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The development of 'Petanque match statistics': an android-based application for petanque matches analysis

El desarrollo de 'Petanque match statistics': una aplicación para análisis de partidos de petanca basada en android

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Abstract. The accelerated pace of technological advancement necessitates that many disciplines align themselves with these developments, whether directly engaged in the process or not. The field of sports provides an illustrative example of the profound impact of modern technology on various disciplines. This research aimed to develop an Android-based statistical application, designated "Petanque Match Statistic," which was designed to analyze Petanque matches. The research and development (R&D) methodology was employed to undertake six project stages. The application, constructed on the Kodular platform, offers real-time data capture, sophisticated statistical analysis, interactive visualization, and comprehensive performance reporting. The application was subjected to rigorous alpha and beta testing to ensure its accuracy, reliability, and usability. Following its deployment, user training and a support system were established. Continuous evaluation and user feedback facilitated ongoing improvements. The application significantly enhances match analysis, benefiting players, coaches, analysts, and fans by providing accurate, real-time data and comprehensive insights, thereby promoting the growth and development of the sport of petanque.
Keywords: Android Application, Match Statistics, Statistical Analysis, Real-Time Data, Sports Technology

Resumen. El rápido desarrollo de la tecnología exige que diversos campos sigan estos avances, estén o no directamente implicados. El ámbito del deporte es un ejemplo de campo que ha experimentado un enorme desarrollo como resultado de la integración de la tecnología moderna. El objetivo de esta investigación era desarrollar una aplicación estadística basada en Android, "Petanque Match Statistic", diseñada para analizar partidos de petanca. Utilizando la metodología de Investigación y Desarrollo (I+D), se llevaron a cabo seis etapas: investigación inicial y recopilación de requisitos, diseño conceptual y creación de prototipos, desarrollo e implementación, pruebas y validación, despliegue y mejora continua. La aplicación, basada en la plataforma Kodular, incluye captura de datos en tiempo real, análisis estadístico avanzado, visualización interactiva e informes detallados de rendimiento. Las rigurosas pruebas, incluidas las fases alfa y beta, garantizaron la precisión, fiabilidad y facilidad de uso de la aplicación. Tras la implantación, se impartió formación a los usuarios y se estableció un sistema de apoyo. La evaluación continua y los comentarios de los usuarios facilitaron las mejoras en curso. La aplicación mejora significativamente el análisis de los partidos, beneficiando a jugadores, entrenadores, analistas y aficionados al proporcionar datos precisos en tiempo real y una visión completa, promoviendo así el crecimiento y el desarrollo del deporte de la petanca.
Palabras clave: Aplicación Android, Estadísticas de Partidos, Análisis Estadístico, Datos en Tiempo Real, Tecnología Deportiva

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Introduction

Petanque is a sport with deep roots in French culture. It has transcended its origins to become a globally recognized and celebrated game. It is played by individuals of all ages with various skill levels (Loser et al., 2011). Petanque has seen a significant rise in popularity and competitive participation. In recent years, it has been played in more than 160 countries with numerous international competitions (Helmi et al., 2024a).

The widespread adoption has increased the need for more structured and sophisticated methods of analyzing matches and player performance (Al Ardha et al., 2024). This sport has seen limited growth in Europe and countries throughout Asia and Africa. Furthermore, the US has embraced this sport, leading to a diverse and vibrant global community (Samoling et al., 2022). This globalization has brought about a greater exchange of techniques, strategies, and cultural influences, enriching the game and its players (Hernandez & DeLosFayosRuiz, 2009). Technology integration into sports has transformed how games are played, watched, and analyzed (Forte et al., 2021). Simple video analysis and wearable tech to advanced statistical software, technology has become an indispensable tool in modern sports (Chavarría-Fernández et al., 2023). In sports like soccer, basketball, and baseball, statistical analysis has provided deep insights into player performance, game strategy, and team dynamics (Ishida, 2020). However, technology adoption has been relatively slow in Petanque (Hidayah et al., 2024). Petanque traditional methods of scoring and match analysis are still prevalent. It relies heavily on manual input and subjective judgment. This gap presents a unique opportunity to develop tools that can bring the same level of sophistication and accuracy as in other sports. The "Petanque Match Statistic" program seeks to fill this gap by providing a platform that leverages technology to enhance match analysis and understanding. Based on research by Ardha et al. (2024) proves that the development of Android-based applications for match analysis is very effective and efficient. This is due to flexible mobility, allowing coaches and athletes to access anytime and anywhere. In addition, the development of training applications for

petanque conducted by Hidayah et al. (2024) has a positive impact on coaches and athletes through monitoring the implementation of the exercises performed. This application also reduces the risk of injury due to the lack of monitoring of petanque athletes.

