Empowering Volleyball Coaches:

A Mobile Application for Match-up Optimization

Understanding the challenge

Rotation Rule Complexity

- Players rotate through six zones clockwise, creating constantly changing match-ups during the game (Durkovic et al., 2007)

Dynamic Match-Ups

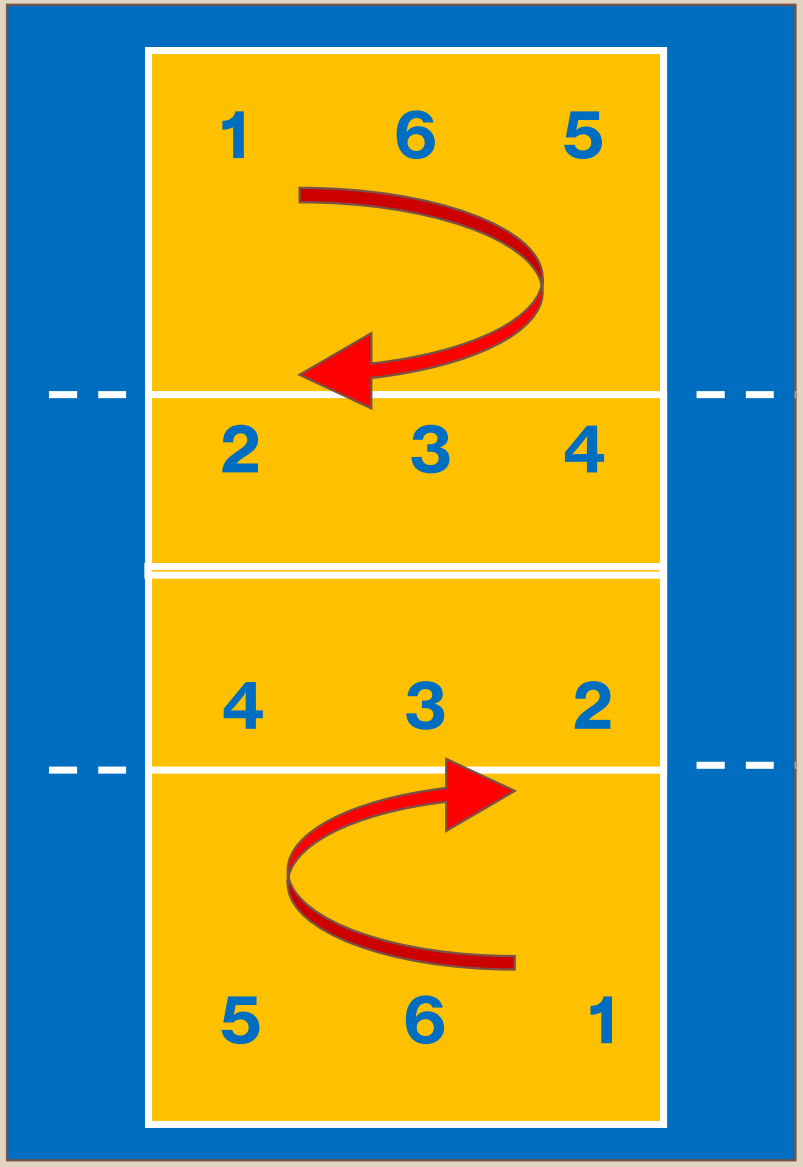
- 1 Line-up but 6 rotations, 6 different teams, 1 for each rotation according to Side-out effectiveness (Lopez et al. 2023), break-point effectiveness, and offensive/defensive abilities (Laios & Kountouris, 2010, 2011)
- Ongoing player movement results in complex and dynamic match-ups that require continuous strategic adjustments.

Coaching Cognitive Load

- Coaches face high cognitive demands, tracking rotations and player positioning under live game pressure.

