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HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

MULTIDISCIPLINARY PROJECT (CO3109)

Project

Smart Home Systems

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Document History

Date	Ver.	Changes	Changed by
18/03/2025	1.0	Create report, initialize sections and functional requirements description	Quang Duy
20/03/2025	1.1	Add devices and use case details	Quang Duy

1 Introduction

In today's world, technology has completely transformed the way we live, and one of the most exciting innovations is the Smart Home System. Smart homes use advanced technologies to make everyday tasks easier, more efficient, and more secure. By connecting various devices in the home through the Internet of Things (IoT), smart home systems allow homeowners to control everything from lights to security systems, all from their smartphones or voice assistants.

The system includes various features, such as remote control of lights and doors, environmental monitoring (temperature, humidity, lighting), voice command integration, and security system alerts. With this setup, users can easily keep track of the conditions inside their homes and make adjustments to suit their needs. Whether it's controlling appliances from a distance or getting notified of security breaches, the system provides a seamless and user-friendly experience.

By gathering real-time data, the system helps users understand and optimize their living environment—improving energy efficiency and providing useful insights into the home's overall performance. Whether it's turning on the lights remotely or getting alerts about unusual activity around the house, this system brings comfort and peace of mind, making everyday tasks easier and more efficient.

For this project, our aim is to develop a prototype of such a system that integrates several key functionalities to demonstrate the potential of smart home technology.

Figure 1: Smart Home System

2 Devices

2.1 Yolo:bit

- **Application**: The Yolo:bit can be used as the central processing unit for controlling various smart home devices. It can handle input from sensors and output control signals to actuators.

- **Input**: It receives data from connected sensors like temperature, humidity, and light sensors.

- **Output**: It sends control signals to other components, such as the relay switch or servo motors, based on the inputs it receives.

2.2 Expansion Board

- **Application**: This board allows for the connection of multiple sensors and devices to the Yolo:bit.

- **Input**: It receives signals from various connected sensors.

- **Output**: It sends signals to the Yolo:bit, allowing it to process the information and control other devices.

2.3 Temperature and Humidity Sensor DHT20

- **Application**: Monitors the temperature and humidity levels in the environment.

- **Input**: The sensor continuously collects temperature and humidity data from the environment.

- **Output**: It sends the temperature and humidity data to the Yolo:bit for processing.

2.4 Light Sensor

- **Application**: Used to monitor the ambient light levels in the room.

- **Input**: It measures the intensity of light in the environment.

- **Output**: The sensor sends the light intensity data to the Yolo:bit for further processing.

2.5 Distance Sensor

- **Application**: Used for security, this sensor detects the presence of people or objects by measuring distance. It can be used for detecting intruders or monitoring door openings.

- **Input**: It sends distance measurements to the Yolo:bit, which can determine whether there is movement or an obstacle in the monitored area.

- **Output**: The sensor's output is a distance value that can be used to trigger alerts or security systems.

2.6   Servo Motor

- **Application**: Used to control doors. The servo motor allows precise positioning, which is essential for tasks like opening or closing a door.

- **Input**: The servo receives a signal from the Yolo:bit to determine its position.

- **Output**: The servo moves to a specific position, such as opening or closing a door.

2.7   Mini Fan

- **Application**: A fan can be controlled to adjust the airflow and cool the room.

- **Input**: The fan receives a signal from the Yolo:bit.

- **Output**: It provides airflow by turning on or off, depending on the control signal it receives.

2.8   LED RGB Lights

- **Application**: The LED RGB lights can be controlled to change colors and brightness, creating different lighting effects or ambiance in the room.

- **Input**: The lights receive control signals from the Yolo:bit based on data from sensors or user preferences.

- **Output**: The lights change their color and brightness according to the signals received, providing desired lighting effects.

3 User Requirements

3.1 Functional Requirements

- The system must allow users to remotely control appliances such as lights, doors, and other smart devices through a mobile app, web interface, or voice commands.

- The system must collect and display real-time data from environmental sensors, including temperature, humidity, and lighting levels, accessible through a user interface or mobile app. The system must integrate with voice assistants, allowing users to control home devices using voice commands.

