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Design Of Shadow Trainer Equipment To Measure The Agility Of Badminton Player

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During this time many badminton athletes that have irregular footsteps, this is because the equipment used in leg practice (footwork) still simple that use simple light is turned on / off by the coach. The method used in this research is experiment by designing, manufacturing and applying equipment based microcontroller. The goal of this research used microcontroller-based system for badminton athlete to improve the effectiveness and efficiency of athlete's movement. Based on the results of the test tool that has been done, the development of system hardware and software based microcontroller using wireless system worked well. Based on reliability with Cronbach Alpha method, the obtained value of Cronbach's alpha coefficient (α) = 0.875. Referring to the value of rtabel with df (0.05, n-2) about 0.632, then α> rtabel so it is said that the measurement of footwork based microcontroller is reliable and classified as very high criteria (good) for entry into the range 0,800 ≤ α ≤ 1.000. Based on those above, it can be said that the data generated by the microcontroller footwork training is valid (accurate) for all values correlation score item> rtabel (0.632). Footwork practice equipement is also equipped timekeeper so the athlete movement from one point to another one can be measured threfore the performance of athlete according to required standard. This can make the coach to observe precisedly all athletes, whether they are good or not. The other advantages of this equipment is all-around because it can be used for athletes of all sports, especially to train agility footwork

Keywords: footwork, agility, microcontroller, athlete, badminton

I. INTRODUCTION

Badminton is an intense sport that requires fast and sudden movements. A professional player is expected to perform a large number of jumps, lunges, and rapid directional changes [8]. Endurance running, interval running, and resisted running are common high-intensity training exercises to build up aerobic, anaerobic and muscular capabilities of athletes [7] , [15]. Resisted running increases muscular endurance, strength and anaerobic fitness by extending the body's physical limit. All these capabilities are prerequisite to all competitive sports. However, it should be noted that the design and ultimate objective of these training exercises should be specific to different types of sport. [3].

Many field and court sports involve some straight sprinting, but more often repeated short sprinting with changes of direction. The ability to sprint repeatedly and change direction while sprinting is a determinant of sport performance in field and court sports, as evidenced by time and motion analysis, validation of testing batteries for elite and non-elite performers, and coaching analysis for sports such as rugby.[5] field hockey [10] and soccer.

The most important factor in badminton is footstep (footwork). Footwork is the fundamental technique of badminton,which is in high need of competition and critical maneuvers such as quick-stop, quick-rotate, jumping and lunging in an extreme short period of time [14]

Effective and efficient footstep (footwork) will ease an athlete engaged in the field so that it takes a little energy. The consideration of athlete's characteristic posture is different such as height, bone shape and balance of the body. During this time they have irregular footsteps because the equipment used in footwork exercise is very simple using the light on / off by the coach. To answer these problems in this research will develop a footwork equipment uses wireless microcontroller-based system for badminton athletes to determine the success of the training methods. By applying these tools, it can be used to monitor an athlete's success rate with proper exercise and can be used as a reference for obtaining the right method to improve the performance of an athlete. The basic techniques of basketball to be possessed by the students obtained that the practice must be applied to basketball athlete include: passing , dribbling, shooting, a rotating body (pivot), footwork, jumping, and fakes and faints. [13].

Badminton utilizes complex motion skills and abilities. It can be observed that the player must perform movements such as sprinting, stopping suddenly and soon moved again, leaping motion, reaching, twisting weight quickly, do stride without ever losing balance. These movements must be done repeatedly and in a long time, as long as the game occurring. This condition will result in "fatigue", which will influence directly the work of the heart, lungs, circulatory system, breathing, muscles, and joints of the body.

Therefore it is very important of badminton's player to have good physical condition. Through well programmed physical training, those factors can be mastered. In other words, they must have good endurance. This will have positive impact on mental fitness, psychic that influence directly to their performance. Hence, they need more power, endurance, speed, agility and good coordination movement. These aspects is highly needed to be able to move and react accurately during the match.

Footwork is the basic technique of badminton to generate better smash, hence it must be done correctly. Practice footwork with back and forth movement, left to right, backward and diagonally forward with your left leg as a footstool and as always there in front of the right leg near the ball (cock).

