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App-Based Volleyball Scoreboard Performance Evaluation

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Abstract

Study purpose. This research aims to develop and evaluate an application-based volleyball scoreboard game device designed to facilitate the process of recording and managing scores in real time.

Materials and methods. This research uses the R&D development method which aims to develop a device-based volleyball game scoreboard application. This research involved 3 IT experts, 5 referees who acted as evaluators of the initial product that had been developed. In addition, there were 5 samples in the small-scale test and 30 samples in the large-scale test.

Results. The results of the analysis of the development of application-based volleyball scoreboard game devices by conducting feasibility / justification tests involving economic, technical, business and environmental aspects by refereeing experts, which obtained an average value of 91.60%, where the value was included in the very good category. While the results of the analysis of IT experts obtained an average value of 90.89%, where the value is included in the very good category. The results of the analysis of the effectiveness of the media development of the application-based volleyball scoreboard game device through a small scale test, which obtained an average value of 92.63%, which means it can be concluded that the development model of the application-based volleyball scoreboard game device that has been developed can be implemented/applied with a very good category. Meanwhile, the results of the large-scale test or broad-scale test obtained an average value of 90.94%, which means it can be concluded that the development model of the application-based volleyball scoreboard game device that has been developed is in the excellent category.

Conclusion. In conclusion, this application-based volleyball scoreboard game device can be an effective solution to overcome the obstacles of manual score recording, while improving the quality of organising volleyball matches.

Keywords: Game Device, Score Board, Volleyball, App-Based

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Introduction

Information technology has developed rapidly and has had a significant impact on various aspects of life, including sport (Ranuharja et al. 2021). One of the sports that has

undergone significant technological development is volleyball. Based on a preliminary study through observation and interviews with volleyball officials or Pengurus Provinsi Persatuan Bola Voli Seluruh Indonesia (PENGPROV PBVSI) South Sumatra, coaches, referees and Proliga players in Sumatra Province, it was concluded that they need the development of an application-based volleyball scoreboard game device. Scoreboards or traditional scoreboards, which are still widely used in various volleyball matches, often have limitations in terms of flexibility, accuracy and efficiency. The use of a manual scoreboard requires intensive supervision, and there are often errors in the recording of the score, which can affect the quality of the match. Therefore, there is an urgent need to develop more sophisticated and integrated application-based scoreboards to improve the efficiency and accuracy of volleyball scoring. (Marsofely and Setiawan 2023).

Previous research shows some efforts to develop digitally based applications to record scores in various sports. (Nisdawati and Handican 2022; Sari, -, and Handayani 2022; Umar, Sabtu, and Sukur 2022). Researched the development of an Android-based scorekeeper application for volleyball that successfully improves the speed and accuracy of scoring compared to manual methods. (Triyanto, Yasi, and Hadi 2021). Developing video assistant referee systems in football, enabling real-time access and better data integration (Radzuwan, Rosdi, and Abdul Rasid 2024; Salam, Hita, and Juliansyah 2021). However, in the context of volleyball, there is still limited research focused on the development of scoreboard applications that can meet the specific needs of this sport, such as player rotation settings, game statistics recording, and integration with other devices.

The concepts of human-computer interaction (HCI), real-time systems and software/hardware integration are often used as a basis for the development of technology-based applications in sport (Hamsiah, Saepudin, and Darmawati 2022; Wei et al. 2023). HCI theory emphasises the importance of intuitive and easy-to-use user interface design, which is very important in the development of volleyball scoreboard applications. In addition, the real-time system concept ensures that input data can be processed immediately and displayed without delay, which is particularly important in sports matches (Basri and Rosid 2021; Sriwahyuniati et al. 2022; Stevenson 2021). A new contribution from this research is the development of scoreboard applications that not only record scores, but also include features such as player rotation, statistical recording and integration with other devices such as monitors or large screens on the pitch.

Some studies have developed scorekeeper applications for different sports, but there is no application developed specifically for volleyball that includes full features such as player rotation and game statistics logging. Most applications focus on simple score keeping without considering the specific needs of a volleyball game. Therefore, this study aims to fill this gap by developing an application-based volleyball scoreboard application that is more comprehensive and meets the needs of modern games. This study aims to develop an application-based volleyball scoreboard that is efficient and accurate, provides an easy-to-use player rotation recording feature and complies with the rules of the game, improves the accuracy and speed of scoring with real-time technology, facilitates the integration of scoreboard applications with other devices such as monitors or large screens, and provides comprehensive game statistics recording features for further analysis.