In Petanque, the need for such analysis is particularly pronounced due to the game's strategic and precision-oriented nature (Phytanza et al., 2022). Statistical analysis will help understand player performance, identify strengths and weaknesses, formulate strategies, and enhance the game experience (Aidilla Pratiwi Siregar et al., 2023). Detailed statistics can help players and coaches understand individual performance metrics (Hughes & Bartlett, 2019).

Metrics of accuracy, consistency, and scoring efficiency are crucial in Petanque, where precision is paramount. By analyzing these metrics, players can identify areas for improvement and tailor their training accordingly (Helmi et al., 2024b). This sport is similar to chess; it is a game of strategy. Each throw can significantly impact the game's outcome, making it essential to plan moves carefully (Rizal et al., 2021). Statistical analysis can provide insights into successful strategies and common pitfalls, helping players make informed decisions during matches (Groll & Liebl, 2023).

For spectators, statistical analysis adds an extra layer of engagement (Lim, Han, & Yang, 2016). Detailed match statistics, player profiles, and performance trends can enhance the viewing experience, making the game more accessible and exciting for fans (Oh, Kang, & Kwon, 2022). Traditional evaluation methods in Petanque can be subjective, often influenced by the observer's perspective. A standardized statistical approach ensures that evaluations are objective, consistent, and reliable (Belouafa et al., 2017).

The "Petanque Match Statistic" program envisions a future where every aspect of the match can be accurately captured, analyzed, and presented. This vision includes several core components: real-time data capture, comprehensive analysis, interactive visualization, detailed performance reports, and a user-friendly interface. The program will allow for real-time input of match data, including scores, player positions, and outcomes of each throw. The program also ensures data is captured accurately and promptly, minimizing errors and discrepancies. This study aimed to report the development of the "Petanque Match Statistic" program as a comprehensive tool for capturing, analyzing, and presenting match data.

Materials and Methods

Research and Development (R&D) methods were applied to develop the Petanque Match Statistic (Figure 1). There are six stages of the R&D method as follows:

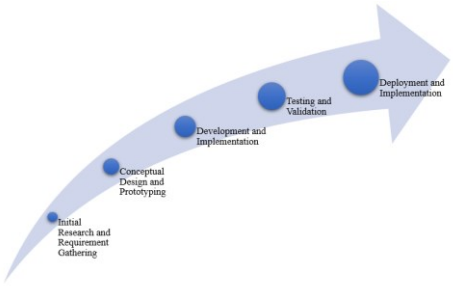

Figure 1. Research development flowchart of the petanque match analysis apps

Initial Research and Requirements Gathering

This phase begins with a thorough literature review of existing research on Petanque, sports statistics, and relevant technologies. By examining the current state of knowledge, it can identify best practices and gaps that our program can address. This foundational understanding sets the stage for a targeted and informed development process.

Next, engaging with key stakeholders through interviews and surveys is essential to gather detailed insights into their needs, challenges, and expectations. These interactions will provide a nuanced understanding of the most critical features and functionalities to the users. Players and coaches, for example, may prioritize real-time data capture and performance analysis, while analysts might focus on statistical rigor and visualization tools. Gathering this information directly from the end-users ensures the program is tailored to their specific requirements.

Finally, the last step is competitively analyzing existing sports statistics programs and tools. This involves studying their features, strengths, and weaknesses to understand what makes them successful and where they fall short. By analyzing competitors, it can identify unique value propositions for the "Petanque Match Statistic" program and ensure that our solution offers distinct advantages. The deliverables from this phase will include a comprehensive requirements report and a prioritized list of critical features for the program.

Conceptual Design and Prototyping

This phase involves creating detailed design documents that outline the overall architecture of the program, including user interface (UI) layouts, data flow diagrams, and feature specifications. The stakeholders will participate to see how the program looks and feels, facilitating feedback and refinement. Iterating on these designs based on stakeholder feedback can ensure that the program is intuitive and user-friendly.

