

Introducing a New Agility Test in Badminton

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Abstract: In every sport there are different agility demands, and agility measurement was supposed to be different. However, existing tools for measurement agility is considered not valid and reliable for measuring agility in badminton. The purpose of this study is to create agility test which is valid and reliable for badminton. For the purpose of this study, we recruited twenty students (10 badminton students of sport faculty and 10 professional badminton athletes, age range between 17 – 21 yr) by using R & D method. There are six stages; (1) analysis needed; (2) design; (3) prototype; (4) testing; (5) revision; and (6) validity and reliability of the test. Min K. Chin test was adopted to create a Badminton Agility Test (BAT) then inserted additional tools of computer software and hardware to facilitate the operation. Result of the quality and feasibility testing are: (1) the panel was slippery; (2) avoid confusion when start. The solutions of quality and feasibility are; (1) to replace the tread surface with non-slip material, rubber carpet is the most logical choice; (2) adding a sound signal when to start the test. The reliability value of BAT was 0.884, and validity of each item (r^{count}) were 0.864; 0.884; 0.869; 0.867; 0.858; 0.885; 0.862; 0.863. Statistical analysis revealed that the correlation coefficient is greater than the correlation coefficient table ($r^{\text{count}} > r^{\text{table}}$), suggesting that the BAT is reliable and valid to measuring badminton agility. Due to movement specificity, the BAT has significance for badminton agility assessment.

Keywords: Specific test, Badminton, Fitness Test

1. Introduction

There are two components forming physical abilities, physical fitness and motor fitness^[22]. Physical fitness consists of muscular strength, muscular endurance of respiratory-circulatory, and flexibility. While motor fitness components are build by motion, speed, coordination, agility, and balance^{[11],[29],[35]}.

Badminton requires short bursts of energy for quick movements and changes of way. In consequence, agility is important to a successful player^{[15],[17],[36]}. Even though badminton is the fifth most popular sport in the world and played by over 200 million people^[27], apparently not so much study done to measure agility in badminton among college students and badminton athletes, especially in Indonesia. Agility is an important component of many sports but it has not been extensively researched^[40].

Agility has been a difficult area to be measured. The agility demands for different sports are very specific, in terms

of the speed and direction of turning, in badminton it include extra factors like controlling a shuttlecock or swinging a racket. Many tests involve complex movements, what is actually being measured may not be clear, and a good score may conceal deficiencies in some aspect of agility. Sheppard & Young reported that sports scientists have yet to agree on a clear definition of agility^[31]. Agility has traditionally defined as speed in changing direction^{[32],[40]}. However, more recently it was argued that agility requires not only ability to change direction with speed, but also some perceptual skill. This argument suggests that agility is multifaceted and that agility itself requires an interaction of a number of components of fitness^[39]. In many field sports, such as rugby, changes of direction are often executed in response to stimuli such as on attacking or defending opponent and therefore agile maneuvers may not be explicitly preplanned^{[8],[13],[32]}. Thus, consistent with Young et al.^[39], agility as previously

thought, a closed motor skill that simply requires change of direction speed—that is, a skill executed in a stable environment and able to be planned. However, agility may be considered an open motor skill that requires perceptual skills and the ability to react quickly; open motor skills are executed in a constantly changing environment or in response to an unpredictable stimulus requiring constant performer adaptation. With this in mind, Sheppard and Young have defined agility as “a rapid whole body movement with change of velocity or direction in response to a sports specific stimulus”^[31].

There are various kinds of measurements are used, for example: burpee test (squat thrust), side step test, shuttle run, quadrant jump, SEMO agility test, right boomerang run, LSU agility obstacle course, Illinois agility run, and 505 agility test^{[14],[37]}. However, it is have a wide range of weaknesses, as described by Johnson & Nelson^[14]. Some of the weaknesses are described as follows:

- a. the surface area and the type of footwear; requires considerable time to administer certain agility tests to large groups
- b. many agility tests involve running ability or ability to change body position
- c. some agility tests do not distribute scores widely enough to give a clear distinction between good and poor performance
- d. advantages for taller student; agility is quite specific to the type of agility measured.

Some researchers supported the need for specific measurement tools to measure agility for every sport^{[7],[13],[18],[19],[32]}.

Badminton has a unique movement style and specific fitness demands. One of the key things to remember is the size of a badminton court. It has a smaller area compared to Tennis, Football, Rugby, Hockey and Netball. This smaller area means that players do not have a chance to build up their maximum speed. Because of this, explosive movements such as jumping, turning, speed off the mark, lateral movements and agility, are extremely important^[4]. Footwork is the foundation to be able to produce quality stroke in badminton, which, if it is done in a good position. To be able to hit with a good position, an athlete must have a movement speed. Footwork speed cannot be achieved if the footwork is irregular. The focus of good footwork is reaching the bird as quickly as possible with as little effort as possible. Good footwork gets player into the best position to execute shots while maintaining good balance and body control^{[15],[19],[36]}.

