



DEVELOPMENT OF MICROCONTROLLER-BASED PUNCH SPEED MEASUREMENTS TOOL OF KARATE ATHLETE

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Abstract

This study aims to develop microcontroller-based punch speed measuring instrument for Karate Athletes. The research method used is research and development (research and development). The subjects in this study were karate athletes coaching FORKI (Indonesian Karate Sports Federation) Palembang City, which consisted of 30 senior athletes aged 17-25 years who were divided into two groups. Small group trials consist of 10 athletes and large group trials consist of 20 athletes. The technique of taking the research subject used a purpose sampling technique. The results showed that the development of a Microcontroller-Based Punch Speed Measurement Tool has a percentage level of validity of material test experts (karate) of 93%, the validity of media experts (Information Technology) is 2 people, 95% and 91%, respectively. exercise test and measurement experts by 97% so that the tool can be said to be feasible. The level of reliability in the small group trial was 0.994 with the High category. While the large group trial was 0.993 with a high category so that it was said that the level of reliability of the tool carried out in large group and small group trials had a high reliability category. Overall, this microcontroller-based punch speed measurement tool has been declared feasible to be used as a tool in calculating punch speed in meters/second (m/s) digitally. 993 with a high category so that it is said that the level of reliability of the tool carried out in large and small group trials has a high reliability category. Overall, this microcontroller-based punch speed measurement tool has been declared feasible to be used as a tool in calculating punch speed in meters/second (m/s) digitally. 993 with a high category so that the level of reliability of the tool carried out in large and small group trials has a high reliability category. Overall, this microcontroller-based punch speed measurement tool has been declared feasible to be used as a tool in calculating punch speed in meters/second (m/s) digitally.

INTRODUCTION

Sports Martial arts is a sport that is used to survive and defend oneself against threats that come from outside or other people. Karate is one of the many sports, especially martial arts, which has been developing for a long time in Indonesia. According to Amertha, Aji, etc (2020) Karate is a type of martial arts that has a hard flow that uses various physical techniques such as parries, punches, evasions, and kicks using horses. According to Sari, Sekar.P & Salmah, Ayu (2020) "Karate can be done anytime and by anyone without conditions that limit a person from doing karate so it is very possible for someone to excel in the sport of karate".

Simbolon (2013) revealed that the karate martial art is different from other martial sports, because this sport is prioritized in the art of movement, meaning that this sport doesn't injure the other opponent or oftenly said not all of things from the context when competing, the one is counted as score is the athlete's movement seen in word matches and committee.

Karate sports coaching has been evenly distributed in every province, one of which is the Student Sports Education and Training Center (PPLP), this coaching is a Kemenpora program run by the Provincial Dispora throughout Indonesia. To recruit PPLP athletes, tests and measurements of biomechanics and karate techniques are carried out. Ideally in sports tests and measurements, especially karate, coaches use tools to facilitate the process of assessing the ability of the physical components and karate techniques so that they can be used as

the basis for coaches in selecting athletes and determining match numbers according to the athlete's physical condition and technique.

The fact that occurs in PPLP athlete selection activities there are several aspects of the athlete's ability who do not have test aids and still are measuring manually. The karate punch technique is one of the athletes' selection test materials that still use conventional test instruments. The karate punch test is used to determine the speed and accuracy of the athlete's stroke. One of the important elements of karate is the speed of the stroke. Speed is very necessary and can affect a person's appearance both at the time of attack and in defense. Mohammed et al (2019). In karate matches, the punching technique has a fairly large percentage, this statement is based on the results of research by Fendrian.F & Nurzaman.

The problem that has occurred so far in the implementation of the manual punch speed test is an error, the results of the speed of the stroke obtained are in the form of how many strokes are obtained within 10 seconds of hitting, not how much speed is obtained in one stroke, in essence speed is a vector quantity that shows how fast an object is moving. The magnitude of this vector is called speed and expressed in meters per second (m/s or ms⁻¹). on norms. The norms for the assessment are as follows:

In addition to the PPLP Dojo, the researcher also observed several karate dojos in Palembang City regarding the measuring speed of strokes as follows: The four dojos visited were the Sriwijaya Karate club, the Wadokai Center Dojo, the Bukit