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2. METHODOLOGY

To comprehend the stages of this research, then a flow chart has been created that can be seen in figure 1

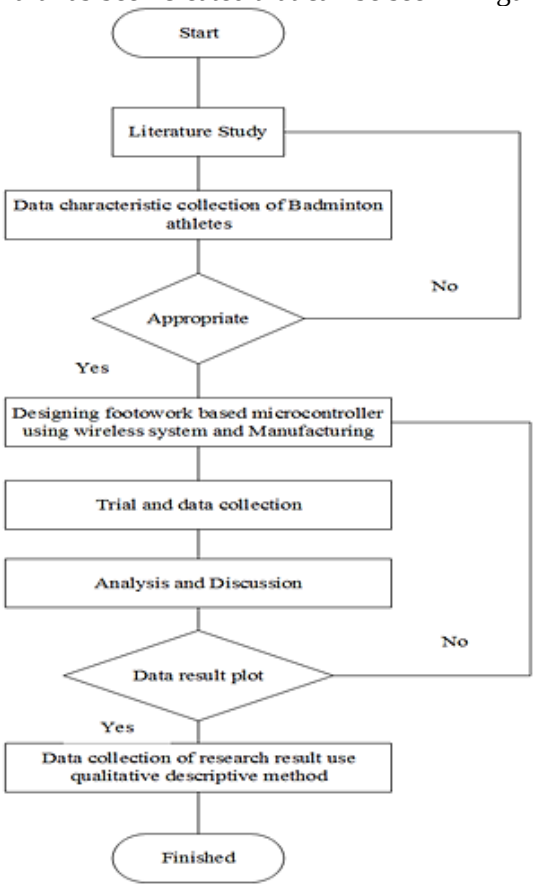

Figure 1. *flowchart of research method*

The method in this study is based on research design development with the execution procedures are grouped into two phases. The study design is as follows:

1) The stage of design research for footwork equipment based microcontroller wireless system for badminton athletes.
2) The stage of implementation outcomes research design footwork equipment based microcontroller wireless system for badminton athletes.

The stage of designing footwork equipment based microcontroller wireless system consist of:

1) The stage of data collection characteristics of the athletes training methods, especially badminton. Data collection techniques by observation in various athlete training centers and interviews with sports coaches about footwork practice method.
2) The stage field test method of footwork practice for badminton athletes. Data collection technique came from some methods that are often used and took the right one.
3) The stage of footwork designing based microcontroller wireless system, such as:

1. The specification of desired equipment.
2. The design of the equipment.
3. The required components for manufacturing
4. The flowchart of manufacturing

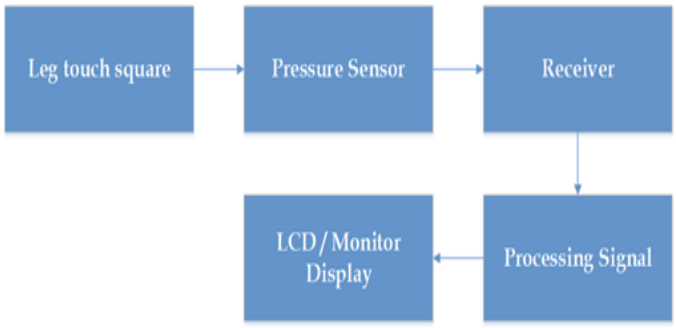

Figure 2. *The block diagram of footwork based microcontroller wireless system hardware*

4) Manufacturing stage of footwork based microcontroller wireless system.
5) The implementation of this equipment at Surabaya various sport training centers.
6) The evaluation of trial stage
7) Data collection by using the qualitative descriptive method.

3. RESULT AND DISCUSSION

Badminton at the elite level requires a high standard of physical fitness as well as the ability to execute a wide range of agility movements such as fast starts, sprinting to the shuttle, stopping from fast movements, and sudden changes of direction with intermittent bursts of activity being supplied from anaerobic energy sources.[2]. From this physically demanding perspective, the application of high-intensity training exercises would be ideal to promote sport daptation during rehabilitation [15]

A sensor network is an infrastructure comprised of sensing(i.e. measuring), computing, and communication elements that gives an administrative ability to instrument, to observe, and to react to events and phenomena in a specified environment [11]. A sensor network can be described as a collection of sensor nodes which co-ordinate to perform some specific actions. These tiny, low-power communication devices can be deployed throughout a physical space, providing dense sensing close to physical phenomena, processing and communicating the information, and coordinating actions with other nodes. Combining these capabilities with the system software technology makes it possible to instrument the world with increasing fidelity [4].

The base station is typically resource-rich in terms of its computational ability, storage capacity and energy lifetime compared to individual sensor nodes. They act as a gateway between sensor nodes and the end users and also refer to as sink node.

Sensor nodes are fitted with an onboard processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data [6].