One of the researchers who conducted study on agility is Min Kai Chin that assisted by several colleagues, managed to make a measurement tool for agility in badminton. There is a specific fitness testing for badminton that controlled the intermittent flashes of light bulbs designed to represent the physiological response in badminton, devised by Min Kai Chin et al. and tested in a badminton court^[19]. A low correlation was found between the results of the field test and the rank-order list of subjects, based on an objective on-field physiological assessment and subjective ranking. The

researchers concluded that this sport specific test provides reliable estimates of badminton players' fitness levels. The aim of this study is to create a new test of Agility for Badminton. A modified version of Ming Kai Chin of sport specific agility test was used, with the addition of several new technologies that can facilitate the calculation of measuring agility in badminton and also to do evaluation on the new agility test with validity and reliability.

2. Methods

Modification of research and development (R & D) of Borg and Gall is used to do this study^[9]. There are six stages in this study; (1) analysis required; (2) design; (3) prototype; (4) testing; (5) revision; and (6) validity and reliability test. First, analysis required in the development of instruments agility is the exact timing from the center to the corner of the court and vice versa. And total time of the task given to the measurement of agility, focus group discussion is used to collect data in this stage. Second, design of instrument agility by selected version modification, which was the main choice as the result of focus group discussion at the previous stage of analysis requirement and application of computerized technology. Third, creating a prototype in accordance with the design intended in previous stage, where the instrument agility was executed in one-half of badminton court. Fourth, after the product is completed, the next stage is to examine the design of badminton agility test. Five students from the faculty of sport of Semarang State University are served as subject for this study and three badminton experts are assigned to assess the tool feasibility. This experiment is used to anticipate any possible errors, as well as to analyze the obstacles that may be encountered and tried to mitigate these constraints. Moreover, the next stage was product revisions; it aims to improve the product before the product is ready to be used. Revisions were based on review and input from experts and coaches, as well as the test results.

Validity and reliability of test is the final stage, twenty well-conditioned agility students (10 badminton students of sport faculty and 10 professionals badminton athletes, age = 17 – 21 yr) were recruited for this study. First group (BS) were recruited based on these requirements: students who take badminton class; qualified in badminton; have the correct badminton footwork; and are available for all testing occasions. Second group (BA) were recruited based on these requirements: a professional athletes at the provincial level; has provincial achievement within the last two years; and are available for all testing occasions.

2.1. Procedures

After badminton agility tool is finished, it is necessary to know the validity and reliability. All participants informed consent was obtained before the testing process. The field test was executed in one half of badminton court. Participants asked to test one time to test the feasibility of test tool.

The test was started with the subjects been placed in the middle of the field, the operator entering data into the

computer: name, age, height and weight. The subject was instructed to pay attention to the command lamp, which will tell what to do. Command panel consists of eight light bulbs, which lit in accordance with the variation of a computer program. Red light bulbs for forward step, yellow to side stepping, and green to step backward. Each time the touch panel trampled, "detection reader" will detect the time and the command lights will turn on again if participants return to the panel base / center. It is located the middle of the net and being on the net.

Pressing the start button if all ready, which is marked with colored light bulb: red, yellow, blue, and green (start). Participants in accordance with the light footwork order: red = step forward (left and right); yellow = to the side (left and right); green = backward (left and right); and blue = front and back (middle). The commands were controlled by computer, with 25 variations, with the same amount of comparison for each participant. Indicator light turns off when the participants were instructed to step on the panel, and it will be able to further order if the participant returned to the center (step on the center panel). Measurement completed after eighteen commands, and the results shows on a computer screen, which includes the whole process time; time to get to the destination panel; and back to the center panel of the destination panel.

2.2. Statistical Analyses

Validity testing using *Corrected Item - Correlation*, that is correlating each item score with a total score and make

corrections of overestimated of the correlation coefficient values. Whereas reliability testing using Cronbach's Alpha [2],[3]. Counting statistics was used SPSS 17 programs.

The criteria of validity are:

- If $r_{\text{count}} \geq r_{\text{table}}$ (test 2 sides with sig. 0.01), the instruments are correlated significantly to the total score (declared high validity)
- If $r_{\text{count}} \leq r_{\text{table}}$ (test 2 sides with sig. 0.01), the instruments are not correlated significantly to the total score (declared invalid)

For reliability, testing typically uses certain restrictions such as 0.6. According to Sekaran, the reliability of less than 0.6 is not good, while 0.7 is acceptable and above 0.8 is good [30].

