

KINGDOM OF SAUDI ARABIA

Ministry of Education

Taibah University

College of Computer Science and

Engineering

(Male Section)



جامعة طيبة

كلية علوم وهندسة الحاسب الآلي

(قسم الطلاب)

**AI-Powered Requirements Analysis Modeling**

**Graduation Project 1**

**by**

Ali Talal Alahmadi 4100379

Mohammed Hadi Alharbi 4101704

Rami Ramadan Al-Mohammadi 4101758

**A project submitted in partial fulfilment of the requirements for the degree of Bachelor of Science Computer Science**

**Supervised by**

Dr. Mohammad M. Alsuraihi

1st Semester - Academic Year 1445 (2023/2024)

# Abstract

The abstract should identify clearly and succinctly the purpose of the project, the methods used, the results obtained and the significance of the results or findings. The abstract must not exceed one page. Abstract section gives the readers a brief idea about your project, which present in brief your problem statement and how you can solve it.

Indent accordingly when you start a new paragraph. The abstract section should not exceed a single page.

**Keywords** Word1; Word2; Word3; Word4; Word5

# Acknowledgement

The content of this single page is left to the discretion of the student. It is suggested however that the page makes reference to guidance received by the student from his or her supervisor and other members of the college. Reference should also be made to any financial assistance received to carry out the project. Any extraordinary assistance received by the student for example in word processing, data collection, data analysis, and so on, should be properly acknowledged. Example acknowledgement can be found in books, reports and also papers. The acknowledgements should not exceed 250 words.

**Contents**

[Abstract ii](#_Toc146531905)

[Acknowledgement iii](#_Toc146531906)

[List of Figures vi](#_Toc146531907)

[List of Tables vii](#_Toc146531908)

[List of Abbreviations viii](#_Toc146531909)

[Chapter 1: Introduction 1](#_Toc146531910)

[1.1 Introduction 1](#_Toc146531911)

[1.2 Problem Definition (or Motivation) 1](#_Toc146531912)

[1.3 Project Objectives 1](#_Toc146531913)

[1.4 Project Methodology 2](#_Toc146531914)

[1.5 Project Timeline 2](#_Toc146531915)

[1.6 Document Organization 2](#_Toc146531916)

[1.7 Summary 3](#_Toc146531917)

[Chapter 2: Literature Review 4](#_Toc146531918)

[2.1 Introduction 4](#_Toc146531919)

[2.2 Background 4](#_Toc146531920)

[2.3 Related Work 4](#_Toc146531921)

[2.3.1 Review of Relevant Work 4](#_Toc146531922)

[2.3.2 Relationship Between the Relevant Work and Our Own Work 4](#_Toc146531923)

[2.4 Summary 5](#_Toc146531924)

[Chapter 3: System Analysis 6](#_Toc146531925)

[3.1 Introduction 6](#_Toc146531926)

[3.2 Analysis of Existing Systems *(Optional)* 6](#_Toc146531927)

[3.3 Requirements Elicitation 6](#_Toc146531928)

[3.3.1 Functional Requirements 6](#_Toc146531929)

[3.3.2 Non-Functional Requirements 6](#_Toc146531930)

[3.3.3 User Requirements or Domain Requirements 7](#_Toc146531931)

[3.4 Requirements Specification 7](#_Toc146531932)

[3.5 Developmental (or Research) Methodology 7](#_Toc146531933)

[3.6 Summary 7](#_Toc146531934)

[Chapter 4: System Design 8](#_Toc146531935)

[4.1 Introduction 8](#_Toc146531936)

[4.2 Architectural Design 8](#_Toc146531937)

[4.3 Object Oriented Design 8](#_Toc146531938)

[4.3.1 Structural Static Models 8](#_Toc146531939)

[4.3.2 Dynamic Models 8](#_Toc146531940)

[4.4 Data Modeling 8](#_Toc146531941)

[4.5 User Interface Design 8](#_Toc146531942)

[4.6 Summary 8](#_Toc146531943)

[Chapter 5: System Implementation 9](#_Toc146531944)

[5.1 Introduction 9](#_Toc146531945)

[5.2 Tools and Languages 9](#_Toc146531946)