- The system must send real-time security alerts to users if motion is detected or doors/windows are opened without authorization.

- The system must display the current status of all connected devices, including whether they are on or off, and provide detailed information about their performance.

3.2 Non-functional Requirements

- The system must be easy to use.

- The system must respond to user commands within 2 seconds.

- The system must be available 99.9% of the time.

- The system must be compatible with a wide range of smart devices.

- The system must ensure that all sensor data is accurately recorded.

4 Use Case Details

4.1 Use Case 1: Remote Home Control via MQTT

4.2   Use Case 2: Environmental Monitoring

4.3 Use Case 3: System Reports and Statistics

Use Case ID	3
Use Case Name	System Reports and Statistics
Created By	Thành Đạt
Date Created	20/03/2025
Actors	User
Description	This use case allows a user to generate system reports and view relevant statistics. The user can select the type of report desired and optionally export the resulting report in different formats.
Preconditions	1. The user is logged into the system. 2. The system contains sufficient data to generate reports. 3. The user has the necessary permissions to view or export reports.
Postconditions	1. The targeted device is in the desired state. 2. The system confirms the successful execution of the command via the user interface.
Normal Flow	1. The user navigates to the "Reports" or "Statistics" section of the system interface. 2. The system displays available report categories or types. 3. The user selects a report type (use case includes Select Report Type). 4. The system gathers the relevant data and generates the report. 5. The system displays the generated report and any relevant statistics to the user. 6. (Optional) The user selects an export option (use case includes Export Report). 7. The system exports the report.
Alternative Flow	Alternative 1 at step 2: 1. The user does not have permission to view a specific report type. 2. The system hides or disables the option to select that report type. 3. The user can only see the report types they are authorized to view.
Exception	Exception 1 at step 5: 1. The system detects that there is insufficient data for the selected report. 2. The system displays a "No Data Available" message. 3. The user is returned to the reports menu. Exception 2 at step 4: 1. The system encounters an error 2. The system displays an error message. 3. The system logs the issue and notifies the user of the failure.

4.4   Use Case 4: Voice Command Integration

Use Case ID	4
Use Case Name	Voice Command Integration
Created By	Quang Duy
Date Created	19/03/2025
Actors	User, Voice Assistant
Description	User controls smart home devices (lights, doors, thermostat, etc.) through voice commands. The voice command is processed by the voice assistant and sent to the smart home system to control the devices.
Preconditions	1. User has a compatible voice assistant configured and connected to the smart home system. 2. User has valid authentication for the smart home system. 3. The smart home system and devices are properly set up and connected to the system. 4. User is within the listening range of the voice assistant device. 5. The voice assistant has a stable internet connection.
Postconditions	1. The targeted device is in the desired state. 2. The system confirms the successful execution of the command via the user interface.
Normal Flow	1. User activates the voice assistant by using a wake word (e.g., "Hey Google" or "Alexa"). 2. User issues a voice command (e.g., "Turn on the living room lights"). 3. The voice assistant receives the voice command and processes the speech recognition. 4. The voice assistant matches the voice command to a predefined action. 5. The voice assistant sends the command to the smart home system via an API or MQTT message. 6. The smart home system receives the command and processes it, sending the corresponding action to the device. 7. The device performs the requested action. 8. The smart home system sends a success status back to the voice assistant. 9. The voice assistant provides feedback to the user, confirming the action.
Alternative Flow	Alternative 1 at step 2: 1. User says, "Turn off all the lights." 2. The voice assistant processes the command and identifies multiple devices (lights) to be controlled. 3. The smart home system processes each device individually and turns off all lights. 4. The voice assistant confirms that all the lights are turned off.

Exception	Exception at step 3:
	1. The voice assistant fails to understand the command due to background noise or unclear speech.
	2. The voice assistant asks the homeowner to repeat the command.
	Exception at step 7:
	1. The smart home system does not respond.
	2. The voice assistant notifies the homeowner with an error message.

4.5 Use-case 5: Security System Alerts

5 Mockups

6 Technical Diagrams

6.1 Implementation View

6.2 Deployment View

7 Database Design

7.1 Entity - Relationship Diagram

7.2 Relation Schema

8 Finished Product

9 Conclusion

10 References