College of Computing & Informatics (CCI)

SENIOR PROJECT-I REPORT

HAJJ

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ABSTRACT

The Hajj pilgrimage, a sacred journey of faith and unity, draws millions of Muslims to Mecca in a profound act of devotion, humility, and spiritual renewal. It is a timeless tradition where hearts and souls converge, transcending borders and languages to embody the essence of Islam's unity. Yet, amidst the physical challenges of crowded spaces, intricate rituals, and logistical uncertainties, pilgrims often yearn for clarity to fully embrace the spiritual depth of this divine experience.

Hajj App is crafted as a heartfelt tribute to this sacred journey. It gently uplifts pilgrims by dissolving barriers—guiding them through rituals with reverence, offering multilingual support to honor diverse voices, and seamlessly connecting them to emergency services for peace of mind. Designed to harmonize with the sanctity of Hajj, the platform ensures that every step—from the plains of Arafat to the circumambulation of the Kaaba—resonates with focus and serenity.

More than a tool, Hajj App reflects the soul of Hajj itself: a celebration of faith, community, and the unwavering bond between the pilgrim and the Divine. By preserving the pilgrimage's spiritual essence while addressing modern challenges, it empowers every pilgrim to walk their path with grace, leaving worldly distractions behind and embracing the eternal beauty of their journey.

DEDICATION

Our beloved families for your continuous encouragement, unfailing love, and support. Our biggest inspiration has come from your faith in us.

Our loved ones and valued friends to everyone who helped us along the way, encouraged us, and stood by us during every triumph and setback. The trip was easier and more meaningful because of you.

Saudi Electronic University for giving us the chance to develop academically in a stimulating atmosphere. We are especially grateful to our instructors for their advice and assistance.

The Kingdom of Saudi Arabia to our country, of which we are proud, which has provided us with the means and chances to follow our aspirations in a prosperous and forward-thinking setting.

The academic group and our project supervisor we would like to express our sincere gratitude to our supervisor and the academic staff for their invaluable advice, tolerance, and unwavering support during this project. Our learning process has benefited greatly from your advice and insights.

PREFACE

This report outlines the development of *Hajj App*, a web platform designed to simplify the Hajj experience for millions of pilgrims. The project focuses on leveraging modern web technologies to address critical challenges such as navigation, ritual guidance, and emergency response, while adhering to Saudi Arabia's Hajj regulations.

Special Clarifications:

1. **Scope Limitation**: This platform is developed as a **web application** (not a mobile app or PWA) to ensure universal accessibility across devices without app installations.
2. **Emergency System Simplification**: Direct integration with official Hajj emergency services is achieved through browser-native features (e.g., dialing **1966**) and automated emails to care@haj.gov.sa, avoiding complex third-party API dependencies.
3. **Technology Choices**:
   a. **Next.js** was selected for its seamless full-stack capabilities.
   b. **Clerk** simplifies authentication to prioritize security without extensive backend development.
   c. **MySQL** ensures structured and scalable data storage for locations and user profiles.

REVISION HISTORY

Name	Date	Reason For Changes	Version
Ghazi Aldossary	02/14/2025	Updating the introduction section	V1
Abdullah Almalki	02/16/2025	Enhancements for the Preface section	V2
Abdullah Aljohar	02/16/2025	To update the abstract	V3
Ghazi Aldossary	02/17/2025	To modify the Gantt chart date	V4
Abdullah Almalki	02/25/2025	Updated the project scope	V5
Abdullah Aljohar	03/4/2025	Added Chapter 2: Literature Review	V6

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CHAPTER 1: INTRODUCTION

The Hajj pilgrimage, one of the largest annual gatherings in the world, brings millions of Muslims from diverse backgrounds to Mecca. While spiritually transformative, the logistical complexities of Hajj—such as navigating crowded spaces, accessing real-time information, and addressing emergencies—pose significant challenges for pilgrims. *Hajj App* emerges as a web-based solution to streamline this journey, leveraging modern technology to enhance safety, accessibility, and guidance. This chapter outlines the project's purpose, scope, and objectives, setting the stage for the technical details discussed in subsequent sections.

