School of Computing and Mathematical Sciences

CO7201 Individual Project

Final Report

A Mobile App for Campus Navigation

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Abstract

University campuses are dynamic and often complex environments, comprising multiple buildings, departments, service facilities, and outdoor areas. While such diversity fosters academic, social, and cultural engagement, it can also present navigational challenges, particularly for new students, visitors, and individuals unfamiliar with the layout. Traditional solutions such as static campus maps and printed guides lack real-time adaptability, while generic digital navigation tools often fail to provide the level of detail and contextual information required within a campus environment.

This project presents the design, development, and evaluation of a mobile application tailored for campus navigation at the University of Leicester. The proposed solution integrates real-time location tracking, interactive mapping, building-level navigation, timetable integration, and additional features such as notifications for events or disruptions. The aim is to provide a user-friendly, context-aware platform that enhances accessibility, efficiency, and the overall user experience for students, staff, and visitors.

The development of the application followed a Human-Computer Interaction (HCI) design framework, ensuring that usability, accessibility, and user engagement were central to each design iteration. Initial research was conducted through a combination of literature review and analysis of existing navigation tools, identifying specific gaps in functionality and accessibility for campus-specific contexts. Insights gained from this research informed the app's feature set, interface design, and technological architecture.

Core features include GPS-based outdoor navigation, searchable campus points of interest, and integration with university systems such as class timetables and event notifications. In addition, accessibility features such as voice-assisted search and audio navigation cues were incorporated to ensure inclusivity for visually impaired users.

Contents

1. Introduction

Navigating a modern university campus can be a daunting task, particularly for new students, visitors, and even staff members who may be unfamiliar with certain areas. University campuses are increasingly complex environments, often spanning multiple acres and incorporating a mix of academic buildings, administrative offices, libraries, laboratories, sports facilities, and student service centres. For first-year students, the initial weeks are often characterised by uncertainty and disorientation, which can result in late arrivals to lectures, missed meetings, and increased stress levels. For visitors attending open days, conferences, or events, these navigational challenges can significantly detract from their overall experience.

While traditional methods such as static campus maps, printed brochures, and directional signboards have been the primary means of wayfinding, they present several limitations. Static maps are prone to becoming outdated due to campus expansion or building relocations. They also lack real-time adaptability, meaning they cannot account for temporary closures, event-specific redirections, or sudden changes in accessibility routes. Signboards, while useful for immediate guidance, may not be placed in sufficient density to guide users effectively through large or intricate areas. Moreover, for visually impaired individuals, both printed maps and signboards may not provide the accessibility required for independent navigation.

With the widespread adoption of smartphones and the growing capabilities of mobile applications, there exists an opportunity to develop context-aware, location-based solutions tailored to campus navigation. General-purpose navigation platforms such as Google Maps and Apple Maps, while highly effective for city-wide travel, often lack the precision, detail, and building-specific data needed for university environments. They typically do not include specific departmental offices, or context-specific features such as lecture hall scheduling, event notifications, or facility availability. As such, there is a clear gap for a dedicated, university-specific navigation tool that combines the precision of location-based services with the contextual relevance of campus-specific data.

This project addresses this gap by developing a dedicated mobile application for campus navigation at the University of Leicester. The app is designed not only to provide point-to-point navigation but also to integrate features that enhance the overall campus experience. By combining real-time GPS tracking, interactive maps, timetable integration, and accessibility-focused features such as voice-assisted search, the application aims to provide an inclusive, user-friendly solution that meets the diverse needs of the campus community.

The motivation for this project stems from both academic and practical considerations. From an academic perspective, the project offers the opportunity to explore the intersection of Human-Computer Interaction (HCI), mobile application development, and context-aware computing. The application serves as a case study in how user-centred design principles can be applied to create solutions that address specific real-world challenges. Practically, the project has the potential to deliver tangible benefits to the university community, including improved orientation for new students, enhanced accessibility for individuals with disabilities, and increased engagement through integration with campus events and services.

The development process is guided by an iterative design methodology, ensuring that feedback from real users is incorporated at multiple stages. Initial requirements were gathered

through literature review, analysis of existing navigation solutions, and informal discussions with students and staff. The app's feature set was refined through low-fidelity prototyping, followed by high-fidelity designs and implementation using cross-platform development tools to ensure compatibility.

A key aspect of the project is its emphasis on inclusivity. Recognising the diverse needs of the campus population, the application incorporates accessibility features such as voice input for search queries, audio-based navigation instructions, and compatibility with screen readers. These features are intended to ensure that the app is usable by individuals with varying abilities and preferences, thereby contributing to a more equitable campus environment.

In summary, the project seeks to bridge the gap between traditional campus navigation methods and the potential of modern mobile technologies. By providing a solution that is accurate, accessible, and tailored to the unique context of the University of Leicester, this work aims to enhance the daily experiences of its users while contributing valuable insights to the broader field of context-aware mobile application development.

2. Aims and Objectives

2.1 Aim

The overarching aim of this project is to design, develop, and evaluate a mobile application that provides a dedicated navigation solution for the University of Leicester campus. The application is intended to address the limitations of traditional navigation methods by leveraging real-time location tracking, interactive campus maps, and accessibility-focused features to deliver a more accurate, user-friendly, and inclusive wayfinding experience.

