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Smart Turf Booking System Using Flutter with Real-Time Admin Interaction

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***Abstract*- This Flutter-based Turf Booking Application facilitates seamless interaction between users and turf administrators, offering an efficient platform for managing turf reservations. The system is divided into two primary modules:**

User and Admin. Users can register and log in to explore available turfs, while the Admin has direct login access to manage turf listings. The Admin module allows the posting of detailed turf information, including location, cost, and other relevant details. Users can filter turfs based on location and view specific turf details, enhancing the user experience through easy navigation and relevant search results. Once a user selects a turf, they can submit a booking request specifying their team details and preferred time slots. These requests are routed to the Admin module, where the administrator can review and either accept or reject them.

Upon acceptance, the user is notified and granted access to a dummy payment interface to complete the booking process. This payment confirmation is then visible in the Admin panel, ensuring transparency and tracking of transactions. In addition to booking and payment functionalities, the application includes a one-on-one chat feature that fosters real-time communication between users and the admin. This interactive feature supports better clarification of turf availability, booking concerns, and other inquiries, thereby enhancing customer support and engagement. Overall, the application aims to digitize and simplify the traditional turf booking process, making it accessible and efficient for both turf managers and sports enthusiasts.

Keywords --- Flutter, Firebase, Java, Android Studio, Dart, Emulators, SDK Tool Kit

I. INTRODUCTION

The Flutter-based Turf Booking Application is designed to simplify and digitize the process of reserving sports turf. It features two main modules: User and Admin, each tailored to meet the specific needs of their roles. Users can register, log in, explore available turfs, and filter them based on location to find the best options quickly. Admin have direct access to the system to post and manage turf details, including location, price, and availability. Once users select a turf and submit a booking request, the admin reviews and either accepts or rejects the request. Upon approval, users proceed to a dummy payment interface to confirm their booking, with payment details visible to the admin for transparency. Additionally, the app offers a real-time one-onone chat feature, allowing users and admins to communicate directly about availability, booking issues, or other queries. With a clean interface and scalable architecture, this application delivers a smooth and efficient turf booking experience for both parties. 1.1. Scope The scope of the Flutter-based Turf Booking Application encompasses the complete digital management of turf reservations, from browsing to booking and payment tracking. It is designed for both users seeking convenient access to sports turfs and admins managing turf availability and schedules. The application enables users to filter and view turfs, submit booking requests, and complete payments through a dummy interface. Admins can manage turf listings, approve or reject bookings, and monitor transactions in real time. The inclusion of a live chat feature further enhances communication between users and admins.

The primary objective of the Flutter-based Turf Booking Application is to establish a user-friendly, streamlined digital platform that modernizes and simplifies the process of reserving sports turfs. This system seeks to eliminate the inefficiencies of traditional, manual booking methods—such as phone calls, physical visits, or spreadsheets—by introducing an automated, real-time interface that allows users to search for available turfs, apply filters based on location, price, timing, and amenities, and complete bookings effortlessly from their mobile devices. The platform is designed to offer a highly responsive and intuitive experience, reducing the time and effort required to find and secure a suitable turf slot, particularly during peak hours or weekends when demand is high. For turf managers and administrators, the application provides a centralized backend interface that simplifies the management of turf listings, booking approvals, slot availability, and customer communication, ensuring operational efficiency and error-free scheduling. The inclusion of a real-time chat feature fosters seamless interaction between users and administrators, allowing users to make inquiries, resolve doubts, or request changes instantly, enhancing trust, clarity, and overall satisfaction. The system also integrates secure user authentication, a reliable payment gateway, and notification services to ensure transparency and accountability throughout the booking lifecycle. In addition, the application is built with scalability and accessibility in mind, supporting

features like GPS-based nearby turf discovery using Google Maps integration, and a responsive design that adapts across devices. By bringing together these features, the Turf Booking Application aims not only to improve the convenience of turf booking for users but also to empower turf owners with better control, analytics, and customer service capabilities—creating a comprehensive and efficient ecosystem for recreational sports infrastructure management

