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Making an Electric Vertical Jump Limb Muscle Explosiveness Test Tool Using Iot Technology in Physical Education Activities

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Abstract

The problem of conventional measurement methods is often less accurate and efficient, so innovation is needed to improve the quality of evaluation of Leg Muscle Explosiveness. This research aims to design and develop an Internet of Things (IoT) technology-based leg muscle explosiveness test tool that can be used in physical education activities. This tool is a breakthrough in the world of sports which usually measures the explosive power of leg muscles by using manually, namely by using a meter attached to the wall but with an electric vertical jump tool students simply stand and jump in front of the media that we have made so that the results can be directly converted automatically. The research method includes the design stage, device development, and testing of 30 high school students. The test results show that this tool has high validity with a correlation (r = 0.93) to the manual method, and provides accurate and consistent data. In addition, the survey showed that 90% of users found the tool easy to use thanks to the app-based digital interface that allows real-time data analysis. This tool makes a significant contribution in improving the accuracy and efficiency of leg muscle explosive power measurement, and is relevant for use in modern physical education. However, limitations such as the need for internet connection and production costs need to be overcome to increase widespread adoption. This study concludes that an IoT-based leg muscle explosive power test device has great potential to improve the quality of physical evaluation in physical education and sports training environments.

Keywords: Vertical Jump Electric; Physical Education; IOT.

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A. Introduction

Leg muscle explosiveness is one of the important components in physical ability, especially in activities that require explosive

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strength such as vertical jumping, sprinting, and other sports. In the context of physical education, the measurement of leg muscle explosive power is not only relevant to evaluate students' physical abilities but also to identify athletic potential, develop training programs, and monitor the development of physical abilities objectively.

Measurement of leg muscle explosive power is often done through vertical jump tests. However, conventional methods such as using a tape measure or scale board often have disadvantages, especially in terms of accuracy, consistency, and time efficiency. Therefore, a more modern, accurate, and easy-to-use leg muscle explosive power measuring device is needed, especially in the physical education environment.

Physical education is basically a form of educational process that uses physical activity to induce qualitative changes in a person's mind whether physical, mental, spiritual and emotional. It treats each student as a unique entity and a perfect body, all of which will essentially only treat them as the student's own body and mind. Physical education is integral to student success and realizing their academic potential. Overall, what can affect these students' potential is their physical education awareness and performance. Therefore, this sport needs to be nurtured by teachers for students, not only for that, physical education is also very important for the physical fitness and body fitness of these students so that there needs to be an increase in every exercise in the learning that takes place.

According to Akhmad, (2016) "Physical education is an inseparable part of general education. Through the PE program, the role of education can be pursued to develop individual personalities. Without PE, the educational process at school will be lame. The real contribution of physical education is to develop skills (psychomotor). Therefore, the position of physical education becomes unique, because it has more opportunities than other subjects to foster skills. This also reveals the advantages of physical education from other subjects. If other lessons are more concerned with intellectual development, then through physical education fostered at the same time aspects of reasoning, attitudes and skills."

According to Wawan S. Suherman (2017) Physical education is a learning process through physical activities designed to improve physical fitness, develop motor skills, knowledge and behavior of healthy and active living, and sportive attitudes, emotional intelligence. The learning environment is carefully organized to improve the growth and development of all domains, physical, psychomotor, cognitive, and affective of each student.

Technological advances in the field of Internet of Things (IoT) have provided new opportunities in the development of sports measuring instruments. IoT enables the integration of smart sensors to measure data

in real-time, which can be transmitted directly to other devices such as smartphones or computers for further analysis. In this context, IoT-based sensors can be used to measure physical parameters such as jump height, jump time, and landing power, which are directly related to leg muscle explosiveness.

According to biomechanical theory, muscle explosive power is the result of optimal interaction between muscle strength, coordination, and muscle contraction time (McGinnis, 2013). Meanwhile, physical measurement and evaluation theory states that a good measurement tool must fulfill aspects of validity, reliability, and ease of use (Baumgartner & Jackson, 2015). The combination of these theories supports the importance of developing a technology-based leg muscle explosiveness test tool that suits the needs of users in the field.