3. Results

This study of creating badminton agility test reported:

3.1. Analysis Required

This stage produced a badminton agility test (BAT) in order to measure characteristics of badminton footwork. Ten coaches and five sports scientists are participated in focus group discussions. Burpee Test, Side Step Test, Shuttle Run, Quadrant Jump, Right Boomerang Run, SEMO Agility Test, LSU Agility Obstacle Course, Illinois agility test, and 505 tests compared to choose the most appropriate to the characteristics of badminton [14],[16]. The results are:

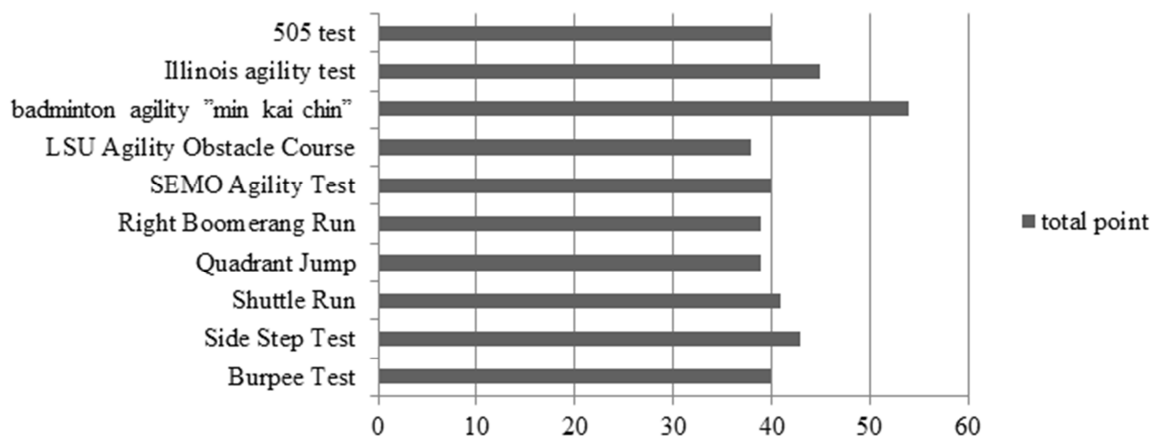


Figure 1. Comparison agility measurement.

3.2. Design

To choose the design, the results of the first stage were used. Badminton field test of Min K. Chin et al was-adopted

[19] and adding some computerized technology to simplify the operation and calculations (figure 2).

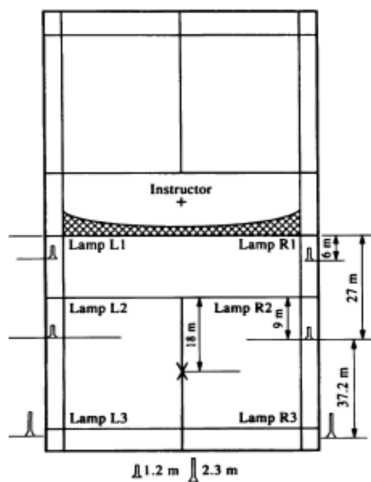


Figure 2. Badminton field test (Min K. Chin et al., 1995).

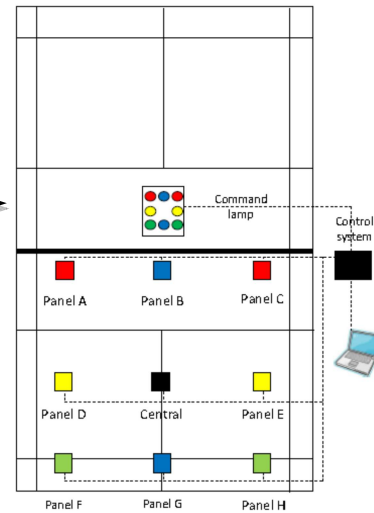


Figure 3. Badminton agility field test.

3.3. Prototype

Adding some support equipment and computer programming, we manage to facilitate the operation of the tool and to calculate the value of agility in badminton. Instrument agility executed in one-half of badminton court; nine pedal sensors of video game were individually mounted on posts, with one shuttle at the lower end of each post. Lighting circuits command placed in the middle of the top of the net. The pedal sensors are connected to a programming device located outside the court^[33]. The layout of the test is illustrated in figure 3.

3.4. Testing and Revision

Eight participants (Five students and three badminton experts) are involved in the quality and feasibility testing. After undergo the test, participants were given an open questionnaire to comment, and the results are: (1) the surface

underfoot panel is very slippery and complicated the movement; (2) avoid any confusion of the test starting time. These results can be solved with: (1) replacing the tread surface with non-slip material, rubber carpet became the most logical choice, because it is strong and can preserve electrical parts inside and also rugged on shoes materials; (2) adding a sound signal to start the test.

3.5. Validity and Reliability Testing

The results obtained in the field test are presented in Table 1. The maximum (total) individual data recorded during the field test was 18.47 seconds, and minimum (total) was 10.85 seconds. Mean times required to move front left was 1.80 s; central/middle front was 1.69 s; front right was 1.72 s; left side was 1.59 s; right side was 1.62 s; rear left was 1.89 s; middle rear was 1.81 s; and rear right was 1.83 s.

Table 1. Results of the Badminton Agility Test (BAT) for individual players (in seconds).