Sejahtera Dojo and the Central KKI Dojo. Of the five dojos so far, to measure the speed of karate strokes, it is still limited to using a manual which refers to Bernanhot Simbolon's theory. The execution is to make as much strokes to the target as possible using the 10 seconds of time and scoring based on norms. The norms for the assessment are as follows:

Table 1. Punch Speed Rating

Category	Female	Male
Very well	> 23	> 25
Good	19 - 22	20 -24
Enough	14 - 18	15 - 19
Less	8 - 13	10 - 14
Less once	< 7	< 9

Source: Simbolon (2014:)

Based on these conditions, the solution that can be done in helping to measure the speed of karate strokes is to develop a microcontroller-based punch speed measuring instrument for karate athletes that is valid, practical and effective. Speed according to Ihsan (2018), is the ability to perform similar movements in a row in the shortest possible time.

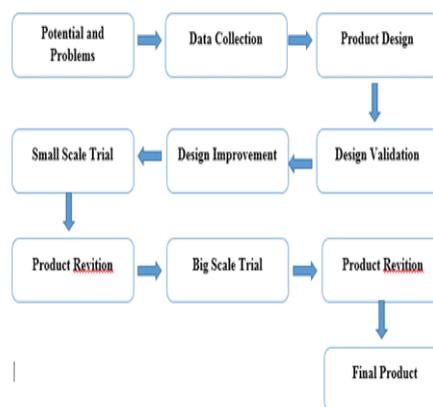
Based on this description, the researchers will conduct research and development on "Development of Microcontroller-Based Punch Speed Measuring Instruments in Karate Athletes".

This study aims to develop a microcontroller-based punch speed measurement tool for karate athletes as a test tool. In addition, to determine the level of feasibility and practicality of a microcontroller-based punch speed measuring instrument for karate athletes. Knowing the effectiveness of a microcontroller-based punch speed measuring tool in karate athletes. And to find out the ability of the stroke speed of the Forki karate athletes in

Palembang City in using a microcontroller-based karate punch speed measuring instrument. Microcontroller is a microprocessor system in which there is a CPU, ROM, RAM, input / output, Clock Oscillator and other internal equipment that are interconnected and well organized (observed) by the manufacturer and packaged in a single chip that is ready to use. (Ardi Winoto,(2010)

METHODS

This research uses research and development methods or better known as Research and Development (R and D). This research method is used to produce certain products and test the effectiveness of these products. The steps for using the Research and Development Method (R & D). The steps are as follows:



Picture 1. Research Procedure

Participants

The subjects in this study were karate athletes coaching FORKI (Indonesian Karate Sports Federation) Palembang City which consisted of 30 senior athletes aged 17-25 years. The technique of taking the research subject used a purpose sampling technique. This technique is a sampling technique with

certain considerations. The selection of subjects in this study was based on technical maturity, for the senior category in the technical aspect and experience was better than the junior category and below. Small group trials were conducted on 10 karate athletes fostered by Forki Palembang City and large group trials were conducted on 20 karate athletes assisted by FORKI Palembang City.

Sampling Procedures

Technique Data collection in this study was carried out by means of observation, interviews and questionnaires by material experts, media experts and test and measurement experts to obtain assessments, responses, criticisms, and suggestions.

Materials and Apparatus

The karate punch speed test tool is a tool in the form of a box that has been installed with an electronic device that combines a proximity sensor system, later simultaneously *Light Emitting Diode* (The LED) will light up and the buzzer sounds then the signal is continued to the Arduino Uno which will later be processed into a data display of the results of the measured stroke speed. displayed on the Liquid Crystal Display (LCD) screen. This tool will work automatically as a distance and time counter, so the results of measuring the speed of karate strokes are in the form of meters/second (m/s) speed units.