II. LITERATURE REVIEW

A. Background and Related Work

Virtual Video Scene Construction in Sports Training

Authors: Rui Yuan, Zhendong Zhang, Pengwei Song, Jia Zhang,LongQin
This study presents a framework for synthesizing realistic virtual video scenes to enhance sports training. It uses motion capture data, encoding-decoding networks, and conditional GANs to transfer motion styles (e.g., from athlete to dancer) while preserving trajectory accuracy. Gram matrices ensure stylistic consistency. A cascade network achieves 200Hz posture tracking for high-resolution motion. The model enables immersive multi-angle observation and VR/AR integration for performance improvement and rehabilitation.

Incentive-Vacation Queueing for Edge Crowd Computing (ECC)

Authors: Sherif B. Azmy, Nizar Zorba, Hossam S. Hassanein This paper introduces the IVQ model to analyze edge crowd computing where user-owned devices rent out computational resources. Devices take "vacations" depending on the incentives offered. The system balances performance with incentive payments using queueing theory. Key factors include incentive-vacation functions and multitenancy. The framework allows orchestrators to optimize device availability while managing costs and user engagement.

Optimizing Sports Culture Dissemination with T-Spherical Fuzzy Logic

Author:PengWang
This research proposes a T-Spherical Fuzzy Information (TSFI) model to analyze and optimize the dissemination of sports culture. It addresses complexities such as emotional engagement, cultural differences, and regional preferences using fuzzy logic and humanized computing. The model quantifies factors like cultural sensitivity and emotional connection for tailored content delivery. It enhances authenticity, accessibility, and audience relevance in the digital sports domain.

Field-it: Mobile App for Sports Field Reservation

Authors: Tonto Claudinus, Made Prayoga, Nicolas Kornelius, MarsaAriqiGustiandza
To solve the inefficiency of manual field rentals, this study presents "Field-it," a mobile app for real-time booking, queue checking, and vendor equipment sales. It eliminates handwritten logs, improves financial data collection, and supports the growing demand for sports facilities by offering a smart platform for both customers and vendors.

Next-Gen Sport Center: Mobile-Based Reservation System

Authors: Anita Waluyo, Gathan Andhika Febriansyah This study proposes a scalable, user-friendly mobile system to automate and streamline sports facility bookings. It provides real-time availability, booking history, notifications, and payment integration. Usability studies confirm high satisfaction. The paper also explores AI integration for smart scheduling and recommendation, promoting digital transformation in sports management.

GoPlay: Sports Facility Reservation Mobile App

Authors: Oshan Mendis, Gayashini Rathnayake GoPlay is a cloud-based mobile application aimed at solving manual booking challenges through real-time updates, payment systems, and booking history tracking. It emphasizes intuitive design and reliability, and reduces errors and administrative overhead. Future upgrades include AI for analytics and recommendations, making it a comprehensive digital solution for sports facility management.

III. METHODOLOGY

The development of the Turf Booking Android Application followed a structured and iterative software engineering methodology to ensure the creation of a user-centric, reliable, and scalable mobile application. The process began with a comprehensive requirement analysis phase, wherein data was collected through interviews, questionnaires, and observational studies involving turf facility managers and potential users. This phase helped in identifying key functionalities such as secure user authentication, browsing of available turf slots, real-time booking, integrated payment systems, user notifications, and an administrative dashboard for turf owners. Based on these requirements, the system architecture was designed using the Model-View-Controller (MVC) pattern to separate business logic from user interface design, promoting maintainability and scalability.