No.	Front Left (A)			Central Front (B)			Front Right (C)			Left Side (D)			Total
	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	
1	1.19	1.23	2.42	1.12	1.08	2.20	1.22	0.97	2.19	0.84	0.94	1.78	17.77
2	0.66	0.63	1.29	0.75	0.77	1.52	0.93	0.92	1.85	0.92	0.94	1.86	15.60
3	1.21	0.66	1.87	1.16	1.11	2.27	0.99	0.97	1.96	0.66	0.63	1.29	13.58
4	1.01	0.92	1.93	1.11	1.16	2.27	1.20	1.14	2.34	0.78	0.77	1.55	15.48
5	1.03	0.66	1.69	0.66	0.63	1.29	0.76	0.69	1.45	0.70	0.72	1.42	12.35
6	1.19	0.78	1.97	0.78	0.79	1.57	0.78	0.77	1.55	0.71	0.63	1.34	13.00
7	0.76	0.66	1.42	0.86	0.93	1.79	0.78	0.70	1.48	0.72	0.77	1.49	13.40
8	1.28	1.27	2.55	1.22	0.97	2.19	0.73	0.74	1.47	0.73	0.75	1.48	15.98
9	0.89	1.12	2.01	0.58	0.70	1.28	1.18	1.19	2.37	1.17	1.16	2.33	16.38
10	1.21	1.37	2.58	1.09	1.06	2.15	1.02	0.92	1.94	1.02	1.01	2.03	18.47
11	0.81	0.82	1.63	0.78	0.80	1.58	0.69	0.70	1.39	0.70	0.78	1.48	12.10

No.	Front Left (A)			Central Front (B)			Front Right (C)			Left Side (D)			Total
	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	
12	0.66	0.63	1.29	0.77	0.77	1.54	0.72	0.72	1.44	0.76	0.77	1.53	11.86
13	0.72	0.66	1.38	0.63	0.63	1.26	0.78	0.79	1.57	0.66	0.63	1.29	11.21
14	0.73	0.92	1.65	0.78	0.77	1.55	0.84	0.84	1.68	0.78	0.77	1.55	12.98
15	0.76	0.66	1.42	0.66	0.63	1.29	0.66	0.63	1.29	0.60	0.62	1.22	10.85
16	0.80	0.78	1.58	0.78	0.78	1.56	0.78	0.77	1.55	0.71	0.63	1.34	12.35
17	0.76	0.66	1.42	0.86	0.63	1.49	0.78	0.70	1.48	0.72	0.77	1.49	11.94
18	0.91	0.95	1.86	0.73	0.75	1.48	0.73	0.74	1.47	0.73	0.75	1.48	13.22
19	0.89	0.99	1.88	0.58	0.70	1.28	1.01	0.98	1.99	0.89	0.90	1.79	14.33
20	1.02	1.04	2.06	1.09	1.06	2.15	1.02	0.92	1.94	1.02	1.01	2.03	15.87
Mean			1.80			1.69			1.72			1.59	
Total Max													18.47
Total Min													10.85

Table 1. (Continue)

No.	Right Side (E)			Rear Left (F)			Middle Rear (G)			Rear Right (H)			Total
	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	leave x	back y	$\sum xy$	
1	1.21	1.02	2.23	1.21	1.02	2.23	1.12	1.08	2.20	1.22	1.30	2.52	17.77
2	1.01	0.66	1.67	1.17	1.14	2.31	1.28	1.27	2.55	1.28	1.27	2.55	15.60
3	1.03	0.78	1.81	0.92	0.63	1.55	0.66	0.63	1.29	0.75	0.79	1.54	13.58
4	1.19	0.60	1.79	0.66	0.77	1.43	0.92	0.94	1.86	1.16	1.15	2.31	15.48
5	0.64	0.60	1.24	0.78	1.21	1.99	1.02	0.87	1.89	0.68	0.70	1.38	12.35
6	0.78	0.79	1.57	0.98	1.01	1.99	0.78	0.78	1.56	0.70	0.75	1.45	13.00
7	0.79	0.63	1.42	1.20	1.03	2.23	0.66	0.63	1.29	1.12	1.16	2.28	13.40
8	0.82	0.77	1.59	1.22	1.19	2.41	1.03	1.07	2.10	1.22	0.97	2.19	15.98
9	1.19	1.25	2.44	0.99	1.11	2.10	0.98	1.02	2.00	0.93	0.92	1.85	16.38
10	1.09	1.11	2.20	1.22	1.30	2.52	1.28	1.27	2.55	1.27	1.23	2.50	18.47
11	0.60	0.61	1.21	0.82	0.82	1.64	0.90	0.91	1.81	0.68	0.68	1.36	12.10
12	0.70	0.66	1.36	0.90	0.91	1.81	0.72	0.72	1.44	0.73	0.72	1.45	11.86
13	0.73	0.78	1.51	0.70	0.63	1.33	0.66	0.63	1.29	0.79	0.79	1.58	11.21
14	0.80	0.79	1.59	0.66	0.77	1.43	0.92	0.94	1.86	0.84	0.83	1.67	12.98
15	0.50	0.54	1.04	0.78	1.21	1.99	0.66	0.67	1.33	0.60	0.67	1.27	10.85
16	0.69	0.68	1.37	0.98	1.01	1.99	0.78	0.77	1.55	0.70	0.71	1.41	12.35
17	0.79	0.63	1.42	0.72	0.72	1.44	0.66	0.78	1.44	0.89	0.87	1.76	11.94
18	0.82	0.77	1.59	0.73	0.73	1.46	1.03	0.91	1.94	0.97	0.97	1.94	13.22
19	0.85	0.85	1.70	0.99	0.89	1.88	0.98	0.98	1.96	0.93	0.92	1.85	14.33
20	0.79	0.79	1.58	1.08	1.07	2.15	1.12	1.10	2.22	0.88	0.86	1.74	15.87
Mean			1.62			1.89			1.81			1.83	
Total Max													18.47
Total Min													10.85

