COURTXPERT HUB: COURT RESERVATIONS & EQUIPMENT PLATFORM

BY

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A REPORT

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ABSTRACT

The CourtXpert Hub project addresses the critical gaps in existing sports court booking systems within Malaysia, particularly in Kampar, Perak. Despite the availability of booking services across Malaysia, current systems such as Courtsite, AFA, 7Stone, and IOI Sports Centre lack integrated Smart dashboa options, multilingual accessibility, and an advanced administrative dashboard. These shortcomings often lead to inconvenience for casual players, reduced inclusivity among multilingual users, and inefficient decision-making by administrators. To overcome these limitations, the proposed platform was enhanced with three major features: an equipment rental prompt, a smart administrative dashboard with predictive analytics, and multilingual support in English, Bahasa Melayu, and Chinese. The system was developed on a PHP–MySQL architecture with Stripe API integration for secure payments (Visa, FPX, and GrabPay). The methodology followed an Agile, incremental development approach, incorporating iterative design, testing, and refinement throughout the process. Moreover, system evaluation demonstrated reliable booking workflows, real-time equipment inventory management, and accurate predictive insights into revenue and venue utilization. In addition, administrators were also equipped with customer retention analytics and re-engagement tools, such as WhatsApp messaging integration, to improve user loyalty. As a result, the findings confirm that CourtXpert Hub successfully achieves its objectives by providing a comprehensive, inclusive, and intelligent booking platform. It not only improves user accessibility and convenience but also empowers administrators through data-driven decision-making tools. The project contributes to the digitalization of sports facility management in Malaysia and lays the foundation for scalable, nationwide deployment.

Area of Study: Software Engineering, Web Development
Keywords: Equipment rental, Multilingual support, Smart dashboard, Predictive analytics, User engagement, Stripe API, CourtXpert Hub

TABLE OF CONTENTS

LIST OF FIGURES

Figure Number **Title** **Page**

LIST OF TABLES

Table Number **Title** **Page**

LIST OF ABBREVIATIONS

CourtXpert Hub	Court Expert Hub (Project System's Name)
FYP	Final Year Project
UI/UX	User Interface / User Experience
API	Application Programming Interface
ERD	Entity–Relationship Diagram
HTTPS	Hypertext Transfer Protocol Secure
i18n	Internationalization (multilingual support)
SQL	Structured Query Language
XAMPP	Cross-Platform Apache, MariaDB, PHP, Perl stack
Stripe	Online Payment Gateway (Stripe Payment API)
PHP	Hypertext Preprocessor

Chapter 1

1.0 Project Background

This chapter presents the historical background, problem statement, objectives, goals, contribution and organization of the report. It introduces the rationale behind extending CourtXpert Hub, a web-based sports court and equipment booking system in Kampar, Perak. The system attempts to address the typical pain point that both users and facility administrators experience in the current booking environment. The chapter also emphasizes the system's role in supporting sports involvement, the digital revolution, and healthy lifestyle promotion. This report builds on Phase 1 (FYP1), which **delivered Favourite Venue and Reviews**, and **now focuses on** inclusivity and data-driven management through **equipment rental prompt option**, **a smart administrative dashboard 安 multilingual support.**

1.1 Introduction

A sports court and equipment booking system constitutes an advanced digital platform designed to facilitate the reservation of various sports courts and associated equipment. This kind of system not only facilitates the booking process for both users and administrators but also improves overall experience by offering an integrated interface for reservations and payments. These systems are crucial for managing reservations for a variety of sporting facilities, including football, badminton, pickleball, table tennis, and more [1]. By doing this, users can check the availability of courts, make reservations and complete online payment through a centralized website easily [2]. Furthermore, these systems improve customer service by enabling secure online registration and transactions, while assisting facility administrators in preventing double bookings and optimizing resource utilization [3]. By offering real-time availability and an intuitive interface, these platforms substantially increase the efficiency and effectiveness of sports facility management.

In the contemporary digital era, participation in sports and access to facilities are increasingly shaped by technological innovations and evolving user expectations. As a result, the development of court and equipment booking systems provides a modern solution that facilitates venue reservations, equipment rentals, and related services through a user-friendly and centralized platform.

Furthermore, several sports booking platforms are accessible in Malaysia, particularly in urban areas, such as Courtsite, AFA, 7Stone, and IOI Sports Centre, which provide online reservations for various sports facilities. While these services have supported the digitalization of sports facility management, they still **lack critical features** such as **equipment rental, multi-language options, and smart admin dashboards**. These shortcomings create barriers for new or occasional users who may not own sports equipment, administrators who require insights to improve operations, and multilingual users seeking localized access. Given Malaysia's multilingual context and the operational needs of local facilities, a platform that couples tri-lingual access with explainable analytics is essential to sustain adoption and improve day-to-day decisions.

Therefore, the CourtXpert Hub platform's phase 2 (FYP2) builds on the foundation of phase 1, which introduced **favorites venues** and **reviews features** to enhance personalization, convenience, and transparency in the booking process. While these features improved user trust and usability but still require further enhancements to address inclusivity and management challenges.

To overcome these gaps, this project introduces three major components, which are an **equipment rental prompt** that ensures users without personal equipment can participate easily, a **smart administrative dashboard** that delivers analytics on booking history overview, revenue, utilization, and customer retention, and **multi-language support** in English, Chinese, and Bahasa Melayu to serve Malaysia's diverse population. Hence, these advancements transform CourtXpert Hub from a booking platform into a comprehensive sports management system that supports inclusivity, convenience, and data-driven operations.

This study is significant not only from a technological perspective but also from a social one. By lowering barriers to participation, supporting multilingual accessibility, and equipping administrators with actionable insights, CourtXpert Hub platform contributes to healthier lifestyles, more inclusive digital services, and smarter sports facility management aligned with Malaysia's broader goals of digital transformation and community well-being.

1.2 Problem Statement and Motivation

Despite the presence of various sports court booking platforms in Malaysia, including Courtsite, AFA, 7Stone, and IOI Sports Centre, these systems continue to face limitations that prevent them from meeting evolving user needs. While Phase 1 of CourtXpert Hub successfully introduced favourites and review systems to enhance personalization and transparency, several critical gaps remain that hinder the platform from providing a complete and user-centric booking experience. The following issues have been identified:

1. **Lack of equipment rental prompt**

   Although users can reserve courts, the current system does not provide an integrated prompt for users to rent essential equipment such as rackets, balls, or roller skates. This oversight will cause inconvenience for users, including beginners or occasional players who do not own the required equipment. Hence, the absence of this feature will force them to purchase new items for one-time use. Such experience decreases the convenience of using the platform and reduces overall satisfaction

2. **Lack of a smart administrative dashboard**

   The administrator's interface of current systems provides only basic booking management and lacks intelligent analytics. For instance, while Courtsite offers an analytics dashboard, its functions are limited to historical and real-time statistics such as revenue breakdown and utilization rates, without predictive insights such as future revenue forecasting or customer retention analysis [4]. Other platforms, such as AFA, 7Stone, and IOI Sports Centre, provide even fewer analytics features. This absence prevents administrators from making data-driven decisions. As a result, it will limit opportunities to optimize operations, enhance customer engagement, and improve long-term revenue.

3. **Lack of multi-language support**

   Existing systems such as Courtsite are available only in English. Given Malaysia's multilingual context, this restricts accessibility for users who are more comfortable in Bahasa Melayu or Chinese (Mandarin). Hence, without proper internationalization (i18n), the platform may exclude a significant portion of potential users, limit adoption and reduce inclusivity.

The limitations of the current system create a strong need for further innovation. By addressing equipment rental, data-driven management via a smart dashboard, and inclusivity through multi-language support. In Phase 2, CourtXpert Hub aims to provide a more comprehensive, accessible, and efficient booking experience for both users and administrators.

1.3 Research Objectives

The CourtXpert Hub project aims to overcome the challenges mentioned above through the following objectives:

1. **To integrate an equipment rental prompt**
   This feature will allow users to conveniently rent essential equipment such as rackets, balls, or roller skates during the booking process. By providing this option, the system aims to reduce inconvenience for beginners or occasional players who may not own the necessary equipment, thereby enhancing overall usability and satisfaction.

2. **To design and implement a smart administrative dashboard**
   A smart dashboard will be developed to provide administrators with real-time analytics and predictive insights, including an overview of booking history, revenue forecasting, customer retention monitoring, and venue utilization rates. This feature will enable data-driven decision-making, improve operational efficiency, and support sustainable management of sports facilities.

3. **To introduce multi-language support**
   The system will be enhanced with internationalization (i18n) capabilities, which offer support for English, Bahasa Melayu, and Chinese (Mandarin). This will ensure accessibility for Malaysia's multilingual population, broaden the user base, and foster inclusivity within the platform.

These revised objectives align with the issues raised in the problem statement and are designed to improve both user and administrator experiences, transforming CourtXpert Hub into a more comprehensive and inclusive sports management platform.

1.4 Project Scope and Direction

CourtXpert Hub's project builds upon the foundation established in phase 1, where features such as favourites and reviews were successfully introduced to enhance personalization and trust in the booking process. Expanding beyond these initial contributions, phase 2 focuses on addressing critical gaps by implementing equipment rental, multi-language support, and a smart dashboard to ensure usability, inclusivity, and data-driven management. The enhanced platform is designed to provide a seamless sports court and equipment booking experience for users in Kampar, Perak.

The scope of Phase 2 focuses on the following enhancements:

1. **Equipment Rental Integration**

   The system will integrate an equipment rental prompt that allows users to rent necessary sports equipment while booking courts. This feature will particularly benefit beginners and casual players, ensuring that a lack of equipment does not become a barrier to participation.

2. **Smart Administrative Dashboard**

   Administrators will gain access to a dashboard that provides both statistical and predictive insights. Key features include an overview of the booking history, revenue forecasting, customer retention tracking, and utilization rate analysis. Hence, these features enable data-driven operations and strategic decision-making.

3. **Multi-Language Support**

   To improve inclusivity, the platform will be localized to support English, Bahasa Melayu, and Chinese (Mandarin). This ensures broader accessibility and adoption among Malaysia's multilingual population.

The platform continues to be developed using PHP and MySQL, following the Agile methodology for iterative development. Its target audience includes sports enthusiasts, casual players, and facility administrators, to promote both accessibility and efficiency in sports facility booking.

1.5 Contributions

The CourtXpert Hub project provides significant contributions in both technological advancement and community impact. From a system perspective, in this project phase 2 introduces **three critical enhancements**: an equipment rental prompt, a smart administrative dashboard and multi-language support. The **equipment rental feature** ensures that beginners and occasional players can conveniently secure necessary equipment without the need for costly purchases, thereby improving usability and inclusivity.

Besides, the **inclusion of a smart dashboard** provides administrators with valuable insights such as an overview of booking history, revenue analysis, utilization tracking, and customer retention metrics, which can ensure data-driven decision-making and more effective facility management. In addition, **multi-language support** in English, Bahasa Melayu, and Chinese extends accessibility to Malaysia's diverse population, breaking language barriers and encouraging broader adoption.

Beyond its technical improvements, the CourtXpert Hub platform contributes to society by lowering barriers to sports participation, particularly in semi-urban areas like Kampar where digital solutions remain limited. By simplifying access, supporting multiple languages, and offering flexible rental options, the platform fosters inclusivity and empowers individuals to engage in healthier, more active lifestyles. Additionally, the integration of intelligent analytics aligns with the national agenda of digital transformation, strengthening the modernization of local sports infrastructure.

In summary, the CourtXpert Hub platform not only extends the technical scope of sports booking systems but also delivers meaningful social value by enhancing inclusivity, promoting healthy living, and supporting smarter, more efficient management of community sports facilities.

1.6 Report Organization

This report is organized into seven chapters that systematically document the research, design, development, testing, and evaluation of the proposed system.

Chapter 1: Introduces the **project background** by establishing the problem statement, **motivation, objectives, scope, and contributions** of this research. It also outlines the significance of the system and the organization of the report.

Chapter 2: Presents a comprehensive **literature review**, focusing on existing booking systems such as Courtsite, AFA, 7Stone, and IOI Sports Centre. This chapter highlights their strengths and weaknesses, identifies research gaps, and discusses approaches to overcome the limitations of current solutions. The technology review **discusses the hardware platform**, **operating system, database, programming language, and algorithms** relevant to the project, concluding with a summary of the selected technologies.

Chapter 3: Details the methodology and design approach adopted in the project. It includes system architecture, design specifications, and development planning. Supporting diagrams such as **system architecture diagrams, use case diagrams, and activity diagrams** are provided to illustrate the functional structure and data flow of the system.

Chapter 4: Focuses on the system design, providing a detailed overview of the **system block diagram, entity relationship diagram (ERD), and flowcharts**. It also explains the specifications of each system component, the design of the system modules, and the interactions between different components and the database.

Chapter 5: Presents the implementation process of the proposed system. It discusses the **hardware setup, software setup, configuration, and overall system operation** with supporting screenshots. This chapter also highlights the implementation issues and challenges encountered, along with concluding remarks on the effectiveness of the implemented system.

Chapter 6: Provides the system evaluation and discussion. It covers **system testing and performance metrics, testing setup and results, challenges faced during evaluation, and objectives assessment**.

Chapter 7: Concludes the report by **summarizing the main findings** and **presenting recommendations for future improvements.**

Chapter 2

2.0 Literature Review

A literature review synthesizes existing research [5] to understand sports court booking systems and their relationship with user satisfaction, particularly within the Malaysian context. This review examines platform effectiveness, user experience, and core functionalities of digital booking systems while identifying key factors that influence user satisfaction. The analysis reveals opportunities for improving overall user experience in sports facility reservations. These findings provide the conceptual foundation for developing CourtXpert Hub, an innovative platform designed to streamline sports court and equipment booking processes for Malaysian sports enthusiasts, ensuring the solution addresses real user needs within the local sporting market.

2.1 Review of Technologies

2.1.1 Hardware Platform

The **CourtXpert Hub project is a web-based system** designed for development on a standard laptop and **deployment on a local host**. During development, the project **ran on an HP Pavilion Laptop 14-dv0xxx** equipped with an 11th Gen Intel Core i7-1165G7 @ 2.80 GHz, 8 GB RAM, a 512 GB SSD, NVIDIA GeForce MX450 graphics, and Windows 10 Home (64-bit). This **configuration is sufficient for local Apache/PHP execution, MySQL queries, and front-end chart rendering**. Not only that, but this profile also keeps costs low and portability high for coding, testing, and demonstrations. As a result, for end users, the system can be accessed via desktops, laptops, tablets, and smartphones with an internet connection, requiring no additional specialized hardware. This **ensures accessibility and reduces barriers to adoption, especially in semi-urban regions like Kampar.**

2.1.2 Firmware/OS

The **development environment runs on Windows 10/11 with a WAMP/XAMPP toolchain**, which **simplifies local debugging** and **provides compatibility with IDEs, database servers**, and **deployment tools**. The application itself is OS-agnostic, relying only on PHP and MySQL features that are equally available on Linux. Hence, for hosting, Ubuntu Server is preferred due to its stability, security updates, and headless operation, as well as

mature package management for Apache, PHP, and MySQL. Moreover, **cross-platform accessibility is emphasized**, ensuring that both Windows and mobile OS users (iOS/Android) can seamlessly interact with the system through standard web browsers.

2.1.3 Database

The project employs **MySQL** as the relational database management system because it combines reliability, tooling (e.g., **phpMyAdmin**), and strong performance for transactional workloads with straightforward support for analytical queries. The schema covers core entities uresuch as users, venues, courts, bookings, reviews, equipment_categories, equipment_items, and equipment rentals. The **dashboard's forecasting layer persists in ai_predictions** (with backtest metadata in ai_backtests and ai_events), while demo snapshots are simple JSON files on disk. Furthermore, the project also applies **UTF-8 MB4** to ensure English/Malay/Chinese text is stored correctly. Moreover, the MySQL date functions (DATE, TIMESTAMPDIFF) are computed with KPIs such as revenue, booking counts, status mix, venue share, and utilization. To keep queries fast as data grows, targeted indexes are applied on bookings(booking_date, status, venue_id), courts(venue_id), and common join keys.

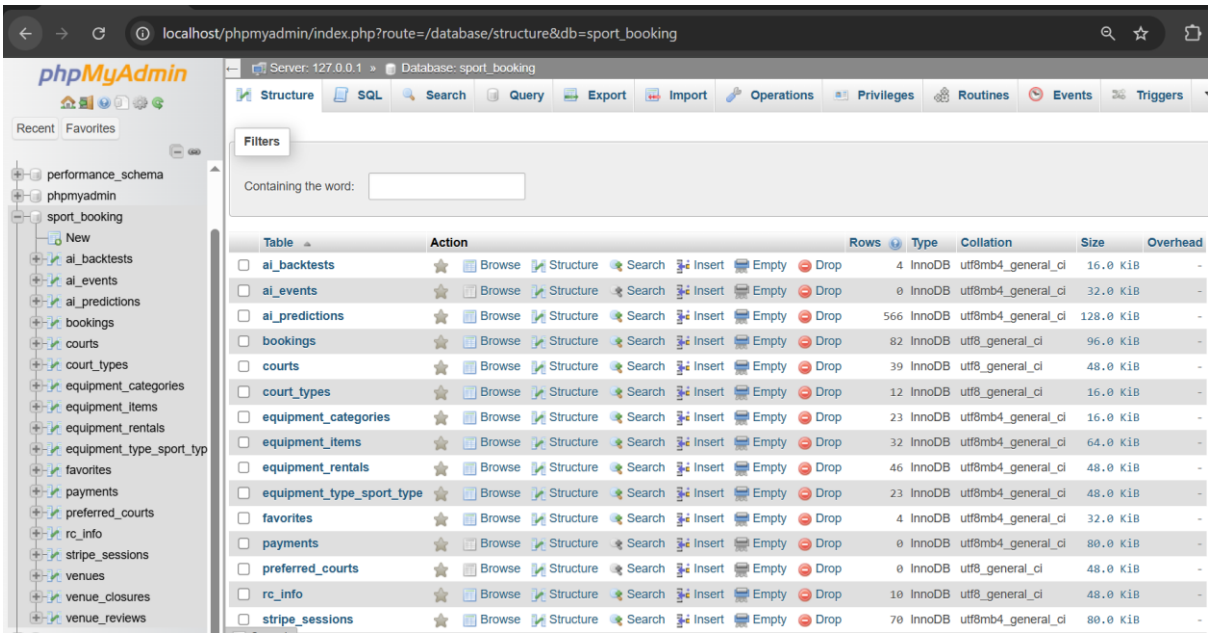


Figure 2.1. 1 Database of CourtXpert

2.1.4 Programming Language

CourtXpert Hub is developed using **PHP for the server-side (backend)** logic, which provides secure session handling (used for multilingual interfaces), simple server-side templating for the admin UI, and a clean JSON API surface for dashboard data. **For the client side, JavaScript** drives interactivity and renders charts with Chart.js; HTML5 and CSS3 deliver a responsive layout suitable for desktop and mobile browsers. This stack minimises operational complexity, integrates naturally with MySQL, and enables incremental feature delivery, such as additional endpoints for forecasts or i18n without architectural rewrites.

2.1.5 Algorithm

The dashboard's analytics use established statistical learning and operational formulas that run efficiently in PHP/MySQL:

- **Short-term forecasting (AI/statistical learning)**: The system uses additive Holt-Winters exponential smoothing to predict booking patterns and revenue trends. This algorithm suits sports bookings because they exhibit predictable weekly cycles with higher weekend demand. Unlike complex machine learning models, Holt-Winters provides transparent predictions that administrators can understand and trust.[6][7]. The algorithm analyzes **three components**: overall booking level, underlying trend, and seasonal patterns. **Three smoothing parameters—alpha (α), beta (β), and gamma (γ)—**control weight distribution between recent and historical data, trend sensitivity, and seasonal pattern sensitivity. The system automatically optimizes these parameters through grid search. Daily data is aggregated with missing dates filled, applying weekly seasonality (m=7) to capture Monday-to-Sunday patterns. Output includes interpretable daily forecasts, enabling administrators to understand predictions like "next Saturday expects 15 bookings due to weekend seasonality and slight upward trend.

- **Utilisation analytics**: calculates efficiency using the formula: booked hours ÷ (number of courts × daily operating hours × time period). This handles varying operating schedules including overnight operations. The system integrates forecasting with capacity planning by mapping predicted bookings to recent capacity estimates using 90-day maximum observed bookings. For example, a venue with 5 courts operating 12

hours daily over 7 days has 420 total hours capacity; 300 booked hours equals 71% utilization, indicating 29% remaining capacity.

- **Customer retention**: This algorithm identifies users at risk of discontinuing platform use through two factors: recency (time since last booking) and frequency (recent booking activity). Recent bookings (0-30 days) indicate low risk, medium gaps (31-90 days) suggest moderate risk, and extended periods (90+ days) signal high risk. Frequency analysis examines recent booking patterns. These combine into risk scores (High/Medium/Low) with clear explanations like "120 days inactive; 0 bookings in last 90 days." This enables targeted re-engagement: high-risk customers receive WhatsApp messages, medium-risk get email reminders, low-risk continue normal service.

- **Language filtering (engineering support)**: The internationalization system supports English, Chinese, and Bahasa Melayu following web i18n best practices. Language selection updates session variables and retrieves content from structured language packs without page reloads, ensuring consistent multilingual functionality across Malaysia's diverse linguistic environment.

2.1.6 Summary of the Technologies Review

Overall, CourtXpert Hub **runs on a pragmatic PHP–MySQL–JavaScript/Chart.js stack**; consequently, it is easy to develop on a laptop and deploy to an Ubuntu server. Moreover, **MySQL (utf8mb4)** stores all transactional and analytic data with appropriate indexes and date functions, thereby enabling fast KPI and trend queries. In addition, the scheme covers bookings, equipment, and AI prediction tables. Meanwhile, analytics rely on lightweight, explainable methods—**Holt–Winters (m=7) for forecasts** and a clear utilisation formula, with an optional recency–frequency model for retention, thus supporting a multilingual, responsive smart dashboard.

2.2 Review of the Existing Systems/Applications

2.2.1 AFA

AFA is an online platform developed to bring sports enthusiasts together by offering facility booking services, team matchmaking options, and tools for organizing activities such as matches and leagues. In addition, the platform promotes community engagement and participation in sports through its interactive modules [8].

Key Features of the Platform:

1. **Venue and Activity Search Filters**
    - AFA provides comprehensive search functionality that enables users to locate venues or activities based on specific preferences, improving the efficiency of the booking process.

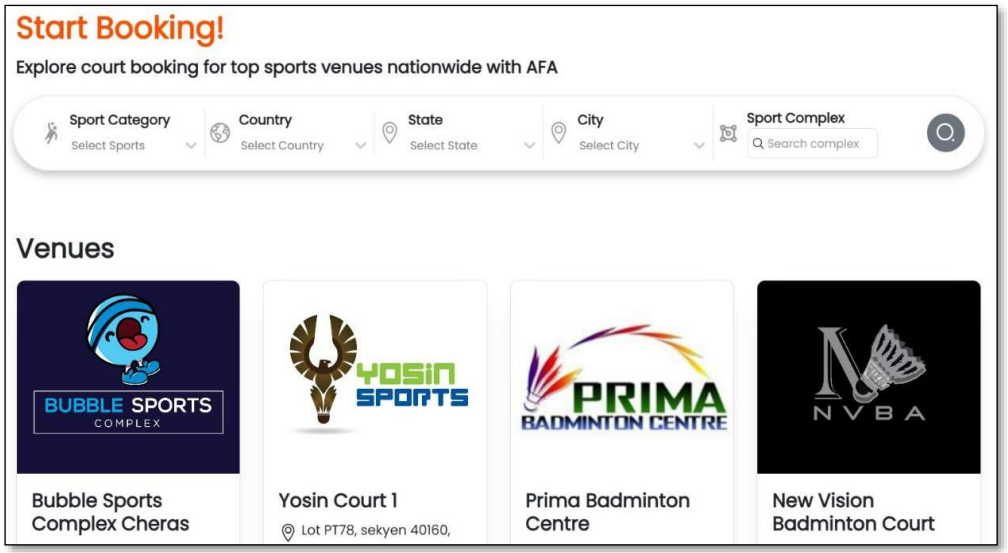


Figure 2.2. 1 Venue Filter and Search Function of AFA

2. **Leaderboards with Tournament Management**

- The system supports the organization and management of tournaments, allowing users to create events, monitor ongoing matches, view leaderboards, and access archived results for reference.

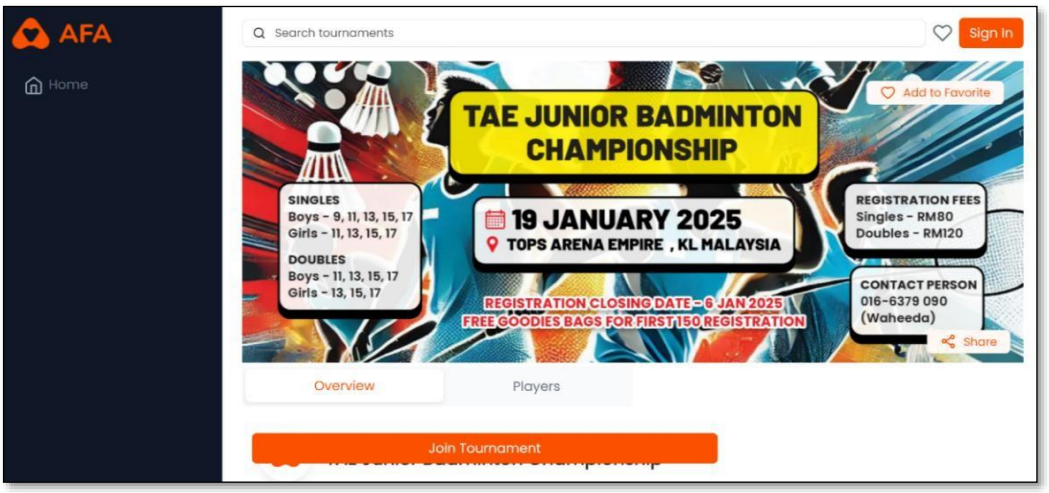


Figure 2.2. 2 AFA's Tournament Leaderboards

3. **Integrated Online Payments**

- The platform incorporates a secure payment gateway, ensuring smooth and cashless transactions for facility reservations and participation in organized activities.

