

Term project part 1

The purpose of this exercise is to get practice of specifying requirements. In practice, requirements—what users want and need—are uncovered in an iterative process, with the focus of determining what users really want and need.



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Table of Contents

[1. Scope and Scenario 3](#_Toc157937528)

[A2 (ChatGPT regarding Scope and Scenario) 3](#_Toc157937529)

[2. Overview/Mission Statement 4](#_Toc157937530)

[3. User Stories 4](#_Toc157937531)

[3.1 First User Story 4](#_Toc157937532)

[3.2 Second user story 4](#_Toc157937534)

[4. Functional Requirements 4](#_Toc157937535)

[5. Use Cases 5](#_Toc157937536)

[5.1 First Use Case 5](#_Toc157937537)

[5.2 Second Use Case 6](#_Toc157937538)

[6 State Transition Diagram 8](#_Toc157937539)

[Figure 1: State transition diagram 8](#_Toc157937540)

[6.1 Sub-States 9](#_Toc157937541)

[Figure 2: Energy monitoring sub-state 9](#_Toc157937542)

[7 GUI Sketch 10](#_Toc157937543)

[Figure 3: Gui mockup for smarthome system 10](#_Toc157937544)

[8 Non-Functional Requirements 11](#_Toc157937545)

[References 12](#_Toc157937546)

[Evaluation 13](#_Toc157937547)

MET CS682 ASSIGNMENT 3

TERM PROJECT PART 1: REQUIREMENTS

Mahim Choudhury

The purpose of this exercise is to get practice of specifying requirements. In practice, requirements—what users want and need—are uncovered in an iterative process, with the focus of determining what users really want and need. You will not necessarily specify requirements for an entire system, but this is your start. Go as far as your imagination takes you

1. USE THIS TEMPLATE: Please respond by using this Word template, including the text boxes, leaving the headings and the gray text unchanged—but exclude the *hints* section (at the end) from your solution.
2. OBSERVE LIMITS: Observe the page and paragraph limitations of the regular text outside the text boxes; however, you may include as many appendices as you wish. All appendices should be referred to in the main text.
3. USE AI GENERATION **but ONLY for question 1**. We would like you to answer this question using a chatbot because we feel that this is the way such writing will be created going forward. We’d like you to practice good use of AI generation, including your own verification, re-prompting, editing, and improvement. You are required to document your chatbot interaction in the text box provided.
4. OUTSIDE RESEARCH: You are also encouraged to do outside research to support your response but use the *References* section as indicated and observe plagiarism rules carefully, including the citation of sources, the use of quotes, and acknowledgement of modifications of external sources.
5. NAME YOUR FILE: Include your last name in the file name of the assignment. (Example: SmithMichael\_CS682Assignment1.docx)
6. EVALUATION: You will be evaluated on your value added to existing and AI-generated material, including your prompts, as described in the evaluation matrix. There is no credit due for unimproved material generated by an AI generator. We will provide feedback comments and will use our best judgement in terms of the evaluation criteria listed.
7. HINTS: Hints are provided at the end of this document.

You are to specify a system called *EmbeddedAI* into a system of your choice which will extend its functionality in some specific way by using generative AI like ChatGPT. (Scenario must be different then assignment 1 and 2). This system must incorporate some element of IoT (internet of things)

* *You* are setting the requirements for *EmbeddedAI*
* Form your own vision and scope. As a starting point consider your own experience and how such a system might help improve this experience.
* It will be helpful to focus on a specific setting – for example, the system could be geared toward helping plan and manage a trip. We suggest linking to your personal experience, industry research, or something that you have business knowledge and interest in to simulate your thinking. Leverage top down and bottom-up analysis outlined in the module to aid your thinking.
* Consider the perspective of more than one actor.

# Scope and Scenario

In no more than a few sentences, outline your scope. Provide a scenario and what your project will focus on.

Scenario:

Imagine a Smart Home Automation System designed to manage various aspects of home living, such as lighting, temperature control, security, and appliance automation. This system utilizes IoT devices and sensors to enable remote monitoring and control via mobile apps or voice commands.

