



Development of a Smartphone-Based Prototype of a Water Multistage Fitness Test Application Instrument

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Abstract

This study aims to: (1) Develop a water MFT test instrument to measure the aerobic endurance of KU-1 swimmers. (2) Design an AFA smartphone application as a database for the aerobic endurance of KU-1 swimmers. (3) Analyze the feasibility of a smartphone-based AFA water MFT instrument application for measuring the aerobic endurance of KU-1 swimmers. This research is a Research and Development (R&D) study with an ADDIE (Analysis, Design, Development, Implementation, and Evaluation) design. The results of the study showed that: (1) The results of the endurance test on land obtained a range of values of levels 8.2-8.8 in the very poor category, a range of values of levels 8.8-9.4 in the poor category, a range of values of 9.4-10.0 in the sufficient category, a range of values of levels 10.0-10.6 in the good category, and a range of levels 10.6-11.2 in the very good category. The results of the endurance test in water obtained a range of values of levels 3.5-4.0 in the very poor category, a range of values of levels 4.0-4.6 in the poor category, a range of values of 4.6-5.1 in the sufficient category, a range of values of levels 5.1-5.7 in the good category, and a range of levels 5.7-6.2 in the very good category. (2) The results of the assessment of material experts for physical conditions 1 and 2 were declared suitable for use with a good percentage of 41.7% and a very good percentage of 58.3%. The results of the assessment of swimming practitioner 1 with a good percentage of 12.5% and very good 87.5%. While swimming practitioner 2 with a good percentage of 20.8% and very good 79.2%. So the application is declared suitable for use. The results of the media expert assessment are declared suitable for use with a good percentage of 18.8% and very good of 81.2%. (3) The results of small-scale tests obtained the results that athletes who have aerobic endurance are categorized as very good 3 athletes with a percentage of 20%, good 3 athletes with a percentage of 20%, sufficient 2 athletes with a percentage of 13.3%, less 2 athletes with a percentage of 13.3%, and very less 5 athletes with a percentage of 33.3%. The results of the large-scale test showed that 7 athletes with good aerobic endurance (23.3%), 9 athletes with adequate aerobic endurance (30%), 7 athletes with poor

Keywords: Water MFT, Instrument, Smartphone, Aerobic Endurance, Swimming

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INTRODUCTION

Swimming is a very popular sport in Indonesia, both among children and adults, men and women, for various purposes, including recreation, maintaining fitness, and achieving success (Saputra et al., 2020). Swimming is a healthy sport because almost every muscle in the body moves and develops by coordinating the strength of each swimmer (I. Pratiwi, 2015). Regular swimming will strengthen and develop muscles, which in turn will help the organs in the body work well (DW Cita, 2013). Swimming is not only good for your health, but also a good way to spend your free time or have fun (Imansyah, 2020). Swimming is a water sport that is very easy for people to enjoy,

because it is easy to do and available everywhere (F. A. Nugroho & Fifukha Dwi Khory, 2020). Swimming is a very popular sport worldwide, both for recreation and competition. It's a water sport that can be enjoyed by anyone, men and women, regardless of age (Yudha Prawira et al., 2021).

Achieving success in sports is quite a complex thing, because many factors influence it (Pratama et al., 2020). Coaching in swimming is one of the efforts to increase the achievement of maximum performance through coaching at a young age (Falaahudin & Sugiyanto, 2013a). Physical condition is one of the prerequisites that is very necessary in every effort to improve performance (Mahdayeni et al., 2019). The physical condition of an athlete plays a very important role in his training program (Ichwanun NH, 2017). Physical conditioning training programs must be well planned and systematic and aimed at improving physical fitness and the functional capabilities of the body's systems, thereby enabling athletes to achieve better performance (Hinda Zhannisa et al., 2018). Physical condition is a prerequisite that is absolutely necessary in efforts to improve an athlete's performance, it can even be said to be a basic need that cannot be postponed or negotiated (Irawadi, 2011). The importance of physical condition in each individual must be realized by each individual in order to achieve success. (Falaahudin et al., 2020). One of the important factors in achieving sports achievements is the need for mastery of techniques, tactics, physical condition and mental abilities that an athlete must have (Rizki Hazazi Ali et al., 2023).