The application was built using the Flutter framework, which leverages the Dart programming language and allows for a single codebase to run on both Android and iOS platforms, thereby improving development efficiency and reducing time-to-market. Firebase was selected as the backend-as-a-service (BaaS) due to its real-time database support, secure user authentication module, cloud functions for server-side logic, and push notification capabilities via Firebase Cloud Messaging (FCM). The frontend was designed using Flutter's widget system and followed material design principles to ensure a consistent and intuitive user experience. Development was managed using Agile methodology, with tasks divided into sprints and frequent reviews conducted to incorporate stakeholder feedback.

During implementation, separate modules were created for different user roles: general users could register, log in, browse available turfs, view time slots, and make bookings, while turf administrators had the ability to add new turf listings, manage schedules, confirm or reject bookings, and monitor usage analytics. Payment gateway integration (such as Google Pay or UPI) was considered for seamless transaction processing. Rigorous testing was conducted throughout the development lifecycle. Unit testing ensured that individual components performed as expected, integration testing verified that modules interacted correctly, and user acceptance testing (UAT) with selected participants provided practical feedback

for improvements. Performance metrics such as loading time, system responsiveness, and booking accuracy were also analyzed.

After successful testing and validation, the application was deployed via the Google Play Console for Android users. Firebase services continued to manage the live backend operations, and beta versions were circulated to a small group of users to collect post-deployment feedback. This feedback was crucial in identifying minor bugs, enhancing usability, and refining the overall user experience before the public release. The methodology adopted in this project emphasizes a balance between technical robustness and user-centered design, ensuring the application effectively meets the needs of its target users.

IV. PROPOSED SCHEME

A. System Architecture

In the turf reservation system architecture, users interact with the frontend to browse available turfs, check slot availability, and make bookings. Admins access the backend to manage turf listings, approve or reject reservations, and monitor the overall system operations.

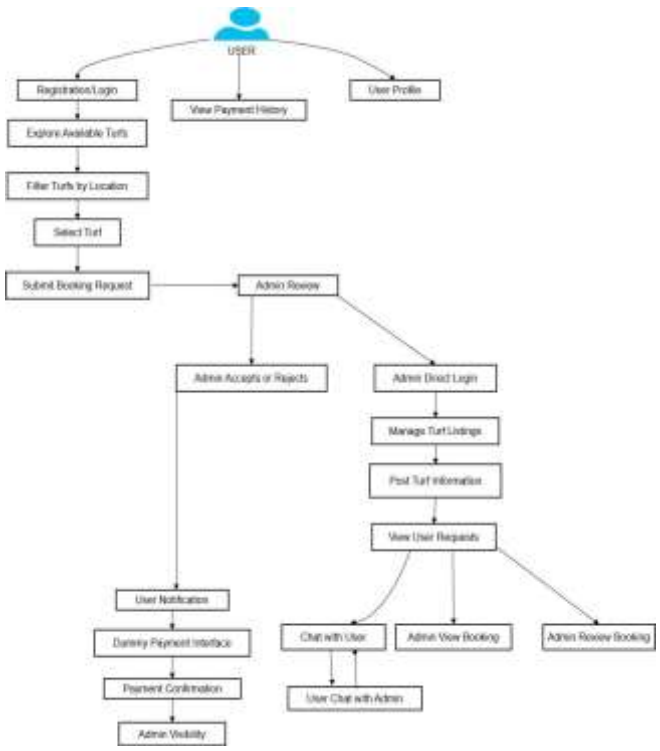

Fig .1 System Architecture

The User Registration and Login feature in the Flutter-based Turf Booking Application allows new users to create an account by providing essential details such as name, email, phone number, and password. Once registered, users can securely log in using their credentials to access the app's features. This module ensures that only authenticated users can browse and book turfs. It provides a personalized experience, allowing users to manage their bookings and chat with the admin. The login system is designed with validation to ensure data accuracy and user security. This feature is the gateway for users to interact with the platform efficiently.

