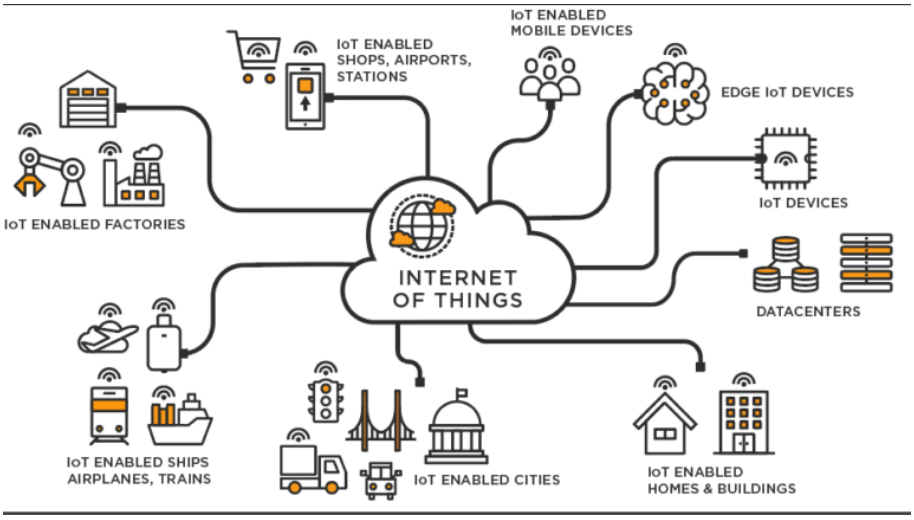

Figure 1.1: Inthernet Of Things([6])

1.3 Evolution of IOT

The Internet of Things (IoT) concept originates from Mark Weiser's vision of "ubiquitous computing" in the late 1980s, envisioning seamless integration of technology into daily life. Coined by Kevin Ashton in 1999, IoT describes a network where physical objects communicate via the internet, marking a pivotal shift towards interconnected devices without direct human intervention. Practical IoT applications began with early examples like a modified Coke machine at Carnegie Mellon University in 1982 and the adoption of RFID technology in the early 2000s. Advancements in sensors and wireless protocols further fueled IoT's expansion, enabling large-scale deployments in monitoring, predictive maintenance, and smart city initiatives. The rise of smartphones and wearables in the 2010s accelerated IoT adoption, transforming how individuals interact with their environment and access personalized services.(26)

This summary captures the evolution of IoT from conceptual origins to practical applications, highlighting key milestones and technological advancements that have shaped its development into the interconnected world we experience today.(26)

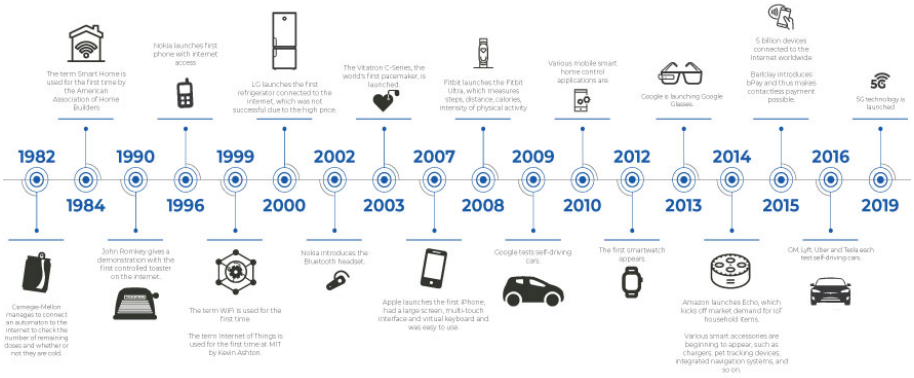

Figure 1.2: Timeline – IoT History(7)

1.4 Architecture Of The Internet of Things (IoT)

The architecture of IoT governs how interconnected devices, networks, and applications interact and communicate, structured across multiple layers to facilitate seamless data flow.

1.4.1 The Three Layer Model

The 3-layer architecture model is foundational in IoT, offering a structured approach to system design:

Perception Layer :

Interfaces between the physical environment and digital IoT systems. It includes sensors for data collection (e.g., temperature, motion) and actuators for physical control.(27)

Network Layer (Transmission Layer):

Manages communication between devices and systems within the IoT ecosystem. Utilizes technologies like WiFi, Bluetooth, and cellular networks (3G/4G/5G) for efficient data exchange.(27)

Application Layer:

Utilizes data from the Perception Layer to deliver value-added services and applications. Includes software applications, analytics engines, and decision-making algorithms across domains like industrial automation, smart cities, and healthcare.(27)

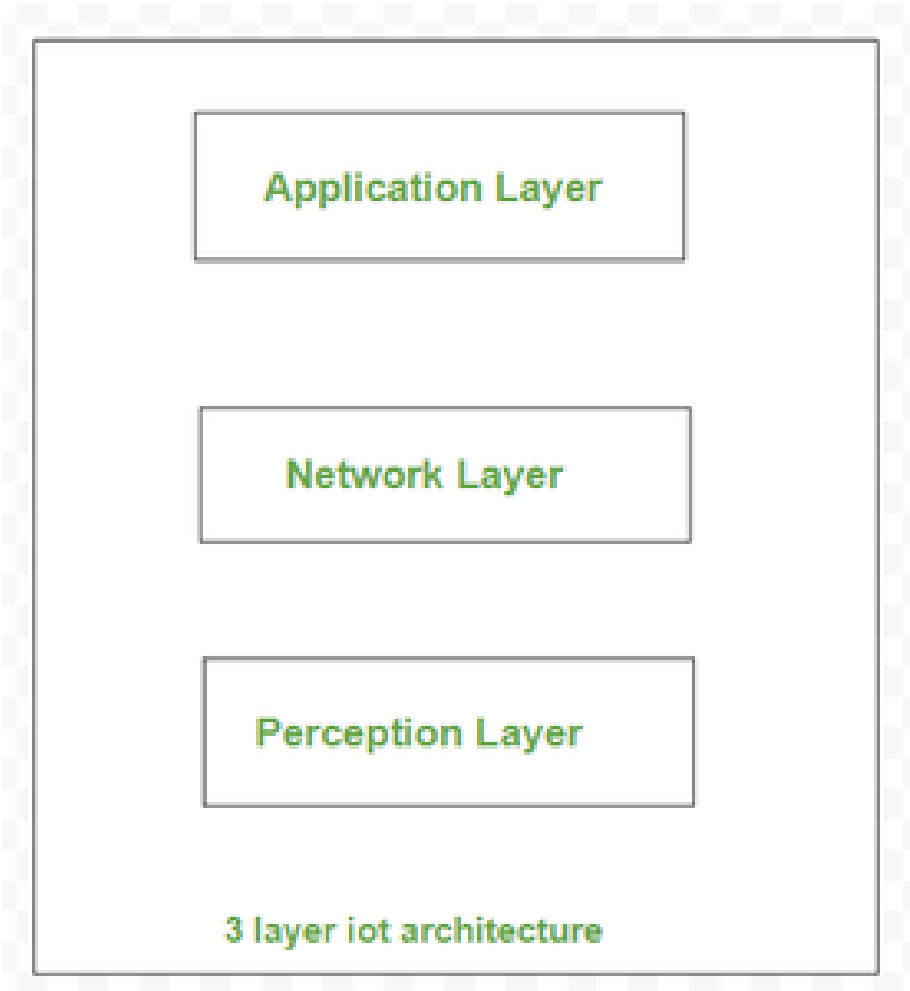

Figure 1.3: The Three Layers Architecture(8)

1.4.2 The Five Layer Model

The Five Layer Model integrates aspects of the TCP/IP model and communication models to meet IoT requirements:

Perception Layer:

Foundation of IoT, deploying sensors and actuators to gather data (e.g., temperature, motion) from the physical environment.

Network Layer:

Handles data transmission from sensors to cloud or edge computing systems using diverse protocols like Wi-Fi, Bluetooth, Zigbee, and LoRaWAN for connectivity.

Data Processing and Analytics Layer:

Core layer where collected data undergoes analysis and processing, employing techniques such as machine learning and big data analytics to derive actionable insights.

Application Layer:

Utilizes insights to deliver value-added services across industries like smart homes, healthcare, transportation, agriculture, and manufacturing.

Security and Privacy Layer:

Integrates mechanisms like encryption, authentication, access control, and device management to ensure data integrity and confidentiality, mitigating cybersecurity risks.

This complex framework enables seamless integration of physical and digital systems, fostering innovative solutions across diverse domains within the IoT ecosystem.

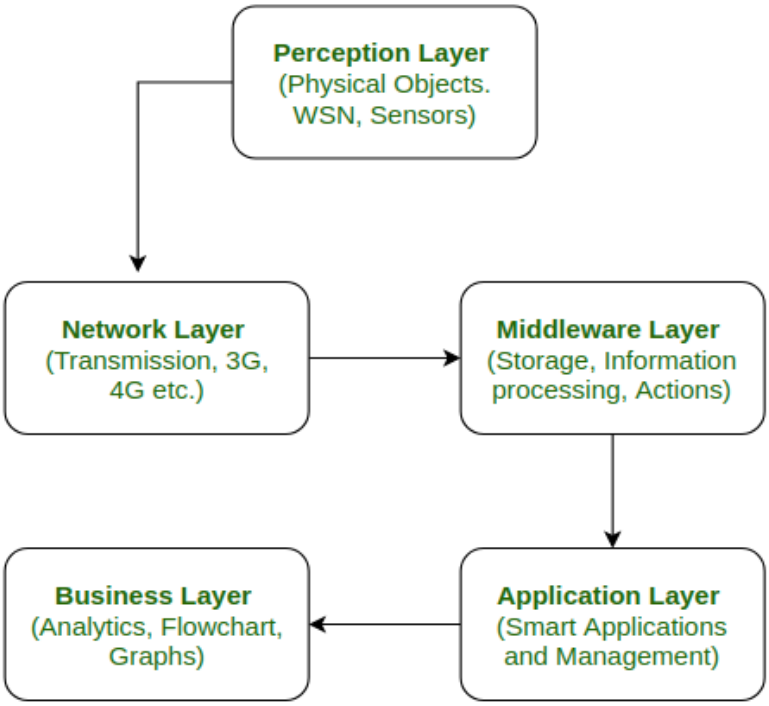

Figure 1.4: The Five Layers Architecture(9)

1.5 Classifications and types of IOT devices

The Internet of Things (IoT) encompasses a diverse array of devices tailored to address various needs and applications. Understanding the types of devices within the IoT landscape provides insight into the breadth and depth of this interconnected ecosystem.

1.5.1 Sensors

Sensors form the backbone of IoT deployments, serving as the eyes and ears of connected systems. These devices detect and measure physical or environmental parameters such as temperature, humidity, light, pressure, motion, and more. Sensors come in various forms, from simple temperature sensors to sophisticated environmental monitoring arrays. Their primary function is to gather real-time data about the surrounding environment, enabling informed decision-making and automation.(28)

Figure 1.5: Sensors (10)

1.5.2 Actuators

Complementing sensors are actuators, which enable physical actions in response to electronic signals or commands. Actuators serve as the hands and feet of IoT systems, translating digital instructions into tangible outcomes. Examples include valves controlling fluid flow, motors driving mechanical motion, relays switching electrical circuits, and locks securing access points. Actuators play a crucial role in implementing automation and remote control capabilities across a wide range of applications, from industrial processes to smart home systems.(29)

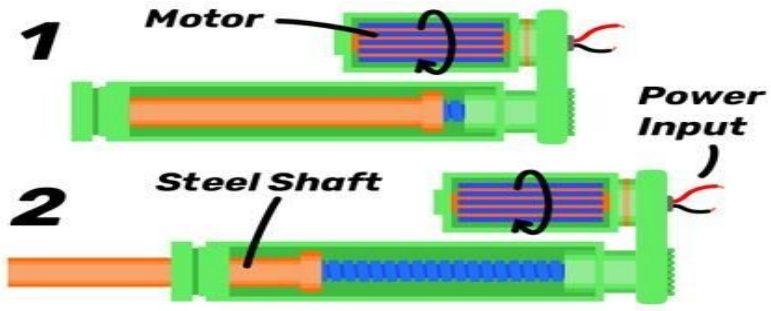

Figure 1.6: Actuator (11)

1.5.3 Wearable Devices

Wearable devices, also known as wearables, have gained significant traction in recent years, revolutionizing personal health and lifestyle management. These compact electronic gadgets are designed to be worn on the body, seamlessly integrating into everyday life. Common examples include smartwatches, fitness bands, smart glasses, and health monitoring patches. Wearables track various biometric data such as heart rate, activity levels, sleep patterns, and more, empowering users to monitor their health in real time and make informed decisions about their well-being.(30)

Figure 1.7: Wearables (12)

1.5.4 Smart Home Devices

Smart home devices are transforming traditional residences into interconnected hubs of automation and convenience. These IoT-enabled gadgets seamlessly integrate into household infrastructure, offering enhanced control and efficiency. From smart thermostats that regulate indoor climate to intelligent lighting systems that adjust brightness based on occupancy, smart home devices optimize energy usage, enhance security, and streamline daily routines. Examples include smart locks, connected appliances, voice-activated assistants, and surveillance cameras, all of which contribute to creating a safer, more comfortable living environment.(31)

Figure 1.8: Smart Home Devices (13)

1.5.5 Industrial Devices

In industrial settings, IoT technology plays a pivotal role in optimizing processes, improving efficiency, and ensuring safety. Industrial IoT (IIoT) devices encompass a wide range of sensors, actuators, and monitoring systems deployed across manufacturing plants, refineries, warehouses, and other industrial facilities. These devices monitor equipment performance, detect anomalies, and facilitate predictive maintenance to minimize downtime and maximize productivity. Examples include pressure sensors, flow meters, vibration monitors, robotic arms, and automated conveyor systems, all interconnected to enable seamless data exchange and decision-making in real time.(32)

1.5.6 Embedded Devices

Embedded devices form the backbone of IoT infrastructure, providing computing, processing, and communication capabilities to interconnected systems. These compact yet powerful devices are integrated into equipment, machinery, and everyday objects, enabling them to participate in the IoT ecosystem. Embedded devices power a wide range of applications, from connected cars and smart appliances to environmental monitoring systems and wearable technology. Their versatility and scalability make them indispensable components of IoT deployments, facilitating seamless connectivity and interoperability across diverse domains.(33)

1.6 The Advantages and Disadvantages of IoT

The Internet of Things (IoT) has gained significant attention in recent years due to its potential to revolutionize various industries and enhance the quality of life for individuals. However, like any emerging technology, IoT comes with its own set of advantages and disadvantages.(34)

1.6.1 Advantages of IoT

- **Efficiency Improvement:** IoT enables automation and optimization of processes, leading to improved efficiency and productivity. For example, in industrial settings, IoT sensors can monitor equipment performance in real-time, allowing for predictive maintenance and minimizing downtime.

- **Enhanced Decision Making:** With the vast amount of data generated by IoT devices, organizations can make data-driven decisions to optimize operations and improve customer experiences. Analyzing data from IoT sensors can provide valuable insights into consumer behavior, market trends, and product performance.

- **Cost Savings:** By streamlining processes and reducing manual intervention, IoT can help businesses save costs. For instance, in agriculture, IoT-enabled precision farming techniques can optimize water usage, reduce wastage, and increase crop yield, resulting in cost savings for farmers.

- **Improved Quality of Life:** IoT applications in healthcare, smart homes, and wearable devices have the potential to enhance the quality of life for individuals. Remote patient monitoring, for example, allows healthcare providers to monitor patients' health in real-time and intervene promptly in case of emergencies.

1.6.2 Disadvantages of IoT

- **Security Concerns:** One of the major challenges facing IoT is the security of data transmitted and stored by interconnected devices. Vulnerabilities in IoT devices can be exploited by malicious actors to gain unauthorized access to sensitive information or launch cyberattacks.
- **Privacy Issues:** IoT devices collect vast amounts of personal data, raising concerns about user privacy and data protection. Unauthorized access to personal information collected by IoT devices can lead to privacy breaches and identity theft.
- **Interoperability Challenges:** As IoT ecosystems grow and diversify, interoperability between different devices and platforms becomes a challenge. Lack of standardized protocols and communication interfaces can hinder the seamless integration of IoT devices and systems.
- **Complexity and Scalability:** Implementing IoT solutions involves dealing with complex networks of interconnected devices, which can be challenging to manage and scale. As the number of IoT devices grows, managing and maintaining them becomes increasingly complex and resource-intensive.

Despite these challenges, the advantages of IoT outweigh the disadvantages, and with proper planning and implementation, IoT has the potential to drive significant advancements in various domains.

1.7 Applications and Use Cases of IoT

The Internet of Things (IoT) has emerged as a transformative technology with diverse applications across various domains. In this section, we will explore several key areas where IoT is making a significant impact.

1.7.1 Smart Home (1)

The smart home of the future is an Internet-connected entity accessible remotely via a smartphone, tablet, or computer. Devices such as doors, televisions, thermostats, refrigerators, umbrellas, and clocks are interconnected, allowing parents to receive alerts via the Internet about their child's arrival at school. Televisions, once mere receivers, become transmitters when connected to the Internet, enabling viewers to send and receive emails and make internet calls. With a smart thermostat connected to the home's Wi-Fi network, temperature control becomes effortless, optimizing comfort and energy savings from anywhere.

A smart refrigerator connected to the Internet and equipped with an RFID system identifies stored items and records information such as storage duration and expiration dates. Users can remotely check the refrigerator's contents before returning home, replenishing missing items either manually or through automated ordering. The smart home integrates various sensors to automate daily tasks, maximizing quality of life through intelligent resource management and security-enhancing decision support services.

Figure 1.9: Smart Home (14)

1.7.2 Agriculture (2)

Agriculture IoT (Internet of Things) is reshaping farming practices by integrating digital sensors and devices to monitor and manage crops and livestock efficiently. Through precision farming techniques, such as soil moisture sensors and drone imaging, farmers can optimize irrigation, detect crop diseases, and enhance yield predictions. Livestock monitoring with wearable IoT devices tracks animal health metrics like body temperature and activity levels, facilitating early disease detection and improving overall herd management. Agriculture IoT also incorporates weather forecasting and climate data analysis to mitigate risks and optimize farming operations, ultimately promoting sustainable and productive agricultural practices.

Figure 1.10: Agriculture IOT (15)

1.7.3 Healthcare (3)

Healthcare IoT (Internet of Things) is revolutionizing patient care and management by leveraging connected devices and sensors to monitor health metrics and enhance treatment outcomes. Wearable IoT devices, such as smartwatches and fitness trackers, collect real-time biometric data like heart rate and sleep patterns, empowering individuals to track their health and fitness goals. Remote patient monitoring systems enable healthcare providers to monitor patients' vital signs and chronic conditions outside traditional clinical settings, facilitating early intervention and personalized care plans. IoT-enabled medical devices, such as insulin pumps and smart inhalers, automate medication delivery and dosage monitoring, improving medication adherence and therapeutic outcomes. Healthcare IoT also integrates telemedicine platforms to connect patients with healthcare professionals virtually, enhancing access to healthcare services and promoting patient-centric care delivery.

Figure 1.11: Healthcare IoT (16)

1.7.4 Industrial (4)

Industrial IoT (Internet of Things) is transforming manufacturing and industrial operations by integrating connected sensors, devices, and systems to optimize production efficiency and ensure operational excellence. Through real-time monitoring and predictive analytics, IoT-enabled sensors track equipment performance and operational parameters, enabling proactive maintenance and minimizing downtime. Industrial IoT facilitates asset tracking and inventory management to streamline supply chain logistics and enhance inventory visibility. Autonomous robots and drones equipped with IoT sensors perform repetitive tasks and inspection activities with precision, improving productivity and workplace safety. IoT-enabled smart factories leverage digital twins and simulation models to simulate production processes and optimize production workflows, promoting agile and adaptive manufacturing practices.

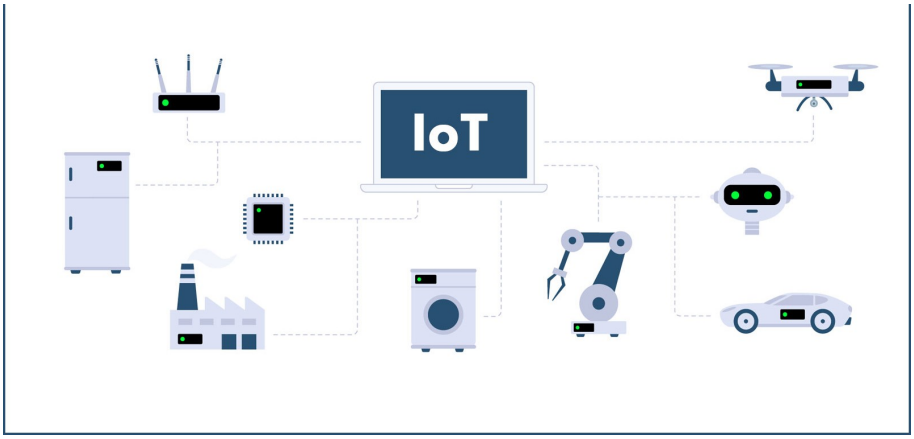

Figure 1.12: Industrial IoT (17)

1.7.5 Real Estate (5)

The IoT landscape is profoundly transforming the real estate sector, enhancing property management, security, and tenant experiences. Key IoT applications in real estate include smart buildings, energy management, predictive maintenance, and tenant experience enhancements.

Figure 1.13: Real Estate (18)

1.8 Conclusion

The Internet of Things (IoT) is a transformative technology that continues to revolutionize various industries and domains, enabling seamless connectivity, data-driven insights, and enhanced operational efficiency. From smart homes and agriculture to healthcare and industrial operations, IoT applications are reshaping business models, optimizing processes, and improving quality of life. While IoT presents numerous benefits, including efficiency improvements, enhanced decision-making, and cost savings, it also poses challenges such as security concerns, privacy issues, and interoperability complexities. Addressing these challenges through robust cybersecurity measures, regulatory frameworks, and standardized protocols is crucial to unlocking the full potential of IoT and ensuring its sustainable growth and adoption across global markets. As IoT continues to evolve and expand its footprint, organizations and individuals alike must embrace innovation, collaboration, and responsible deployment to harness the transformative power of IoT and create a connected world of limitless possibilities.In next chapter we'll be focused on presenting a general view about real estate .

Chapter 2

Real Estate

2.1 Introduction

The real estate industry has undergone significant transformation over the centuries, evolving from basic land ownership concepts to a complex sector encompassing residential, commercial, and industrial properties.

2.2 Definition and Overview of Real Estate

Real estate refers to property consisting of land and the buildings on it, along with its natural resources such as crops, minerals, or water. It also encompasses the business of buying, selling, or renting land, buildings, or housing (35).

2.3 Importance of Real Estate in the Economy

Real estate is a cornerstone of the economy, providing housing, office space, and retail locations essential for everyday life and business operations. It represents a significant portion of individual and corporate wealth and is a key driver of economic growth through construction, sales, and leasing activities. Real estate investment also contributes to capital formation and can provide stable returns through rental income and property appreciation (36).

2.4 Historical Evolution of Real Estate

The real estate industry has undergone significant transformations throughout history, evolving from simple land ownership to a sophisticated sector encompassing residential, commercial, and industrial properties. This section explores the major historical milestones that have shaped the modern real estate landscape.

2.4.1 Early Land Ownership and Agriculture

In ancient times, real estate was primarily associated with land ownership for agricultural purposes. Land was a crucial resource for sustenance and economic activities. Feudal systems in medieval Europe exemplified early structured land ownership, where land was held by lords and worked by serfs (37).

2.4.2 Urbanization and Industrialization

The Industrial Revolution in the 18th and 19th centuries marked a significant shift in real estate. Rapid urbanization led to the development of cities, and real estate became an essential component of urban infrastructure. The rise of factories and the need for worker housing transformed real estate into a dynamic industry, driving economic growth and societal changes (38).

2.4.3 Modern Real Estate Markets

The 20th century saw the emergence of modern real estate markets, characterized by the development of commercial properties, residential complexes, and industrial zones. Key developments included:

- **Suburbanization**: Post-World War II, the growth of suburban areas became a prominent trend, driven by the demand for single-family homes and improved transportation networks (39).
- **Commercial Real Estate**: The rise of office buildings, retail spaces, and shopping malls transformed urban centers and contributed to economic diversification (40).
- **Real Estate Financing**: Innovations in mortgage financing, real estate investment trusts (REITs), and other financial instruments expanded investment opportunities and accessibility to property ownership (41).

2.4.4 Technological Advancements and Smart Real Estate

The 21st century introduced groundbreaking technological advancements that revolutionized the real estate industry. Key trends include:

- **Digital Transformation**: The adoption of digital platforms for property listings, virtual tours, and online transactions streamlined real estate processes and enhanced market transparency (42).
- **Sustainability Initiatives**: Growing awareness of environmental issues led to the integration of green building practices and sustainable design in real estate development (43).
- **Smart Real Estate**: The convergence of IoT, AI, and Big Data has paved the way for smart real estate. Intelligent building systems, energy management solutions, and enhanced security features are transforming property management and tenant experiences (44).

2.4.5 The Future of Real Estate

As technology continues to advance, the future of real estate is poised to be even more dynamic and innovative. Emerging trends such as blockchain for secure transactions, augmented reality for property visualization, and smart cities integrating real estate with urban planning will shape the next phase of evolution in the industry (45).

The historical evolution of real estate demonstrates the sector's adaptability and resilience in the face of changing societal needs, economic shifts, and technological advancements. Understanding this evolution provides valuable insights into the current state and future potential of the real estate industry.

2.5 Overview of Smart Real Estate

Smart real estate refers to the integration of advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data into real estate management and development. This integration aims to improve efficiency, sustainability, and tenant experience in residential, commercial, and industrial properties. Smart real estate leverages technology to create more responsive, efficient, and sustainable buildings, ultimately enhancing the quality of life for occupants and increasing the value of properties (46).

2.6 Transforming Real Estate Management with IoT

The integration of Internet of Things (IoT) technologies into real estate management is transforming the industry by significantly enhancing operational efficiency, sustainability, and tenant experience. By merging IoT with traditional real estate practices, property managers can achieve unprecedented control and monitoring of building systems, leading to substantial energy savings and improved overall building performance. IoT-enabled Building Management Systems (BMS) optimize energy consumption through intelligent control of heating, ventilation, and air conditioning (HVAC) systems, while also enabling real-time energy monitoring and predictive maintenance (47).

However, the integration of IoT into real estate management is not without challenges. Interoperability among diverse IoT devices and systems remains a significant hurdle, due to the lack of standardized communication protocols and architectures. Addressing these challenges necessitates the development of open standards and frameworks to ensure seamless operation and compatibility across IoT ecosystems. Additionally, the extensive data collection capabilities of IoT devices raise serious concerns about data privacy and security. Implementing advanced encryption techniques and secure data storage solutions is crucial to mitigate these risks (48).

