DEVELOPMENT OF "SIT AND REACH" FLEXOMETER USING INFRA-RED

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Abstract

This research generally aims to develop a "sit and reach test" flexometer which is able to measure the flexibility of a person's body. Specifically, this research aims to: (1) replace conventional measurement of flexibility, because this measuring instrument will work electronically; (2) developing a flexometer which works electronically using infrared so that it is processed by a microcontroller in order to get the test results in the form of distance are automatically classified (3) developing a flexometer which is more modern, practical, effective and efficient This research used a product development (research & development) method that is consists of several steps, namely observation, planning and design, experimentation and testing, and analysis. The product trial subjects were 40 students of STKIP PJKR Muhammadiyah of Bangka Belitung. The results of measurements of body flexibility used conventional flexometers and the results of measurements of body flexibility used an auto flexometer. Products were tested for validity using the construct validity and product reliability methods with the retest method. Based on data analysis, the validity value of the flexometer auto compared to the conventional measurement of flexibility is 0.645098. Based on the analysis of the reliability test data obtained r11 = 0.988> rt = 0.312. It can be concluded that the automation flexometer used valid and reliable infrared to be used in measuring the flexibility of the body in the sit and reach test.

Keywords: Flexometer, Sit and Reach Test

Introduction

Flexibility is included as a key of performance component, and as an integral part of the physical conditioning program for many sports, Draper, Brent, Hodgson, & Blackwell (2009). Flexibility is also recognized as an important component of one's physical fitness condition, Afsharnezhad, Nateghi, & Soufi (2010). However, there is currently no development of a flexibility measuring instrument that uses Flexometer. Meanwhile, countries with advanced sports science and technology are followed by advanced sports achievements, Haryono & Pribadi (2012). Measurement of flexibility performed today still uses a Flexometer table which has a cm scale on the surface of the table, or even uses a table / bench that is then placed on a ruler, and recorded the results of the test implementation to be compared with the classification table of flexibility, Afsharnezhad et al (2010), López-Miñarro, Andújar, & Rodríguez-García (2009), Lemmink, Greef, Rispens, Kemper, & Stevens (2003), Hoeger & Hopkins (1992). The methods and tools used are currently still used and they are conventional. Until now, this tool has not yet developed practically and working with a

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computerized electronic system to measure this flexibility effectively and efficiently.

Technology of Infrared distance measure has been widely used in several scientific fields, but there is still little use of this technology, especially in the field of sports testing and measurement. Nowadays, at the national scale infrared distance sensors have been used in the development of vertical jump measuring instrument, Personal & Haryono (2011) and also on leg power measuring instruments, Haryono & Pribadi (2012). Data from statistical calculations show that the leg power measuring device that utilizes infrared technology has a high validity value and a very high reliability value, Haryono & Pribadi (2012). From the results of the study, it was found that the measuring instrument of vertical jump developed by the use of infrared technology has a high enough validity value so that it can be said that the developed instrument is in accordance with similar measuring devices, Personal & Haryono (2011). It shows that infrared technology can be utilized and developed in the field of sports testing and measurement.

An innovation is needed, because there is no technology which can measure flexibility electronically and use these practical tools. The purpose of this research is to produce a product. The expected product is a technology which measures practical flexibility and uses an electronic system. It is hypothesized that the development of this flexibility measurement tool can not only measure a person's flexibility validly and reliably, but is also more practical than conventional methods of measuring flexibility.

Flexibility as a physical condition which is one of the main performance components in sports, when compared with other aspects of performance, flexibility receives less research attention, Draper et al (2009). Prabandani and Laksono measured body flexibility using a sit and reach box (flexometer), Prabandani & Laksono (2016). Research conducted by Afsharnezad, Nateghi, & Soufi measures flexibility by using a 12 inch bench which is then placed on a ruler, Afsharnezhad et al (2010). Research conducted by Arjuna & Susanto uses a sit and reach test with a sit and reach box (Flexometer) measuring tool to determine the flexibility of U-17 soccer players Romberz FC, Arjuna & Susanto (2013).