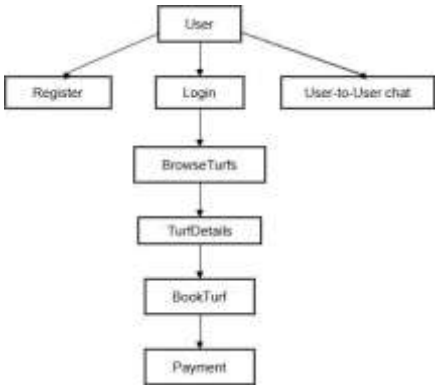

Fig.1.1 User Roles

The Admin module in the Turf Booking Application provides turf managers with direct access to manage the entire system. Admins can add, update, or delete turf listings, including details like location, cost, and availability. They can view and respond to booking requests by accepting or rejecting them based on slot availability.
The admin also monitors payment confirmations and interacts with users through the integrated chat system. This module ensures smooth management and oversight of all turf-related activities.

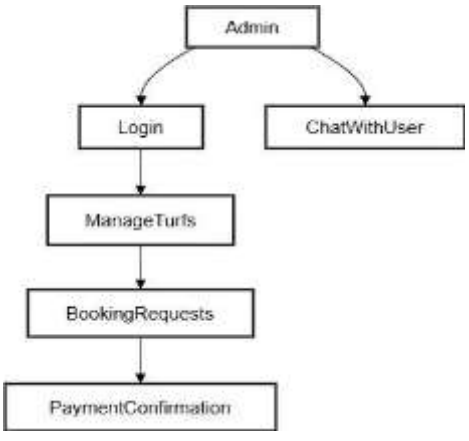

Fig.1.2 Admin Roles

IV. Function Modules

The system is designed with a robust architecture that ensures secure user authentication and role-based access control for Admin and Customer roles. During registration via the Flutter-based RegisterScreen.dart, users provide essential details such as name, email, password, phone number, and role, with appropriate validations applied. Firebase Authentication manages account creation, generating unique UIDs for users, while Firestore stores additional profile

information. The backend, developed using Spring Boot, manages login and registration processes through the AuthController and AuthService components. Upon successful login, JWT tokens are issued and linked with the Firebase UID and user role. Middleware is employed to validate JWTs on each request, enforcing role-based access control and ensuring that users can only access resources appropriate to their roles. This seamless integration of Flutter, Firebase, and Spring Boot ensures secure, efficient login and session handling.

The platform offers a powerful Search and Discovery System that enables users to locate turfs efficiently using various filters, including location, price, amenities, and available time slots. Flutter provides a responsive UI with a search bar and filtering options, sending queries to endpoints such as GET /api/turfs/search. The results are displayed using card or grid views to enhance visualization. Additionally, for users searching for nearby turfs, Google Maps integration displays turf markers on a live map. Backend support is provided via the /api/turfs/nearby endpoint, where GeoQuery logic processes user location and search parameters. Compound queries are applied to Firestore to enable fast and optimized filtering, providing an intuitive and location-aware discovery experience for users.

Turf Management functionality is reserved for Admins, allowing them full control over turf listings. Admins can create, update, and delete turf entries through the Flutter AddTurfScreen.dart, which captures vital data like turf name, location, description, pricing, available slots, and images. Images are uploaded to Firebase Storage, and their URLs are stored alongside other turf details in Firestore. The Spring Boot backend processes turf management operations through TurfController and TurfService, using endpoints like POST /api/turfs, PUT /api/turfs/{turfId}, and DELETE /api/turfs/{turfId}. Each turf is linked to the admin's UID to ensure data integrity and ownership. Validations are enforced both client- and server-side to ensure that only the turf's creator can modify or delete it.

The Turf Booking System empowers customers to reserve turfs smoothly through the BookTurfScreen.dart, where they can select a turf, choose available time slots, and initiate a booking. These requests are processed through the POST /api/bookings endpoint. Bookings are stored in Firestore with status labels like Pending, Approved, Completed, or Canceled. Admins can manage booking requests via their dashboard, using endpoints like GET /api/bookings/admin/{id}, while customers can view their bookings with GET /api/bookings/customer/{id}. This structured booking process ensures transparency and efficiency in managing turf reservations.

