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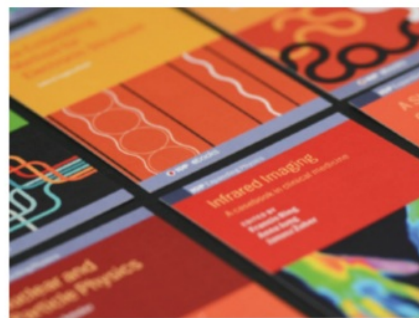
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To cite this article: Hartati *et al* 2020 *J. Phys.: Conf. Ser.* **1480** 012076

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Development of ball capture test based on vibration sensor

Hartati^{1*}, Destriana^{1*}, S Aryanti^{1*}

¹Physical Education Department, Universitas Sriwijaya, Palembang, South Sumatra, Indonesia

*Corresponding author's email: hartati@fkip.unsri.ac.id

Abstract. The purpose of this research is to produce a ball-to-wall throwing sensor based vibrating sensor that can be used to calculate coordination. This study uses an R&D research method developed by Borg and Gall. The subjects of this research trial were 28 physical education students, one test and measurement experts and one electronics experts to validate of the equipment test. The validation results obtained an average value of 80% so that a valid tool for further use of the trial was held to find that the catching device that was made could work as it should even though there was an error of 1.8% so that it could still be tolerated. This tool can be used as a wall ball throwing test tool to test athletes, students, or students so that it can facilitate tests conducted by teachers and trainers.

1. Introduction

Sports science is still continuing to develop with science and technology, while many sports that have used science and technology in the training process as well as in progress, in addition to training and competition, training instruments measuring the branches of sports also need to be developed according to using ICTs that have been added in the field of education, since it was included in the 2004 curriculum, it was agreed that students could improve their skills, so that it could be used in other subjects as a cross-curriculum.

The instrument developed was the coordination test instrument. The test is one form of instrument used to conduct assessments, with the aim to find out the learning or competencies that have been obtained by students. [1] Tests are instruments or tools used to obtain information about individuals or objects. The coordination test is done by throwing a ball. Vibration sensor based ball throwing test instrument, the development is done by using the vibration sensor as a detection tool integrated with a microcontroller called adriano uno. In research [2] development of test device and measurement of computer based volleyball passing have result the advantages of these tools are providing efficiency and effectiveness to the trainer when giving training, providing a new variant in evaluating volleyball passing, data obtained is more objective, easily moved (portable), the tools developed were unprecedented. The use of technologies is varied in sport. They are able to detect and assess athletes' performances, measure accuracy (such as eagle eye in badminton) and data collecting [3].

The advantage of this tool is to develop a vibration sensor with a microcontroller, so that this Twith the opinion [4] that technology is widely employed in sport since this equipment brings some beneficial feature towards the sport and its athletes in terms of monitoring, developing skill, and competitive edge. This tool changes how the data is gathered and transferred from trainers to athletes, and vice versa. The application of this tool in training are seen as a way to give feedback in order to develop athletes' competitiveness, discipline, and skill. Early references regarding the development of the throwing instrument for the coordination test were very minimal for this research to be developed beforehand. This catch test was developed due to differences in perception of how many throws made



4

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by the testes were counted by the tester or testers with the problem at hand, the development of this tool is believed to be used as a good test and measurement tool and can be used easily.

2. Method

Research method is R&D with a design developed by Borg and Gall. Development research is discussed as a systematic study of the process of designing, developing, evaluating programs and learning products, as well as meeting internal criteria and effective use of programs or products [5]. This study involved the first semester of Physical Education students as the subject of a throwing catch test tool, totaling 28 students. The steps of this research are requirements analysis, design of test kits, expert validation, and testing of test kits. The performance of the device was tested using an error calculation so that the tool works properly or not. Expert validation was used to see the validity of tools developed with 2 expert validations, namely sports test and measurement experts and electronics experts. This research was conducted in the Health Laboratory of Sriwijaya University in Juli-September 2019.