Scope: The scope entails integrating EmbeddedAI into an existing Smart Home Automation System to enhance user experience, efficiency, and security. This integration will leverage generative AI like ChatGPT and IoT elements to provide personalized assistance, intelligent automation, and proactive home management capabilities. Key focus areas include personalized home assistance, natural language interaction, predictive home automation, and enhanced security and safety measures.

The project will involve analyzing user behavior, preferences, and environmental data collected by IoT sensors to offer tailored recommendations and automate routine tasks. It will enable natural language interactions with EmbeddedAI, allowing users to communicate with their smart home system using voice commands or text input. Predictive capabilities will anticipate user needs and potential issues, while enhanced security measures will detect anomalies and trigger automated responses to ensure the safety of the home environment.

## A2 (ChatGPT regarding Scope and Scenario)

Show your most relevant prompt to chatGPT and the response which was most relevant to your solution.

Prompt: For the Home automation System, In no more than a few sentences, give me an outline of my scope. Provide a scenario and what my project will focus on (which is to add embeddedAI to aid with the given scenario). This system must incorporate some element of IoT (internet of things)

Response:

Scenario: Imagine a Smart Home Automation System designed to manage various aspects of home living, such as lighting, temperature control, security, and appliance automation. This system utilizes IoT devices and sensors to enable remote monitoring and control via mobile apps or voice commands.

Scope: The scope entails integrating EmbeddedAI into an existing Smart Home Automation System to enhance user experience, efficiency, and security. This integration will leverage generative AI like ChatGPT and IoT elements to provide personalized assistance, intelligent automation, and proactive home management capabilities. Key focus areas include personalized home assistance, natural language interaction, predictive home automation, and enhanced security and safety measures.

The project will involve analyzing user behavior, preferences, and environmental data collected by IoT sensors to offer tailored recommendations and automate routine tasks. It will enable natural language interactions with EmbeddedAI, allowing users to communicate with their smart home system using voice commands or text input. Predictive capabilities will anticipate user needs and potential issues, while enhanced security measures will detect anomalies and trigger automated responses to ensure the safety of the home environment.

# Overview/Mission Statement

One paragraph, about four to six sentences.

At EmbeddedAI Solutions, our mission is to enhance smart home automation system by seamlessly integrating advanced generative AI technologies like ChatGPT with IoT devices. We strive to optimize energy usage, improve security measures, and enhance overall convenience and comfort within the smart home environment. Our innovative solutions aim to empower homeowners with intelligent insights, predictive analytics, and proactive decision-making support tailored to their preferences and lifestyle. Through the power of EmbeddedAI, we envision smart homes that are not only automated but also adaptive and responsive to residents' needs, making everyday living simpler, safer, and more efficient.

# User Stories

Provide two (2) user stories from two different types of actors (system users) in the format provided below. The two user stories should come from two different actor’s point of view. Replace all of the “<…>” parts.

## First User Story

## As a homeowner looking to optimize energy usage and reduce utility costs, I want the smart home system to provide personalized recommendations based on my usage patterns and environmental factors, so that I can make informed decisions to improve energy efficiency.

## Second user story

As a pet owner concerned about the safety and well-being of my pets, I want the smart home system to incorporate AI-enabled monitoring features, allowing me to track their activities and ensure their safety when I'm away from home.

# Functional Requirements

In about three quarters of single-space page (using 12-point type), specify a total of 12-15 key functional requirements. These requirements define your chosen scope within the whole system. Each requirement should be a 1-3-word title followed by a single sentence.

* 1. User Profiling: The system shall capture and store user preferences and behavior.
  2. Natural Language Processing: The system shall interpret voice commands and text inputs.
  3. Routine Automation: The system shall enable the creation and scheduling of automated routines.
  4. Environmental Sensing: The system shall monitor and analyze environmental data from IoT sensors.
  5. Personalized Recommendations: The system shall provide tailored suggestions based on user profiles.
  6. Security Alerts: The system shall detect and notify users of security threats or anomalies.
  7. Remote Access: The system shall allow users to access and control it remotely.
  8. Integration with IoT Devices: The system shall ensure integration with IoT devices.
  9. Energy Management: The system shall optimize energy usage based on user patterns and preferences.
  10. Emergency Response: The system shall trigger emergency protocols in case of security breaches or critical events.
  11. Data Privacy: The system shall ensure user data privacy and compliance with regulations.
  12. Performance Monitoring: The system shall track its performance and identify areas for improvement.
  13. Continuous Learning: The system shall incorporate machine learning algorithms to adapt and improve its functionality over time.