Therefore, every swimmer must be in prime physical condition to face a competition or championship. In competitive sports, individuals or athletes require good physical condition in addition to technical ability (Hudayhana, 2014). In providing training, a trainer must pay attention to the elements of leg length, leg muscle strength, and maximum oxygen volume by providing an appropriate training program (Putra & Witorsyah, 2019). Maximum oxygen volume is very important in swimming, especially in achieving success (Falaahudin & Sugiyanto, 2013b). An athlete who has a good maximum oxygen volume will be able to carry out heavy activities for a long period of time without experiencing fatigue (Paramita et al., 2020).

The low physical abilities of athletes are due to the trainer not providing an understanding of physical training, the trainer not creating a training program and not understanding the dosage of training presented to athletes (Falaahudin et al., 2021). Furthermore, there is a lack of knowledge about the types of tests and measurements used to analyze athletes' physical condition, and coaches have difficulty analyzing the results. Besides this lack of knowledge, coaches also impose very heavy training loads, which can lead to injuries and affect the physical condition of swimmers (Boroh & Cahyani, 2016).

Apart from technical and physical aspects, several steps that must be taken include increasing the procurement of facilities and infrastructure (Pujianto, 2015). Because it is the main pillar that supports every activity related to sports, sports facilities and infrastructure are very important in the process of learning activities or improving the achievements of athletes/students (Irawan, 2017). In addition to sports facilities and infrastructure, attention must also be paid to talent development and improving the quality of coaching and training. Therefore, achieving all of this requires ongoing development, starting at an early age.

As technology advances, systems and data storage are inextricably linked. A system is an arrangement (integration) consisting of a number of functional components (with specific functional units and tasks) that are interconnected and collectively aim to fulfill a specific process (H. Pratiwi, 2020). One of the steps in building an information system is designing a database. A database is a collection of interrelated data items organized according to a specific scheme or structure, stored on computer hardware and with software to manipulate them for specific purposes (Ladjamudin, 2005). A database is an important component in an information system, because it functions as a basis for providing information, determining the quality of accurate, timely and relevant information (Pambudi et al., 2023). The application of databases in information systems is called a database system. A database system is an information system that integrates a collection of interrelated data and makes it available for various applications within an organization (Pauliana, 2007). The goal of database design is to determine the data needed in the system so that the resulting information can be properly fulfilled. A database that has been stored on a storage medium will never be accessible without familiar application software, for example, database-based application software (Surbakti, 2018).

An organization with a database system must be able to manage that data accurately and timely. Integrity theory plays a crucial role in a relational database model, ensuring its successful

implementation, both theoretically and systematically. Nearly all information systems utilize a relational database. One example is a decision support information system. The design process for such systems always involves a database. Essentially, a decision support system requires a container to store the data needed to perform calculations (Kurniawan et al., 2021).

The advent of computer technology has changed everything. Archives and documents that were previously stored manually are now stored digitally. Digital storage provides effective and efficient storage. All archives and documents can be neatly stored within a computer system, and retrieval is easier when needed, as simply searching for the file name will display the desired archive (Putri et al., 2019). In an information system, the primary foundation is the database and program implementation. An ineffective database and unstructured program implementation can impact the performance of the information system. Data on an athlete's physical condition, specifically their biomotor components, is crucial for developing training schedules. Information about an athlete's physical condition or abilities is crucial for coaching and developing their overall physical condition.

An application is a ready-to-use program designed to perform a function for the user of the application and other applications that can be used by a specific target group. An application is defined as a problem-solving process that utilizes data processing techniques, typically focused on a desired or expected competency or data processing goal (Juansyah, 2015). Mobile applications are also important due to their versatility, which can significantly simplify people's lives.

In the field of science, applications can be used to obtain scientific information. These applications can also be developed to assist individuals in conducting research. One example of this application is an application that can connect students with teachers or private tutors. In education, applications function as teaching materials. An example of this application is Microsoft PowerPoint, which can be used to present educational material beyond text. It can also include video, audio, animations, and other resources, making the learning environment more engaging and enjoyable.