3. Result and Discussion

3.1. Profile of Vibration Based Throwing Tool

The instrument developed was a ball-throwing test that was used to determine one's coordination ability. This tool consists of components in the form of a vibrating sensor as a vibrating catcher (signal), arduino uno as a microcontroller, a small screen from the toss and a throw board.



Figure 1. Vibration sensor.

Figure one is a vibrating sensor, a vibrating sensor is a device that serves to detect the presence of vibrations and will be converted into an electrical signal, this sensor captures vibrations that come from the teste ball throw. Vibration sensor is often used as a signal catcher as in [2] which contains "A voice activity detector (VAD) combines the use of an acoustic VAD and a VAD vibration sensor as appropriate to the conditions a host device is operated. The VAD includes a first detector receiving a first signal and a second detector receiving a second signal. The VAD includes a first VAD component coupled to the first and second detectors". The quantification of the physical sports utilize the sensor, does microsensor innovation measure the physical requests of rugby association and American football are essentially expanded through the enormous number of impacts players are required to perform during match play [6]. Due to the work concentrated nature of coding crashes from video chronicles, producers of wearable microsensor (such as GPS) units have refined the innovation to naturally recognize collisions, these discoveries show that just a single industrially accessible and wearable microtechnology unit (minimaxX) can be viewed as fit for offering a legitimate technique for evaluating the contact stacks that normally happen in impact sports, so the sensor can use for measure.

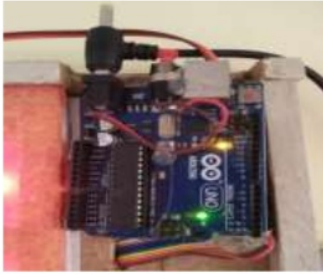


Figure 2. Arduino uno.

Figure 2 is Arduino is an open source electronic unit explicitly intended to make it simpler for the individuals who are keen on making articles or creating electronic gadgets that can communicate with different sensors and controllers [7]. Arduino is an open-source stage and comprises of both a physical programmable circuit board (regularly alluded to as a microcontroller) and a bit of programming, used to compose and transfer PC code to the physical board, adjacent to that [8] Arduino microcontrollers are an open source single-board microcontroller intended to make the hardware ends increasingly available. They have been effectively utilized in numerous logical applications. Arduino UNO is a microcontroller board that is completely constrained by ATmega328. As appeared in the image above, Arduino UNO has 14 advanced information/output pins, a 16 MHz Crystal oscillator, a USB association, a power jack, an ICSP header, and a reset catch. Arduino UNO contains everything expected to help a microcontroller, in study [9] compact ease ECG and EMG gadgets that assume the job of nonstop observing of the client pulse and muscle movement Arduino Uno goes about as a microcontroller to break down the gathered flag and afterward transmits the information by means of Bluetooth to Android-based cell phones; workstation through Processing programming; or LCD screen. Handling programming was utilized to play out an acquired information in the graphical perspectives. The beat sensor applies photoplethysmography (PPG) strategy to quantify the pulse in beats every moment (bpm), in examine [10] builds up a robotized family unit utility power checking framework and information signing progressively. It uses the Arduino Uno Rev3 Microcontroller board planned for use related to the ATmega328 chip.



Figure 3. Monitor counter.

The counter monitor is a screen produces how many throws the teste makes with the screen.



Figure 4. Ball Throwing Board

This throw board is the pitch where the vibrating sensor is installed, the vibration is obtained through the ball throw conducted by the teste so that the origin of the signal or vibration originates from this target board.

3.2. Expert Validation for Development of Test

The development of vibrating sensor-based throwing test kits is validated by experts in their fields, namely an electronic expert and a sports test and measurement expert. Validity Test is performed to determine the level of validity of products that have been developed [11]. The following shows the results of the validation of electronic engineering experts

Table 1. Electronic expert validation assessment results ball-based throwing test.

