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DESIGN PHYSICS PROPS BASED ON ARDUINO NANO SENSORS ON IRREGULARLY CHANGING STRAIGHT MOTION MATERIALS (GLBB)

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Abstract

This study aims to design, test the feasibility and measure the response of students of physics teaching aids based on Arduino Nano sensors on Regularly Changing Straight Motion (GLBB) material. This study uses the method of research and development (Research and Development). The subjects of this study consisted of four validators and 16 students. Data analysis was carried out by descriptive analysis. The results of the feasibility test of the props product obtained a mean score of 3.54 with very good criteria. The results of the students' responses to the teaching aids obtained a mean score of 2.91 with agreed criteria.

***Keywords**: Design, Props, Arduino Nano, GLBB*

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INTRODUCTION

The development of technological and information advances in the digital 4.0 era is accelerating. This has an impact on the development of the world of education that everything must be based on technology both facilities and infrastructure. Even digital technology has entered into the syllabus of physics materials in high school (SMA). However, the development of education in Indonesia is still inferior to education in other countries. According to a student capability survey published by the Programme for international Student Assessment (PISA) in 2019, Indonesia is ranked 72nd out of 77 countries, ranking well below neighboring countries such as Brunei Darussalam and Malaysia (Maghiszha, 2019).

Physics is a science that examines concepts, facts related to the symptoms of nature that occur both real and abstract. Physics is a science that examines the concepts, facts, principles and laws of nature as evidenced through a series of scientific methods (Maiyena et al., 2018). It can be said that physics is close to everyday life because it can happen at any time, such as motion, direction, and magnitude used to measure.

In the world of education, physics is still a difficult subject for students, this is a classic problem of learning in school (Saputro, 2016). Based on the results of a 2017 research survey at SMA 1 Pakem Yogyakarta stated that 23 out of 32 students expressed dislike of physics subjects almost reached 72% (Yunas & Rachmawati, 2018). Physics is not only studied in theory, but must also be studied by observation of its concepts, facts and principles of nature. In the approach of physics it takes proof of concepts and facts through experimentation.

In the new normal era of covid-19, most of the learning is conducted online, this is a challenge for physics teachers in conducting learning in creative and innovative ways to achieve the competence of students (Saputra & Muharammah, 2020). Without innovation in the learning process, students' interest in lessons will continue to decrease (Saputro, 2016). Therefore, teachers are required to have the ability to innovate and be creative in teaching students to be interested in what is delivered. There are various ways to attract students' attention in learning, one of which is the use of props. Props is one of the learning media designed, created, and compiled by teachers to help students in instilling and understanding the concept or principle of a lesson material.

In previous studies stated that props have the effectiveness of being able to increase the learning motivation of learners (Marsella, 2017). The use of props can also develop critical thinking skills in learners, even in the learning process can help students be more active (Yunita & Ilyas, 2019). However, based on the observation of physical practicum in high school some of the tools used are still analog and manual, so the results obtained have a relatively small accuracy, and it is difficult for students to prove the concepts they have learned, one of which is in the experiments of regular straight motion experiments (GLBB). Therefore, it is necessary to have the right props, easy to understand, and attract the attention of students.

In previous studies using Arduino Uno as the main control, 6 photodiode sensors and laser diodes as motion detectors, can produce glbb timer design in Arduino-based slope that can measure precisely and accurately (Deesera et al., 2017).

Therefore, the researchers conducted this study aimed to design, test the feasibility and test the response of students of arduino Nano sensor-based physics props on Regular Straight Motion Changing material (GLBB).

METHOD

This research is included in the type of research development developed by Sugiyono. This study consists of ten stages shown in Figure 1.

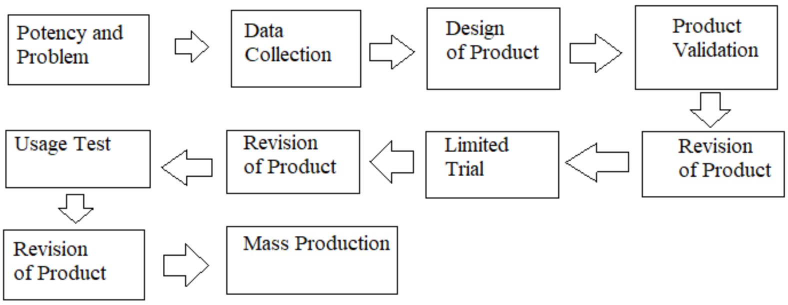


Figure 1. Stages of Research (Sugiyono, 2009)

The collection techniques used in this study include observations and questionnaires. Validation questionnaires are used to conduct due diligence assessments by media experts, material experts, and teachers. Feasibility test of props using validation instrument sheets by three physics lecturers and one physics teacher as testers. The assessment components used in the form of validation questionnaires include (1) quality, to assess the accuracy, suitability, and ability of props in conveying concepts, (2) implementation, to assess the effectiveness and practicality of the use of props and (3) appearance, to assess the attractiveness and durability of props; each component consists of 4 indicators. The response test was used to measure the response of learners to props in 16 students of class X MIA. The assessment component in the response questionnaire includes, (1) the quality of props, to assess the suitability of props with materials consisting of 3 indicators; (2) implementation, to assess the ability of props in delivering materials consisting of 3 indicators; and (3) display of props, to assess the ease of use of props consisting of 2 indicators.