Building on the wireframes and mockups will develop an initial prototype of the program that demonstrates core functionalities. This prototype will be a working model that users can interact with, providing a tangible sense of how the final program will operate. Prototyping is an essential step in the development process as it allows for early testing and feedback, helping to identify potential issues and areas for improvement before full-scale development begins. The

deliverables from this phase will include design documents, wireframes, mockups, and a functional prototype.

Development and Implementation

This application was developed using the Kodular Android app development platform similar to "MIT App Inventor." Coding in Kodular is performed using a block-based method rather than a command-line interface like Android Studio or Visual Studio Code. The UI design in Kodular is flexible, easy to understand, and relatively user-friendly for beginner developers. This begins with software development, using appropriate programming languages and frameworks to build the backend, frontend, and database components. The backend will handle data processing and storage, while the frontend will provide the user interface through which users interact with the program. The database will store all match data, player statistics, and other relevant information securely and efficiently.

Once the core components are in place, the development will focus on integrating key features such as real-time data capture, statistical analysis, interactive visualization, and performance reporting. Real-time data capture allows users to input match data as it happens, ensuring accuracy and timeliness. Statistical analysis will leverage advanced algorithms to provide deep insights into player performance and match dynamics. Interactive visualization tools will present data in an easily understandable format, while performance reports will highlight key metrics and areas for improvement.

Throughout the development process, it is necessary to conduct rigorous quality assurance testing to identify and fix bugs and issues. This includes unit testing, which checks individual components for correctness; integration testing, which ensures that different elements work together seamlessly; and system testing, which evaluates the program as a whole. Systematically testing the program at various stages will ensure it is reliable, efficient, and user-friendly. The deliverables from this phase will include a fully developed program and comprehensive documentation of its architecture, code, and features.

Testing and Validation

After development, the program must undergo thorough testing and validation to ensure it meets the desired accuracy, reliability, and usability standards. The testing phase begins with alpha testing, where a small group of internal testers uses the program to identify initial issues. This phase helps to catch significant bugs and usability problems early on, allowing developers to address them before broader testing.

Following alpha testing, the beta version of the program was released to a larger group of external users, including players, coaches, and analysts. Beta testing allows for a broader evaluation of the program under real-world conditions, helping to identify issues that may not have been apparent during alpha testing. User feedback during this phase is crucial for understanding how the program performs in various settings and making necessary adjustments.

In addition to alpha and beta testing, conducting specialized usability and performance testing is essential. Usability testing ensures that the program is easy to use and meets the needs of its target audience. This includes task-based testing, where users complete specific tasks to evaluate the program's interface and functionality. Performance testing evaluates the program's responsiveness and stability under different conditions, ensuring it can handle various workloads without issues. The deliverables from this phase will include tested versions of the program, detailed reports on testing results, and a final version that incorporates feedback and fixes.

Deployment and Implementation

The deployment phase involves rolling out the final version of the "Petanque Match Statistic" program to the target audience and ensuring a smooth implementation. This begins with detailed deployment planning, which outlines the steps and resources required for a successful rollout. Deployment planning includes setting up the necessary infrastructure, coordinating with stakeholders, and scheduling the deployment activities to minimize disruption and ensure a seamless transition.

Comprehensive training sessions and resources will be provided to ensure users can use the program effectively. Training will include user manuals, tutorials, and workshops covering all program aspects, from basic functionality to advanced features. These resources will help users understand how to input match data, analyze statistics, and generate reports, ensuring they can make the most of the program. By equipping users with the knowledge and skills they need, the program can maximize its impact and effectiveness.

Post-deployment will establish a maintenance system to assist users with any issues they may encounter based on user feedback. This includes providing technical support, addressing user queries, and offering regular updates to keep the program running smoothly. The deliverables from this phase will consist of a deployed and operational program, training materials, and a support and maintenance plan.

Evaluation and Continuous Improvement

Evaluation and continuous improvement are essential for ensuring the long-term success and relevance of the "Petanque Match Statistic" program. After deployment, it is important to collect feedback from users regularly to understand their experiences and identify areas for improvement. User feedback can be gathered through surveys, interviews, and usage analytics, providing insights into how the program is used and what changes might enhance its effectiveness.