Need for Technological Support

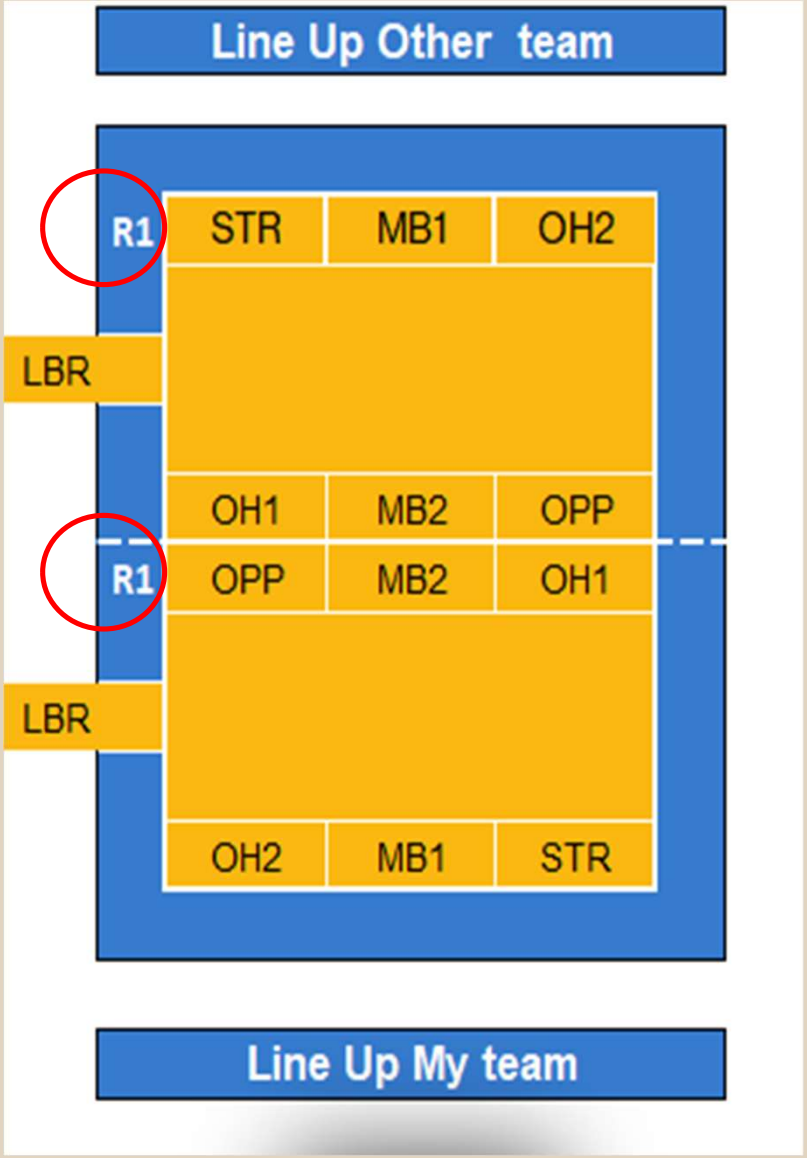
- Technological tools can reduce cognitive burden, helping coaches focus on strategic planning rather than manual tracking.



Understanding Line-up

Definition of Line-up

- Almost all teams in all competitive levels are using the 5-1 formation system, and so they have the same players, from the point of view of players' in-game roles (STR, OH1, MB2, OPP, OH2 and MB1), in the same order of rotation.
- Each in-game player/role is specialised in specific skills.
- Position Rotation (PR) is fully described by the setter's (STR) position.
- The initial Rotation of a set is called the Starting Rotation (SR).



Understanding Match-ups

Definition of Match-ups

Match-ups are specific player alignment combinations during volleyball rotations that influence game dynamics.

Types of Match-ups

There are six match-ups: M0, M-1, M-2, M#, M+2, and M+1, that denote different rotational alignments between teams.

Strategic Importance

Understanding match-ups helps coaches shift from reactive to proactive strategies by anticipating opponent moves.

M0	Same rotation with the opponent team (e.g.R1 vs R1)
M-1	One rotation prior to the opponent (e.g R1 vs R6)
M-2	Two rotations prior to the opponent (e.g R1 vs R5)
M#	Three rotations prior or ahead of the opponent (e.g., R1 vs R4)
M+2	Two rotations ahead of the opponent (e.g R1 vs R3)
M+1	One rotation ahead of the opponent (e.g R1 vs R6)

Other team with Reception

Serve \ Receive (STR in:)	1	6	5	4	3	2
1	M0	M-1	M-2	M#	M+2	M+1
6	M+1	M0	M-1	M-2	M#	M+2
5	M+2	M+1	M0	M-1	M-2	M#
4	M#	M+2	M+1	M0	M-1	M-2
3	M-2	M#	M+2	M+1	M0	M-1
2	M-1	M-2	M#	M+2	M+1	M0