One general function of applications is to serve as a fun entertainment medium. For example, some applications are designed for playing games, watching movies, and so on. These applications are designed to prevent people from getting bored easily, wherever they are. Applications can also serve as a means of communication and friendship. With applications, people can make friends without distance constraints. This means that someone can communicate and make friends with those who are far away. Applications can function as a medium for the latest news updates. When people use the application, notifications from the application can provide updates. This way, you won't miss out on the latest news.

The multistage fitness test, or bleep test, is a series of fitness tests designed to measure a person's fitness level. This simple, field-based test yields a fairly accurate estimate of maximum oxygen consumption for various purposes (W. A. Nugroho et al., 2020). Aerobic endurance, also called aerobic fitness or cardiovascular endurance, is one of the important factors of physical fitness. Aerobic endurance is the main requirement for endurance sports (Akbar, 2014). Cardiovascular endurance is a strong predictor of future health for individuals of all ages and genders. Increasing cardiovascular endurance has a protective effect at an early age, as there is some evidence that cardiovascular endurance levels play a significant role from childhood and adolescence through adulthood (Anggraini & Herdiyanto, 2018).

Aerobic endurance training can stimulate the heart muscles. By strengthening the heart muscle, more blood is pumped from the heart, thereby increasing the oxygen supply throughout the body. Furthermore, endurance training increases the vital capacity of the lungs and enhances their ability to absorb oxygen, which is essential for prolonged physical activity.

The body requires a significant amount of energy, a significant amount of which is influenced by the availability of oxygen in the lungs. Achieving good physical condition and aerobic endurance certainly doesn't happen overnight; it requires rigorous training supported by appropriate training methods from coaches and sports teachers at school. Many training methods can be used to improve physical condition, particularly those aimed at improving aerobic endurance.

With this background, researchers want to conduct research and develop a smartphone-based water MFT instrument application to measure the aerobic endurance of KU-1 swimmers, designed in a simple, measurable, and convenient way to implement it in the field.

METHOD

The research methodology section describes in detail how the study was conducted. A complete description of the methods used enables the reader to evaluate the appropriateness of the research methodology. You must describe exactly what you did: what and how experiments were run, what, how much, where, when, and why equipment and materials were used. The main consideration is to ensure that enough detail is provided to verify your findings and to enable the replication of the research.

This research is a Research and Development (R&D) study with an ADDIE (Analysis, Design, Development, Implementation, and Evaluation) design.

1. Analysis

The first step in this research and development process is to analyze current and potential problems that need to be addressed to find the best solution. At this point, the researcher examined the swimming club environment, the training process, the coaches' perceptions of KU 1 swimmers and their physical development, and the physical training techniques used by the athletes. The researcher then considered the existing problems in relation to these factors to propose solutions. The researcher developed a smartphone-based application for monitoring the physical condition of KU 1 swimmers as a solution to the existing problems.

2. Design

The product design stage was carried out by creating a basic design for the smartphone-based application for monitoring the physical condition of KU 1 swimmers, which was created considering the athletes' needs for improving their physical abilities.

3. Development

The goal of product creation was to realize the design approved by the supervising lecturer. The finished product was a smartphone-based application for monitoring the physical condition of KU 1 swimmers. Experts in swimmer physical training programs assessed the product's feasibility after the program was developed.

4. Implementation

After the product was developed, the smartphone-based application for improving the physical condition of KU-1 swimmers was piloted at swimming clubs in Yogyakarta. The implementation aimed to improve physical conditioning abilities and innovation to alleviate boredom during training and increase coaches' knowledge when providing physical conditioning training materials to athletes.

5. Evaluation

After implementation, the product was evaluated as a program to improve the physical condition of KU-1 swimmers. The goal was to improve the physical condition of KU-1 swimmers by addressing product weaknesses, similar to a program. The smartphone-based application model for KU-1 swimmers as a program to improve the physical condition of KU-1 swimmers was developed after improvements were made during the evaluation phase.

The research subjects were two physical conditioning experts, two swimming practitioners, and one media expert. A small-scale test involving 15 KU-1 swimmers registered with PRSI Yogyakarta was conducted, and a large-scale test involving 30 sports science students from UMBY with basic swimming skills. The instruments used were a questionnaire and an aerobic endurance test based on the MFT in a swimming pool. Data analysis used descriptive statistics with percentages.

