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Development of Digital-Based Bleep Test Tools

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Bleep test; Sensor Ultrasonic; ARDBT

ABSTRACT
In the world of sports, technology has become essential to improve the accuracy and efficiency of measuring athletes' fitness. The bleep test, a popular method for measuring cardiovascular endurance, often suffers from accuracy issues when performed manually. The purpose of this research is to develop a digital-based bleep test tool. In the implementation of the bleep test, there is currently no tool that ensures that bleep test participants pass the specified distance, and recording is still manual. This bleep test aid uses an ultrasonic sensor to detect test participants during the bleep test, and the data from this sensor will be sent to a PC or laptop to display the test results. This research method uses the R&D research method with the Borg and Gall research model. The result of this research is a sensor tool to help record the implementation of the bleep test digitally. The results of the operational field test of this tool are able to detect test participants in the implementation of the bleep test and send data on the level, rotation, and Vo2max of participants in the implementation of the bleep test.

1. Introduction

The development of technology-based aids in the world of sports has been widely used today. One of the technology-based sports aids that we often encounter today is in soccer matches, namely VAR (Video Assistant Referee). VAR is a technological assistance procedure in soccer games to help assistant referees review replays of an incident in a soccer game, as a consideration for the main referee to make a decision (Wiarto Giri, 2022).

Many tests can be done to measure fitness or endurance when doing sports that have a high level of movement. one of them is the bleep test. Blep test is a series of runs back and forth with a certain time that gets shorter as the level increases. consists of 23 levels and each level ranges in time approximately one minute, The length of the running track is 20 meters where the initial speed is 8.5 km / h and will increase 0.5 km / h at each level with the sound of one beep and 3 beeps at the end of the level which indicates the beginning of the next level (Brian Mackenzie, 2005). Athletes who run back and forth (shuttles) between 2 lines marked with cones with a distance of 20 meters, the speed of the subject or athlete is regulated by the sound of the audio recorder “bleep” and the subject is expected to reach the cones when doing the shuttle (Penry, Wilcox, and Yun 2011).

In the implementation of the Bleep Test manually, problems often occur where fitness test participants with the Bleep Test technique do not cross the 20 meter line, due to the increasing rotation speed at each level and the level of fatigue during the test. It certainly affects the test implementation procedure, causing the test implementation not in accordance with the provisions.

Because there is no tool that can be used as a consideration of the case, it cannot be proven. From these problems, researchers want to create the development of a {VO}_2max measuring instrument through the bleep test technique which is developed into a digital-based tool. Apart from replacing manul recording, it can also detect test participants crossing the 20 meter line before the beep in the implementation of the bleep test.

The primary purpose of this research is to develop a digital-based bleep test tool. This tool aims to enhance the accuracy of measuring athletes' cardiovascular endurance by ensuring participants cross the 20-meter line before the beep sound, addressing common issues faced in manual bleep test implementations. This research topic was chosen due to the challenges associated with the manual execution of the bleep test, which often results in inaccuracies. Participants frequently fail to reach the 20-meter mark due to increasing speed demands and fatigue, leading to unreliable test results. By developing a digital tool, the study seeks to provide a more precise and efficient method for assessing athletes' fitness levels, ultimately contributing to improved training and performance evaluation in sports.

2. Materials and Methods

The research method used of Research and Development or often abbreviated as R&D. This research model refers to the Borg and Gall method, According to (Borg & Gall, 1983) this development model uses a waterfall at the stage of development. The Borg and Gall development model has relatively long stages because there are 10 implementation steps: (1) Research and information collection, (2) planning, (3) Developing a preliminary form, (4) Preparatory field test, (5) Main product revision (6) Main field trial, (7) Implementation of product revision, (8) Operational field test, (9) Final product revision and (10) dissemination and implementation (Tegeh, Made at all, 2014). These steps are shown in the following chart:

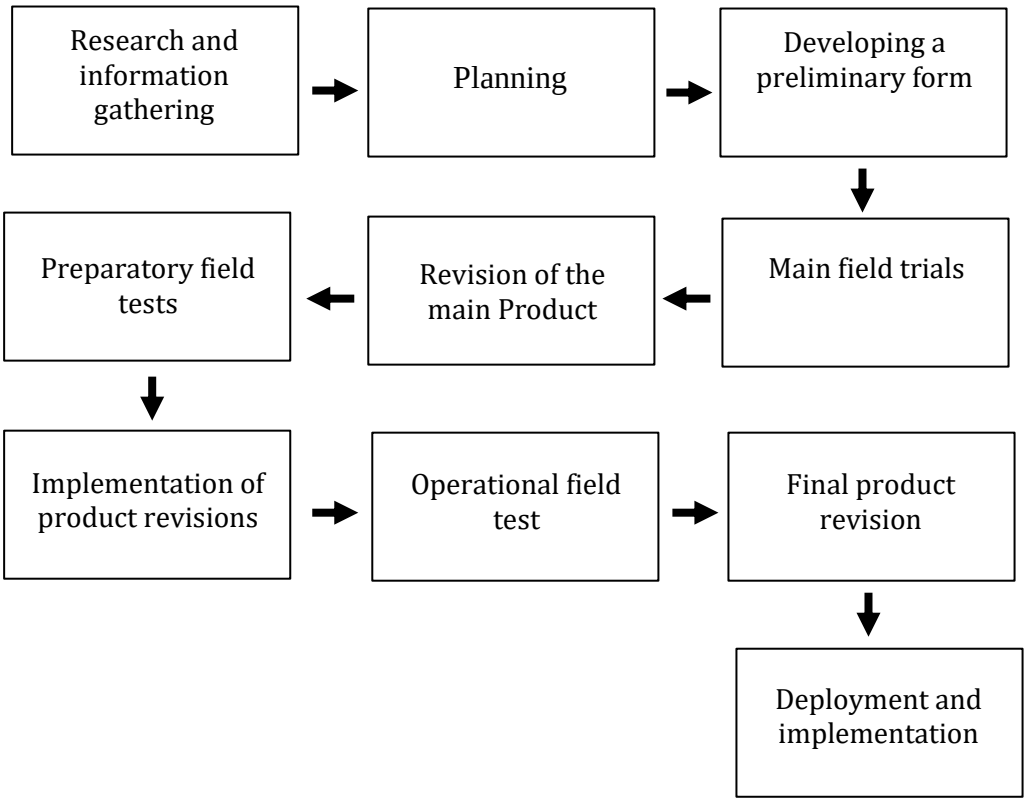


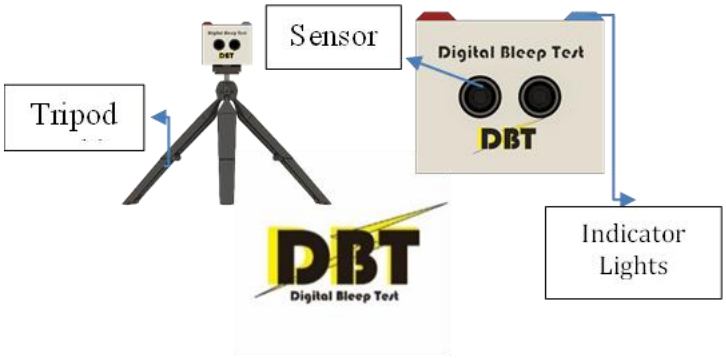
Figure 1 Borg and Gall Research Model Flow

The components of the devices used are purchased at offline and online stores of electronic goods providers. The *hardware device* consists of an ultrasonic sensor, ESP8266, buzzer, led light, AAA battery holder, DC socket, and acrylic cover. For *software* and programming, use Visual Studio Code applications with Platform.Io as a means of programming tools and web applications.