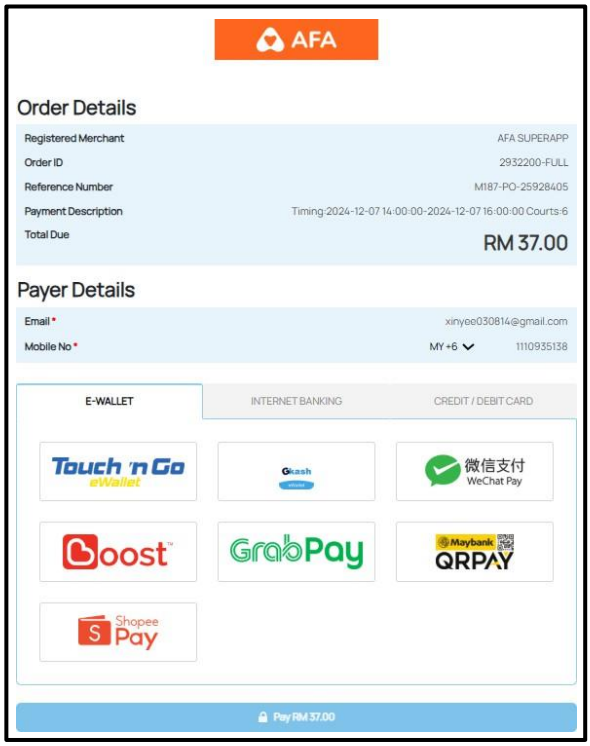


Figure 2.2. 3 Payment Options of AFA

Strengths and Weaknesses of AFA:

Strengths	Weaknesses
Advanced search filters streamline the process of locating suitable venues and activities.	Lack of personalization features (e.g., saving favorite venues and user reviews & ratings features
Integrated tournament management with leaderboard features fosters community engagement and competitive participation.	Absent from integrated equipment-rental workflow
A calendar-based booking interface enables convenient access to real-time court availability.	No administrative analytics dashboard (e.g., KPIs, trends, forecasts).
A secure digital payment system facilitates smooth and cashless transactions.	No multilingual support, reducing accessibility for non-English users.

Table 2.2. 1 Strengths and Weaknesses of AFA

2.2.2 Courtsite

The main objective of Courtsite is to streamline the process of booking sports facilities by offering an intuitive interface supported with essential features such as integrated payment gateways, real-time availability tracking, and centralized tools for both users and administrators [9].

Key Features of the Platform:

i. **Advanced Search Capabilities**

- Courtsite enables users to perform refined searches using filters such as sport type, venue name, location (city/state), and date, ensuring that facilities can be located according to specific user preferences.

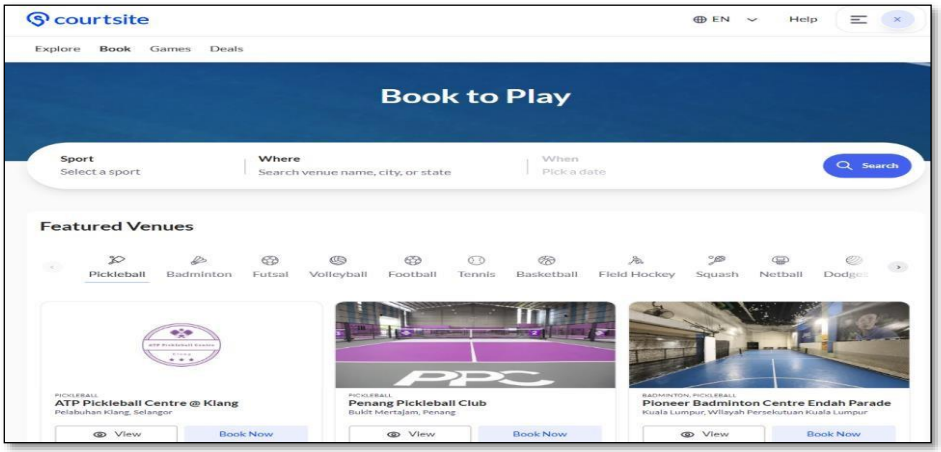


Figure 2.2. 4 Search and Filter Function of Courtsite

ii. Live Booking with Calendar Integration

- The system incorporates a calendar-based interface that displays real-time slot availability, allowing users to make instant and accurate reservations.

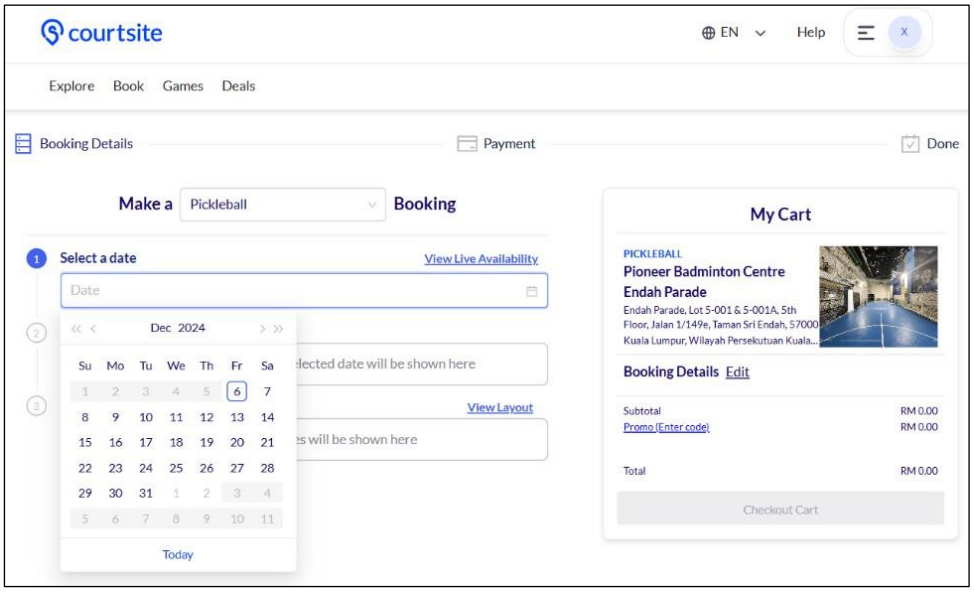


Figure 2.2. 5 Real Time Booking with Calendar View of Courtsite

iii. Secure Online Payment

- The platform provides secure and cashless payment options for confirmed bookings, reducing dependence on physical transactions.

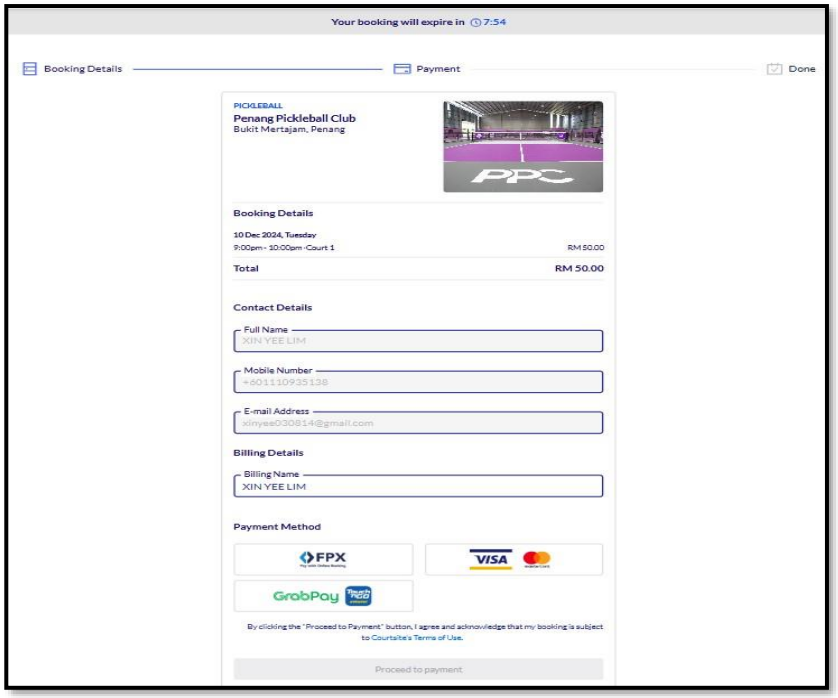


Figure 2.2. 6 Payment Options of Courtsite

iv. Admin Dashboard

- Courtsite has provided admin dashboard for revenue and utilization but it's limited to descriptive statistics [10].

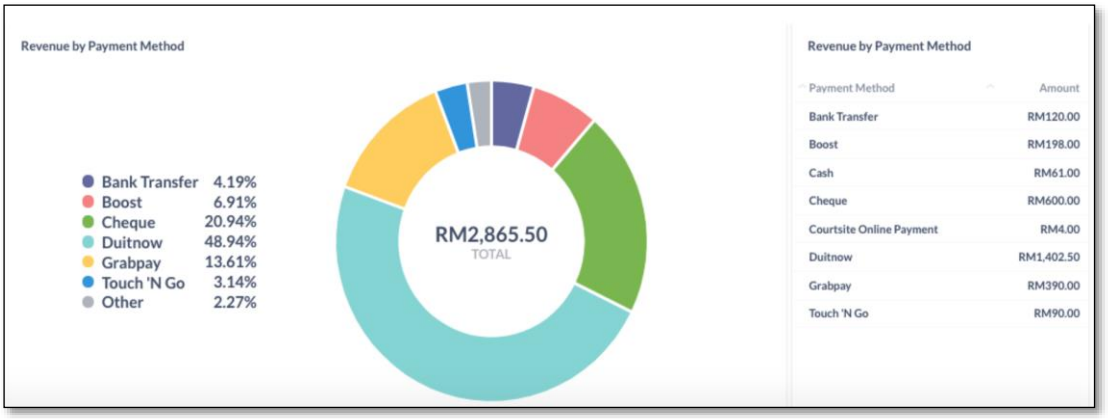


Figure 2.2. 7 Admin dashboard of Courtsite

Strengths and Weaknesses of Courtsite

Strengths	Weaknesses
Clean and user-friendly interface for easy navigation and booking	Lacks personalization features, such as saving favorite venues
Advanced search filters and calendar integration for real-time booking	No user review or rating system, limiting transparency
Secure and seamless online payments	No integrated equipment rental, which is an inconvenience for beginner users
Provides an administrator dashboard with descriptive statistics (e.g., revenue, utilization rates).	Admin dashboard limited to descriptive statistics; lacks predictive insights (e.g., demand forecasting, customer retention).
Multi-language support improves accessibility.	

Table 2.2. 2 Strengths and Weaknesses of Courtsite

2.2.3 7Stone

7Stone is a digital platform designed to streamline badminton court reservations in Malaysia, with a particular focus on Sarawak. The system enhances user convenience by providing core functionalities such as real-time availability tracking, booking tools, and facility details, accessible through both web and mobile platforms [11].

Key Features of the Platform:

1. **Calendar-Integrated Real-Time Booking**
    - The platform incorporates a calendar-based interface that enables users to view available time slots and make instant reservations, ensuring clarity and convenience.

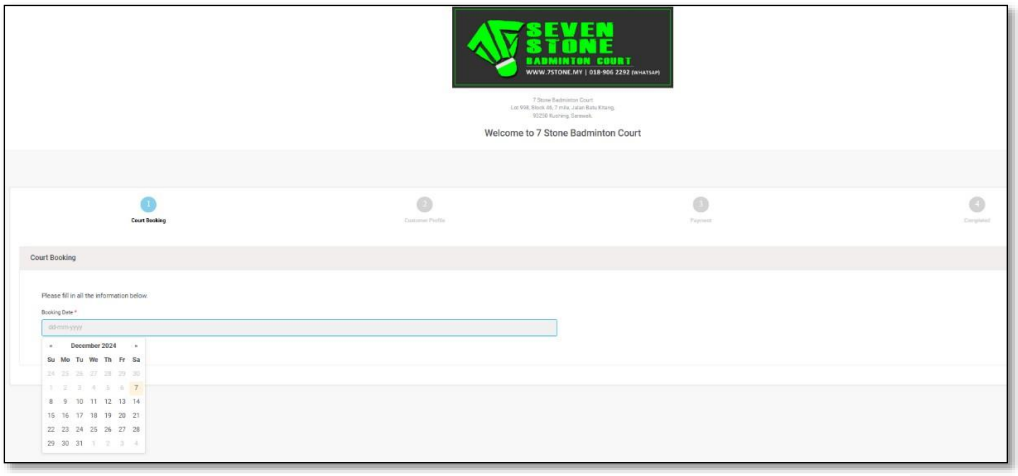


Figure 2.2. 8 7Stone's real-time booking with calendar view

2. **Secure Digital Payment Options**
    - It supports multiple payment methods, including online banking and Sarawak Pay, delivering a safe and hassle-free transaction process.

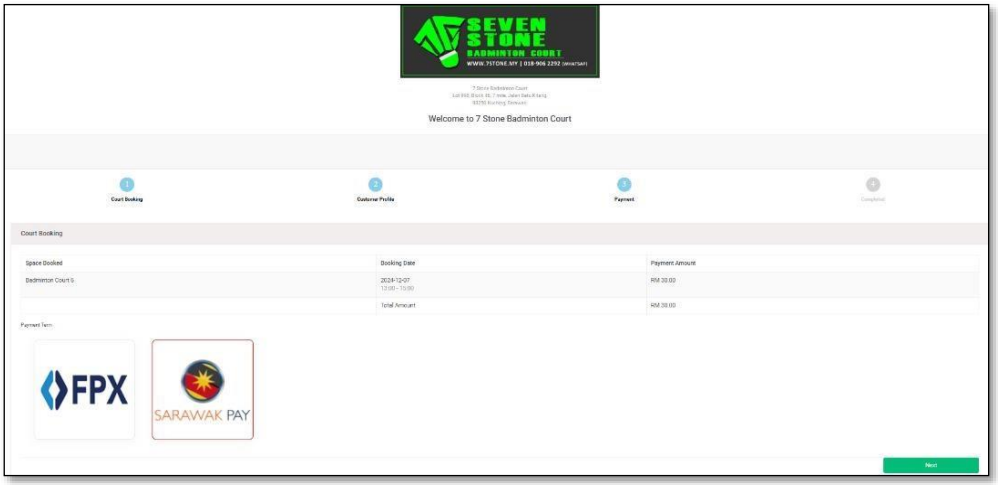


Figure 2.2. 9 Payment Options of 7Stone

3. **Automated Self-Service Functions**
    - Offers features like automated lighting controls and self-check-in, guaranteeing seamless and self-sufficient user experience

Strengths and Weaknesses of 7Stone:

Strengths	Weaknesses
Clean, intuitive interface that supports seamless navigation	Missing personalization (e.g., saving favorite venues)
Live court availability, enabling flexible planning and scheduling	Lacks a rating or review system for users to share their experience
Secure online payments, including support for Sarawak Pay	Do not prompt the equipment rental options
Convenience features (e.g., self-checking, smart lighting) reduce manual steps	Lack of a smart analytics dashboard for administrators
Social media integration for timely updates and announcements.	An English-only interface reduces accessibility and inclusivity for non-English-speaking users

Table 2.2. 3 Strengths and Weaknesses of 7Stone

2.2.4 IOI Sports Centre

IOI Sports Centre simplifies the reservation process for badminton and futsal courts by offering users convenient access to premium sports facilities. In addition to general bookings, it also supports professional training programs such as the Rashid Sidek Badminton Academy [12].

Key Features of the Platform:

1. **Graphical Court Layout Selection**
    - The platform presents a visual map of available courts during the booking process, enabling users to choose their preferred court easily.

Figure 2.2. 10 Court Layout Viewing of IOI Sports Centre

2. **Comprehensive Booking Summary**
    - Prior to confirming payment, users receive a detailed overview of their reservation—including sport type, court number, schedule, and cost—ensuring accuracy and reducing error

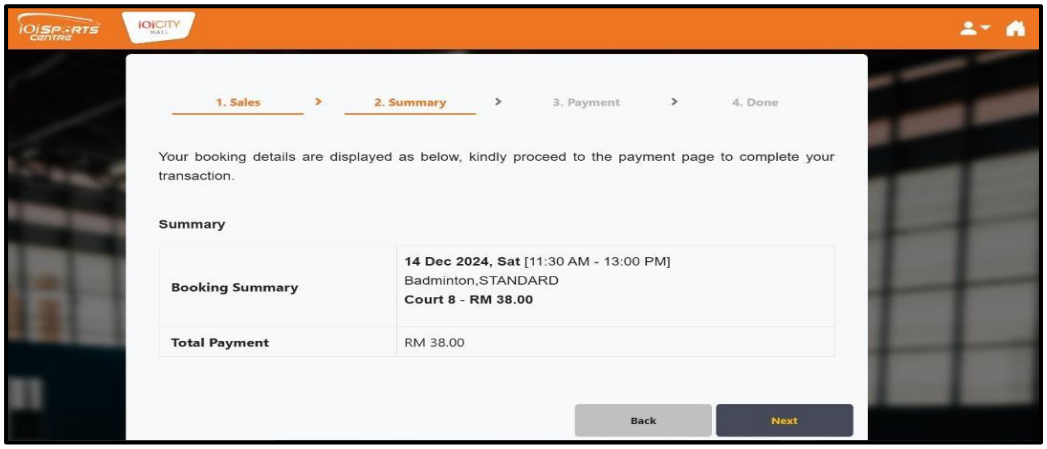


Figure 2.2. 11 Booking Summary of IOI Sports Centre

3. **Diverse Digital Payment Options**

- IOI Sports Centre accommodates a broad range of e-payment methods, including Touch 'n Go, Boost, GrabPay, ShopeePay, and standard credit or debit cards, offering users fast and flexible transaction choices.

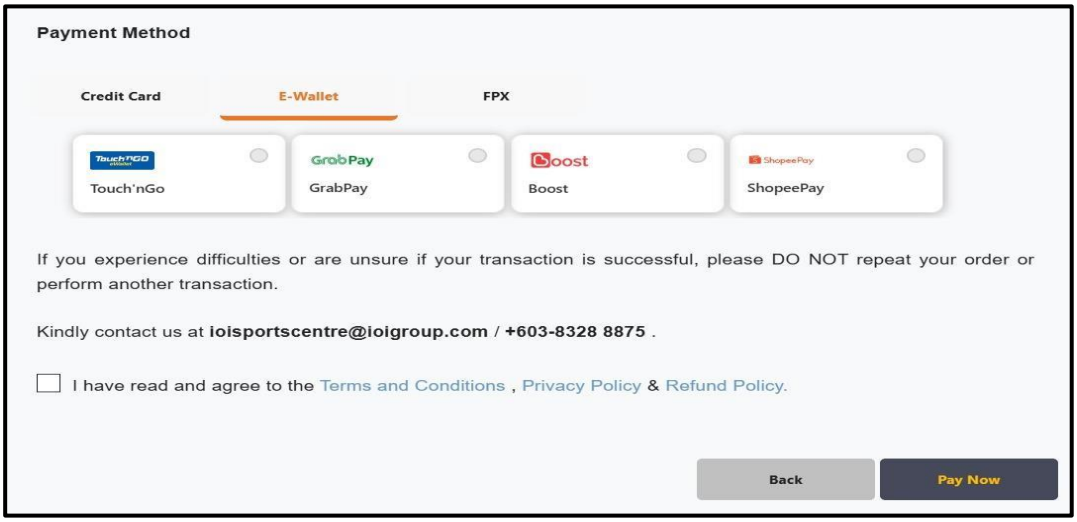


Figure 2.2. 12 IOI Sports Centre's payment option

Strengths and Weaknesses of IOI Sports Centre:

Strengths	Weaknesses
Intuitive booking interface with real-time updates	Lack of user personalization features such as favorites venues
Graphical court layout that supports informed selection	Absence of user reviews and ratings
Comprehensive booking summary that minimises entry error	Does not offer integrated equipment-rental capability
Broad payment support (Touch 'n Go, Boost, GrabPay, ShopeePay, credit/debit cards)	Do not provide administrative analytics dashboard
Booking summaries are able to improve transaction clarity and reduce errors	No multilingual support, which could be a barrier for non-English speakers

Table 2.2. 4 Strengths and Weaknesses of IOI Sports Centre

2.2.5 Comparison Analysis of Existing and Proposed Systems

This section contrasts existing solutions with CourtXpert Hub and establishes a benchmark to guide the design and enhancement of the proposed platform.

Feature	AFA	Courtsite	7Stone	IOI Sports Centre	CourtXpert Hub (Proposed)
User Interface	Community-oriented with tournament emphasis	Clean and user-friendly	Simple and self-service oriented	Graphical and structured	Clear, modern, and user-centred.
Search and Filters	Venue and activity filters	Advanced search with location/date filters	Limited (basic selection only)	Not available	Advanced and detailed multi-criteria search
Community Features	Tournament, matchmaking, leaderboards	Game hosting and joining	Not available	Not available	Not included
Personalization	Not available	Not available	Not available	Not available	Users can save, revisit and quickly book their favorite venues ✓ (FYP1)
Review/Rating System	Not available	Not available	Not available	Not available	Integrated reviews and ratings ✓ (FYP1)
Equipment Rental Prompt	Not available	Not available	Not available	Not available	Available
Real-Time Booking	Available	Available	Available	Available	Available
Secure Payment	Available	Available	Available	Available	Available

					(integrated with Stripe API payment gateway)
Admin Dashboard	Not available	Available (limited descriptive stats)	Not available	Not available	Smart analytics dashboard (KPIs, forecasts, trends)
Self-Service Automation	Not available	Not available	Available (check-in, lighting)	Not available	Not available
Multi-Language Support	Not available	Available	English only	Not available	Available for English, Malay, and Chinese

Table 2.2. 5 2.2.5 Comparison Analysis of Existing and Proposed Systems

Explanation and Analysis

The comparative review shows that while all platforms provide basic booking, calendar integration, and secure online payments, these existing systems are still absent in delivering a **holistic, user-centric, and data-driven solution**.

- **Courtsite** stands out for its clean design, advanced search, and admin dashboard. However, its analytics are limited to descriptive statistics, with no predictive capabilities such as demand forecasting or customer retention insights.
- **AFA** supports tournaments and community interaction but lacks multilingual accessibility, personalization, and smart administrative features.
- **7Stone** introduces automation such as self-check-in and lighting but excludes personalization, multilingual support, and analytics.
- **IOI Sports Centre** provides strong payment diversity and court layout selection but lacks advanced features such as multilingual support , equipment rental options, and a management dashboard.

Hence, the proposed system which is CourtXpert Hub addresses these gaps by integrating **equipment rental prompts**, **multi-language support**, and a **smart administrative dashboard** with predictive analytics. These innovations extend beyond existing systems, enhancing both inclusivity and operational intelligence.

2.3 Solution done by researcher/ developers to resolve the problem

To overcome typical challenges in court booking, developers of current platforms have introduced solutions such as:

1. **Real-Time Booking Interfaces:** Platforms including Courtsite, AFA, IOI Sports Centre, and 7Stone offer real-time, calendar-based booking that reduces scheduling conflicts and improves user convenience.

2. **Secure Online Payment Gateways:** The reviewed platforms embed trusted digital payment gateways, reducing reliance on cash and improving the safety and efficiency of bookings.

3. **Community-oriented function:** Courtsite and AFA foster interaction through match hosting, tournament participation, and forum features, thereby strengthening community engagement.

4. **Self-service automation:** Current systems, such as 7Stone has increased user autonomy and operational efficiency by implementing features such as self-check-in and smart lighting controls.

5. **Court layout visualization:** IOI Sports Centre presents visual court maps during booking, enabling more informed choices based on layout preferences.

2.4 Strengths of Existing Solutions

1. **User-friendly interfaces**: All reviewed platforms emphasize clear, accessible UIs that enable smooth navigation and straightforward bookings for users with varied digital literacy.

2. **Real-time availability**: Live scheduling updates reduce clashes and enhance time-slot management for users and operators.

3. **Secure and Robust Payment Options**: Integrated gateways (e-wallets, online banking, cards) increase transaction security and user confidence.

4. **Community Engagement features:** Platforms such as AFA and Courtsite encourage engagement via match hosting, tournaments, leaderboards, and forums.

5. **Automation and Self-Service Tools:** 7Stone's automated check-in and smart lighting improve user autonomy and streamline operations.

2.5 Weaknesses/Limitations of Existing Solutions

Scope note: The following limitations refer to existing platforms; CourtXpert Hub already provides favourites and reviews (FYP1).

1. **Lack of Equipment Rental Options:** The lack of built-in options for renting sports equipment poses a challenge and inconvenience for users who do not own or carry their own equipment.

2. **Absence of multilingual support**: No multilingual support: An English-only interface excludes or disadvantages non-English speakers. Hence, it will raise the risk of input errors, and increase support overhead, reducing overall accessibility

3. **Do not provide a smart analytics dashboard:** Administrators of existing systems are limited to basic, backward-looking KPIs; without forecasting, utilisation insights, or explainable retention signals, pricing, staffing, and scheduling decisions rely on guesswork rather than data.

2.6 How These Weaknesses/Limitations Can Be Resolved

The proposed system, CourtXpert Hub, aims to solve the shortcomings of existing platforms by implementing the following enhancements

1. **Integrated equipment rental options:** Users can add the equipment items that are needed within the booking flow to reduce friction for new or occasional players.

2. **Implementation of multilingual support:** A session-based i18n layer provides English, Chinese, and Bahasa Melayu to improve inclusivity.

3. **Implementation of smart administrator dashboard**: An administrative dashboard with KPIs, trends, utilisation analytics, and interpretable short-term forecasts (Holt–Winters) enables data-driven operations.

2.7 Summary

This literature review examined Malaysian sports booking platforms (Courtsite, AFA, 7Stone, IOI Sports Centre), highlighting strengths such as intuitive interfaces, real-time availability, secure payments, and community/automation features; however, common gaps remain in integrated equipment rental, multilingual access, and smart, explainable analytics beyond basic KPIs. Consequently, CourtXpert Hub **addresses these gap**s via **an equipment rental prompt within the booking workflow**, a **multilingual support** interface (EN/MS/ZH), and a **smart administrative dashboard** that combines KPIs, utilisation insights, and interpretable short-term forecasts. As a result, able to improve inclusivity, convenience, and data-driven operations for Malaysian sports facilities.

Chapter 3: System Methodology/Approach

This chapter describes the system design and development approach for CourtXpert Hub platform. The project follows an Agile, incremental development approach which the FYP2 (Phase 2) extends the FYP1 (Phase 1) system by adding: **(1) an Equipment Rental Prompt** integrated into the booking flow, **(2) Multi-language (EN / ZH / MS) support** via session-based i18n, and **(3) a Smart Administrative Dashboard with descriptive and predictive analytics** (Holt-Winters ETS forecasting as default, plus simple retention heuristics). Hence, the following will explain the design artifacts of this project, including the system architecture, use-case diagram, and activity diagrams.

3.1 Methodologies and General Work Procedures (SDLC)

The development of CourtXpert Hub project adopts a hybrid Software Development Life Cycle (SDLC) with Agile principles. The structured SDLC ensures a systematic process for requirement analysis, design, implementation, testing, and deployment, while Agile iterations enable rapid prototyping and continuous feedback—critical for integrating the new equipment-rental workflow, multilingual interface, and smart analytics dashboard.

Phase	Description
Requirement Gathering	Collected new requirements through FYP1 user feedback, competitor analysis (Courtsite, AFA, 7Stone, IOI Sports Centre), and discussions with the project supervisor. Identified needs: equipment rental, multilingual (EN/ZH/MS) support, and predictive analytics dashboard.
System Analysis	Refined functional and non-functional requirements, focusing on real-time inventory control, Stripe payment security, and accurate demand forecasting.
System Design	Updated Figma wireframes to include an extra booking step for equipment rental and multilingual UI. Extended the MySQL schema with new tables (equipment_categories, equipment_items, equipment_rentals, ai_predictions, etc.). Produced revised architecture, use-case, activity, flowchart and ERD diagrams using draw.io and MySQL Workbench.

Implementation	Coded in PHP, JavaScript/Chart.js, HTML/CSS, and MySQL under XAMPP. Integrated Stripe API for Visa/FPX/GrabPay, and session-based i18n for language switching. Agile sprints delivered modules incrementally: (1) equipment rental, (2) multilingual interface, (3) smart dashboard with forecasting and retention analytics.
Testing	Performed unit, integration, and user-acceptance tests. Verified concurrent booking logic, multilingual rendering, equipment inventory updates, and accuracy of predictive analytics. Stress-tested to maintain < 2s average page-load under peak load.
Deployment & Maintenance	Prepared for production on an Ubuntu server with HTTPS and database backups. Established a maintenance plan for Stripe key rotation, AI model recalibration, and incremental feature updates.