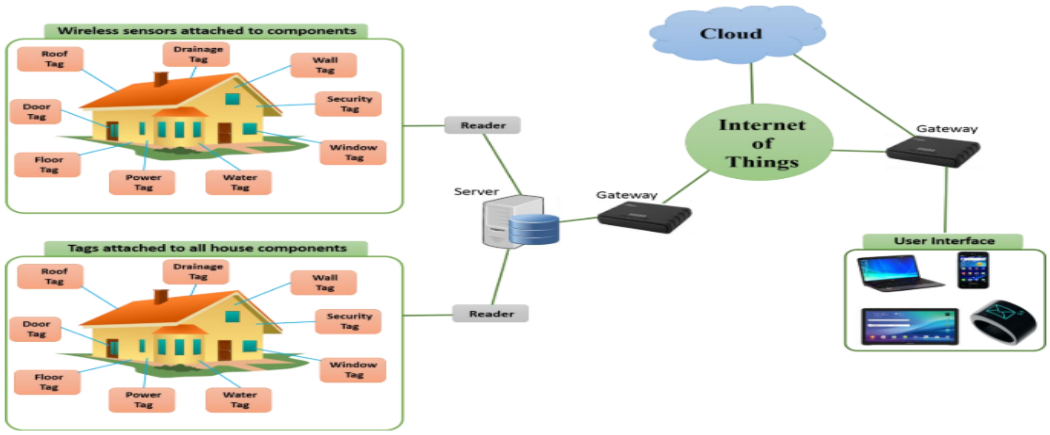

Figure 2.1: Model Architecture for Integrated Smart Real Estate.(19)

2.7 Key Components of Smart Real Estate

2.7.1 Internet of Things (IoT)

Definition

IoT refers to a network of interconnected devices that communicate and exchange data over the internet without human intervention (49).

Application

In real estate, IoT devices include sensors, actuators, and other smart devices that collect and transmit data about the physical environment (e.g., temperature, humidity, energy consumption) to centralized systems for analysis and control (50).

Benefits

IoT enhances operational efficiency, enables predictive maintenance, improves energy management, and enhances tenant experience through smart building features (51).

2.7.2 Artificial Intelligence (AI) and Machine Learning

Definition

AI involves the simulation of human intelligence by machines, while machine learning allows systems to learn from data and make decisions based on patterns and algorithms (52).

Application

AI and machine learning algorithms are used in smart real estate for predictive analytics, demand forecasting, personalized marketing, and automated decision-making processes (53).

Benefits

AI optimizes property management, improves resource allocation, enhances security through technologies like facial recognition and pattern recognition, and provides personalized tenant services (54).

2.7.3 Big Data and Analytics

Definition

Big Data refers to large volumes of data that can be analyzed computationally to reveal patterns, trends, and associations (55).

Application

Real estate utilizes big data analytics to analyze market trends, predict property valuations, optimize leasing strategies, and improve operational efficiencies (56).

Benefits

Big Data facilitates data-driven decision-making, enhances risk management, enables personalized customer experiences, and supports strategic planning and forecasting (57).

2.7.4 Blockchain Technology

Definition

Blockchain is a decentralized digital ledger technology that records transactions across multiple computers in a secure and transparent manner (58).

Application

In real estate, blockchain technology is used for property transactions, smart contracts, title verification, and reducing fraud through immutable records and secure digital identities (59).

Benefits

Blockchain enhances transparency, reduces transaction costs, speeds up transaction processes, mitigates fraud risks, and simplifies property management and ownership transfer (60).

2.7.5 Smart Sensors and Devices

Definition

Smart sensors and devices are physical devices equipped with sensors and actuators that can collect data, process it, and communicate with other devices or systems over the internet (61).

Application

In real estate, smart sensors monitor environmental conditions (e.g., temperature, humidity, air quality), manage energy consumption, control access, and enhance security systems (62).

Benefits

Smart sensors improve building automation, enhance energy efficiency, increase security, provide real-time monitoring, and improve occupant comfort and safety (63).

2.8 Technological Components in Smart Real Estate

2.8.1 Cloud Computing

- **Importance**: Cloud computing provides scalable and flexible data storage solutions necessary for managing vast amounts of data generated by IoT devices (64).
- **Application**: Enables centralized data storage, advanced analytics, and machine learning algorithms to process data efficiently for insights and decision-making (65).
- **Benefits**: Enhances cybersecurity measures, facilitates data-driven decision-making, and supports seamless integration with other smart technologies (66).

2.8.2 Edge Computing

- **Importance**: Edge computing involves processing data closer to its source, reducing latency and improving response times for critical applications (67).
-
- **Application**: Allows real-time data analysis and decision-making at the edge of the network, minimizing bandwidth usage and optimizing system performance (68).
- **Benefits**: Supports applications requiring low latency, enhances privacy by processing sensitive data locally, and improves overall system reliability (69).

Together, these technological components form the backbone of smart real estate infrastructure, enabling efficient management, enhanced functionality, and improved user experiences in modern buildings.

2.9 Challenges and Solutions

2.9.1 Challenges in Smart Real Estate

- **Data Privacy and Security**: Managing large volumes of sensitive data from IoT devices raises concerns about privacy breaches and cyber threats (70).
- **Interoperability Issues**: Compatibility and integration challenges between diverse IoT devices and platforms hinder seamless operations (71).
- **Cost and ROI**: High initial investment costs for implementing smart technologies may pose financial challenges, requiring careful cost-benefit analysis (72).
- **Skill Gap**: The need for skilled personnel to manage and maintain advanced technologies in real estate operations (73).
- **Regulatory Compliance**: Adhering to evolving regulations and standards related to data privacy, energy efficiency, and building codes (74).

2.9.2 Solutions

- **Enhanced Security Measures**: Implementing robust encryption protocols and secure data storage solutions to protect sensitive information (75).
- **Standardization Efforts**: Developing industry standards and protocols to ensure interoperability among IoT devices and systems (76).
- **Cost Efficiency Strategies**: Adopting scalable solutions, conducting thorough cost-benefit analyses, and exploring financing options like energy savings (77).
- **Training and Education**: Investing in workforce development programs and training to build expertise in managing smart real estate technologies (78).
- **Compliance Management Systems**: Implementing automated systems for monitoring and complying with regulatory requirements (79).

2.10 Future Trends in Smart Real Estate

2.10.1 Emerging Technologies

- **AI and Machine Learning**: Advancements in AI for predictive analytics and automation in property management (80).
- **5G Connectivity**: Faster and more reliable internet speeds to support real-time data processing and IoT applications (81).
- **Augmented Reality (AR) and Virtual Reality (VR)**: Enhancing property tours, interior design, and customer experiences (82).
- **Blockchain for Property Transactions**: Transparent and secure transactions, smart contracts, and digital identities (83).

2.10.2 Market Trends

- **Demand for Smart Buildings**: Increasing preference for energy-efficient, sustainable, and technologically advanced buildings (84).
- **Integration with PropTech**: Collaboration between real estate firms and PropTech startups for innovative solutions (85).
- **Focus on User Experience**: Customized services, IoT-enabled amenities, and personalized tenant experiences (86).
- **Global Expansion**: Growth of smart real estate initiatives in major urban centers and emerging markets worldwide (87).

These sections provide an overview of the challenges faced by the smart real estate industry and potential solutions, as well as insights into future trends driven by technological advancements and market demands.

2.11 Similar Projects

It is essential before embarking on the realization of everything project, to carefully study similar projects to benefit from the advantages and avoid malice in this project.

2.11.1 SmartRent

specializes in integrating IoT technology directly into property management for multi-family properties. Their platform enhances operational efficiency and improves resident experience by deploying smart home automation solutions. SmartRent enables property managers to remotely monitor and control various aspects of their properties, such as HVAC systems, access control with smart locks, and security monitoring through integrated IoT devices. This integration not only streamlines property management tasks but also enhances security, energy efficiency, and overall tenant satisfaction by offering modern, connected living experiences.

Figure 2.2: SmartRent([20])

2.11.2 Airbnb

Airbnb has transformed the hospitality and accommodation industry by offering a platform where hosts can list unique properties and travelers can book them for short-term stays worldwide. It facilitates a diverse range of accommodations, from apartments to unconventional options like castles and treehouses.

Unlike some platforms, such as ours which integrate IoT technology for enhanced property management and maintenance, Airbnb does not incorporate IoT features directly into its platform. This distinction positions our project uniquely, as we leverage IoT to provide advanced connectivity and smart features that optimize property management beyond traditional rental services.

Figure 2.3: Airbnb(21)

2.11.3 krello

Kreelo represents a significant value addition and true innovation in the real estate market, specifically in property management in Algeria. It serves as a central hub connecting property owners, tenants, and real estate agents, ensuring user security and data protection.

Unlike some competitors, such as Kreelo, which focuses on traditional property management services, our project integrates IoT technology. This distinction allows us to offer advanced connectivity and smart features for property management and maintenance, enhancing efficiency and convenience for users.

Figure 2.4: krello(22)

2.11.4 Malaaz

Malaz is a notable player in the real estate market, offering a platform for buying, selling, and renting properties. It provides users with access to a range of property listings and facilitates transactions between buyers and sellers. However, unlike some competitors, Malaz does not currently integrate IoT technology into its platform. This distinction means

that while Malaz excels in traditional real estate services and digital transactions, it may not offer the advanced connectivity and smart features that IoT integration can provide in property management and maintenance.

Figure 2.5: Malaaz ([23])

2.11.5 discucion

In contrast to competitors like Kreelo, which emphasizes traditional property management services and SmartRent, which presents a complete IoT integration solution, , our project distinguishes itself by integrating IoT technology. This integration enhances our platform with advanced connectivity and smart features for efficient property management and maintenance, offering enhanced convenience and operational efficiency for users. Similarly, unlike Malaz, which does not currently integrate IoT technology into its platform, our project leverages IoT to provide proactive property management capabilities and personalized tenant experiences, surpassing traditional real estate services and digital transactions. Additionally, unlike platforms such as Airbnb, which do not directly incorporate IoT features, our project uniquely utilizes IoT to optimize property management beyond conventional rental services, ensuring superior connectivity and tailored smart functionalities for enhanced operational effectiveness.

2.12 Conclusion

The evolution of real estate into the realm of smart technology represents a pivotal shift in how properties are managed, operated, and experienced. This chapter has explored various aspects of smart real estate, including its definition, technological components, benefits, challenges, and future trends. As the industry continues to evolve, embracing smart technologies will be essential for enhancing property value, improving operational efficiency, and providing superior tenant experiences. In the next chapter we'll present conception of the whole system. ([88]).

Chapter 3

Design

3.1 Introduction

This chapter will present the design process and highlight the objectives of our platform, its stakeholders, and their needs, which are essential for entering the implementation phase. The assurance of such a task relies primarily on a graphical representation of these needs and all aspects of the system, created using UML diagrams.

3.2 The UML Modeling Language

3.2.1 What is UML

UML, or Unified Modeling Language, is a standardized modeling language used to specify, visualize, design, and document the components of a software system. It provides a set of diagrams to represent different aspects of a system, from its static structure to its dynamic behavior.(89)

3.2.2 Importance of UML

Using UML allows developers and stakeholders to better understand the system's requirements, communicate effectively, and ensure that all aspects of the system are well-defined before starting the development phase. This reduces errors and inconsistencies while facilitating system maintenance and extensibility.(90)

3.3 Justification for choice of UML

In the same way that it is better to draw a house before building it, it is better to model a system before realizing it. In the context of an IT project, using UML modeling provides many advantages, among which we cite:

- UML allows for greater precision, encourages the use of tools, and thereby ensures stability.
- It is an effective communication support:
- It frames the analysis and facilitates the understanding of complex abstract representations. Its versatility and flexibility make it a universal language.

3.4 Identification of Actors

An actor represents a role played by an external entity that interacts directly with the system studied. In our case, we have three actors:

User(visitor) : An unauthenticated person accessing the site for the first time.

Client : Individuals or entities who own or seek to rent residential or commercial properties through the platform.

Admin : Platform administrators responsible for managing user accounts, property listings, and overall platform functionality.

3.5 Design Overview of our platform

Our platform aims to revolutionize property management by providing a comprehensive solution that streamlines processes, enhances collaboration, and improves efficiency for property owners, managers, tenants, and real estate agents. With a focus on automation, transparency, and compliance, the platform seeks to simplify tasks such as listing management, tenant onboarding, rent collection, and maintenance tracking. By offering real-time access to property data, financial information, and communication logs, it fosters transparency and trust among stakeholders. Moreover, the platform prioritizes tenant experience through self-service functionalities and ensures compliance with regulatory requirements. Through data-driven insights and scalability, our platform empowers stakeholders to make informed decisions and adapt to evolving property portfolios effectively.

3.6 Different Types of UML Diagrams

UML offers a variety of diagrams to capture different aspects of a software system:

Use Case Diagrams :

A use case diagram is a graphical representation that shows how a system interacts with external actors. The use case diagram is a useful tool for defining and understanding the needs and interactions of users with a software system or process.(91)

1 -Use Case Diagram for the Admin :

This diagram illustrates the use cases associated with the Admin :

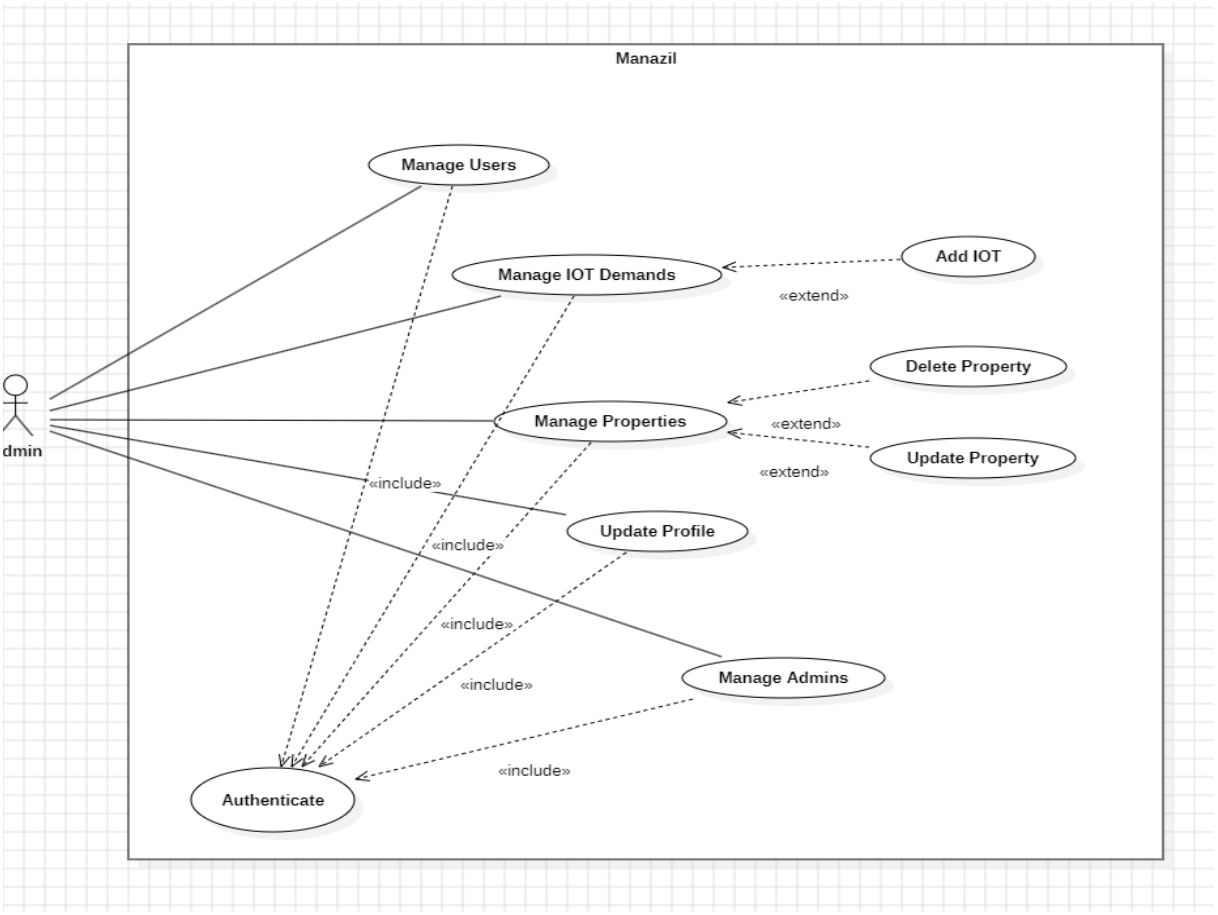

Figure 3.1: Admin Use case Diagram

2 - Use Case Diagram for the User :

This diagram illustrates the use cases associated with the User :

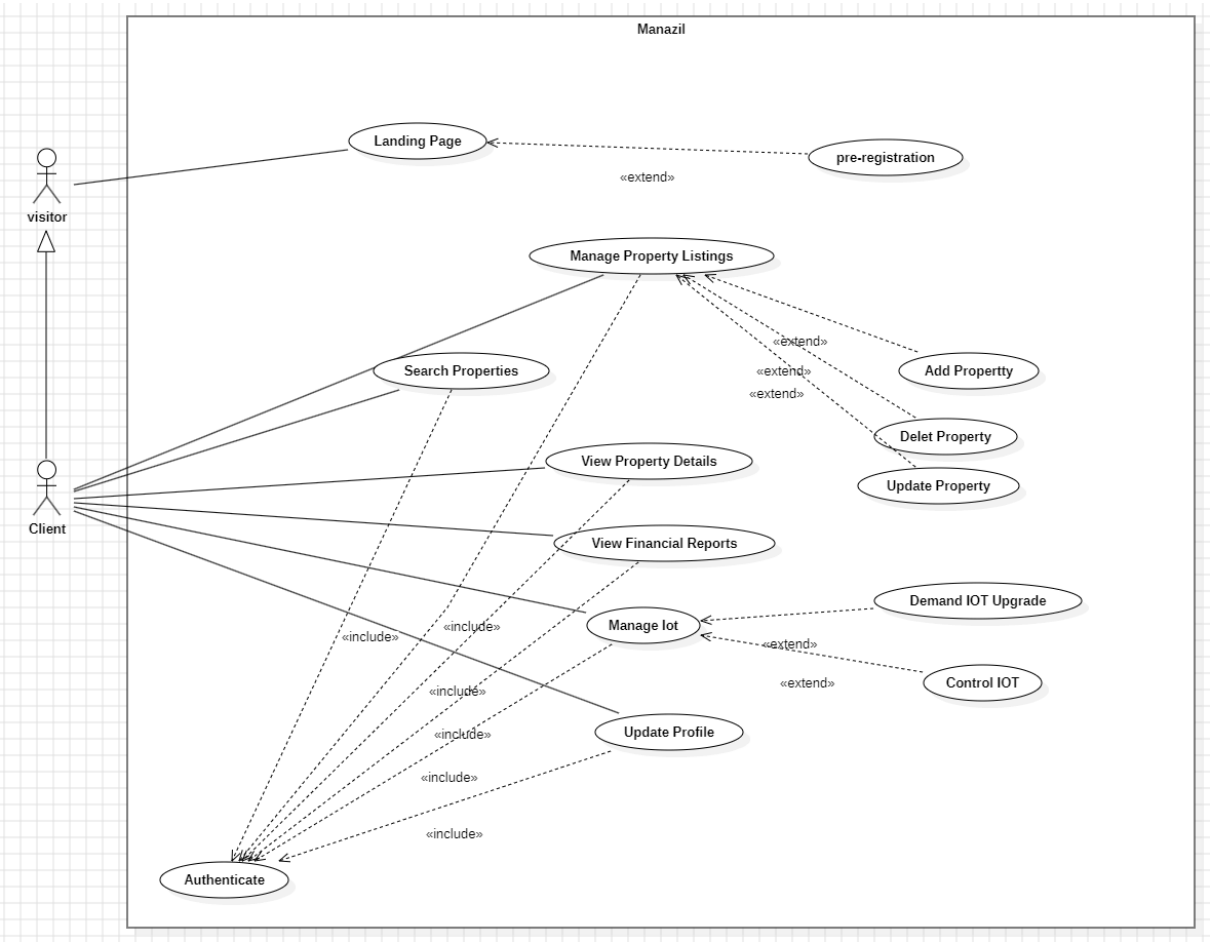

Figure 3.2: Client Use case Diagram

Text description of use cases :

Use case	pre-registration
Actor	Visitor (User)
Precondition	Availability of access to the internet network Server accessible 24/7 The system in working order
Post-condition	Registration of a new user.
Nominal scenario	1. The user accesses the Sign-Up page by clicking the sign-up link. 2. The system displays the Sign-Up page along with the sign-up form. 3. The user fills out the form and requests the system to validate. 4. The system verifies the provided data. 5. The user accesses their account.
Alternative scenario	**A1: Missing information in the form.** 1. Display error message "Please fill in the missing information." 2. The nominal scenario returns to step 4.

Figure 3.3: Text description of the “pre-registration” case

Use case	Authenticate
Actor	Administrator, User
Precondition	1. Availability of access to the internet. 2. Server accessible 24/7. 3. Browser in good working condition.
Post-condition	• Access to the account on the site. • Issuance of a JWT (JSON Web Token).
Nominal scenario	1. User launches the browser. 2. User enters the URL of the site. 3. The system displays the authentication form. 4. User enters login and password and submits. 5. The system verifies the login and password. 6. The system issues a JWT to the user and displays the corresponding interface.
Alternative scenario	**A1: Authentication for the site** 1. Administrator enters the URL of the site. Go to step 3. **A2: Password verification on the server** 1. The system displays an error message. Go to step 3.

Figure 3.4: Text description of the “Authenticate” case

Use Case	ADD IOT
Actor	**Administrateur,**
Precondition	• Internet access available. • Server accessible 24/7. • Functional web browser. • IoT devices connected and operational for enhanced property management features.
Post-condition:	• Access to the site account. • Session opened. • IoT devices ready for interaction and management.
Scenario nominale	1. The admin launches the web browser. 2. The admin enters the site's URL. 3. The system displays the authentication form. 4. The admin enters their login and password and submits. 5. The system verifies the login and password. 6. The admin enter demand page . 7. Select a demand 8. Fill the form
Scenario alternatif	➢ A1 : Authentication for the site. 1. The administrator enters the site's URL. 2. Proceed to step 3. ➢ A2 : Password verification at the server level. 1. Proceed to the step following step 5. 2. The system displays an error message. 3. Proceed to step 3.

Figure 3.5: Text description of the “ADD IOT” case

Class Diagram :

Used to graphically represent the static structure of a software system, a class diagram illustrates the classes of the system, the relationships between these classes, as well as the attributes and methods associated with each class. A class diagram provides a static view of a system, showing the classes, their attributes, methods, and relationships. This helps developers understand the system's structure and design effective software solutions.(92)

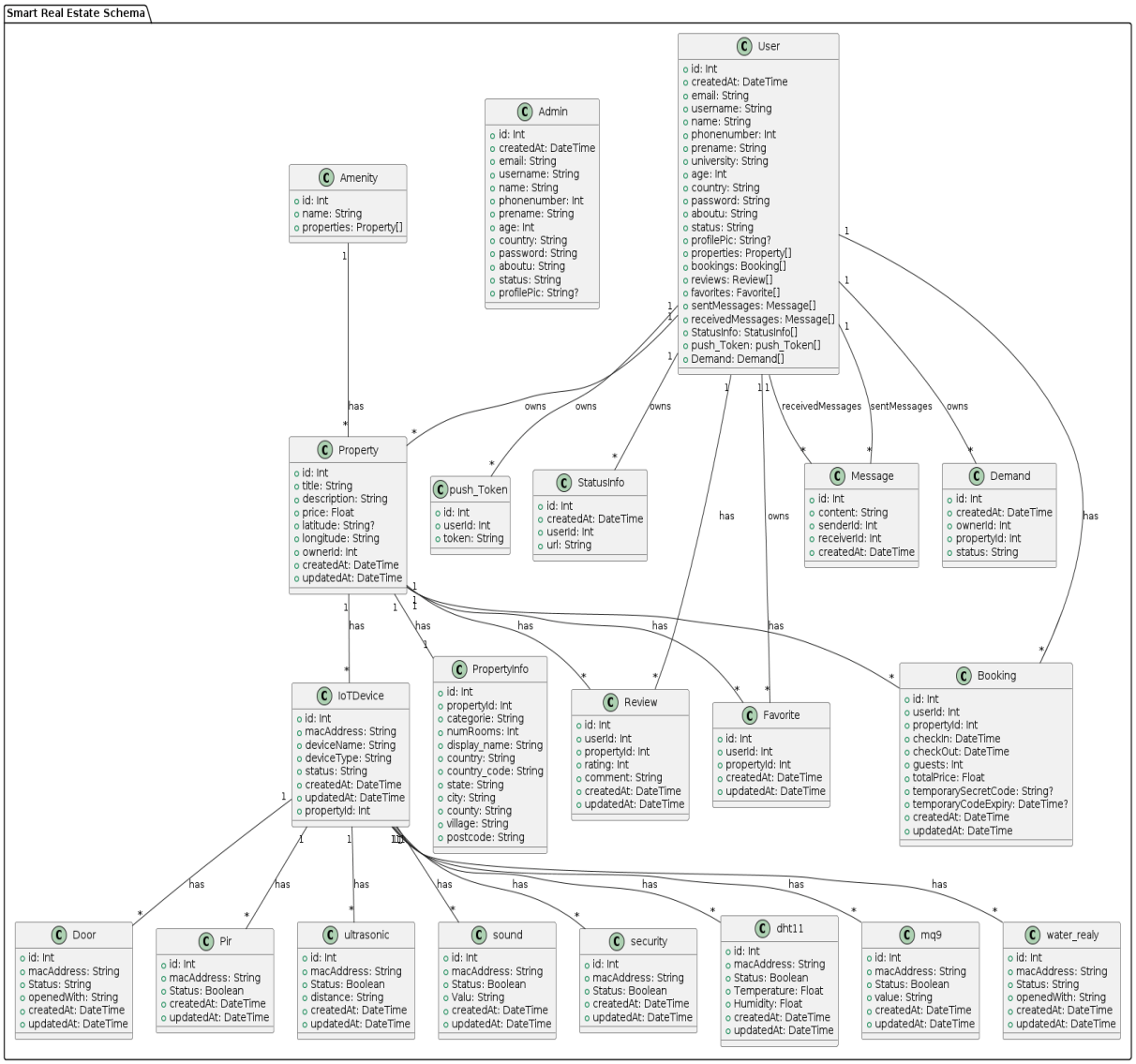

Figure 3.6: Class Diagram

Sequence diagram :

A sequence diagram is used to represent interactions between objects or components in a system over time. It illustrates the flow of messages between these objects and the order in which they occur.(92)

Signin Sequence diagram :