Previous studies have shown that electronic and IoT-based measuring devices have the potential to improve accuracy and efficiency in physical performance measurement (Carpes et al., 2018). However, the limited implementation of this kind of tool in physical education in Indonesia is one of the main reasons for developing an IoT sensor-based vertical leg muscle explosive power test tool that can be accessed and used easily.

Based on this background, this study aims to design and develop an IoT sensor-based vertical leg muscle explosive power test tool that has a high level of accuracy, is easy to use, and is relevant to be applied in physical education activities. In addition, this study will also evaluate the effectiveness of the tool in providing data that can be used as a basis for developing a more evidence-based physical education learning program.

According to experts Leger and Lambert, the bleep test involves running back and forth between two points for a certain distance, following an increasingly rapid beep.

B. Methods

This research is a study that will make a breakthrough where to make it easier for an Educator / trainer to help more quickly find out the results of the ability of Limb Muscle Explosiveness in students / athletes. This research aims to make a measurement tool for Limb Muscle Explosiveness, according to the title of this research, namely "Making an Electric Vertical Jump Limb Muscle Explosiveness Test Tool Using IOT technology", using quantitative R&D methods or types of research.

This research was conducted with the aim of making a test tool for leg muscle explosive power which is given an electric vertical jump. By using this tool the results of the vertical jump can be seen without having to be processed by using the existing formula in the sports measurement test for the vertical jump. This tool is a breakthrough in the world of sports which usually measures the

explosive power of leg muscles by using manually, namely by using a meter attached to the wall but with an electric vertical jump tool students simply stand and jump in front of the media that we have made so that the results can be directly converted automatically by using S = V x T, namely V = Calibration / Acceleration (cm / sec), T = time obtained in the tool (m / s) so that the results of S = Distance / Height (cm) are sought.

In this process we collect data, in the form of information that can be used as material for planning products that are expected to overcome these problems. This data collection technique comes from the leg muscle explosive power test using research tools, namely observation, as well as questionnaires and documentation. So that we as writers can find out later how much their leg muscle explosive power is. And this tool was created and developed for educators and students in conducting leg muscle explosiveness test measurement activities. After collecting data, the author immediately follows up by designing what products or tools we will make. The final result of this activity is a new product design, complete with specifications. After the product design is validated through discussions with experts and other experts, the weaknesses will be known. These weaknesses are then tried to be reduced by improving the design. The one in charge of improving the design is the author who wants to produce the product, namely in the process of making leg muscle explosive power test equipment. The last stage, at this stage we as authors carry out the production of our tools that have passed several stages in their manufacture, so we carry out this production process, as the final stage in the process of making leg muscle explosive test equipment using IOT Technology.

C. Results and Discussion

Results

This research and development aims to produce a leg muscle explosive power test tool that uses edmodo sensors. The making of this tool is to make it easier to see how much the explosive force of the leg muscles in students, the developed tool is declared feasible to use based on validation by material experts, IT expert validation, and the results of direct trials in the field both small and large scale.

The results of this study use the type of Research And Development (R&D) research, this study produces a "Vertical Jump Limb Muscle Explosiveness Test Tool Using Edmodo Sensor Cabanag Athletic Sports". This research refers to the Research And Development (R&D) development model, namely by Prof.Dr.Sugiyono (2013) which is adapted from Borg and Gall (1989), with stages: potential and problems, data collection, product design, design validation, design revision, product trials, product revision, usage trials, revision, production.