Table 3.1. 1 SDLC phase of CourtXpert

This structured yet flexible methodology ensured that CourtXpert Hub project achieved its goals of enhanced inclusivity, operational intelligence, and seamless booking while remaining scalable and reliable.

3.2 System Design Diagram/Equation

3.2.1 System Architecture Diagram

The system architecture demonstrates the integration of new Phase 2 components with the existing Phase 1 infrastructure. The architecture follows a three-tier model with presentation, application, and data layers, enhanced with multilingual support and analytics capabilities.

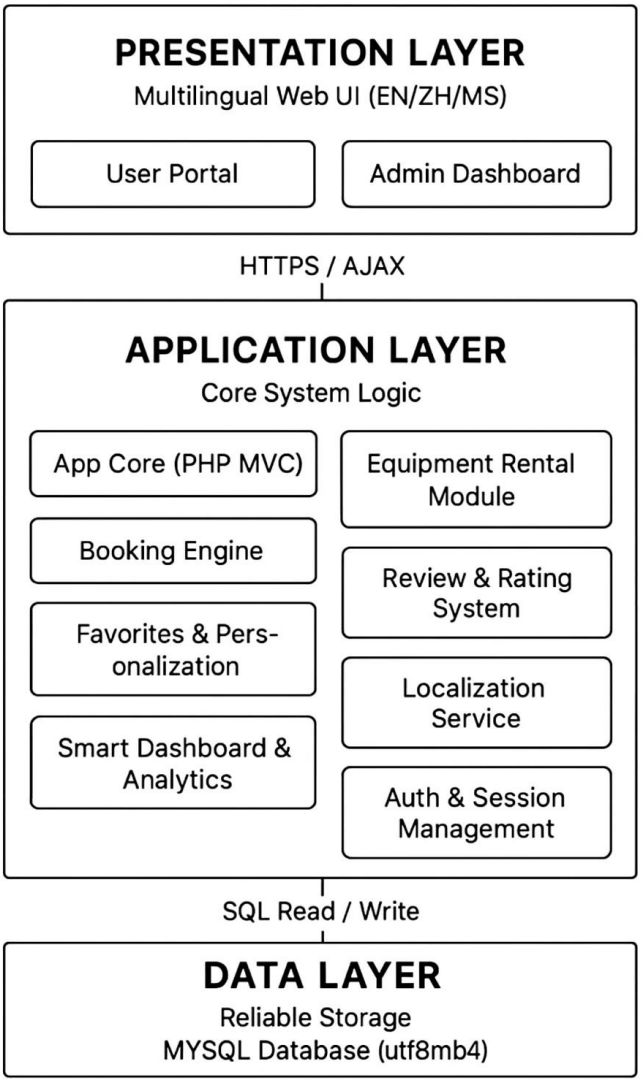


Figure 3.2. 1 System Architecture Diagram

Explanation based on System Architecture Diagram:

The **Presentation Layer**, positioned at the top of the architecture, delivers the user-facing interface for both general users and administrators. It **provides a responsive multilingual interface supporting English, Bahasa Melayu, and Chinese**. For general users, the portal allows browsing venues, booking courts, renting equipment, managing favourites, and submitting reviews. Administrators access the system through **a smart dashboard** that presents booking statistics, venue utilisation trends, revenue patterns, and customer engagement insights. All interactions within this layer are logically routed to the application layer for processing.

The **Application Layer**, situated in the middle, serves as the core of the system and coordinates the platform's functional logic. This layer comprises multiple functional modules that coordinate the platform's logic. Key modules include the **Booking Engine** (manages the reservation process and slot availability), **Equipment Rental Module** (provides context-aware equipment suggestions), **Review & Rating System** (which handles user feedback and ratings), and **Favourites & Personalisation** (maintains user preferences and quick-access lists). The **Localization Service** enables session-based language switching, while the **Smart Dashboard & Analytics** provides high-level summary metrics and insights for administrators. Supporting components manage authentication, session handling, and the routing of requests between the presentation and data layers.

The **Data Layer**, positioned at the bottom, conceptually stores all relevant system information, including user accounts, venues, courts, bookings, equipment inventory, and reviews. It ensures consistent and reliable access to data as requested by the application layer and maintains logical data integrity across all modules.

Note: This conceptual explanation focuses on the system's functional structure and module interactions. Detailed implementation, technical stack, database schemas, and predictive analytics are described in Chapter 4.

3.2.2 Use Case Diagram and Description

The enhanced use case diagram illustrates the expanded functionality for Phase 2, incorporating new user interactions and administrative capabilities.

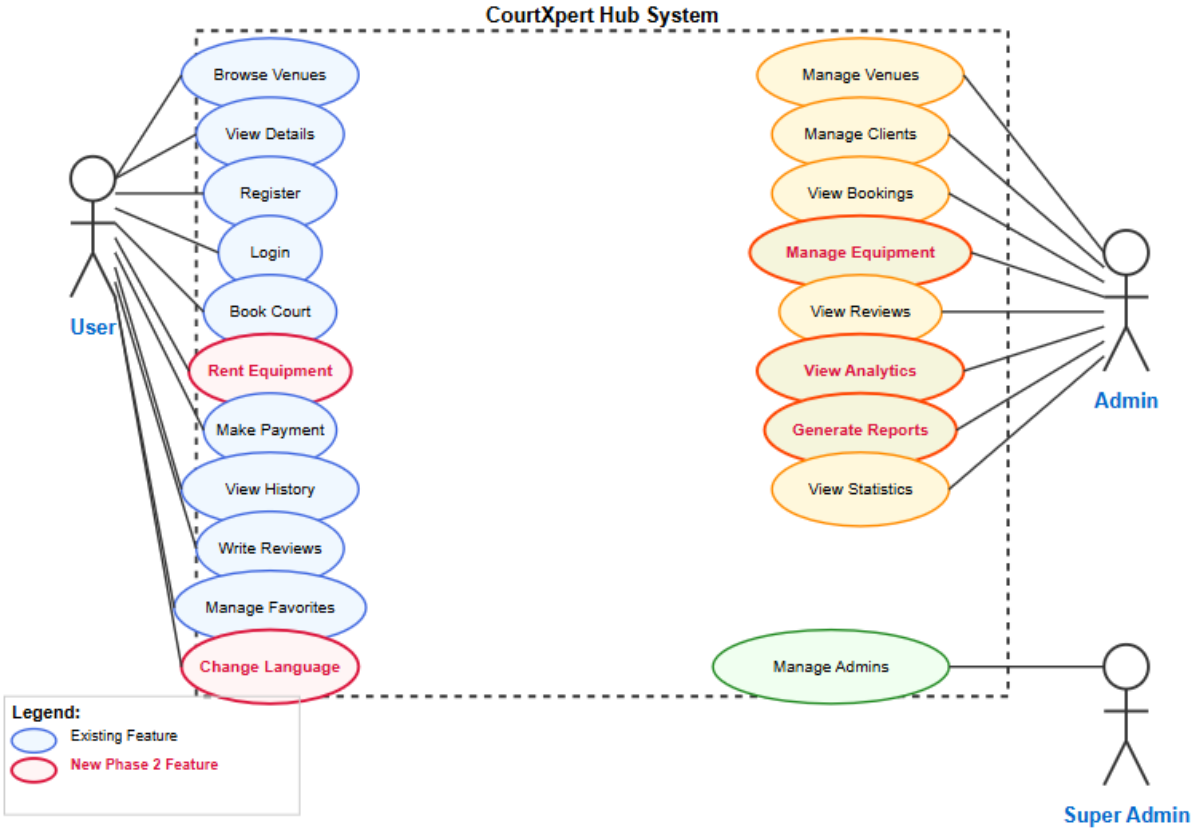


Figure 3.2. 2 Use Case Diagram

Explanation:

The CourtXpert Sports Facility Booking System use case diagram highlights the key functionalities available to three main user roles: Users, Admins, and Super Admins.

On the left side, **Regular users can** access to essential features that enhance their booking experience. They can browse venues, check availability, book courts, rent equipment, make payments, write reviews, manage their list of favorite venues, and switch between different languages for better accessibility. For example, in the *Rent Equipment* use case, the system displays available items once the user has selected a court and time slot. After that, the user can choose the desired equipment, and the system automatically calculates rental fees and adds the selected items to the booking total.

For **Admins, positioned on the right,** are responsible for managing the operational aspects of the platform. Their privileges include managing bookings, updating venue and court information, maintaining the equipment inventory, overseeing user reviews, and accessing advanced system analytics. In the *View Analytics Dashboard* use case, an authenticated Admin can navigate to the dashboard to view booking overviews, revenue trends, utilization rates, and customer retention statistics. The system also provides forecasting and reporting capabilities, enabling data-driven decision-making.

Lastly, the **Super Admin**, located at the bottom right of the diagram, holds the highest authority within the system. This role is specifically tasked with managing Admin accounts to ensure smooth platform governance and proper access control. This hierarchical structure not only organizes the roles clearly but also guarantees that each user type has the appropriate tools and permissions to interact with the sports facility booking platform effectively.

3.2.3 Activity Diagram

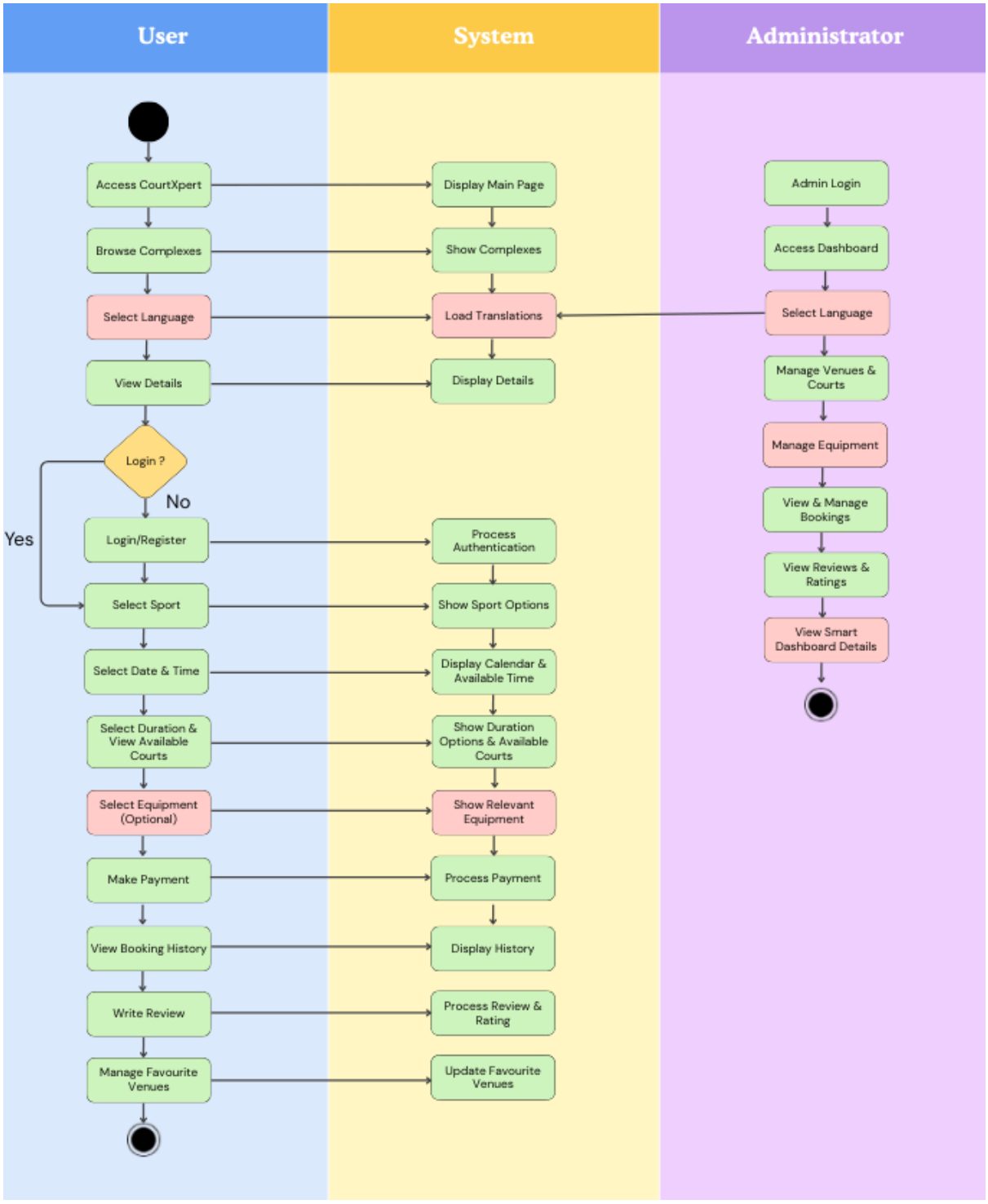


Figure 3.2. 3 Activity Diagram

Explanation based on the activity diagram:

User Activities

- Users begin by accessing CourtXpert to browse available venues and court complexes
- Before proceeding with any booking, users **may choose to change the system's display language (English/Malay/Chinese)** for better accessibility
- To make a reservation, users must log in or register an account (before booking)
- Once authenticated, users proceed through the booking process:
    1. Select the preferred sport type and court
    2. Choose the desired date and time (future slots only)
    3. Indicate the duration and view available courts
    4. At this stage, the system prompts users with an option for **equipment rental** related to the selected sport
    5. Confirm the booking and proceed with **secure payment (Stripe API)**
- After booking is confirmed, users can:
    - View and manage their booking history
    - Write reviews and provide ratings for venues
    - Organize and update their favorite venues list
    - Access a multilingual interface by switching between available languages

System Activities

- Displays filtered venue information, court details, and available booking slots
- Provides language selection to ensure usability across different user groups
- Handles user authentication, booking operations, equipment rental availability, and payment confirmation
- Updates booking records, user reviews, and favorite lists accordingly

Administrator Activities

- Admin logs in to access the management dashboard
- The dashboard provides both operational and analytical functions:
    - Manage venues, courts, and user bookings
    - Maintain the equipment inventory
    - Oversee reviews and user feedback
    - View predictive analytics, such as booking overviews, revenue trends, utilization rates, and customer retention
    - Generate system reports for performance and decision-making

Chapter 4: System Design

This chapter provides comprehensive technical details for implementing the CourtXpert Hub platform. It describes the system block diagram, component specifications, design implementations, and interaction mechanisms necessary for someone to rebuild the entire system from scratch. The chapter focuses on the three major enhancements, which include equipment rental integration, multi-language support, and a smart administrative dashboard with predictive analytics.

4.1 System Block Diagram

The CourtXpert Hub system is designed with a modular three-tier structure that ensures scalability, maintainability, and smooth integration of new enhancements. The block diagram **(Figure 4-1-1)** illustrates the top-down flow of user interaction, application logic, and data management.

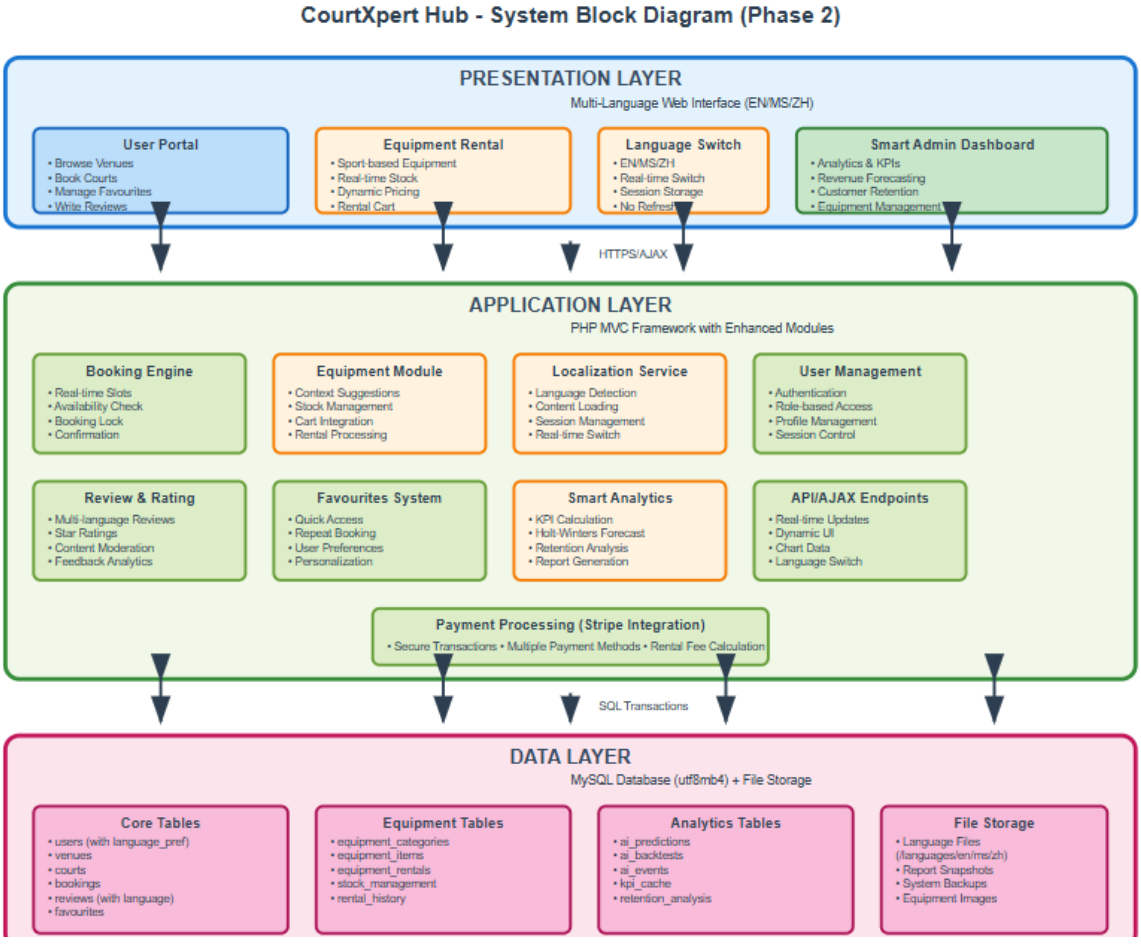


Figure 4.1. 1 System Block Diagram

4.2 System Components Specifications

The system components of CourtXpert Hub are organized according to the three-tier architecture. Each layer is described below, including its technology stack, functional responsibilities, and key features.

(i) Presentation Layer (Top Layer)

Technology: HTML5, CSS3, JavaScript, Bootstrap, Chart.js, DataTables

Components and Functions:

- **User Portal:** A responsive multilingual interface (English, Bahasa Melayu, and Chinese) that allows users to browse venues, book courts, rent equipment, manage favourite venues, and submit reviews.
- **Admin Dashboard:** A smart analytics interface providing administrators with key performance indicators (KPIs), venue utilisation, revenue trends, customer retention rates, and predictive insights.

Features:

- Fully responsive design suitable for multiple devices.
- AJAX-powered interactivity for real-time updates.
- Dynamic rendering of dashboards, charts, and tables.
- Supports seamless multilingual switching for user accessibility.

(ii) Application Layer (Middle Layer)

Technology: PHP MVC framework (XAMPP environment)

Core Modules and Functions:

- **App Core (PHP MVC):** The central controller that routes requests, manages sessions, and orchestrates functional modules.
- **Booking Engine:** Handles slot availability, slot locking, and reservation persistence.
- **Equipment Rental Module:** Provides sport-specific equipment suggestions, integrates rentals into the booking flow, and updates stock availability.

- **Review & Rating System:** Stores multilingual user reviews and star ratings post-booking.
- **Favourites & Personalisation:** Allows users to save venues and preferences for quick re-bookings.
- **Localization Service:** Enables dynamic session-based language switching via structured language packs.
- **Smart Dashboard & Analytics:** Aggregates booking and revenue data, applies Holt-Winters forecasting, and generates customer retention insights.
- **Authentication & Session Management:** Secures user/admin login and role-based access.
- **API / AJAX Endpoints:** Provides JSON responses for dynamic content and dashboards.

Features:

- Modular design allows scalable extension of new functionalities.
- Real-time workflow handling for bookings, equipment rental, and review management.
- Integration of predictive analytics for administrative decision-making.

(iii) Data Layer (Bottom Layer)

Technology: MySQL (utf8mb4 relational schema)

Core Modules and Functions:

- **Core Tables:** users, venues, courts, bookings, equipment_items, booking_rentals, reviews, ai_forecasts.
- **Equipment Tables:** Manage inventory and track rental analytics.
- **Analytics Tables:** Store forecasting results, historical booking, and revenue data for predictive modelling.
- **File Storage System:** Handles reports, backups, and system exports.

Features:

- ACID-compliant transactions ensure data integrity.

- Multilingual metadata storage to support the Presentation Layer.
- Caching predictive results for enhanced performance.
- Reliable storage and retrieval for reports, analytics, and backup data.

Data Flow of the diagram:

The data flow of the CourtXpert Hub system begins with users and administrators interacting with the presentation layer via HTTPS and AJAX requests. After that, these requests are processed by the application layer, which handles workflows such as booking, rental management, and review submissions. The application layer communicates directly with the MySQL database, performing read and write operations to maintain up-to-date records. In addition, the analytics engine retrieves historical booking and revenue data, applies predictive algorithms, and writes the resulting forecasts into dedicated tables for future access. In addition, file storage is also integrated into the workflow to support reporting, exporting, and long-term archiving. This coordinated flow ensures that all system layers operate seamlessly to deliver accurate, secure, and efficient services.

4.3 Database Design

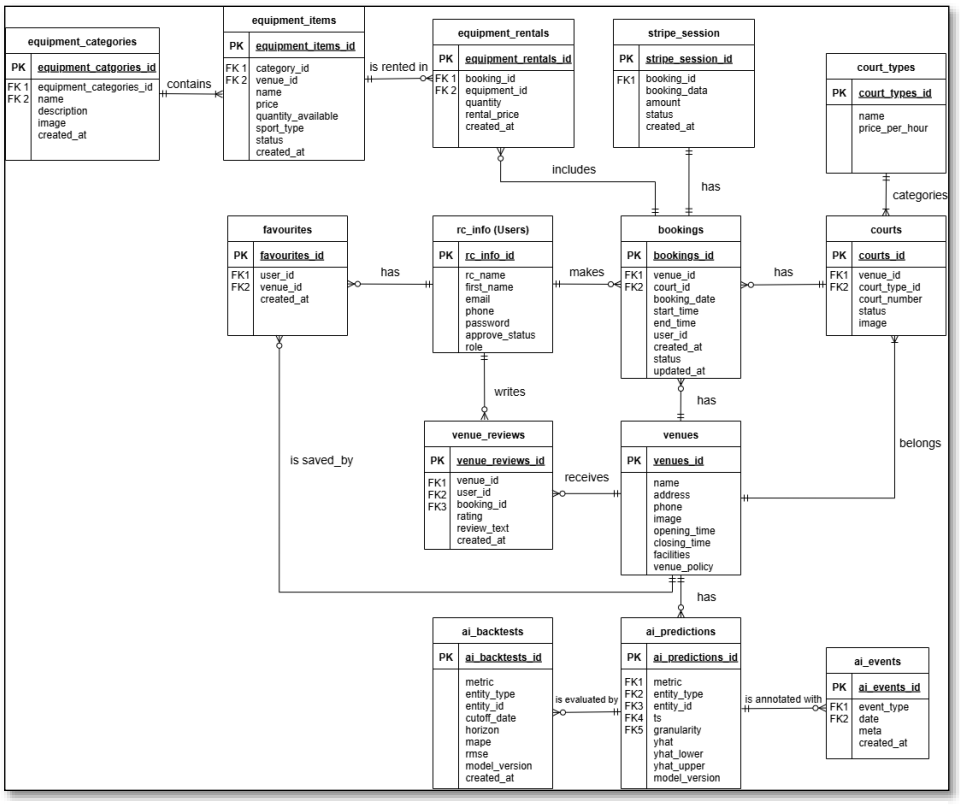


Figure 4.3. 1 ERD Diagram

Explanation based on ERD diagram:

The CourtXpert Hub's database expands upon the initial design by incorporating fourteen interrelated tables that together manage bookings, rentals, payments, and analytics for sports facilities. The **rc_info** table stores user accounts, while **bookings** link users to **specific courts and venues**, with pricing determined by **court types**. **Venues** store essential details such as facilities, policies, and schedules, and are further linked to courts, **reviews**, and **user favourites.**

This project also introduces new modules to extend system functionality. An **equipment rental module** allows users to rent sports gear alongside court bookings, managed through categories, items, and rental records. Moreover, a **stripe_session** table is added to securely track each payment, ensuring that every booking corresponds to a unique transaction. For administration and decision support, an **AI analytics module** stores forecasts, backtesting results, and annotated events, enabling revenue prediction and performance evaluation. Overall, this enhanced relational design not only supports core booking and venue management but also integrates equipment rental, secure payments, and smart analytics, creating a more comprehensive and scalable sports court management platform.