Other team with Serve

Receive \ Serve (STR in:)	1	6	5	4	3	2
1	M+1	M0	M-1	M-2	M#	M+2
6	M+2	M+1	M0	M-1	M-2	M#
5	M#	M+2	M+1	M0	M-1	M-2
4	M-2	M#	M+2	M+1	M0	M-1
3	M-1	M-2	M#	M+2	M+1	M0
2	M0	M-1	M-2	M#	M+2	M+1

The Coach's Decision-Making Process

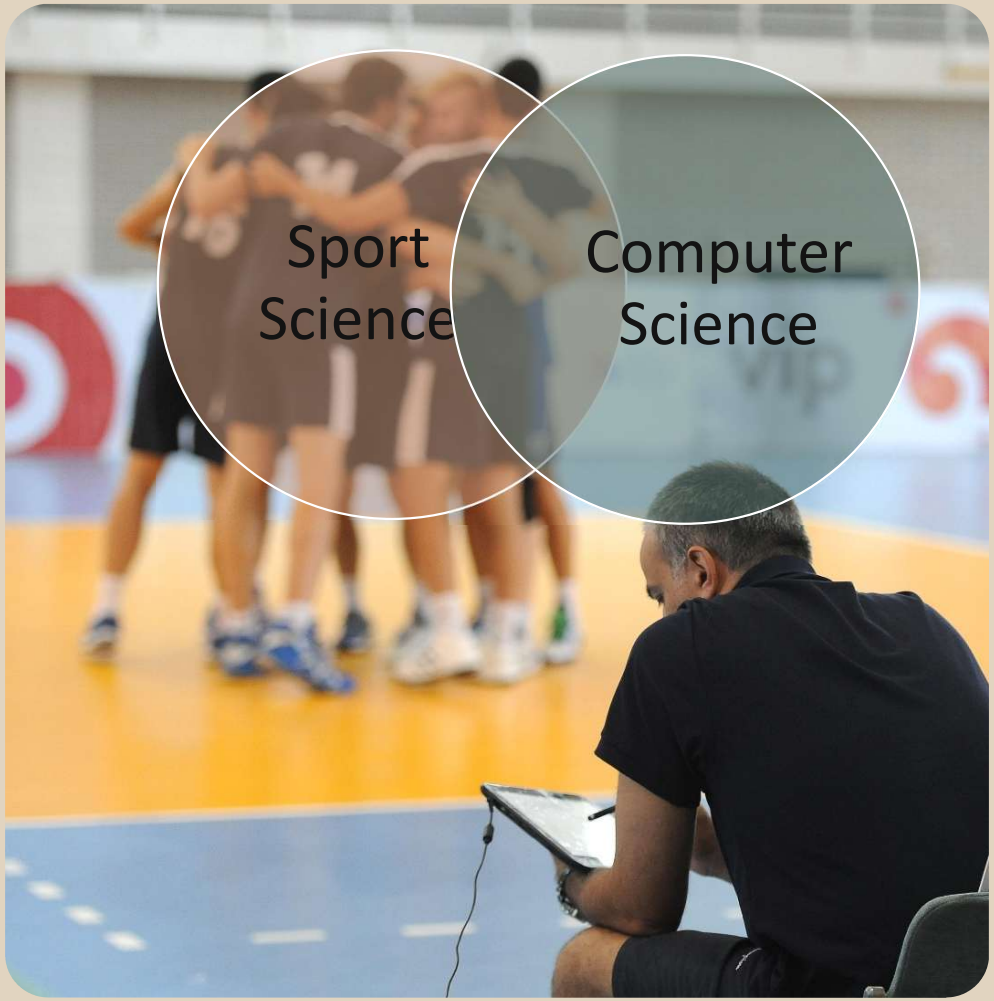
Match-up Analysis
Coaches analyze player match-ups to identify who should

- Block top attackers.
- Create or avoid of mismatch situations (hide the short player)
- Create favourable situations for serve (hard server vs best side-out rotation or safe server vs worst side-out rotation)

Strategic Rotation Selection
Selecting starting rotations locks in advantageous configurations for the entire set, maximizing team strengths.

