

Location-Based Futsal Opponent Matching and Game Scheduling Using Collaborative Filtering

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Abstract

Location-Based Futsal Opponent Matching and Game Scheduling Using Collaborative Filtering present a mobile application that addresses the growing demand for efficient futsal game organization in Nepal. Traditional methods rely heavily on personal networks and manual scheduling, often leading to inefficiencies and missed opportunities. The proposed application addresses this challenge by incorporating location-based services and intelligent matchmaking through advanced algorithms. Using cosine similarity in collaborative filtering, the app recommends players with similar skill levels and preferences, enhancing fair and balanced team formation. Simultaneously, the Haversine algorithm is employed to suggest the nearest futsal venues based on the user's live location, optimizing travel convenience. Real-time push notifications further improve user engagement by updating them on bookings, team status, and match schedules. Built using Flutter for the frontend and Django for the backend, the application is cross-platform and scalable. A MySQL database ensures reliable data storage and retrieval. Initial testing indicates that the application significantly reduces coordination time and improves the futsal experience for players. The system also promotes community involvement by simplifying team creation and venue booking. Overall, the proposed application enhances accessibility, efficiency, and engagement in Nepal's futsal community through smart technology integration.

Keywords: Booking, Cosine Similarity Algorithm, Futsal, Haversine Formula, Location

1. Introduction

Organizing futsal matches in Nepal remains a cumbersome and inefficient process due to the absence of a specialized digital platform tailored to local needs. Players often face challenges in finding teammates, opponents, or available venues, relying instead on manual coordination, social media, or limited personal networks. Existing global sports applications do not provide the necessary features such as location-based filtering, real-time notifications, or skill-based matchmaking specific to futsal, making them inadequate for the local context. Moreover, the lack of intelligent recommendations leads to unbalanced teams and underutilized futsal facilities. This work is motivated by the need to simplify and modernize futsal game organization through a mobile application that leverages smart algorithms to enhance accessibility, coordination, and user engagement in Nepal's futsal community.

To address this gap, the proposed application offers a digital solution by enabling players to create game requests, form teams, and book futsal venues using mobile technology. By integrating location services and intelligent algorithms, users receive tailored recommendations, making it easier to connect with other players and access facilities based on availability and proximity. The main objectives are to develop a mobile application that enables futsal players to find suitable teammates and nearby venues using collaborative filtering and location-based algorithms and to streamline the futsal scheduling process by integrating player matchmaking, venue booking, and real-time notifications into a unified and user-friendly platform.

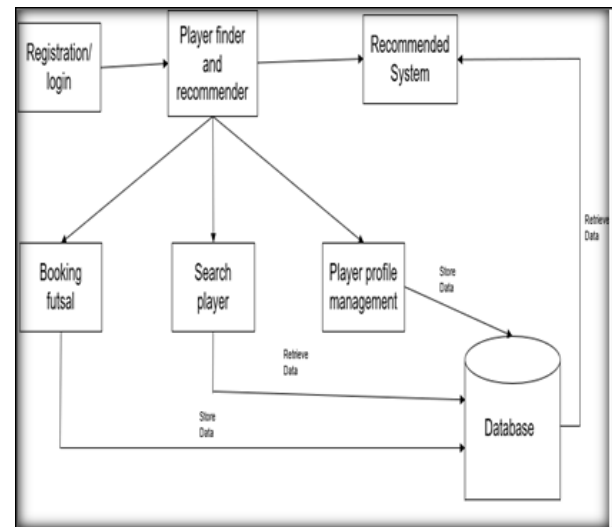
2. Literature Review

Organizing sports activities using mobile platforms has received increasing attention in recent years. Various applications have attempted to solve the logistical challenges associated with team sports, such as scheduling, player matchmaking, and venue booking as discussed by Shrivastava & Gupta [1], Gupta et al. [2]. However, most existing systems tend to generalize across multiple sports without optimizing for the specific requirements of games like futsal. This lack of specialization often results in mismatched player capabilities, inefficient booking systems, and limited local engagement.

Several research efforts have demonstrated the effectiveness of collaborative filtering in user recommendation systems. Schafer et al. [3] and Liu et al. [4] discuss collaborative filtering as a core approach in modern recommender systems, particularly focusing on user-to-user similarity measures for generating personalized suggestions. In our system, this methodology is applied using cosine similarity [5], which is well-suited for comparing vectors of user attributes such as skill level, age, and past participation. Unlike traditional Euclidean-based models, cosine similarity evaluates directional likeness, making it ideal for identifying players with parallel playing styles regardless of absolute rating differences.