4.4 System Components Interaction Operations

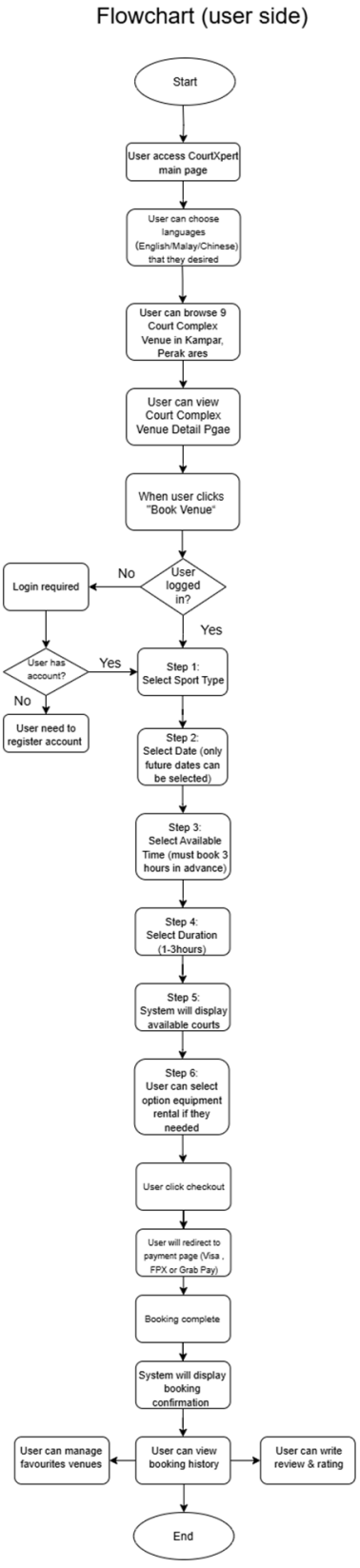


Figure 4.4. 1 Flowchart (user side)

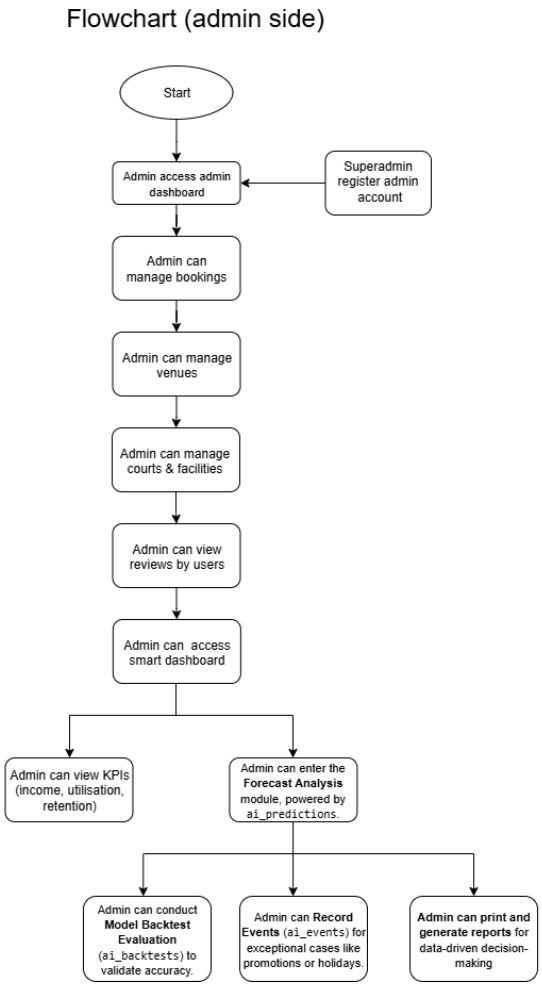


Figure 4.4. 2 Flowchart (admin side)

Explanation based on the flowchart:

User Side

- Users can access the CourtXpert Hub main page and browse available sports court complexes in Kampar, Perak.
- They can view venue details and must log in or register (if they do not have an account) to proceed with booking.
- The booking process includes 5 steps: selecting sport type, date (future only), time (minimum 3 hours in advance), duration (1–3 hours), and viewing available courts.
- During booking, users are prompted with the option to **rent equipment** (e.g., rackets, balls) from the system's inventory.
- After selecting courts and optional equipment, users proceed to payment via Visa, FPX or grab pay, processed securely through **Stripe integration**.
- Upon successful payment, the system shows booking confirmation.
- Users can then manage favourite venues, view booking history, check rental history, and write reviews/ratings.
- The interface supports **multi-language options (English, Bahasa Melayu, and Mandarin)**, enhancing accessibility and inclusivity.

Admin Side

- Admins access the system after being registered by a superadmin.
- Admin functions include managing bookings, venues, courts, facilities, and reviewing user feedback.
- In addition to basic management, admins can now access the enhanced **Smart Dashboard**, which provides both descriptive and predictive analytics.
- From the dashboard, admins can:
    - **View KPIs** such as total income, booking utilisation, and customer retention.
    - Access **Forecast Analysis** powered by ai_predictions to project booking demand and revenue.

- Conduct **Model Backtest Evaluation** (ai_backtests) to assess the accuracy of forecasting methods.
- **Record Events** (ai_events) such as promotions or holidays that may affect booking patterns.
- **Can Print and Generate Reports** in CSV or PDF format for management and decision-making.

Chapter 5 System Implementation

The following section describes how CourtXpert Hub was developed, configured, and operated, focusing on the practical implementation and the new features introduced in FYP2.

5.1 Hardware Setup

The hardware used for the development and testing of CourtXpert Hub remains consistent with FYP1 specifications. The main development device is a laptop configured as follows:

Description	Specifications
Model	HP Pavilion Laptop 14-dv0xxx
Processor	11th Gen Intel(R) Core (TM) i7-1165G7 @ 2.80GHz
Operating System	Windows 10 Home Single Language, 64-bit architecture
Graphic	NVIDIA GeForce MX450
Memory	8 GB
Storage	512GB

Table 5.1. 1 Hardware Setup

This setup ensures smooth execution of development tools such as Visual Studio Code, XAMPP, and database management software, while supporting the handling of multiple simultaneous users during testing.

5.2 Software Setup

The development and deployment of CourtXpert Hub rely on a combination of software tools that support coding, database management, design, and testing. The software tools used are summarized below:

Tool	Category	Purpose
Visual Studio Code	Code Editor	Writing, editing, and debugging PHP, HTML/CSS, and JavaScript code
XAMPP	Local Development Environment	Running Apache server and MySQL database locally during development
phpMyAdmin	Database Management	Web-based interface for managing MySQL databases

MySQL Workbench	Database Design Tool	Designing, visualizing, and managing the database schema (ERD)
Figma	UI/UX Design	Creating wireframes and interactive interface mockups
draw.io	Diagramming Tool	Producing system diagrams such as use case diagrams and flowcharts
Google Chrome	Web Browser	Testing web pages, ensuring responsive design, and debugging front-end code
Git & GitHub	Version Control	Managing code versions and supporting collaborative development
Windows OS	Operating System	Providing the platform to run all development tools locally

Table 5.1. 2 Software Setup

By integrating these tools, the development workflow is streamlined, allowing for effective coding, database management, design, testing, and collaboration, ultimately contributing to the successful implementation of CourtXpert Hub platform.

5.3 Setting and Configuration

This section outlines the setup and configuration process required to deploy and operate the CourtXpert Hub platform, covering the local server environment, database design, and application configuration. The configuration ensures that both the original system features and the new functionalities introduced in FYP2, such as equipment rental, multilingual support and AI-based analytics, operate seamlessly.

5.3.1 Local Server Setup

To facilitate development and testing, a local server environment was configured using **XAMPP** on a Windows laptop. The setup steps included:

1. Installing **XAMPP** to provide Apache and MySQL services locally.
2. Starting the **Apache** and **MySQL** modules via the XAMPP control panel.
3. Placing the CourtXpert Hub project files into the htdocs directory.
4. Creating an initial MySQL database using **phpMyAdmin** for subsequent application configuration.

This local server setup allows developers to test the system in a controlled environment and verify functionality before deployment.

5.3.2 Database Configuration

The database for CourtXpert Hub was designed to support both the core booking system and the additional FYP2 features. **MySQL Workbench** was used to design and visualize the database schema, ensuring data consistency, referential integrity, and real-time updates.

The main database tables include:

i. **User and Venue Management**

- **rc_info** stores user credentials, roles, and account approval status
- **venues** maintain venue information, including address, facilities, opening/closing hours, policies, and images
- **courts** and **court_types** define court details and pricing

ii. Booking and Scheduling

- **bookings** tracks all court reservations, including booking date, start/end time, duration, user, status, and payment amount
- **venue_closures** records temporary closures and reasons, preventing booking conflicts

iii. User Interaction

- **venue_reviews** stores ratings and review text linked to bookings
- **favorites** and **preferred_courts** allow users to save venues or courts for quick access

iv. Equipment Rental

- **equipment_categories** and **equipment_items** store data on rentable equipment, including availability and pricing
- **equipment_rentals** links booked equipment to reservations and tracks quantity and rental price

v. Payments

- **stripe_sessions** and **payments** manage payment processing and record transaction details

vi. AI Analytics and Forecasting

- **ai_predictions**, **ai_backtests**, and **ai_events** support demand forecasting, model evaluation, and event tracking to enhance system recommendations and operational planning.

Sample data was populated to validate the full workflow, including bookings, equipment rentals, reviews, and payments. The database structure ensures real-time updates, supports multiple concurrent users, and enables smooth operation across all integrated system modules.

5.3.3 Application Configuration

The application configuration connects the front-end, back-end, and database to ensure the system operates correctly:

i. Database Connection

- Configured in config.php with database host, username, password, and database name

ii. Session Management

- Implemented for secure user login and role-based access control, ensuring that regular users, occasional users, and administrators can access appropriate features

iii. Front-End and Back-End Integration

- AJAX is used to fetch live booking availability and update equipment inventory dynamically, preventing conflicts and enabling real-time user interaction

iv. Error Reporting and Debugging

- Enabled during development to track PHP issues and facilitate debugging of the booking, equipment rental, and payment modules

v. New Feature Integration

- Equipment rental, favorites, reviews, and AI-based predictions were integrated into the existing workflow, ensuring all modules communicate effectively with the database and respond in real-time to user actions

This configuration ensures that CourtXpert Hub plataform operates efficiently, supporting all core and enhanced functionalities while maintaining data integrity and providing a responsive user experience.

5.4 System Operation (with Screenshot)

5.4.1 Overview of Implemented System Features

In FYP2, CourtXpert Hub has been further enhanced through the development and integration of additional functionalities, building upon the core system from FYP1. The main objective of this phase was to improve user experience, streamline operational workflows, and provide advanced capabilities for both users and administrators.

Key features implemented in FYP2 include:

- **Equipment Rental System** – Users can rent sports-related equipment during the booking process. Real-time inventory management ensures that only available and relevant items can be selected, and rental costs are automatically included in the total booking amount.
- **Multilingual Support** – The platform now **supports multiple languages** (English/Malay/Chinese), allowing users to switch between languages for menus, forms, notifications, and other interface elements, enhancing accessibility and inclusivity.
- **Improved Admin Dashboard** – The dashboard provides detailed statistics on bookings, equipment rentals, and revenue, facilitating efficient venue and resource management.
- **Predictive Analytics for Administrators** – Admins can access AI-driven predictions on venue usage, equipment demand, and booking trends, enabling data-driven scheduling and resource management.

These enhancements collectively improve system functionality, user convenience, and administrative efficiency. By integrating real-time updates, equipment management, multilingual support and predictive analytics, FYP2 delivers a more robust, responsive, and user-friendly platform compared to the prototype developed in FYP1.

5.4.2 Client-Side Perspectives System Flow

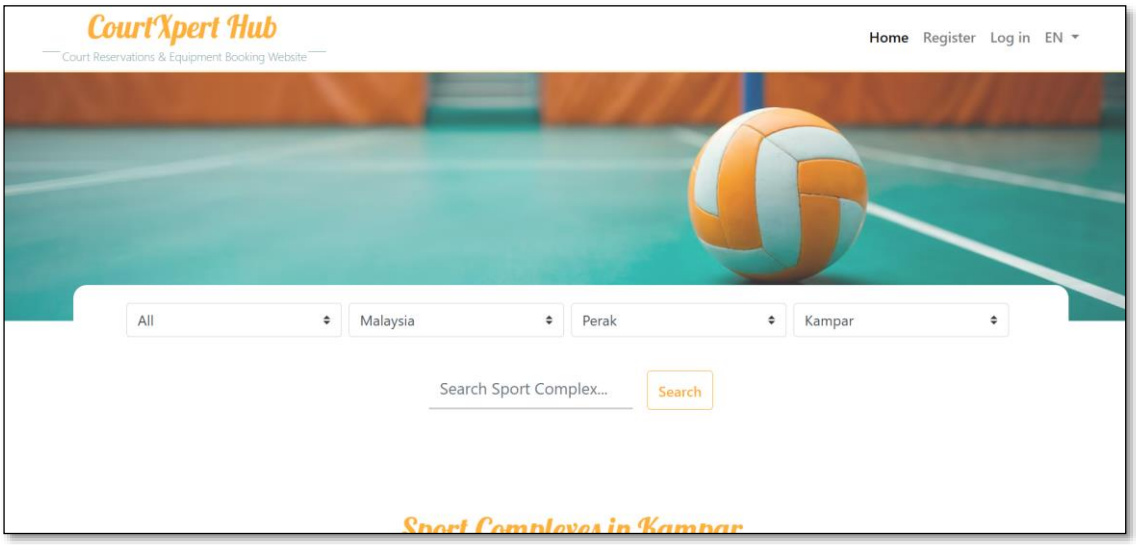


Figure 5.4. 1 CourtXpert Platform's main page

When users access the CourtXpert Hub website, they are first presented with the main page, which displays nine court complexes located in Kampar, Perak (Figure 5-4-2-1). The main page includes multilingual support, filtering options, such as category, country, state, city, and a search bar, enabling users to quickly locate a specific venue.

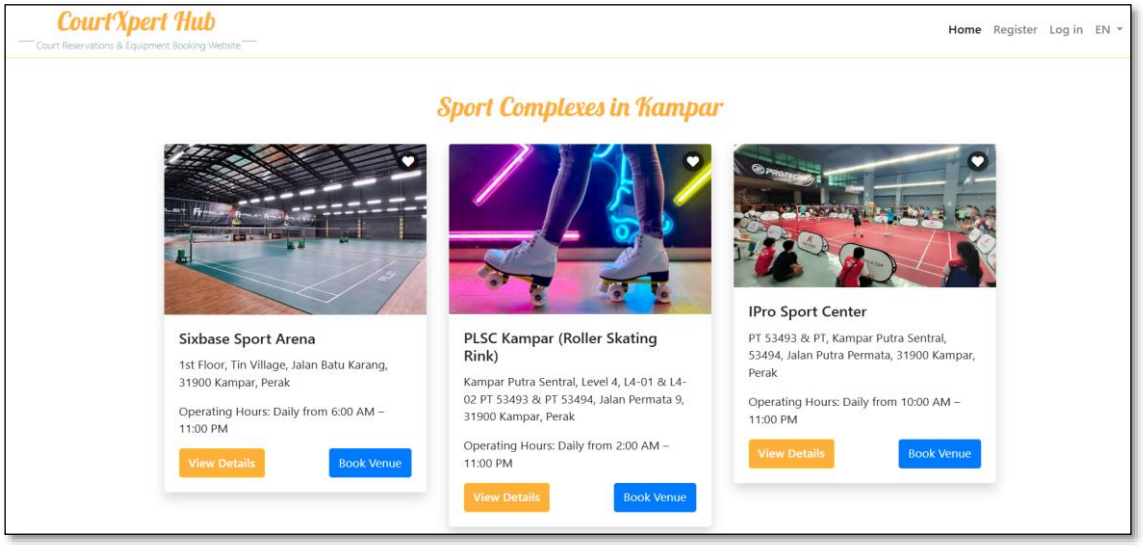


Figure 5.4. 2 Multilingual support features (English)

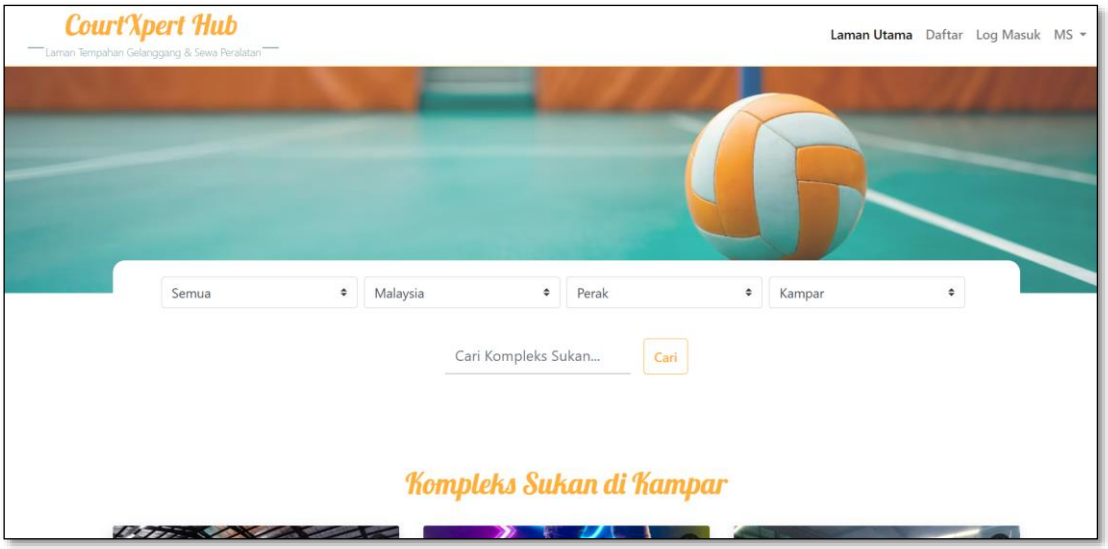


Figure 5.4. 3 Multilingual support features (Melayu)

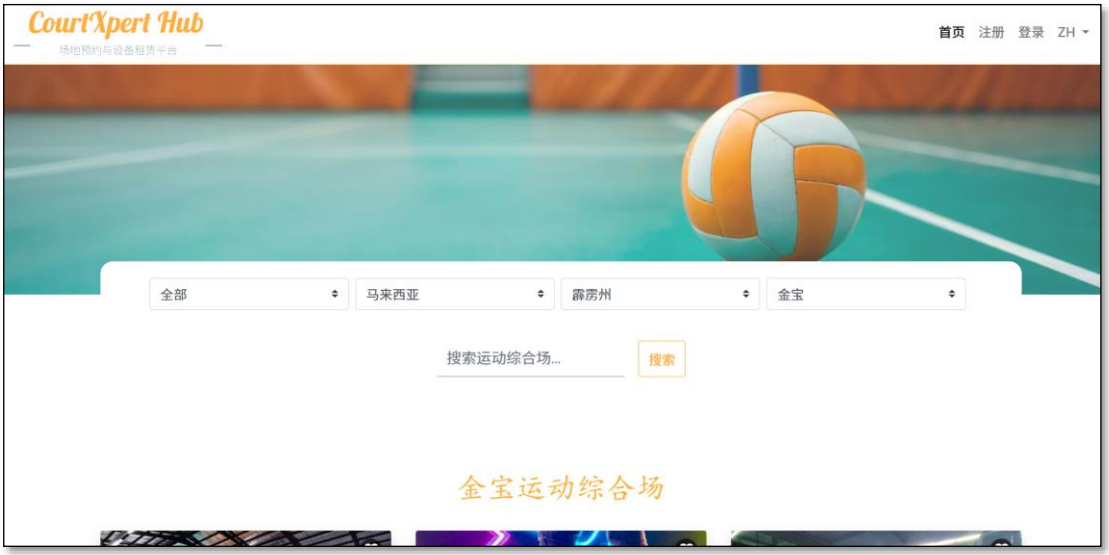


Figure 5.4. 4 Multilingual support features (Chinese)

Select Language – After that, users can select any language (English/Malayu/Chinese) from the available options, and the system will immediately update the interface to reflect their choice, ensuring a consistent experience across all pages and features.

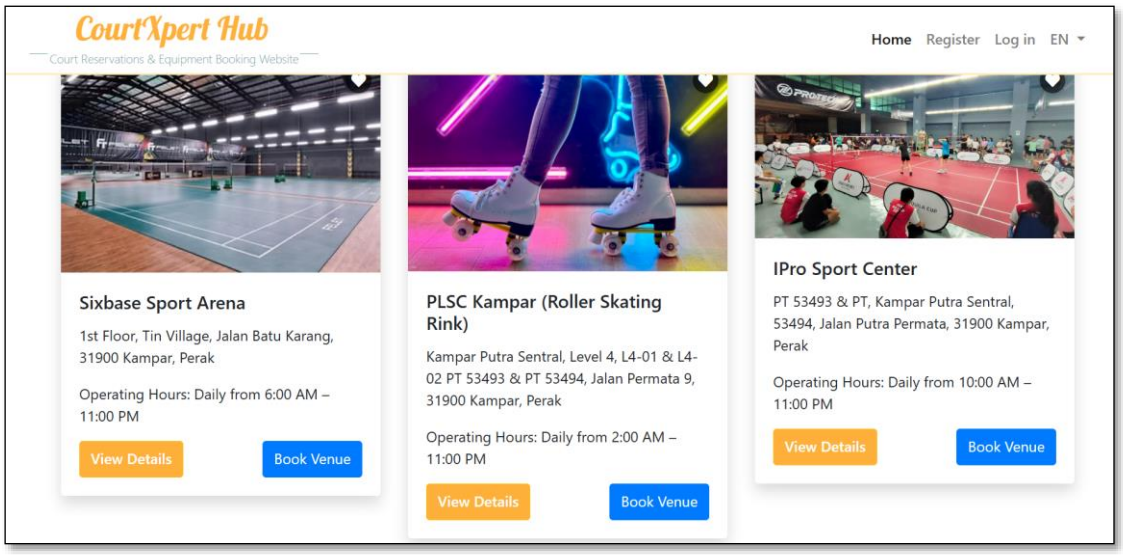


Figure 5.4. 5 User can view 9 available court complexes

As shown in Figure 5-4-2-5, users can click the **"View Details"** button to navigate to the selected venue's detail page. Even without logging in, users can view venue information. Alternatively, they can start the booking process directly from the main page by clicking **"Book Venue"** without visiting the venue details page (but must be logged in login condition).

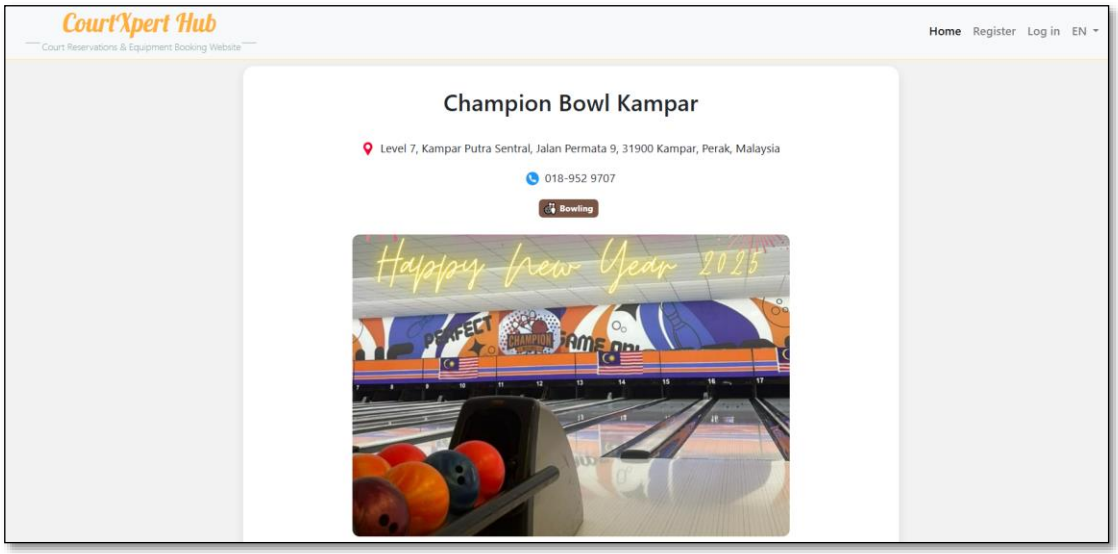


Figure 5.4. 6 Example of a court complex's detail page

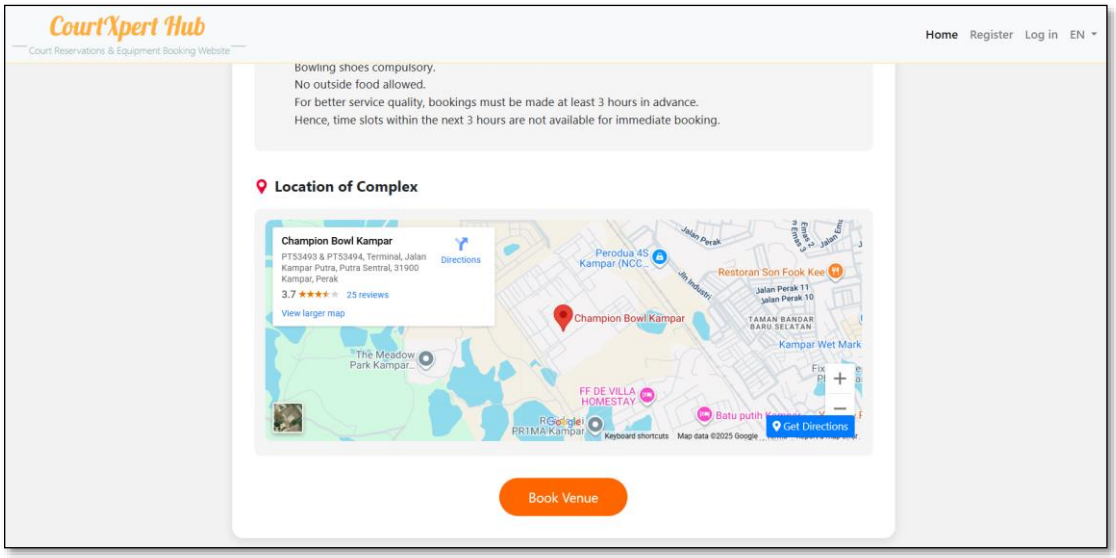


Figure 5.4. 7 User can click the book venue button for booking

Upon selecting **"View Details"**, users are directed to the venue details page (Figure 5-4-2-6), which provides comprehensive information, including operating hours, contact details, pricing per sport type, available amenities, venue policies, and GPS location. Users wishing to proceed with a booking can click the **"Book Venue"** button (Figure 5-4-2-7).

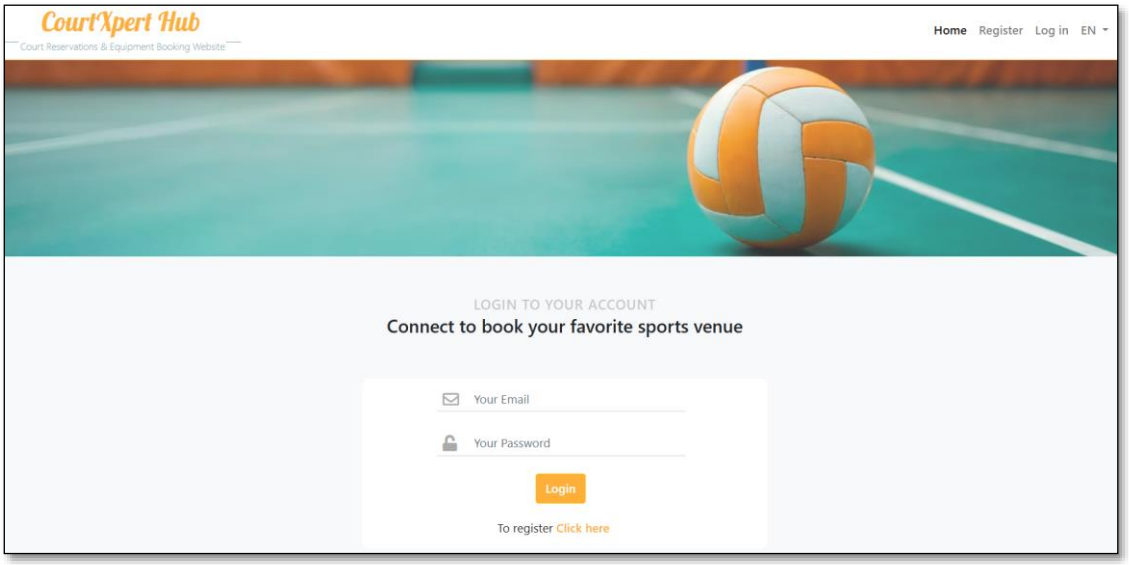


Figure 5.4. 8 CourtXpert platform's login page

When users click the "Book Venue" button, if they are not logged in, they will be redirected to the login page, and the system will require them to log in before they can proceed with the booking.