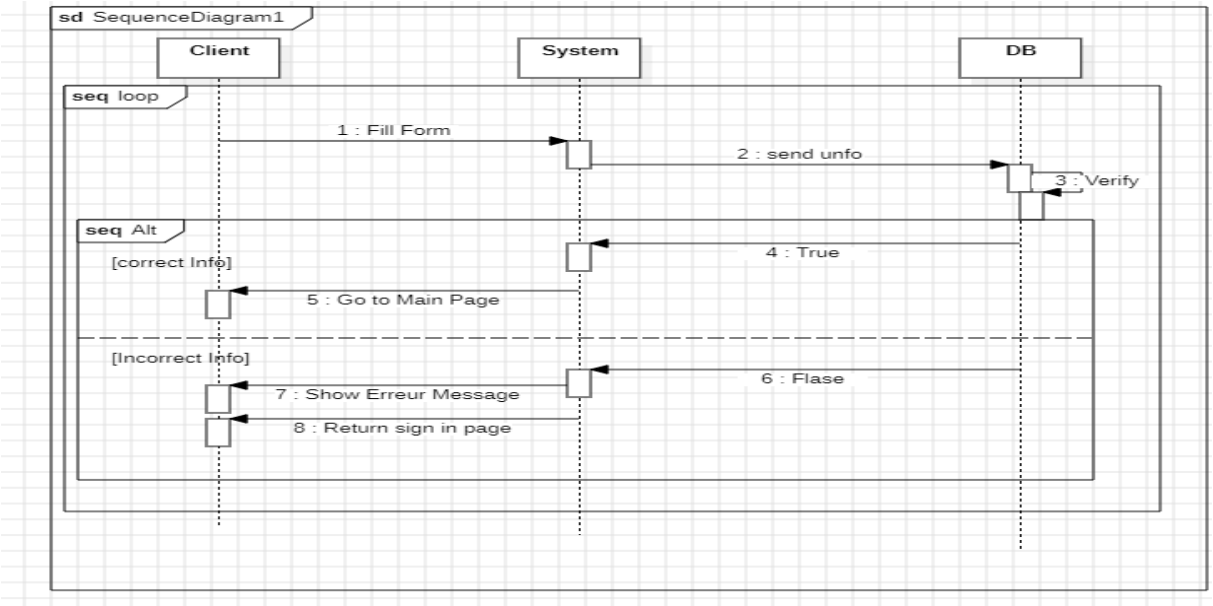

Figure 3.7: Sign In

ADD Property diagram :

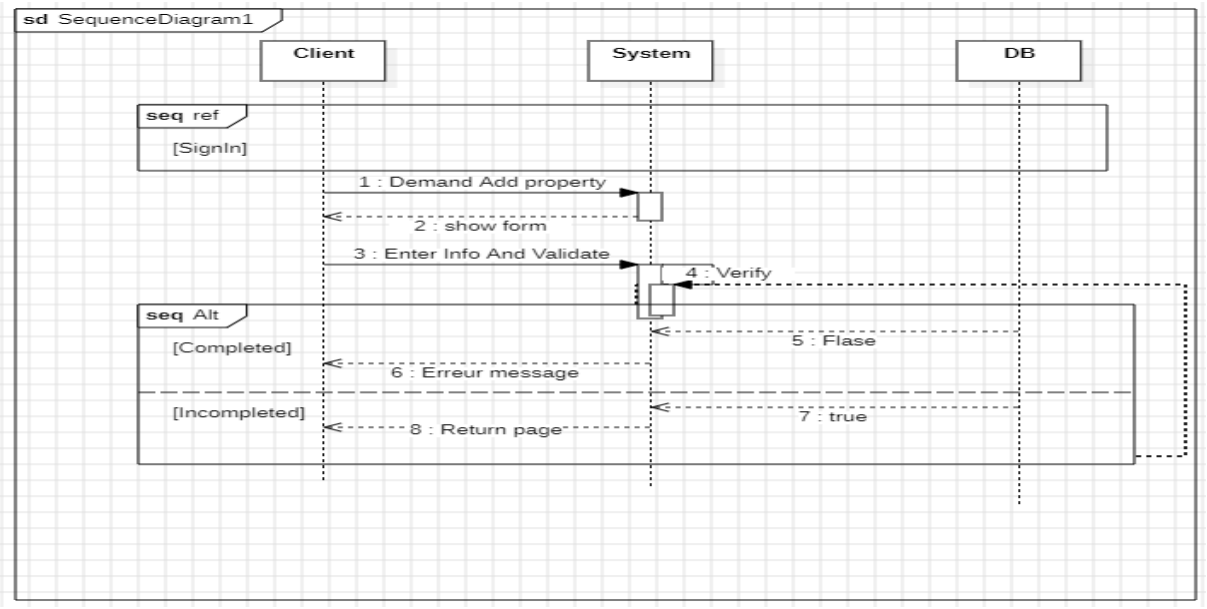

Figure 3.8: ADD Property

MQTT Sequence diagram :

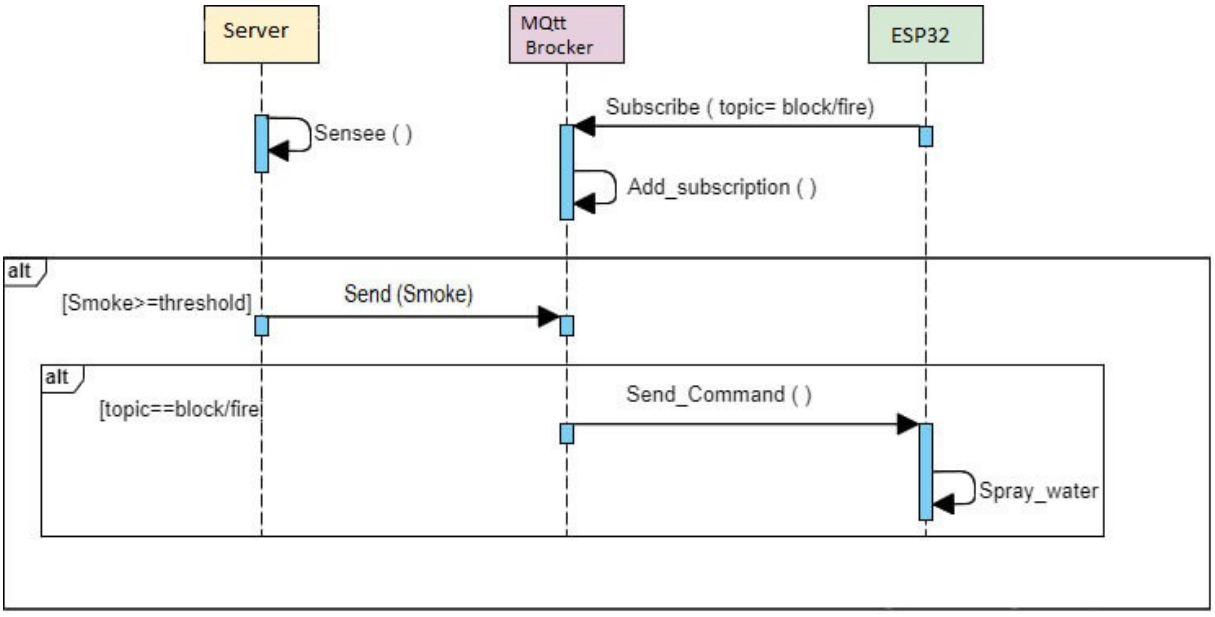

Figure 3.9: MQTT

ADD IOT :

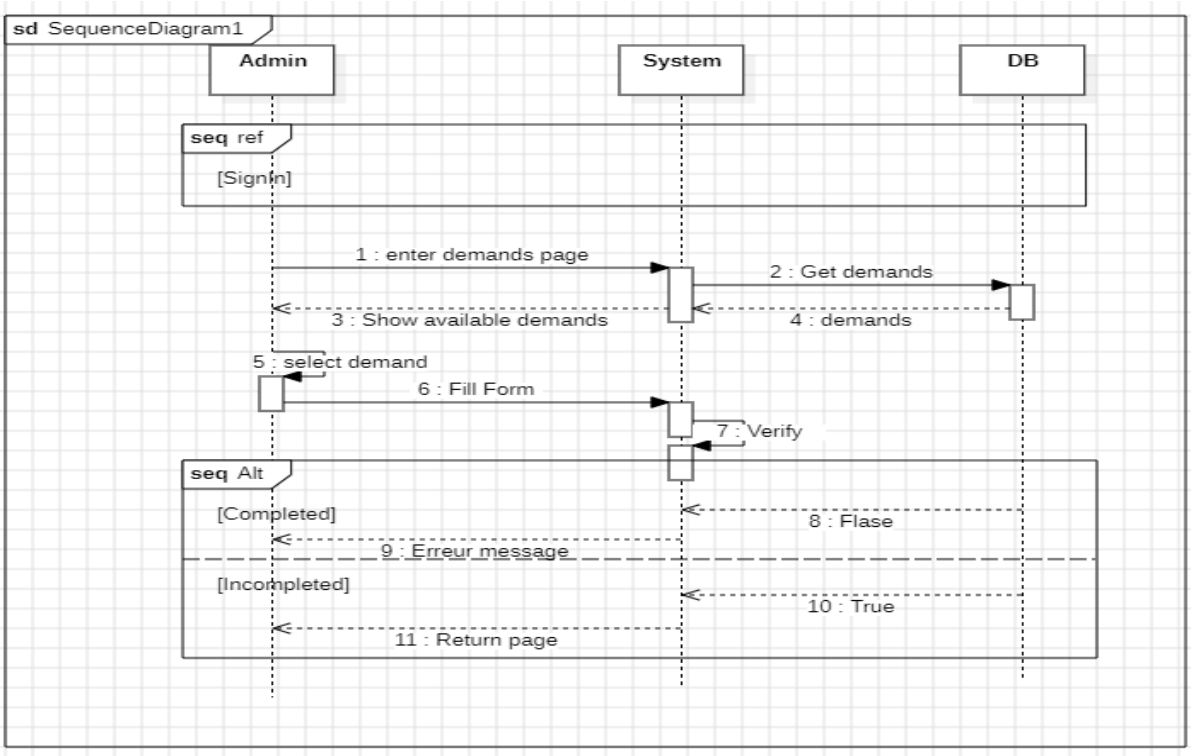

Figure 3.10: ADD IOT

3.7 Conclusion

In this chapter we designed our system using UML. This done, allowed us to have a general view of the theoretical behavior of the functionalities offered by our application. This theoretical basis will serve as a guide for the realization of the application, which will be the subject of the next chapter.

Chapter 4

Implementation

4.1 Introduction

In this chapter we will discuss about the required parts of our project. The main parts that we've used here are:

4.2 Development environment

4.2.1 Hardware environment

We use as a hardware tool in our project:

- A Computer with the following components:

  CPU : Intel Core I5-9400F @ 2.90GHz

  RAM : 16 GB

  OS : Windows 10 PRO 64-bit

  Graphic Card : The GeForce GTX 1660 Ti

- A Maquet with sensors:

  - ESP32-Cam Microcontroller Module.
  - ESP32 Module.
  - HC-SR04 Ultrasonic Sensor.
  - Jumper wires.

- As well as some other hardware:

  - Micro USB Cable.
  - ESP32 Module.

Presentation of ESP32-Cam :

- The ESP32-CAM is a small size, low power consumption camera module based on ESP32. It comes with an OV2640 camera and provides onboard TF card slot.
- The ESP32-CAM can be widely used in intelligent IoT applications such as wireless video monitoring, Wi-Fi image upload and so on.
- The ESP32 is programmable using the Arduino IDE and allows access to the video stream from the camera via a local Wi-Fi network or the internet.
- The simple codes are integrated directly into the Arduino IDE by adding the ESP32 board package from Espressif.

- A USB-to-serial converter is required for programming. The module is delivered with soldered male connectors allowing the card to be plugged into a quick mounting plate.
- A 5 V / 2 A power supply is also recommended.
- The ESP32-CAM suit for IOT applications such as:
  - Smart home devices image upload,
  - Wireless monitoring,
  - Intelligent agriculture,
  - QR wireless identification,
  - Facial recognition.(93)

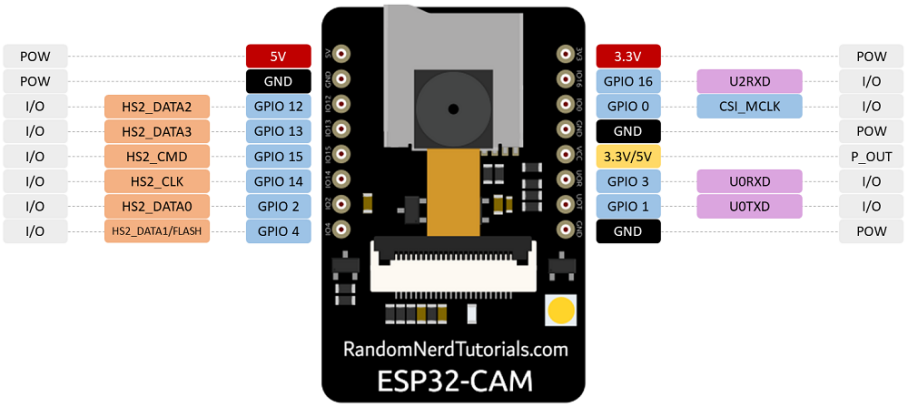

Figure 4.1: ESP32-Cam.(24)

Presentation of ESP32:

The ESP32 is a low-cost, low-power system on a chip (SoC) with Wi-Fi and Bluetooth capabilities developed by Espressif Systems. It is widely used in Internet of Things (IoT) projects due to its versatility and performance. Here are some key features and common applications of the ESP32,

- Key Features:
  - Wi-Fi and Bluetooth
  - Dual-Core Processor
  - Memory
  - GPIO
  - Peripheral Interfaces
  - Low Power Consumption

- Integrated Development

- The ESP32 suit for IOT applications such as:
  - Home Automation,
  - Wearable Devices,
  - Industrial Automation,
  - IoT Projects,
  - Robotics.([25])

Figure 4.2: ESP32.([25])

Comparison with ESP32-CAM:

The ESP32 is like the "mother" of the ESP32-CAM, sharing the same core features except for the integrated camera. The ESP32-CAM is a specialized variant designed for camera applications, retaining most of the ESP32's functionalities while adding camera capabilities.

4.3 Components

Here some components we used in our project :

LCD: Liquid Crystal Display, used for visual output in various electronic devices, often interfaced with microcontrollers to display text or graphics.

RFID: Radio Frequency Identification, a technology for identifying and tracking tags attached to objects using radio waves.

Keypad: A set of buttons arranged in a grid, used for inputting data or commands into electronic systems.

Motion Sensor: Detects movement or motion within its field of view using various technologies such as infrared or ultrasonic sensors.

Relays: Electrically operated switches used to control high-power devices with low-power signals, commonly used for home automation.

Ultrasonic Sensor: Uses sound waves above the frequency of human hearing to measure distance to objects, often used in robotics and automation.

DHT11: A basic digital temperature and humidity sensor.

Sound Sensor: Detects sound levels or specific frequencies in the environment, used in applications like noise monitoring or alarm systems.

MC38: A type of magnetic contact switch used to detect the opening or closing of doors or windows.

MQ-9 Gas Sensor: Detects gases like carbon monoxide and methane in the air, commonly used for monitoring indoor air quality or safety.

Fan: A device that creates airflow, typically used for cooling purposes in electronic devices or ventilation systems.

Solenoid Door Lock 12V: An electrically controlled locking mechanism that operates with a 12V current, used for securing doors.

Water Solenoid 12V: An electrically controlled valve that regulates the flow of water with a 12V current, used in irrigation systems or fluid control applications.

Jumper Wires: Pre-cut wires with connectors used to interconnect electronic components on a breadboard or circuit board.

I2C Expander: Integrated Circuit Expander, a device that increases the number of I/O pins available to a microcontroller via the I2C communication protocol, useful when additional sensors or peripherals need to be connected.

Figure 4.3: Components

4.3.1 The general architecture of the system

The following represents The general architecture of the system :

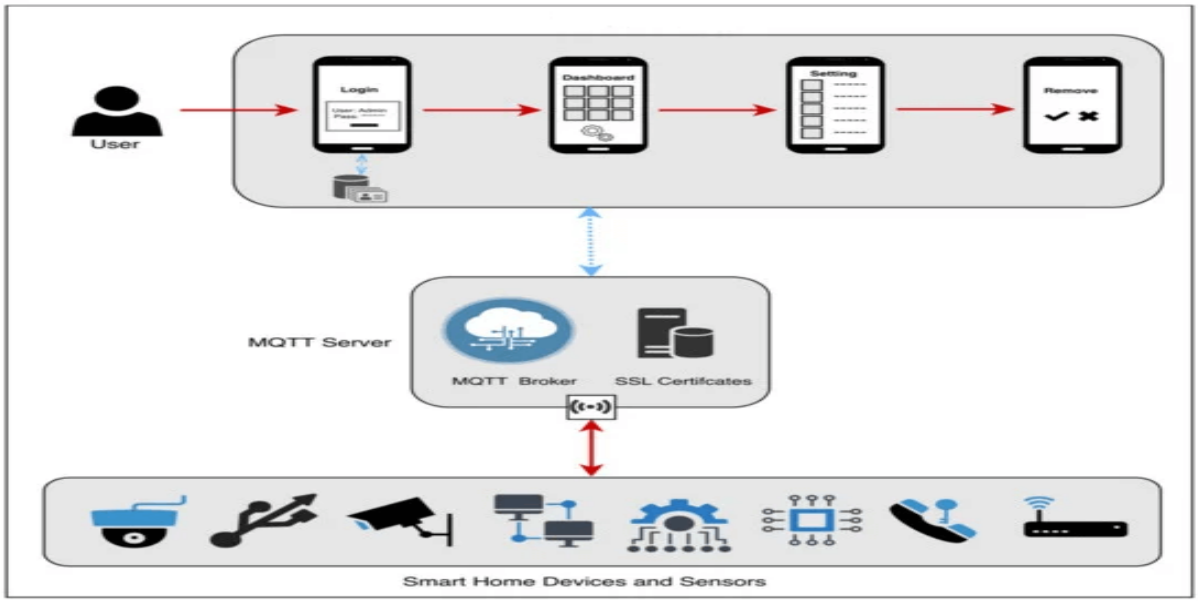

Figure 4.4: The general architecture of the system

4.3.2 Software environment

Visual Studio Code (VSCode) :

Visual Studio Code is a source-code editor made by Microsoft for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git. Users can change the theme, keyboard shortcuts, preferences, and install extensions that add additional functionality. (94)

Arduino IDE :

Arduino is platform IDE that works with the Arduino control for writing, compile and upload code to board. The program provides support for a wide range of Arduino boards such as Arduino UNO, mega pro mini. The public and similar languages for Arduino are C++ and C. (95)

Node.js :

Definition :

Node.js is an open-source and cross-platform JavaScript runtime environment. It is a popular tool for almost any kind of project. Node.js runs the V8JavaScript engine. The core of Google Chrome, outside of browser. This allows Node.js to be very performant. (96)

Features of Node.js :

Extremely fast : Node.js is built on Google Chrome's V8 JavaScript engine, so its library is very fast in code execution.

Asynchronous and Event Driven All APIs of Node.js library are asynchronous i.e. Non-blocking. So a Node.js based server never wait for an API to return data. the server moves to the next API after calling it and notification mechanism of Events of Node.js helps the server to get a response from the previous API call. It is also a reason that it is very fast.

Highly Scalable : Node.js is highly scalable because event mechanism helps the server to respond in a Non-blocking way.

No buffering : Node.js cuts down the overall processing time while uploading audio and video files. Node.js applications never buffer any data. These applications simply output the data in chunks.

Open source : Node.js has an open source community which has produced many excellent modules to add additional capabilities to Node.js applications.(96)

4.3.3 Programming environment

Programming Language :

C++ Programming Language :

The first part of project code is written in C++ programing language. The C++ is a middle-level programming language developed by Bjarne Stroustrup in 1979 at Bell Labs. C++ runs on a variety of platforms, such as Windows, Mac OS, and the various versions of UNIX. (97)

HTML, CSS :

HTML is a markup language that is used to create documents on the World Wide Web incorporating text, graphics, sound, video, and hyperlinks.
CSS is Stands for "Cascading Style Sheet." Cascading style sheets are used to format the layout of Web pages. They can be used to define text styles, table sizes, and other aspects of Web pages that previously could only be defined in a page's HTML. (98)

JavaScript :

JavaScript is a dynamic computer programming language. It is lightweight and most commonly used as a part of web pages, whose implementations allow client-side script to interact with the user and make dynamic pages. It is an interpreted programming language with object-oriented capabilities.

- Designed for creating network-centric applications.
- Complementary to and integrated with Java.

- Complementary to and integrated with HTML.
- Open and cross-platform.
- Client-side JavaScript is the most common form of the language. The script should Be included in or referenced by an HTML document for the code to be interpreted by the browser. It means that a web page need not be a static HTML, but can include programs that interact with the user, control the browser, and dynamically create HTML content.(99)

Packages and Frameworks :

1 - NPM "Node Package Manager" :

NPM is a package manager for Node.js packages, or modules if you like. The NPM program is installed on your computer when you install Node.js www.npmjs.com hosts thousands of free packages to download and use.(100)

Package :

- A package in Node.js contains all the files you need for a module.
- Modules are JavaScript libraries you can include in your project.(100)

Download a Package :

- Downloading a package is very easy.
- Open the command line interface and tell NPM to download the package you want. I want to download a package called "upper-case":
  - `C:\Users\\Your-project> npm install upper-case`
  - Now you have downloaded and installed your first package!

NPM creates a folder named "node modules", where the package will be placed. All packages you install in the future will be placed in this folder.(100)

Using a Package :

- Once the package is installed, it is ready to use.
- Include the "upper-case" package the same way you include any other module. (100) For example:
  - var uc = require('upper-case');

2 - Express.JS :

Express.js, or simply Express, is a back end web application framework for Node.js, released as free and open-source software under the MIT License. It is designed for building web applications and APIs. It has been called the de facto standard server framework for Node.js.(101)

3 - React Js :

React.js is a popular JavaScript library for creating interfaces The user is interactive and responsive. It was developed by Facebook and is widely used Used in the web development industry. React.js is a solid choice for Develop modern web applications because of their performance and style arity, ease of maintenance and a large developer community. he Particularly suitable for applications that require responsive and responsive user interfaces Moving(102)

4 - Tailwind Css :

Tailwind CSS is a powerful CSS framework that provides increased productivity, easy customization, simplified maintenance and great performance. He's from become a popular choice among web developers for creating user interfaces modern and responsive(103)

5 - WebSocket :

To initiate communication, the client sends a request just like with HTTP, but after this, an open connection is maintained via TCP.(104) The new URL scheme for websites that use WebSocket is wss instead of http.

7 - MQTT :

MQTT (Message Queuing Telemetry Transport) is a lightweight, publish-subscribe network protocol that transports messages between devices. It is designed for connections with remote locations where a small code footprint is required, and network bandwidth is at a premium. MQTT is particularly suited for Internet of Things (IoT) applications.(105)

Database :

- PostgreSQL :

PostgreSQL, often referred to simply as "Postgres", is a core management system open source relational data. It is based on the relational data model, where data is organized into tables with rows and columns. PostgreSQL takes supports SQL (Structured Query Language) to interact with data, and it offers many advanced features for data management.(106)

4.4 Project representation

4.4.1 Physical system

The following model represents the prototype of our project :

Figure 4.5: Project model

4.4.2 digital system

Here is the interfaces of the platform :

4.4.3 Client

Landing Page

Once the URL address is entered and launched, a home page of the platform will be displayed .

Figure 4.6: Landing Page

Sign In Modal

After the registration phase, the user must authenticate in order to have access to their space .

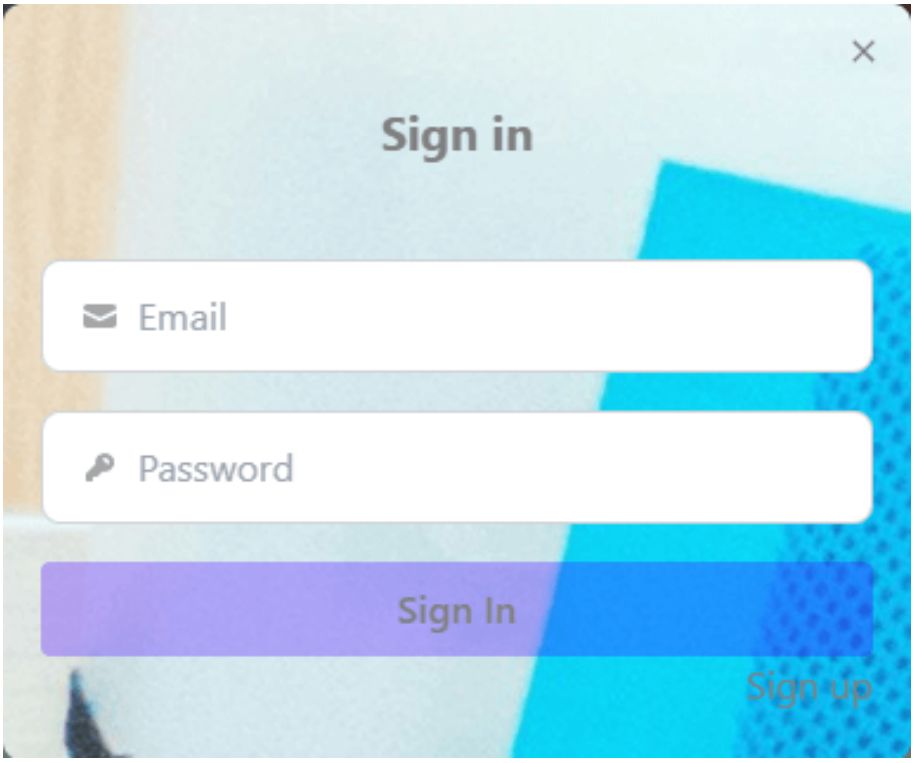

Figure 4.7: Sign In Modal

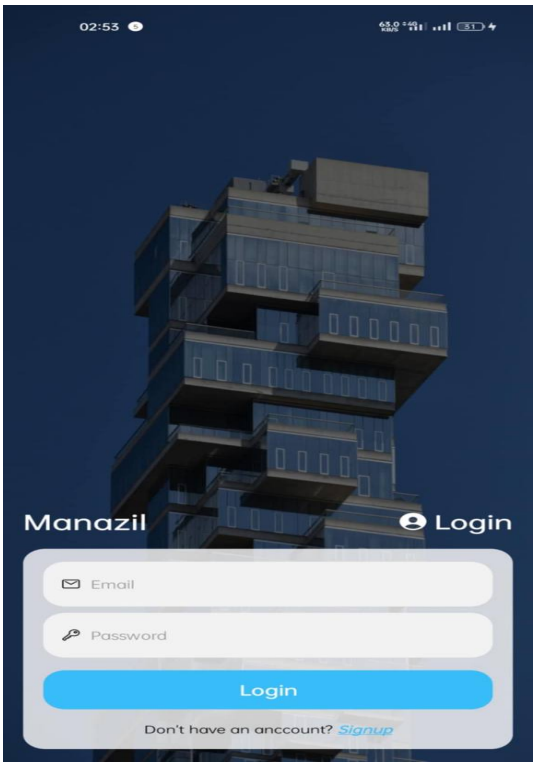

Figure 4.8: Sign In App Screen

Sign Up Page

Our platform provides its visitors with an accessible registration form .