Cosine similarity has also proven effective in domains like movie and product recommendations, where feature vectors are sparse but meaningful. Research by Cut and Maharani [6] confirms its performance advantages in high-dimensional data scenarios, similar to how user profiles are structured in the proposed application. Furthermore, the nuances regarding the mathematical application of cosine similarity in modern

The flowchart shown in Figure 2 for the Location-Based Futsal Player Finder and Game Scheduling Using Collaborative Filtering App outlines the user journey from sign-up to futsal booking. Initially, users sign up or log in, after which the user can search for teammates or receive player recommendations based on ratings. Once a team is formed, the user search for available futsal venues and proceed to book a slot. The process involves decisions at each stage, such as verifying credentials, confirming team formation, and adjusting search criteria for venues. The app ensures a smooth experience by guiding users



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graph TD
    Start([Start]) --> Registered{Registered?}
    Registered -- No --> Signal[Signal]
    Signal --> Verified{Verified?}
    Verified -- No --> Signal
    Verified -- Yes --> Login[Login]
    Login --> HomePage[Home page]
    HomePage --> CreateRequest{Create Reservation request}
    CreateRequest -- No Request --> DisplayRequest[Display the Request created based on location]
    DisplayRequest --> SearchRequest[Search for request created on day and time slot]
    SearchRequest --> SlotAvail{Slot available?}
    SlotAvail -- No --> GetLocation{Get location?}
    GetLocation --> CreateRequest
    SlotAvail -- Yes --> WaitReservation[Wait for reservation of request]
    WaitReservation --> ReservationConfirmed{Reservation confirmed?}
    ReservationConfirmed -- No --> WaitReservation
    ReservationConfirmed -- Yes --> ReservationConfirmedYes[Reservation confirmed]
    ReservationConfirmedYes --> Conversation[Conversation verify location and football team]
    Conversation --> TeamMatch{Team matches?}
    TeamMatch -- No --> Duration[Duration for recovery finished?]
    Duration -- No --> Conversation
    Duration -- Yes --> WaitReservation
    TeamMatch -- Yes --> BookFuture[Book the future]
    BookFuture --> WaitReservation
    WaitReservation --> DisplayFutsal[Display Futsal time and date slot/available]
    DisplayFutsal --> AvailableSlot{Available time slot?}
    AvailableSlot -- No --> ChooseDifferent[Choose different time slot]
    ChooseDifferent --> WaitReservation
    AvailableSlot -- Yes --> DisplaySlot[Display the slot and put file of players needed]
    DisplaySlot --> DisplayPlayers[Display players based on location]
    DisplayPlayers --> WaitPlayer[Wait for player to join the request]
    WaitPlayer --> ChoosePlayer{Choose player?}
    ChoosePlayer -- No --> WaitPlayer
    ChoosePlayer -- Yes --> JoinPlayer[Join player]
    JoinPlayer --> PlayerConfirmed{Player confirmed?}