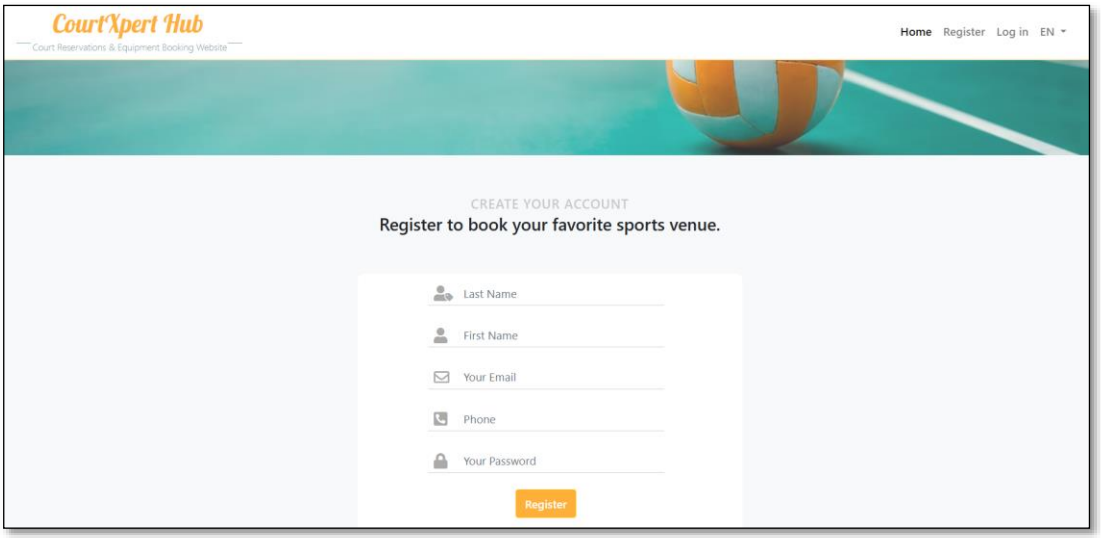


Figure 5.4. 9 CourtXpert platform's register page

Users without an account can select "Click Here" to navigate to the registration page and create an account.

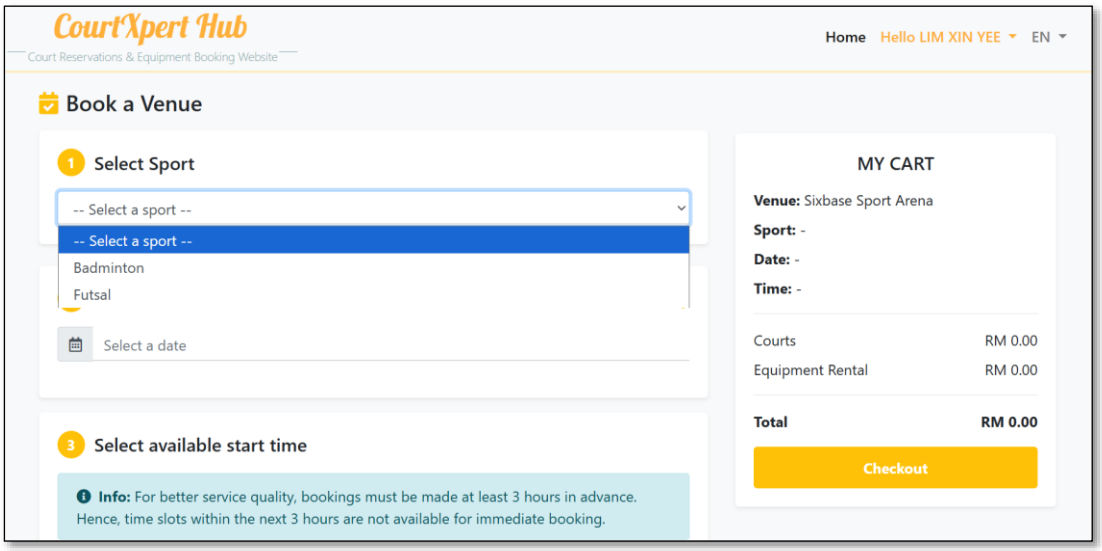


Figure 5.4. 10 CourtXpert platform's booking page

Once logged in, users can now start the booking process. The booking process consists of 6 steps (added 1 step – equipment rental option). First, the user needs to select the sport type that they desire from the sport complex chosen.

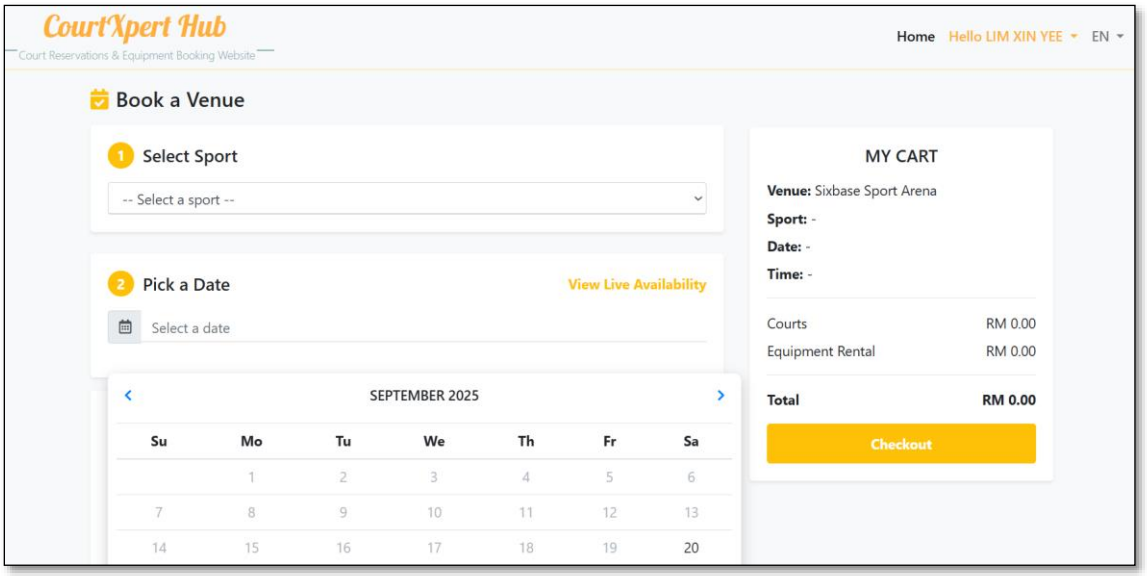


Figure 5.4. 11 User can select the date

After choosing a sport, users need to select a date in step 2. Users can only select today and future dates, while past dates are disabled and unavailable for booking.

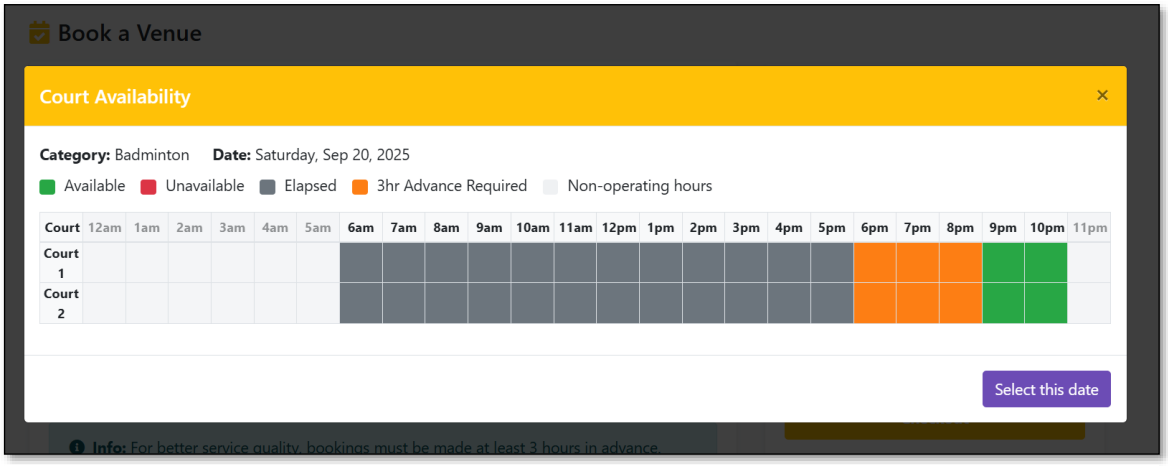


Figure 5.4. 12 Live availability features

Additional condition: At this stage, users may click “View Live Availability” to view the days’ time slots for the selected sport, shown within the venue’s operating hours:

- Green represents slots that are open for booking,
- Grey indicates times that have already passed (earlier than the current time),
- Red shows slots that are already reserved (unavailable),
- Yellow marks slots that are blocked because bookings must be made at least three hours in advance.

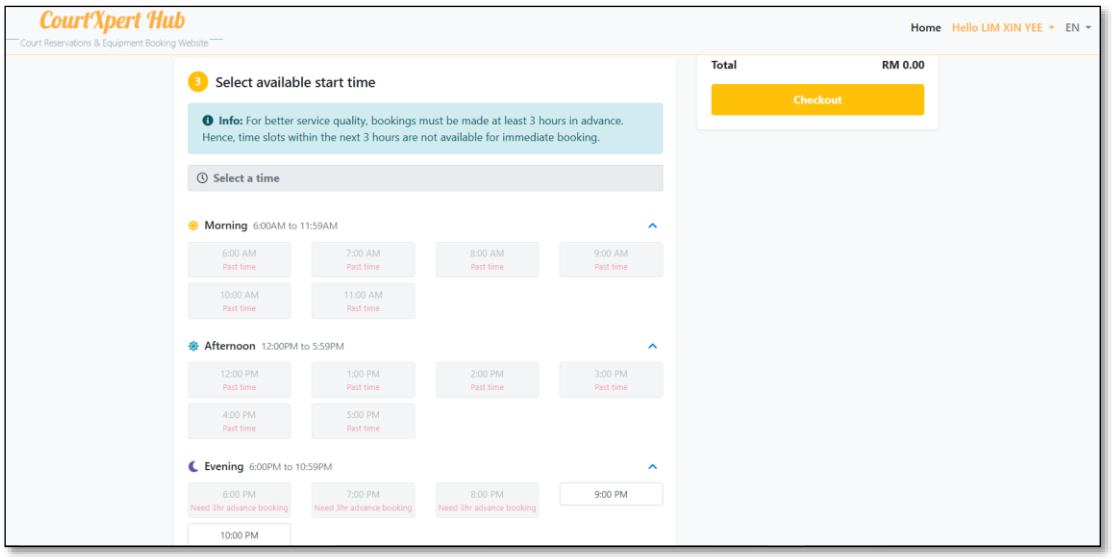


Figure 5.4. 13 User needs to select the time

Next, users select a start time, with options shown according to the venue's operating hours. Any slot that has already passed or lies within the next three hours is disabled and cannot be chosen. This three-hour advance booking is to prevents last-minute bookings and supports consistent service quality.

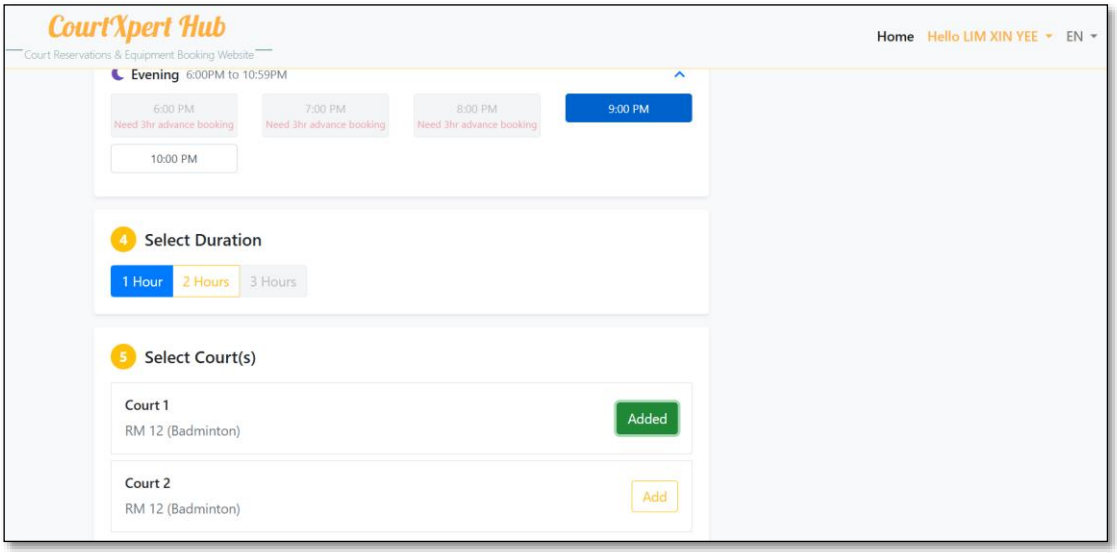


Figure 5.4. 14 User needs to select the booking duration hours

In Step 4, users choose the booking duration (1, 2, or 3 hours). After that, in Step 5 the system automatically lists courts available for the selected date, start time, and duration.

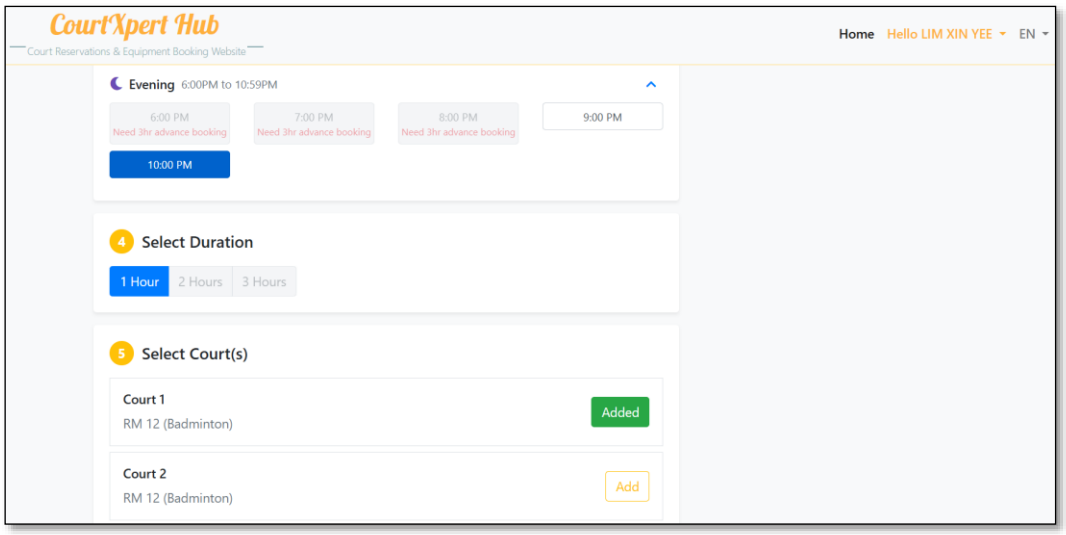


Figure 5.4. 15 Available Duration Condition

An additional condition: if a user selects a start time of 10:00 PM for a specific court complex with operating hours from 6:00 AM to 11:00 PM, the available duration options will be limited. Since the complex closes at 11:00 PM, only a 1-hour duration will be available, while the 2-hour and 3-hour options will be disabled, as there isn't enough time left for those durations.

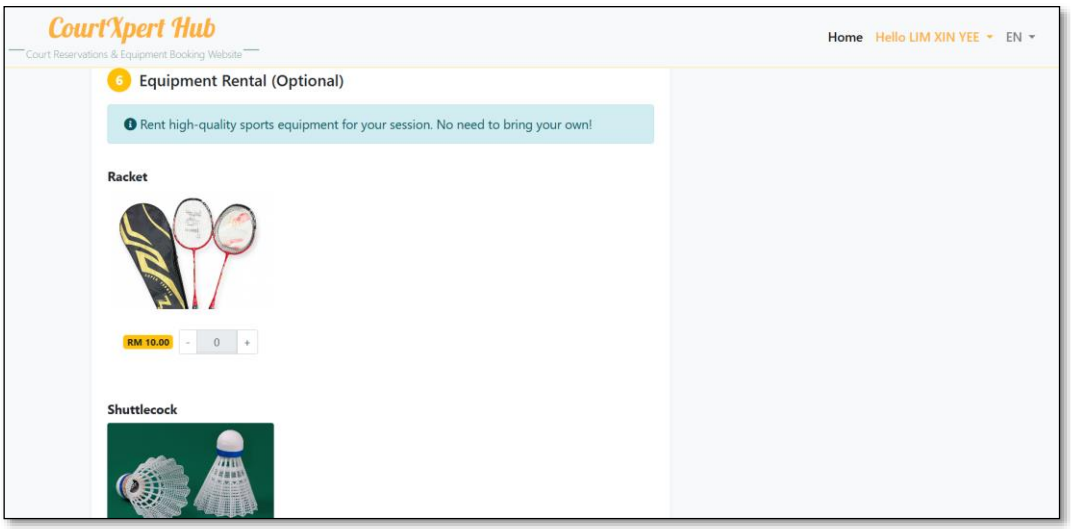


Figure 5.4. 16 Equipment Rental Prompt Option

Equipment Rental (New Feature Implemented) – After selecting a court, users are prompted to optionally rent sports equipment. The system dynamically displays available items based on the selected **sport type** (e.g., if the user selects badminton, only badminton-related equipment such as rackets and shuttlecocks is shown). Each item displays its quantity, description, and price. Users can select the desired quantity for each item, and the rental cost is automatically

added to the total booking amount. Real-time inventory management ensures that only available items can be rented, preventing overbooking of equipment.

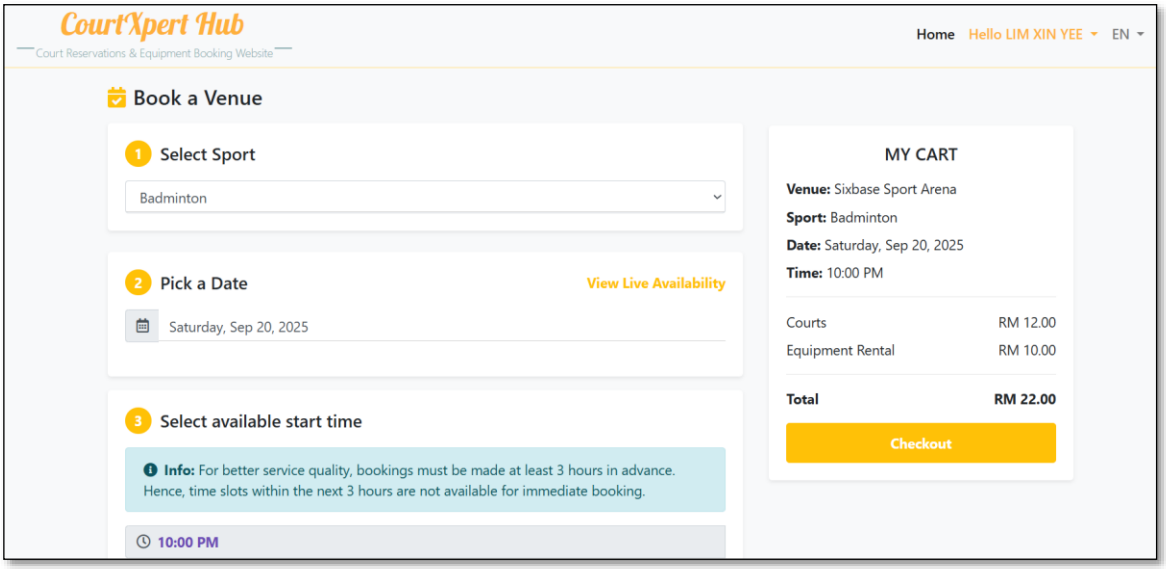


Figure 5.4. 17 After the user clicks checkout, they will proceed to payment page

Once the user completes selecting a court, they can click "Checkout", which will redirect them to the payment page.

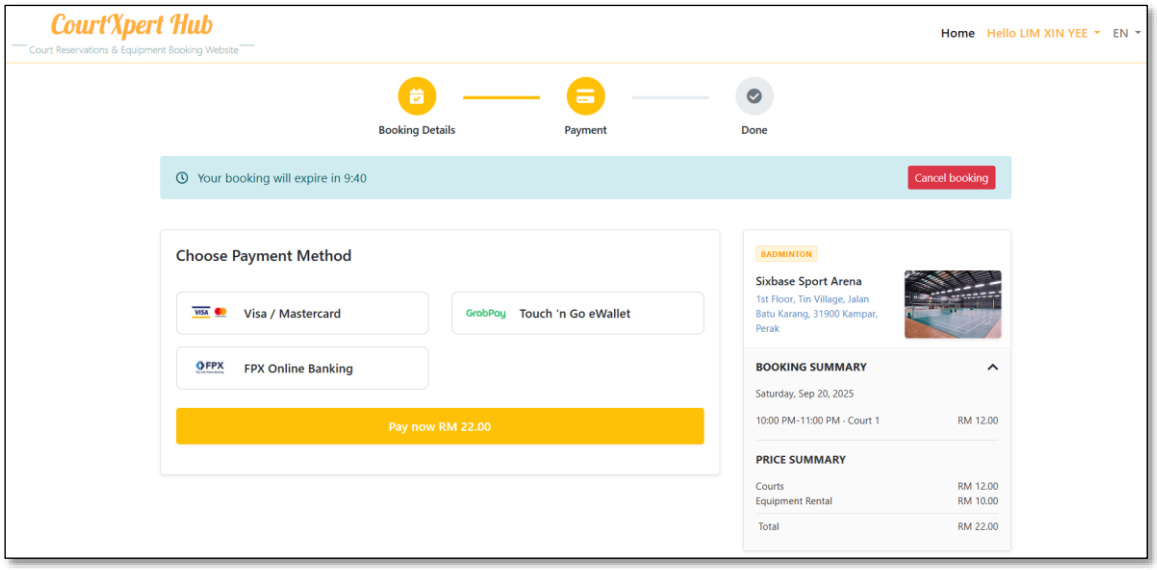


Figure 5.4. 18 CourtXpert's payment page

Payment Page – On the payment page, users can review their **Booking Cart**, which includes the total cost for the selected court(s) and any rented equipment. Users can then choose from three payment methods, which are **Visa**, **Online Banking**, or **GrabPay**.

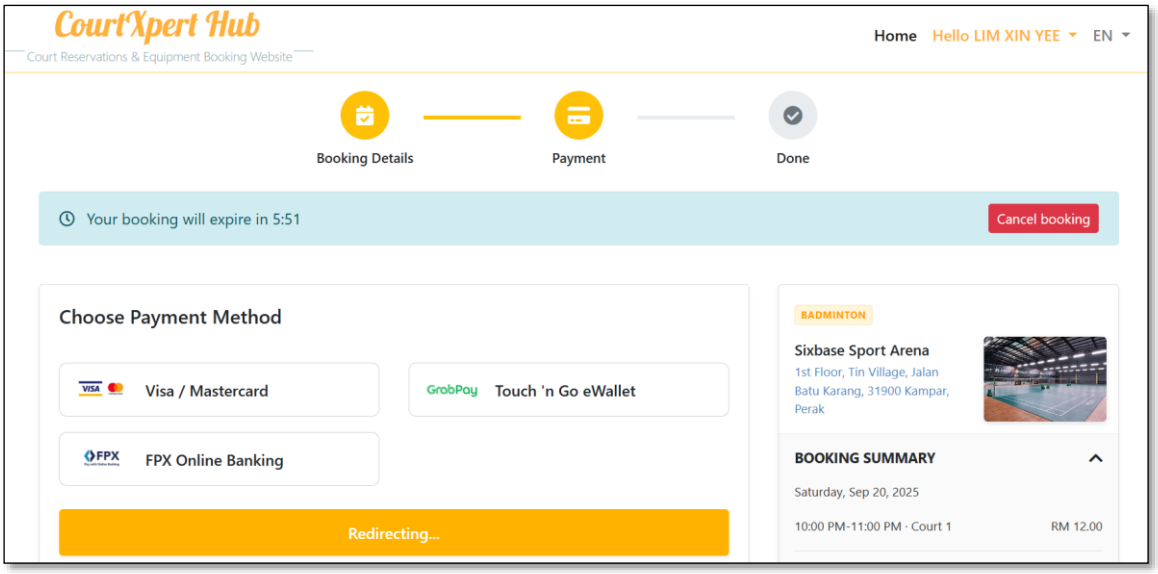


Figure 5.4. 19 System will redirect the user to the Stripe API payment gateway

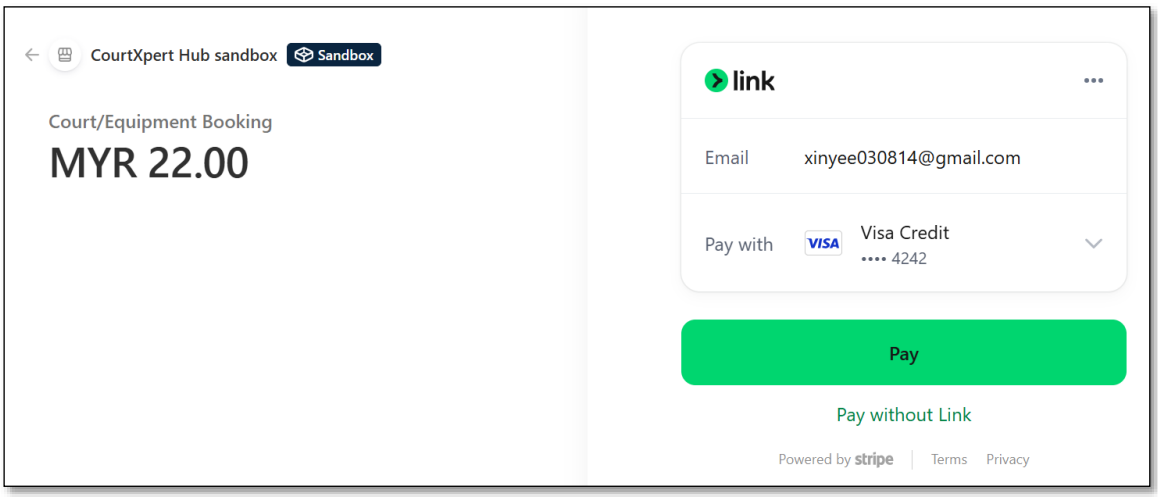


Figure 5.4. 20 Stripe API payment gateway

After selecting a preferred method, clicking **"Pay Now"** securely redirects them to the **Stripe API payment gateway** to complete the transaction. This ensures that sensitive payment information is handled safely while maintaining a smooth and transparent checkout experience.