Sensor networking is a multidisciplinary area that involves, among others, radio and networking, signals processing, artificial intelligence, database management, system architectures for operator-friendly infrastructure administration, resource optimization, power management algorithms, and platform technology (i.e. hardware and software, such as operating system [11]

The hardware in designing footwork based microcontroller wireless system is carried out with minimum design of system transmitter and receiver based on the flowchart in Figure 3 with the results shown in Figure 7

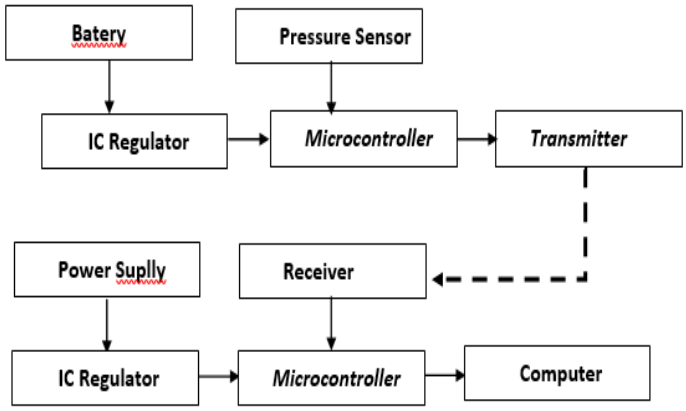

Figure 3. *Hardware flowchart of footwork based microcontroller wireless system*

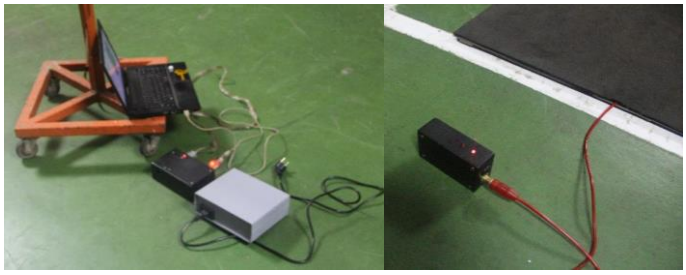

Figure 4. *Hardware of Footwork based microcontroller wireless system.*

Figure 5. *Footwork used by combination lamp*

Figure 6. *Footwork program interface setting*

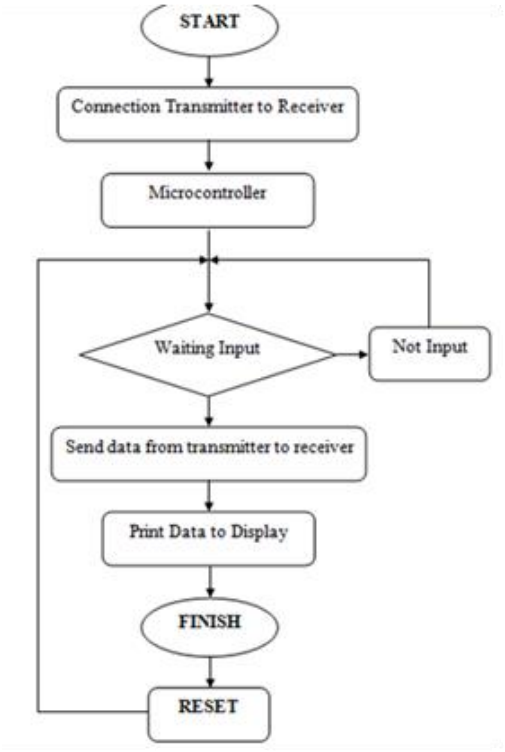

Figure 7. *Software flowchart of footwork based microcontroller wireless system*

At the function test equipment components drills footwork-based microcontroller is done with a light will turn on / off and move to another point automatically by the displacement of lights can be adjusted with a timer that can be adjusted as needed through a program that entered into the microcontroller so that athletes follow the movements of the lights are lit , Tests carried out 4 times to practice footwork badminton athletes with variations and different time intervals with the results shown in the following table

Table 1. *Results of the function test footwork sequence 1-6-7-2-8-3-9-4-5 light*

No.	The time interval displacement lights (seconds)	Lamp									Error
		1	6	7	2	8	3	9	4	5	
1	1	√	√	√	√	√	√	√	√	√	-
2	1,5	√	√	√	√	√	√	√	√	√	-
3	2	√	√	√	√	√	√	√	√	√	-
4	2,5	√	√	√	√	√	√	√	√	√	-

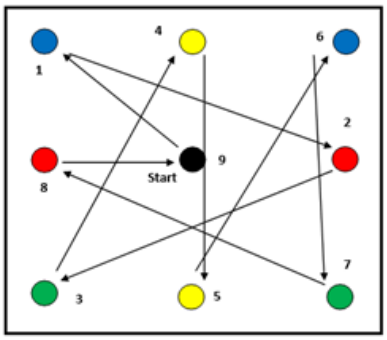

Figure 8. *Illustration function test footwork based microcontroller-wireless system*

In the implementation of the test instrument, the position of the steps to be accomplished athlete in accordance layout placement panel lights are shown in the following figure.