    PlayerConfirmed -- No --> WaitPlayer
    PlayerConfirmed -- Yes --> Conversation
  
```

The flowchart illustrates the system process for a football match prediction system. It begins with a 'Start' terminal, leading to a decision 'Registered?'. If not registered, a 'Signal' is sent to a 'Verified?' decision. If verified, the user proceeds to 'Login' and then to the 'Home page'. From the home page, the user can 'Create Reservation request'. If no request is created, the system displays requests based on location, allowing for a search by day and time slot. If a slot is available, the user waits for a reservation. If confirmed, a conversation verifies the location and football team. If the team matches, the user books the future; otherwise, the system checks if the duration for recovery is finished. If not finished, the process loops back to the reservation wait step. If the user creates a reservation request, the system displays futsal time and date slots. If a slot is available, it displays the slot and the file of players needed, then displays players based on location. The user then waits for a player to join the request. If a player is chosen, they join the team. If the player is confirmed, the process proceeds to the conversation verification step. If not confirmed, it loops back to the player wait step.

This metric compares vectors based on direction rather than magnitude, focusing on relational similarity. When a user seeks teammates, the system matches the most similar users based on prior preferences and game participation.

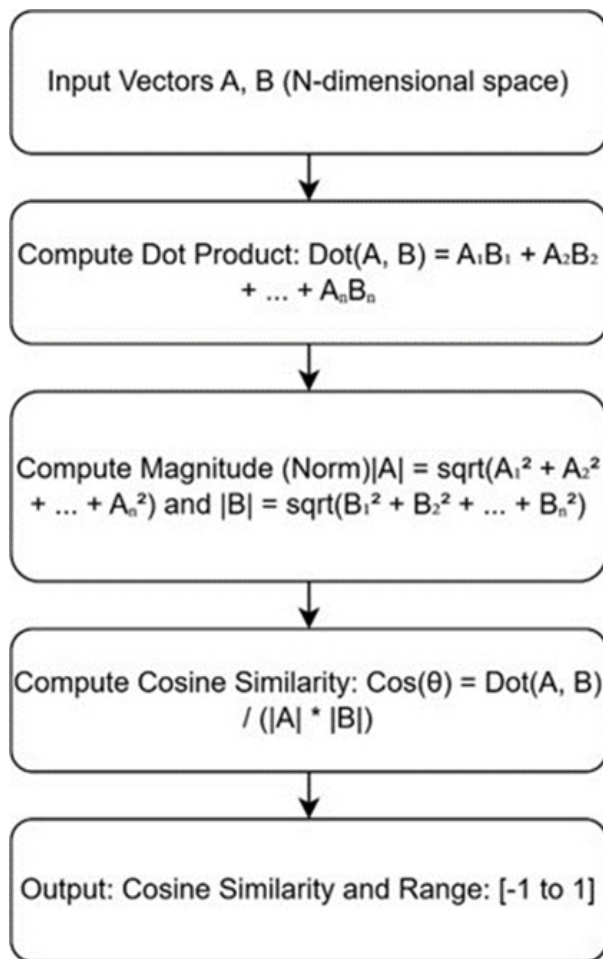


Figure 3. Steps of Collaborative Filtering

3.3 Haversine Algorithm

The Haversine algorithm calculates the shortest distance over the Earth's surface between two points using latitude and longitude.

4. Results and Analysis

The developed application was thoroughly evaluated using real users and futsal venues to evaluate its performance, usability, and accuracy. The experimental evaluation was conducted over a 3-week period (June 2024) on Android devices (version 11 and above) with a sample of 60 participants across Lalitpur and Kathmandu districts. Five futsal venues: - Kick Futsal, Royal Futsal, Baglamukhi Futsal, Dhanyentari Futsal, and Galaxy Futsal- were used for testing and validation. The dataset contained 60 user profiles with attributes such as age (18–35 years), skill rating (1–10), preferred playtime, and geographic coordinates.

4.1 Quantative Evaluation

To assess system performance, four primary metrics were considered: matchmaking accuracy, booking coordination time reduction, user satisfaction, and venue proximity accuracy.

1) **Matchmaking Accuracy:** Based on cosine similarity

scores and post-match user feedback, the average match-making accuracy was 87.4%. This indicates that most players were successfully paired with others of comparable skill and availability. The similarity score distribution is shown in Figure 4.