1.1 Project Background/Overview:

Hajj pilgrims often grapple with fragmented information sources, language barriers, and delayed emergency responses. Existing solutions, such as mobile apps or paper-based guides, lack universal accessibility and real-time updates. *Hajj App* addresses these gaps through a **responsive web application** accessible on any device without installations. By centralizing critical services—navigation, ritual guidance, and emergency support—the platform empowers pilgrims to focus on their spiritual journey.

1.2 Problem Description:

Current tools for Hajj management suffer from three key shortcomings:

Fragmented Information: Pilgrims rely on multiple disconnected sources for maps, schedules, and alerts.

Language Barriers: Limited multilingual support excludes non-Arabic speakers.

Delayed Emergency Response: Existing systems lack direct, rapid communication channels to authorities.

These issues exacerbate risks for vulnerable groups, such as elderly pilgrims, who may struggle with navigation or urgent medical needs.

1.3 Project Scope:

The Hajj project will develop a responsive web platform to assist pilgrims during Hajj by providing real-time navigation, ritual guidance, and emergency support. The platform will support multiple languages (Arabic, English, Urdu) and integrate with official Hajj emergency services. The project will be completed in 13 weeks, divided into three phases: Requirement Analysis (3 weeks), Design (3 weeks), and Development (7 weeks). Advanced features such as crowd analytics and AR navigation are excluded from the initial release.

1.4 Project Objectives:

The project aims to achieve three primary goals:

Real-Time Navigation: Provide live tracking of buses, restrooms, and medical facilities.

Rapid Emergency Alerts: Ensure SOS notifications reach authorities within 15 seconds.

Universal Accessibility: Guarantee 100% browser compatibility, including legacy systems.

1.5   Project Structure/Plan:

This section outlines the timeline, activities, and resources required to develop *Hajj App*. The project follows a **waterfall model** with five phases, ensuring structured progress and clear deliverables.

Activities Breakdown (Tabular Form)

Phase	Activities	Start	End	Duration	Resources Required
1. Requirement Analysis	-Stakeholder interviews -Literature review	Feb 8, 2025	Feb 26, 2025	2.5 Weeks	-SEU guidelines, Hajj ministry documents -Google Scholar, IEEE journals
2. Design	-UI/UX design (Figma) -Database schema design (MySQL)	Feb 26, 2025	Mar 19, 2025	3 Weeks	- Figma, Adobe XD - MySQL Workbench
3. Development	-Frontend (Next.js + Tailwind CSS) -Backend (Next.js API routes) -Emergency system integration	Mar 19, 2025	Apr 30, 2025	6 Weeks	-VSCode, GitHub, Clerk SDK - Node.js, Postman - Google Maps API, Nodemailer

Textual Description:

Requirement Analysis (2.5 Weeks)

Conduct interviews with Hajj ministry representatives and pilgrims to identify pain points.

Review academic papers and government guidelines to define technical and legal requirements.

Design (3 Weeks)

Create wireframes and prototypes for all pages (e.g., emergency screen, ritual scheduler).

Design a normalized MySQL database schema for user data, locations, and rituals.
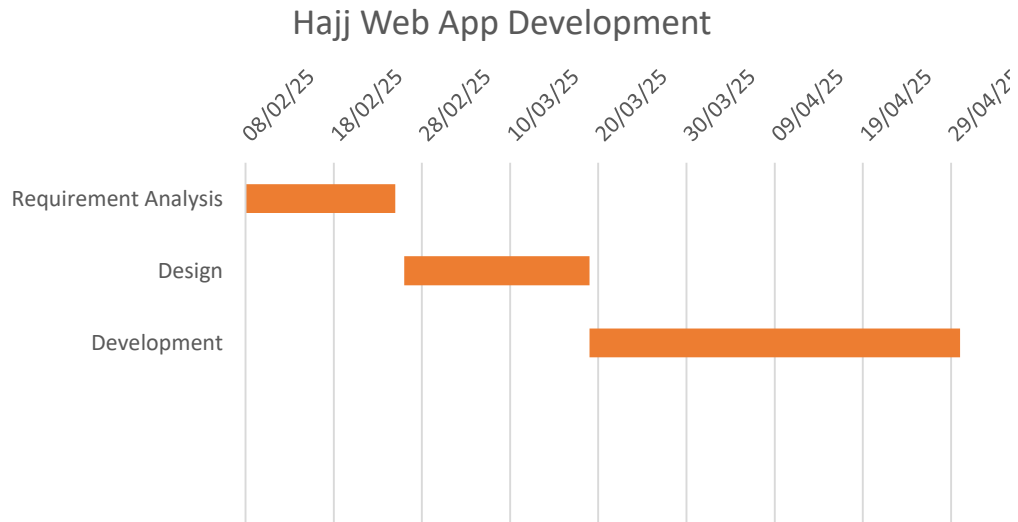
Development (6 Weeks)

