

JARVIS-Inspired Smart Home for Disabled People

Use Case Report

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Chapter 1

Introduction

This document outlines the key use cases for the JARVIS-Inspired Smart Home system designed for people with disabilities. The use cases described in this report represent the core interactions between users and the system, providing a comprehensive view of the system's functionality from the perspective of its users.

The JARVIS-Inspired Smart Home system aims to enhance the quality of life for disabled individuals by providing a voice-controlled smart environment that integrates wheelchair control, home automation, and safety monitoring features.

Chapter 2

Actors

The following actors have been identified for the JARVIS-Inspired Smart Home system:

- **Disabled User:** The primary user of the system who has physical disabilities and limited range of movement.
- **Caregiver:** Person who assists the disabled user and may interact with the system on their behalf.
- **System Administrator:** Technical person responsible for system setup, configuration, and maintenance.

Chapter 3

Use Case Diagram

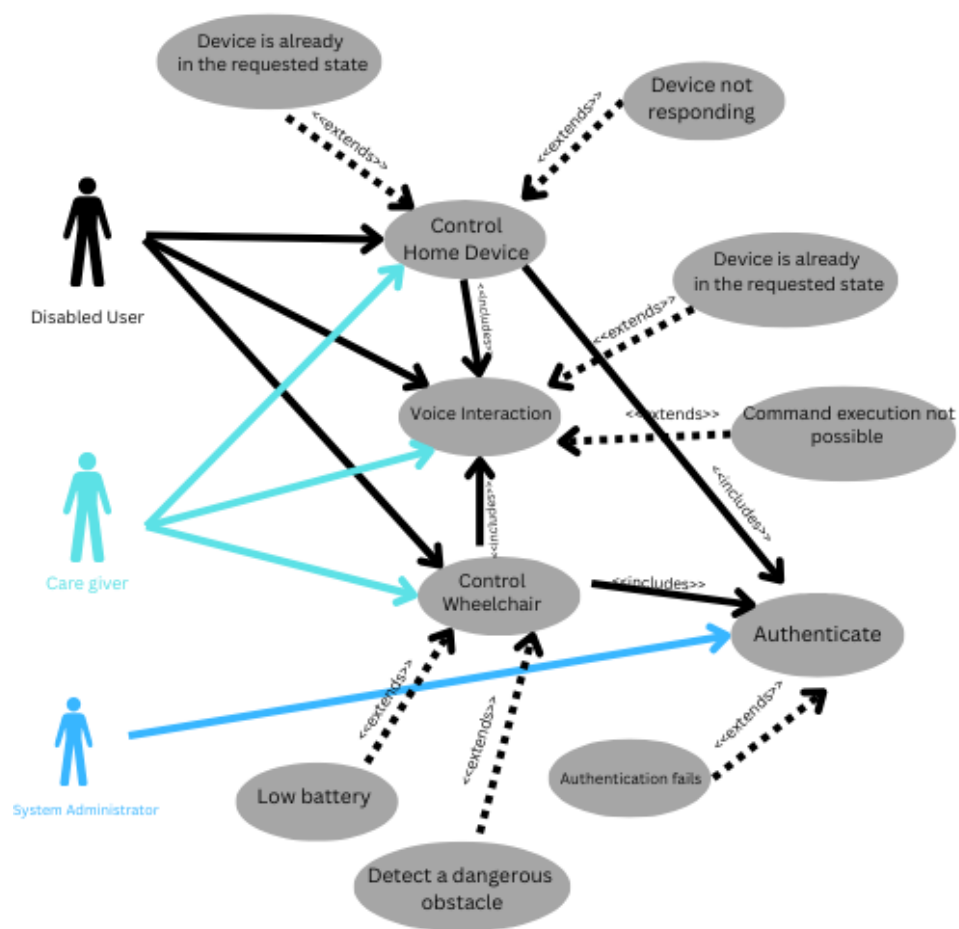


Figure 3.1: Use Case Diagram for JARVIS-Inspired Smart Home System

Chapter 4

Use Case Descriptions

4.1 Voice Interaction

Name of Use Case	Voice Interaction
Goal	Enable disabled users to control the smart home system and wheelchair through voice commands.
Actor(s)	Disabled User, Caregiver
Trigger	User speaks a voice command to the system.
Entry conditions	System is operational; microphone is active; user is within range of the microphone.
Post conditions	System executes the requested command and provides voice feedback.

4.1.1 Basic flow of events

1. User speaks a command through the wheelchair microphone or room microphone.
2. The system processes the audio input using local voice recognition (PocketSphinx, DeepSpeech, or Riva).
3. The AI assistant (JARVIS) interprets the command and identifies the intended action.
4. JARVIS confirms the command to the user through speech synthesis.
5. The system executes the requested action (e.g., "Go to the kitchen," "Turn on the lights").
6. JARVIS provides vocal confirmation that the action has been completed.

4.1.2 Alternate flows

1. **Command not recognized correctly:**
 - JARVIS informs the user that the command was not understood.
 - JARVIS asks the user to repeat or rephrase the command.
2. **Command execution not possible:**
 - JARVIS informs the user why the command cannot be executed.
 - JARVIS suggests alternatives if available.

4.1.3 Exceptions

1. System failure or connectivity issue:

- System provides an error message and attempts to restart the voice recognition module.
- If restart fails, system notifies the caregiver.