- 2) **Coordination and Booking Time Reduction:** Before using the system, players reported an average of **27 minutes** spent coordinating via phone or social media. Using the app, this was reduced to an average of **9 minutes**, representing a **66.7% reduction** in coordination time.
- 3) **User Satisfaction:** A post-test survey (1–5 Likert scale) measured satisfaction regarding ease of use, accuracy of recommendations, and overall convenience. The results yielded an average satisfaction rating of **4.6/5**, with 92% of users indicating they would continue using the app for future futsal scheduling.
- 4) **Venue Recommendation Accuracy:** The Haversine-based venue filtering achieved a 93% success rate in correctly recommending the nearest available futsal venue within 1.5 km of the user's location.

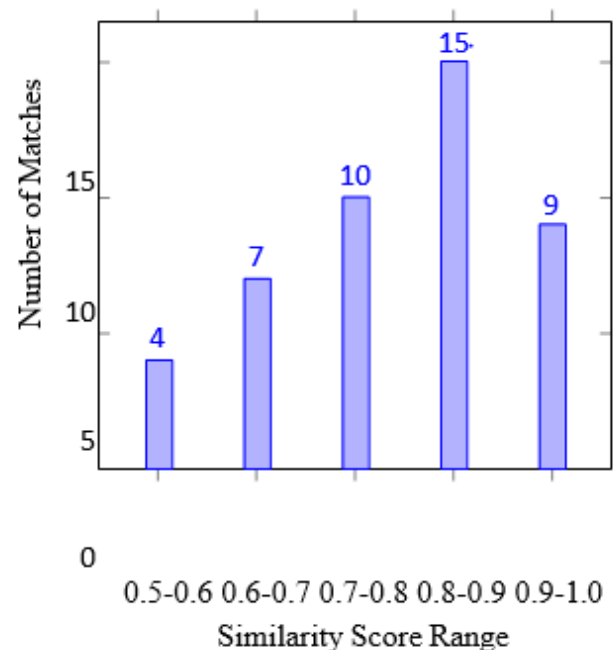


Figure 4. Distribution of Matchmaking Similarity Scores

4.2 Experimental Environmet

The experiment involved:

- **Participants:** 60 active futsal players (52 males, 8 females)
- **Venues:** 5 local futsal courts in Lalitpur and Kathmandu
- **Duration:** 3 weeks of testing (20 sessions total)
- **Platform:** Android (v11–v14) and Flutter-based frontend

Dataset Parameters:

- Age: 18–35 years
- Rating: 1–10 scale (average 6.8)
- Location: within 8 km radius

- Preferred Playtime: 6 AM–8 PM

4.3 Distance Accuracy

While effective, the Haversine-based calculation showed a 31.67% deviation from Google Maps' route-based distances. For example, the calculated straight-line distance from the user's location to "Kick Futsal" was 0.82 km, whereas the actual road distance was 1.2 km (see figure 5). Despite this difference, the approximation proved sufficient for proximity-based filtering. Venue distance accuracy comparison

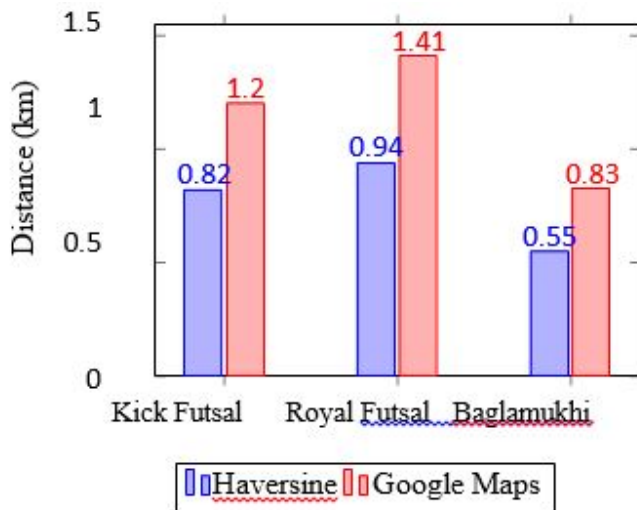


Figure 5. Comparison of Haversine vs Google Maps Distance

4.4 Cosine Similarity Score Analysis

Figure 6 presents the similarity scores of five players, with values ranging between 0.58 and 0.92. Higher scores indicate greater compatibility for matchmaking. The results indicate

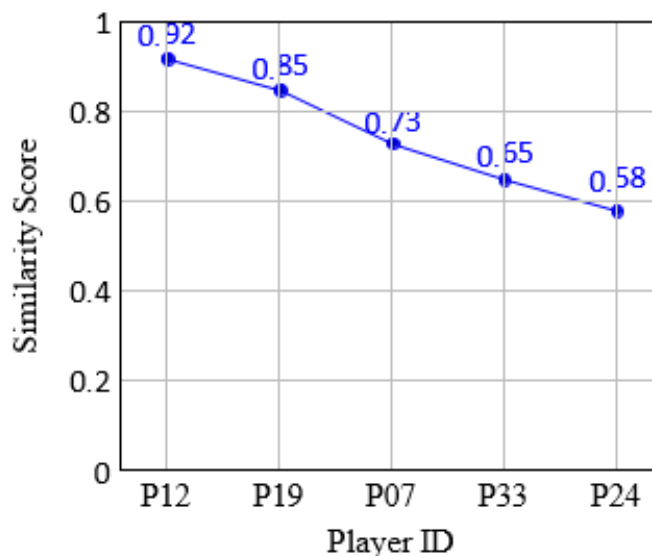


Figure 6. Player Similarity Scores Using Cosine Similarity

players with higher compatibility, enhancing the fairness and competitiveness of futsal matches.

Overall, the experimental results confirm that the proposed system improves matchmaking precision, reduces organizational time, and enhances user engagement in community-based futsal events.

5. Conclusion

The proposed application successfully addresses the organizational challenges faced by futsal enthusiasts. By leveraging collaborative filtering and location-based services, it simplifies team formation and venue access. The project demonstrated both technical and operational feasibility.

Future Work: It includes integrating the Google Maps API for route-aware distance calculations, adding support for real-time chat, and extending functionality to other sports.

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that the collaborative filtering system effectively prioritizes