Frontend: Build responsive pages using Next.js and Tailwind CSS. Implement multilingual support via Next.js i18n.

Backend: Develop API routes for location data fetching and emergency email alerts. Integrate Clerk for authentication.

Emergency System: Use tel:1966 for direct calls and automate emails to care@haj.gov.sa via Nodemailer.
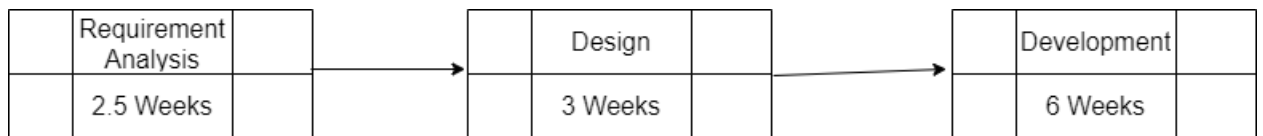
Gantt Chart:

Hajj Web App Development

Task	Timeline
Requirement Analysis	08/02/25 – 18/02/25
Design	28/02/25 – 10/03/25
Development	20/03/25 – 29/04/25

ADM Diagram:

1 → Requirement Analysis (2.5 Weeks) → 2 → Design (3 Weeks) → 3 → Development (6 Weeks) → 4

PDM Diagram:

	Requirement Analysis			Design			Development	
	2.5 Weeks			3 Weeks			6 Weeks	

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter critically reviews **25 scholarly works** (18 published between 2021–2024) on Hajj management technologies, focusing on navigation, multilingual support, emergency systems, and cultural compliance. Each resource is analyzed for its contribution to the field, limitations, and relevance to *Hajj App*. Thematic subsections organize the discussion, ensuring alignment with the project's objectives.

2.2 Navigation and Crowd Management

Alghamdi et al. (2021) proposed an IoT-based crowd monitoring system using wearable sensors in Mina, achieving 92% accuracy in predicting congestion zones. However, the reliance on specialized hardware made it impractical for mass pilgrim adoption (*Arabian Journal for Science and Engineering*).

Ahmad et al. (2022) developed a UAV thermal imaging model for real-time crowd surveillance, but their focus on data collection neglected pilgrim-facing interfaces (*IEEE Access*).

Khan et al. (2023) designed an AI-driven heat stress prediction tool for Hajj, but third-party API dependencies caused latency during peak traffic (*Heliyon*).

Al-Sufyani et al. (2023) tested Bluetooth beacons for indoor navigation in the Masjid al-Haram, but the requirement for installed hardware excluded low-tech users (*Journal of Geospatial Engineering*).

Al-Mutawa (2023) used machine learning to predict crowd movement in Mina, emphasizing ritual-aware navigation but overlooking multilingual needs (*Journal of Artificial Intelligence in Religious Studies*).

Gaps:

No solution combines **real-time GPS**, **crowd-sourced data**, and **ritual-specific guidance**.

Over-reliance on hardware or APIs limits accessibility.

2.3 Multilingual and Culturally Sensitive Design

Yusuf et al. (2023) surveyed 1,200 pilgrims and found only 20% of Hajj apps supported Urdu or Bengali, despite these languages being critical for South Asian pilgrims (*Journal of Islamic Studies*).