Complementing the booking feature is the integrated Payment and Wallet System. Customers can top up their digital wallets using the Flutter WalletScreen.dart, initiating a request through POST /api/wallet/add-money. The backend, using WalletController, securely handles transactions and updates wallet balances. When a booking is confirmed, the corresponding payment is automatically deducted via POST /api/wallet/pay. All wallet transactions are logged and validated for security and 4ccuracyy. Users have access to transaction histories and current balances, ensuring a cashless, convenient, and fraud-resistant payment experience.

To enhance communication and user engagement, the system incorporates real-time Notification and Communication capabilities. Firebase Cloud Messaging (FCM) is used to send push notifications for key events such as booking confirmations, payment updates, and cancellations. The Spring Boot backend leverages the Firebase Admin SDK to dispatch these notifications based on application events. Additionally, an in-app chat feature is available, built using Flutter's StreamBuilder and integrated with Firestore for storing and managing real-time messages. Optional Firebase Functions can be used for monitoring chats to maintain community standards.

A Review and Rating System is also in place to allow customers to share feedback on their turf experiences. Using the ReviewScreen.dart, users can rate turfs on aspects like cleanliness, amenities, and value for money, alongside text-based reviews. These are submitted via POST /api/reviews and stored under the respective turf records in Firestore. Existing reviews and average ratings can be viewed through the GET /api/reviews/{turfId} endpoint, aiding other users in making informed decisions.

Finally, the Admin Dashboard and Analytics module provides a data-driven overview of platform operations. Built with Flutter and enhanced using visualization libraries like fl_chart, the dashboard displays key performance indicators such as total users, revenue, active bookings, and turf utilization trends. Backend support through endpoints like GET /api/admin/stats and GET /api/admin/revenue enables efficient aggregation of data from Firestore, providing admins with actionable insights for business optimization and strategic planning.

IV. RESULTS AND DISCUSSION

The main page of the application serves as the entry point for two distinct user roles: User and Admin. This screenshot displays a clean, intuitive interface with separate login options, ensuring secure access based on user type. The User Login allows general users to access features such as browsing, booking, or interacting with the app, while the Admin Login is restricted to authorized personnel for managing backend tasks like updating content, monitoring usage, or handling reservations. Clear visual separation between the two modules enhances usability and reduces confusion. This design supports role- based access control, maintaining both functionality and security. The layout is responsive and optimized for both mobile and web platforms, providing a seamless experience. Upon launching the application, users are directed to the **Main Page**, which prominently features two distinct navigation paths: **User Login** and **Admin Login**. When a user selects the **User Login** option, they are redirected to a login form where they enter their credentials to access features like event browsing, reservations, and personal dashboard functionalities. Upon successful authentication, they are taken to the **User Dashboard** with personalized content and options.If the **Admin Login** option is selected, the user is directed to a separate admin authentication page. Only authorized administrators can log in here. Once authenticated, the user is taken to the **Admin Panel**, where they can perform tasks such

as managing users, updating events or services, viewing analytics, and handling system configurations. Both login modules are guarded with proper authentication and validation, and any unauthorized access is blocked with error messages or redirections. The navigation flow ensures a secure and user-specific experience, maintaining a clear boundary between front-end users and back- end administrators.

The Final Booking Page serves as the crucial step for users to confirm and finalize their turf booking. After selecting the preferred turf, date, and time slot, the user is redirected to this page where they can review all their booking details. This includes information such as the turf name, location, sport type, selected date and time, booking duration, cost breakdown, taxes, and any discounts applied.