The app is envisioned not merely as a static navigation tool, but as a dynamic platform capable of integrating additional services such as timetable access, event notifications, and accessibility routes. In doing so, it will cater to a wide range of stakeholders, including students, staff, and visitors, while setting the foundation for future scalability and cross-campus applicability.

2.2 Objectives

The aims of the project are translated into the following key objectives, each of which is designed to ensure that the application is functional, accessible, and contextually relevant to the unique needs of the University of Leicester community.

Objective 1: Conduct comprehensive background research

A robust foundation of academic and technical knowledge is essential for the successful design and implementation of the application. This objective involves reviewing relevant literature in areas such as Human-Computer Interaction (HCI), location-based services, mobile app usability, and accessibility design principles. Additionally, an analysis of existing campus navigation tools and general-purpose mapping platforms will be conducted to identify both strengths and shortcomings that can inform the app's design.

Objective 2: Gather and analyse user requirements

The development process will be guided by user-centred design principles, making it essential to understand the specific needs, preferences, and challenges faced by the app's intended audience. This will involve a combination of methods, including informal interviews, surveys, and observation of navigation behaviours within the campus. Feedback from students, academic staff, administrative personnel, and visitors will help shape the functionality, interface design, and accessibility features of the application.

Objective 3: Design an intuitive and accessible user interface

The success of the application depends heavily on its usability. This objective focuses on creating a user interface (UI) that is visually clear, logically structured, and responsive to varying device screen sizes. The design will also follow accessibility standards, ensuring compatibility with assistive technologies such as screen readers and incorporating features like high-contrast themes, scalable text, and voice-based input. Low- and high-fidelity prototypes will be developed, tested, and refined iteratively based on user feedback.

Objective 4: Implement accurate and real-time navigation functionality

The core function of the application is to provide precise point-to-point navigation within the campus environment. This will be achieved by integrating GPS for outdoor navigation. Real-time tracking will be complemented by dynamic map updates, enabling users to visualise their current position and route progress. Additional functionality will include route recalculation in case of deviations, and the provision of shortest or most accessible routes based on user preferences.

Objective 5: Integrate campus-specific data and features

Unlike general mapping applications, this project requires the inclusion of detailed, campus-specific data. This will include locations of academic departments, lecture halls, laboratories, student service centres, sports facilities, libraries, and cafes. Timetable integration will allow students to view their upcoming lectures and receive navigation guidance to the relevant rooms. Event integration will ensure that users can locate and attend campus activities such as open days, guest lectures, or club meetings.

Objective 6: Implement accessibility-focused features

Accessibility is a central priority of the project, ensuring that the app caters to the needs of users with disabilities or special requirements. Voice search will be implemented to allow hands-free operation, while spoken navigation instructions will assist visually impaired users. Accessibility routes, such as step-free paths and ramps, will be included where possible.

Objective 7: Ensure system scalability and maintainability

To future-proof the application, the system architecture will be designed for scalability, enabling new features or datasets to be added without significant redevelopment. The codebase will follow modular programming practices to facilitate maintainability, making it easier for future developers or the university's IT services to manage updates and enhancements.

Rigorous testing will be carried out to ensure that the application meets its functional, usability, and accessibility goals. Testing will include unit testing for individual components, integration testing to ensure smooth interaction between modules, and system testing to verify overall functionality. Usability testing with real users will provide feedback on interface clarity, navigation accuracy, and feature usefulness. Iterative refinement based on test results will ensure a polished final product.

2.3 Scope of the Project

The scope of the project will be limited to the University of Leicester campus during its initial implementation phase. While the primary audience will be students and staff, the design will also account for the needs of short-term visitors. The focus will be on outdoor navigation, with future potential for indoor navigation enhancements. The system will be developed to run on Android, and the backend architecture will be designed to allow data updates without requiring complete redeployment of the app.

3. Background and Literature Review

This section will include

• Review of related academic research on campus navigation, HCI, mobile application design, accessibility, and location-based services.

• Critical analysis of existing navigation solutions, both general-purpose (e.g., Google Maps) and campus specific.

• Identification of technological gaps and opportunities for innovation.

4. System Design and Architecture

This section will include

• Overall system architecture diagram.

• Description of frontend and backend design.

• Choice of development technologies and frameworks (Flutter, Firebase, Google Maps API, etc).

• Data structure and database schema.

5. Implementation

This section will include

• Detailed account of coding process, features implemented, and integration of APIs.

• Screenshots of key app features.

• Challenges faced during implementation and solutions applied.

6. Testing and Evaluation

This section will include

• Testing methodology.

• Test results, feedback from pilot users.

• Analysis of app performance, accuracy of navigation, and usability.

7. Results and Discussion

This section will include

• Key findings from testing and user evaluation.

• Discussion of whether the app met its aims and objectives.

• Insights into the app's impact on navigation experience for users.

8. Conclusion

This section will include

• Summary of project achievements.

• Reflection on challenges, learning outcomes, and contributions to the field.

9. Future Work

This section will include

• Proposed improvements such as indoor navigation, AR integration, multilingual support, advanced accessibility tools.

• Potential for deployment across other campuses.

10.   References

This section will include

• All books, journal articles, conference papers, and online resources cited in the report.

11.   Appendices

This section will include

• Survey/interview questions.

• Additional diagrams and screenshots.

• Sample code snippets.