Materials and methods

Study participants

This study involved 3 IT experts, 5 referees who act as evaluators of initial products that have been developed. In addition, in this study, 5 samples in the small-scale test and 30 samples in the large-scale test consisted of application users, most of whom acted as referees for volleyball matches. They were selected to test and evaluate the scoreboard application

developed, to ensure that the application fits the needs and can be operated properly in volleyball matches. These experts are selected on the basis of their expertise relevant to the field of information technology and refereeing in sport in order to provide a comprehensive assessment.

Study organization

This research uses R&D development method, which aims to develop a volleyball scoreboard game device based on application. This study used Borg and Gall development model adapted into seven stages. These stages include: (1) research and Information Collection, (2) Planning, (3) initial product development, (4) small-scale initial trials, (5) product revision, (6) large-scale field trials, and (7) final refinement and implementation. Each stage is tailored to ensure product development is effective and relevant to research needs (Hamzah 2021; Risal, Hakim, and Abdullah 2023; Sugiyono 2019). This research process involves several stages, including needs analysis, design, development, testing and product evaluation. In the needs analysis stage, data is collected through interviews and questionnaires to identify the features required in the application. The design stage involves the creation of an initial prototype, which is then further developed in the development stage (Efendy et al. 2022; Rahayu, Irawan, and Nuzulah 2022; Untari et al. 2021). Trials are conducted in real-world conditions to evaluate the functionality and performance of the application. The results of these trials are then analysed and used to improve the product. The initial product description for the development of an application-based volleyball scoreboard game device in Figure 1 is as follows:

Figure 1. Product Display Initial Score Board Game

From the expert evaluation of the development model of the volleyball scoreboard game based on the developed application, there are several inputs and suggestions on the developed products that still need improvement and refinement by adding items such as score sheets, timeouts, number of substitutions, background colours and logos that can be customised. The expert validation questionnaire items in Table 1 are as follows:

Table 1. IT Expert Validation Questionnaire Application

No.	Assessed aspects	5	4	3	2	1	Comments
1	Features already working well						
2	Recording game results and scores well and completely						

3	Have good communication skills in English
4	The accuracy of the data entered into the scoreboard application is good
5	The application is well connected to the monitor
6	The application is connected and can be properly accessed by the referee at the secretary's desk (live scores).
7	Application can be used in indoor or outdoor field
8	This application is more practical to use
9	The application display has automatic lighting settings
10	Has an attractive and original design

From the results of the analysis of the questionnaire given to the IIT experts, there are several inputs and suggestions from these experts and then the researchers improve and refine the products developed according to the suggestions and inputs from the experts. The things that were improved by the researcher in Figure 2 are as follows:

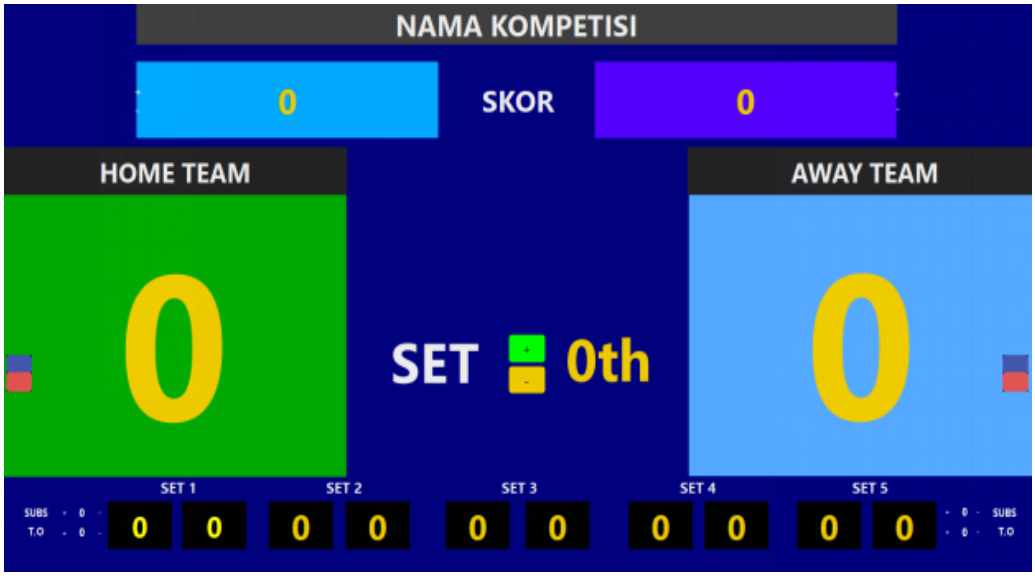


Figure 2. Revision Of The Product Initial Display Score Board Game

The assessment grid and criteria can be seen in table 2 below:

Table 2. Questionnaire scoring grids and criteria

No.	Aspects and indicators	Description	Description
1.	Originality :	Already have the application peenghitung score teetapi still using manual/digital	1-2
	Original work by researchers Have different characteristics	Product does not replicate existing applications	3-4
		The product has a different look than existing applications	5-6

2.	Advantages:	The scoreboard application has advantages over manual and digital scoreboards	7-8
		The application has an automatic nature in its use.	9-10
	Advantages in terms of usability	The application is supported by a modern menu system.	11-12
		Easy to install application	13-14
3.	Excellence in terms of simplicity	Application is easy to understand as peenggaannya	15-16
	Suitability:	Application can be used in standard volleyball matches	17-18
		Application provides convenience for match referees	19-20
4.	Advantages of the application in terms of use	Application helps referees and coaches to know seecara quickly on the status of the match	21-22
		The application is a modern application at an affordable price.	23-24
5.	The benefits of the application in terms of convenience	Applications have the potential to be commercialised for the benefit of the game	25-26
		Safe application to use during a match	27-28
6.	Economical:	Applications that are easy for referees to use during a match	29-30
		Applications that are more complete in terms of supporting menus of existing applications	31-32

Statistical analysis

The technique of data analysis in this study used quantitative and qualitative descriptive approach to evaluate the development of volleyball scoreboard game device based on application. The validity test involves the evaluation of experts, including referees and IT

experts, using questionnaires designed to measure product quality. The data obtained is analysed using the validity formula and the results are interpreted into categories ranging from "very good" to "less than once" according to the value intervals established. In addition, feasibility or effectiveness tests are carried out to assess aspects such as originality, excellence, usefulness, economy, safety, comfort and completeness of the device. The results of this feasibility test are also interpreted on the basis of the same category. This statistical analysis approach allows the study to provide a comprehensive evaluation of the validity and feasibility of the product to support decision making in the development and implementation of application-based volleyball scoreboards.

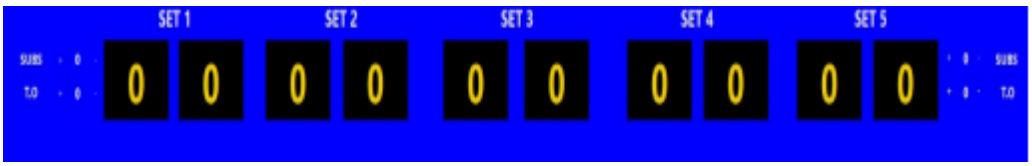
Results

Early product development is the stage where a product is first designed, developed and tested before it is widely marketed. Some important things from the experts' input that can be used as a consideration in designing the initial product development model of the volleyball scoreboard game device based on the application used in the match are as follows:

1) ScoreBoard Screen Display

2) Name of competition and Score result

3) *Score Seet*



4) *Timer*

5) Overall Score Board view

After going through three stages of research development, which include preliminary studies (research and information gathering), planning (planning) and design development (developing preliminary of the product). Then the next step is to conduct an expert justification test to obtain the feasibility of the model. The feasibility of the model is tested theoretically through expert validation and empirically through practical tests.

The results of the feasibility test validation of the product development of the volleyball scoreboard game device based on the application by providing 10 (ten) question items. A product feasibility test score of 1 to 5 is then presented to determine the feasibility of the developed product. The results of the feasibility test can be seen in the following table 3:

Table 3. Analysis Of Referees ' Eligibility Test

No	Respondent	Total	Value	Percentage (%)
1	R1	47	94.00	94.00
2	R2	48	96.00	96.00
3	R3	44	88.00	88.00
4	R4	44	88.00	88.00
5	R5	46	92.00	92.00
	Average			91.60

Based on the results of the analysis of the feasibility test of the referee expert above, the average value of the feasibility test of the referee expert on the development model of the application-based volleyball scoreboard game is 91.60%, which is in the excellent category. From the calculation of the results of the average value of five respondents referee experts with

ten aspects of the feasibility test questions, it can be concluded that it is very good and worthy of use in the development of the application-based volleyball score board game device.