3. Results and Discussion

Research Results

The purpose of this study is to develop a bleep test tool. The result of this study is a monitoring system for the implementation of bleep test in the form of hardware and software. The hardware developed is a set of sensor tools to read the level of participants and ensure that test participants pass a distance of 20 meters or not. The software developed is a web application to monitor the implementation of the test and receive participant-level data read by the sensor. This series of sensor tools functions as a recorder of test bleep participant data and as a tool that ensures whether the test taker crosses the distance specified in the test or not. The following is a picture of the bleep test sensor tool.



Picture 2 Bleep Test Instrument Sensor

This sensor tool works by calculating one round at the level being taken when the test participant passes in front of it. The data that the sensor has captured will enter the ESP8266 on the sensor, and then it will be retransmitted to the ESP8266, which is also connected to a laptop or PC device. The data received by the ESP8266 on the laptop or PC device will be saved first, and the results will be displayed immediately after the test is completed.

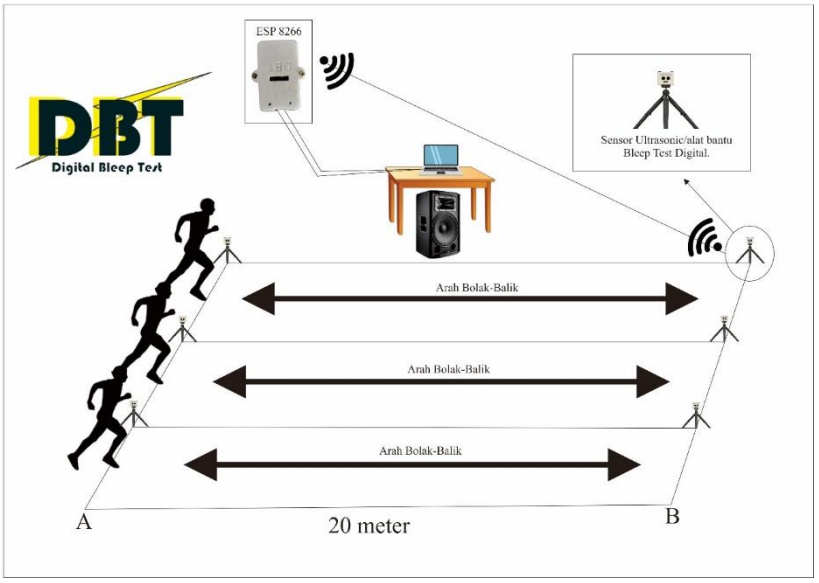


Figure 3 Digital-Based Bleep Test Implementation Series

The software developed functions to control *hardware* and monitor the implementation *of bleep tests*. The display of the implementation of the digital-based bleep test can be seen on the monitor screen in the web application as follows