Procedures

The steps that need to be considered in the implementation of the workings of the microcontroller-based karate punch speed measuring tool are as follows: the first step, which is to activate the tool circuit after that, the LCD listed on the sensor and microcontroller circuit will light up and issue a program text. Next, make sure the

sensor circuit is detected by Arduino. Microcontroller is a microprocessor system in which there is a CPU, ROM, RAM, input / output, Clock Oscillator and other internal equipment that are interconnected and well organized (observed) by the manufacturer and packaged in a single chip that is ready to use. (Ardi Winoto,(2010)

The next step is to adjust the sample with the pole to position the proximity sensor to a certain height, make sure the hand position when hitting is detected by the proximity sensor. According to Kho, Dickson (2021) proximity sensor or proximity sensor commonly used to detect presence, proximity, position and counting in automated machines and manufacturing systems. The application of proximity sensor technology is used in an effort to encourage the improvement of the quality of sports test and measurement activities, especially karate. Click start to start the test and the sample starts to hit, During the test the sensor will detect the captured signal marked by a buzzer sound which indicates the sample has hit correctly if the buzzer does not sound it means the sample is not moving correctly then the LCD will not display the results the speed of the blow is wrong. The sample is given 3 chances to hit.

Design or Data Analysis

The data obtained in this study are qualitative and quantitative data. Qualitative data were obtained from material experts (karate experts), sports test and measurement experts and media (information technology) experts in the form of criticism and suggestions as input for product validation materials. While the data from the questionnaire given will be processed into quantitative data.

Validity test data obtained from questionnaires were then analyzed by percentage analysis techniques, the data itself is quantitative and can be converted into qualitative data in the form of intervals using a Likert scale. Based on the results of these scores, a total assessment is then carried out to obtain the percentage of the feasibility of the tool using calculations.

$$\text{Presentase Kelayakan (\%)} = \frac{\text{Skor yang diperoleh}}{\text{Skor yang diharapkan}} \times 100\%$$

To determine the effectiveness of the development of a microcontroller-based karate stroke measuring instrument, a different paired sample t-test or paired t-test was carried out, the level of significance $\alpha = 0,05$ Conclusion data if the value is significant $> 0,05$ then H_0 accepted and if the value is significant $< 0,05$ then H_0 is rejected (Sugiyono, 2011).

RESULT

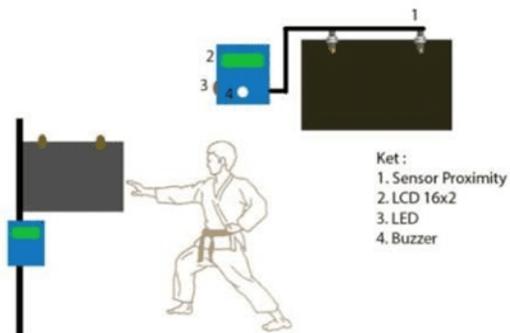
The results of the development product developed in the form of a tool in measuring the speed of a microcontroller-based stroke. This tool uses a proximity sensor or what is often called a proximity sensor. This research is entitled "Microcontroller-Based Punch Speed Test Measuring Instrument for Karate Athletes".

This sensor technology-based punch test instrument uses two proximity sensors that are integrated with the Arduino microcontroller.

According to Wicaksono (2019) Arduino is an electronic platform that is open source and easy to use. According to Harlan (2020) Arduino is a tool to control electronic goods. The first sensor is placed on the mat which functions to detect push-up movements when the body drops down. While the second sensor is placed on a support

pole which functions to detect movement when the body is up.

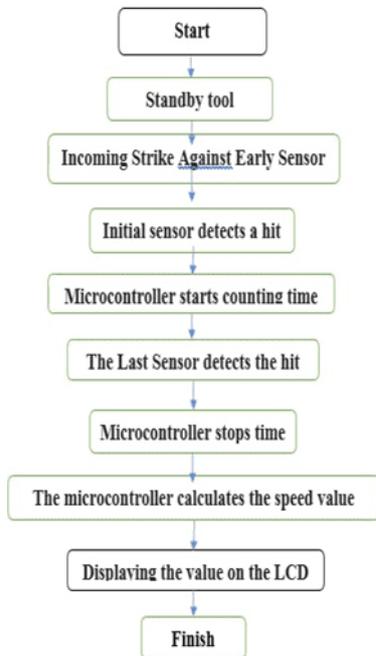
The way it works is by combining a sensor system that will send a signal to the microcontroller which will later be processed into a display of the calculated data blowdisplayed on the Liquid Crystal Display (LCD) screen as well as the monitor on the laptop. This tool will work automatically as a timer and count blow which is conducted. The two sensors will receive a signal when touched by a body part at a distance that is set in the program. The signal is captured by the receptor then will enter and be processed into the microcontroller before appearing on the LCD screen.