Fig.2 Main Login Page

The system dynamically calculates the total cost and displays it clearly for user confirmation. The user is then prompted to confirm the details before proceeding to the payment section. The payment options are integrated with secure payment gateways such as Razorpay, Stripe, or UPI- based services, providing multiple payment methods, including credit/debit cards, net banking, digital wallets, and UPI. Once the user proceeds and confirms the payment, the system triggers an immediate transaction. Upon successful payment, the system processes the booking by assigning a unique booking ID, which is displayed on the confirmation page, and generates a downloadable receipt for the user. Simultaneously, the status of the selected time slot is updated in the database to "Booked", ensuring that no other user can book the same slot. A real-time notification is sent to the admin, either through email or directly via the admin dashboard, alerting them to the new booking. The notification includes important details such as the user's name, turf name, time slot, and payment status, enabling the admin to easily track and manage all bookings. This helps the admin keep track of turf usage and avoid overbooking or scheduling conflicts. In case of a failed payment or if the user does not complete the transaction within a specified timeout period, the system automatically releases the selected slot, making it available for other users to book. The user is notified of the payment failure and prompted to retry the payment process. This ensures that the user is kept informed of their booking status, as well as any necessary actions (such as payment retries or booking cancellations). The system also provides the option to cancel bookings based on the cancellation policy. Through this comprehensive and

V. FUTURE WORK

Feature enhancements for the Secured Public Grievance System focus on significantly improving user experience, security, and operational efficiency. A redesigned, user-friendly interface will simplify the complaint submission process, making it easily accessible for individuals of all technical backgrounds.

A real-time chat support system will provide users with instant assistance for filing complaints, troubleshooting, or tracking updates. The complaint tracking module will be enhanced to offer stage-wise detailed status updates, ensuring users are informed at every step from registration to resolution. Multi-language support will be implemented to cater to diverse linguistic communities, enabling users to submit and track grievances in their native languages. A feedback and rating mechanism will be introduced postresolution to encourage greater transparency, accountability, and continual service improvement. To improve accessibility, a dedicated mobile application for Android and iOS will allow users to conveniently file and monitor complaints from their smartphones. The system will integrate advanced data visualization tools, such as interactive dashboards and analytical charts, enabling government agencies to identify complaint trends, monitor service bottlenecks, and make informed policy decisions.

An automated acknowledgment system will confirm the receipt of complaints via SMS, email, or in-app notifications, reassuring users that their grievances are recorded. Furthermore, social media integration with platforms like Facebook, Twitter, and WhatsApp will allow users to submit or track grievances directly through official pages and chatbots, expanding public engagement. An educational resource center featuring FAQs, step-by-step guides, eligibility information, and grievance redressal timelines will also be developed to assist users throughout the process.

VI. CONCLUSION

The Flutter-based Turf Booking Application provides a comprehensive, smart, and highly efficient platform for managing turf reservations in a modern, digitized manner. By seamlessly integrating user and admin modules, the system ensures that both ends of the platform are equipped with essential functionalities such as advanced filtering options, hassle-free booking processes, secure payment handling, and real-time communication through an integrated chat system. Admins benefit from a powerful backend management panel that allows them to oversee bookings, monitor transactions, update turf availability, and respond to user queries promptly, ensuring operational smoothness and customer satisfaction. The intuitive and interactive UI/UX design enhances the user journey, making it simple for customers to explore turfs,

compare options, make bookings, and track their activities in real-time. The inclusion of a real-time chat feature bridges communication gaps between users and administrators, promoting transparency and immediate issue resolution.

Furthermore, the application's scalability and modular architecture make it capable of accommodating future expansions, such as the addition of new turfs, advanced analytics, or multi-location management. Overall, the Turf Booking Application successfully transforms the traditional, manual turf reservation process into a streamlined, user-centric digital solution, promoting greater convenience, efficiency, scalability, and trust for both service providers and users. Building upon its foundational strengths, the Flutterbased Turf Booking Application is engineered with robust performance and security protocols that ensure a seamless and safe experience for every interaction

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