Table 2 displays the SPSS 17 reliability statistics values for the badminton agility test (BAT). This data indicate that badminton agility tool is reliable, because the value obtained

by Cronbach's alpha is 0.884, and since the value is greater than 0.8, it can be concluded that the measuring instrument is “reliable”. According to Sekaran, the reliability of less than

0.6 is bad, while 0.7 is acceptable and above 0.8 is good [30],[28].

Table 2. Reliability Statistics.

Cronbach's Alpha	N of Items
.884	8

Table 3 displays the SPSS 17 validity statistics values for the badminton agility test (BAT). Correlation results shows in

Table 3. Item-Total Statistics.

Item	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
A	12.1410	3.575	.702	.864
B	12.2505	3.899	.502	.884
C	12.2160	3.824	.662	.869
D	12.3475	3.888	.702	.867
E	12.3195	3.626	.773	.858
F	12.0420	3.941	.487	.885
G	12.1295	3.538	.720	.862
H	12.1060	3.474	.714	.863

4. Discussion

The developing badminton agility test (BAT) adopted from Min K. Chin et al is used for early prototype, in a manner of similar work [19]. Agility of the various instruments does not represent the character of badminton movement, a movement that carried only a limited run, changing direction, and jumping. For example, "*Illinois agility test*" test and "*505 test*", participants are required to run fast and zigzag to change direction [12],[16]. While badminton footwork consists of Step-close-step or crossover step, shuffle step, and Chasse step Three-step recovery sequence [1],[6],[15].

In addition, the FGD results shows a high trend towards the Min K. Chin instrument, which is amount of 54 points, followed by *Illinois agility test* by 45 points, and the lowest *Quadrant jump* and *Boomerang run* both of 39 points. An outline of the essays in this study consists of two main sections, namely; (1) *hardware*, which covers; detectors touch / panel; the touch detection reader; command panel, and (2) *programming software*.

Originated from the touch panel is made from the former part of video game "*dance pad*" (TPUSB638) which is arranged in eight corner (front left, front right, central front, left side, right side, rear left, rear right, and middle rear) and one in the middle/base of the badminton court, with synthetic carpet to protect the components inside. Then it is connected by cable to the "detection reader" which is located outside the badminton court. The panel's work the same way with video games, whenever receiving pressure it will automatically send a signal to the reader / detection reader

"MySQL" is used for computer programming which is, to control hardware performance (touch panel, command panel),

the *Item-Total Statistics* output in the *Corrected Item-Total Correlation* column. This value is compared with the value of r_{table} . Look at the r_{table} at the 0.05 significance level of two sides test, the amount of data was $(n) = 20$, then obtained r_{table} for 0.444 [28]. The analysis results can be seen that items A, B, C, D, E, F, G, and H values were more than $r_{table} = 0.444$, it can be concluded that the item was "valid instrument".

and the main thing that the time is measured for both partially footwork's and total time of testing. MySQL is a relational database management system (RDBMS), and ships with no GUI tools to administer MySQL databases or managing data contained within the databases. Users may use the included command line tools or use MySQL "front-ends", desktop software and web applications that create and manage MySQL databases, build database structures, back up data, inspect status, and work with data records [20],[21],[22],[23],[24],[25],[26]. It is based on the structure query language (SQL), which is use for adding, removing, and modifying information in the database. Standard SQL commands, such as ADD, DROP, INSERT, and UPDATE [35].

The field test was executed in one-half of a badminton court. Eight light bulbs were individually mounted on command panel (mounted on top of the net), and nine pedal panels were affixed on the floor in each corner badminton courts. The first trios of pedal panels (A, B, C) were located near the forecourt, the second trios (D, center, and E) at midcourt, and the third trios (F, G, H) at the rear (figure 3). Officers entered data of participants into a computer database, including name, age, gender, height, leg length, body length. Participants were instructed to step (badminton footwork) from central panel/black panel towards each shuttle as soon as the corresponding bulbs (command lamp) was lit and to strike the shuttle in a technically appropriate manner. For the forecourt and midcourt light flashes, subjects performed a front and side lunge. For the rear court flashes, it is necessary to imitate a backward jump smash and land between the court lines, and then return to the central panel. The test consists of eight time steps and there are 25 different variations.