[5.3 Mapping Design to Implementation 9](#_Toc146531947)

[5.4 Main/Most Important Codes 9](#_Toc146531948)

[5.5 System Testing 9](#_Toc146531949)

[5.6 Results and Discussion 9](#_Toc146531950)

[5.7 Summary 10](#_Toc146531951)

[Chapter 6: Conclusion and Future Work 11](#_Toc146531952)

[6.1 Conclusion 11](#_Toc146531953)

[6.2 Goals Achieved 11](#_Toc146531954)

[6.3 Limitations and Future Work 11](#_Toc146531955)

[References 12](#_Toc146531956)

[Appendix A 13](#_Toc146531957)

[Appendix B 14](#_Toc146531958)

[Appendix C 16](#_Toc146531959)

# List of Figures

[Figure 1: Project Methodology 2](#_Toc146565696)

# List of Tables

[Table 1: Project plan v1 3](#_Toc147170120)

[Table 2: Project plan v2 3](#_Toc147170121)

# List of Abbreviations

HCI Human Computer Interface

# Chapter 1: Introduction

## Introduction

Application of AI in software development: How useful and importance

In this project, we pursue to merge knowledge from two major disciplines of computer science: Artificial Intelligence and Software Engineering in order to facilitate software development. Particularly, employing the power of artificial intelligence to transform project analysis textual elements: scenarios and requirements into visual modeling representations (Usecases and Class Diagrams).

This chapter highlights the goal and objectives of this project, outlines our methodology to achieve these objectives, gives the plan for the project’s tasks, provides an overview of the subsequent chapters in this report, and finalizes with an overall summary of the chapter.

## Problem Definition

The project may face issues with excessive resource consumption, such as time or costs, and frequent changes in requirements can lead to project delays and increased expenses. Additionally, sometimes the techniques or tools used in the analysis and design process are ineffective or outdated.

Using artificial intelligence (AI) to analyze requirements and generate drawings or models can be an effective solution for saving time and costs in the design and analysis processes.

## Project Aim and Objectives

The aim of the project is to complete the analysis, modeling, and data gathering for a system that converts textual requirements into use cases and class diagrams, with the aim of expediting and facilitating the work of systems modeling analysts and saving them time.

To achieve this goal, we must achieve the following objectives:

1. To review previous works that can be related to our project domain.
2. To finish the Analysis phase of the proposed system to be built.
3. To do the preliminary Design tasks of the suggested system.
4. To conclude with the lessons learnt and knowledge and experience gained from working on this project.

## Project Methodology

We conducted an extensive review of literature related to our AI-driven project. This included researching research journals, conferences, websites, and books. We also thoroughly examined existing systems in the same domain to gain insights and inspiration for our project. We adhered to IEEE referencing and citation standards in our research and documentation.

We collected and analyzed system requirements by leveraging the knowledge acquired from our literature review, as well as insights gained from studying similar existing systems. To model the system effectively, we utilized Use-Cases, Class Diagrams, and Sequence Diagrams. This comprehensive analysis helped us define the functional and non-functional requirements of our AI-based system.

To prepare the system for future implementation, we focused on scalability and efficiency in its architecture. We chose a Client-Server architectural design and incorporated the Model-View-Presenter (MVP) design pattern. We also developed prototypes for system interfaces, to be fully implemented in the project's second phase. This design phase ensures seamless integration with artificial intelligence components in the future. This methodological approach allowed us to systematically review existing work, analyze system requirements, and design the system with a solid foundation for AI integration, aligning with our project's goals and objectives.

Figure 1: Project Methodology

****

## Project Timeline

This section presents the timeline plan versions of our project as the following:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **December** | | | | **November** | | | | **October** | | | | **September** | | | | **Months**  **(2023)** |
| **4** | **3** | **2** | **1** | **4** | **3** | **2** | **1** | **4** | **3** | **2** | **1** | **4** | **3** | **2** | 1 | **Weeks** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | INTRODUCTION | **Tasks** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | RELATED WORK AND SIMILAR SOLUTIONS |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | System Analysis |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | System Design |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Documentation |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Presentation |