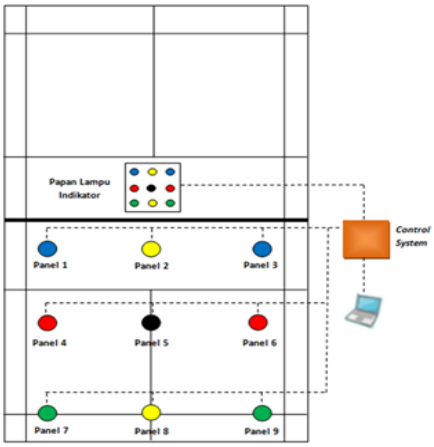

Figure 9. *Layout panel placement of the lights to practice footwork badminton*

The trial of footwork based microcontroller wireless system is done by setting the displacement of lights using the midpoint of the field. If the athlete after moving to the front/side/rear should be returned to the middle of the new lights will be moved so that it can be seen travel times at each step of each athlete.

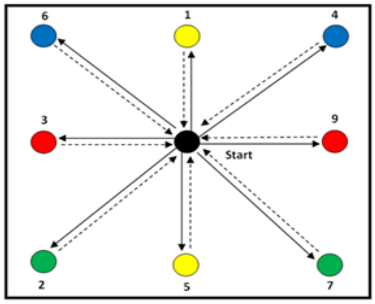

Figure 10. *Illustration footstep taken by athletes in footwork training*

At the trial of footwork based microcontroller-wireless system with the second variation is to use 10 people consisting of 5 students majoring in sports coaching education Nikken Unesa and 5 student badminton club. The trial results in footwork training equipment with the second variation can be seen in the following table

Table 2. *Results of footwork equipment test with the second variation*

Athlet	Front left	Front middle	Front right	Left side	Right side	Back left	Back middle	Back right	Total
1	2.32	2.25	2.22	2.22	2.25	2.25	2.21	2.55	18.27
2	1.89	1.76	1.90	1.85	1.68	2.37	1.83	2.65	15.93
3	1.78	1.88	1.95	1.84	1.78	1.58	1.47	1.59	13.87
4	1.89	1.71	2.25	1.85	1.82	2.28	1.88	2.34	16.02
5	1.73	1.35	1.56	1.48	1.43	1.89	1.85	1.37	12.66
6	1.95	1.65	1.62	1.66	1.59	1.93	1.58	1.45	13.43
7	1.57	1.82	1.55	1.52	1.45	2.31	1.83	2.32	14.37
8	2.45	2.05	1.91	1.79	1.64	2.46	2.17	2.28	16.75
9	1.97	1.61	2.14	2.37	2.51	2.12	1.79	1.96	16.47
10	2.12	1.99	1.95	2.05	2.25	2.57	2.27	2.55	17.75
Average	1.97	1.81	1.91	1.86	1.84	2.18	1.89	2.11	15.55
Variant	**0.071**	**0.064**	**0.067**	**0.081**	**0.137**	**0.089**	**0.068**	**0.231**	**3.550**
∑ varian								**0.811**	

Referring to the table above, then calculated reliability with Cronbach Alpha method using the following equation:

$$\alpha = \left(\frac{k}{k-1}\right)\left(1-\frac{\sum \sigma b_2}{(\sigma^2 t)}\right)$$

Nomenclature :

α : *Alpha Cronbach coeficient*
k : Item number = 8
$\sum \sigma_b^2$: Item number varian = 0,811
σ_t^2 : Item varian total = 3,550

Then :

$$\alpha = \left(\frac{8}{8-1}\right)\left(1-\frac{0,811}{3,550}\right)$$
$$\alpha = 0,857$$

To test the validity of the measurement tool using Microsoft Excel with the results as shown in the following table.