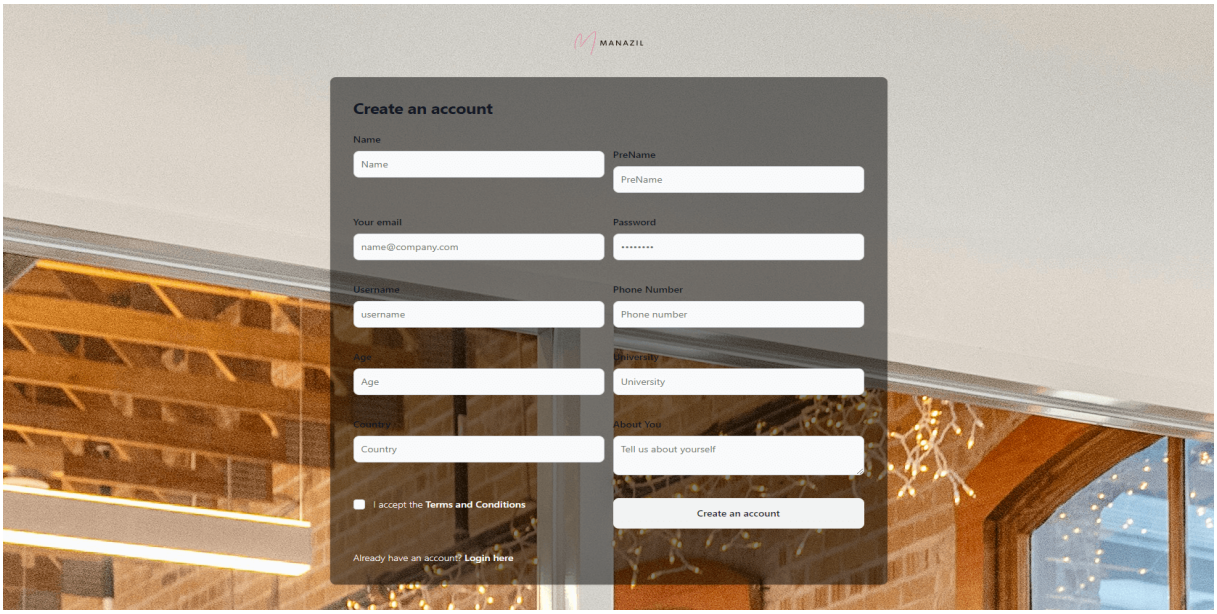

Figure 4.9: Sign Up Page

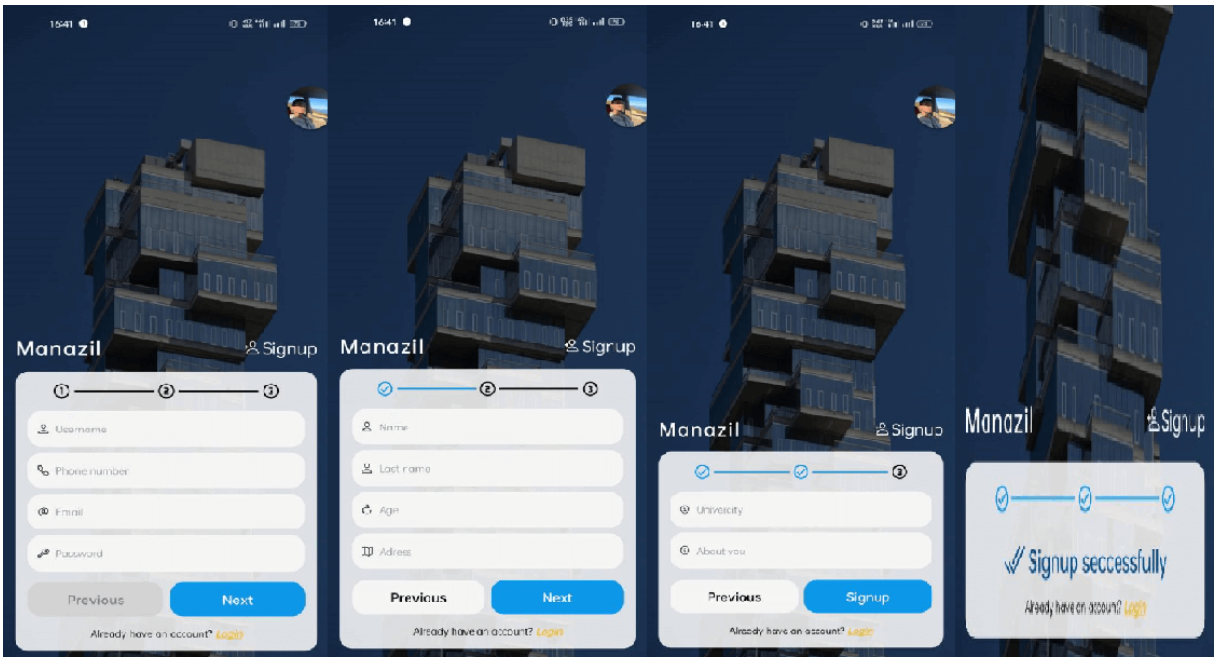

Figure 4.10: Sign Up App Screen

Main Page

The main page provides clients with access to property listings, search functionality, and other essential features for seamless navigation and interaction .

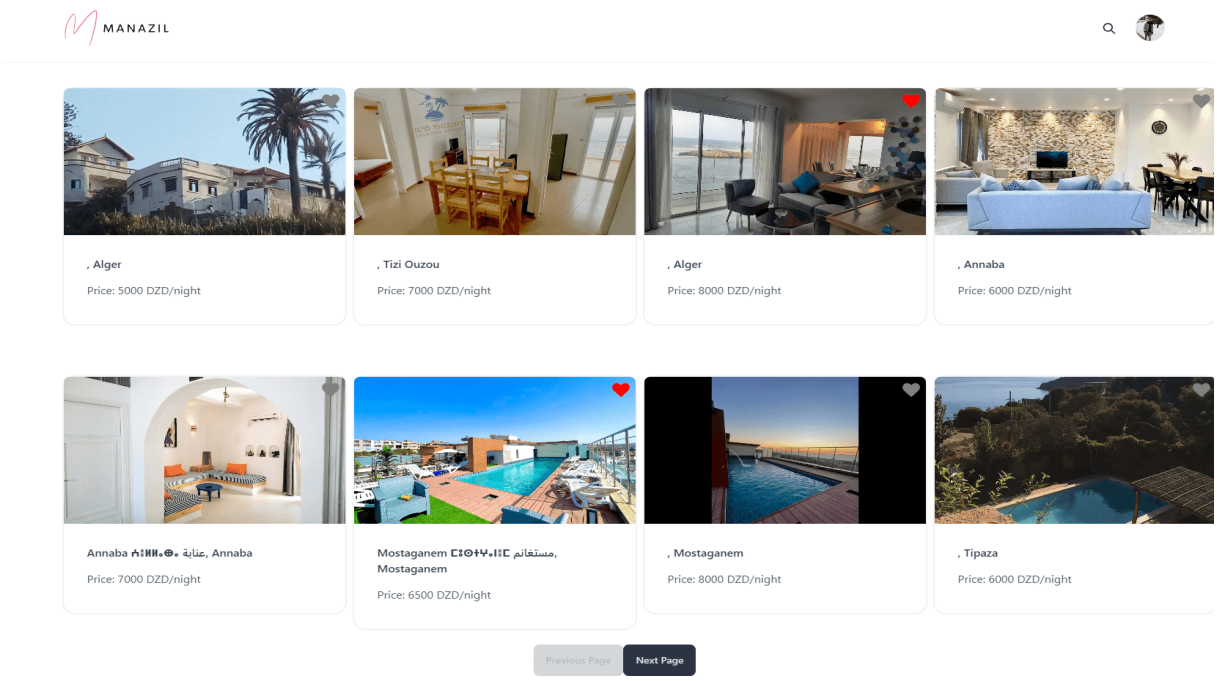

Figure 4.11: Main Page

Figure 4.12: Main Screen App

Detail Page

The detail page displays comprehensive property information and allows clients to book. Also request IoT upgrades if they own the property .

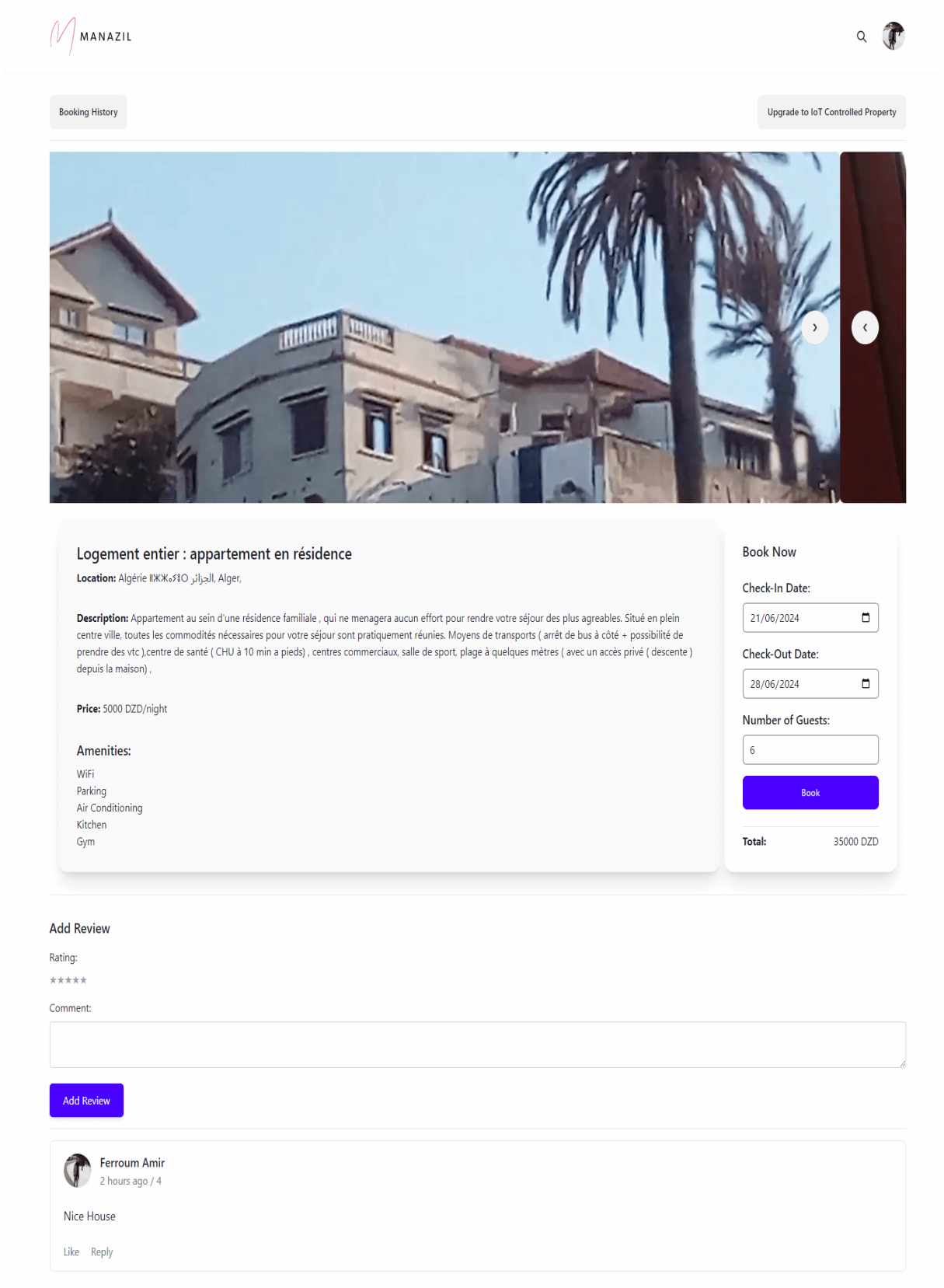

Figure 4.13: Detail Page

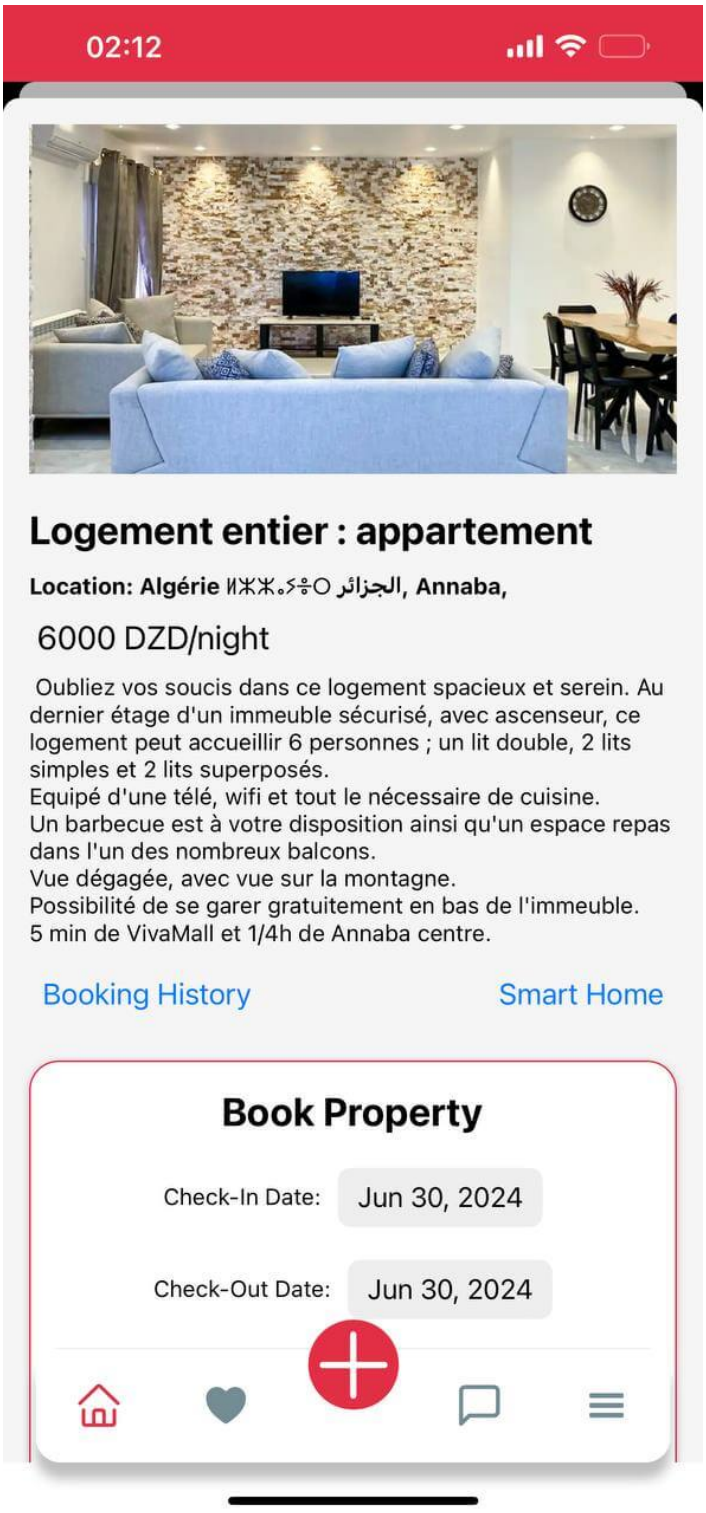

Figure 4.14: Detail Screen App

Demand Page

The demand page allows clients to request IoT upgrades for their property .

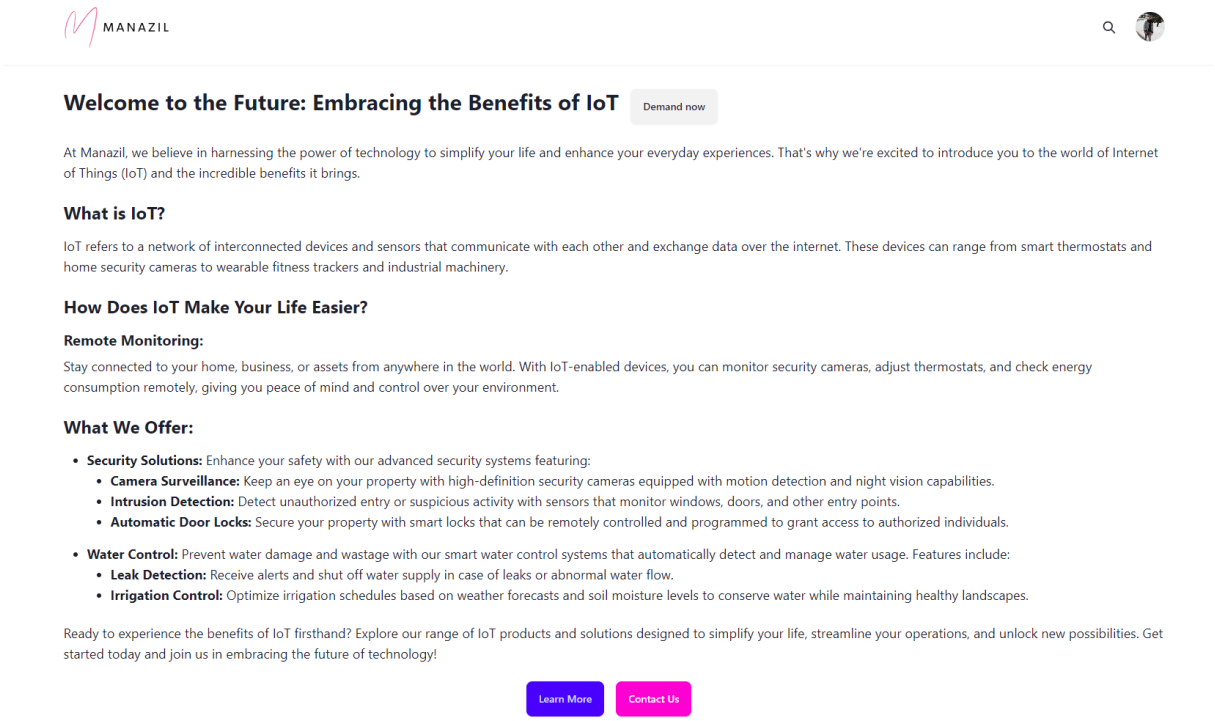

Figure 4.15: Demand Page

IoT Page

The IoT page enables clients to manage their upgraded smart home, including monitoring cameras, controlling lights, doors, and other IoT-connected devices.

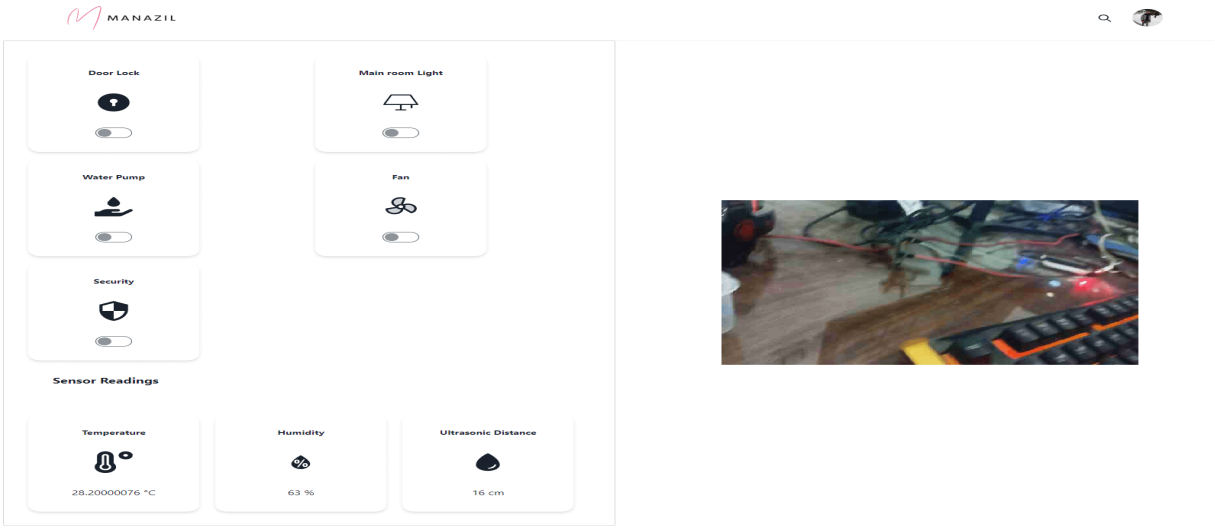

Figure 4.16: IOT Control Page

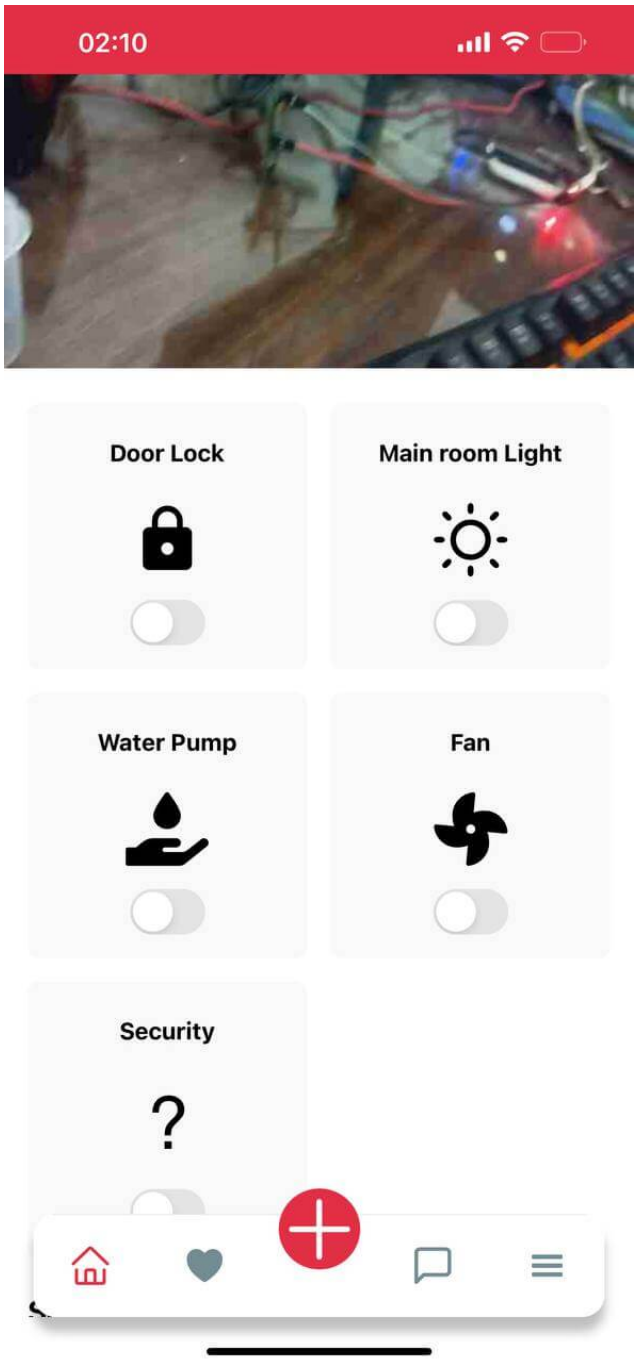

Figure 4.17: IOT Control App Screen

Profile Page

The profile page includes a favorite section where clients can manage their preferred listings or saved properties, as well as modify their profile images and other personal information .

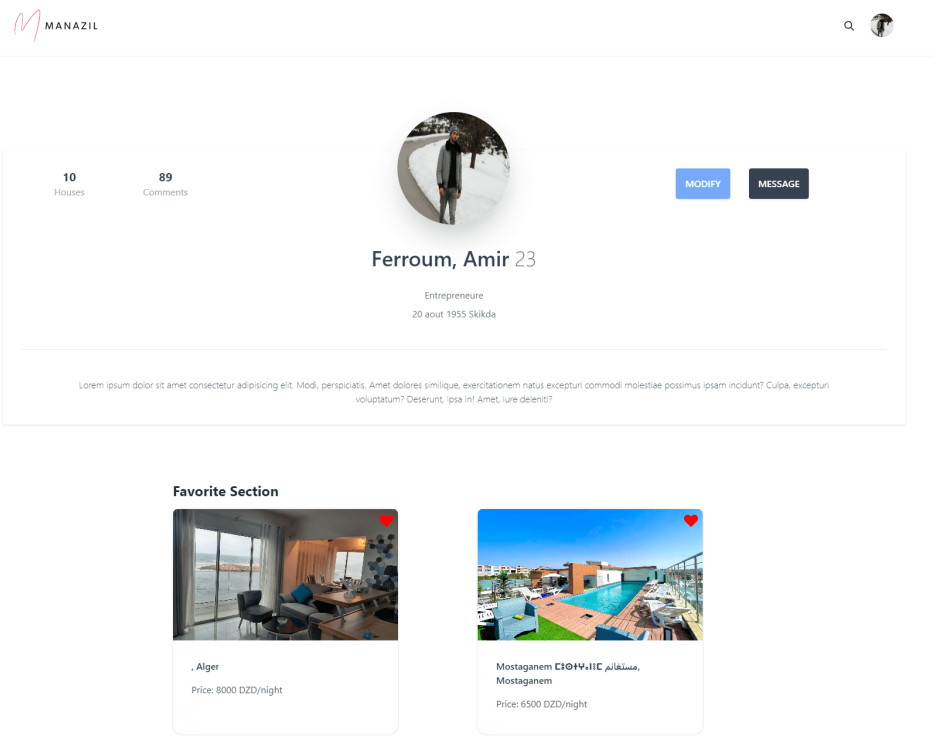

Figure 4.18: Profile Page

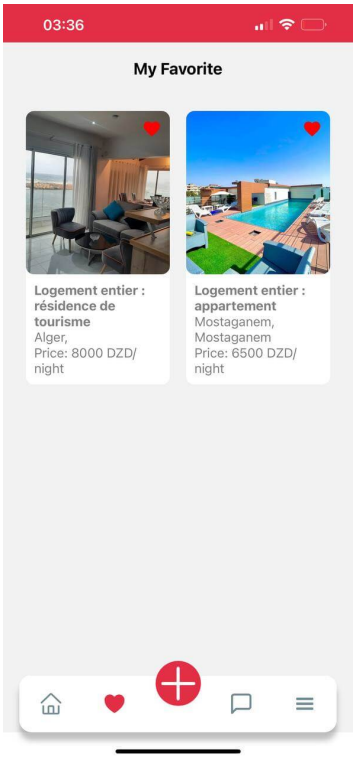

Figure 4.19: Fav Screen App

My Booking Page

The booking page offers clients a comprehensive view of both past and upcoming bookings, along with access to the secret code needed for entry to the booked house, ensuring convenient and secure access for clients .

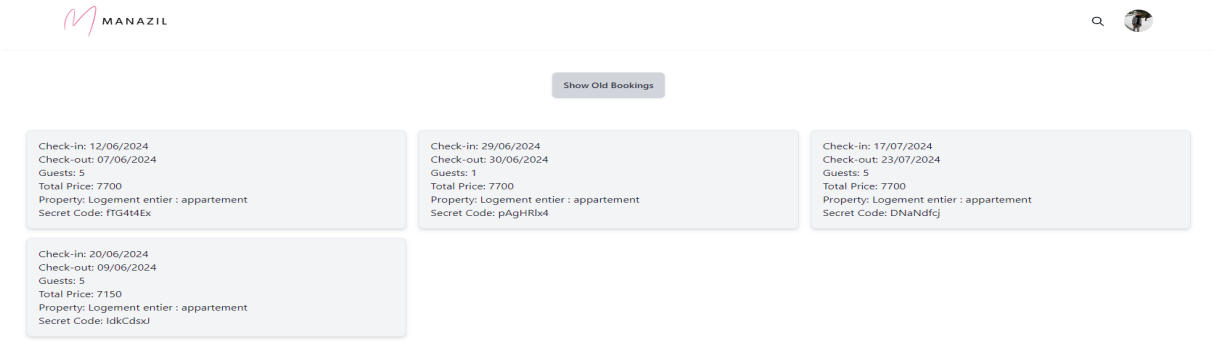

Figure 4.20: My Booking Page

History Page

The history page enables clients to view the booking history of their property (see Figure 4.21).