Data-Driven Decisions
Utilizing data and real-time insights elevates coaching effectiveness beyond relying solely on player skill.

Our Solution:
A Mobile Application



Project Overview
Introducing a mobile app designed to optimize volleyball match-up strategies for coaches.

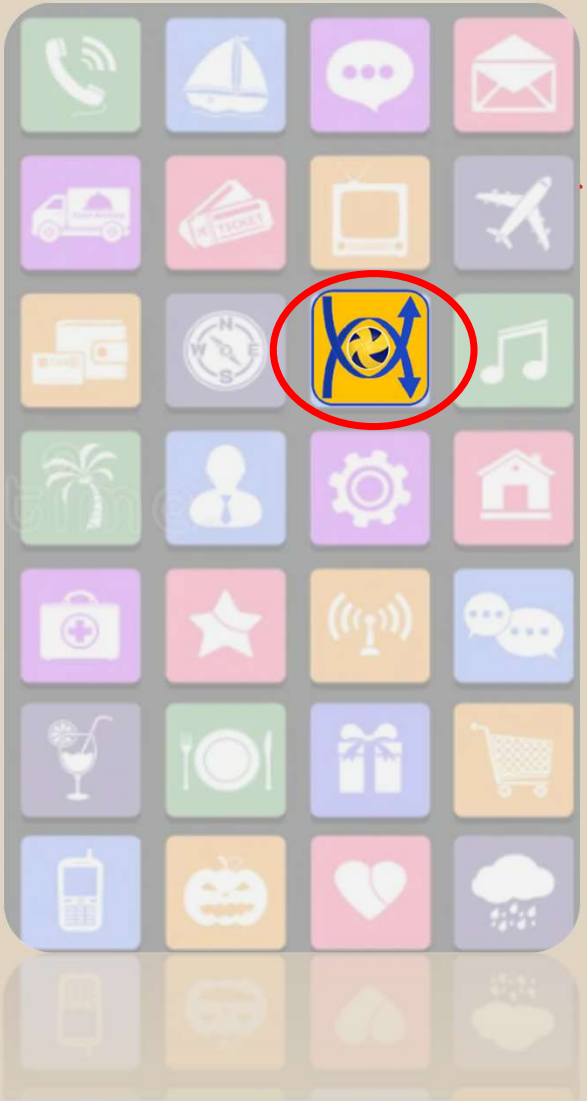
Interdisciplinary Approach
Combines sports science and software engineering to enhance coaching decision-making.

Real-Time Match-Up Optimization
The app provides instant match-up analysis by tracking team and opponent rotations in real time.

Pre-Game Analysis and Planning
Coaches can prepare strategies with detailed pre-game analysis and planning features within the app.

Enhanced Coaching Capabilities
This tool empowers coaches with data-driven insights, improving decision-making and adaptability in play. Aims to transform traditional coaching by providing real-time strategic support during games.

Technical Architecture



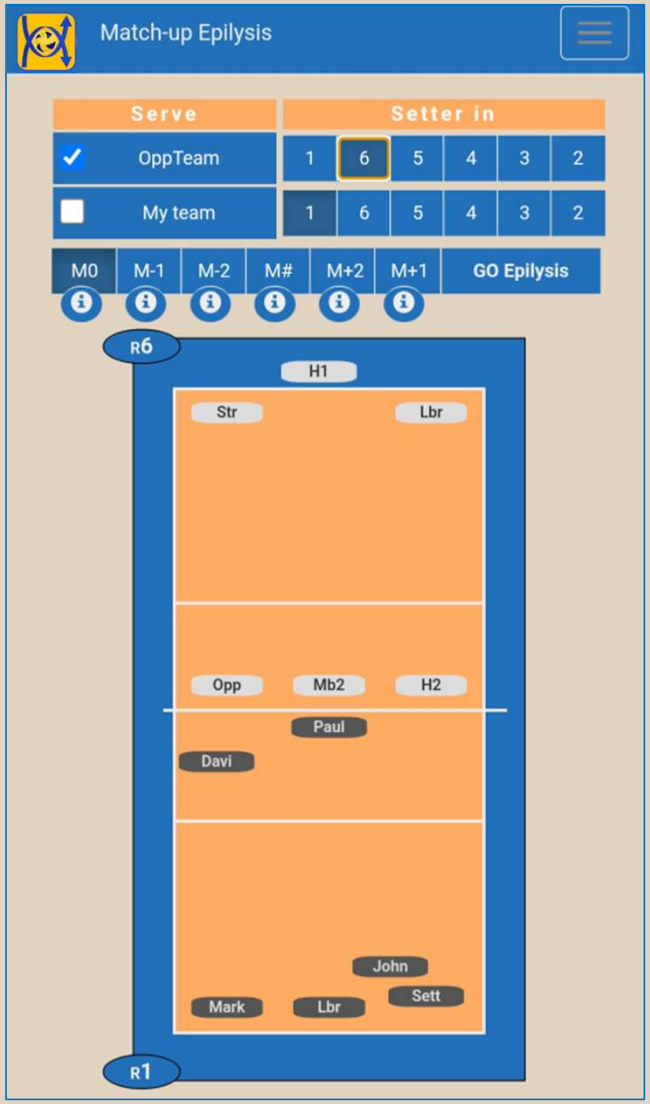
Progressive Web App Design
The app is designed as a PWA to function reliably in courtside environments with unstable internet connections.