Figure 1. Sit and reach box (flexometer), Source:
https://www.wepasports.com/physical-education-equipment/sit-and-reach-
flexibility-box/

Research conducted by Lubis & Sulatri collected subject flexibility data through sit and reach tests, Lubis & Sulastri (2015). The same thing was done in the Perbandani & Laksono's study, they collected data on the flexibility of postpartum mothers using sit and reach box (flexometer), Prabandani & Laksono (2016). The illustration of the implementation of the sit and reach test using a conventional flexometer can be seen in Figure 2 below:

Figure. 2 Illustration of sit and reach test using Conventional Flexometer, Source: https://www.google.co.id/search?q=sit+and+reach&rlz

Figure 1 is a conventional sit and reach box (flexometer) model that will be developed in this study. Utilization of infrared technology and electronical flexometer working systems are the focus of this research. In addition, this research will also develop the shape of the flexometer itself, in order to obtain products which are not only effective and efficient, but also practical. The initial design of the flexometer development using infrared can be seen in Figure 7.

Previous research stated that the infrared sensor type GP2Y0A02YK0F can be used as a proximity sensor, Personal & Haryono (2011). Haryono & Personal Research uses four infrared sensors to measure the height of jumps with a cm scale, Haryono & Pribadi (2012). Based on the validity and reliability test, the jump power meter using infrared has a high validity value and a very high reliability value, Haryono & Pribadi (2012). Infrared sensors are easy to detect distances because they adopt the triangulation method, Personal & Haryono (2011).

Figure 3. GP2Y0A02YK0F Infra Red Sensor type, Source: https://www.google.co.id/search?q=infrared+tipe+GP2Y0A02YK0F

The microcontroller used in this study was "Arduino Uno." Without doing any configuration, once an arduino board is removed from its packaging box it can be directly connected to a computer via a USB cable, besides that a 5 volt DC current flows so that the arduino board does not require external power sources. Sutono (2014) this arduino uno controller provides a simple implementation of the system compared to other types of controllers in the literature. Bader M. O. Al-thobaiti, Faith I. M. Abosolaiman, Mahdi H. M. Alzahrani & Mohamed S. Soliman (2014) this microcontroller is a high performance device that has a low power A VR S-bit microcontroller with 32K bytes in-system and advanced reduced instruction set computing. Bin Bahrudin, Kassim, & Buniyamin (2013).
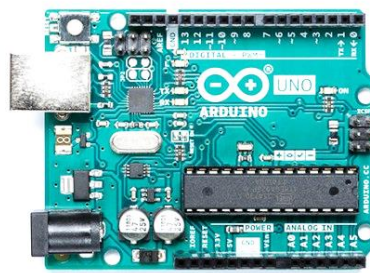
Figure 4. *Micro Controller* Arduino Uno, Sumber: https://store-cdn.arduino.cc/usa/catalog/product

This research will continue with several developments. The next development phase is planned to develop this measuring instrument with an android-based. At this stage it is also planned to develop software which is able to provide recommendations on the subject matter measured. The recommendation in question is a program to improve / increase the subject's flexibility status in the form of a training program for the subject being measured.

Method

After paying attention to the description in the background and literature review, the following are the stages of the implementation of the research to be carried out as presented in Figure 5 of the research design below:
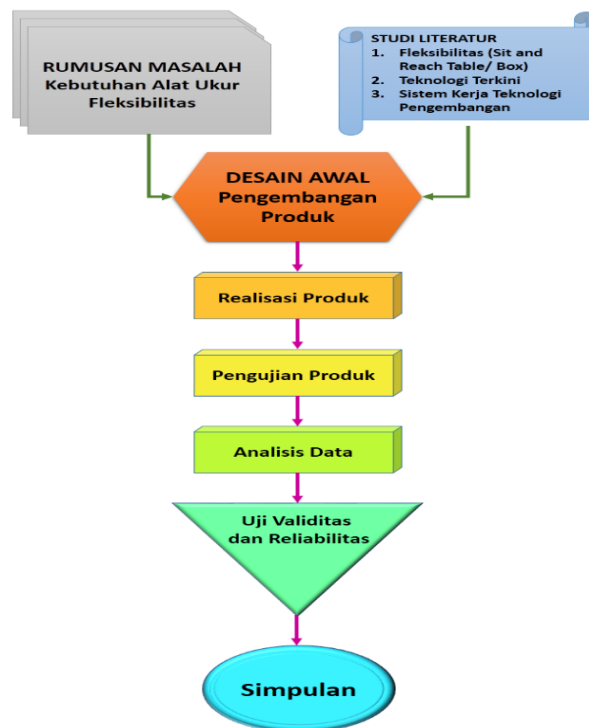
Figure 5. Research Design

Based on the research design, there are several methods which will be carried out to achieve the objectives of this study.