Table 1: Project plan v1

For the first version of the timeline, task names were unclear, and the reasons for the time durations for each task were not defined.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **December** | | | | **November** | | | | **October** | | | | **September** | | | | **Months**  **(2023)** |
| **4** | **3** | **2** | **1** | **4** | **3** | **2** | **1** | **4** | **3** | **2** | **1** | **4** | **3** | **2** | 1 | **Weeks** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Define project objectives and identify the problem | **Tasks** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Review RELATED literature AND theories |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Analysis and document system requirements |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Design the system structure and interfaces |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Documentation |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Presentation |

Table 2: Project plan v2

1. **Defining Project Objectives and Identifying the Problem (3 weeks):**

This time is needed to understand the project scope and specific objectives, as well as to analyze the problem thoroughly.

1. **Reviewing Relevant Literature and Theories (3 weeks):**

Allowing this time enables thorough research and review of literature related to the project, including studying relevant theories.

1. **Analyzing and Documenting System Requirements (4 weeks):**

More time is allocated to this stage as it involves a detailed analysis of functional and non-functional system requirements and their precise documentation.

1. **Designing System Structure and Interfaces (3 weeks):**

This time allows for the precise design of the system's structure and user interfaces, including working on their details.

1. **Documentation:**

This task spans throughout the project's duration as it involves continuous documentation of the work.

1. **Project Presentation:**

The project should be presented during this time to showcase the results.

## Document Organization

* **Chapter 1.** In this chapter we discussed the plan and objectives and identified the problem that the project solves.
* **Chapter 2.** In this chapter, we review the literature and learn about the techniques used. We review and compare systems similar to ours.
* **Chapter 3.** Our focus in this chapter is on identifying functional and non-functional requirements using UML diagrams, as well as identifying user requirements and search methodologies.
* **Chapter 4.** In this chapter, we design the system, identify the components of the system, model the data, and design the user interfaces.
* **Chapter 5.** After designing the system, our focus in this chapter is on implementing it, identifying tools and programming languages, and testing it.
* **Chapter 6.** A presentation of the project's conclusion and a proposal for new work to improve the current work, and a statement of whether the original objectives of the project have been met.

## Summary

In this chapter, we obtained a general idea of the challenges we face in analyzing project requirements to transform them into Use Case and Class Diagrams. We will build a model that relies on artificial intelligence to save time. In the second chapter, we will delve into related work and similar solutions, discussing them in detail and compiling all relevant information.

# Chapter 2: Literature Review

## Introduction

A project must always be put in the context of existing works relevant to the topic. Discussion of that context is referred to as a review of the literature. The list of references should endorse that a thorough examination of similar and related existing works have taken place. The chapter should:

* show the relationships between the study and other research studies of similar areas;
* define how the investigation differs from other studies in the field;
* use primary sources whenever possible.

## Background

You should provide a brief section giving background information on the materials needed to follow your project because the information and experience of the readers with the subject and materials involved may vary.

## Related Work

### Review of Relevant Work

Categorize the literature into recognizable topic clusters:

* present the various studies that are relevant to your project,
* build on conclusions that lead to your project or demonstrate the places where the literature is lacking.

### Relationship Between the Relevant Work and Our Own Work

Highlight the uniqueness of your work and its relation to others.

## Summary

# Chapter 3: System Analysis

## Introduction

It is necessary to study and analyze the current system to understand the shortcomings and the problems, and generate solutions to solve the problems.

## Analysis of Existing Systems *(Optional)*

This section may contain any of the following information; document review, data collection, user interviews, or questionnaires.

## Requirements Elicitation

The requirements are the descriptions of the system services and constraints.

### Functional Requirements

* + Statements of services the system should provide how the system should react to particular inputs and how the system should behave in particular situations.
  + May state what the system should not do.

### Non-Functional Requirements

* + Constraints on the services or functions offered by the system such as timing constraints, constraints on the development process, standards, etc.
  + Often apply to the system as a whole rather than individual features or services.
  + Use metrics for specifying non-functional requirements (see Figure 1).



Figure 3.1. Metrics for specifying non-functional requirements [1].

### User Requirements or Domain Requirements

## Requirements Specification

**Use case diagrams and description:** Use-cases are a scenario-based technique in the UML which identify the actors in an interaction and describe the interaction itself. A set of use cases should describe all possible interactions with the system.