No	Statement of Results										Σ	Maximu m value	Percentage (%)	Category
	1	2	3	4	5	6	7	8	9	10				
1	3	3	3	3	3	3	3	3	3	3	31	40	77.5	Valid

$$\begin{aligned}
 \text{Percentage} &= \frac{\sum}{n} \times 100\% \\
 &= \frac{31}{40} \times 100\% \\
 &= 77.5\%
 \end{aligned}$$

The results of the electronic validation of the percentage obtained 77.5% can thus be stated that according to electronics experts, in the ball-throwing sensor-based vibrating ball test the material aspect gets the "Valid" category.

Validation of Sports Tests and Measurements, following are the results of the validation of the test and measurement experts:

Table 2. Results of test expert validation assessment and measurement.

No	Statement of Results										Σ	Maximu m value	Percentage (%)	Category
	1	2	3	4	5	6	7	8	9	10				
1	4	3	3	3	3	3	3	4	3	4	33	40	82.5	Valid

$$\begin{aligned}
 \text{Percentage} &= \frac{\sum}{n} \times 100\% \\
 &= \frac{33}{40} \times 100\% \\
 &= 82.5\%
 \end{aligned}$$

In the validation of the test expert and the measurement of the percentage obtained 82.5%, it can be stated that in the opinion of the test and measurement expert, the development of a vibrating sensor-based throwing test is in the "Valid" category. The results of the test and measurement experts and

electronics experts obtained a percentage of 82.5% and 77.5% so that an average of 80% is obtained so that the vibrating sensor-based throwing device is valid to be tested.

The validation of the tool is carried out on the health education students, while the analysis is done using the test error test, which is to see comparing the results of manual tests and tests developed. Error calculation is the difference between manual readings and readings by dividing the total number of errors divided by the total number of samples using a sensor. The following is the formula for calculating the error value:

$$\% \text{ error} = \frac{\text{number of errors}}{\text{number of test subjects}} \times 100\%$$

All data obtained is calculated by finding the average value of % error. The results of the calculation of the accuracy of the lat throw test can be seen in Table 3.

Table 3. Testing data for the throwing capture test tool.

N0	Name (Initial)	Manual Test	Sensor Test	Error	% Error
1	MA	24	24	0	0
2	MR	22	21	1	4.5
3	SS	20	20	0	0
4	FA	19	18	1	4.5
5	MTR	21	20	2	4.5
6	FR	20	20	0	0
7	MAM	23	23	0	0
8	FBP	28	28	0	0
9	GYH	23	22	1	4.5
10	MRA	25	25	0	0
11	DR	22	21	1	4.5
12	MFJ	19	18	1	4.5
13	AAT	26	26	0	0
14	NLE	22	21	1	4.5
15	GST	20	20	0	0
16	AR	18	18	0	0
17	MJP	21	20	1	4.5
18	RAI	19	19	0	0
19	BP	24	24	0	0
20	SNK	22	22	0	0
21	MK	20	19	1	4.5
22	DK	21	21	0	0
23	BS	25	25	0	0
24	SFT	23	23	0	0
25	FY	22	22	0	0
26	RRP	23	22	1	4.5
27	PKAN	20	21	1	4.5
28	EA	18	18	0	0
					49.5

$$\begin{aligned} \% \text{ error} &= \frac{\text{number of errors}}{\text{number of test subjects}} \times 100\% \\ &= \frac{49.5}{28} \\ &= 1.8\% \end{aligned}$$

By adding up all the errors, the results were 49.5 and divided by all 28 subjects, the percentage was 1.8%. Based on the stages of testing by means of vibration-based throwing instruments that have been conducted so that it can be concluded that the catching devices that are made can work as they should even though there is an error of 1.8% so that it can still be tolerated, according to the opinion [12] the