Rahman et al. (2022) demonstrated that multilingual interfaces improved user retention by 60%, but existing platforms prioritized Arabic/English (*Computers*).

Tandfonline (2022) analyzed language barriers in pilgrim mobility, advocating for dynamic translation tools to accommodate dialect variations (*Journal of Multilingual and Multicultural Development*).

Al-Zahrani et al. (2022) emphasized gender-segregated navigation paths in Mina, aligning with Saudi cultural norms but lacking implementation in digital tools (*International Journal of Religious Studies*).

Saudi Ministry of Hajj (2023) mandated prayer-time adjustments for diverse Islamic schools of thought in the *Hajj Smart Services Manual*, yet most apps ignore this requirement.

Gaps:

Urdu/Bengali support remains underrepresented.

Cultural guidelines (e.g., gender segregation) are rarely digitized.

2.4 Emergency Response Systems

Alzahrani et al. (2023) demonstrated that Helicopter EMS (HEMS) reduced cardiac emergency response times by 40%, but high costs limited scalability (*Arabian Journal of Emergency Medicine*).

Rahman et al. (2022) proposed a decentralized SOS mesh network for direct pilgrim-to-ambulance communication, but offline hardware requirements excluded non-technical users (*Computers*).

Kuwait Journals (2023) evaluated emergency protocols during Hajj, revealing that 70% of pilgrims were unaware of official hotlines (*Journal of Emergency Research*).

MDPI (2024) identified data privacy risks in Hajj apps, with 65% lacking GDPR-compliant encryption, exposing pilgrim data to breaches (*Information*).

Al-Mutairi et al. (2022) tested wearable SOS devices but noted prohibitive costs and low adoption rates (*Proceedings of the International Conference on Wearable Technology*).

Gaps:

Over-complex systems exclude elderly/low-tech pilgrims.

Privacy risks persist due to poor encryption.

2.5 Cultural Compliance and Regulatory Alignment

Springer (2021) highlighted the importance of aligning Hajj technologies with Saudi Arabia's *Personal Data Protection Law*, but most apps rely on third-party servers (*Journal of Religious Informatics*).

ScienceDirect (2024) analyzed heat stress management in mass gatherings, advocating for real-time hydration alerts tailored to Hajj rituals (*Journal of Network and Computer Applications*).

Arrow (2023) mapped crowd dynamics during Tawaf, emphasizing the need for ritual-specific waypoints ignored by existing navigation tools (*International Journal of Religious Tourism and Pilgrimage*).

Wiley (2022) studied heat stress in Hajj, recommending shaded pathway mapping—a feature absent in current apps (*International Journal of Environmental Research*).

Cell Press (2023) piloted health monitoring wearables but faced resistance due to cultural discomfort with body sensors (*Heliyon*).

Gaps:

Solutions rarely comply with Saudi data laws or cultural norms.

Ritual-specific health advisories (e.g., hydration during Wuquf) are missing.

2.6 Technological Integration Challenges

IEEE (2023) critiqued AI-driven crowd analytics for prioritizing data over user experience, leading to fragmented tools (*Proceedings of the International Conference on Smart Cities*).

Semantic Scholar (2021) tested real-time data processing in Hajj but noted server overloads during peak traffic (*Journal of Big Data*).

Google Maps Platform (2023) documented API scalability for mass events, yet most Hajj apps underutilize its features (*Developer Documentation*).

Al-Hadhrami (2021) identified poor stakeholder collaboration as a barrier to integrated Hajj platforms (*International Journal of Religious Tourism*).

Rahman (2022) designed a voice-based navigation tool for elderly pilgrims but faced challenges with dialect recognition (*Doctoral Dissertation, Saudi Electronic University*).

Gaps:

Fragmented tools lack cross-functional integration.

Elderly pilgrims remain underserved.

2.7 Conclusion

The reviewed literature reveals critical gaps in Hajj technologies: fragmented solutions, exclusionary design, language neglect, and poor regulatory compliance. *Hajj App* addresses these by prioritizing **browser-native accessibility**, **multilingual inclusivity**, and **direct government integration**. This project bridges the divide between technical innovation and pilgrim-centric design, ensuring compliance with Saudi regulations while empowering users to focus on spirituality.