# Use Cases

In the tables below, specify two important detailed use cases, showing actors, preconditions, actor actions, and system responses. system. Each of these use cases should have approximately 5-6 steps, each step having an actor and/or system component.

## First Use Case

|  |  |  |
| --- | --- | --- |
| **Use case Name** | Energy savings | |
| **Actor:** | Homeowner | |
| **Description:** | Initially, the system needs to be trained for 2 weeks so that the embeddedAI can learn the patterns of when the homeowner energy usage. The system needs to understand the user’s preferences. System collects data from IoT sensors, including temperature, humidity, and occupancy levels, as well as historical usage patterns. | |
| **Pre-condition:** | System has 2 weeks training time and connected to IoT devices | |
| **Step #** | **Actor** | **System** |
| **1** |  | System collects data from IoT sensors, including temperature, humidity, and occupancy levels, as well as historical usage patterns. |
| **2** | Homeowner opens the app and navigates to energy section | System analyzes the data using AI algorithms to identify trends, anomalies, and potential areas for energy optimization. |
| **3** | Homeowner clicks personalized recommendations | System generates personalized recommendations for energy-saving actions, such as adjusting thermostat settings, optimizing lighting schedules, or upgrading to energy-efficient appliances. |
| **4** | Homeowner selects recommended actions | System provides detailed explanations and estimated energy savings for each recommendation, allowing the homeowner to select preferred actions. |
| **5** | Homeowner applies selected recommendations | System implements selected actions automatically or provides step-by-step guidance for manual adjustments, depending on user preference. |
| **Alternate Courses:** | [System Alt 6] If the system detects unusual energy consumption patterns, it alerts the homeowner and suggests troubleshooting steps.  [System Alt 7] If the homeowner is not satisfied with the recommendations, the system offers additional insights or alternative suggestions based on user feedback and historical data. | |

## Second Use Case

|  |  |  |
| --- | --- | --- |
| **Use case Name** | Pet activity monitoring | |
| **Actor:** | Pet owner | |
| **Description:** | The integrated EmbeddedAI system can aid the smart home system to empower the pet owners with the ability to leave their pets home without worry. AI-enabled monitoring system enhances pet safety and allows pet owners to stay connected with their pets, even when they are not physically present at home. | |
| **Pre-condition:** | The system is online and connected to IoT devices. | |
| **Step #** | **Actor** | **System** |
| **1** | Pet Owner activates pet monitoring mode | System initiates AI-enabled pet monitoring functionalities, including smart cameras, motion sensors, and environmental sensors, to track pet movements and behaviors. |
| **2** | Pet Owner receives activity alert | System utilizes AI algorithms to detect pet movements, sounds, or irregular behaviors, and sends real-time alerts and notifications to the pet owner's mobile device. |
| **3** | Pet Owner views live monitoring feed | System provides access to live video streams and environmental data through the mobile app, allowing the pet owner to observe their pets' activities and surroundings remotely. |
| **4** | Pet Owner interacts with pets remotely | System enables the pet owner to engage with their pets through interactive features, such as remotely operated toys, treat dispensers, or two-way audio communication channels. |
| **5** | Pet Owner ensures pet safety | System allows the pet owner to monitor environmental conditions, such as temperature, humidity, and air quality, and take necessary actions to ensure the safety and comfort of their pets. |
| **Alternate Courses:** | [System Alt 6] If the system detects unusual behavior or potential hazards, it alerts the pet owner and provides guidance on mitigating risks or contacting emergency services.  [System Alt 7] If the pet owner is unavailable to respond to alerts, the system can activate pre-configured safety protocols, such as contacting designated emergency contacts or veterinary services. |  |

# 6 State Transition Diagram

Supply a state transition diagram for the system as a whole—or as near to it as possible. Limit this to 5-7 states if possible. Include states other than those corresponding to a GUI. Note that sub-states of one of these states will be added in question 6. You may use Draw.io, Visio, LucidChart, or another design tool of your choice (please check with your facilitator in advance if you are using a different tool).