Furthermore, the feasibility test in the development of an application-based volleyball scoreboard game device was validated by 3 (three) IT experts. The following is the result of the validation of the feasibility test of the application-based volleyball score board game development product by providing 10 (ten) question items. The product feasibility test scores, ranging from 1 to 5, are then presented to determine the feasibility of the developed product. The results of the feasibility test can be seen in the following table 4:

Table 4. Analysis Uji Kelayakan Ahli IT Scoreboard

No	Respondent	Total	Value	Percentage (%)
1	R1	47	94.00	92.67
2	R2	48	96.00	93.33
3	R3	44	88.00	86.67
	Average			90.89

The average value of the feasibility test by IT experts on the development model of the application-based volleyball score board match device is 90.89%, where the value is included in the excellent category. From the calculation of the average value results by three IT expert respondents with ten aspects of feasibility test questions, it can be concluded that it is declared very good and feasible to use in the development of an application-based volleyball score board match device.

This initial field trial will be conducted at an event or friendly match between clubs in Palembang city which is held at the Jasdam II Sriwijaya field with a total of 5 (five) referees as respondents. The data can be seen in table 5 below:

Table 5. Results Of Analysis Of Small-Scale Trials

No	Respondent	Total	Value	Percentage (%)
1	R1	47	94.00	94.00
2	R2	48	96.00	96.00
3	R3	44	88.00	88.00
4	R4	46	92.00	92.00
5	R5	46	92.00	92.00
	Average			**92.63**

The results of the analysis obtained an average value of 92.63%, which means that it can be concluded that the development model of the volleyball scoreboard game based on the developed applications can be implemented/applied with very good categories. The results of small scale trials on the implementation in the field there is some input and advice from the referee on duty in the field together with researchers. Revisions that need to be improved are the addition of a time-out menu and the number of substitutions displayed on the volleyball scoreboard. Adding an edit menu to change the logo and background colour on the display, which can later be adapted to the competing team.

Extensive testing was carried out with up to 30 respondents consisting of referees, coaches and athletes from various regional and national tournaments. The following are the results of direct observation by the researchers, supported by a team of refereeing experts and a team of IT experts, who together directly observed each implementation of the application-based volleyball scoreboard game development model. The results of the large-scale research are in table 6 as follows:

Table 6. Results Of Analysis Of Large-Scale Trials

No	Respondent	Total	Value	Percentage (%)
1	R1	45	90.00	90.00
2	R2	46	92.00	92.00
3	R3	43	86.00	86.00
4	R4	47	94.00	94.00
5	R5	45	90.00	90.00
6	R6	46	92.00	92.00
7	R7	44	88.00	88.00
8	R8	48	96.00	96.00
9	R9	45	90.00	90.00
10	R10	46	92.00	92.00
11	R11	44	88.00	88.00
12	R12	47	94.00	94.00
13	R13	43	86.00	86.00
14	R14	45	90.00	90.00
15	R15	46	92.00	92.00
16	R16	44	88.00	88.00
17	R17	47	94.00	94.00
18	R18	45	90.00	90.00
19	R19	43	86.00	86.00
20	R20	46	92.00	92.00
21	R21	48	96.00	96.00
22	R22	44	88.00	88.00
23	R23	45	90.00	90.00
24	R24	46	92.00	92.00
25	R25	47	94.00	94.00
26	R26	43	86.00	86.00
27	R27	45	90.00	90.00
28	R28	46	92.00	92.00
29	R29	44	88.00	88.00
30	R30	48	96.00	96.00
	Average			90.94

The table above shows the scores and percentages for each of the 30 respondents, with an average percentage of 90.94%. The results of a large-scale trial analysis in table 6 above, by distributing a closed questionnaire to 30 respondents about the application-based volleyball score board game development model. From the results of the analysis, an average value of 90.94% was obtained, which means that it can be concluded that the development model of the volleyball scoreboard game device based on the developed application is in the very good category.