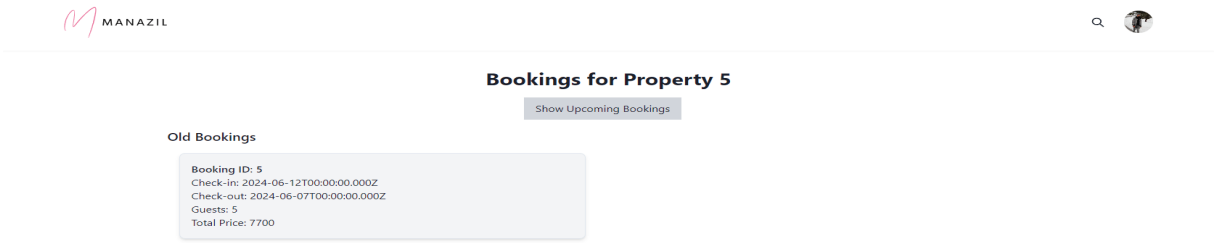

Figure 4.21: History Page

My Properties Page

The property page allows clients to view all the properties they have added to their account.

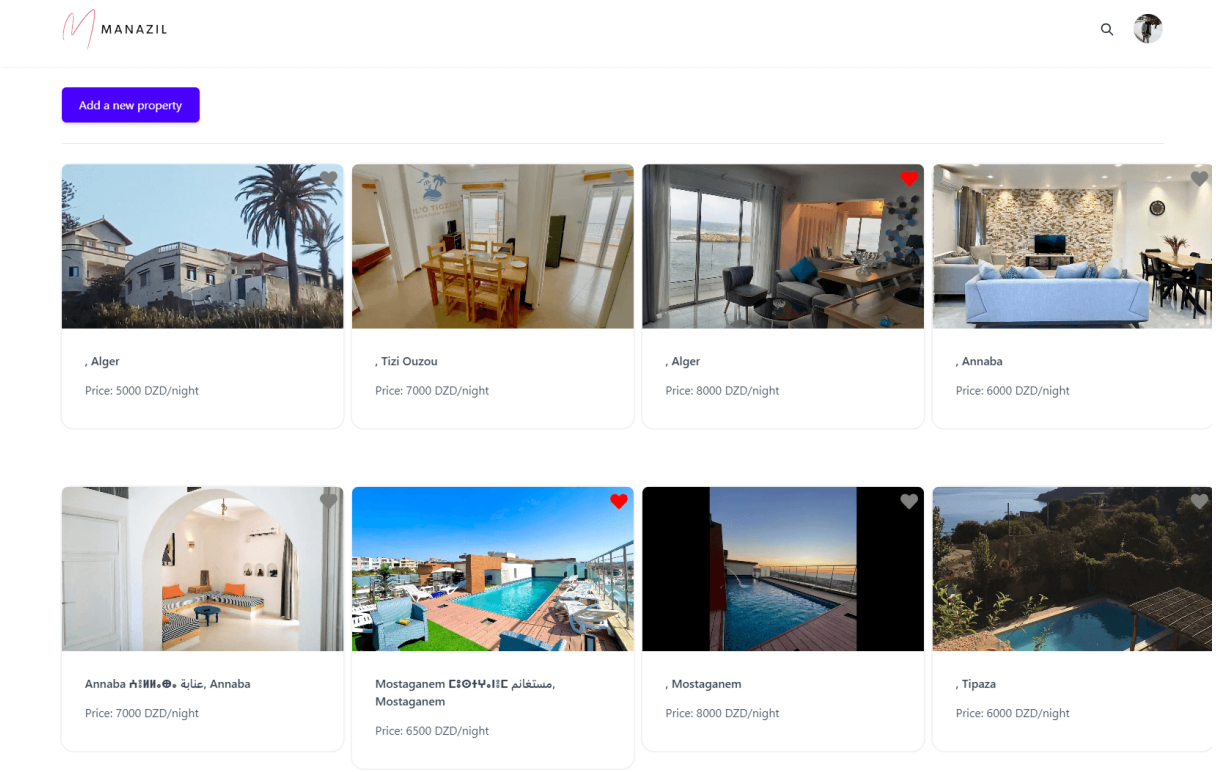

Figure 4.22: My Properties Page

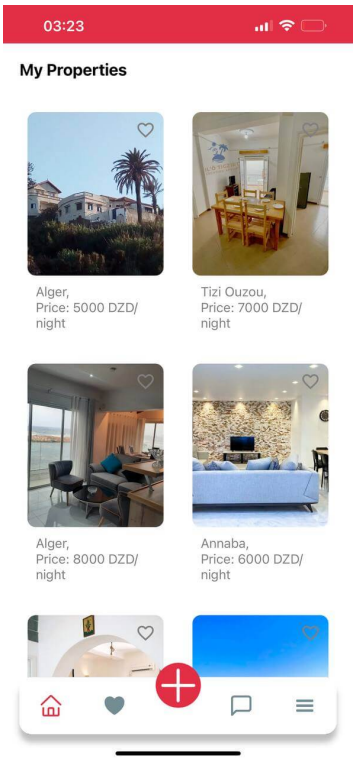

Figure 4.23: My Properties Screen App

Create Property Modal

The property modal allows clients to add new properties to their account .

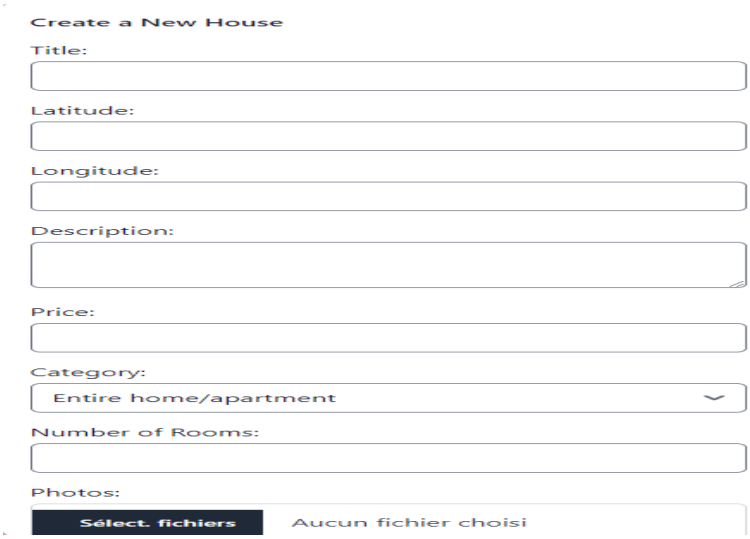

Figure 4.24: Create Property Modal

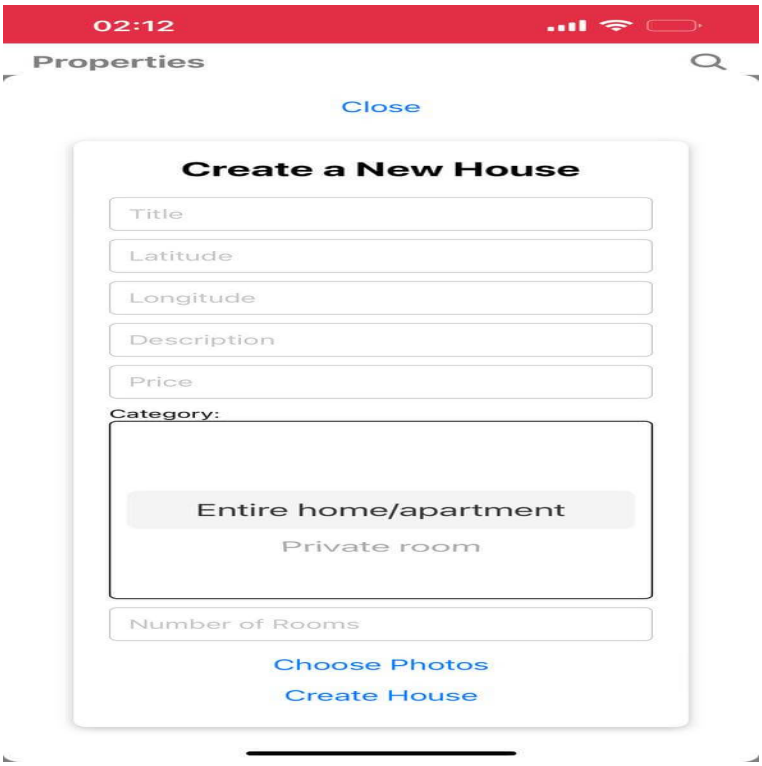

Figure 4.25: Create Property Screen App

Admin :

Sign In Page:

The sign-in page allows admins to access the admin dashboard for managing platform operations and data.

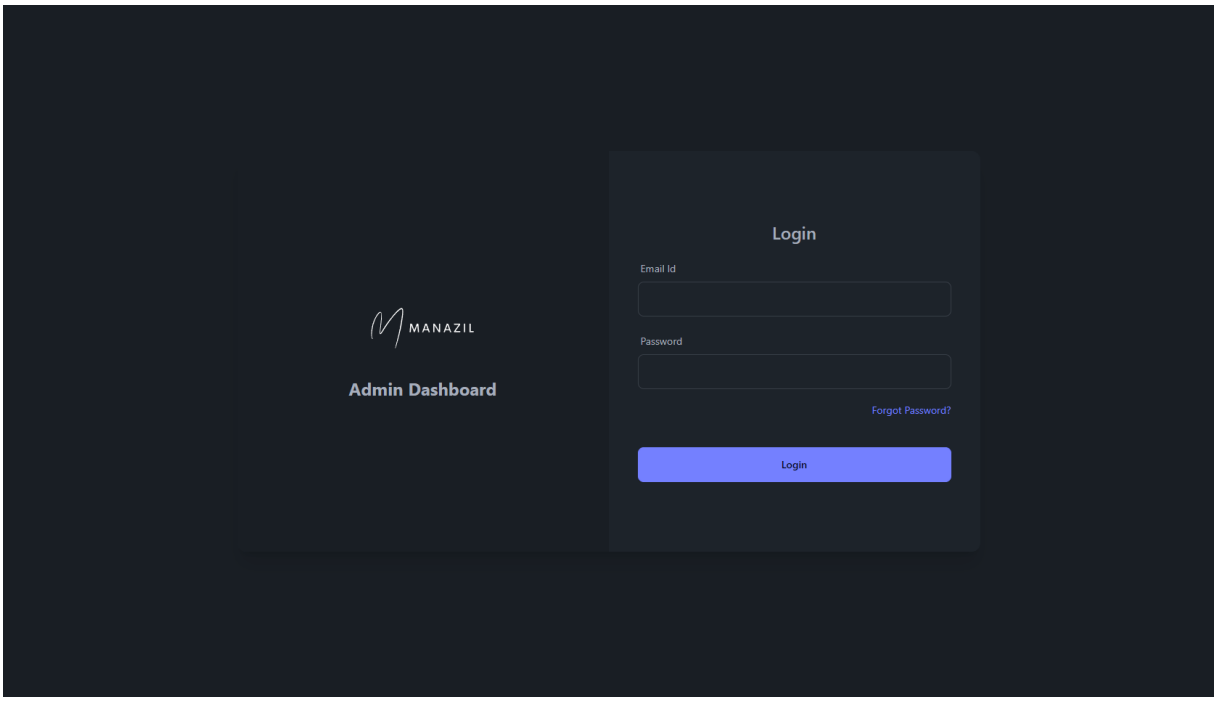

Figure 4.26: Sign In Page

Welcom Page:

This page shows the Admin area and the features it can access from the sidebar menu

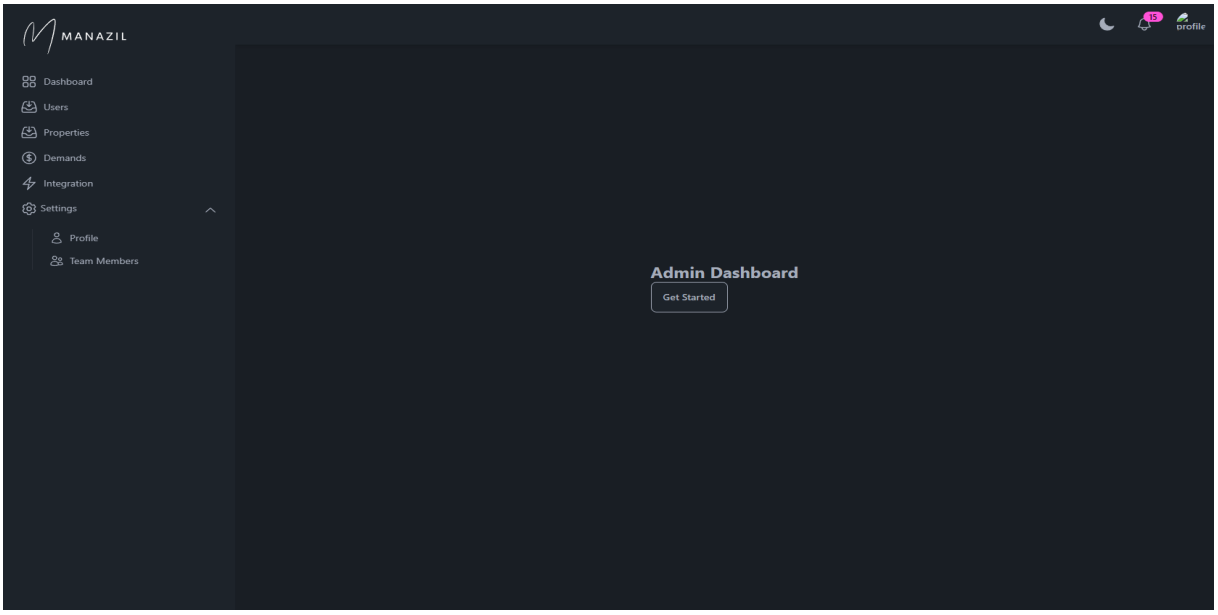

Figure 4.27: Welcom Page

Users Page:

The users page allows admins to view and manage user accounts and activities on the platform.

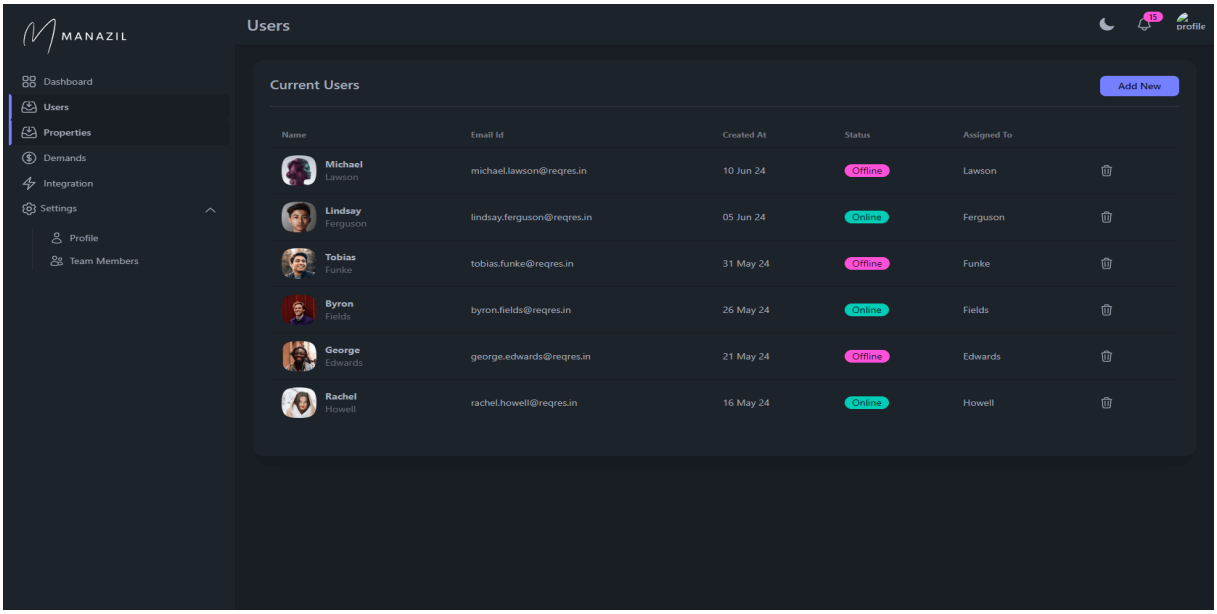

Figure 4.28: Users Page

Demands Page:

The demand page enables admins to review and accept upgrade requests, adding IoT capabilities to properties as needed.

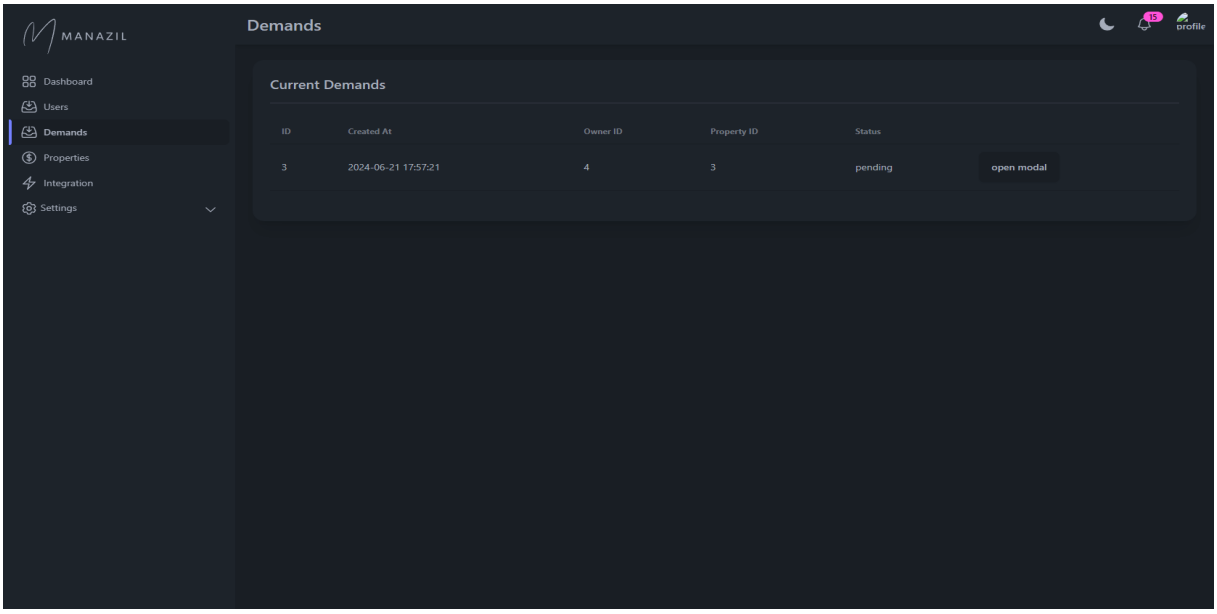

Figure 4.29: Demands Page

Add Iot Device Modal:

The IoT device add modal allows admins to add IoT devices to properties, enhancing their functionality and connectivity.

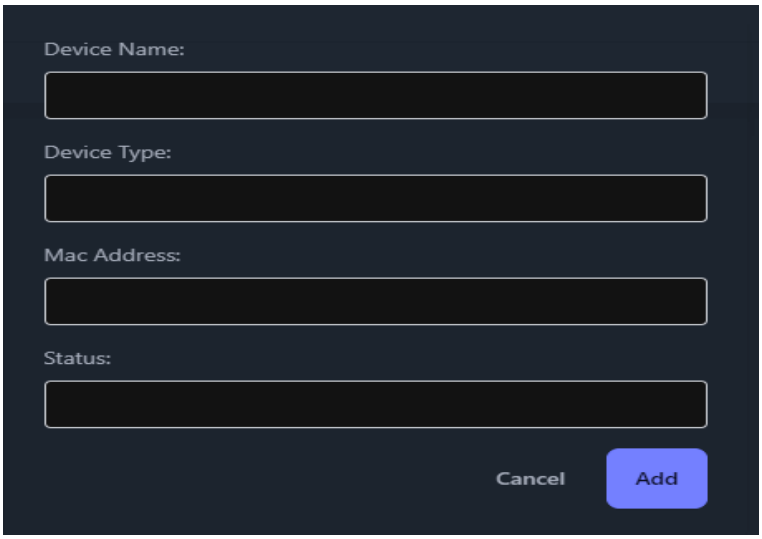

Figure 4.30: Add Iot Device Modal

Properties Page:

The properties page enables admins to manage and oversee all properties listed on the platform.

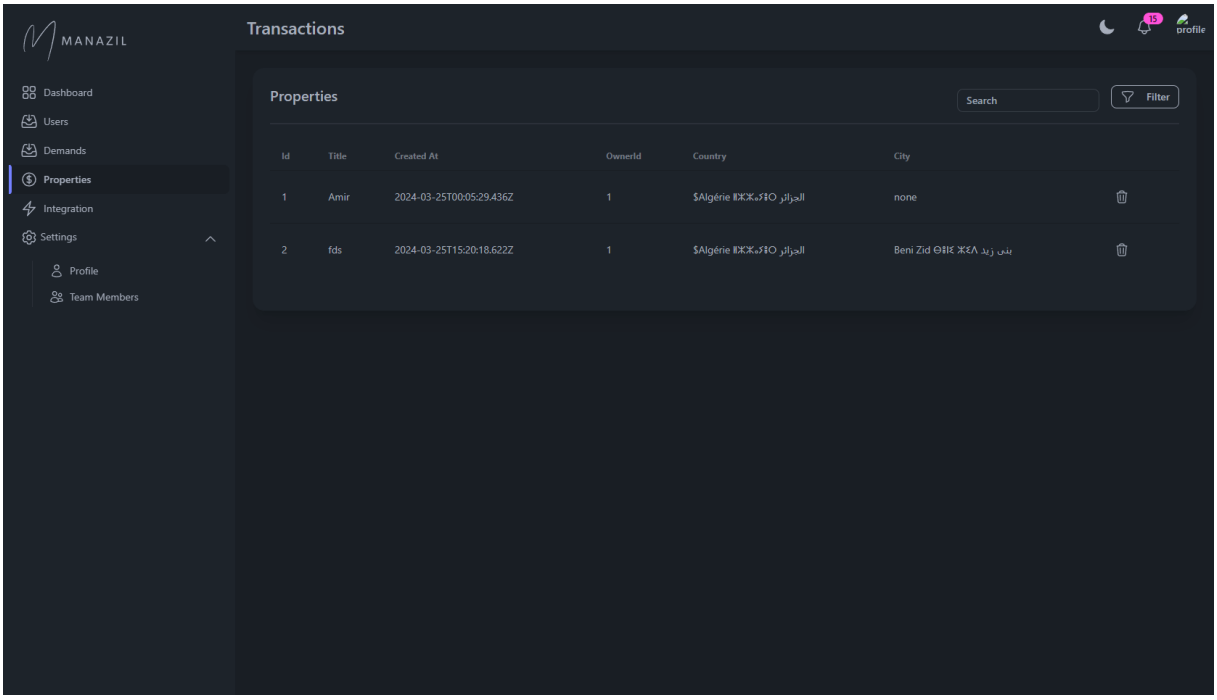

Figure 4.31: Properties Page

Admin Profile Page:

The admin profile page provides access to manage and update administrative account information and settings.

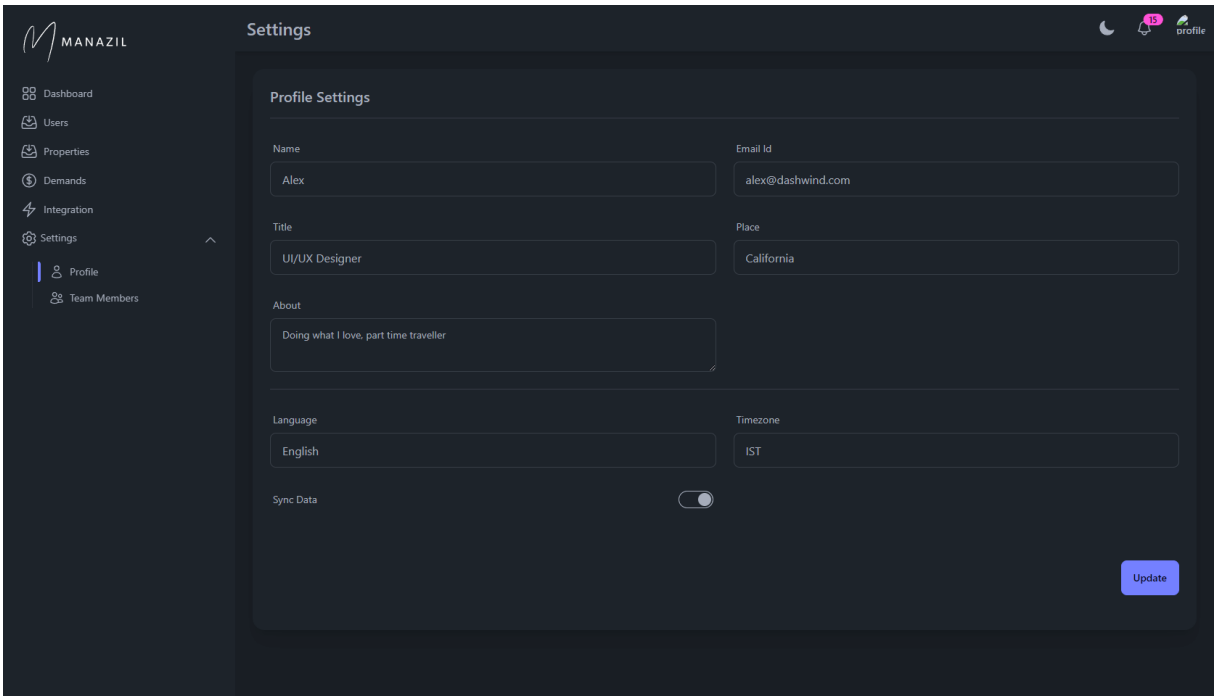

Figure 4.32: Admin Profile Page

4.5 Conclusion

In this chapter we have presented in order way all hardware and software for our implementation, the characteristics of used material and different interfaces realized and we finish with a test cases that explain all the results of our application.

General Conclusion

In conclusion, our project represents a significant advancement in the real estate sector by leveraging cutting-edge IoT technologies to enhance property management and tenant experiences. By integrating IoT devices and smart systems, we have enabled unprecedented levels of connectivity, efficiency, and sustainability in both residential and commercial properties. Our platform not only optimizes operational processes such as energy management and predictive maintenance but also enhances security and facilitates seamless interactions between property owners, tenants, and management teams. As the industry continues to evolve with technological innovations, our project stands at the forefront, poised to transform how properties are managed, operated, and experienced in the digital age.

Futur Prespective

Looking ahead to the future of our project, there are several aspects we can consider to enhance its capabilities:

- Alerting occupants via SMS or a phone call in case of anomalies.
- Alerting emergency services in case of anomalies.
- Utilizing renewable energies such as solar and wind energy to ensure continuous system availability during power outages, thereby enhancing overall sustainability and efficiency.
- Integrating artificial intelligence (AI) technologies into home security systems.
- AI offers numerous benefits including task automation, advanced data analysis, intrusion prevention, and improved incident response. Continuous learning capabilities of AI can optimize smart home security.

- Exploring advanced features offered by AI-based cameras such as object and people detection, facial recognition, motion tracking, and behavior analysis. These features significantly improve surveillance and incident detection.
- Incorporating GPS (Global Positioning System) to enable rapid emergency response.