utilization of innovative applications is presently broad crosswise over many significant games science disciplines and the reception of these apparatuses to increase an 'upper hand' is an undeniably significant element of tip top games. These advancements have molded the manner in which information is gathered and prepared, how data is handed-off among mentors and staff or to competitors, and has bigly affected the manner by which competitors are checked in the every day preparing and rivalry situations [13]. The motivation behind this investigation was to evaluate the viability of the utilization of video criticism on understudy learning in physical instruction, while likewise analyzing the instructor's reactions to the development, these conditions contrasted with the utilization of video input (either from the educator or from peers) with no video. The 'video and educator input' condition gave the best in general outcomes, with factually noteworthy upgrades in aptitude execution, method, and information learning, just as the most significant level of training. In any case, while recognizing the utility of video criticism as an instructional device, the educator feels overpowered by the requests of the innovation on the two his time responsibilities and regarding his very own innovation abilities, other than as indicated by [14] sport innovation has accordingly contributed extraordinarily to the upgrade of the study of disease transmission, counteractive action and the executives of wounds, the executives of non-transmittable illnesses, physical movement and sports execution so that from this investigation innovation is required in sports and learning exercises.

3.3. Trial Test Equipment

In conducting the field test the tool was carried out to see how effective the sensor-based throwing catch. This test was conducted at the Penjaskes Laboratory of Sriwijaya University. Below this will be shown the trial test of the catching throw test using a developed tool



Figure 5. Ball throw trial



Figure 6. Ball throw trial

The results of observations of 28 physical education students found that 24 students (85.7%) did not experience difficulties in carrying out the catching test, students did not experience difficulties

seen in the absence of questions about how to use the equipment, and students were able to use the tool well, then it can be concluded that the development of vibrating sensor-based throwing devices can be used effectively. Like other studies the technology so important [15] Two-dimensional (2D) video analysis of frontal-plane dynamic knee valgus during common athletic screening tasks has been purported to identify individuals who may be at high risk of suffering knee injuries such as anterior cruciate ligament tear or patellofemoral pain syndrome. Although the validity of 2D video analysis has been studied, the associated reliability and measurement error have not, and the result show Standard error of measurement and smallest detectable difference values ranged from 2.72° to 3.01° and 7.54° to 8.93°, respectively. 2D FPPA has previously been shown to be valid and has now also been shown to be a reliable measure of lower extremity dynamic knee valgus, clinicians can now make informed judgments about individual performance and changes in performance resulting, beside that the study of sport technology [16] like the Sports Concussion Assessment Tool 2 (SCAT2) and King-Devick (K-D) tests have both been proposed as sideline tools to detect sports-related concussion. We performed an exploratory analysis to determine the relation of SCAT2 components, particularly the Standardized Assessment of Concussion (SAC), to K-D test scores in a professional ice hockey team cohort during pre-season baseline testing. Athletes with concussion also underwent rinkside testing. Lower (worse) scores for the SCAT2 SAC Immediate Memory Score and the overall SAC score were associated with greater (worse) times required to complete the K-D test at baseline. Both working memory and saccadic eye movements share closely related anatomical structures, including the dorsolateral prefrontal cortex (DLPFC). A composite of brief rapid sideline tests, including SAC and K-D (and balance testing for non-ice hockey sports), is likely to provide an effective clinical tool to assess the athlete with suspected concussion, beside [17] that study of Electronic Sports Gloves to assist players in training which can be used in indoor as well as outdoor sports, these gloves are pre-calibrated using the Inertial Measurement Unit (IMU) for efficient hand movements. Yaw, pitch and roll angles of wrist actions are calculated by the gyro and accelerometer, present on IMU. Gloves will recognize and compare these values with reference values so that a protégé can be guided to make those movements precisely and achieve optimum results, so from various studies on the development of sports equipment can be very helpful both for teachers, trainers, sports doctors and lecturers.

4. Conclusion

The conclusion is the product is valid, the results of the validation of test and measurement experts as well as electronics experts obtained a percentage of 82.5% and 77.5% besides the throwing gear is validated to students used an error test with a 1.8% result, the vibrating sensor-based throwing device is feasible to be tested, the test results obtained 24 students (85.7%) did not experience difficulties in conducting the throwing test so that this was declared effective for use, so this product can be used for the ball throw test for teachers, lecturers, and trainers.

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