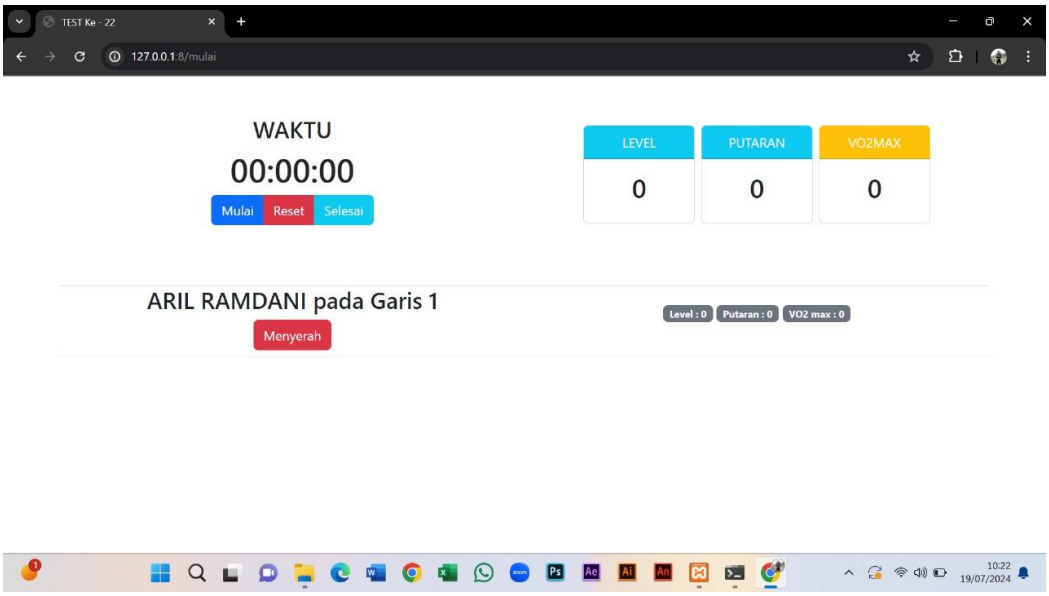


Figure 4 Software Digital Bleep Test

Discussion

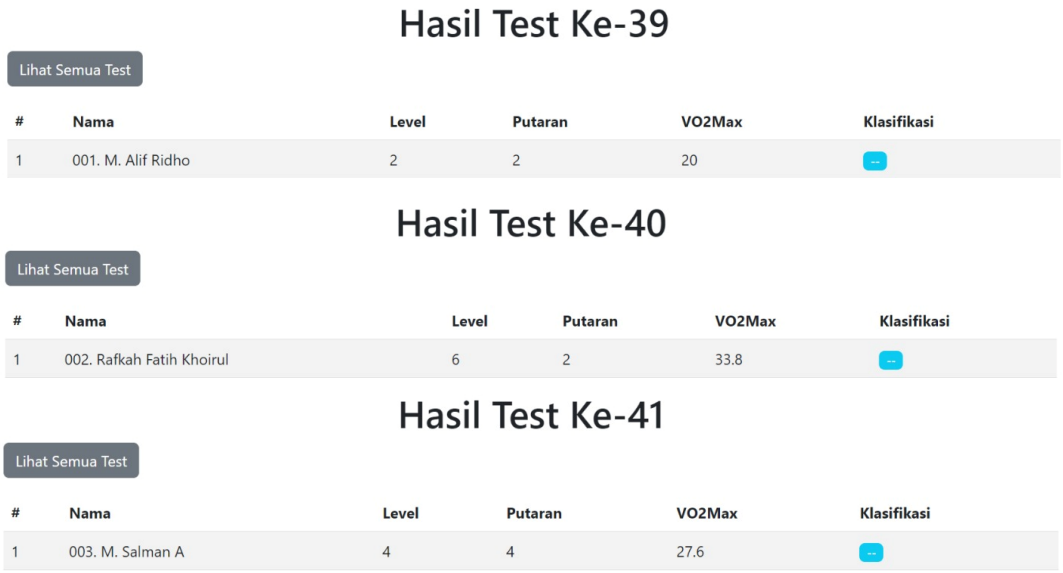
To test hardware and software, this study uses black box testing to test the functions of the developed tools and software. The results of one of the black box testing tests on device connectivity are as follows;

Table 1. Black box testing test results on DBT hardware and software connectivity.

No.	Tested Features	Testing Action	Expected Results	Test Status
1	Connection between software and hardware	Run the bleep test software and check the connection with the hardware	The software can connect with the hardware without any problems	Appropriate
2	Data delivery	Send commands from software to hardware	Command successfully received and executed by hardware	Appropriate
3	Data reception	Hardware sends data to software	The data received by the software corresponds to that sent by the hardware	Appropriate
4	Function integration	Use all hardware-connected software functions	The functions can be carried out well and produce the expected results	Appropriate
5	Connection stability	Test over a long period of time	Stable connection between software and hardware without interruption	Appropriate

After completing the test with black box testing, the next product is tested on a large scale.