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Chapter 5

Annex : Project Guide

People's Democratic Republic Of Algeria

Ministry Of Higher Education And Scientific Research

Skikda University Business Incubator

20 août 1955, Skikda University

FACULTY OF SCIENCES

PROJECT GUIDE FOR OBTAINING AN EMERGING BUSINESS CERTIFICATE IN ACCORDANCE WITH MINISTERIAL DECISION 1275

SUBJECT

Manazil: A Revolutionary Platform for Secure and Controlled Real Estate Management

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Presented By
Ferroum Amir

Supervised By
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Session : 2023 - 2024

Information Card

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Chapter 1

Project Presentation

1.1 Project Idea (Proposed Solution)

Our project aims to develop an innovative digital platform for real estate management integrating IoT (Internet of Things) technologies. This idea emerged from the need to simplify and optimize the process of property rental and management, providing property owners and tenants with a convenient and efficient solution. By integrating IoT sensors into properties, we will be able to remotely monitor and control various aspects of the property, such as security, energy consumption, and occupant comfort. Our platform will offer a seamless and personalized user experience, facilitating communication between property owners and tenants and enhancing the quality of life in residential spaces.

1.2 Proposed Values

The values proposed by this solution are multiple:

1.2.1 Comfort and Convenience

Users benefit from accommodations equipped with IoT devices, offering features such as automated lighting, air conditioning, and security.

1.2.2 Security and Peace of Mind

Advanced security systems, such as surveillance cameras and smart locks, ensure the tenants' peace of mind.

1.2.3 Energy Efficiency

IoT technologies help reduce energy costs through optimized energy management.

1.2.4 Personalized Experience

Tenants can customize their stays according to their preferences with automatic settings.

1.2.5 Ease of Management

Property owners can manage their properties remotely and in real-time, simplifying rental management.

1.2.6 Sustainability

By optimizing energy usage and resource management, our solution contributes to a more sustainable and eco-friendly living environment.

1.2.7 Data-driven Insights

The collection and analysis of data from IoT devices provide valuable insights for property owners to make informed decisions and improve operational efficiency.

1.2.8 Community Engagement

Our platform fosters community engagement by facilitating communication and collaboration among residents, creating a sense of belonging and social interaction.

1.3 Work Team

Name and Surname: Ferroum Amir

Level: Master 2

Specialty: Networks and Distributed Systems

1.4 Project Objectives

- Develop and launch a functional and intuitive platform by the end of the year.
- Integrate IoT devices into at least 500 properties during the first year of operation.
- Reach a user base of 50,000 active tenants and 10,000 registered property owners by the end of the second year.
- Reduce users' energy costs by 20% through the use of IoT technologies.
- Achieve a customer satisfaction rate of over 90% through high-quality services and experiences.

1.5 Project Implementation Schedule

Here is the detailed project implementation schedule by key stages:

This schedule serves as a guide to ensure that all necessary steps for project realization are planned and executed in a structured and efficient manner.

Stage	Timeline	Description
Market Study and Feasibility Analysis	Month 1 - Month 2	Data collection, market needs analysis
Platform Design	Month 3 - Month 4	UI/UX design, technical architecture
Platform Development	Month 5 - Month 8	Application coding, feature development
IoT Device Integration	Month 6 - Month 9	Partnerships with manufacturers, technological integration
Testing and Iterations	Month 9 - Month 10	Beta testing, fixes, and improvements
Initial Launch	Month 11	Soft launch of the platform in a pilot region
Marketing and Promotion	Month 11 - Month 12	Marketing campaigns, platform promotion
Official Launch	Month 12	Large-scale launch, expansion of operations
Continuous Evaluation and Optimization	Month 13 and beyond	Feedback collection, adjustments, and continuous updates

Table 1.1: Project Implementation Schedule

Chapter 2

Innovative Aspects

2.1 Nature of Innovations

This project leverages modern technology to revolutionize real estate management. By integrating advanced technologies such as the Internet of Things (IoT), it aims to enhance operational efficiency, sustainability, and user experience in the real estate sector. Property owners, tenants, and managers can benefit from innovative solutions for optimal property management, predictive maintenance, and improved connectivity. This approach ensures real-time monitoring and control of various property aspects, leading to proactive management and cost savings. Enhanced connectivity facilitates seamless communication and automation, providing a smarter, more sustainable, and user-friendly real estate environment.

2.2 Areas of Innovation

The innovation areas of this project cover several crucial aspects in the real estate and technology industries, offering novel solutions for tenants and property owners.

2.2.1 Internet of Things (IoT) Technology

Integration of IoT devices in properties to enhance user experience, energy efficiency, and security.

- Smart Home Devices: Integration of smart thermostats, lighting systems, and appliance controls to provide tenants with seamless control over their living environment.
- Remote Monitoring: Property owners and tenants can monitor and control their property remotely, ensuring security and convenience even when they are not physically present.
- Interconnected Systems: Development of a cohesive network where various IoT devices communicate with each other to optimize home management and energy use.

2.2.2 Digital Platform

Development of an intuitive and user-friendly application and website, enabling quick bookings and simplified property management.

- User-Friendly Interface: A clean, intuitive design that simplifies navigation, making it easy for users of all tech levels to manage their bookings and property settings.
- Mobile Compatibility: Ensuring that both the website and application are fully optimized for mobile devices, providing a seamless user experience across platforms.
- Comprehensive Dashboard: A centralized hub where property owners can manage multiple properties, view analytics, and handle tenant interactions.

2.2.3 Customer Experience

Utilizing technology to personalize and enrich tenants' experiences, making stays more comfortable and tailored to individual needs.

- Personalization Options: Tenants can set preferences for lighting, temperature, and other environmental controls that adjust automatically upon arrival.
- Enhanced Communication: Providing a platform for direct communication between tenants and property owners/managers, including instant messaging and feedback systems.
- Interactive Guides: Offering digital guides and tutorials on how to use the IoT features in their rental property.

2.2.4 Operational Efficiency

Improving property management processes through automation and real-time monitoring.

- Automated Booking Management: Streamlining the booking process with automated confirmations, reminders, and cancellations to reduce administrative workload.
- Real-Time Analytics: Using data analytics to provide property owners with insights into occupancy rates, tenant preferences, and property performance.
- Predictive Maintenance: Leveraging IoT data to predict when maintenance is needed, reducing downtime and ensuring properties are always in top condition.

2.2.5 Security and Privacy

Implementing advanced security measures to protect user data and ensure confidentiality.

- Data Encryption: Employing robust encryption methods to protect user data and communications.
- Access Control: Utilizing smart locks and access control systems to manage who can enter the property and when.
- Surveillance Integration: Incorporating advanced surveillance systems that can be monitored remotely, ensuring tenant safety and property security.

Chapter 3

Strategic market analysis

3.1 Market Segment

In Algeria, the real estate market is undergoing significant evolution, with a growing demand for more modern and connected housing solutions. Here is a relevant market segmentation for the project:

3.1.1 Target Market

- Young Professionals: Individuals seeking modern and connected housing for short to medium-term stays.
- Families: Families looking for comfortable and secure housing with modern features for extended stays.
- Business Travelers: Professionals traveling for business reasons, requiring accommodations equipped with modern technologies for their comfort and efficiency.
- Tourists: Visitors seeking to rent properties with modern and connected amenities to enhance their travel experience.
- Property Owners: Individuals or companies owning real estate wishing to rent them out via an innovative and secure platform.

3.2 Competition Analysis

To evaluate the level of competition in our market, we will examine several key factors:

3.2.1 Direct Competitors

Our direct competitors are companies offering similar IoT-integrated housing solutions. As of now, there are no direct competitors in the local market providing IoT integration with housing solutions like ours.

3.2.2 Indirect Competitors

While Malaaz and Krello may not offer IoT integration, they remain indirect competitors as they provide alternative housing solutions. Although they lack IoT features, their presence in the market can still influence consumer choices.

3.2.3 Market Penetration and Share

We will examine the market penetration and share of existing housing platforms like Malaaz and Krello to gauge their impact on the market. Despite their lack of IoT integration, their market share and user base could pose a challenge.

3.2.4 Strengths and Weaknesses

While Malaaz and Krello may excel in certain areas such as user experience or property listings, they may lack the technological edge offered by IoT integration. Understanding their strengths and weaknesses will help us position our product effectively.

3.2.5 Potential and Target Market

Our potential market includes individuals seeking modern, technologically advanced housing solutions. Our target market comprises tech-savvy consumers, property owners, and property management companies interested in IoT-integrated housing.

3.2.6 Conclusion

Analyzing competition helps us identify gaps in the market and opportunities for differentiation. While Malaaz and Krello may not directly offer IoT integration, their presence underscores the demand for housing solutions. By leveraging our technological advantage, we can capitalize on untapped market segments and establish ourselves as pioneers in IoT-integrated housing solutions locally.

3.3 Marketing Strategy

To effectively penetrate the Algerian market and attract both tenants and property owners, here is a detailed marketing strategy:

3.3.1 Market Research

- Analysis of Local Needs: Understand the preferences and expectations of Algerian users regarding smart housing.
- Surveys and Focus Groups: Collect direct data from target segments to refine the platform's offerings and features.

3.3.2 Brand Positioning

- Brand Image: Position the platform as a modern, innovative, and reliable solution for smart housing rental.
- Value Proposition: Highlight unique benefits such as comfort, security, energy efficiency, and personalized experience.

3.3.3 Marketing Mix (4Ps)

- Product: Develop features tailored to local needs, including specific integrations with popular IoT devices in Algeria.

- Price: Structure pricing competitively while offering flexible payment options and attractive promotions for new users.
- Place: Use an online platform accessible via a mobile app and website, supplemented by social media presence and partnerships with local agencies.
- Promotion:
  - Digital Advertising Campaigns: Utilize targeted ads on social media, Google Ads, and collaborations with local influencers.
  - SEO and Quality Content: Optimize the website for search engines and regularly publish helpful blog articles and guides on smart homes and smart rentals.
  - Public Relations: Organize launch events and press conferences to raise awareness among the media and the public about the new platform.
  - Referral Programs: Encourage current users to recommend the platform to their friends and family through discounts and benefits.

3.3.4 Monitoring and Adaptation

- Performance Analysis: Use analytics tools to track the performance of marketing campaigns and adjust strategies based on results.
- User Feedback: Collect and analyze user feedback to continuously improve the product and customer experience.

By following this marketing strategy, we can establish a strong presence in the Algerian market and attract a loyal user base, while differentiating ourselves from the competition through our technological innovations and unique value proposition.

Chapter 4

Production and Organization plan

4.1 Production Process

The production process of our project involves several crucial stages to ensure the quality and reliability of the final product. These stages are essential to ensure efficient development and successful delivery of our real estate application integrated with IoT technology. Here are the different stages of the production process:

1. **Needs Analysis and Planning:**
    - Before starting the production process, a thorough analysis of the project's requirements is conducted. This includes identifying necessary features, hardware and software requirements, as well as resource and timeline planning.
2. **Design and Prototype:**
    - In this phase, the team focuses on creating user-friendly interfaces and designing the overall look and feel of the platform.
    - This involves wireframing, prototyping, and ensuring the design meets user experience standards.
3. **Development:**
    - In this phase, the development team focuses on implementing the design into a functional platform.
    - This involves developing robust features, programming interactions between the application and IoT devices, and ensuring the system works as intended.
4. **IoT Integration:**
    - Once the core platform is developed, the integration of IoT devices begins. This step involves connecting and configuring sensors, actuators, and other IoT components to ensure smooth communication with the application.
5. **Testing and Validation:**
    - After integration, rigorous testing is conducted to verify the proper functioning of the entire system. This includes compatibility testing, load testing, security testing, as well as user interface testing to ensure an optimal user experience.
6. **Deployment and Commissioning:**
    - Once testing is successful, the platform is ready for deployment. This stage involves deploying the application to appropriate servers, configuring security settings, and commissioning IoT devices in real estate properties.

7. **Maintenance and Support:**

    - After deployment, a maintenance and support team is established to ensure the ongoing smooth operation of the application and IoT devices. This includes troubleshooting, software and hardware updates, as well as technical support for end-users.

This well-defined production process ensures that our real estate platform integrated with IoT technology is developed, deployed, and maintained efficiently and professionally, thereby providing an exceptional user experience and reliable functionality.

4.2 Supply

In our project's procurement process, we directly engage with suppliers who provide IoT devices and related technology components. This direct engagement ensures better control over the quality and reliability of the equipment we acquire.

We meticulously define our procurement policy, outlining the acquisition process for IoT devices, sensors, networking equipment, and other necessary components. It's imperative to identify reliable suppliers who can deliver high-quality products that meet our project requirements.

We evaluate potential suppliers based on factors such as their expertise in IoT technology, product quality, reliability, and pricing. Additionally, we establish clear payment terms and delivery schedules to ensure the timely receipt of materials and equipment.

This involves negotiating contracts, determining payment methods, and setting up favorable delivery terms with suppliers. By carefully managing our procurement process, we aim to secure the best equipment for our project while optimizing costs and ensuring smooth operations.

4.3 Labor

Our project is an economical online business that can create thousands of jobs indirectly. The main areas of direct employment include:

- Technology: Developers, QA engineers, IoT specialists.
- Customer Service: Support agents, community managers.
- Marketing and Sales: Digital marketing specialists, sales representatives.
- Logistics: IoT device management, coordination of installations and maintenance.
- Administration: Accountants, human resources.

4.4 Key Partnerships

Our project relies on strategic partnerships to thrive and grow. While our clients are crucial collaborators in utilizing our services, our primary partnerships lie with external entities. We have established a valuable partnership with the business incubator at the University of Skikda, leveraging their resources and expertise to support our project's development and expansion.

Looking forward, we plan to further diversify our partnerships. Our focus will be on collaborating with IoT device manufacturers, real estate agencies, technology partners, maintenance services, and marketing agencies. These partnerships will play a pivotal role in expanding our project's reach, efficiency, and overall impact in the market.

With our commitment to fostering strong partnerships and leveraging external expertise, we are well-equipped to ensure the success and sustainability of our project.

Chapter 5

Financial Plan

5.1 Costs and Expenses

To establish a realistic financial plan, it is crucial to identify and detail all costs and expenses associated with launching and operating our project. Costs can be divided into initial costs (startup investment) and recurring costs (operational expenses).

5.1.1 Initial Costs

Initial costs encompass the investments required to kickstart your project. These include expenses such as design and development of the application and website, integration of IoT technologies, purchase of IoT devices, server infrastructure and initial hosting, marketing campaign, launch events and public relations, recruitment and initial training, legal and compliance fees, as well as office and equipment costs. Here is the details:

Description	**Amount (DZD)**
Design and development of the application and website	100,000
Integration of IoT technologies	100,000
Purchase of IoT devices	100,000
Server infrastructure and initial hosting	40,000
Marketing campaign	100,000
Launch events and public relations	50,000
Recruitment and initial training	100,000
Legal and compliance fees	100,000
Office and equipment	40,000
Total Initial Costs	**730,000**

Table 5.1: Initial Costs

5.1.2 Recurring Costs (Monthly)

Recurring costs are the ongoing operational expenses required to sustain our project on a monthly basis. These include platform maintenance, updates and continuous development, customer support, online and offline advertising, hosting and server infrastructure, as well as administrative costs. Here is the details:

Description	Amount (DZD)
Platform maintenance	20,000
Updates and continuous development	30,000
Customer support	30,000
Online and offline advertising	20,000
Hosting and server infrastructure	20,000
Administrative costs	40,000
Total Recurring Costs	**160,000**

Table 5.2: Recurring Costs

5.2 Revenue

To estimate revenue, we need to project the expected income from various previously identified sources.

5.2.1 Optimistic Scenario

In the optimistic scenario, we anticipate robust growth and higher revenue generation. This scenario assumes a favorable market environment, increased customer adoption, and successful execution of marketing strategies. Here is the details:

Revenue Source	Monthly Revenue (DZD)
Booking Fees	250,000
Subscriptions	200,000
IoT Device Sales/Rentals	400,000
Value-Added Services	360,000
Total Monthly Revenue	**1,210,000**

Table 5.3: Revenue - Optimistic Scenario

5.2.2 Pessimistic Scenario

The pessimistic scenario presents a more conservative outlook, considering potential challenges and market fluctuations. This scenario assumes slower growth and lower revenue generation compared to the optimistic scenario. Here is the details:

Revenue Source	Monthly Revenue (DZD)
Booking Fees	150,000
Subscriptions	100,000
IoT Device Sales/Rentals	200,000
Value-Added Services	180,000
Total Monthly Revenue	**630,000**

Table 5.4: Revenue - Pessimistic Scenario

5.3 Projected Income Statement

To evaluate the financial viability of the project, we need to establish a projected income statement. We present it in the table below :

Description	Monthly Amount (DZD)
Revenue	
Booking Fees	250,000
Subscriptions	200,000
IoT Device Sales/Rentals	400,000
Value-Added Services	360,000
Total Revenue	**1,210,000**
Expenses	
Platform maintenance	20,000
Updates and continuous development	30,000
Customer support	30,000
Online and offline advertising	20,000
Hosting and server infrastructure	20,000
Administrative costs	40,000
Total Expenses	**160,000**
Profit/Loss	**1,050,000**

Table 5.5: Projected Income Statement

5.4 Cash Flow Plan

A detailed cash flow plan is essential for managing the financial aspects of the project effectively.

This monthly cash flow plan outlines the expected inflows and outflows of cash over the course of each month. This helps in understanding the liquidity position and ensuring that the project remains financially stable. Here are the details:

Month	Revenue (DZD)	Expenses (DZD)	Starting Cash (DZD)	Ending Cash (DZD)
January	630,000	160,000	0	470,000
February	630,000	180,000	470,000	920,000
March	850,000	170,000	920,000	1,600,000
April	900,000	160,000	1,600,000	2,340,000
May	1,100,000	175,000	2,340,000	3,265,000
June	1,200,000	165,000	3,265,000	4,300,000
July	1,300,000	170,000	4,300,000	5,430,000
August	1,350,000	160,000	5,430,000	6,620,000
September	630,000	180,000	6,620,000	7,070,000
October	630,000	175,000	7,070,000	7,525,000
November	630,000	160,000	7,525,000	7,995,000
December	850,000	170,000	7,995,000	8,675,000

Table 5.6: Monthly Cash Flow Plan

5.5 Conclusion

This financial plan outlines the key costs, expenses, revenue projections, and financial viability of our project. By thoroughly analyzing the initial and recurring costs, potential revenue streams, and projecting the financial performance, we aim to ensure the project's sustainability and profitability. Continuous monitoring and adjustment of this plan will be essential to adapt to market changes and achieve our financial goals.

Chapter 6

Experimental prototype

6.1 Components

Here some components we used in our project :

ESP32: A low-cost, low-power system-on-a-chip microcontroller with integrated Wi-Fi and Bluetooth capabilities, widely used in IoT applications.

ESP32-CAM: A variant of the ESP32 that includes a camera module, suitable for projects requiring video streaming or image capture.

LCD: Liquid Crystal Display, used for visual output in various electronic devices, often interfaced with microcontrollers to display text or graphics.

RFID: Radio Frequency Identification, a technology for identifying and tracking tags attached to objects using radio waves.

Keypad: A set of buttons arranged in a grid, used for inputting data or commands into electronic systems.

Motion Sensor: Detects movement or motion within its field of view using various technologies such as infrared or ultrasonic sensors.

Relays: Electrically operated switches used to control high-power devices with low-power signals, commonly used for home automation.

Ultrasonic Sensor: Uses sound waves above the frequency of human hearing to measure distance to objects, often used in robotics and automation.

DHT11: A basic digital temperature and humidity sensor.

Sound Sensor: Detects sound levels or specific frequencies in the environment, used in applications like noise monitoring or alarm systems.

MC38: A type of magnetic contact switch used to detect the opening or closing of doors or windows.

MQ-9 Gas Sensor: Detects gases like carbon monoxide and methane in the air, commonly used for monitoring indoor air quality or safety.

Fan: A device that creates airflow, typically used for cooling purposes in electronic devices or ventilation systems.

Solenoid Door Lock 12V: An electrically controlled locking mechanism that operates with a 12V current, used for securing doors.

Water Solenoid 12V: An electrically controlled valve that regulates the flow of water with a 12V current, used in irrigation systems or fluid control applications.

Jumper Wires: Pre-cut wires with connectors used to interconnect electronic components on a breadboard or circuit board.

I2C Expander: Integrated Circuit Expander, a device that increases the number of I/O pins available to a microcontroller via the I2C communication protocol, useful when additional sensors or peripherals need to be connected.

Figure 6.1: Components

6.2 The general architecture of the system

The following represents The general architecture of the system :

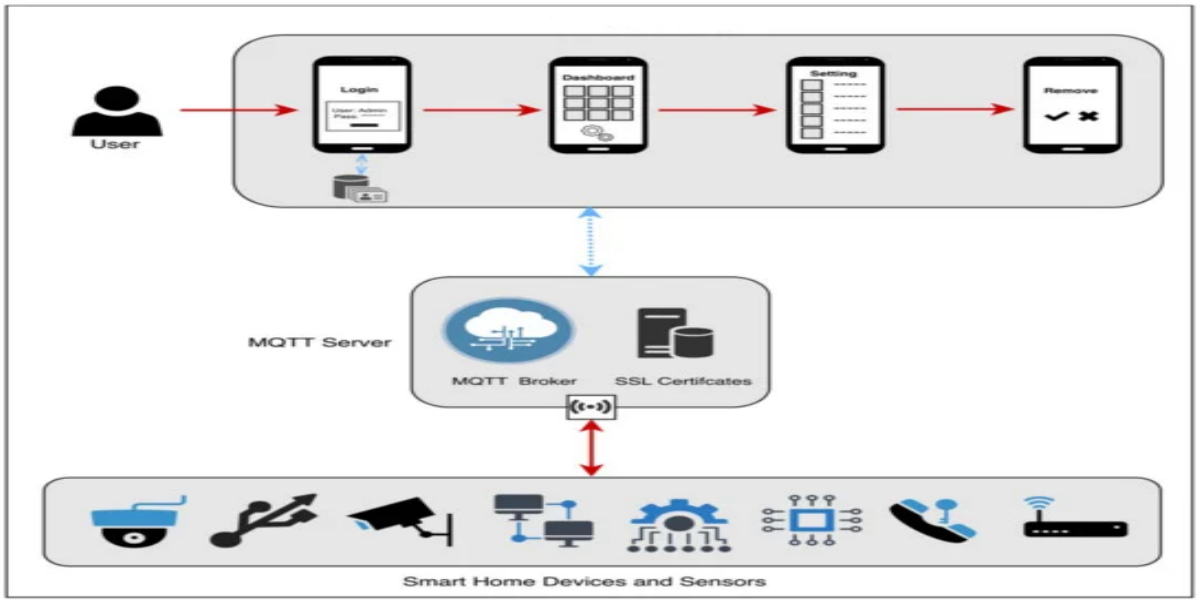

Figure 6.2: The general architecture of the system

6.3 Project model

The following model represents the prototype of our project:

Figure 6.3: Project model

6.4 System Structure and Working Principle

In this section we provides a detailed overview of the platform functionalities . It explains how the system operates from both client and administrative perspectives, covering key pages, this section offers a comprehensive understanding of the platform's capabilities and workflow.

6.4.1 Client

Landing Page

Once the URL address is entered and launched, a home page of the platform will be displayed .

Figure 6.4: Landing Page

Sign In Modal

After the registration phase, the user must authenticate in order to have access to their space .

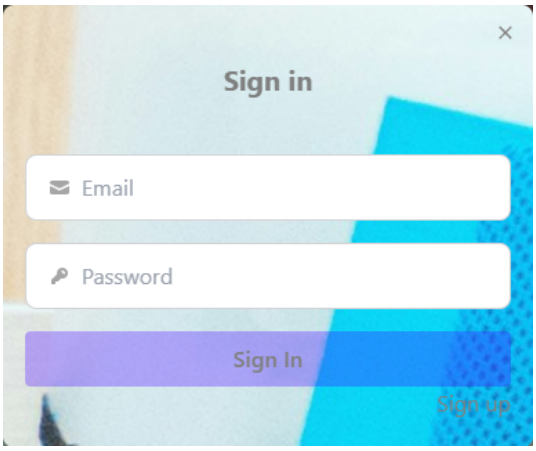

Figure 6.5: Sign In Modal

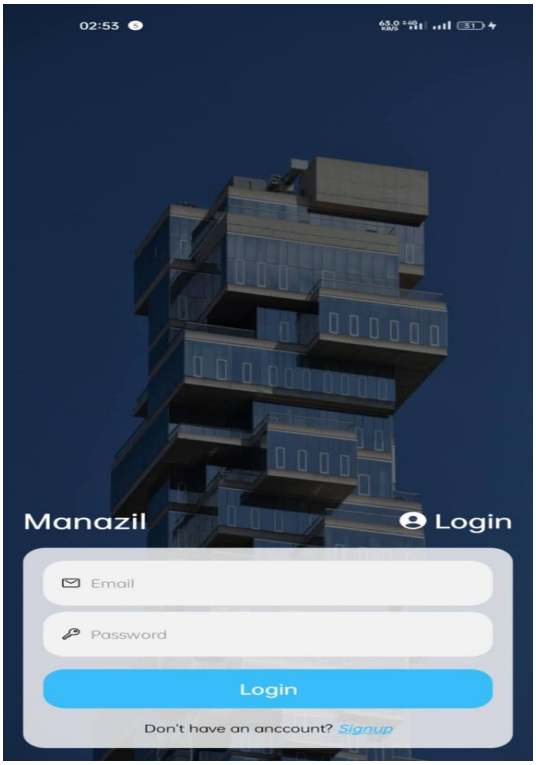

Figure 6.6: Sign In App Screen

Sign Up Page

Our platform provides its visitors with an accessible registration form .