In addition to user feedback, monitoring the program's performance ensures it meets the desired standards. This includes tracking key performance indicators (KPIs) such as accuracy, reliability, and user satisfaction. Performance

monitoring helps us identify any issues that may arise and address them promptly, ensuring the program continues to operate smoothly and effectively.

The deliverables from this phase will include regular updates and enhancements to the program, reports on user feedback and performance, and a continuously improving program that adapts to its users' needs.

Result

Initial variable and reset function to ensure the initial position

In programming, the initial step involves defining the required variables, all of which must be initialized to a value of zero (Figure 2). As the application is executed, the values of certain variables change due to commands triggered by the user interface buttons. Each button is associated with a distinct command that modifies the variable values, resulting in a diverse range of possible outputs. Some of these variables are integral to mathematical algorithms that ultimately compute the team score. Upon completing a given stage and transitioning to the subsequent stage, the user needs to reset all variable values back to zero. Neglecting to do so would lead to the continuation of the previous stage's variable values, which would be compounded with those of the new stage, thereby rendering the new stage's score inaccurate and introducing data inconsistencies. Consequently, a reset function is indispensable, as it ensures that all variables revert to their initial state of zero, thereby maintaining the integrity of the scoring process.

Figure 2. Initial variable and reset function to ensure the initial position

Code executing the analytical function

Most variables utilized in the application remain hidden from the user, with only the final results of the mathematical computations being visible (Figure 3). Specific variables are designated for value assignment, while others are dedicated to executing analytical processes. The analytical variables substitute values into mathematical formulas, generating key performance metrics such as team scores (throws, pointing, shooting) and success rates. These computed outputs are then presented to the user within the designated results display section of the application.

Figure 3. Code executing the analytical functions

Application Development Process

The development stage marks the transition from conceptual design to actual construction and management of the application (Figure 4). During this phase, the application's code structure is meticulously organized, and the build process is executed using the Kodular platform, a block-based development environment. Kodular's visual programming interface allows for efficient code organization and integration of essential features. This phase also involves refining the user interface (UI) by making critical adjustments to button layouts, selecting appropriate design elements, and ensuring the application is visually appealing and functionally effective.