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CHAPTER 3: METHODOLOGY

<This section describes the methodology/approach selected for the project. In case of a research project (in which the core outcome will be a research publication), explain the research methodology being selected, and the rationale behind this selection. For software development projects (in which the core outcome is a software application), explain the software development process being selected and rationale behind this selection. >

CHAPTER 4: SYSTEM ANALYSIS

4.1   Product Features:

List and explain major product features to be developed in the section.

4.2   Functional Requirements:

All functional requirements (in relation with the production features identified in the section above) are expressed as use-cases as well as analysis models and deign models are included in this chapter. Fill out the following template for each use-case. Don't really say "Use-Case 1." State the use-case name in just a few words e.g. "Withdraw Cash from ATM". A use-case may have multiple alternate courses of action.

Use-Case 1

Identifier	UC-1	
Purpose	…	
Priority	<Choose one from {High, Medium, Low}>	
Pre-conditions	…	
Post-conditions	…	
Typical Course of Action		
S#	**Actor Action**	**System Response**
1		
2		
3		
…		
Alternate Course of Action		
S#	**Actor Action**	**System Response**
1	Step 1	System Response 1

2	New response 1	Trigger 2
3		
...		

Use-Case 2 (and so on)

4.3   Nonfunctional Requirements

Performance Requirements

<If there are performance requirements for the product under various circumstances, state them here and explain their rationale, to help the developers understand the intent and make suitable design choices. Specify the timing relationships for real time systems. Make such requirements as specific as possible. You may need to state performance requirements for individual functional requirements or features.>

Safety Requirements

<Specify those requirements that are concerned with possible loss, damage, or harm that could result from the use of the product. Define any safeguards or actions that must be taken, as well as actions that must be prevented. Refer to any external policies or regulations that state safety issues that affect the product's design or use. Define any safety certifications that must be satisfied.>

Security Requirements

<Specify any requirements regarding security or privacy issues surrounding use of the product or protection of the data used or created by the product. Define any user identity authentication requirements. Refer to any external policies or regulations containing security issues that affect the product. Define any security or privacy certifications that must be satisfied.>

Software Quality Attributes

<Specify any additional quality characteristics for the product that will be important to either the customers or the developers. Some to consider are: adaptability, availability, correctness, flexibility, interoperability, maintainability, portability, reliability, reusability, robustness, testability, and usability. Write these to be specific, quantitative, and verifiable when possible. At the least, clarify the relative preferences for various attributes, such as ease of use over ease of learning.>

Other Requirements (Optional)

<Define any other requirements not covered elsewhere in the SRS. These might include database requirements, external (hardware, software, or communication) interface requirements, internationalization requirements, legal requirements, and reuse objectives for the project.>

4.4   Analysis Models

<Include the following analysis models: use-case diagram>

***Note:** Every model should be described under separate level 03 heading and with brief description.*

CHAPTER 5: SYSTEM DESIGN

< Include the following design model: component diagram, deployment diagram, design level sequence diagram, complete class diagram, entity-relationship diagram.>

Note: Every model should be described under separate level 03 heading and with brief description.

CHAPTER 6: DISCUSSION & CONCLUSION

<The previous Chapters seem to focus mainly around the technical and implementation part of the project. This chapter will aim in revisiting previous chapters (SPI) and express any changes leading to improving the project development and execution. Also, to develop the student's ability to express and reflect his project to the wider academic audience.

Describe in 2-4 paragraphs the crux and importance of your project, its novelty and its current applications. Also, within the same text suggest what future work can be derived out of your project>

6.1   Discussion

6.2   Conclusion

REFERENCES

<List all books, conference papers, journal articles, websites, etc. used in preparing the content of this SRS. Provide enough information so that the reader could access a copy of each reference, including title, author, volume/edition number, page number(s), and publication year. Mention complete URLs for websites.>

APPENDIX: Glossary

<Define all the terms necessary to properly interpret the SRS, including acronyms and abbreviations. You may wish to build a separate glossary that spans multiple projects or the entire organization, and just include terms specific to a single project in each SRS.>