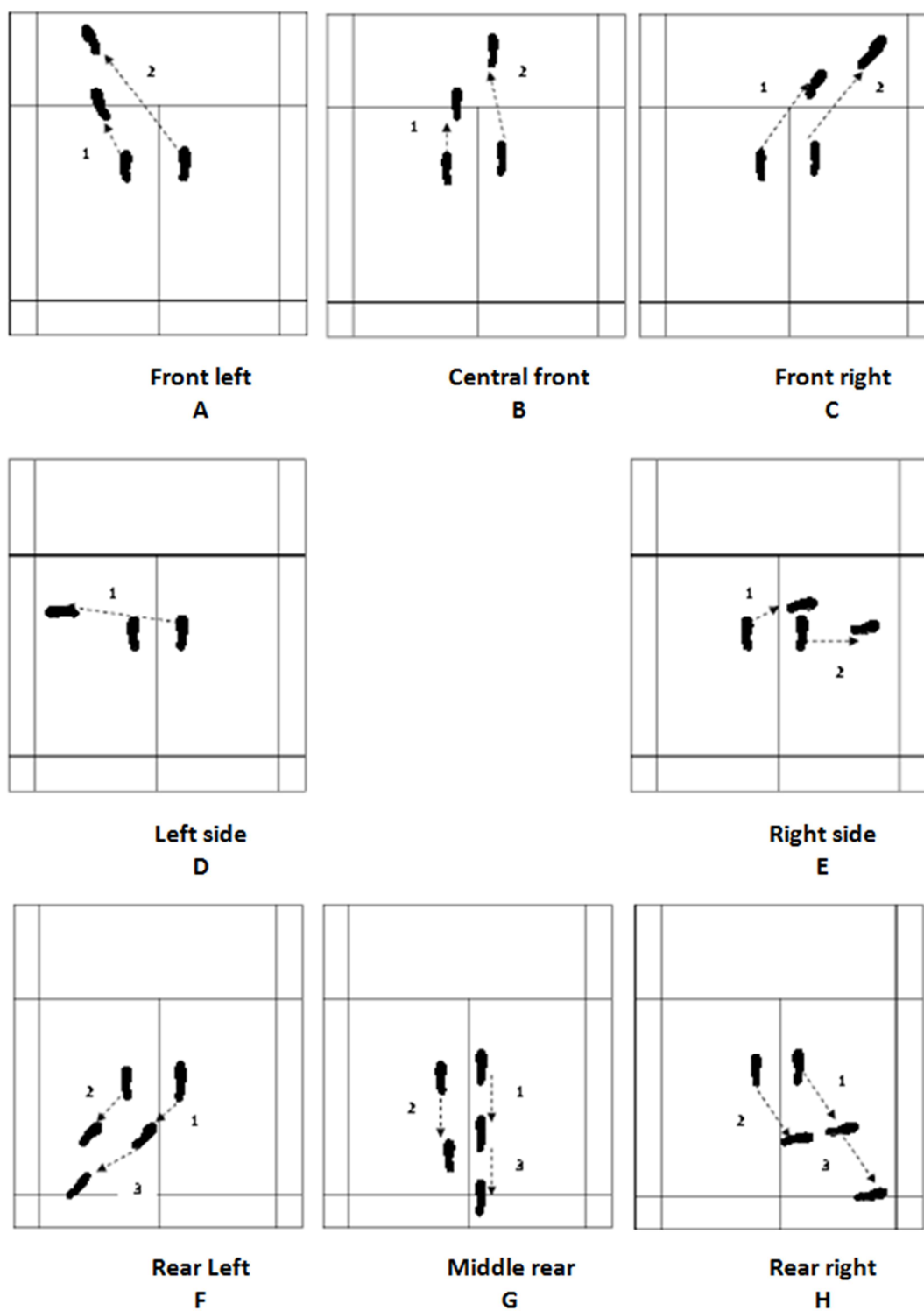


Figure 4. Badminton Footwork (Analysis of: Grice, 2008; Bernd, 2010; Anderson, 2013).