Discussion

This study uses Borg and Gall model development research, which was conducted with 7 (seven) stages of research tailored to the needs of researchers. The results of this study started from the needs analysis carried out with the distribution of closed questionnaires and interviews, the results of which are the needs for the development of application-based volleyball scoreboard game development models. This innovative step is a form of effort to help improve and facilitate the performance of referees in carrying out their duties in a match.

The development of the application-based volleyball scoreboard game device has been validated and declared very feasible by experts, namely refereeing experts and IT experts. The

development of this application-based volleyball score board game device is described in the form of a display through a projector. The development model of the volleyball scoreboard game device based on the developed application is systematically arranged.

In the course of conducting the initial field trials, with the participation of referees and IT experts as research subjects, the results of the application-based volleyball scoreboard game device development model that can be later applied and used in the next phase of the trial are obtained. Then, the application-based volleyball scoreboard game development model will be revised according to the input and suggestions. After the initial field trial, a feasibility test was conducted by distributing a closed-ended questionnaire to 5 referees and 3 IT experts with a set of 10 questions. As for the results of the feasibility test of the referee expert, which obtained an average value of 91.60% and the results of the IT expert obtained an average value of 90.89%, where the average results of both are included in the category of very feasible.

After carrying out the feasibility test, further small-scale trials were carried out with 5 referees in charge of event or regional matches as research subjects, with an average value of 92.63%, which means that these results can be classified in the excellent category. Once the results of the small-scale trials were known, large-scale trials were carried out with 30 respondents from various local and regional match events. The results of the analysis of the large-scale trials conducted get an average value of 90.94%, which means that it can be concluded that the results of large-scale trials of the development of volleyball scoreboard game devices based on applications that are in the category of excellent.

The results are also supported by previous studies showing that the application can be used to assist referees or spectators watching a match, with four sports options that can be used, namely football, badminton, basketball and table tennis, as well as displaying the score of each team competing (Suripto and Suhermon 2022; Syaputra 2022; Willis and Erwin 2022). Research a volleyball match monitoring system that helps in recording scores, player rotations, time-outs, and substitutions, so that referee errors can be minimized (Agustini Raaiyatini et al. 2024; Manullang and Ngatimin 2023; Rubiyatno et al. 2023). The system consists of a mobile-based application for referees and a desktop application for the organising committee, built using the Java programming language. Next, the badminton scoreboard calculation research aims to design a badminton scoreboard tool using Arduino and IoT to produce fair play calculations to prevent cheating in the calculation of match scores and to facilitate the input of numbers in badminton matches (Dieu et al. 2022).

Subsequent research on match organisers recorded lineups, service executions, player rotations, game points, substitutions, final sets, team captains, libero players and overall match results, which can be printed at the end of the match (Probo Ismoko and Putro 2023). Research into scoreboard applications for Android-based sports games has resulted in scoreboard applications using Matrix P10 LEDs that can be controlled by a smartphone running the Android platform, which can be applied to various sports such as volleyball, futsal, basketball and badminton. (Naji, Shabkhiz, Rezaei, Derakhshi, & Kordi, 2021; Wheaton & Thorpe, 2021a, 2021c, 2021b).

Previous studies have shown that various applications and systems have been developed to assist referees and spectators in monitoring sports matches, recording scores, player rotations and substitutions. Some of these applications include different sports such as football, badminton, basketball, table tennis and volleyball. The use of technologies such as Arduino, IoT and Matrix P10 LEDs in scoreboard applications further improves the accuracy and efficiency of scoring and simplifies match management, which also prevents cheating and refereeing errors. These applications not only make it easier to input and record data, but can also be accessed via mobile and desktop devices, as well as allowing the final results of the match to be printed in physical form.

Conclusions

This research has successfully developed an application-based volleyball scoreboard match device that represents a significant novelty in the field of sports technology, with important contributions to knowledge and practice in the industry. The results of feasibility tests with referees and IT experts showed very good average values, indicating that the device is ready for implementation. In addition, small and large scale effectiveness tests showed consistent results, supporting the conclusion that the app is effective in supporting referee performance and improving match efficiency. Methodologically, this research provides a new approach in developing technological devices that are relevant to practical needs in the field, while practically, this application provides innovative solutions for BPVSI administrators in South Sumatra Province, as well as insight and inspiration for coaches and athletes in volleyball.

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Conflict of interest

The authors declare that they have no competition.

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