The results of the large-scale test are as follows:



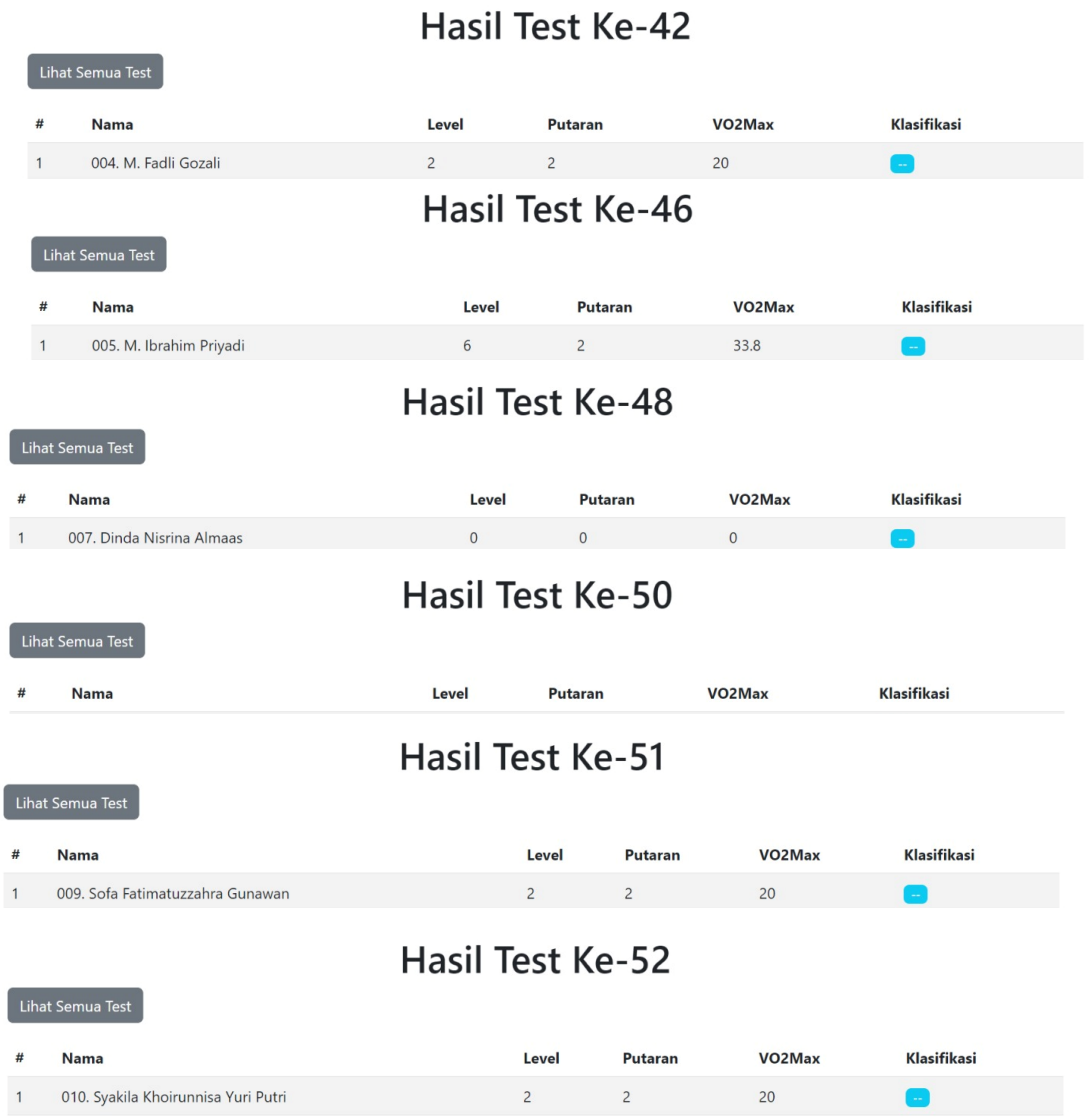


Figure 5 Data from operational field tests

4. Conclusion,

The research on the development of this digital-based bleep test tool has succeeded in creating a sensor tool that can record the level, round at the level, Vo2max, and status in the implementation of the bleep test and is able to process the data so that the data can be recorded in the web application.

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