Picture 2. Initial product of a Microcontroller-Based Punch Speed Measuring Tool

This product was developed by utilizing the proximity sensor, which integrates with the Arduino Uno microcontroller as a tool in detecting the speed of the stroke digitally. Proximity sensor optical proximity sensor. An optical proximity sensor that looks for the presence of an object by its refraction or reflection of light (reflection) is infrared. If there is an object with a fairly close distance to the sensor, the light contained in the sensor will reflect back on the receiver (receiver) so that the receiver will catch the signal as a sign that there is an object

that passes through the sensor. The steps needed to implementing the workings of the microcontroller-based punch speed measuring instrument are as follows:



Picture 3 How the microcontroller-based karate stroke measuring tool works

Tables & Figures

The form and steps for the operation of the punch speed measuring instrument in more detail can be seen in the image below:



Picture 4. Mount the Tool on the Stand



Picture 5. Connect to stream electricity



Picture 6. After being connected to current, the tool will appear to do a punch countdown number after 1 tester can hit



Picture 7. Athletes are getting ready

to do an electri



Picture 8. Athlete's Position When Hitting



Picture 9. LCD display of results punch speed

The next step in this research is the product that has been made is validated by a material test (karate) expert validator, Mr. Shihan Drs. Mulyadi Basari, MM showed that obtained through the validation of the Material Questionnaire (Karate) was 23% for the product suitability aspect, the value was 22% for the product accuracy aspect, the 24% for the convenience of the product, and a value of 24% for the practicality of the product with a total final value of 93%.

In addition, based on the validator, there are 2 media experts (Information Technology) named Dr.

Sardianto Markos Siahaan, M.Sc., M.P obtained by 23% for the aspect of product suitability, the value of 24% for the aspect of product accuracy, the value of 24% for the convenience of the product, and a value of 24% for the practicality of the product with a total final value of 95%. After that which both Dr. Ade Silvia Handayani, ST, MT showed that the value obtained through the validation of the media expert questionnaire (Information Technology) The second validator was 23% for the product suitability aspect, the value 22% for the product accuracy aspect, the 23% for the convenience of the product, and 23% for the practicality of the product with a total final value of 91%.

The next validator Validate the tool with a test and measurement expert, namely Dr. Iyarus, M.Kes. shows that the value obtained through the validation of the test and measurement expert questionnaire is 25% for the product suitability aspect, the value is 24% for the product accuracy aspect, the 24% for the convenience of the product, and a value of 24% for the practicality of the product with a total final value of 97%

Arsil (2015) suggests that very good/decent criteria in the validation process lie in the percentage range of 81 – 100%. Based on this opinion, it can be said that the results of the validation of the experts on sports tests and measurements can be included in that very good or decent category so that the product can be continued at the trial stage.

The karate punch test is used to determine the accuracy of the athlete's stroke. One of the important elements of karate is the speed of the stroke. Speed is very necessary and can affect a person's appearance both when attacking and defending, Pranata et al:

(2017). Through the use of this tool, the process of measuring the speed of karate strokes can be carried out objectively with a good level of effectiveness.

The next step After the expert validator assessment has been carried out, then the trials are carried out in small group trials, and large group trials. The results of the small group and large group trials were combined to determine the results of the stroke speed guidelines.

The results of the women's small group trial showed that there were 3 athletes who got stroke speed results between 3.1 - 3.3 with sufficient category, and as many as 2 athletes who got stroke speed results between 2.8 – 3.0 with less category. In addition, the results of the men's small-scale trial showed that there was 1 athlete who got a stroke speed result between 3.40 - 3.64 in the good category, as many as 1 athlete who got a stroke speed result between 3.15 - 3.39 in the moderate category. , and as many as 3 athletes who get the results of the stroke speed between 2.9 – 3.14 with less category. The calculation also uses SPSS 21, the mean value is 3.100, the median is 3.100, and the standard deviation is 0.1286.

In addition, the data above also shows the normality test. The normality test obtained is 0.971, it can be concluded that the significance value is $0.971 > 0.05$ which is normally distributed. The results of the calculation of the reliability of the small group data obtained a value of 0.994, it can be said that the development product of the development of a microcontroller-based punch speed measuring instrument on a small-scale test has a high and significant correlation because $r_{count} > r_{table}$ ($0.994 > 0.632$).