RESULT AND DISCUSSION

1. Analysis

In this stage, the main activity is to analyze the need to develop a practical Android-based physical condition testing application for KU1 swimmers and to analyze the requirements and feasibility of the product for developing a model for the KU1 swimmers' physical condition testing application. This stage aims to identify preliminary sources that address the underlying issues and analyze development needs. In this stage, the author sought information from several sources related to the Android-based physical condition testing application for KU1 swimmers. This stage was conducted to analyze the product to be developed. Furthermore, it is hoped that it will assist coaches in conveying the importance of physical condition testing. Therefore, to meet these research needs, the researcher conducted initial literature studies and field studies.

The results of this analysis indicate that question 13, which asked about the need for media to assist training, scored a high score of 3.80, and question 14, which asked about the need for applications/software to facilitate the analysis of athletes' abilities and physical condition, scored a high score of 3.80. This indicates a high need for tools/applications.

2. Design (Product Design)

The design stage includes drafting the material to be presented, drafting the script, developing the flowchart for the material delivery, creating a media storyboard, and gathering the materials needed for media development. This activity is a systematic process that begins with planning the research objectives, research work procedures, determining the timeframe, and funding. Researchers gain an overview of the research to be undertaken. After conducting a preliminary study, problems were identified and analyzed. This was followed by the development of a practical and engaging Android smartphone-based physical condition training application for KU 1 swimmers. This application is designed to facilitate coaches in analyzing the physical condition of KU 1 swimmers by compiling instrument items based on predetermined indicators.

a. Initial Display of the AFA TEST Application

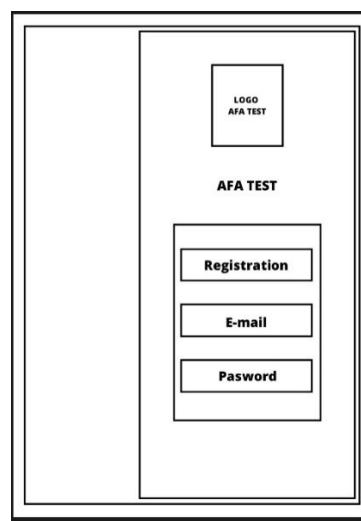


Figure 1. Initial layout design of the AFA TEST application

This initial screen displays the logo, registration, email, and password. After logging in with your email and password, the application will look like this:

b. Athlete Identity Menu

This menu contains the identity of each athlete. The Athlete List menu appears below:

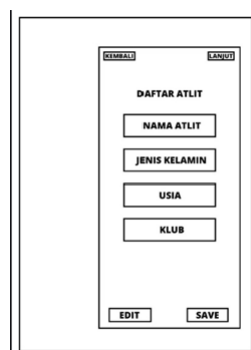


Figure 2. Design plan for the athlete list menu display.

The athlete list menu in the AFA TEST application contains:

- 1) Name:
- 2) Gender:
- 3) Age:
- 4) Club:

c. Test Assessment Menu

The test assessment menu displays the assessment results (from the athletes). The following is a display of the test assessment menu.

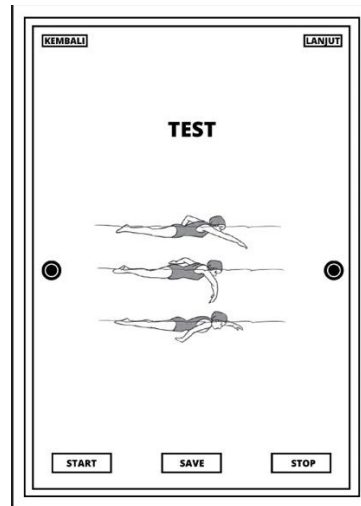


Figure 3. Design plan for the test assessment menu display

d. Test Results Menu

The results of this assessment will be reported in PDF format.

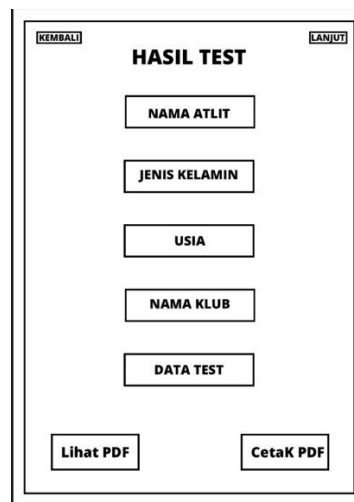


Figure 4. Design plan for the test results menu display.