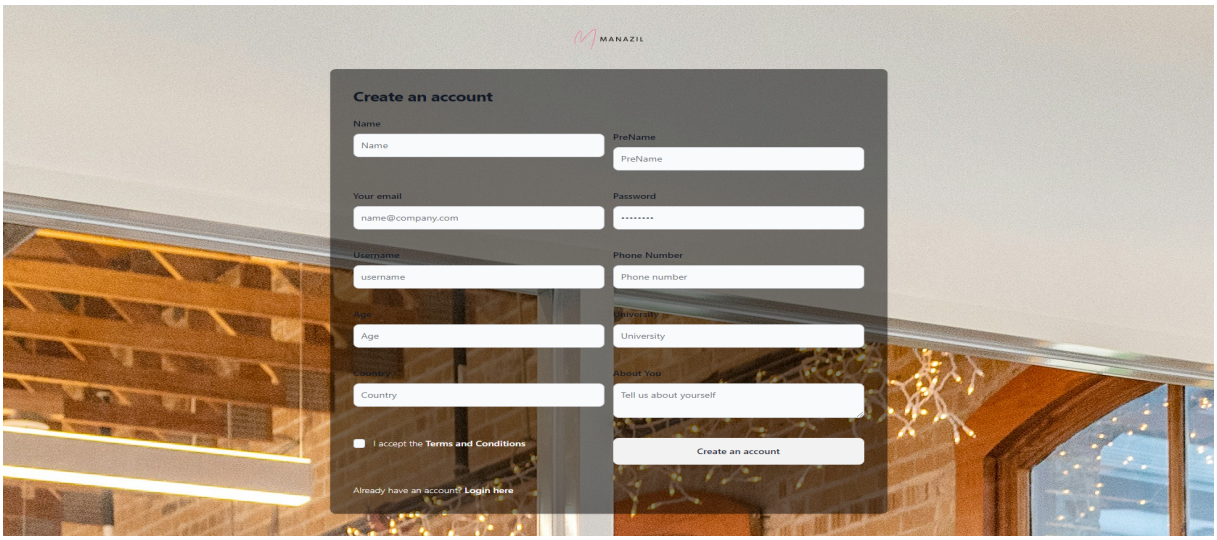

Figure 6.7: Sign Up Page

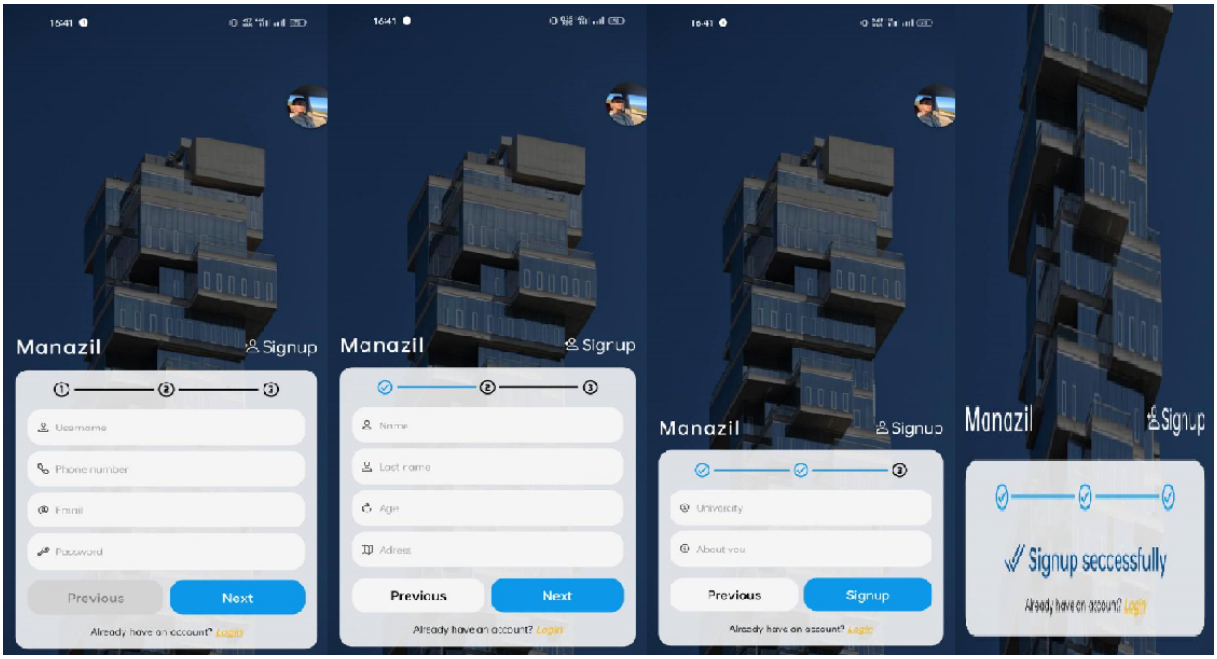

Figure 6.8: Sign Up App Screen

Main Page

The main page provides clients with access to property listings, search functionality, and other essential features for seamless navigation and interaction .

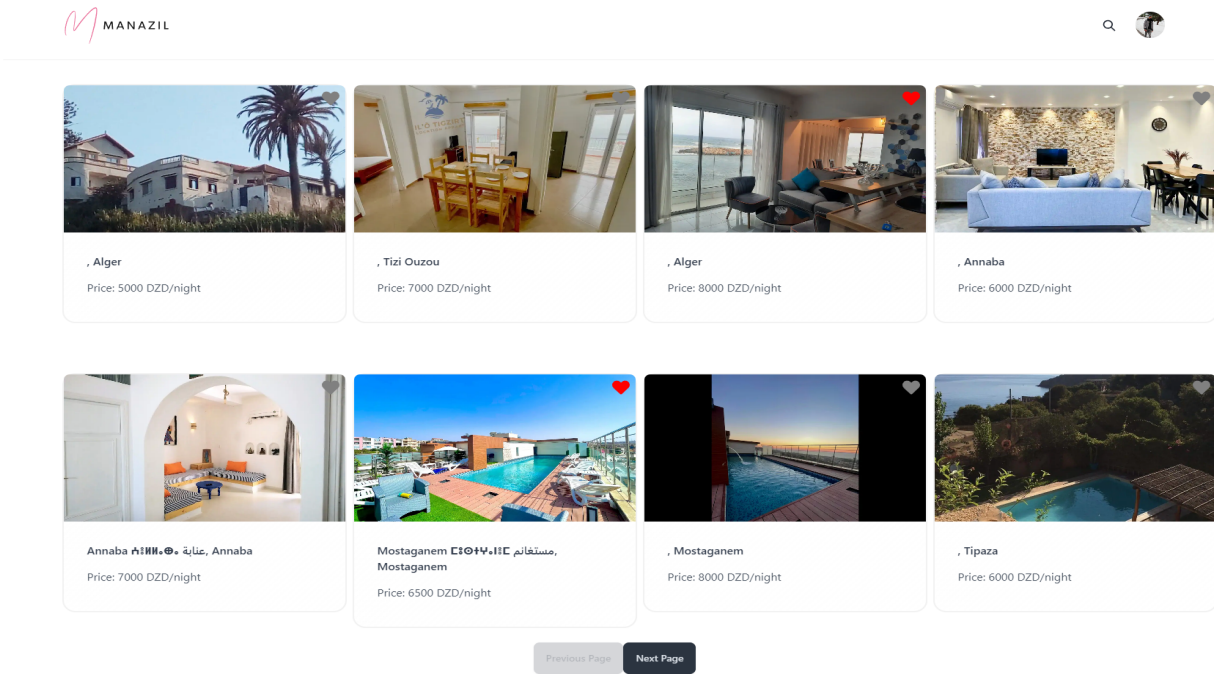

Figure 6.9: Main Page

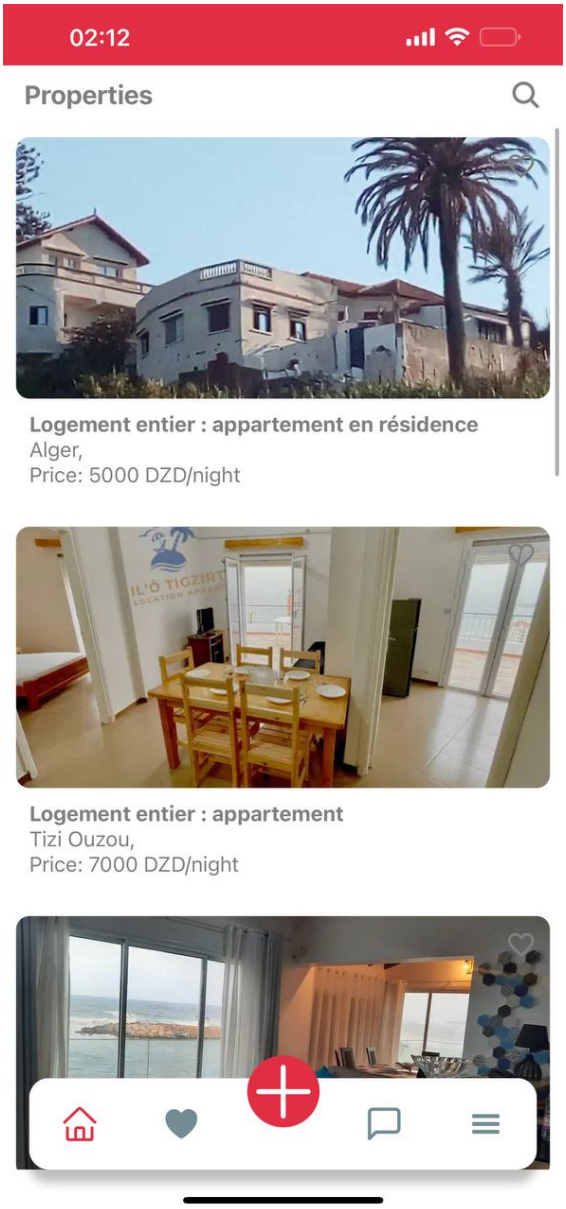

Figure 6.10: Main Screen App

Detail Page

The detail page displays comprehensive property information and allows clients to book. Also request IoT upgrades if they own the property .

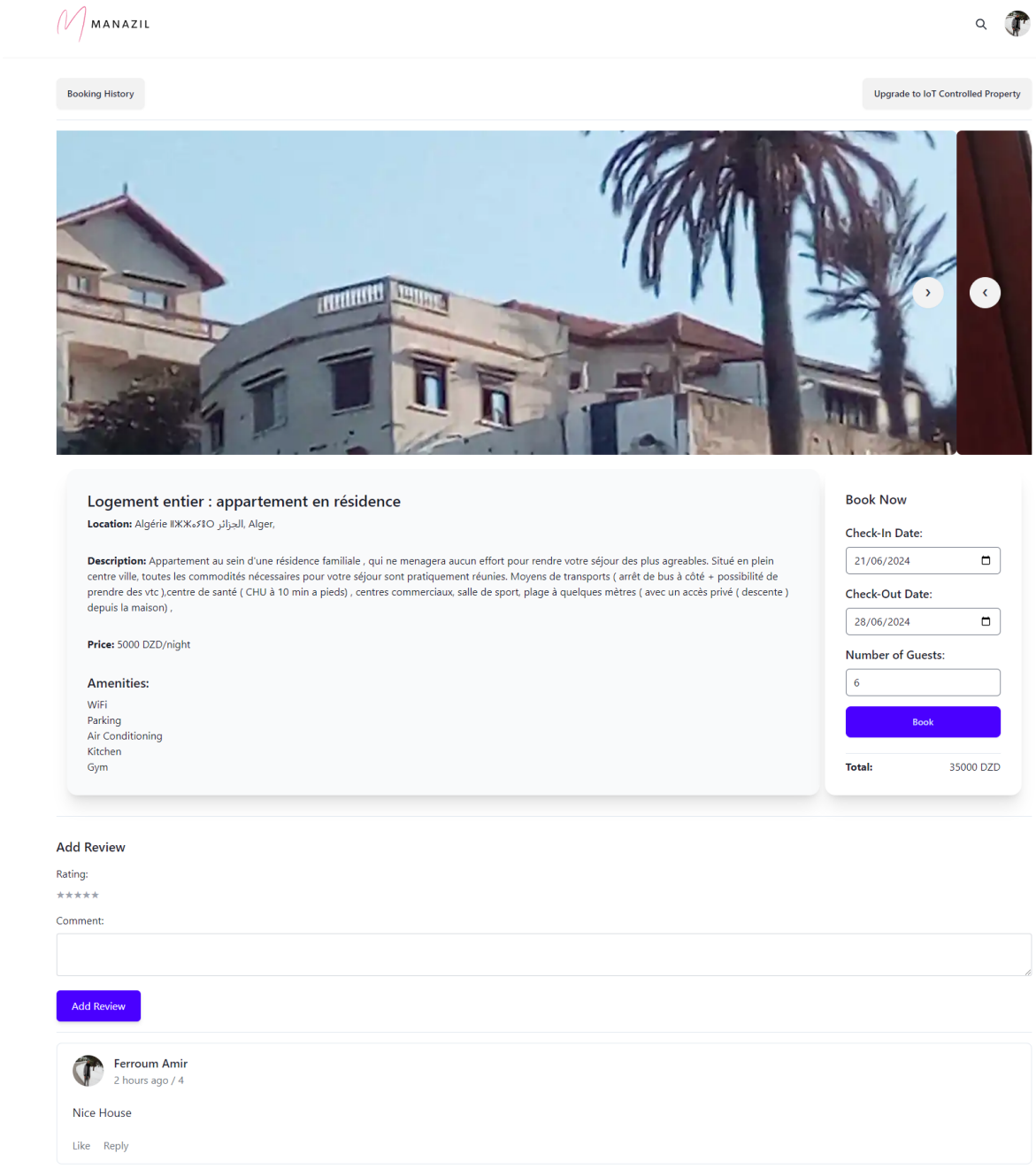

Figure 6.11: Detail Page

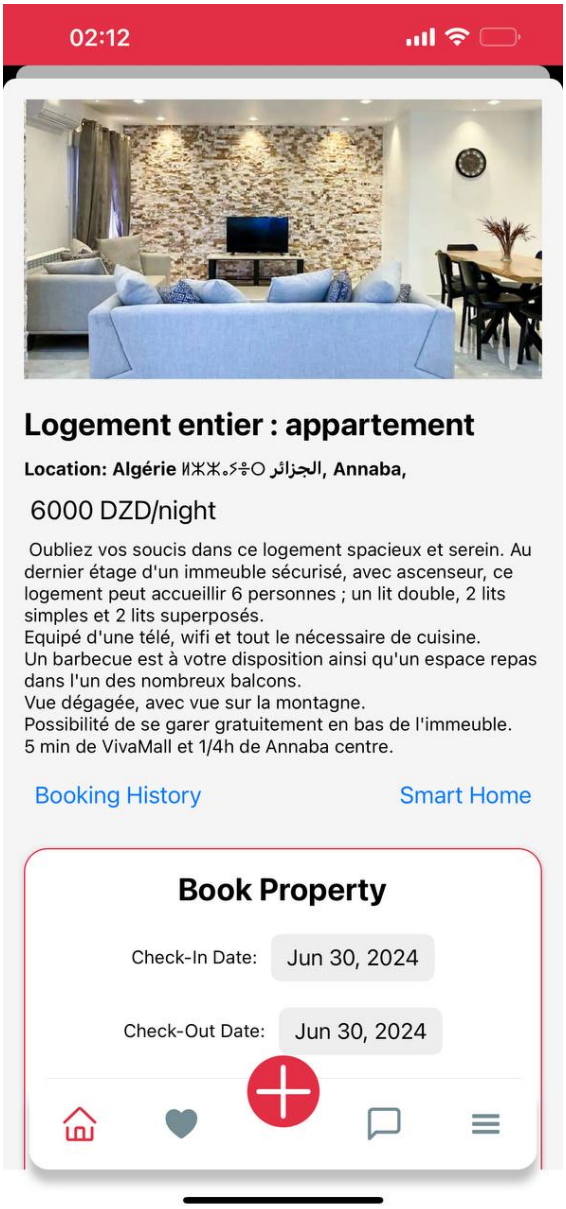

Figure 6.12: Detail Screen App

Demand Page

The demand page allows clients to request IoT upgrades for their property .

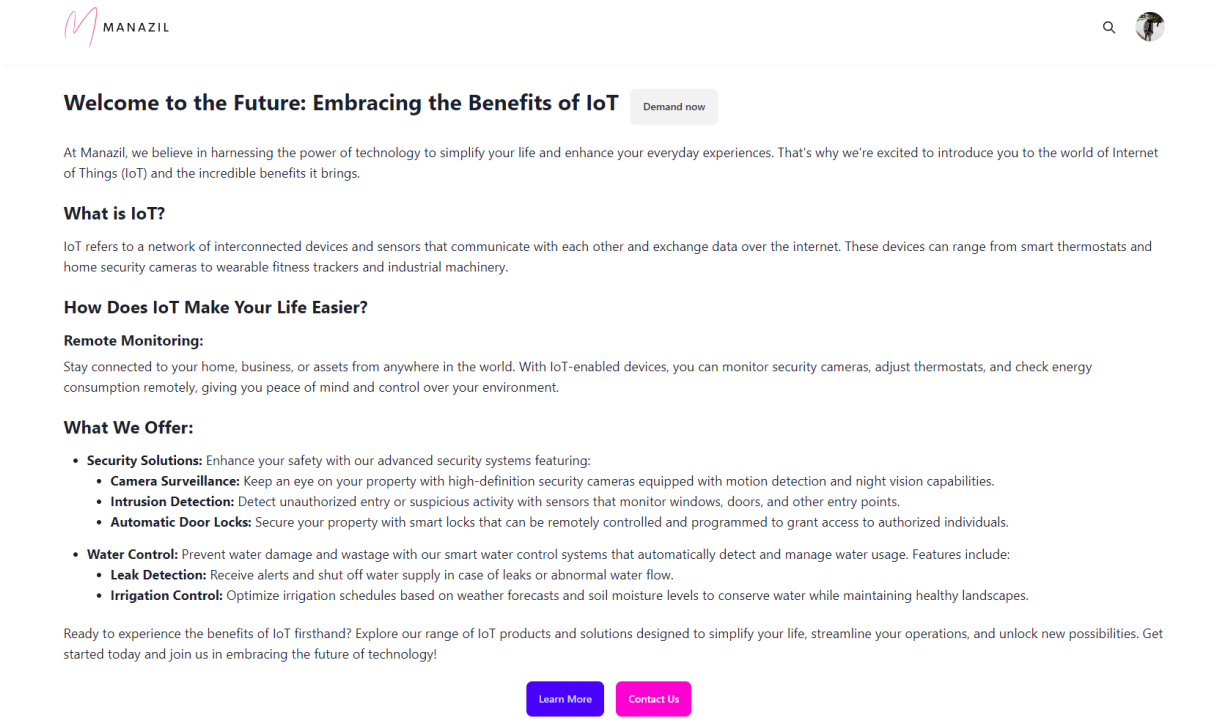

Figure 6.13: Demand Page

IoT Page

The IoT page enables clients to manage their upgraded smart home, including monitoring cameras, controlling lights, doors, and other IoT-connected devices.

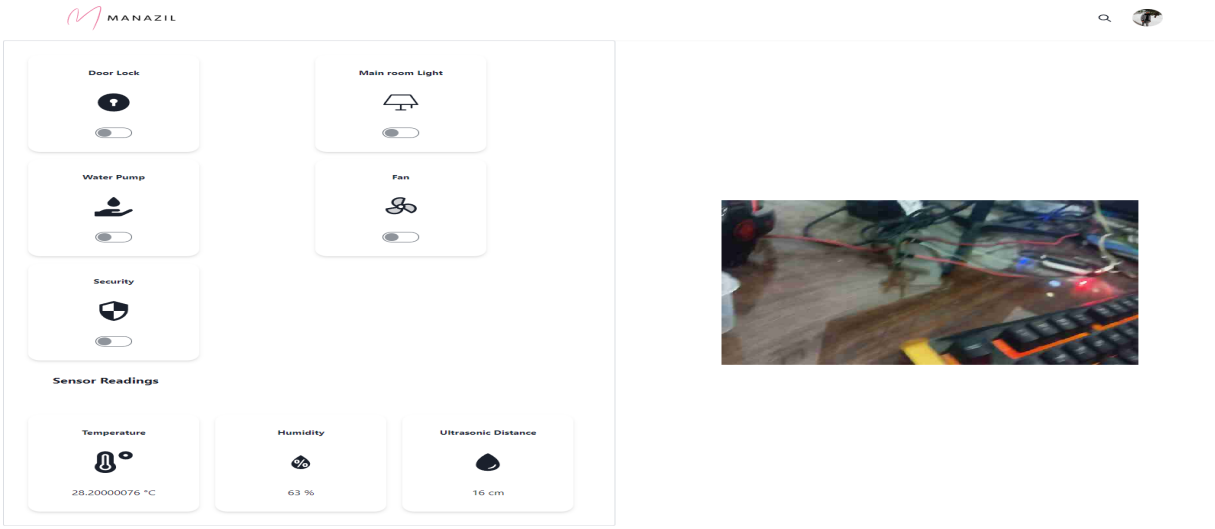

Figure 6.14: IOT Control Page

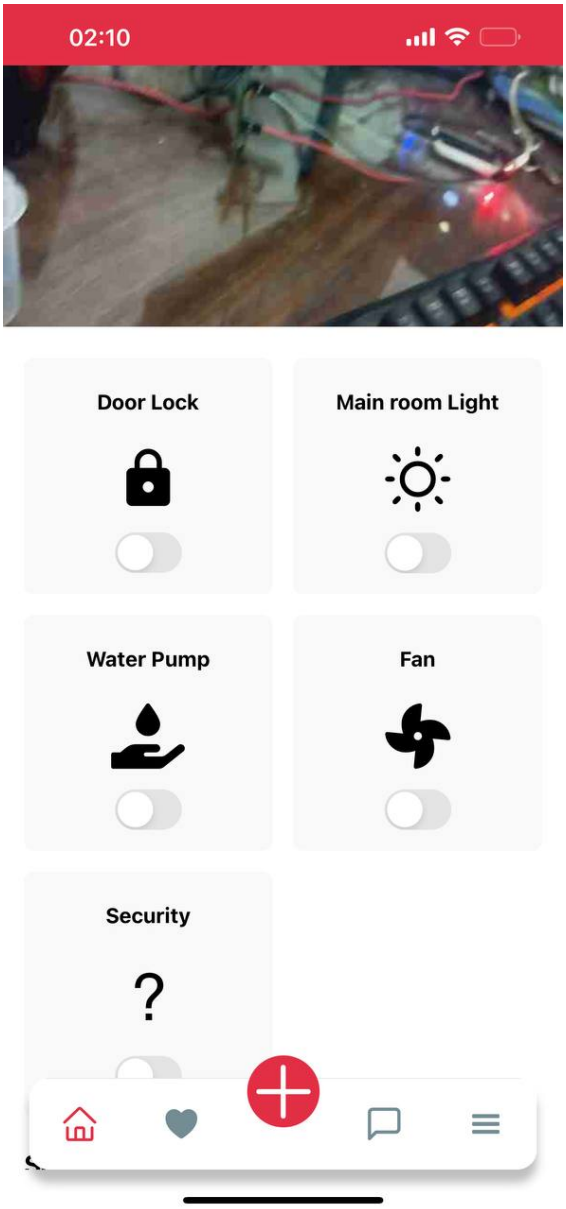

Figure 6.15: IOT Control App Screen

Profile Page

The profile page includes a favorite section where clients can manage their preferred listings or saved properties, as well as modify their profile images and other personal information .

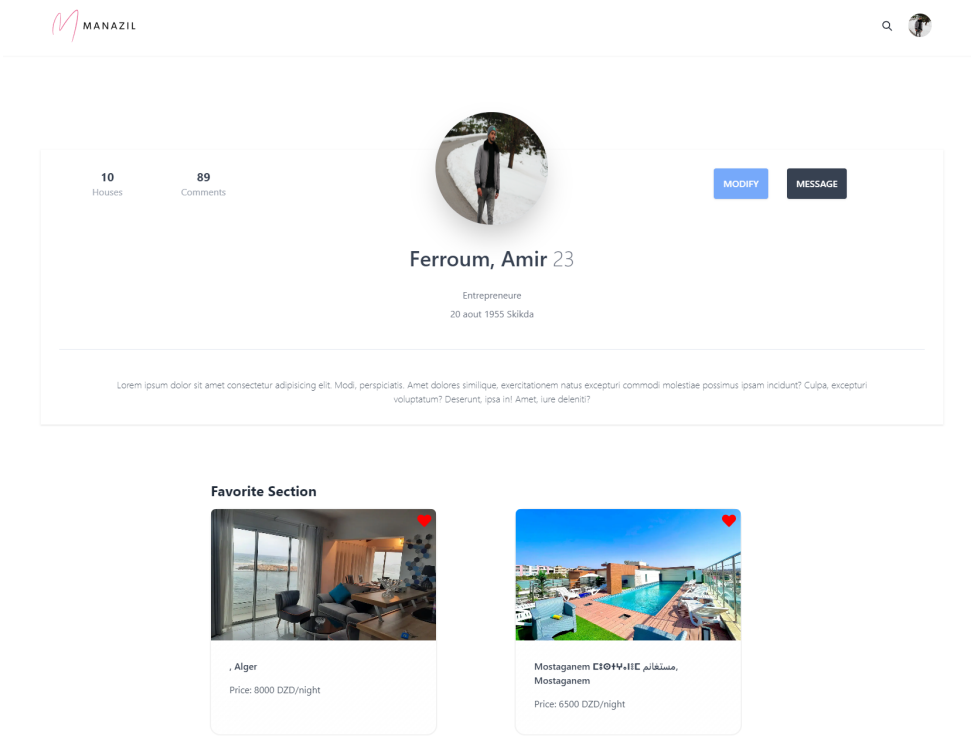

Figure 6.16: Profile Page

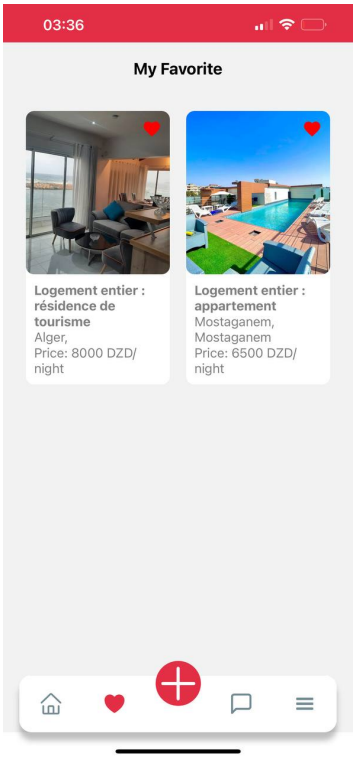

Figure 6.17: Fav Screen App

My Booking Page

The booking page offers clients a comprehensive view of both past and upcoming bookings, along with access to the secret code needed for entry to the booked house, ensuring convenient and secure access for clients .

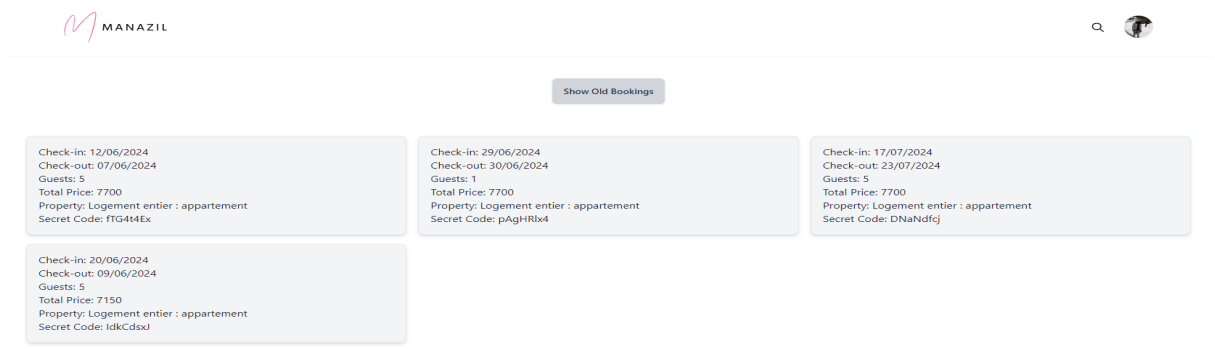

Figure 6.18: My Booking Page

History Page

The history page enables clients to view the booking history of their property (see Figure 6.19).

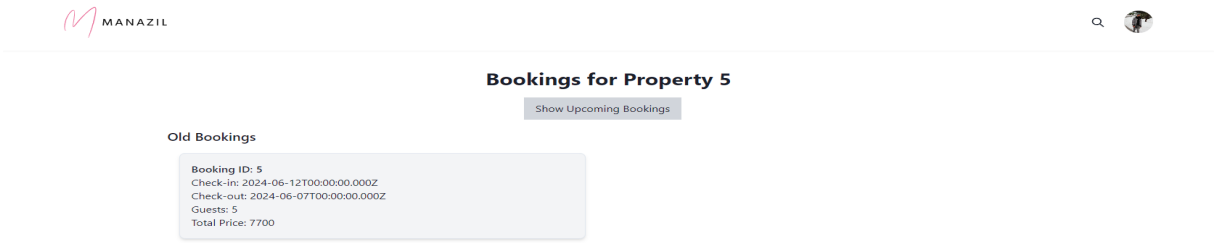

Figure 6.19: History Page

My Properties Page

The property page allows clients to view all the properties they have added to their account.