Furthermore, after the small group trial was declared feasible, namely to test the large group. The results of the women's large-scale trial showed that there was 1 athlete who got a stroke speed result > 3.61 with a very good category, as many as 2 athletes who got a stroke speed between 3.4 – 3.6 with a good category, as many as 2 athletes who get the results of the speed between pukulan 3.1 – 3.3 with sufficient category, and as many as 2 athletes who get the results of the speed

Category	Female	Male
Very well	> 3.61	> 3.65
Good	3.40 – 3.60	3.40 – 3.64
Enough	3.10 – 3.30	3.15 – 3.39
Less	2.80 – 3.00	2.90 – 3.14
Less once	< 2.80	< 2.90

between pukulan 2.8 – 3.0 with less category. In addition, the results of the large-scale male trial showed that there were 2 athletes who got stroke speed results > 3.65 in the very good category, as many as 7 athletes who got the stroke speed between 3.40 - 3.64 in the good category, as many as 2 the athlete who gets the result of hitting speed between pukulan 3.15 – 3.39 with sufficient category, and as many as 2 athletes who get the results of the speed between pukulan 2.9 – 3.14 with less category. The calculation also uses SPSS 21, the mean value is 3.375, the median is 3.400, and the standard deviation is 0.3275.

In addition, the data above also shows the normality test. The normality test obtained is 0.847, it can be concluded that the significance value is $0.847 > 0.05$ which is normally distributed. Reliability can be known through the retest method, which is using an instrument to test twice with a minimum time span of one day (Widiastuti, 2019). And the data is calculated the correlation between the two data obtained a value of 0.993, it can be said that the product development of the development of a microcontroller-based punch speed measuring instrument on a large-scale test has a high and significant correlation because $r_{count} > r_{table}$ ($0.993 > 0.444$).

DISCUSSION

In addition, the research really shows that the existence of technology is useful in various ways, one of which is in the implementation of sports. Like Rahmat's opinion, (2017) argues that technology has a big influence in the scope of sports. In line with that, Kos et.al, (2018) also stated that technological progress is used by developed countries to assist in observing, collecting information, and processing data in a short time.

Agreeing with this, Wicaksono, (2019) stated that the adoption of technology into sports can help develop materials, designs, and equipment. The solution in overcoming the problem of athlete selection tests that still use conventional test instruments.

CONCLUSION

This research and development produces a microcontroller-based punch speed measuring instrument by utilizing proximity sensor technology,

the Arduino uno program application which is used to display data on the LCD. This product is named "Microcontroller-Based Karate Punch Speed Test Measuring Instrument". This tool consists of Arduino Uno components, Proximity Sensors, LCD, LEDs and Buzzers which are programmed continuously. The karate punch speed test tool is in the form of a box that has been installed with an electronic device that combines a proximity sensor system, then simultaneously the Light Emitting Diode (LED) will light up and the buzzer sounds then the signal is continued to the Arduino Uno which will later be processed into a speed measurement data display. the stroke displayed on the Liquid Crystal Display (LCD) screen. This tool will work automatically as a distance and time counter, so the results of measuring the speed of karate strokes are in the form of meters/second (m/s) speed units. The purpose of developing a microcontroller-based punch speed measuring tool for karate athletes is to make it easier for coaches as a tool to digitally calculate stroke speed in meters/second (m/s). Based on the experimental results that have been analyzed, it can be concluded that the Microcontroller-Based Karate Punch Speed Test Measuring Tool is feasible to be used in measuring the speed of strokes in karate athletes. The purpose of developing a microcontroller-based punch speed measuring tool for karate athletes is to make it easier for coaches as a tool to digitally calculate stroke speed in meters/second (m/s). Based on the experimental results that have been analyzed, it can be concluded that the Microcontroller- Based Karate Punch Speed Test Measuring Tool is feasible to be used in measuring the speed of strokes in karate athletes. The purpose

of developing a microcontroller-based punch speed measuring tool for karate athletes is to make it easier for coaches as a tool to digitally calculate stroke speed in meters/second (m/s). Based on the experimental results that have been analyzed, it can be concluded that the Microcontroller-Based Karate Punch Speed Test Measuring Tool is feasible to be used in measuring the speed of strokes in karate athletes.