The initial product will then be developed into an application that compiles swimming endurance test norms for comparisons in water and on land.

3. Development

The product, an Android-based smartphone application for testing the physical condition of KU 1 swimmers, is currently in the development process, with several steps including:

- a. Creating and compiling swimming endurance test norms on land.



Figure 5. Measuring the endurance of KU 1 swimmers using a beep test on land.

Data collection on the endurance capabilities of KU 1 swimmers using a beep test on land over a distance of 20 meters yielded the following results:

Table 1. Analysis of swimming endurance norms on land

Interval Class	Evaluation		Assessment Categories
Interval 1	8,2	8,8	Very less
Interval 2	8,8	9,4	Not enough
Interval 3	9,4	10,0	Enough
Interval 4	10,0	10,6	Good
Interval 5	10,6	11,2	Very good
Highest Value	11,2		
Smallest Value	8,2		
Many classes	5		

From the analysis of the above land endurance test results, it can be concluded that the range of values of 8.2-8.8 is categorized as very poor, the range of 8.8-9.4 is categorized as poor, the range of 9.4-10.0 is categorized as sufficient, the range of 10.0-10.6 is categorized as good, and the range of 10.6-11.2 is categorized as very good.

- b. Creation and compilation of swimming endurance test norms comparing in water



Figure 6. Measuring the endurance of KU 1 swimmers using a beep test in water.

Data collection on the endurance capabilities of KU 1 swimmers using a beep test in water over a distance of 8 meters and a pool depth of 1.5 meters yielded the following results:

Table 2. Assessment category norms for the swimming endurance test in water.

Interval Class	Assessment Level		Assessment Categories
Interval 1	3,5	4,0	Very less
Interval 2	4,0	4,6	Not enough
Interval 3	4,6	5,1	Enough
Interval 4	5,1	5,7	Good
Interval 5	5,7	6,2	Very good

The analysis above shows that a score range of 3.5-4.0 is categorized as very poor, a score range of 4.0-4.6 is poor, a score range of 4.6-5.1 is adequate, a score range of 5.1-5.7 is good, and a score range of 5.7-6.2 is very good.

Based on these standards, an Android smartphone-based application for testing the physical condition of KU 1 swimmers was developed. The following is an overview of the application:



Figure 7. AFA TEST application logo

- c. Initial AFA TEST application display



Figure 8. Initial screen of the AFA TEST application

d. Athlete Identity Menu

This menu contains the identity of each athlete. The Athlete List menu displays as follows:

Figure 9. Athlete List menu display in the AFA TEST application

The Athlete List menu in the AFA TEST application contains:

- 1) Name:
- 2) Gender:
- 3) Date of Birth:
- 4) Club:

e. Test Assessment Menu

The test assessment menu displays the assessment results (of the athletes). The test assessment menu displays as follows:

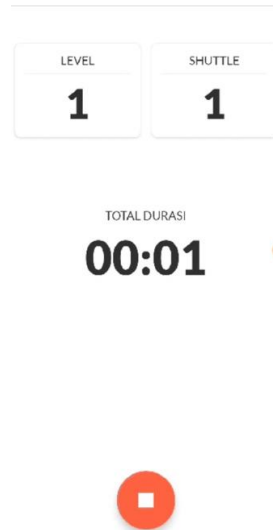


Figure 10. Test Assessment menu display in the AFA TEST application

f. Test Results Menu

The results of this assessment will be reported in PDF format

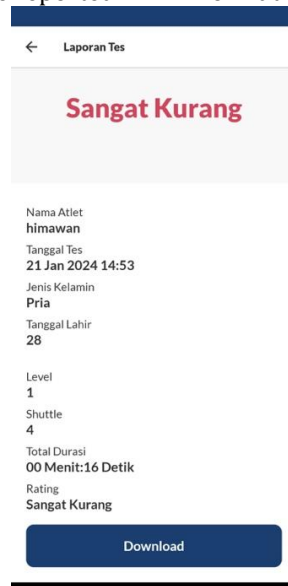


Figure 11. Test Results menu display in the AFA TEST application

4. Implementation

The development of the Android smartphone-based physical condition testing application for KU1 swimmers was then implemented and assessed by several experts. The assessment results are as follows:

a. Expert Assessment of Physical Condition

In this study, the subject matter experts were Dr. Devi Tirtawiryo, M.Or., and Dr. Sujarwo, M.Or., lecturers at the Faculty of Sport Science, Yogyakarta State University. The results of the subject matter expert assessment of the Android smartphone-based physical condition testing application for KU1 swimmers are presented in the following table:

Table 3. Expert Assessment of Physical Condition Material 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	5	41.7	41.7	41.7
	Very good	7	58.3	58.3	100.0
	Total	12	100.0	100.0	

Table 4. Expert Assessment of Physical Condition Material 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	5	41.7	41.7	41.7
	Very good	7	58.3	58.3	100.0
	Total	12	100.0	100.0	

Based on the expert assessment results for physical condition 1 and 2, using the indicators of material suitability, accuracy, currency, and motivation, the application was deemed suitable for use, with a good percentage of 41.7% and a very good percentage of 58.3%.

b. Swimming Practitioner Assessment

In this study, the swimming practitioners were Dr. Ermawan Susanto, M.Pd., a lecturer at the Faculty of Sport Science, Yogyakarta State University, teaching swimming courses, and Dr. Agung Purwandono Saleh, M.Pd., an administrator of the Yogyakarta Special Region Sports Association (PRSI). The results of the swimming practitioners' assessment of the Android-based KU 1-year physical condition application for swimming athletes are presented in the following table:

Table 5. Swimming Practitioner Assessment 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	3	12.5	12.5	12.5
	Very good	21	87.5	87.5	100.0
	Total	24	100.0	100.0	

Table 6. Assessment of Swimming Practitioner 2

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	5	20.8	20.8	20.8
	Very good	19	79.2	79.2	100.0
	Total	24	100.0	100.0	

Based on the assessment results table, swimming practitioner 1's indicators of material suitability, material accuracy, and material currency were rated as good (12.5%) and very good (87.5%). Meanwhile, swimming practitioner 2's indicators of material suitability, material accuracy, and material currency were rated as good (20.8%) and very good (79.2%). Therefore, it is concluded that the application is suitable for use.

c. Media Expert Assessment

In this study, the media expert was Dr. Phil Rahmatul Irfan, S.T., M.T., a lecturer in the Faculty of Engineering, Electronics and Informatics Engineering Education Study Program, Yogyakarta State University. The results of the swimming practitioner assessment of the Android smartphone-based application for assessing the physical condition of KU 1 swimmers are presented in the following table:

Table 7. Media Expert Assessment 1

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Good	6	18.8	18.8	18.8
	Very good	26	81.2	81.2	100.0
	Total	32	100.0	100.0	

From the table of results of the media expert assessment with indicators of functionality, readability, ease of use, it is stated that it is suitable for use with a good percentage of 18.8% and very good at 81.2%.

5. Evaluation

Each stage of product development is evaluated to ensure the product remains up-to-date with any changes. This evaluation is conducted continuously to ensure that even the smallest errors can be corrected immediately without waiting for the final product to be produced. Although the product has gone through several stages by media and material experts and can be considered complete, it must still be assessed by field practitioners and users, allowing for the detection of minor errors that were missed in previous stages.

Evaluation is conducted in two forms: formative and summative. Formative evaluation is conducted at every stage, from analysis to implementation, to identify minor errors in the product. Summative evaluation is conducted at the end of the research process to assess the overall quality and feasibility of the product. Revisions are made based on the evaluation results or any unmet needs. If there are no further revisions, the product is deemed suitable for use.

Table 8. Frequency Distribution of Beep Test Results in Water/Small-Scale Testing

Number	Interval	Category	Frequency (f)	Percentage (%)
1	5	Very good	3	20.0
2	4	Good	3	20.0
3	3	Enough	2	13.3
4	2	Not enough	2	13.3
5	1	Very less	5	33.3
Total			15	100

Based on the results of the small-scale test above, it can be explained that 3 athletes with aerobic endurance were categorized as very good (20%), 3 athletes with good (20%), 2 athletes with sufficient (13.3%), 2 athletes with poor (13.3%), and 5 athletes with very poor (33.3%).