Observation Method

It includes observations to be made by researchers in the field, observation of current sports and health technology developments. Observation is also made on the needs of sports and health technology, especially in Indonesia.

Planning and Design Methods

This method is the planning and design of the product work system so that it can be used as a product which can be used in sports and health tests and measurements. Product planning and design in this study is a flexibility measuring instrument in the form of a flexometer for sit and reach test. The concept of flexometer using infrared is the development of a conventional flexometer. Utilizing infrared sensor technology is to obtain digital data on the distance of test subjects (cm). Then the data is processed by the microcontroller to classify the flexibility of the subject being classified. Then the data display is obtained in the form of distance achieved, and the classification of flexibility of the subjects measured on a computer. Data is not only in the form of display but can also be saved and printed.

Experimentation and Testing Methods

This method is used to try and test products to produce a valid and reliable system. System performance is also tested so the results can be accounted for. External validity is conducted by correlating the product with conventional measuring devices. Reliability is conducted by the retest method.

Analysis

The validity of the product is carried out by correlating the flexibility measurement data using the auto flexometer with the flexibility measurement results using a conventional flexometer. This validity is also called construct validity, this validity is the strictest form of validity, Jones & Gratton (2004). Product reliability is tested by the retest method. Reliability of the retest is the extent to which the study will provide the same measurement if repeated at different times, so the test will give the same score over and over, Jones & Gratton (2004). Then correlate the results of retest data conducted using the auto

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flexometer. To find out the validity and reliability value of this auto flexometer is calculated using the product moment formula:

$$r_{xy} = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{\{N\sum x^2 - (\sum x)^2\}}\sqrt{\{N\sum y^2 - (\sum y)^2\}}}$$

Product Trial Subject

The product trial subjects are 40 students of STKIP PJKR Muhammadiyah of Bangka Belitung. Subjects are students who already know and can do a "sit and reach test" body flexibility test.

Instrument and Research Data Collection

The data of this study were obtained from the results of measurements of body flexibility using conventional flexometer and the results of measurements of body flexibility using an auto flexometer. The type of data obtained is quantitative data in the form of distance between subjects and units (cm). Measurement using a conventional flexometer gets results based on the distance achieved minus the distance of the position of the toes. While measurements using auto flexometer do not need to be added, this is because the auto flexometer automatically measures and classifies the subject's flexibility. Data validity was collected on 8 October 2019, while data collection for reliability testing using the retest method was conducted on 8 October 2019 and 12 October 2019.

Discussion

Auto Flexometer Realization

Automation flexometer is the development of a conventional flexometer which is used to measure the flexibility of one's body. This flexometer is also equipped with an LCD to display the measurement results of the body flexibility in automation. The realization of the automation flexometer product can be seen in Figure 6 testing the automation flexometer device using the following infrared below:

Figure 6. Testing Automation Flexometer Devices Using Infrared

This flexometer is equipped with software that can store measurement results and classify the measurement results automatically. This flexometer is also equipped with a connection system to the computer. When connected to a computer, there are applications which can be used to input the subject data to be measured. This application also provides the same display as an auto flexometer LCD. Measurement data stored in the application can also be imported into Microsoft Excel programs. In brief, classification of the body's flexibility of the subject being measured can be known without having to calculate in advance the distance of the achievement and the position of the toes of the subject as is conducted when using a conventional flexometer.
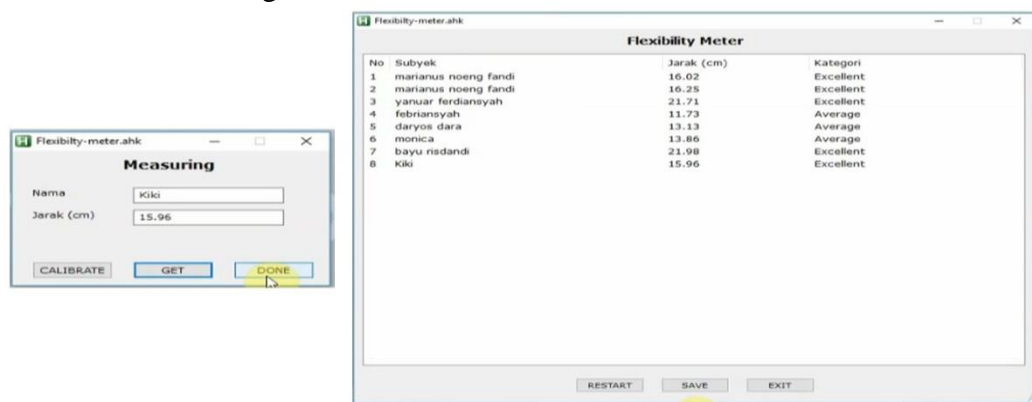

Figure 7. Display of Auto Flexometer Application on a Computer

Data Description

Data collection is carried out in two ways. First, conventional measurements with the sit and reach flexometer table. Second, automation measurements uses the auto Flexometer. The comparison of data obtained manually and automation can be seen in Table 1 comparison of conventional flexometer and automation measurement data as follows:

Table 1. Comparison of Conventional and Automation Flexometer Measurement Data

No	Result (cm)	
	Conventional Flexometer	**Auto Flexometer**
1	6.5	8.82
2	9.5	24.04
3	16	17.9
4	16.5	21.98
5	2.5	10.02
6	7.5	13.13
7	12	16.15

8	24	23.57
9	18.5	16.47
10	15.5	23.77
11	15	11.73
12	1	3.93
13	19	20.65
14	6.5	12.37
15	2	11.2
16	6	11.35
17	14.5	19.05
18	2.5	3.33
19	25	24.22
20	15	15.96
21	14	16.25
22	13	13.86
23	7	13
24	10.5	10.76
25	8	9.59
26	6.5	12.65
27	18.5	28.03
28	23.5	9.52
29	2.5	18.77
30	12.5	16.23
31	8.5	15.7
32	11	15.27
33	14	21.92
34	8	15.22
35	12.5	10.11
36	9	11.64
37	17	21.71
38	7	13.55
39	14	17.84
40	21	21.09

Based on the result measurement of data on Table 1, it was obtained that the comparison of the analysis result of statistical description between measurements used conventional flexometer and auto flexometer. The average of measurement result used conventional flexometer was 11.825, and auto flexometer was 15.559. Measurement used auto flexometer was higher than conventional flexometer. The difference was till 3.774 cm. furthermore, the result of statistical description analysis can be seen on Table 2 Comparison of Data Description of Conventional and Automation Flexometer, as follows:

Table 2. Comparison of Data Description of Conventional and Automation Flexometer

	Flexometer	
	Conventional	Automation
n	40	40
Mean	11.825	15.559
Median	12.25	15.485
Deviation Standard	6.245563	5.630055
Range	24	24.7
Minimum	1	3.33
Maximum	25	28.03
Sum	473	622.35

Note: Significance level of 0.05

Based on data analysis using product moment correlation obtained the value of the auto flexometer compared to the conventional measurement of flexibility of 0.645098. When compared with $r$kritis = 0.30, it can be concluded that the auto flexometer is declared valid to measure the flexibility of the body in the sit and reach test.

Table 3. Automation Flexometer Validity and Reliability Test Results

Score	
Validity	Reliability
0.645098	0.988130

Based on the reliability test of data analysis using product moment correlation, obtained $r11 = 0.988 > rt = 0.312$. It can be concluded that the auto-flexometer uses reliable infrared to be used in measuring body flexibility in sit and reach tests.

Conclusion

Automation flexometer using infrared can be used to measure body flexibility in sit and reach tests more practically and efficiently. The result of data analysis shows that the automation flexometer uses valid and reliable infrared to measure body flexibility. Although the result has differences from the average of data between conventional and automation flexometer. But in determining the classification of body flexibility, automation flexometer is more efficient. This efficiency is due to the automation flexometer equipped with software that can classify results automatically.

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