Core Technology Stack
Angular, IndexedDB, and Capacitor provide modular structure, local storage, and cross-platform native deployment.

Key Architectural Advantages
Offline capability, cross-platform support, lightweight performance, and automatic updates enhance app reliability.

Reliability in Sports Setting
The architecture ensures the app remains functional and dependable during high-pressure coaching situations.

How it Works?



System Configuration and Operational Procedures
Team Selection and Roster Management:

- **Select** the appropriate team designation. The system defaults to "Other Team" and "My Team".
- **Populate** the rosters by inputting player names or numbers. By default, the positions are labelled with their standard in-game roles.

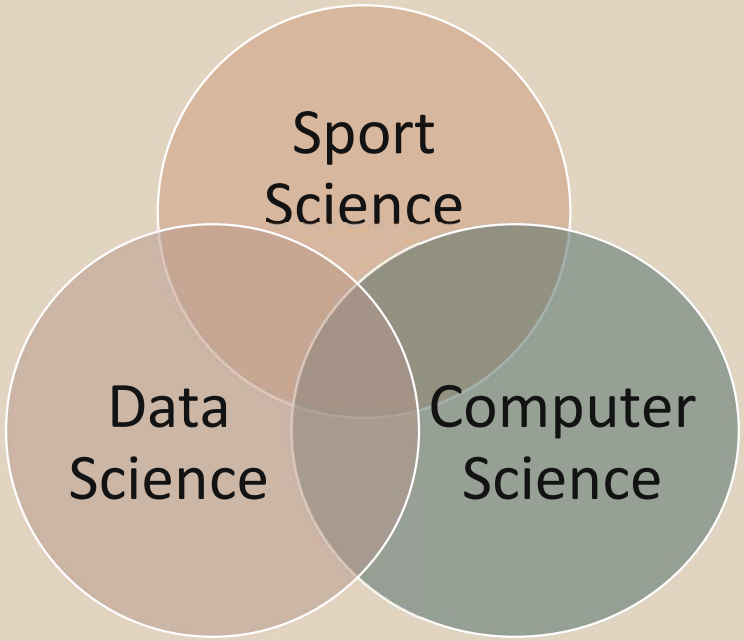
Initial Match Setup:

- **Designate** the initial serving team for the match.
- **Configure** the starting rotation for both teams.
- **Identify and tag** one key player on each team for specialized analysis.

Match Analysis and Live Tracking:

- **Review** the generated "Match-up Analysis" summary.
- **Access** the comprehensive view of the full rotational match-up.
    - The established starting rotation will be visually indicated by a red line.
- During the match, manually **select** and **update** the active rotational match-up as it changes.

Conclusion & Future Work



Future Enhancements
Planned upgrades include:

- Advanced analytics (Side-out and break point effectivity per rotation)
  - Simulation of the set (based on the i.i.d. assumption)
- Opponent strategy prediction by providing past match data per rotation
- Expanded iOS availability
- Cover other options of the game tactics (4 receivers or Rot1 new edition)

Key Achievements Summary

- The app provides real-time strategic insights, effectively solving critical volleyball coaching challenges.

Strategic Coaching Partner

- The application supports coaches in managing complex match-ups and enhancing strategic decision-making.

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