The suggestions given to the readers who want to continue further research from the results of this study are as follows: 1) For users of the Microcontroller-Based Karate Punch Speed Test Measuring Tool, it is expected to first read the tool operating manual which aims to make it easier for users to use the tool properly. 2) Trainers are expected to continue to develop Microcontroller-Based Karate Punch Speed Test Measurement Tools that can support karate activities. 3) For further researchers, it is hoped that they will be able to improve the results of the development of the Microcontroller-Based Karate Punch Speed Test Measurement Tool that has been made because it still has limitations.

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REFERENCES

- Alinaghypour, M., Zareian, E., & Ardakani, ZP (2020). The scoring techniques in the final competitions of the Karate World Championships 2016. *Annals of Applied Sport Science*, 8(2), 1–7
<https://doi.org/10.29252/aassjournal.760>
- Amertha, PASUWA, Winaya, IMN, Wahyuni, N., & Dinata, IMK (2020). The Relationship between Arm Explosive Power and Gyaku Tsuki's Punching Ability at a Karate Dojo In Denpasar. *Indonesian Physiotherapy Scientific Magazine*, 8(3), 58.
<https://doi.org/10.24843/mifi.2020.v08.i03.p08>
- Ardi, Winoto. 2010. *Microcontroller AVR ATmega 8/ 32/ 16/ 8535 and Programming with C Language on WinAVR*, Informatics, Bandung
- Arsil. 2015. *Evaluation of Physical Education and Sports*. Padang: Wineka Media December 1, 2020
- Fendrian, F., & Nurzaman, M. (2016). The Effectiveness of Punch Attack Techniques and Kick Attack Techniques Against Earning Points in Kumite Competitions in Karate Sports. *Journal of Sports Coaching*, 8(2), 1–13.
- Harlan. (2020, September 8). *Understanding Arduino, Functions, Advantages, Language, etc.* Accessed via <https://www.progresstech.co.id/blog/arduino/> December 1, 2020.
- Ihsan, N., Yulkifli, Y., & Yohandri, Y. (2018). *Speed Instrument*

- Technology-Based Pencak Silat Kick. *Journal of Sociotechnology*, 17(1), 124–131.
- Kos, A., Wei, Y., Tomazic, S., & Umek, A. 2018. The Role of Science and Technology in Sport. *Procedia Computer Science*, 129, 489-495.
- Kho, Dickson (2020, October 1) Understanding LCD (Liquid Crystal Display) and LCD Working Principle. Accessed via <https://electronicengineering.com/understanding-of-lcd-liquid-crystal-display-principles-lcd-work/>
- Mohammed Sayyd, S., Asnaldi, A., & Laura Putri, R. (2019). Eye-hand Coordination of Skill Gyaku Tsuki Karateka Gokasi. *International Journal of Kinesiology and Physical Education*, 1(2), 27–35. <https://doi.org/10.34004/ijkpe.v1i1.12>
- Pranata, LD, Yarmani, Y., & Sugihartono, T. (2017). Exercise Effect Tire Rubber Spring-Force Load Against Punch Speed Kumite Gyaku Tzuki For Karate Athletes Inkanas Bengkulu City. *Kinesthetic*, 1(2). <https://doi.org/10.33369/Jk.V1i2.3473>
- Rahmat, E. 2017. Development of Chin Up Test Technology Based on Arduino Uno and Infrared Laser Sensor With LCD Display. *Journal of Applied Sports Science*, Volume 2 Number, 14-17
- Sari, Sekar.P & Salmah, Ayu.N. (2020). Brand Image, Product Quality, Price and Its Influence on Interest in Buying Arawaza Brand Karate Clothes in Palembang City. *Economics: Journal Of Economics and Business*. <http://dx.doi.org/10.33087/economy.v4i2.184>
- Symbolon, Barmathon. 2014. *Training and Training Karateka*. Jakarta: Griyak Pustaka.
- Sugiyono. 2013. *Educational Research Methods Quantitative Approach, Qualitative, and R&D*. Bandung: Alfabeta.
- Widiastuti, 2019. *Sports Tests and Measurements*. Jakarta: PT Raja Grafindo Homeland.
- Wicaksono, Fajar. 2019. *Arduino Applications and Sensors*. Bandung. informatics.