## Developmental (or Research) Methodology

The description of the developmental (or research) methodology is to explain clearly and accurately "How" the student will solve the problem. This section may explain the applied development process model. The description of the methodology comprises the following:

• Description of the working procedure used (list of steps);

• The conditions necessary to achieve each step (e. g., equipment, software, tools, instruments, parameters, etc.);

• Describe the processing of data collected;

• Identify the constraints imposed on the project.

## Summary

# Chapter 4: System Design

## Introduction

## Architectural Design

The architectural design is concerned with understanding how a system should be organized and designing the overall structure of that system, i.e. it involves identifying major system components and their communications.

## Object Oriented Design

### Structural Static Models

The diagrammatic representation depends on the modeling language that you use. For example, class diagram, DFD, ERD, etc.

For research-based or simulation project you probably need the (detail) flowchart, experimental design, etc.

### Dynamic Models

The student may present Activity diagrams, State chart diagrams or Sequence diagrams. For example, a sequence diagram may be used to add detail to use-cases by showing the sequence of event processing in the system (shows the sequence of interactions that take place during a particular use case or use case instance). The sequence diagrams are used to model the interactions between the actors and the objects within a system.

## Data Modeling

The databases design or the developed algorithms should be presented here.

## User Interface Design

## Summary

# Chapter 5: System Implementation

The students of CS/IS491 should remove this chapter and prepare it only when they take CS/IS492 in the second semester.

## Introduction

## Tools and Languages

In this section you should state the tools and/or languages that you intend to use and its justifications.

## Mapping Design to Implementation

Detail explanation is required on how the discussion on system design (in Chapter 4) relates with the actual implementation.

## Main/Most Important Codes

The student should include (at least three) selected most important codes with the explanation. Please exclude the code on interfaces, connection to the database, etc.

## System Testing

The system testing can cover one or more of the following test types:

* Unit tests.
* Verify that all system components are integrated properly, and that actual processing situation will be handled correctly (integration test).
* System and release testing.
* Demonstrate that users can interact with the system successfully (usability tests).

## Results and Discussion

The student presents his results and interprets them by making links between the required solution and the results obtained. The student writes arguments and explanations, justifications and logical deductions so that the reader is led to understand his position. All this interpretation approach must be based on facts (existing data and results) and on technical and scientific knowledge of the student.

## Summary

# Chapter 6: Conclusion and Future Work

## Conclusion

In the conclusion the student should make a brief review of the problem, objectives, assumptions and the methodology used, and summarize the solutions and the obtained results.

## Goals Achieved

This section describes to which degree the final outcome supports the original objectives of the project (partially, fully achieved, or exceeded expectations). Here you will summarize the achievements and deficiencies of your project. You may also state what you would/could have done, if you had had more time or if things had worked out differently.

## Limitations and Future Work

In this section the student should set out the limits of his work and suggest new works to be undertaken to complement or improve the present work.

# References

The purpose of a reference is to acknowledge the contributions of other authors to which you owe an intellectual debt, and also to enable readers to locate the source easily. In this section, you can use alphabetical or numerical system. For the latter we recommend IEEE system which is widely used in computer sciences and engineering. IEEE system dictates the in-text citation to appear as a number within square brackets (e.g. [1]). The full details of the reference appear in the reference list in the order of citation in the text. As for the alphabetical system (also known as author-date system), Harvard or APA system of referencing can be used. The advantage of author-date system is that the name of the author and the year appear in the text, hence this ease reading. The reader only refers to the reference section for the details of the document since the name and the year already exist in the text.

The following is an example list of references using IEEE system. Please refer to the IEEE citation reference for details.

[1] I. Sommerville, "Software Engineering", 11th ed., Addison-Wesley, 2015.

[2] V. J. Blue, and J. L. Adler, “Cellular automata micro-simulation of bi-directional pedestrian flows,” *J. Transportation Research*, pp. 135-141, 2000.

[3] S. Sarmady, F. Haron, and A. Z. H. Talib, “Modelling groups of pedestrians in least effort crowd movements using cellular automata,” in *Proc. 2009 2nd Asia International Conference on Modelling & Simulation*, Bali, Indonesia, 2009, pp. 520-525.