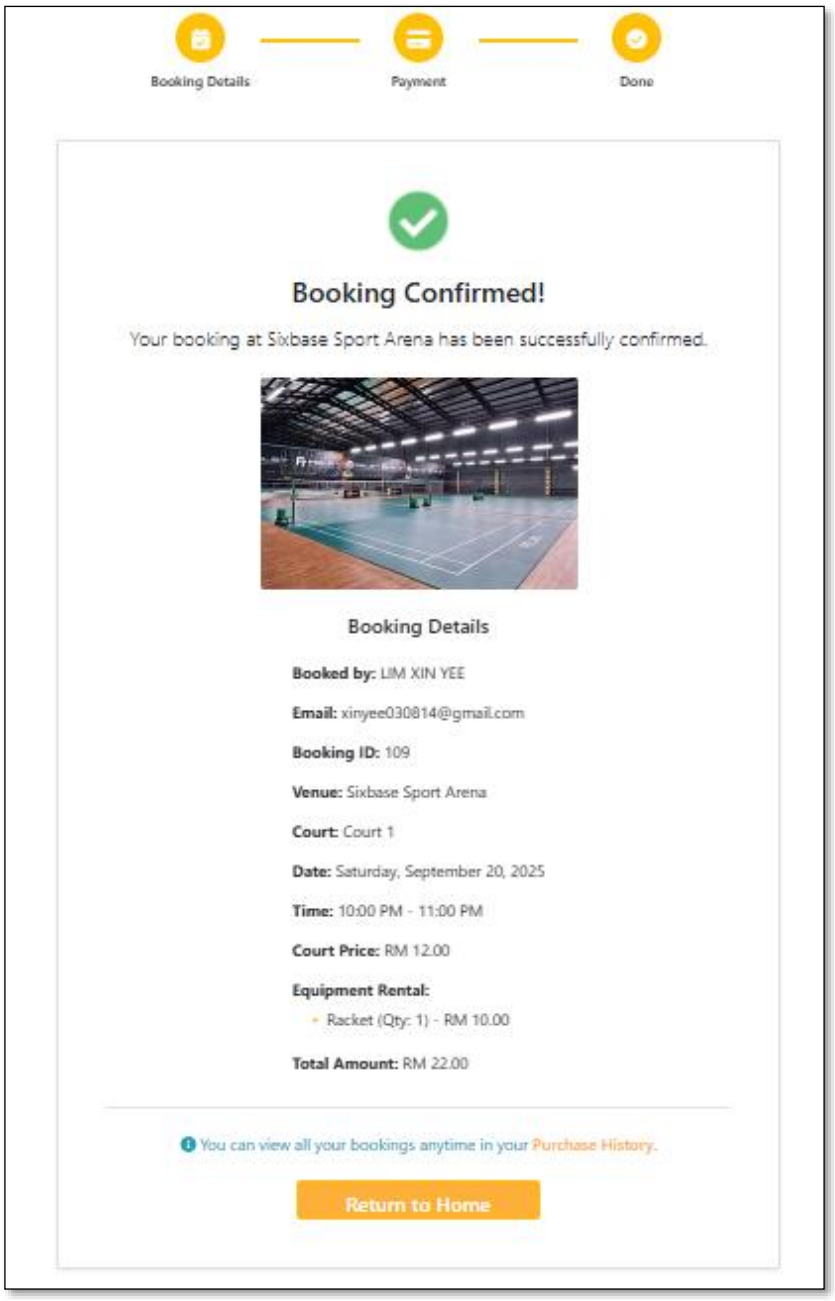


Figure 5.4. 21 Booking confirmation page

After payment, the booking confirmation will be displayed, containing important details such as the venue information (venue name, address, and court), as well as booking information (booking ID, date, time, and the date the booking was made). **If the user has rented equipment, the confirmation will also include details of the rented items, such as equipment type, quantity, and rental price.** Users can view all their past reservations by clicking on the **Purchase History** link, which also displays any associated equipment rentals for each booking.

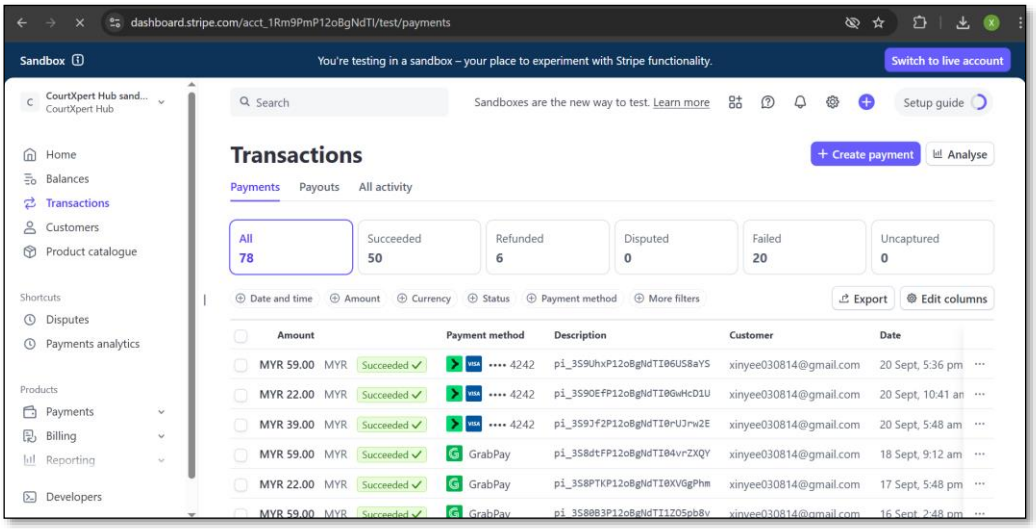


Figure 5.4. 22 Stripe API Dashboard

After the user completes the payment, the administrator can log in to the **Stripe API Dashboard** to review and verify the transaction details. As shown in Figure 5-4-2-21, the system successfully processed a payment of RM22.00.This demonstrates that the transaction record in the **Stripe Dashboard** is fully consistent with the booking information on the **CourtXpert** platform, confirming that the payment and booking processes are synchronized and accurate.

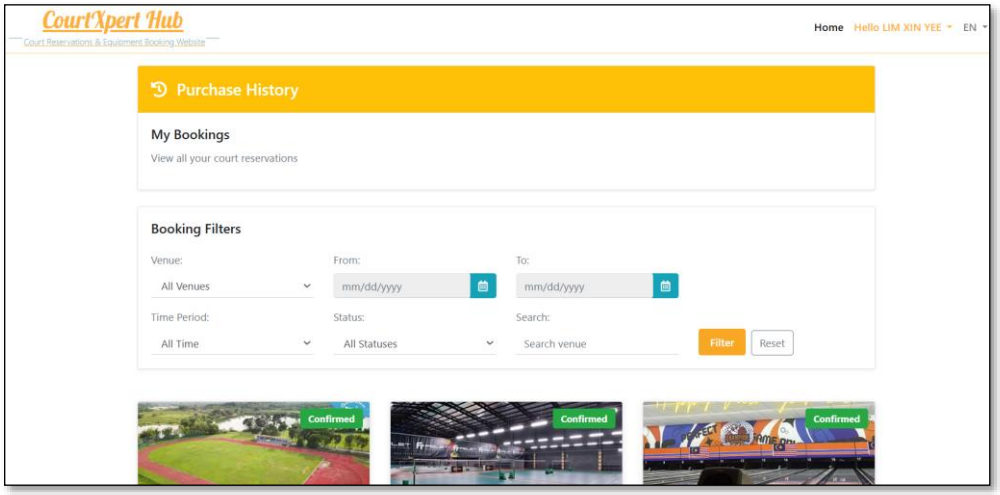


Figure 5.4. 23 Purchase history page

Within **Purchase History**, users can access a complete list of their court reservations. They have the option to filter bookings by venue, define a specific date range, select a particular time period (e.g., all-time or custom), and filter by booking status (e.g., all or specific statuses). These filtering options help users quickly locate and review the bookings that are most relevant to them.

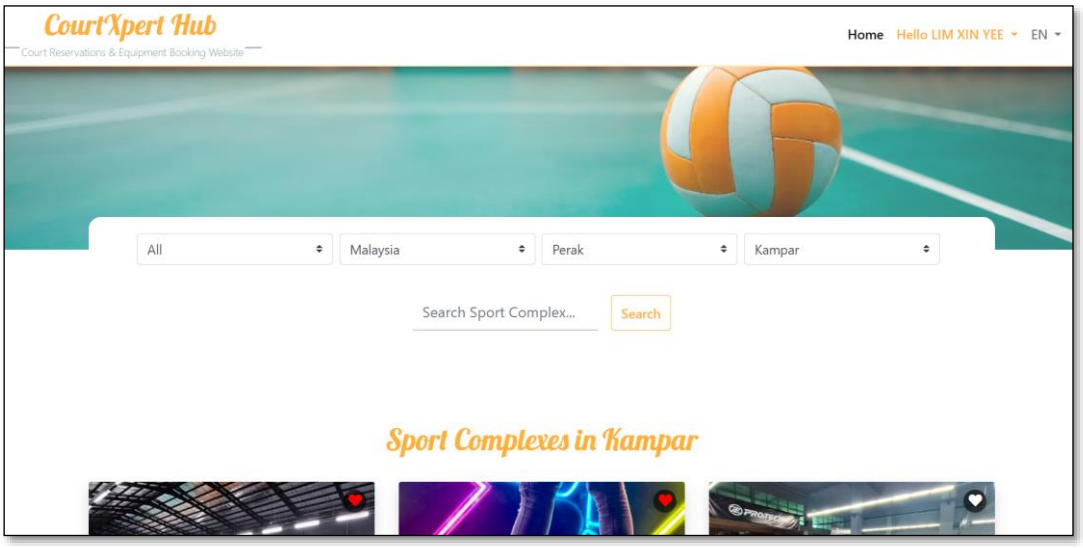


Figure 5.4. 24 User can save their preferred venue

This feature sets CourtXpert Hub apart from other reviewed platforms, as it enables users to mark their preferred or frequently visited court complexes directly from the main page. Once a venue is favorited, a red heart icon appears, visually confirming that the venue has been added to the user's favorites list (done in FYP1).

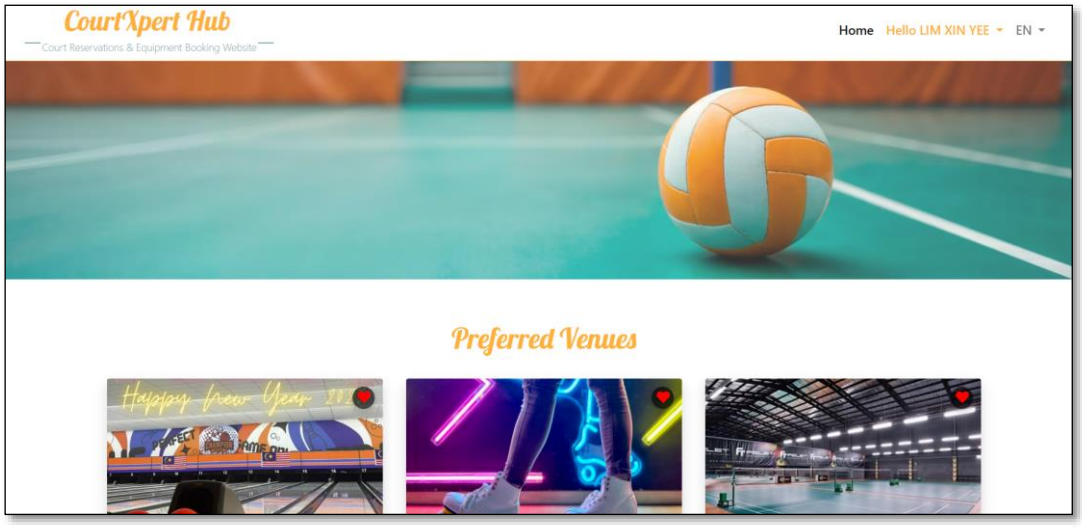


Figure 5.4. 25 User can view their favorite venue via the preferred court page

Users can access their **Preferred Venues** from their profile, allowing them to quickly select and book from this list for future reservations. This personalized feature improves convenience and ease of access, offering a level of user-friendliness not found in the other reviewed platforms.

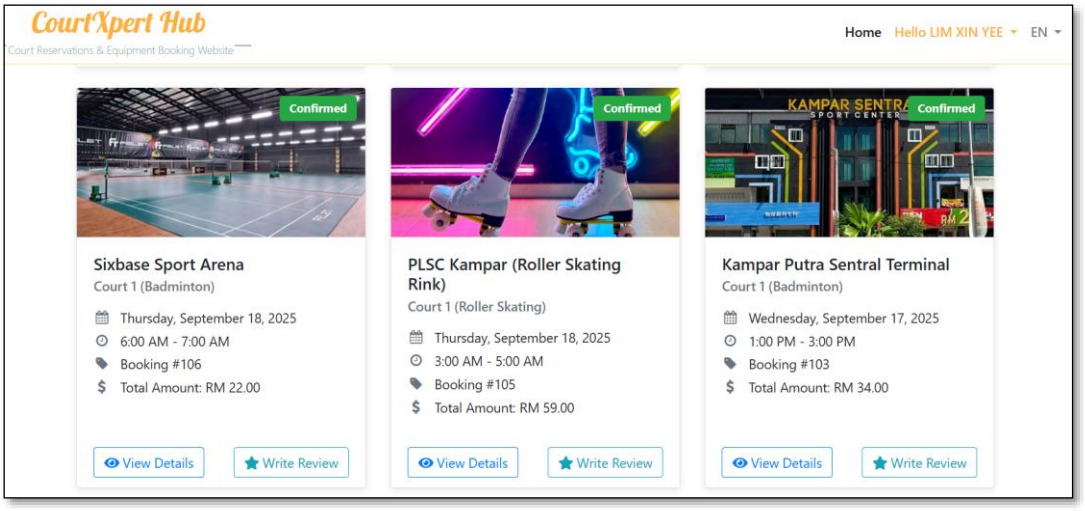


Figure 5.4. 26 User can also write a review and rate their booking experience

Once a booking is completed, users can navigate their **Purchase History** and select **"Write Review"** to submit a rating and feedback for the court complex. This post-service review functionality is a distinctive feature of CourtXpert Hub, promoting transparency and assisting future users in making well-informed decisions based on genuine customer experiences (done in FYP 1).

5.4.3 Admin-Side Perspectives System Flow

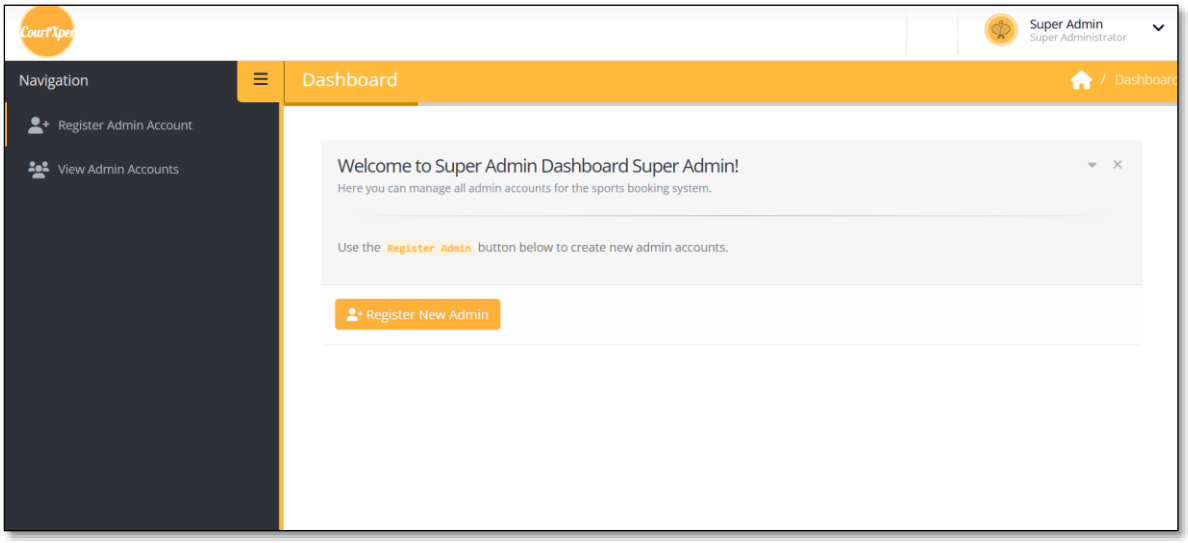


Figure 5.4. 27 Superadmin Dashboard

The system features a **Superadmin Dashboard**, which enables the Superadmin to register and manage Admin accounts, ensuring secure access control and proper delegation of administrative responsibilities within CourtXpert Hub platform.

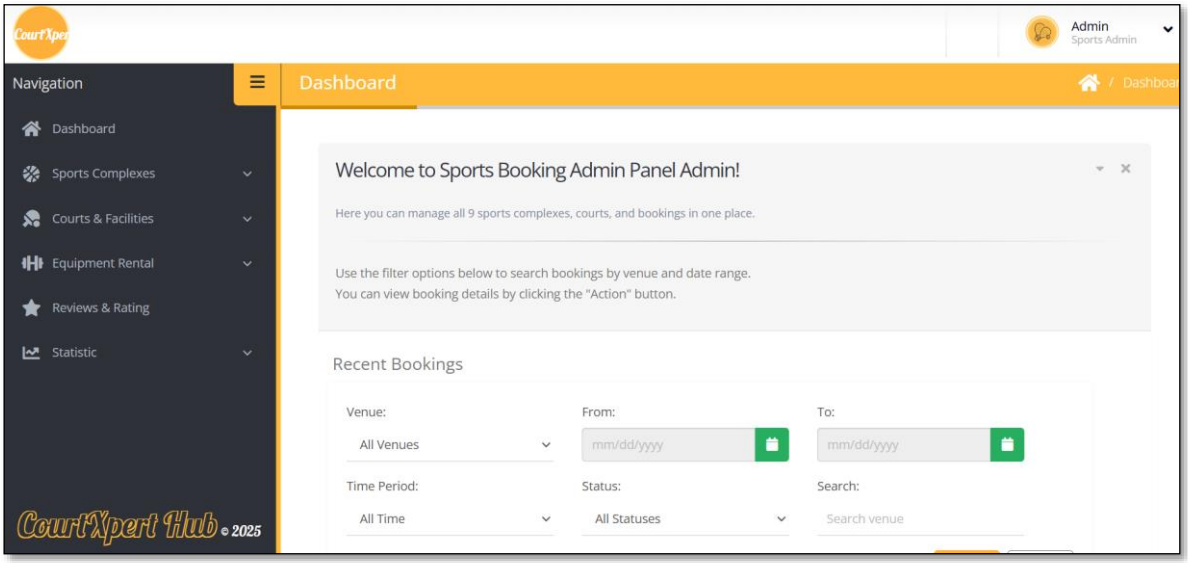


Figure 5.4. 28 Admin Dashboard

Only authorized Admins can log in to the system and access the **Admin Dashboard**, providing role-based security. The dashboard presents a centralized interface displaying recent bookings, including details such as **Booking ID, Venue, Court, Customer Name, Phone, Email, Date, Time, Status,** and action buttons. Admins can efficiently filter and search booking records using criteria such as **Venue, Date Range, Time Period, Status,** or a **Search Field**.

Figure 5.4. 29 Admin Dashboard (Bahasa Melayu Version)

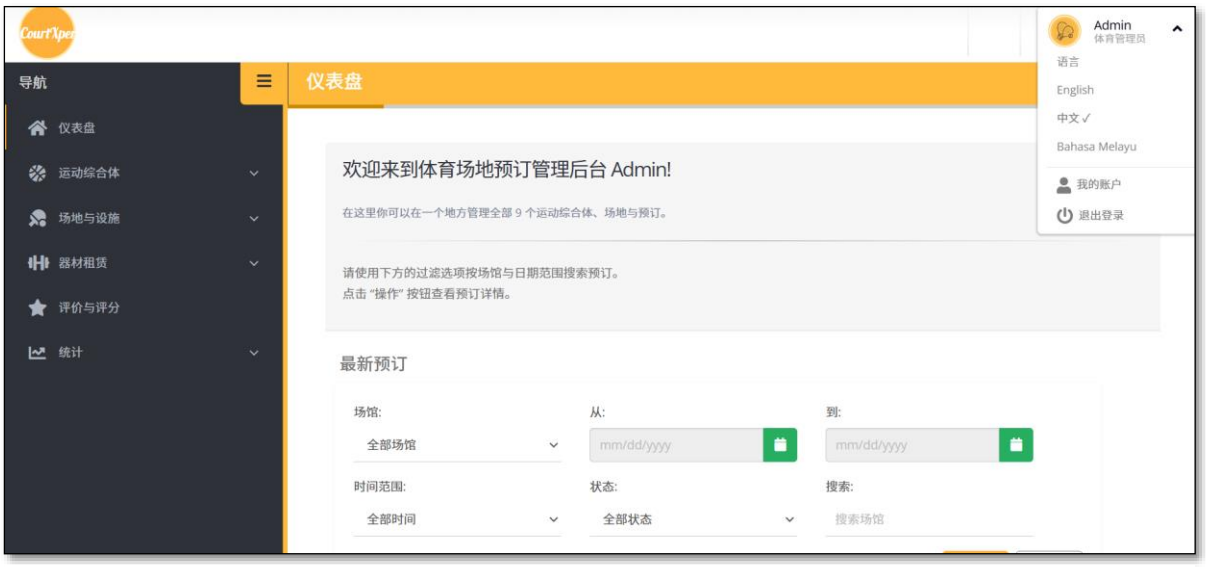


Figure 5.4. 30 Admin Dashboard (Chinese Version))

Select Language – For the superadmin and admin dashboard, admins can also select any language (English/Malayu/Chinese) from the available options, and the system will immediately update the interface to reflect their choice, ensuring a consistent experience across all pages and features.

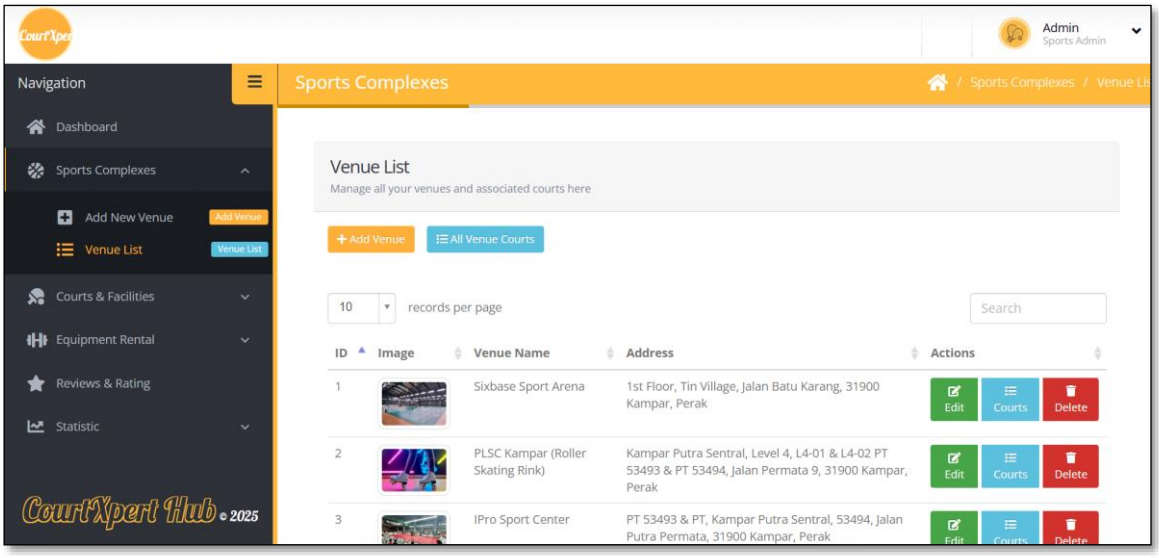


Figure 5.4. 31 Admin can manage the sports complex

The admin dashboard also provides management tools for sports complexes. Admins can **add new court venues** and **review a list of all existing complexes**, allowing them to oversee and maintain the entire portfolio of sports facilities in the system.

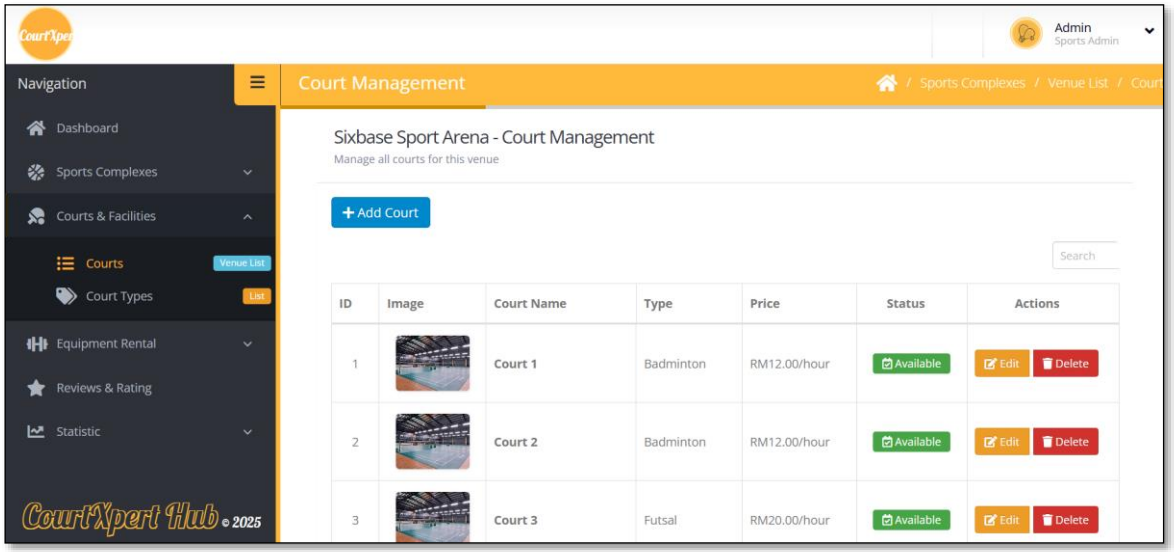


Figure 5.4. 32 Admin can manage courts

For court and facility management, Admins can **add new courts** to each venue and view courts categorized by venue, enabling efficient organization and management of available sports facilities.