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The potential in this study is the manufacture of a Vertical Jump Limb Muscle Explosiveness Test Tool Using IOT Technology, the potential of making this tool is to maximize students to see how much strength their leg muscles have in doing the test. In addition, this tool makes it easy and efficient to use so that students or educators can do it easily and flexibly. After analyzing the needs, the next step is product design, this product design aims to illustrate the design for the first step in making a product that will be made. This is the design of the product we made:

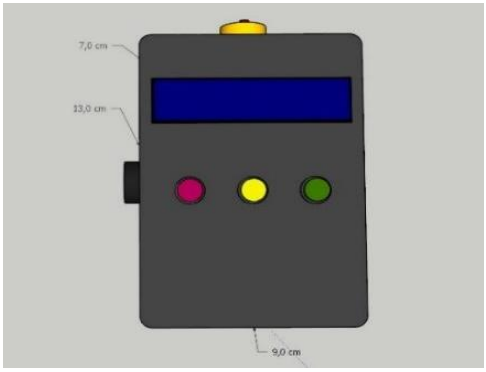

Figure 1 Tool Top View

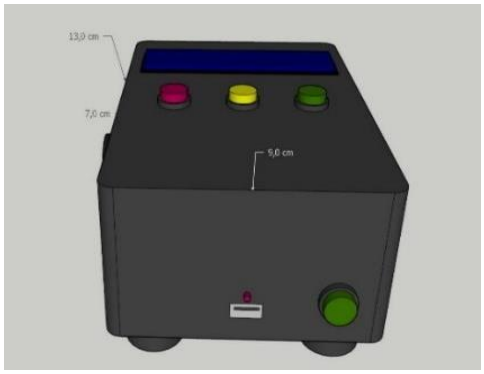

Figure 2 Tool Rear View

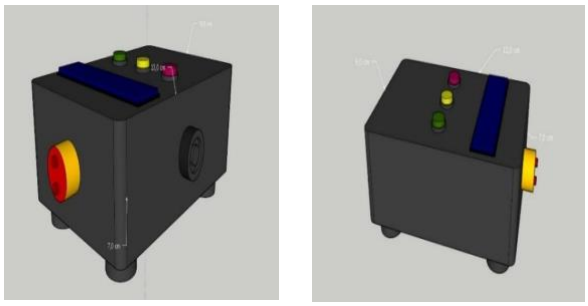

Figure3 tool view from left and right

Figure1 = The top view of the tool includes a display screen / display with several function buttons including a red button to set the mode, yellow to research and green to start. Figure 2 = Rear view which includes a USB Chargh port for battery life,

as well as a small light for detection of incoming Chargh current and a small green button for the on/off button. Figure 3 = The left side view shows a small speaker to emit sound and looks at the front of the tool there is an infrared sensor to detect movement, the right side view does not have any buttons or sensors just looks plain.

This product validation was assisted by 2 experts, including material experts, and IT (Technology) experts. This validation aims to validate a product so that it is tested both in terms of assessment and the usefulness of the tool. So that later there will be accountability for what has been made for quality and quantity. The material in the product is assessed by material experts, namely: 1 senior teacher at SMK TONS Cibitung.

Before conducting the validation test, the senior teacher who is the material expert checks all the needs that will be carried out for this validation activity, from all the readiness of tools, materials and other readiness. This assessment will validate what will be assessed one by one. So that this research is true from preparing the tool to the final presentation in the delivery of the product tool. There are 5 aspects of statement indicators in the material expert validation sheet. The material expert validates once. The following is a validation assessment table.

No.	Indicator	Assessment Instrument		
		1 (Less)	2 (Enough)	3 (Good)
		10 points	15 points	20 points
1	Prepare tools and materials			√
2	Observation description			√
3	Interpreting events that will happen		√	
4	Doing practice			√
5	Present the results of practice			√
Total score obtained		0	1	4

The final assessment score of the media expert validation of 95 points is in the range of 90 - 100 points. Which means in this case shows the "good" category. Based on these results, it can be seen that the manufacture of explosive power test tools

Based on the data tested on the leg muscle explosive power test tool. it can be seen that the number of scores obtained is 95 points and the score range is 90 - 100 with the category "good". Based on these calculations, the conversion of the material expert validation score can be made as follows:

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Table 4. Validation Score Conversion

Rentang Skor	Katagori
90 - 100	Baik
60 - 90	Cukup
30 - 60	Kurang
10 - 30	Tidak Layak

Validation of research tools by material experts was carried out once. Validation by material experts aims to make the product developed into a quality product in terms of material, learning and validity.