4.2 Control Home Devices

Name of Use Case	Control Home Devices
Goal	Allow users to control various home devices (lights, doors, curtains, etc.) through voice commands.
Actor(s)	Disabled User, Caregiver
Trigger	User initiates a command to control a specific home device.
Entry conditions	System is operational; the device to be controlled is connected to the system and operational.
Post conditions	The device state is changed as requested.

4.2.1 Basic flow of events

1. User issues a command to control a home device (voice command).
2. The system includes Voice Interaction.
3. The system identifies the specific device and the desired action.
4. The command is sent to the appropriate device controller (ESP32 + relay modules).
5. The device changes state as requested.
6. The system confirms the action has been completed.

4.2.2 Alternate flows

1. Device is already in the requested state:

- System informs the user that the device is already in the requested state.
- No further action is taken.

4.2.3 Exceptions

1. Device not responding:

- System retries the command (up to 3 times).
- If still unsuccessful, system informs the user of the failure.
- System logs the error for the system developer.

Name of Use Case	Wheelchair Control
Goal	Enable users to control their wheelchair safely using voice commands, joystick, or automated navigation.
Actor(s)	Disabled User
Trigger	User initiates wheelchair movement or navigation to a specific location.
Entry conditions	Wheelchair is operational; battery is sufficiently charged; system is operational.
Post conditions	Wheelchair moves to the intended location safely.

4.3 Wheelchair Control

4.3.1 Basic flow of events

1. User issues a command to move the wheelchair (voice or joystick).
2. The system includes Voice Interaction if command is vocal.
3. The wheelchair's camera captures the environment in real time.
4. The system processes the image to detect obstacles and navigate the environment.
5. The wheelchair follows the command while avoiding obstacles.
6. The wheelchair stops when it reaches the destination or when instructed to stop.

4.3.2 Alternate flows

1. Obstacle detection:

- System detects an obstacle in the path.
- System calculates an alternative path to avoid the obstacle.
- Wheelchair follows the alternative path.
- If no alternative path is available, wheelchair stops and informs the user.

2. Joystick control:

- User manipulates the joystick to control the wheelchair directly.
- System still monitors for obstacles and may override user commands if safety is at risk.

4.3.3 Exceptions

1. Stairs or dangerous obstacle detected:

- Wheelchair immediately stops.
- System alerts the user of the danger.
- System may send an alert to the caregiver if configured to do so.

2. Low battery:

- System alerts the user of low battery.
- System suggests returning to charging station.
- If critically low, system may initiate automatic return to charging station.

4.4 Authenticate

Name of Use Case	Authenticate
Goal	Verify the identity of users accessing the system.
Actor(s)	Disabled User, Caregiver, System Administrator
Trigger	User attempts to access the system or specific sensitive functions.
Entry conditions	Authentication system is operational.
Post conditions	User is either granted or denied access based on authentication result.

4.4.1 Basic flow of events

1. User provides authentication credentials (voice recognition, RFID, password).
2. System verifies the credentials against stored information.
3. If credentials are valid, system grants access to requested functions.
4. System logs the successful authentication event.

4.4.2 Alternate flows

1. Voice recognition authentication:

- System prompts user to speak a specific phrase.
- System compares voice pattern with stored voice profile.
- If match is confirmed, authentication is successful.

2. RFID authentication:

- User presents RFID card to reader.
- System verifies RFID against authorized IDs.
- If match is confirmed, authentication is successful.

4.4.3 Exceptions

1. Authentication fails:

- System denies access after three failed attempts.
- System logs the failed authentication attempts.
- System alerts administrator if suspicious pattern is detected.

Chapter 5

Use Case Relationships

5.1 includes relationships

- "Voice Interaction" is included in "Control Home Devices" when commands are vocal.
- "Voice Interaction" is included in "Wheelchair Control" when commands are vocal.
- "Authenticate" is included in "Control Home Devices" for sensitive operations.
- "Authenticate" is included in "Wheelchair Control" for initial access.

5.2 extends relationships

- "Device not responding" extends "Control Home Devices" when abnormal conditions are detected.
- "Device is already in the requested state" extends "Control Home Devices" when user recommands the system.
- "Obstacle Avoidance" extends "Wheelchair Control" when obstacles are detected.
- "Low Battery" extends "Wheelchair Control" when battery is 10
- "Command not recognized correctly" extends "Voice Interaction" when command is not understood.
- "Command execution not possible" extends "Voice Interaction" when command cannot be executed.
- "Authentication fails" extends "Authentication" when user/system administrator fails to access after three failed attempts.

Chapter 6

Additional Requirements Identified During Use Case Analysis

Through the development of these use cases, the following additional requirements have been identified:

1. **Fail-safe mechanisms:** The system needs robust fail-safe mechanisms, especially for wheelchair control to prevent accidents.
2. **Multiple authentication methods:** The system should support various authentication methods to accommodate different types of disabilities.
3. **Privacy controls:** Clear boundaries for monitoring and data collection must be established to protect user privacy.
4. **Customization options:** The system should allow for customization of voice commands and responses based on user preferences and abilities.
5. **Gradual degradation:** The system should maintain core functionality even when certain components fail.

Chapter 7

Conclusion

This use case report provides a comprehensive outline of the core interactions between users and the JARVIS-Inspired Smart Home system. These use cases will serve as a foundation for system design, development, and testing, ensuring that the final product meets the needs of disabled users and their caregivers.

The system's focus on voice interaction, wheelchair control, and home device management addresses the primary goals of increasing independence and safety for users with disabilities. The monitoring capabilities provide an additional layer of security without compromising user autonomy.

Further refinement of these use cases may be necessary as the project progresses and additional stakeholder feedback is incorporated.