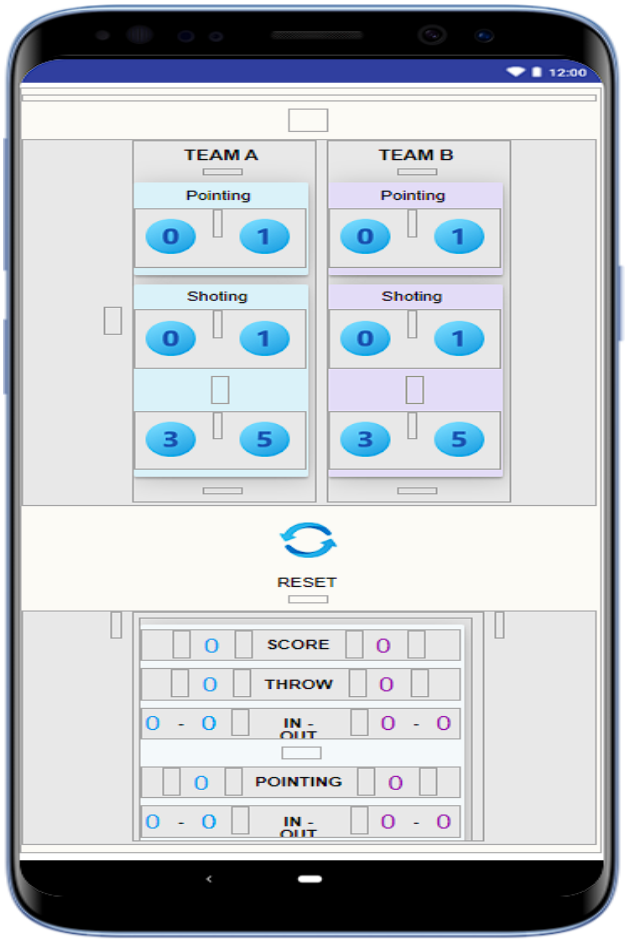

Figure 4. Development view

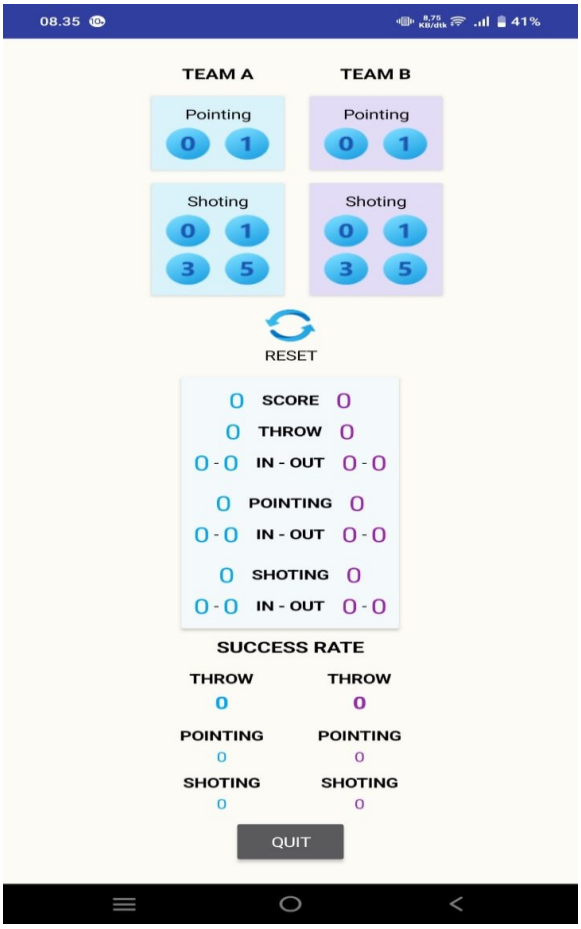

Figure 5. Normal app view

Following these refinements, the application undergoes a thorough review to confirm that the design aligns with user needs and expectations. The focus is on achieving a balance between functionality and user experience. Once these aspects are finalized, the application reaches a stage where it is fully prepared for rigorous testing. The prototype is ready to undergo alpha and beta testing phases, ensuring that any usability issues or technical glitches are identified and addressed before the final release. The application is then primed for deployment to digital distribution platforms (Figure 5), such as Google Play Store, marking a critical step towards making the tool accessible to a broader audience.

Application Deployment on Digital Platforms

The petanque match analysis application has been made widely available to users after extensive development and rigorous testing phases. The deployment process enables Android users to download and install the application via the Google Play Store, a leading digital distribution platform (Figure 6). This strategic release is expected to drive significant advancements in the application's development and the overall growth of the sport. By making the application accessible to a broad audience, this deployment stage marks a critical milestone in enhancing the analysis capabilities within Petanque, offering stakeholders a powerful tool for data-driven insights.

The feedback from real-world users during the application's initial deployment phase will be pivotal for continuous improvement. User evaluations and practical insights will be critical inputs for refining the application's features, optimizing performance, and addressing unforeseen issues. This iterative process of incorporating user feedback ensures that the application remains relevant, effective, and aligned with the evolving needs of coaches, athletes, and analysts. Ultimately, this ongoing evaluation will contribute to the sustained enhancement of the application, reinforcing its role in driving the future development of petanque as a competitive sport.