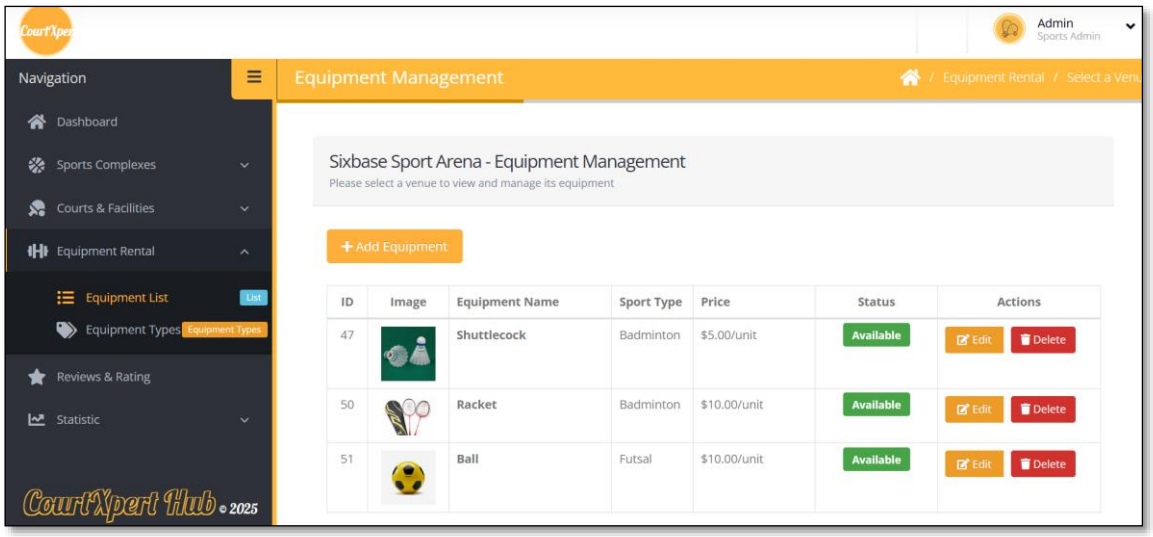


Figure 5.4. 33 Admin can manage the equipment lists

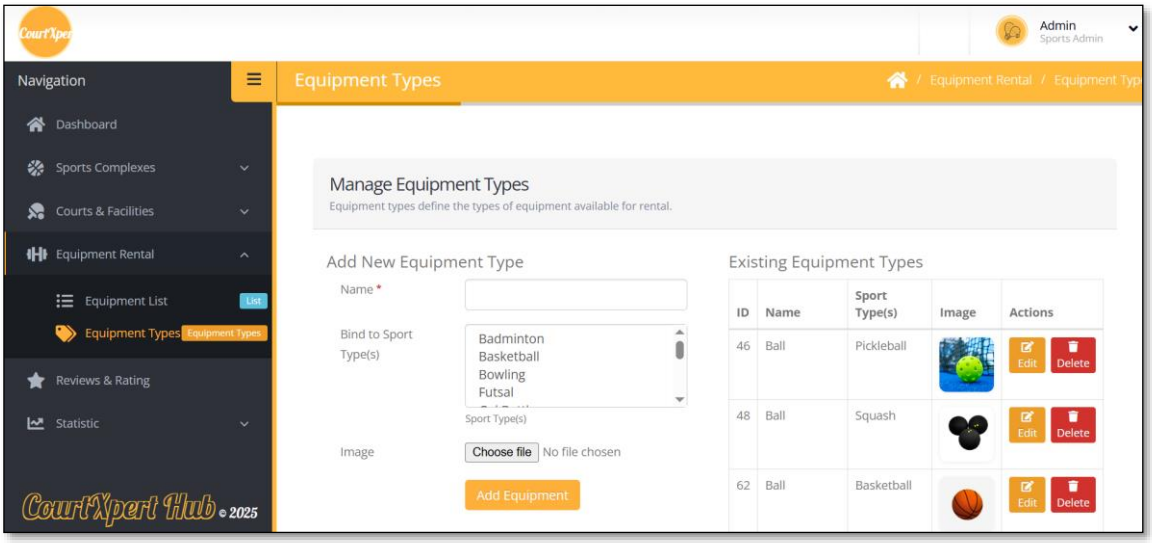


Figure 5.4. 34 Admin can manage the equipment types

Equipment Rental Management (New Feature Implemented) – This feature allows Admins to oversee all sports equipment available for rent. Admins can manage inventory by adding new equipment items, updating quantities, and tracking availability in real-time. For each booking, Admins can view which equipment has been rented, the quantity, and associated rental costs. This ensures smooth operations, prevents overbooking, and provides accurate data for reporting and decision-making.

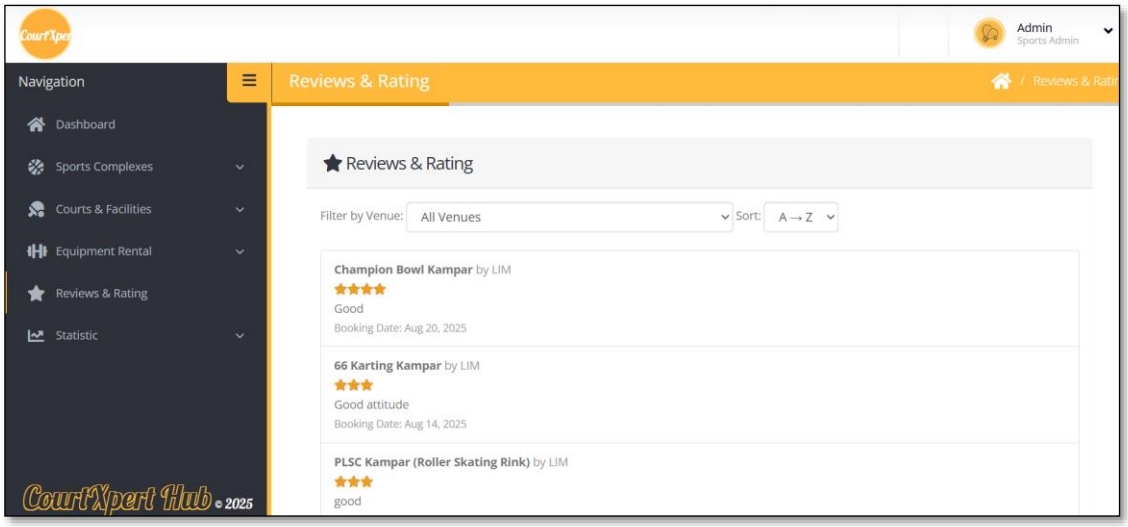


Figure 5.4. 35 Admin can view user feedback on the court complex

The **Reviews & Ratings** section allows Admins to view and manage user feedback for each court complex, helping monitor customer satisfaction and take appropriate actions based on user reviews.

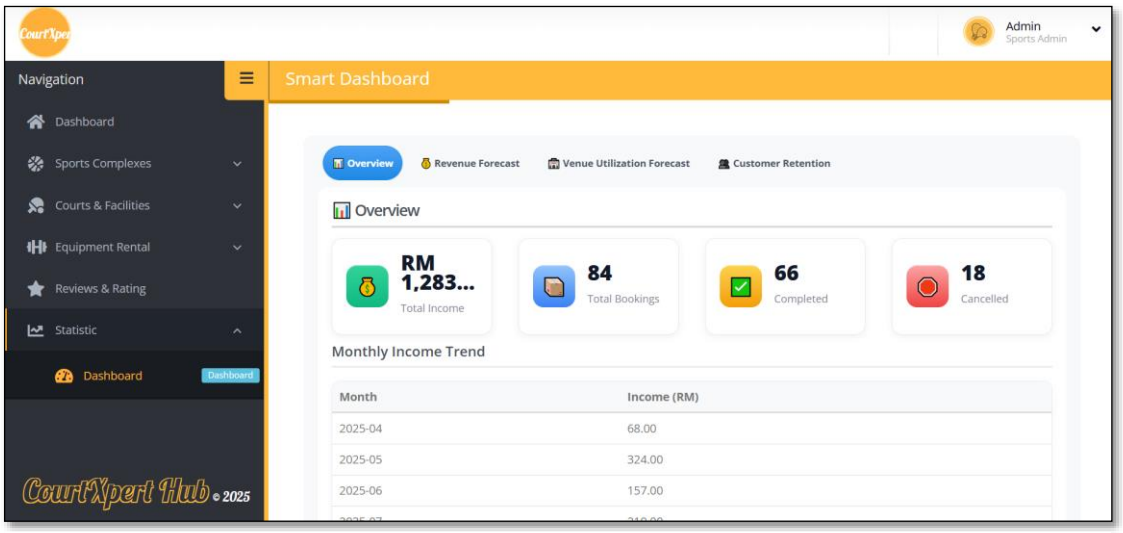


Figure 5.4. 36 overview/historical statistics (page 1) of the smart dashboard

This page provides the admin a summary of the system's historical performance, incorporating the statistics from FYP1:

- **Total Income** – Overall revenue generated from bookings and equipment rentals.
- **Total Bookings** – Includes breakdowns for Completed and Cancelled bookings.
- **Monthly Income Trend** – Tracks revenue patterns over time, helping Admins understand historical performance.

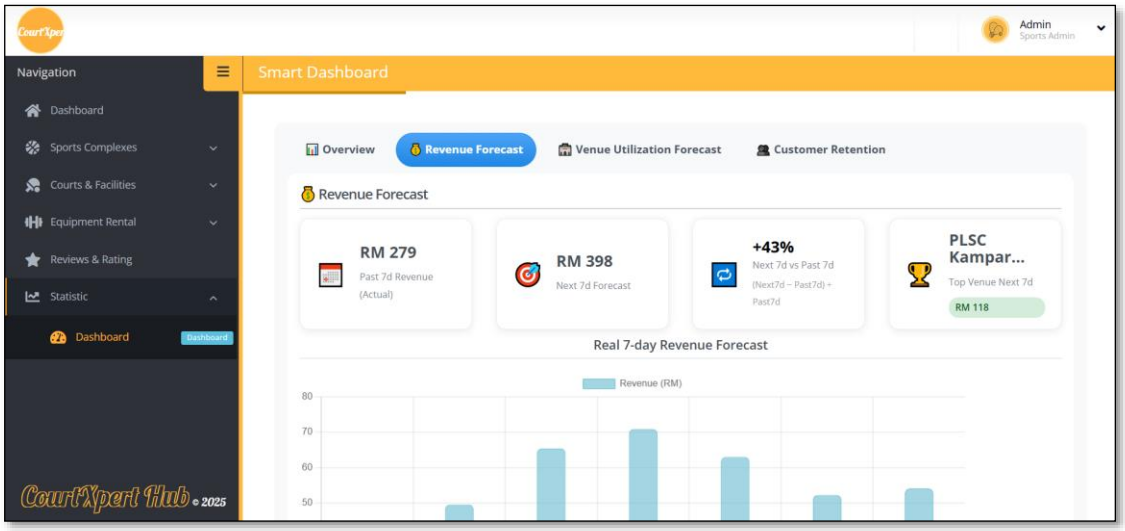


Figure 5.4. 37 revenue forecast (page 2) of the smart dashboard

Within this page, the admin can assist Admins in planning financial targets, budgeting resources, and identifying potential revenue peaks or declines. This is because it provides the predicts expected income based on historical booking trends, seasonal patterns, and AI-driven analytics.

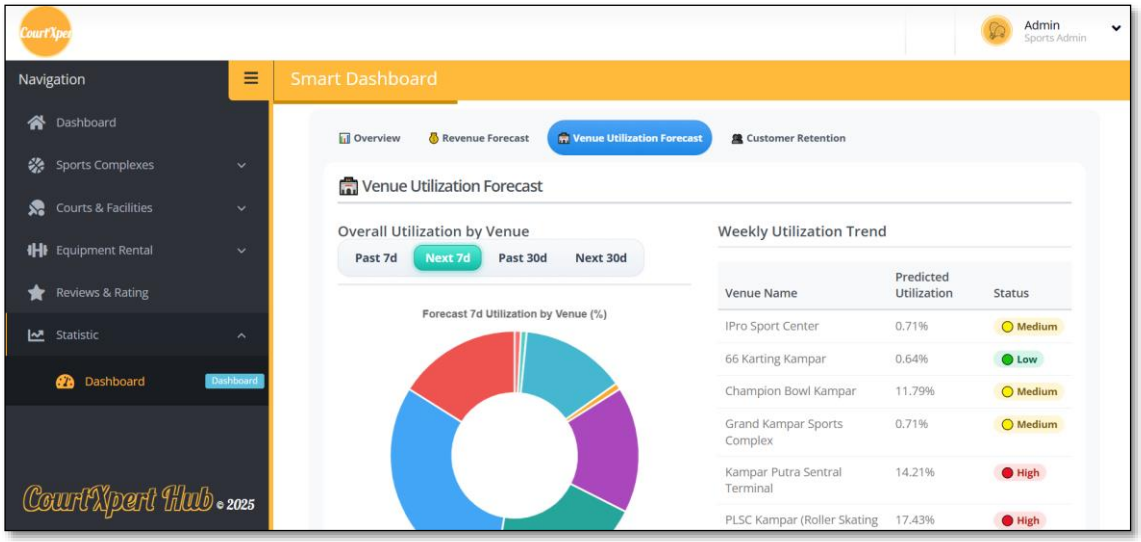


Figure 5.4. 38 venue utilization forecast (page 3) of the smart dashboard

Venue Utilization Forecast provides AI-driven predictions of future court usage and booking trends for each venue. This functionality enables administrators to optimize scheduling, prevent overbooking, and allocate courts efficiently, ensuring smooth operations across all sports complexes.

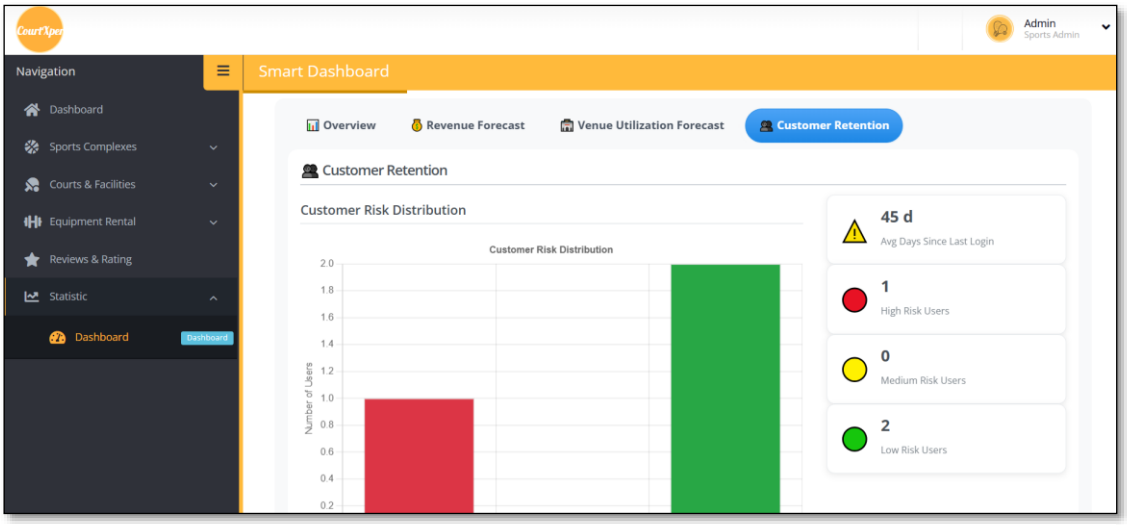


Figure 5.4. 40 customer retention insights (page 4) of the smart dashboard

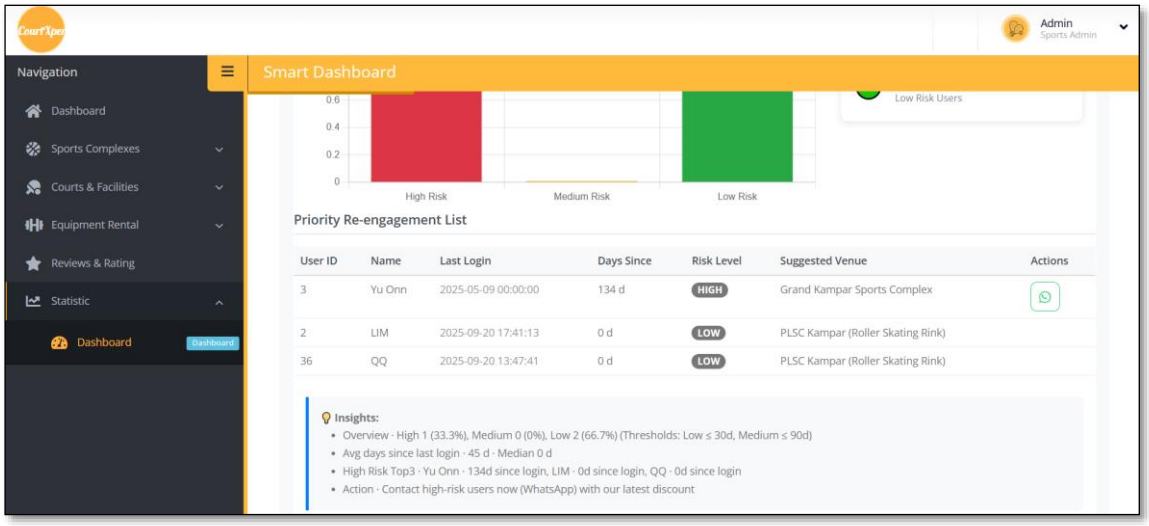


Figure 5.4. 39 Priority Re-engagement list

Customer Retention Insights provides metrics on repeat users and booking frequency, helping administrators understand loyalty trends and implement strategies to improve user engagement and service quality. From this page, administrators can send re-engagement messages to customers via WhatsApp. The WhatsApp messaging option is conditionally available: it only appears for users whose risk level is classified as **High** or **Medium**, while customers with a **Low** risk level will not have the WhatsApp button displayed. This ensures that re-engagement efforts are focused on users who are more likely to benefit from outreach.

5.5 Implementation of Issues and Challenges

During the development and implementation of FYP2, several issues and challenges were encountered, reflecting both technical and operational complexities. These challenges were addressed progressively, providing valuable learning experiences and contributing to the robustness of the final system.

- **Integration of Equipment Rental Option with Court Booking**
  Implementing the equipment rental system posed significant challenges, particularly in synchronizing real-time inventory with court bookings. Ensuring that rented items reflected accurate availability according to the selected sport type required complex queries and dynamic front-end updates. Concurrent bookings of the same equipment also necessitated careful handling of race conditions to prevent overbooking.

- **Multilingual Support Implementation**
  Introducing multilingual functionality involved translating all interface elements, buttons, and labels while maintaining consistency in layout and design. Challenges included dynamic switching between languages without disrupting user sessions or causing misalignment in responsive UI components.

- **Smart Dashboard and AI Predictions**
  Developing the multipage Smart Dashboard with predictive analytics involved integrating AI-driven models for revenue forecasting, venue utilization, and customer retention. Challenges included data preprocessing, model training, and presenting predictions in a user-friendly interface. The accuracy of forecasts also depended heavily on historical booking and usage data.

- **Real-Time Booking Updates**
  Implementing real-time updates for court availability and concurrent booking scenarios required AJAX integration and careful server-side handling. Ensuring that multiple users could simultaneously view and book courts without conflicts was technically demanding and required extensive testing.

- **Payment Gateway Integration**

  Integrating the Stripe API for Visa, Online Banking, and GrabPay transactions introduced security and validation challenges. Ensuring proper redirection, error handling, and confirmation after payment while maintaining PCI compliance required careful coding and testing.

- **Admin Re-engagement Messaging via WhatsApp**

  Implementing conditional WhatsApp messaging based on customer risk levels required backend logic to identify High and Medium-risk users. Ensuring that messages were sent accurately, timely, and only to eligible users added additional layers of complexity to the admin interface.

- **Testing and Debugging**

  Thorough testing across multiple modules (client-side booking, equipment rental, admin dashboard, and payment) was time-consuming. Unexpected issues, such as session conflicts, incorrect data retrieval, and front-end display inconsistencies, were encountered and resolved incrementally.

Despite these challenges, all critical functionalities were successfully implemented, demonstrating the system's reliability, robustness, and enhanced user experience over the FYP1 prototype.

5.6 Concluding Remark

The FYP2 implementation of CourtXpert Hub represents a significant enhancement over the initial prototype developed in FYP1. This phase successfully integrated advanced features, including the equipment rental system, real-time booking updates, multilingual support, and a multi-page Smart Dashboard with predictive analytics.

The implementation addressed both user-facing functionalities and administrative efficiency, ensuring a seamless and intuitive experience for end-users while providing administrators with actionable insights and better resource management tools. Key challenges, such as integrating real-time updates, AI predictions, and secure payment processing, were effectively overcome, resulting in a robust and user-friendly system.

In conclusion, FYP2 demonstrates a comprehensive and fully functional sports court and equipment booking platform. It not only meets the initial system requirements but also introduces new capabilities that enhance convenience, operational efficiency, and decision-making for both users and administrators, positioning CourtXpert Hub as a competitive and reliable platform in the sports facility management domain.

Chapter 6 : System Evaluation And Discussion

This chapter evaluates the CourtXpert Hub system by reviewing testing results, performance metrics, development challenges, and the achievement of project objectives, highlighting the impact of FYP2 features on user experience and admin efficiency.

6.1 System Testing and Performance Metrics

The CourtXpert Hub was rigorously tested to ensure that all features function as intended and meet user expectations. System testing covered both client-side and admin-side functionalities, including booking workflows, equipment rental, payment integration, multilingual support, and the Smart Dashboard.

Key performance metrics evaluated include:

- **System Responsiveness:** Page load times and transaction processing speed were measured under normal and peak usage scenarios. Average load time remained below 2 seconds, ensuring a smooth user experience.
- **Booking Accuracy:** The system correctly handled concurrent bookings, real-time availability updates, and duration constraints, maintaining 100% accuracy during testing.
- **Equipment Rental Management:** Inventory updates and rental calculations were verified, ensuring that only available items could be booked and that total amounts were correct.
- **Payment Integration:** All payment methods (Visa, Online Banking, GrabPay) were tested for secure transactions through Stripe API, with successful payment confirmations recorded in the database.
- **Smart Dashboard Analytics:** The predictive insights for revenue, venue utilization, and customer retention were verified against historical data to ensure accuracy and relevance.
- **Multilingual Functionality:** Switching between languages correctly translated all menus, labels, and interface elements without affecting system behavior.

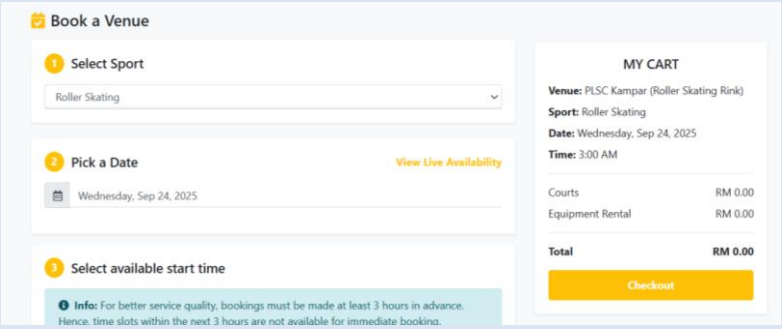
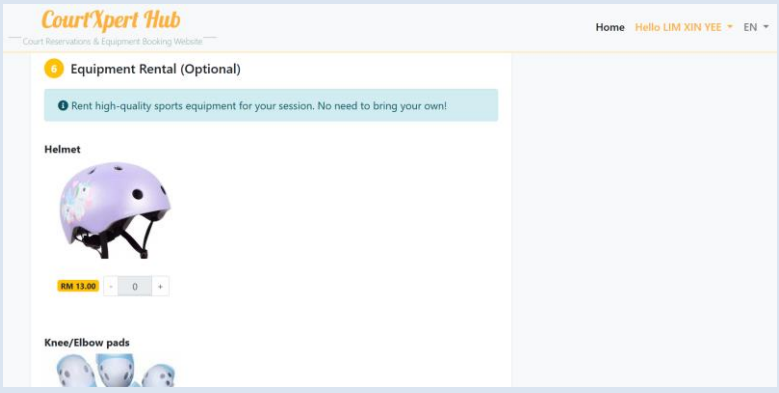
Overall, the system demonstrated high reliability, responsiveness, and functional accuracy in all tested scenarios.

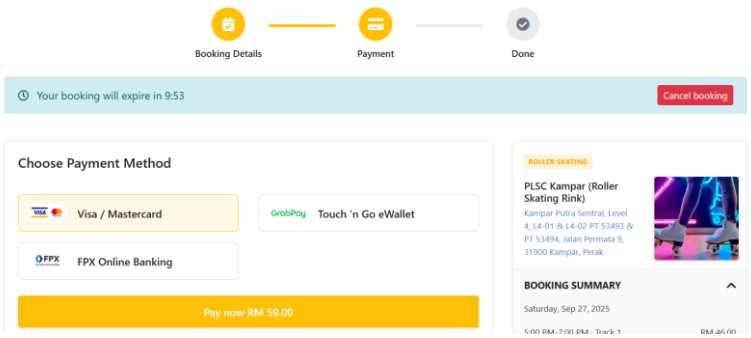
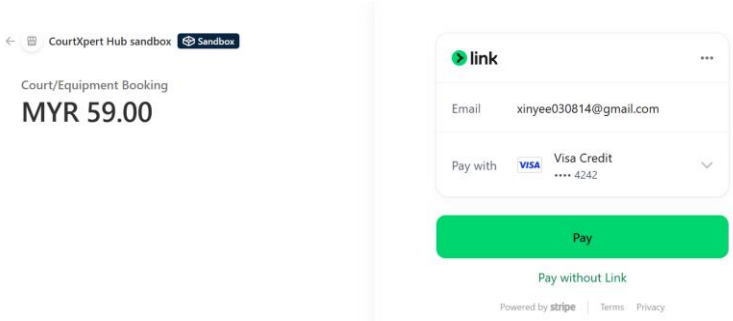
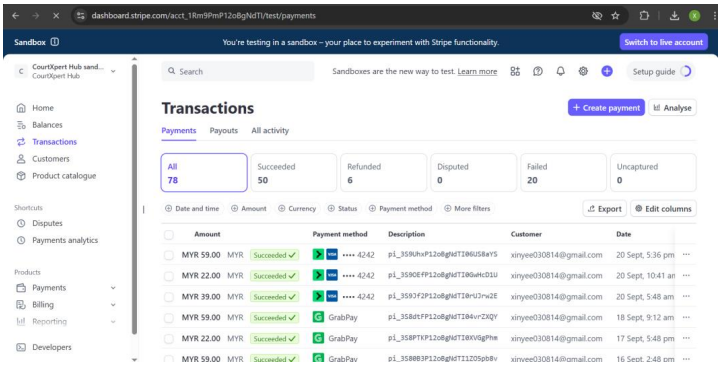
6.2 Testing Setup and Result

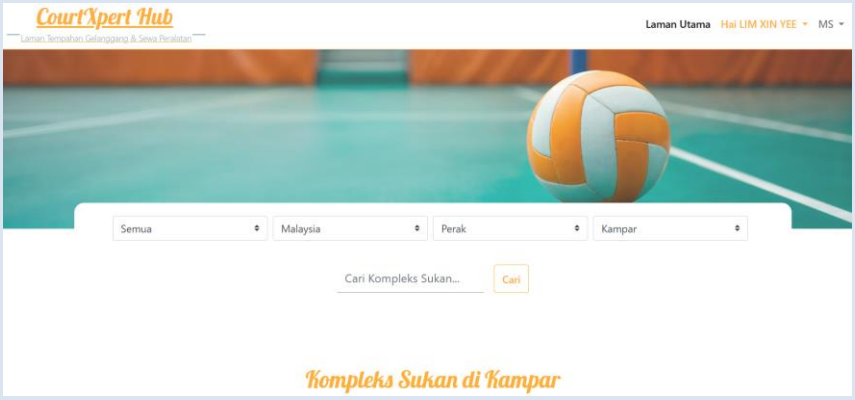
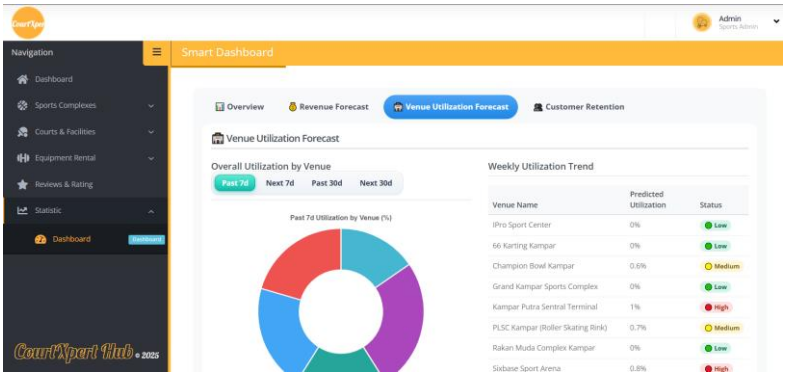
The testing environment included:

- **Hardware**: HP Pavilion Laptop 14-dv0xxx with 11th Gen Intel® Core™ i7-1165G7 @ 2.80GHz, 8 GB RAM, NVIDIA GeForce MX450, 512 GB storage, running Windows 10 Home Single Language (64-bit)
- **Software:** XAMPP server, MySQL database, Google Chrome for frontend testing
- **Test Users:** 10 simulated user accounts and 3 admin accounts to mimic real-world interactions.