Table 9. Frequency Distribution of Beep Test Results in Water/Large-Scale Test

Number	Interval	Category	Frequency (f)	Percentage (%)
2	4	Very good	7	23.3
3	3	Good	9	30.0

4	2	Enough	7	23.3
5	1	Not enough	7	23.3
Total			30	100

Based on the results of the large-scale test above, it can be explained that 7 athletes have good aerobic endurance with a percentage of 23.3%, 9 athletes are sufficient with a percentage of 30%, 7 athletes are lacking with a percentage of 23.3%, and 7 athletes are very lacking with a percentage of 23.3%.

DISCUSSION

With the increasingly sophisticated development of technology, systems and data storage are inextricably linked. A system is an arrangement (integration) consisting of a number of functional components (with specific functional units and tasks) that are interconnected and collectively aim to fulfill a specific process (H. Pratiwi, 2020). One of the steps in building an information system is designing a database. A database is a collection of interrelated data items organized according to a specific scheme or structure, stored on computer hardware and with software to manipulate them for specific purposes (Ladjamudin, 2005). A database is a crucial component of an information system, serving as the basis for providing information and ensuring that information is accurate, timely, and relevant. The application of a database in an information system is called a database system. A database system is an information system that integrates a collection of interrelated data and makes it available for various applications within an organization (Pauliana, 2007). The goal of database design is to determine the data needed in the system so that the resulting information can be properly fulfilled. A database that has been stored on a storage medium will never be accessible without familiar application software, for example, database-based application software (Surbakti, 2018).

At the national and international levels, four different swimming styles are competed in (Wibisana et al., 2019). These include freestyle, breaststroke, backstroke, and butterfly (Winarti Sulamtari, 2017). A person's physical condition encompasses all aspects of movement and strength, from speed and agility to flexibility and strength, and even explosive power and endurance (Hardiansyah, 2018). Endurance, explosive power, speed, and agility are all essential physical traits for soccer (Maliki et al., 2017). It is crucial for athletes to be in good physical condition because it can enhance performance and maximize achievement in sports (Elkadiowanda et al., 2019). As a platform for achievement, physical condition plays a key role in various sports, including boxing (Wani, 2018).

Physical fitness plays a crucial role in swimming as it is a swimmer's primary asset when starting a competition (Berrezokhy et al., 2020). Endurance is the capacity to engage in physical activity or movement for extended periods without becoming overly fatigued (Harsono, 2017). Furthermore, endurance can be defined as the ability to deliver oxygen to the muscles and lungs to support physical activity (Armstrong & Barker, 2010; Hughes et al., 2017). From a physiological perspective, endurance is exercise performed at maximum intensity, with the primary goal of progressively shifting the anaerobic threshold—the initial stage of anaerobic metabolism and lactate production—to higher exercise intensities. This is achieved through complex modifications in muscle metabolism, including increased mitochondrial density and oxidative enzymes, shifts in fiber type, and increased muscle fiber capillaryization (Morici et al., 2016).

During training, fat utilization increases as an energy source (Burke, 2021). Factors that determine high $\text{Vo}_{2\text{max}}$ in the lungs include waist circumference, exercise and fat levels in the body. (Dagan et al., 2013; Huldani. et al., 2019; Rahma et al., 2019) Excessive body fat composition of athletes will affect cardiorespiratory endurance and $\text{Vo}_{2\text{max}}$ capacity. (Nurhayati et al., 2019) meaning that swimming athletes must maintain fat levels in the body so that they are not excessive and maintain athlete performance. Circuit training is a workout that uses varying workloads and is performed by switching from one exercise to the next, while training different muscle groups until each muscle group is fully utilized. (Gokulkrishnan, 2018; Mayorga-Vega et al., 2013; Paoli et al., 2013). The structure of circuit training must align with the overall training objectives (April & Suharjana, 2016; Festiawan et al., 2019). This means that the form of circuit training must be

aligned with the components of physical condition (the goal is endurance training; each exercise must be dosed) (Ilham & Rifki, 2020; Sucipto & Widiyanto, 2016).