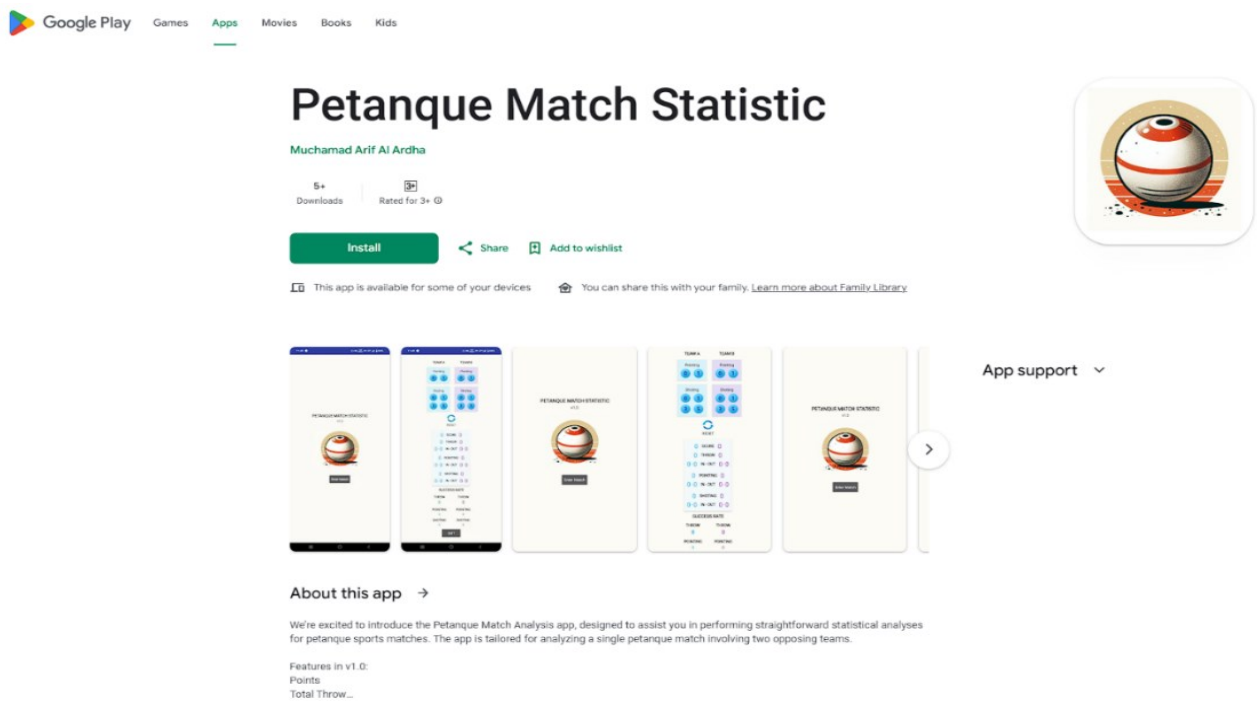

Figure 6. Availability on playstore

Discussion

Petanque is a sport deeply rooted in French culture and is known for its strategic gameplay and increasing popularity worldwide (Eler & Eler, 2018). Despite its rich history and growing international presence, Petanque needs more sophisticated tools for analyzing player performance and match statistics. This study aimed to report the development of the "Petanque Match Statistic" program as a comprehensive tool for capturing, analyzing, and presenting match data.

This development research obtained the results as an android-based application that analyzes matches in petanque sports. The match analysis is carried out using a percentage of athlete success based on the results of the throws made. Researchers provide easy access to users with the availability of this application through Google Playstore. The implementation of the Android system in the development of this application impacts its efficiency and effectiveness. A design that is simple and easy to understand also supports the efficacy of this application.

Research on the sport of Australian football by Aarons et al. (2024) proved that the application of artificial intelligence (AI) to computer systems, namely decision support systems (DSS), is practical in time efficiency and focuses on important performance. In addition, it helps trainers in time management and information management as well. Meanwhile, according to Lin et al. (2024), implementing virtual reality in badminton match analysis can reduce workload and time efficiency compared to manual analysis. The development of Android applications in taekwondo sports for match analysis was also carried out by Ardha et al. (2024). Furthermore, according to Ardha et al. (2024), the Android-based application developed can increase efficiency and accuracy in analyzing taekwondo matches. In addition, this application can also be utilized for competition preparation or during the training process.

The need for statistical analysis in Petanque is multifaceted (Irawan et al., 2022). For players and coaches, detailed statistics can provide performance insights, helping identify strengths and weaknesses (Waters et al., 2019). For analysts, statistical data is crucial for understanding trends and developing strategies (Barbosa et al., 2021). Fans and enthusiasts also benefit from enhanced viewing experiences, with real-time data adding depth to their understanding of the game (Uhrich, 2022). A robust statistical tool can elevate the sport by providing objective, data-driven insights that improve training, strategy, and engagement (Tsai et al., 2016).

An android-based solution for petanque match statistics offers several advantages. Android's widespread adoption and user-friendly interface make it an ideal platform for developing accessible and practical applications (Perdana et al., 2021). Leveraging Android's capabilities can create a real-time tool that captures, analyzes, and presents data, providing immediate feedback and insights (Cuesta-Morales et al., 2022). This approach ensures that the tool is accessible to a broad audience, from professional players to casual enthusiasts, and can be used in various settings, from local clubs to international tournaments (Rana et al., 2023).