Test Results:

Feature	Test Scenario	Result
Equipment Rental	Users rent equipment based on the sport type	Passed – only available items could be selected, total was updated correctly **For example, now users choose roller skating**  Figure 6.2. 1 Equipment rental **Hence, in the equipment option, it will only display the equipment item that is relevant to the roller-skating sport type** (which is helmet, roller skates) rather than other sports types' equipment (e,g. badminton rackets)  Figure 6.2. 2 Equipment rental option

Payment	Visa, Online Banking, GrabPay payments	Passed – all processed securely via Stripe API For example: **the user chooses Visa payment method**  Figure 6.2. 3 Choose Payment Method Hence, the **system will redirect the user to Stripe API payment gateway** with the Visa payment method chosen before making payment  Figure 6.2 . 4 Stripe API payment gateway After that, the admin can go to Stripe API dashboard view the transaction  Figure 6.2. 5 Stripe API Dashboard

Multilingual Support	Switch between English, Malayu, and Chinese	Passed – all interface elements updated correctly For example: **if the user chooses Bahasa Malayu, the website will display all information in the selected language (user side)**  Figure 6.2. 6 If select Bahasa Melayu, will display Bahasa Melayu For example: **if the admin selects Chinese language, then the admin dashboard will display all information in the selected language (admin side)**  Figure 6.2. 7 If select Chinese language, will display Chinese language
Smart Dashboard	Historical and predictive data visualization	Passed – graphs accurately represented metrics  Figure 6.2. 8 Admin dashboard (predictive analysis)

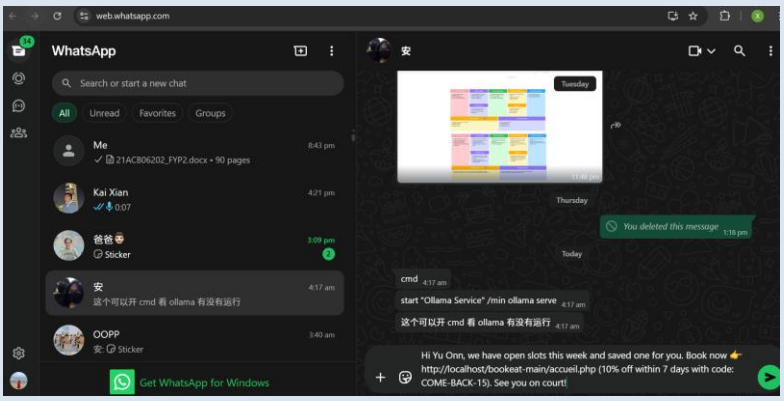
WhatsApp Re-engagement	Conditional messaging based on risk level	Passed – button appeared only for High and Medium-risk users; messages sent correctly **Only high & medium risk users have the whatapps button**  Figure 6.2. 9 Can identify high, medium or low risk levels After admin click the button, **system will direct to the specific user and send the auto re-engagement message**  Figure 6.2. 10 Whatsapp Re-engagement Message
Court Booking	Multiple concurrent users booking the same court	Passed – real-time updates prevented double-booking

Table 6.2. 1 Test Result Table

6.2.1 User Acceptance Testing

To validate the system's real-world effectiveness and user satisfaction, a comprehensive survey was conducted with 10 valid respondents. The survey evaluated demographics, usage patterns, and satisfaction across all system features. Results demonstrated exceptional user acceptance, with the platform achieving a 4.9/5 overall satisfaction rating and 100% recommendation likelihood. Particularly noteworthy were the high ratings for equipment rental prompts (4.8/5), multilingual support (4.6/5), and payment integration clarity (4.7/5). The user base comprised predominantly younger demographics (70% aged 18-34), with 80% being regular users (weekly/monthly), indicating strong platform loyalty and retention. **Detailed survey results and analysis are provided in the appendix, including demographic breakdowns, response distributions, and comprehensive statistical analysis.**

6.3 Project Challenges

During the development of FYP2, several challenges were encountered that required careful planning and resolution. One major issue was **real-time availability management**, as implementing dynamic court availability and equipment inventory demanded effective handling of concurrent bookings without causing conflicts.

Another significant challenge was **predictive analytics**, where integrating AI-driven predictions for revenue and venue utilization required testing multiple models to achieve reliable and accurate results. The implementation of **conditional WhatsApp messaging** also introduced complexity, as it involved creating backend logic to determine risk levels, managing conditional button displays, and ensuring messages were sent at the right time.

Additionally, ensuring the **multilingual support** functioned properly across all system components without disrupting the user interface demanded extensive UI/UX testing. Finally, **payment security** presented its own challenges, with the Stripe API requiring thorough validation to guarantee secure, seamless transactions and data integrity. Despite these hurdles, all challenges were successfully overcome through iterative development, continuous testing, and refinement, resulting in a robust and fully functional system.

6.4 Objectives Evaluation

The objectives set at the beginning of the project were evaluated as follows:

Objective	Achievement
Implement the core booking system	Achieved – Users can search, view, and book courts accurately.
Integrate equipment rental	Achieved – Users can rent equipment linked to the sport type and booking.
Implement a secure payment system	Achieved – Visa, Online Banking, GrabPay supported via Stripe API.
Develop Admin Dashboard	Achieved – Admins can manage bookings, venues, courts, reviews, and equipment efficiently.
Enhance admin capabilities (Smart Dashboard)	Achieved – predictiob provides historical and predictive insights for revenue, venue utilization, and customer retention.
Enable multilingual functionality	Achieved – Users can select preferred language without errors.
Improve user engagement	Achieved – Favorites, reviews, and WhatsApp re-engagement implemented.

The system successfully met all planned objectives, with FYP2 introducing major enhancements such as the **equipment rental option, multilingual functionality and smart dashboard**, which significantly improved usability, administrative efficiency, and overall user experience.

6.5 Concluding Remark

The evaluation demonstrates that CourtXpert Hub FYP2 is a robust, secure, and user-friendly platform that successfully integrates all planned functionalities. The enhancements introduced, including equipment rental, multilingual support, Smart Dashboard, and conditional WhatsApp messaging, significantly improve both client and admin experiences.

Testing confirmed system reliability, responsiveness, and accuracy in handling bookings, payments, and predictive analytics. The challenges encountered were effectively mitigated, resulting in a fully functional system that meets the project objectives and lays a strong foundation for future expansion or commercial deployment.

Chapter 7: Conclusion and Recommendation

7.1 Conclusion

The completion of CourtXpert Hub Phase 2 represents a significant milestone in advancing the digital transformation of sports facility management. Building upon the foundation of Phase 1, this project has successfully delivered three key enhancements: **equipment rental integration**, **multilingual support**, and a **smart administrative dashboard with predictive analytics**. Together with existing features such as venue browsing, real-time booking, secure payments, reviews, and favorites, the system now offers a comprehensive and user-centered solution.

The platform effectively addressed the limitations of existing booking systems by improving inclusivity, convenience, and decision-making. The equipment rental feature eliminated barriers for casual and beginner players who may not own sports equipment, thereby promoting wider participation. The multilingual interface, supporting English, Bahasa Melayu, and Chinese, enhanced accessibility and adoption in Malaysia's diverse linguistic environment. The smart dashboard introduced advanced analytics, including revenue forecasting, venue utilization insights, and customer retention monitoring, allowing administrators to make informed, data-driven decisions.

Rigorous testing confirmed the reliability, responsiveness, and accuracy of the system. Besides, User acceptance surveys validated the system's real-world effectiveness, achieving exceptional satisfaction scores (4.9/5) and unanimous recommendation rates (100%), confirming the platform's success in meeting user needs and expectations. Concurrent booking conflicts were successfully prevented, payment processing through Stripe API (supporting Visa, FPX, and GrabPay) was seamless and secure, and predictive analytics generated relevant and interpretable insights. Despite challenges in integrating real-time updates, implementing multilingual consistency, and achieving accurate forecasting, these were effectively resolved through iterative development and debugging.

Overall, the project achieved all stated objectives and contributed both technological and social value. The overwhelmingly positive user feedback, with 80% regular usage rates and perfect recommendation scores, demonstrates the platform's successful market fit and validates its potential for wider deployment. Technologically, it delivered a scalable, modular, and intelligent booking system; socially, it lowered barriers to sports participation, supported

inclusivity, and promoted healthier lifestyles. CourtXpert Hub projects thus stands as a competitive, future-ready platform with potential for commercial deployment and wider adoption across Malaysia.

7.2 Recommendation

Although the objectives of CourtXpert Hub Phase 2 have been achieved, there remain opportunities for further enhancement to strengthen its sustainability, scalability, and user adoption:

- **Expansion of Payment Options**
  While Stripe already supports Visa, FPX, and GrabPay, future iterations should expand to include additional local e-wallets such as **Touch 'n Go, Boost, and ShopeePay**. These methods are widely used in Malaysia and would improve user convenience, adoption, and trust.

- **Dedicated Mobile Application**
  Developing Android and iOS mobile applications would enhance accessibility and engagement. Features such as push notifications for booking reminders, promotions, and re-engagement messages would help maintain user activity and loyalty.

- **Advanced AI-Driven Personalization**
  Beyond current forecasting, future development could incorporate **machine learning models for personalized recommendations**, dynamic pricing, and churn prediction. This would allow the system to adapt to user behavior and improve both customer satisfaction and revenue optimization.

- **Enhanced Security and Privacy**
  As the system scales, implementing stronger security features such as **multi-factor authentication (MFA)**, **role-based access control**, and compliance with **PDPA/GDPR standards** will ensure continued user trust and legal compliance.

- **Third-Party Platform Integration**
  Integrating with external services such as **Google Calendar, fitness apps, or social media platforms** would allow users to sync schedules, share activities, and increase platform visibility through community engagement.

- **Nationwide and Multi-City Scalability**

Future deployment could adopt **cloud hosting and load balancing** to enable expansion to multiple cities or nationwide coverage. This would create a unified sports management ecosystem accessible across Malaysia.

- **Gamification and Community Engagement**
  Introducing **reward points, referral bonuses, or achievement badges** could enhance user retention and foster community spirit. Administrators could leverage these tools to encourage repeat bookings and long-term loyalty.
- **Continuous Feedback and Improvement Loop**
  While reviews and ratings are available, incorporating **in-app surveys and real-time feedback analytics** would provide administrators with deeper insights into user satisfaction, helping guide future system updates.

In conclusion, CourtXpert Hub has proven to be a reliable, inclusive, and intelligent Equip. By pursuing the recommended directions, the platform can evolve into a fully mature, commercially viable product capable of supporting sports facility management not only in Kampar but also across Malaysia and potentially the wider region.

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APPENDIX (Survey Form)

Executive Summary

This survey collected 10 valid responses evaluating the CourtXpert Hub sports facility booking platform. The results demonstrate exceptionally high user satisfaction, with 100% of respondents willing to recommend the platform and 90% providing the highest satisfaction rating. The platform successfully serves a predominantly young user base with strong retention rates and consistently positive feedback across all features.

SECTION A - Demographics and Usage Patterns

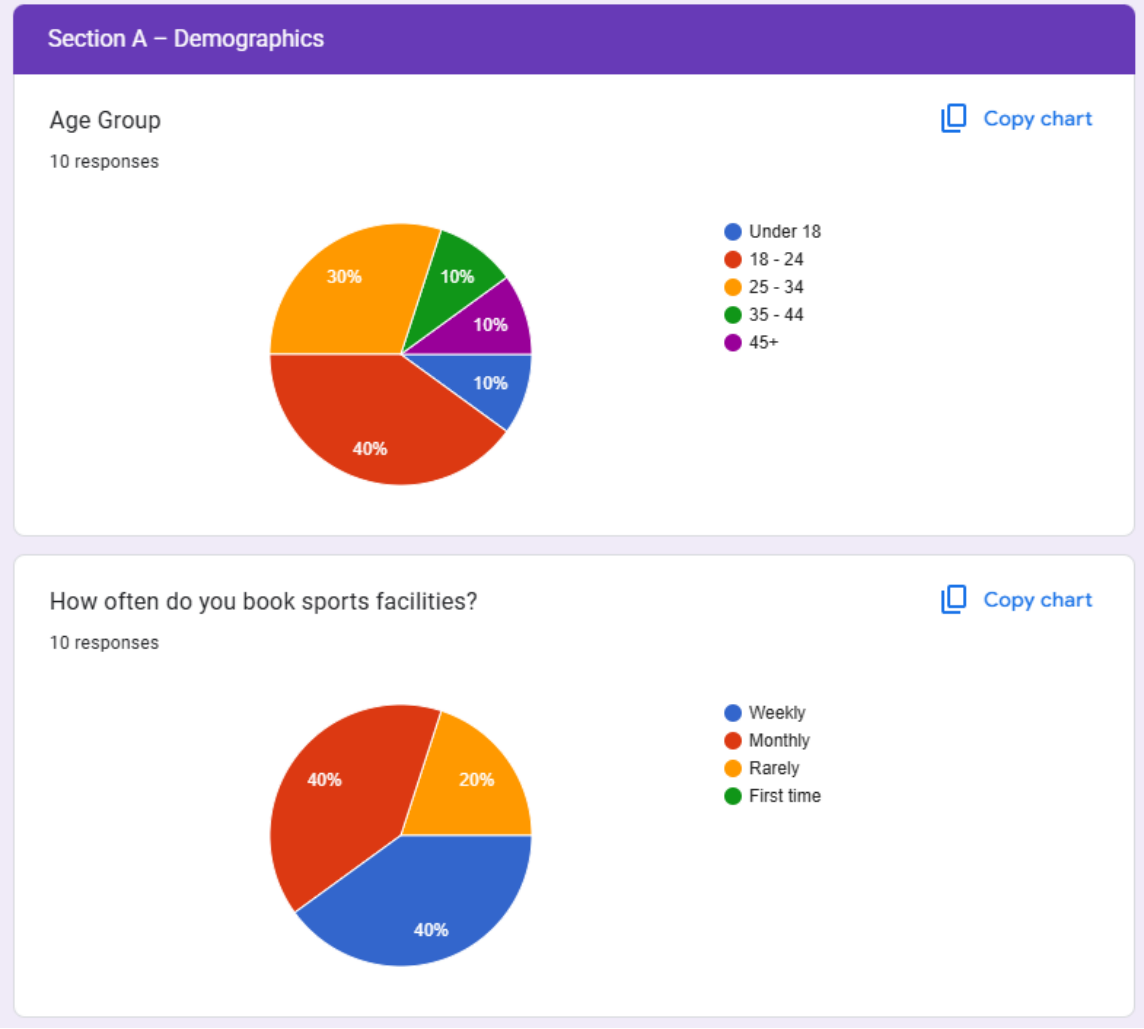

Figure A-1 1 Age Distribution & Booking Frequency Survey Results

Age Distribution The user base is dominated by younger demographics, with 18-24 year-olds comprising 40% of respondents and 25-34 year-olds representing 30%. This 70% concentration in the 18-34 age range aligns perfectly with the target audience for digital sports facility

booking platforms. The remaining users are distributed equally (10% each) across under-18, 35-44, and 45+ age groups.

Booking Frequency User engagement patterns reveal strong platform loyalty, with 40% booking sports facilities weekly and another 40% booking monthly. Only 20% are occasional users, and notably, no respondents were first-time users. This 80% regular user base indicates excellent user retention and demonstrates the platform's value proposition.

SECTION B - Usability and Interface Evaluation

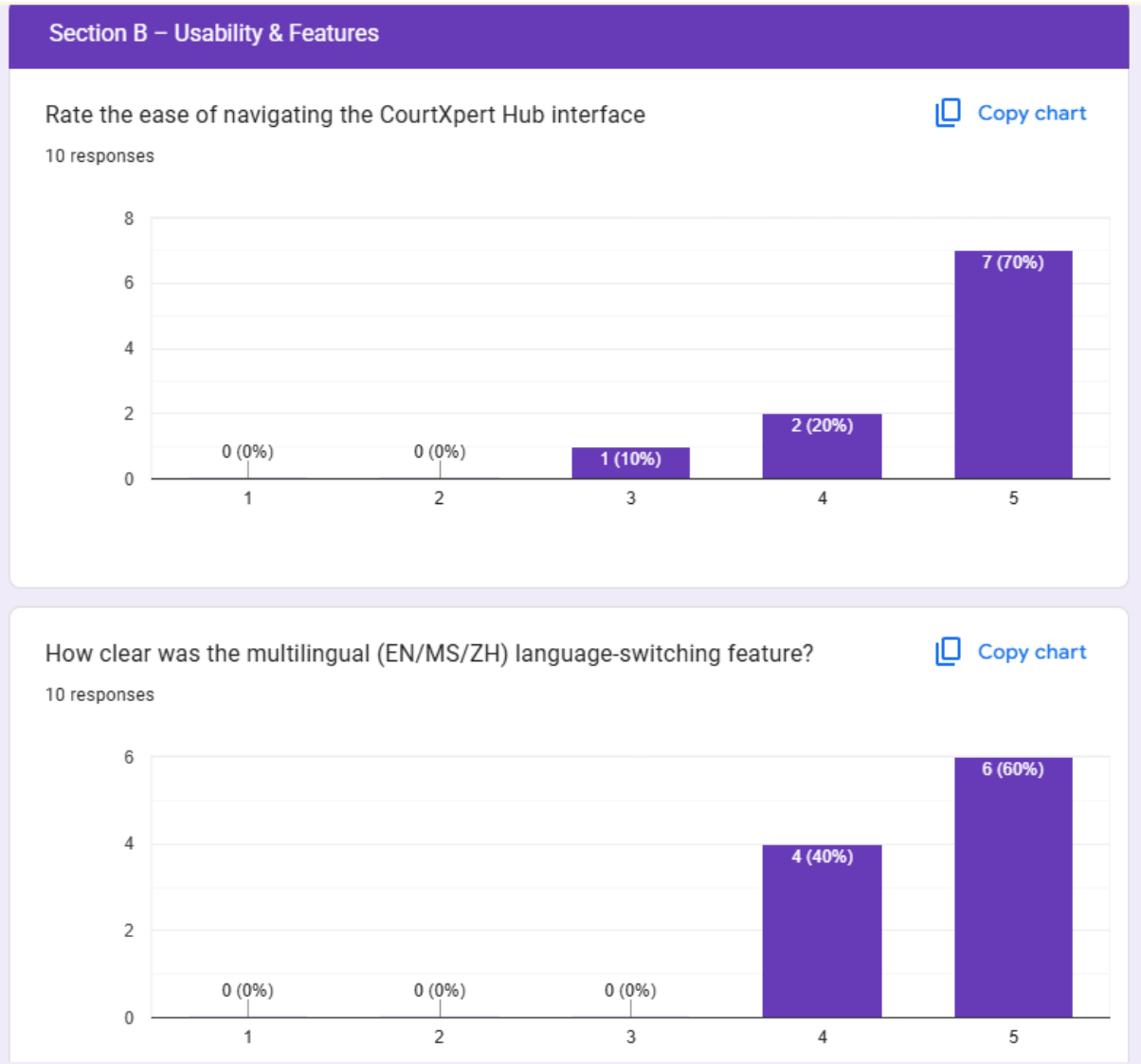

Figure A-1 2 Navigation Experience & Multilingual Language Switching Survey Results

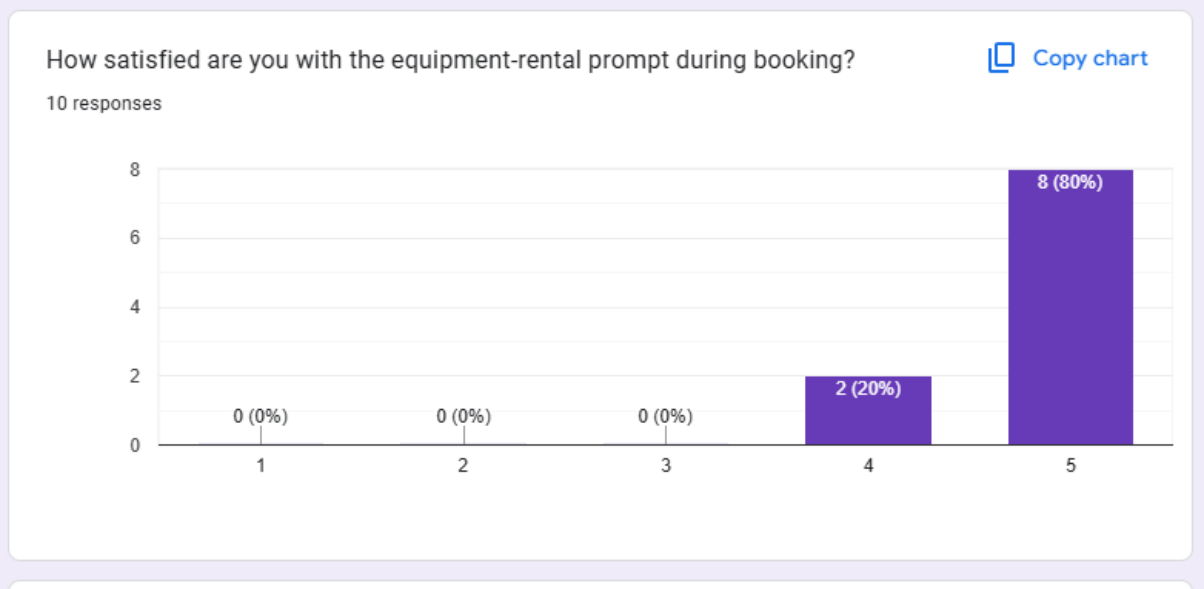

Figure A-1 3 Equipment Rental Prompts Survey Results

Navigation Experience The CourtXpert Hub interface receives outstanding usability ratings, with 70% of users rating navigation as extremely easy (5/5) and 20% rating it as easy (4/5). Only 10% provided a neutral rating, while no users reported navigation difficulties. This 4.6 average score reflects highly intuitive interface design that successfully minimizes user friction.

Multilingual Language Switching The platform's multilingual functionality (EN/MS/ZH) performs exceptionally well, earning perfect positive feedback from all respondents. 60% rate the language-switching feature as very clear (5/5) and 40% rate it as clear (4/5). The 4.6 average score demonstrates successful localization that meets Malaysia's diverse linguistic needs.

Equipment Rental Prompts The equipment rental prompt feature achieves the highest satisfaction rating among all evaluated features. 80% of users express complete satisfaction (5/5) with this functionality, while the remaining 20% are satisfied (4/5). The 4.8 average score indicates this feature effectively addresses user needs and enhances the booking experience.

Figure A-1 4 Stripe Payment Integration and Booking History & Review Survey Results

Payment and Technical Features

Stripe Payment Integration The payment process clarity receives excellent ratings, with 70% of users finding it very clear (5/5) and 30% rating it as clear (4/5). The 4.7 average score demonstrates successful Stripe integration that provides users with confidence and ease during transactions.

Booking History and Review System Users find significant value in the booking history and review features, with 70% rating them as very useful (5/5) and 30% as useful (4/5). This 4.7 average score indicates these features successfully support user decision-making and enhance overall platform utility.

SECTION C – Overall Experience

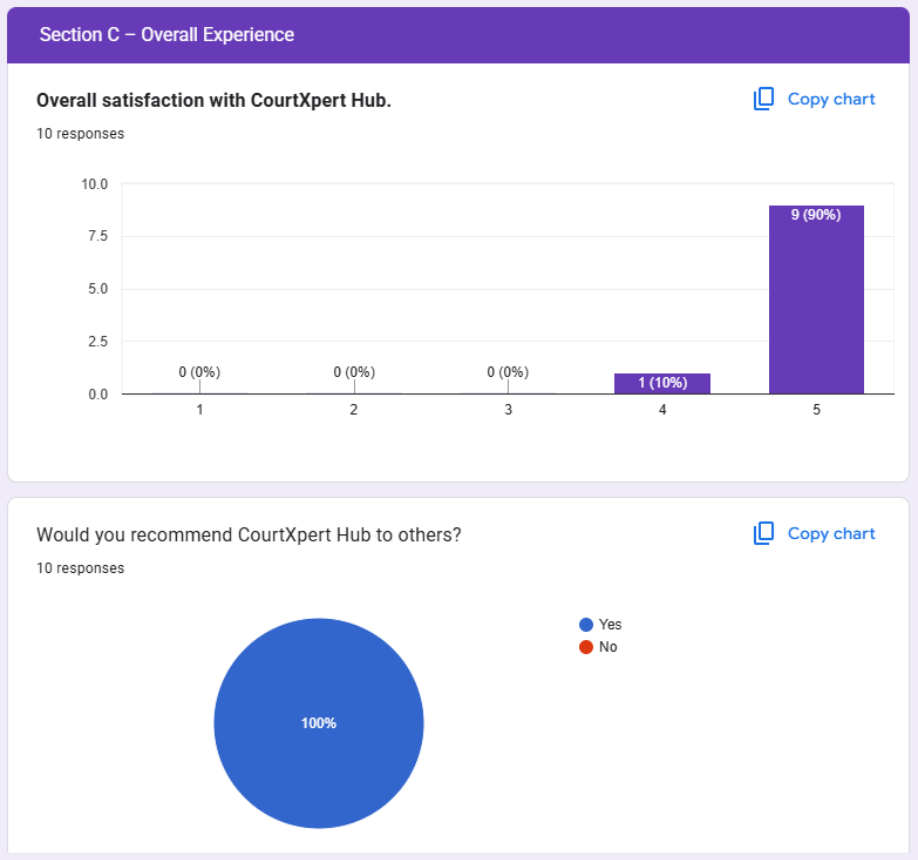

Figure A-1 5 Overall Satisfaction & Recommendation Likelihood Survey Results

Overall Satisfaction User satisfaction reaches exceptional levels, with 90% providing the highest rating (5/5) and 10% rating their experience as satisfactory (4/5). The resulting 4.9 average score represents outstanding platform performance across all evaluated dimensions.

Recommendation Likelihood The platform achieves perfect recommendation rates, with 100% of users willing to recommend CourtXpert Hub to others. This unanimous endorsement represents the strongest possible indicator of user satisfaction and platform success.

Conclusion

CourtXpert Hub demonstrates exceptional success across all evaluated metrics, achieving industry-leading satisfaction scores and perfect recommendation rates. The platform's multilingual capabilities, intuitive interface design, reliable technical implementation, and practical feature set have created a compelling user experience that generates strong loyalty and advocacy. The survey results indicate a mature, well-executed platform that has successfully established itself in the Malaysian sports facility booking market.

POSTER


COURTXPERT HUB:
COURT RESERVATION'S
& EQUIPMENT PLATFORM
Lim Xin Yee
INTRODUCTION
Existing Booking Systems lack equipment rental, multilingual support, smart admin
Target location: Kampar. Perak sports facilities
METHODS
Presentation Layer
Application Layer
Data Layer
php
MySQL
stripe
Technology stack
• Agile incrermental methodology
• Holt-Winters exponential smooning
RESULTS
100% AC CURACY
<2s LOAD TIME
3 LANGUAGES
EN
MS
SH
01 Equipment
02 Multlingual
Smart dashboard
Easting validation
Real-time inventory
Secure payments
Predictive analytics
DISCUSSION
• Competitive advantages
• Enhanced inclusivity acccessibility
• Data-driven decision making for administrators
CONCLUSIONS
Successful transformation from basic booking to comprehensive sports management system
Commercial deployment potential across Malaysia