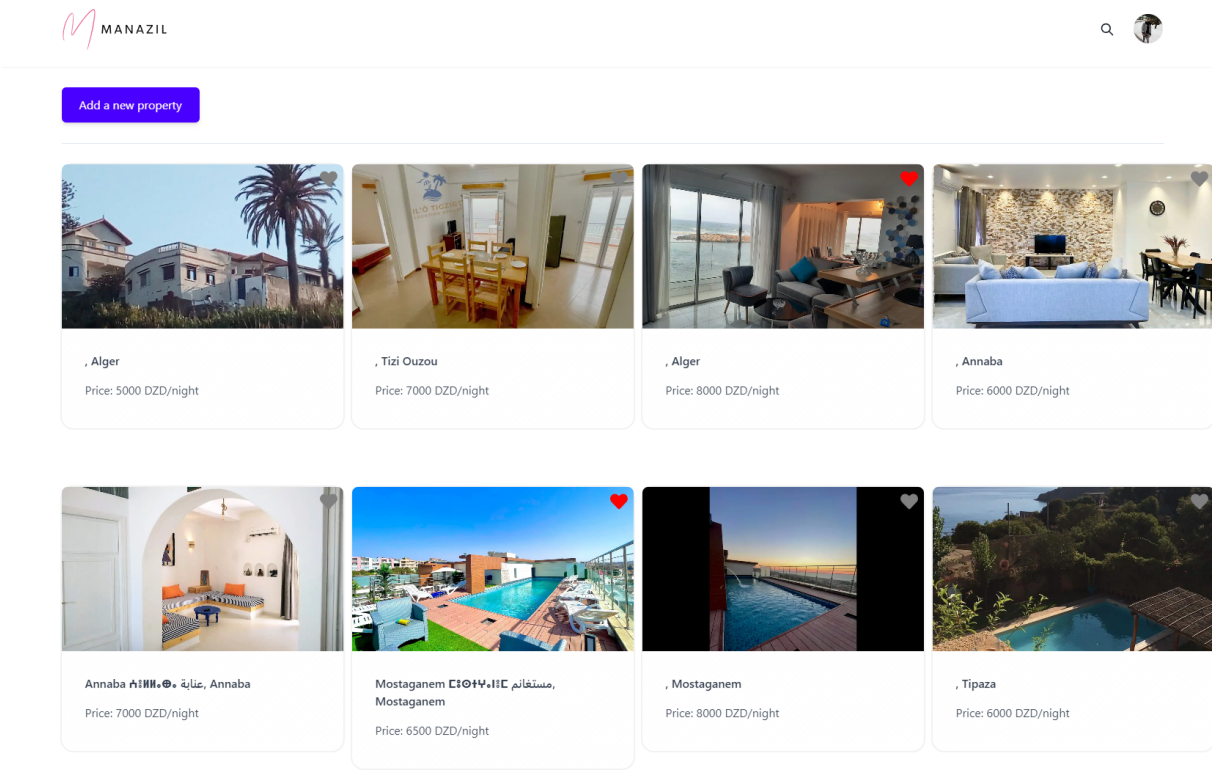

Figure 6.20: My Properties Page

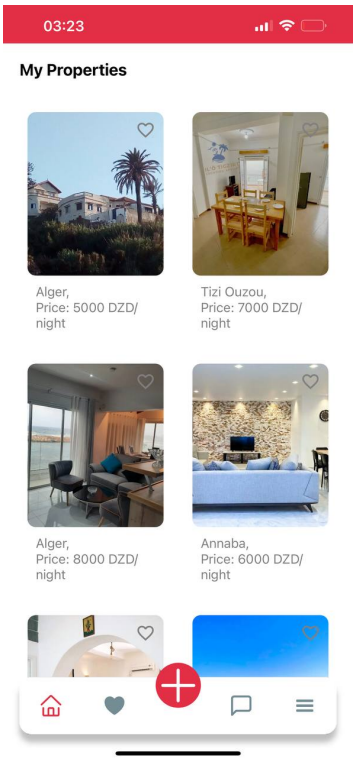

Figure 6.21: My Properties Screen App

Create Property Modal

The property modal allows clients to add new properties to their account .

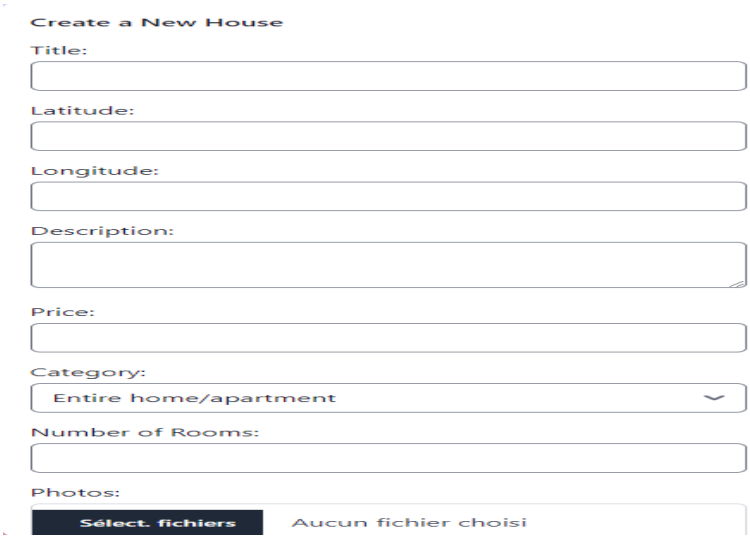

Figure 6.22: Create Property Modal

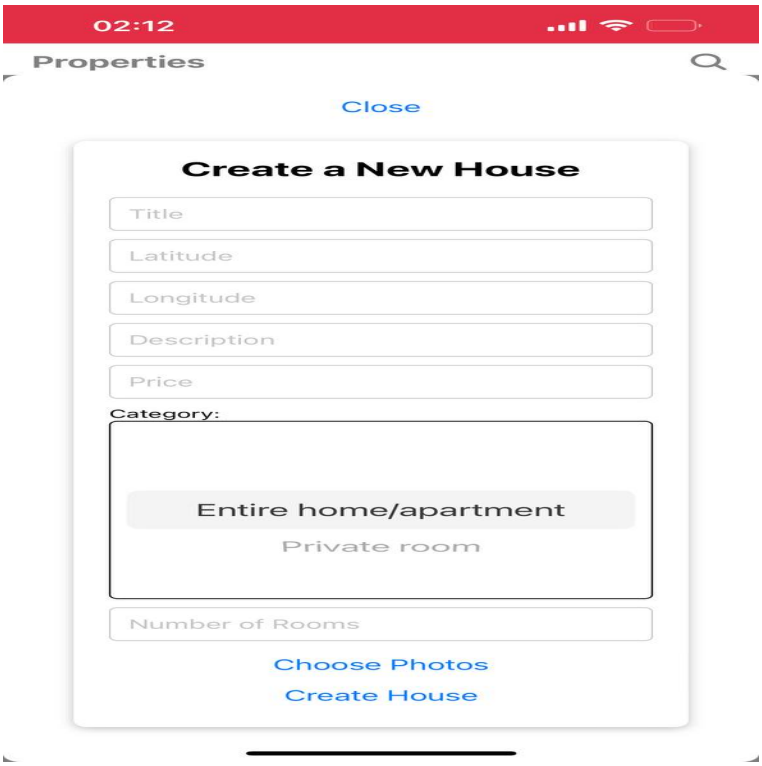

Figure 6.23: Create Property Screen App

6.4.2 Admin

Sign In Page

The sign-in page allows admins to access the admin dashboard for managing platform operations and data .

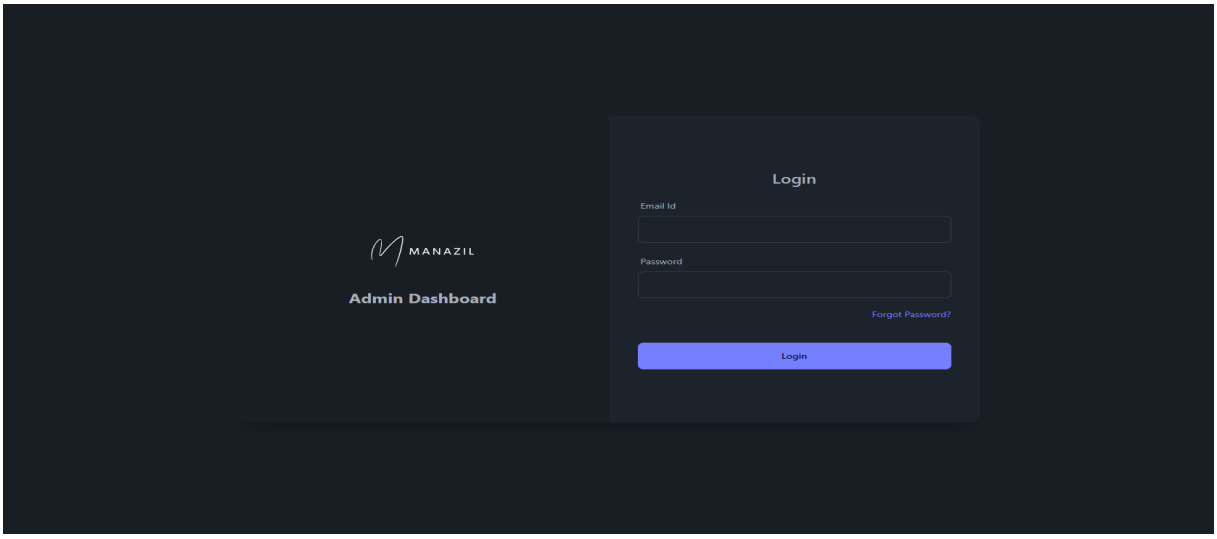

Figure 6.24: Admin Sign In Page

Welcome Page

This page shows the Admin area and the features it can access from the sidebar menu .

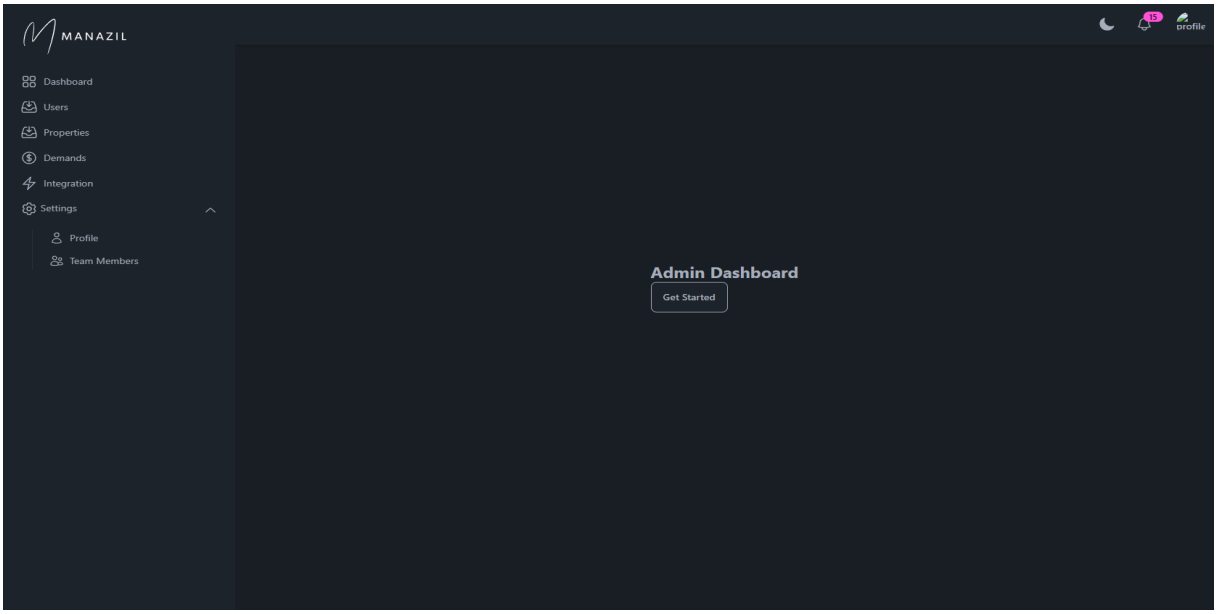

Figure 6.25: Admin Welcome Page

Users Page

The users page allows admins to view and manage user accounts and activities on the platform (see Figure 6.26).

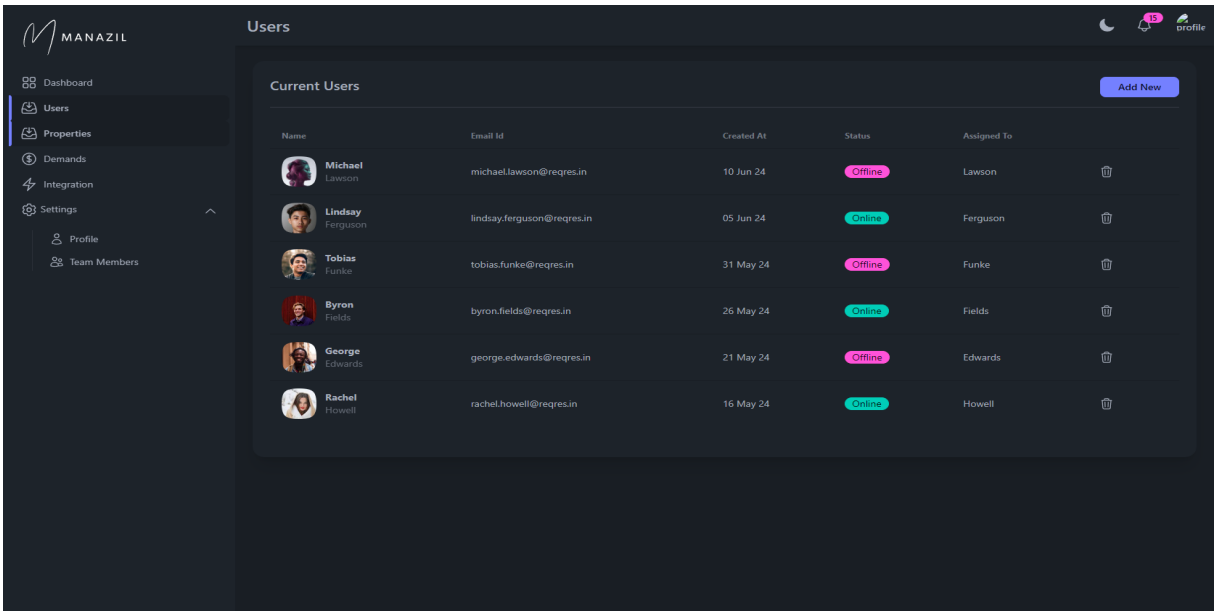

Figure 6.26: Users Page

Demands Page

The demand page enables admins to review and accept upgrade requests, adding IoT capabilities to properties as needed .

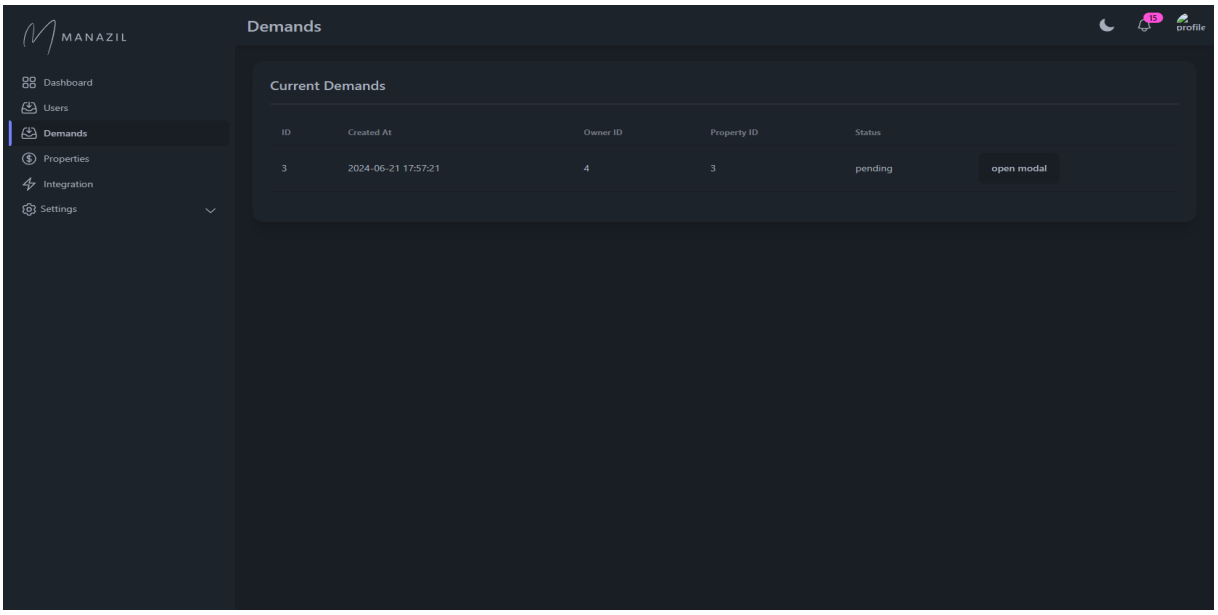

Figure 6.27: Admin Demands Page

Add IoT Device Modal

The IoT device add modal allows admins to add IoT devices to properties, enhancing their functionality and connectivity.

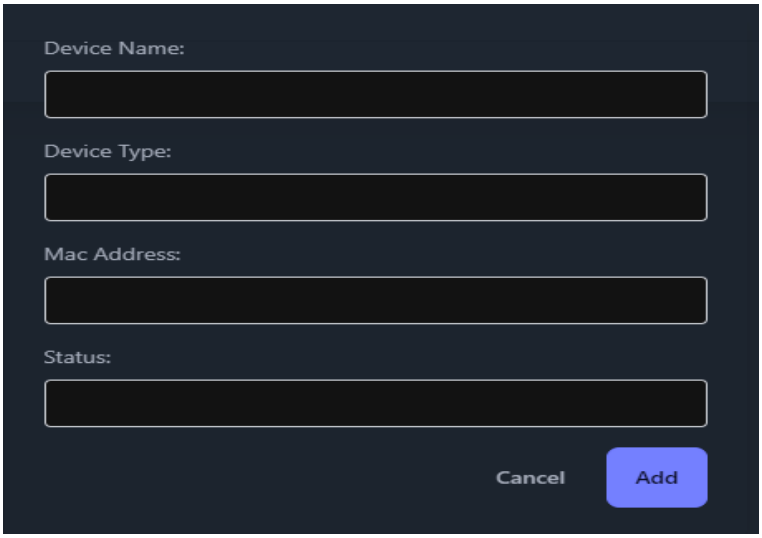

Figure 6.28: Add IoT Device Modal

Properties Page

The properties page enables admins to manage and oversee all properties listed on the platform .

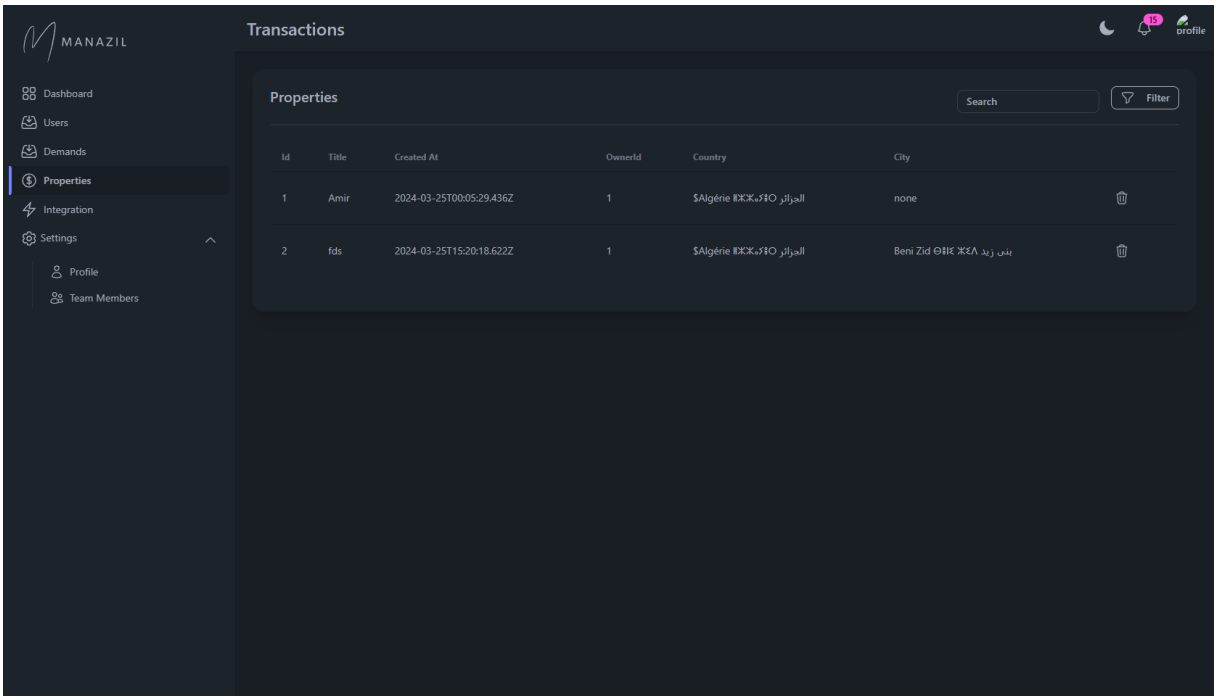

Figure 6.29: Admin Properties Page

Admin Profile Page

The admin profile page provides access to manage and update administrative account information and settings.

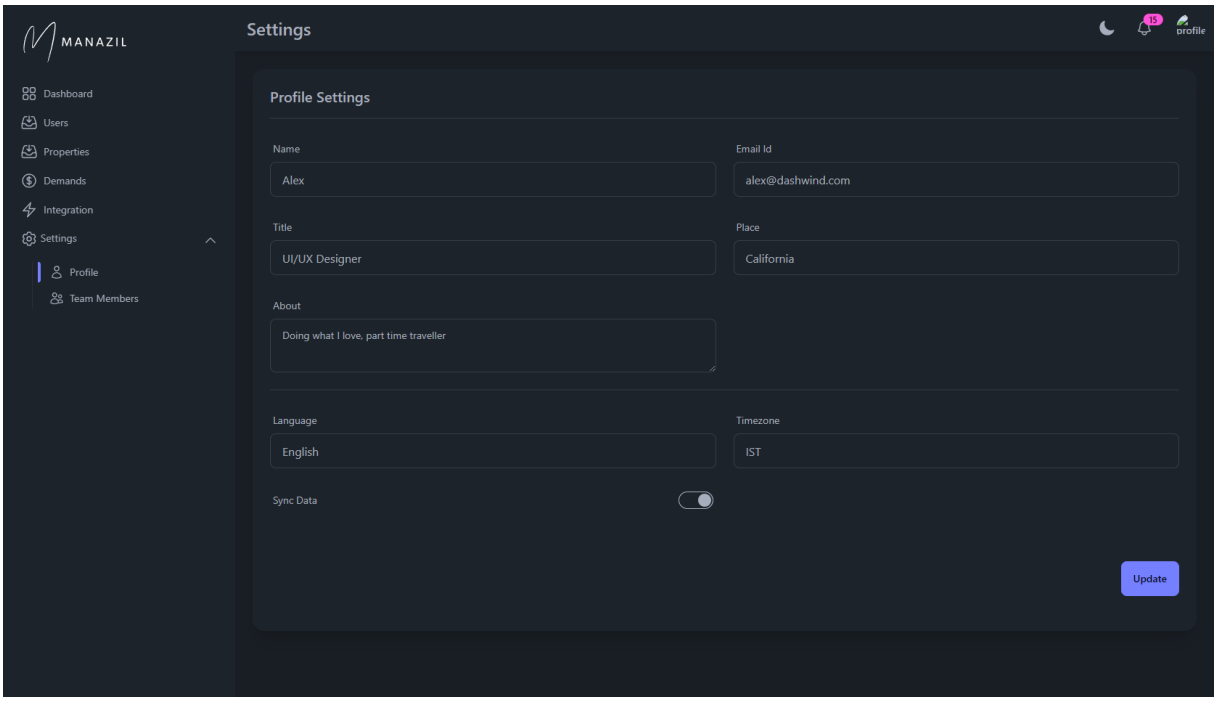

Figure 6.30: Admin Profile Page

Chapter 7

Annex : Business Model Canvas

BMC

The Business Model Canvas (BMC) is a structured framework that visually represents key elements of a business model, helping to clarify, design, and innovate business strategies effectively.

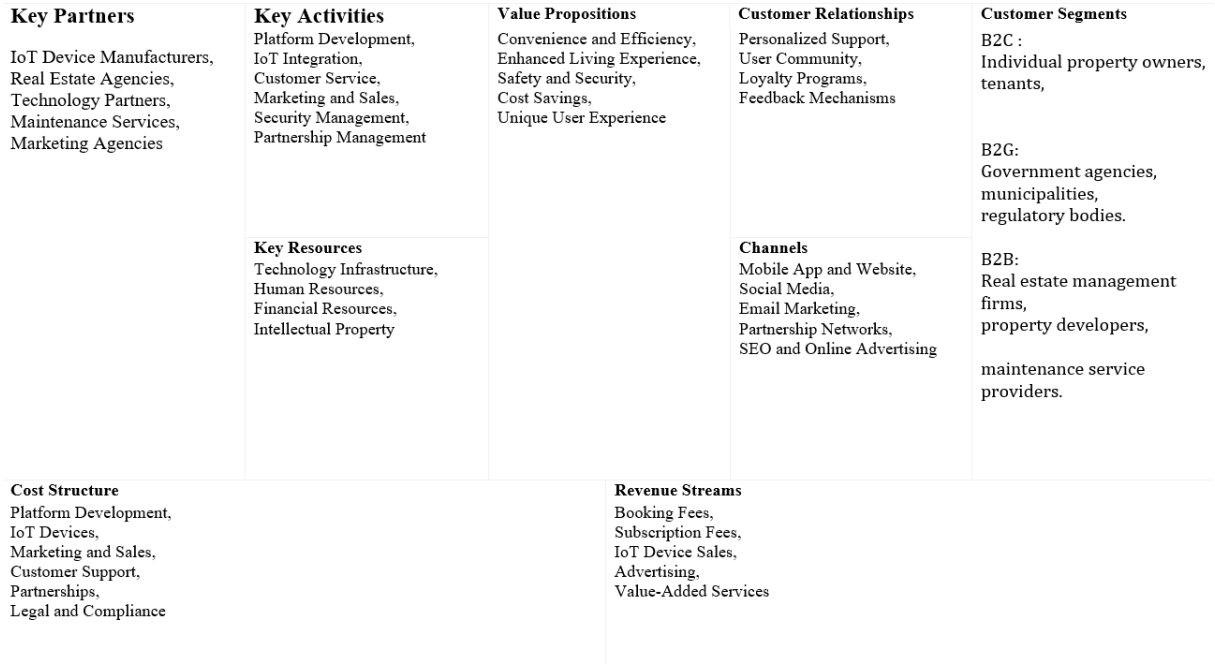

Figure 7.1: BMC

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عنوان المذكرة : Smart Homes: Reinventing Real Estate Management With Security and Control

القسم : إعلام آلي

المستوى : Master 2 Ro

التخصص : شبكات و أنظمة موزعة ~~Net~~