Interactive visualization tools are also essential for making data easily understandable (Wang et al., 2020). The application will include charts, graphs, and heat maps that visualize match data and trends (Rekik et al., 2021). These visualizations help users quickly grasp vital insights and make informed decisions (Sungkono et al., 2017). For example, a heat map can show the distribution of successful throws,

highlighting the areas where a player excels or needs improvement (Kondo et al., 2022). Such tools are helpful for players and coaches and enhance the viewing experience for fans.

A well-designed interface enhances usability, reduces the learning curve, and ensures that users can quickly access the needed features (Hao et al., 2022). One of the primary principles of good UX design is simplicity (Choi, Kim, & Yoon, 2014). The interface should be clean and uncluttered, with clear navigation paths and minimal distractions. Users should be able to easily find and use features without having to navigate through complex menus or multiple screens (Velasquez, Garcia, Ramirez, Gholkar, & Torres, 2021). Using familiar icons and terminology helps users quickly understand the application's functions. Consistent design patterns and layouts across the application also contribute to a seamless user experience. Users should be able to customize the interface based on their preferences, such as changing themes and font sizes or arranging dashboard elements (Gupta, Sisodia, Fazulbhoy, Raju, & Agrawal, 2019).

Another essential consideration is responsiveness and feedback. The application should respond quickly to user inputs, providing immediate feedback to indicate that actions have been recognized (Folt, Lam, Miller, & Goyal, 2021). This is especially important for real-time data capture, where delays or unresponsive elements can lead to frustration and errors. Visual and auditory feedback, such as highlighting selected options or playing confirmation sounds, helps users confirm their actions and enhances their interaction with the application.

The android-based petanque match statistics application has the potential to transform the sport by providing a comprehensive, data-driven approach to match analysis. The application fosters a deeper understanding and appreciation of the game by addressing the needs of players, coaches, analysts, and fans. This innovation supports the growth and development of Petanque, helping it reach new heights in terms of performance, strategy, and engagement.

However, the development of this application has a challenge that needs to be considered for future research. At the start of development, the app could facilitate up to 25 match stages for two teams, each containing three players. The hope was to enable the app to obtain data results for each stage and each player's performance. In realization, coding the application was more complicated than expected. Facilitating 25 stages meant 25 layers of mathematical formulas that had to be linked to the user interface (UI). The complexity made the buttons in the user interface more numerous, smaller, and difficult for the user to operate.

Based on these problems, the researcher decided to design more concisely by only facilitating 1 stage. In addition, it does not distinguish between player one and player 3 in the team. The score that appears is summarized only by the team score in 1 stage without distinguishing who throws. When switching to the next stage, players must press the reset button to return to the initial position of the application. This more concise design has made the UI more superficial and accessible. The design and coding process became more accessible and faster as well.

In summary, developing an android-based statistical tool for Petanque is a necessary and timely innovation. It addresses the current limitations in match analysis and offers a comprehensive solution that benefits players, coaches, analysts, and fans. By providing accurate and real-time data, the tool can enhance the overall experience of the sport, fostering growth and development in the Petanque community.

Conclusion

The development of an Android-based Petanque match statistics application is a significant advancement in the analytical capabilities of this sport. Utilizing the Android system in this application provides a comprehensive solution to capture, analyze, and present data. Real-time data presentation, advanced statistical analysis, interactive visualization, and detailed performance reports impact both coaches and athletes to monitor effectively and efficiently. Through internal testing by stakeholders involved in this study, this application received a pretty good level of satisfaction with some evaluations.

The Petanque match statistics application needs to be developed to perfection and provide a more satisfying user experience. Design improvements such as color and font selection can be made. Team name customization features also need to be added to provide more accuracy in the analysis process. Its availability on various platforms, not just on PlayStore, will be a positive point in terms of accessibility.

Further research is needed to develop Petanque applications that can measure, analyze, and evaluate team match numbers directly. Research also needs to be done to test the validity and reliability of this application. Thus, the modernization of the Petanque match system and accurate analysis tools can be developed optimally.

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