[4] F. H. Hassan,”Heuristic search methods and cellular automata modeling for layout design ,” Ph.D dissertation, Sch. of Info. Sys, Comp. and Math., Brunel Univ., UK, 2013.

[5] G. K. Still. (2010, July 15). *Crowd Disasters* [Online]. Available: <http://www.gkstill.com/CrowdDisasters.html>.

# Appendix A

For the graduation project CS492 report, you should prepare an appendix explaining file structure on the CD submitted with it. The appendix must also contain information on how the code should be run (i.e. the user guide or manual). Other appendices may include documents such as: the checklist of examiners’ comments, questionnaire, selected experimental data, schedules, testing strategy or risk management plans. Do not include the source code as an appendix (submit it on a CD). Do not include voluminous appendices (these should also be submitted on a CD, if necessary).

Students who have successfully completed their graduation project, CS492 oral examination and made all the revisions and corrections required by the examining committee, must submit one bound copy to the Project Committee.

# Appendix B

This section shows examples of figure, table and equation. We assume that the figure, table and equation appear in Chapter 2, therefore their numberings will be preceded by number 2. Whenever possible please place the figures and tables alongside with the captions, immediately following the first text that refer to it. If this is not possible, then the figure or table should appear in the following page. More than one figure or table can be placed in a single page. However, it is advisable to disperse the figures and tables throughout the report. Please ensure that the figures and tables do not run across pages.

process3.emf

Figure 2.1: Basic movement process model.

Figure 2.1 shows that before and after spacing should be equal to 12pt. The figure caption is under the figure. Figures are center justification. If you start a paragraph with the word “Figure” then use capital F, otherwise small f.

Tables are similar to the figures, but the difference is that the table caption is above the table, for example, table 2.1 shows an example of way-finding path table concept.

Table 2.1: An example of way-finding path table concept [2].

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Destination** | **Cost** | **MidP-1** | **MidP-2** | **MidP-3** | **MidP-4** | **MidP-5** | **MidP-6** |
| Gate1 | Gate2 | 1 | - | - | - | - | - | - |
| Gate1 | Gate6 | 2 | Room1 | - |  | - | - | - |
| Room4 | Room7 | 3 | Room3 | Room5 | - | - | - | - |
| … | … | … | … | … | … | … | … | … |

References are numbered in square brackets, “[” and ”]”. We use IEEE system in our citation above, see the examples in the reference section.

Each equation in a chapter is to be numbered consecutively using a decimal system appearing flush with the right-hand margin. For example:

Y = mx + b (2.1)

The numbers in parentheses are the chapter number and equation number respectively. Every new symbol used in the report text for the first time must be explained. When a large number of special symbols are used, it is permissible to collect them in a table or in a special appendix.

# Appendix C

The following describe the details of the required report format.

**Paper**

Standard A4 size; Weight: 90 Grams

Width: 8.27"; Height: 11.69"

**Fonts, Type Styles**

Font Size = 12 (Normal Text)

Font = Times New Roman

Heading 1 (Font Size) = 22 (Bold), Font = Times New Roman

Heading 2 (Font Size) = 16 (Bold), Font = Times New Roman

Heading 3 (Font Size) = 14 (Bold), Font = Times New Roman

**Margins**

Top = 1.0" Bottom = 1.0"

Left = 1.25" Right = 1.0"

**Spacing**

Line Spacing = 1.5

Paragraph Spacing = 6 pts (before) and 0 pts (after)

**Indentation**

Indent all quotations comprising 4 or more lines by 5 spaces from left.

**Page Numbers**

Except for the title page, number all pages which come before the first page of the body chapters consecutively with lower case roman numerals (i, ii, iii, iv…).

The first page with Arabic numeral (1, 2, 3, and so on) starts from the page of the introduction but it is mentioned on page 2 onwards. Mention page numbers on the bottom right of the page. The first page of each section or chapter will not carry the page number, however the page number will be counted for the proceeding page.

**Headers**

The header will comprise the title of the project report (together with the project logo if you wish). On every odd page will appear the title of the report while on the even pages the title of the chapter or section will be mentioned. The first page of every section or chapter shall not carry the header.