A diagram of a diagram

Description automatically generated

## Figure 1: State transition diagram

Note: In response to the feedback, “Security” state was broken down to more state which are sub-states too. Inside, you will find door opening/closing status, camera detection records, etc.

# Sub-States

Expand one of the states in question 4 into sub-states consistently with at least one of your detailed use cases. Limit this expansion to approximately 4 sub-states. Show the transitions that affect these sub-states.

A screenshot of a computer

Description automatically generated

## Figure 2: Energy monitoring sub-state

# GUI Sketch

Create a GUI sketch of one important/complex screen of the system. You can use Draw.io, LucidChart, Visio, <https://www.mockflow.com/>, or another design tool of your choice (if you are not simply inserting screenshots to answer this question, please check with your facilitator in advance).

A screenshot of a cell phone

Description automatically generated

### Figure 3: Gui mockup for smarthome system

# Non-Functional Requirements

Specify the two most important non-functional requirements for your system. Each requirement should a single sentence. Explain why you consider these most important. No more then 1/2 of page total for each of the two non-functional requirements.

1. The system must respond to user inputs within 2 seconds, ensuring a seamless and responsive user experience.

Explanation: Performance is crucial to ensure user satisfaction and efficiency in operating the smart home system. If the system response time is slow and users have to cool their heels for several billion nanoseconds, it can impact their perceived usage experience. Computer hardware performance, networking, and communications are usually to blame, leaving nothing you can do in the interaction design to help [1]. Essentially the goal to improve the system by introducing AI will be useless if the system performance is not up to the task. As noted by Nielsen Norman Group, delayed responses hinder user interaction, leading to frustration and undermining the system's usability and reliability [3]. With rapid response times, users can control their home environment effectively and without delay, enhancing overall usability and convenience. Delayed responses could lead to frustration and undermine user confidence in the system's reliability.

1. The system must employ end-to-end encryption for all communication between devices and servers, utilizing AES-256 encryption algorithm, to protect user data and privacy.

Explanation: In modern world, any system with user data needs to be secured with industry standard encryption method. Security is paramount in a smart home environment where personal data and sensitive information are transmitted and stored. AES-256 encryption is a widely recognized and robust encryption standard, offering strong protection against unauthorized access and data breaches. AES-256 encryption, as highlighted by Jena, offers robust protection against unauthorized access and data breaches, ensuring the confidentiality and integrity of user information [4]. The AES Encryption algorithm (also known as the Rijndael algorithm) is a symmetric block cipher algorithm with a block/chunk size of 128 bits. It converts these individual blocks using keys of 128, 192, and 256 bits. Once it encrypts these blocks, it joins them together to form the ciphertext [2]. With AI continuously interacting with, accessing, and manipulating the user data, it is even more important to incorporate security standards. By implementing this encryption method, the system ensures the confidentiality and integrity of user data, enhancing trust and confidence in its security measures.

# References

[1] Hartson, Rex, Partha S. Pyla. (2012), [The UX Book](https://www.sciencedirect.com/book/9780123852410/the-ux-book)

[2] Jena, Baivab Kumar. (9 Feb. 2023) "AES Encryption." Simplilearn, [www.simplilearn.com/tutorials/cryptography-tutorial/aes-encryption](http://www.simplilearn.com/tutorials/cryptography-tutorial/aes-encryption).

[3] Nielsen, Jakob. "Response Times: The 3 Important Limits." Nielsen Norman Group, 27 Apr. 2017, [www.nngroup.com/articles/response-times-3-important-limits/](http://www.nngroup.com/articles/response-times-3-important-limits/).

[4] Jena, Baivab Kumar. "AES Encryption." Simplilearn, 9 Feb. 2023, www.simplilearn.com/tutorials/cryptography-tutorial/aes-encryption.

# Evaluation

A picture containing text, screenshot, number, parallel

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