Table 3. The correlation coefficient score items

	Panel 1	Panel 2	Panel 3	Panel 4	Panel 6	Panel 7	Panel 8	Panel 9	*Total*
Panel 1	1								
Panel 2	0.664	1							
Panel 3	0.504	0.458	1						
Panel 4	0.522	0.427	0.822	1					
Panel 6	0.442	0.358	0.748	0.970	1				
Panel 7	0.459	0.429	0.227	0.227	0.227	1			
Panel 8	0.681	0.567	0.323	0.333	0.362	0.816	1		
Panel 9	0.385	0.643	0.487	0.404	0.345	0.851	0.685	1	
Total	**0.732**	**0.738**	**0.747**	**0.772**	**0.731**	**0.722**	**0.782**	**0.823**	1

4 DISCUSSION

Based on the test results footwork exercise equipment components function-based microcontroller, it can be said that all components can work well as long as the function test with four variations of time is not an error. Components observed is focused on the minimum system, microcontrollers, system wiring, and software system. Switching lights according to the setting at the beginning and flexible with different sequence variations as needed. To determine the reliability and accuracy of the data generated footwork microcontroller-based training tool that has been developed, it would require a test of reliability and validity. Reliability is a level that measures the consistency of results if performed repeated measurements on a characteristic [12]. Testing reliability can be calculated with a formula Cronbach Alpha (α). Empirically given the following conditions From the results of the identification, the real users of the system to be built is Farmers, Farmers Association, Distributors, Transporter, traders, and consumers both households and industry. However, when viewed from its activities, the role of these users can be grouped into:

a) If a value of $0 < \alpha < 0.600$ indicates the internal consistency reliability criteria relatively low so that the measurement results can not be trusted
b) If the value of $0.600 \leq \alpha \leq 0.799$ then indicate internal consistency reliability criteria relatively high so that the measurement results can be trusted.
c) If the value of $0.800 \leq \alpha \leq 1.000$ then indicate internal consistency reliability classified criteria are so high that very trustworthy measurement results.

Reliability is basically what extent the results of a measurement can be trusted. Results of measuring repetitive yield relatively equal then the measurement is considered to have a good level of reliability. An instrument is said to be reliable if it has a value of Cronbach's alpha coefficient (α)> r (df: α, n-2).

Based on calculations of reliability with Cronbach Alpha method, the obtained value of Cronbach's alpha coefficient (α) = 0.875. Referring to the value of rtabel with df (0.05, n-2) amounted to 0.632, then α> rtabel so it can be said that the measurement of footwork drills microcontroller-based tool is reliable (trustworthy) and classified as very high criteria (good) for entry into the range $0{,}800 \leq \alpha \leq 1.000$.

The validity of the test is required to determine the extent of the accuracy and precision of a measuring instrument in doing measuring function. An instrument used to measure the attributes A and was able to provide information on A, then the instrument is declared invalid. A valid measuring tool, not only able to reveal the data correctly but must also be able to give a thorough picture of the data. A measuring instrument is usually only a measure which is valid for one specific purpose.

An instrument is valid if it has value to the item total correlation coefficient (rhitung)> rtabel with df (0.05, n-2). Referring to the correlation coefficient table and rtabel item score (0.632), it can be diuraiakan as follows :

a) Correlation of the total panel 1: 0.732> 0.632 (valid)
b) Correlation panel 2 against total: 0.738> 0.632 (valid)
c) Correlation panel 3 against the total: 0.747> 0.632 (valid)
d) Correlation panel 4 of the total: 0.772> 0.632 (valid)
e) Correlation panel 6 to the total: 0.731> 0.632 (valid)
f) Correlation panel 7 against total: 0.722> 0.632 (valid)
g) Correlation panel 8 against total: 0.782> 0.632 (valid)
h) Correlation panel 9 against total: 0.823> 0.632 (valid)

Based on the above, it can be said that the data generated by the microcontroller-based training tools footwork is valid (accurate) for all values correlation score item> rtabel.

The realization of microcontroller-based training tools footwork is a real contribution to support technological advances in the field of sports. The operation of this equipment is specifically designed so that practical and does not require special skills to operate it. By knowing the time it takes the athlete to move from one point to another point, it can facilitate badminton coach in analyzing the performance athlete development surrogate for agility footwork is one of the factors of concern, especially for novice athletes

5. CONCLUSIONS

Based on the results of the test tool that has been done, the result for the system hardware and software tools based microcontroller footwork exercises developed to function properly. Tool can work automatically with three combinations: (1) the light will turn on / off and move to another point automatically by the displacement of lights can be random and customized with a timer that can be adjusted as needed through a program that entered into the microcontroller so that athletes follow the movements lamps are lit; (2) transfer of the flame using the midpoint of the field, if an athlete after moving to the front/side/rear should be returned to the middle of the new lights will move;

(3) transfer of the flame using a 9 point in the area of the field, if the athlete has not reached the point lights are lit, the lights will not change. Footwork exercise tool is

also equipped time recording during the movement of the athlete moves from one point to another point so it can be measured the performance of the athletes within the required standards. This makes the trainer be more focused observed the athletes step carefully, whether it's good or not. Other advantages of this tool that is multi-functional because it can be used for athletes of all sports, especially to train agility footwork.

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