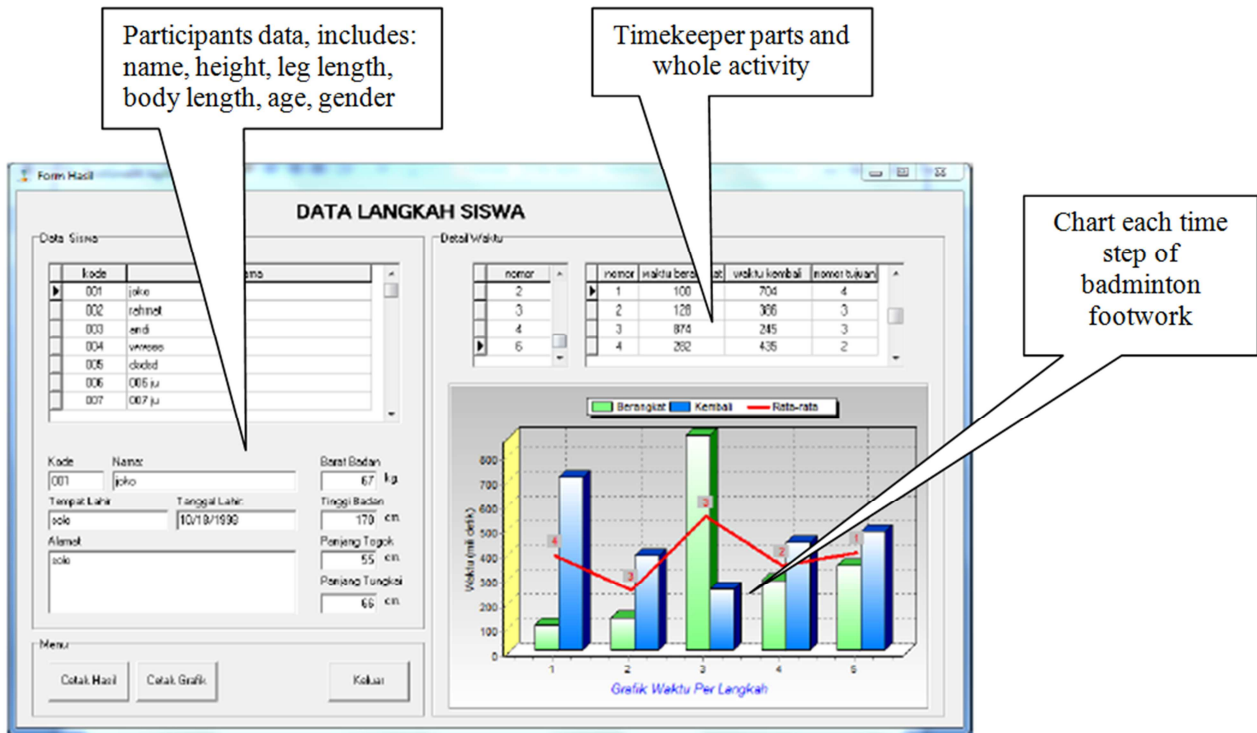


Figure 5. Display results of badminton agility test.

Figure 4 shows the final view of the computer, which shown the results of badminton agility tests (BAT). The result includes data from the participants (name, height, leg length, body length, age, gender), timers (each step / footwork and total time), and a graph of the record time. The display is presented in a clear and precise of individual records of participants and the performance records of each participant. The display also shows the time achieved by the participants at each step is done, the time of the position in the middle/base of the court (central panel) to the angle (each panel) of the destination, and from the point of destination (each panel) back to the middle / base court (figure 5).

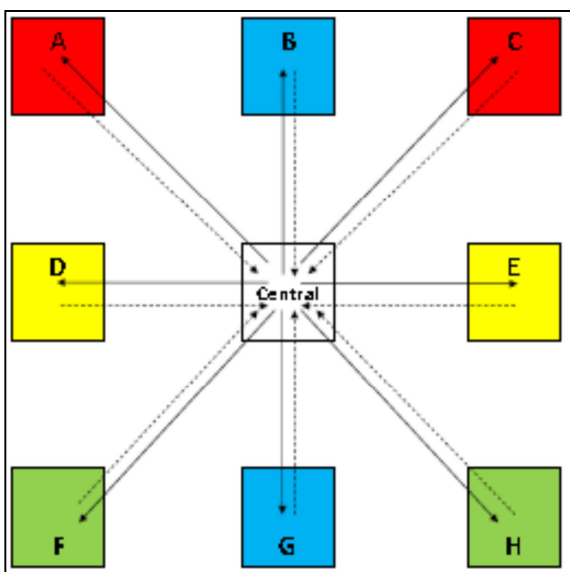


Figure 6. Illustration of badminton agility footwork.

As submitted by Borg et al ^{[9],[10]}, a revision of product is carried out by testing the product. By analyzing weaknesses identified during the trial the deficiency occurred can be corrected immediately. There is variety of shortcomings during the trials in this study, obtained from the results of discussions with badminton experts, and the results of the questionnaire analysis. Obtained problems are (1) the surface of underfoot panel is very slippery and complicated the movement; (2) confusion when the participant can start the test.

Surface panels made from synthetic carpets and chosen because it is easy to come by. Nevertheless, this only creates the problem in accordance to the safety of the participants; the surface becomes slippery because it does not conform to the surface of badminton shoes which are made of rubber. Surface that is suitable for badminton shoes are made of rubber carpet. Therefore, the entire surface of the panel replaced with rubber made in such a way so as not to impede when stepped on.