The final assessment score of the technology expert validation of 90 points is in the range of 90 - 100 points. Which means in this case shows the "good" category. Based on these results, it can be seen that the manufacture of a vertical jump leg muscle explosiveness test tool using this edmodo sensor which was developed is feasible to use in terms of model aspects, performance assessment, technological novelty from technology experts.

After the product goes through the validation stage by material experts, motion experts, measurement test experts, and IT (Technology) experts, we conduct product trials for a small scale with the next product will be tested with a small group trial consisting of 10 students. The results of the product trial are as follows:

No	Nama	Jarak/ ketinggian (s)	Kalibrasi/ percepatan (v)	Waktu (t)	Hasil (cm)
1	M. Afriyanto	31,4 cm	66,9 cm/detik	04,70 m/s	31,4 cm
2	Muhammad Doni	29,9 cm	66,9 cm/detik	04,48 m/s	29,9 cm
3	Pandu Sandi. P	28,4 cm	66,9 cm/detik	04,26 m/s	28,4 cm
4	Pikri	34,4 cm	66,9 cm/detik	05,15 m/s	34,4 cm
5	Ramadani	29,4 cm	66,9 cm/detik	04,40 m/s	29,4 cm
6	Rangga Kusumaini	28,4 cm	66,9 cm/detik	04,26 m/s	28,4 cm
7	Rasya Mulya. P	21,7 cm	66,9 cm/detik	02,25 m/s	21,7 cm
8	Rayhan Adi. PS	25,6 cm	66,9 cm/detik	03,83 m/s	25,6 cm
9	Restu Surya. R	16,3 cm	66,9 cm/detik	02,44 m/s	16,3 cm
10	Ricky Nurrachmad	34,2 cm	66,9 cm/detik	05,12 m/s	34,2 cm

Based on the test results above that the eletric vertical jump using IOT technology can function properly after the manual test results and the results of the tool test can be compared according to the formula for the provisions of the vertical jump. Then we conclude that based on the results of the tests carried out the eletric vertical jump using IOT technology can help in testing physical fitness activities on leg muscle explosive power activities.

Discussion

The results showed that the development of an IoT-based vertical leg muscle explosive power test tool provides significant benefits in the context of physical education. This tool is able to provide measurements that are accurate, efficient, and relevant to the needs

of evaluating students' physical performance. In this discussion, we will outline some of the main aspects related to the research results, both from a technical point of view and practical applications in the field. The tool shows high validity with a significant correlation (r = 0.93) to the manual methods that have been used, such as Vertec or tape measures. This shows that IoT-based technology can replace conventional methods with more accurate and efficient results. The use of pressure sensors to detect take-off and landing times, as well as proximity sensors to measure jump height, ensures that the device is able to measure important parameters with precision.

D. Conclusion

This research successfully developed an IoT technology-based vertical leg muscle explosive power test tool that has a high level of accuracy and efficiency to be applied in physical education activities. This tool utilizes a pressure sensor and a distance sensor integrated with an IoT-based microcontroller, allowing real-time measurement of jump height and time in the air. The resulting data can be used to evaluate leg muscle explosive power more accurately than conventional manual methods. The tool showed a high correlation (r = 0.93) with the manual measurement method, indicating that measurements using IoT technology are able to provide valid and consistent results. These results support physical evaluation theory (Baumgartner & Jackson, 2015) which states that a good measurement tool must have high validity and reliability to produce reliable data. Overall, this IoT-based vertical leg muscle explosiveness test tool provides an innovative solution to overcome the limitations of manual measurement methods. This tool is not only relevant for use in physical education but also has the potential to be applied in athletic training and physical rehabilitation. With proper implementation support, this tool can be one of the important instruments in improving the quality of learning and physical evaluation of students at various educational levels.

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