Cardiovascular endurance testing has two methods of measurement: field testing and laboratory testing (Fitrianto, 2017; Hermanto & Robianto, 2020). The validity of field and laboratory tests is not significantly different (Budiman, 2017; Eko, 2016), but field tests are less expensive and require less expertise. Therefore, these tests are used to assess athlete data and evaluate their physical condition (Harsono, 2018; Moreno-Perez et al., 2020). The maximum weight that can be lifted depends on muscle size, so the larger the muscle fibers and the more muscle tissue, the stronger the muscle (Budi & Lhisdiantoro, 2017; Grgic et al., 2018; Suharjana, 2018a). Weight training is a method for increasing muscle size (hypertrophy) to maintain optimal physical condition and allow the muscles to perform their tasks effectively without injury that could prevent the athlete from training (Lestari & Nasrulloh, 2018; Rangga & Bripandika, 2017). Therefore, muscle strength is crucial for an athlete's physical condition, supporting other physical abilities (Widianti et al., 2017).

Aging in adult athletes is accompanied by damage to body tissues and proteins found in muscle cells, which then reduces muscle capacity and other organ function (Pranata et al., 2019; Sapti et al., 2018). Peak muscle strength in humans occurs around age 20 and declines after age 40 (Latella et al., 2018). However, this decline can be slowed through regular exercise, stress management, and individual biological factors (Mase et al., 2006; Muhammad, 2018). From a physiological perspective, physical differences are clearly visible, encompassing the cells, tissues, and organ systems of humans (Sumiyati et al., 2021). The number of male bone cells is greater than that of female cells (Handayani, 2021) the hemoglobin levels of men and women are also different, men have 14-18 g/dl and women are 13-15 g/dl (Otto et al., 2017) men have a greater physiological capacity than women, so they have higher hemoglobin levels that can carry oxygen and nutrients to the body's organs (muscles), thus giving them more energy (Nadzalan et al., 2018).

Based on this description, an application is needed to support coach performance. The goal of product creation is to create an attractive design for coaches, particularly in swimming. After product development and expert testing are complete, the next step in this research is to develop an Android smartphone-based application for use in swimming clubs in Yogyakarta Regency. The application is expected to be attractive and effective for swimming coaches. The goal of this implementation is to improve physical conditioning skills, as well as provide innovation to break up boredom during training and increase coaches' knowledge when providing physical conditioning training materials to their athletes.

CONCLUSION

Based on the research results and data analysis, the following conclusions were obtained. The results of the land endurance test showed that scores ranging from 8.2 to 8.8 are categorized as very poor, 8.8 to 9.4 are poor, 9.4 to 10.0 are adequate, 10.0 to 10.6 are good, and 10.6 to 11.2 are excellent. The results of the water endurance test showed a score range of 3.5-4.0, categorized as very poor, a score range of 4.0-4.6 as poor, a score range of 4.6-5.1 as adequate, a score range of 5.1-5.7 as good, and a score range of 5.7-6.2 as very good. The assessment results of material experts for physical conditions 1 and 2, using the indicators of material suitability, material accuracy, material currency, and motivation, were declared suitable for use with a good percentage of 41.7% and a very good percentage of 58.3%. The assessment results of swimming practitioner 1, based on the indicators of material suitability, material accuracy, and material currency, were good at 12.5% and very good at 87.5%. Meanwhile, swimming practitioner 2, with a good percentage of 20.8% and very good at 79.2%. Therefore, the application was declared suitable for use. The results of the media expert assessment with indicators of functionality, readability, ease of use, and display were declared suitable for use with a good percentage of 18.8% and very good at 81.2%. The results of the small-scale test showed that athletes who had aerobic endurance were categorized as very good were 3 athletes with a percentage of 20%, good were 3 athletes with a percentage of 20%, sufficient were 2 athletes with a percentage of 13.3%, poor were 2 athletes with a percentage of 13.3%, and very poor were 5 athletes with a percentage of 33.3%. The results of the large-scale test showed that athletes who had aerobic endurance were categorized as good were 7 athletes with a percentage of 23.3%, sufficient were 9 athletes with a percentage of 30%, poor were 7 athletes with a percentage of 23.3%, and very poor were 7 athletes with a percentage of 23.3%. The

conclusion is that the AFA-based smartphone water meter instrument application for measuring aerobic endurance in age group KU-1 swimmers is deemed suitable for use.

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