Second problem, participants is confused when to start the test. Some participants only concentrate on officers, not paying attention to the lights command, so they started late and the test need to be repeated. In the testing phase, the measurement tool only indicates the command to start the test with flaring lights command simultaneously. There should be some improvement for participants to be able to concentrate, and know when the test starts. Giving special tones embedded in the device, the tone sounds is similar with the starting of motor or car race. There are three different tones, the first tone follows flaring red light simultaneously, which means participants stand in the middle panel. The second tone by flaring yellow light

simultaneously, which means that participants get ready. Last tone is green light which means participants can begin to move / step according to the direction given. With this revision, the measurement tool can be used to measure agility in badminton.

The next step is finding the validity and reliability of measuring instruments. This test designed for use in badminton footwork only. To determine reliability, testing typically uses certain restrictions such as 0.6. According to Sekaran, the reliability of less than 0.6 is bad, while 0.7 is acceptable and above 0.8 is good [3],[30]. While for the validity of these instruments is by correlating each item score with a total score and make corrections to the overestimation of the correlation coefficient value [28]. In other words, this analysis calculates the correlation of each item with the total score (Pearson bivariate techniques), but the total score does not include calculated the item scores. Whereas the testing criteria are as follows [3],[28]:

- If $r^{\text{count}} \geq r^{\text{table}}$ (test two sides with sig. 0.01), the instruments are correlated significantly to the total score (declared high validity).
- If $r^{\text{count}} \leq r^{\text{table}}$ (test two sides with sig. 0.01), the instruments are not correlated significantly to the total score (declared invalid).

The results from this study demonstrated that although there were some limitations, the badminton agility test (BAT) displayed acceptable reliability and validity for badminton footwork. The BAT also can detect changes in performance when to leave and return of badminton footwork (table 1, figure 4, and figure 5). From table 1 can be explained that the fastest step or a short time step is left side, note in figure 4 (badminton footwork) can be seen that in doing step to the left side only takes one step only to reached the left side panel, and took an average 1.59 seconds. While the longest time was to the rear/backward left step, and it takes an average 1.89 seconds. This requires three steps to get to the backward left panel.

This means a backward left step has a higher degree of difficulty when compared with footwork in the other direction. Besides of requiring three steps, rear/backward step using diagonal steps, needs body contortion, and it usually use an over the head forehand stroke.

Badminton places demands overall body, from speed to concentration and conditions to sensitivity, coordination and finesse. The aim of the game is to place the shuttle where the opponent can no longer reach it or can only return it with difficulty. The corners of the opponents' court are therefore tactically the most sensible points to aim for, as they are furthest away from the opponent [6]. Because it leads to a difficult pitch angle, so it takes a good control of the court. Footwork as a means for the control is very much needed in this sport. Proper footwork, quick, and agile movements can trigger effectiveness in reaching shuttlecock at every opponents stroke. See figure 4, the movement of the foot in badminton is very special; it takes the unusual step done in other sports. So testing to determine the truth of the steps can be different from other

sports. Based on these arguments, this study focuses on agility test with specific agility test for badminton.

The purpose of last stage was to analyze a validity and reliability of Badminton Agility Test (BAT). This test is designed for use in badminton court. Validity test is use to measure the accuracy of the BAT in measuring badminton agility. Meanwhile, the reliability test is use to determine of the BAT consistency in measuring badminton agility. The validity of the items is use to validate the test, as indicated by a correlation or support towards the total score. Calculation is done by correlating the scores of items with a total score of items [28],[38]. The calculation will be obtained from the correlation coefficient used to measure the degree of validity of each item; and to determine whether the item is worth to use to measure agility.

The results from this study demonstrated that the BAT displayed acceptable reliability and validity for field sport testing. Table 2 displays the SPSS 17 reliability statistics values for the badminton agility test (BAT). This data indicate that badminton agility tool was reliable, because the value obtained Cronbach's alpha was 0.884, the value is greater than 0.8, it can be concluded that the measuring instrument is "reliable". According to Sekaran, the reliability of less than 0.6 is bad, while 0.7 is acceptable and above 0.8 is good [3],[28].

Table 3 displays the SPSS 17 validity statistics values for the badminton agility test (BAT). Correlation results shows in the *Item-Total Statistics* output in the *Corrected Item-Total Correlation* column. This value was compare with the value of r^{table} . Look the r^{table} at the 0.05 significance level of two sides test, the amount of data was (n) = 20, then obtained r^{table} for 0.444 [28]. The analysis results can be seen that items A, B, C, D, E, F, G, and H values were more than $r^{\text{table}} = 0.444$, it can be concluded that the item was "valid instrument".

5. Conclusion

We believe that this field test allows the calculation of reasonable that can estimates badminton athletes' agility levels and may be included as one of the means of on-court fitness conditioning. The regular, repeated physiological monitoring with on-field stimulation of badminton stroke moves is welcomed by the Semarang badminton coach and may provide a good indication of improvement or otherwise in training of each individual athlete.

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