The data analysis technique used in this study is descriptive statistical analysis according to Widoyoko (2012). This descriptive analysis was conducted by converting the average score obtained into qualitative criteria values using a validation likert scale that includes (1) Very Less, (2) Less, (3) Good, (4) Excellent, and for the response of learners including (1) Strongly Disagree, (2) Disagree, (3) Agree and (4) Strongly Agree, as shown in Table 1.

Table 1. Average Score Assessment Interval against Product Qualitative Criteria

Average Score	**Validation Criteria**	**Response Criteria**
$3,25 < \bar{X} \leq 4,00$	Excellent (SB)	Strongly Agree (SS)
$2,50 < \bar{X} \leq 3,25$	Good (B)	Agree (S)
$1,75 < \bar{X} \leq 2,50$	Less (K)	Disagree (TS)
$1,00 \leq \bar{X} \leq 1,75$	Very Less (SK)	Strongly Disagree (STS)

Source: (Widoyoko, 2012)

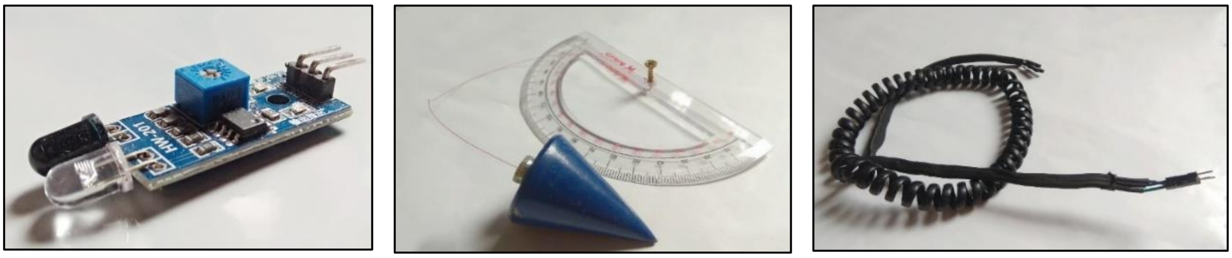
RESULTS AND DISCUSSION

Build Design

Product design in this study in the form of props. The props in this study were designed in the form of slopes with IR Obstacle sensor technology for start and stop switches in the timer module using Arduino Nano as the system controller. The stages of designing the props are as follows:

Stage I: Preparing tools and materials

Tools needed to support the design process of props include soldering, scissors, saws, wood carvers, electric drills, cutters, meters, and screwdrivers. While the materials needed in the manufacture of props consists of: wooden boards, bow, earrings, meter, IR Obstacle sensor, 16x2 screen, X4 black box, door hinge, reset button, Arduino Nano microcontroller ATM328p module, I2C module, breadboard, spiral cable, jumper cable, mini USB, mobile phone charger adapter, toy car, tenol, wood glue, glue G, duct tape burn cable, screw, nut, bolt, string thread, nail , and matches. Some of the materials needed to design props can be seen in Figure 2.a, Figure 2.b, and Figure 2.c.



(a) (b) (c)

Figure 2. (a) IR Obstacle Sensor (b) Arc and Untang-Earring (c) Spiral Cable

Stage II: Build a slope board

The slope board is designed using mahogany and teak wood. The slope board consists of a horizontal wooden board and slanted wood. On the horizontal wooden board is given the rear front shoe to maintain the balance of the tool, while the wooden board tilts as the trajectory of the trolley slide. Between the two wooden boards there is a door hinge that can change the slope of the plane with the buffer shifted and arranged. Beside the sloping wooden board there is a sensor trajectory to detect the passing trolley. At the bottom end of the slanted wooden board is given a place to install a timer module. Between the track board and the timer module there is a separation wood and a reducer. The track board has a size (120 x 11 x 4.5) cm3. The maximum distance on the slope path is 105 cm. The design of the slope board can be seen in Figure 3.

Figure 3. Props Slope Board

Stage III: Build a timer module

The timer module includes a range of X4 box materials, a 16x2 LCD screen, an I2C module, an Arduino Nano, a jumper cable, a breadboard, a reset switch, an adapter, and a mini USB. This timer module is designed with a size (12 x 8.5 x 5) cm3 in the X4 box. This set of timer modules can be seen in Figure 4.

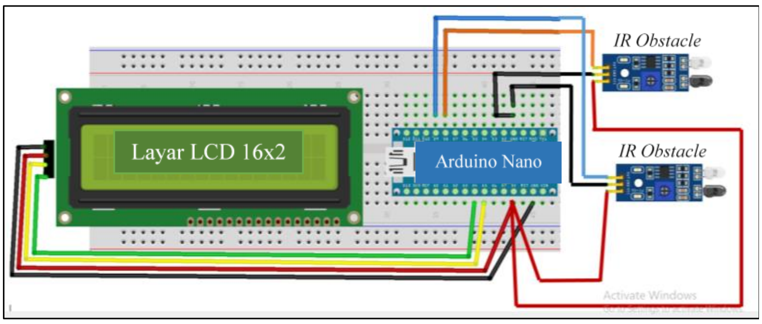


Figure 4. Timance Module Series.

In the timer module there are several parts, namely the 16x2 LCD screen as the time display traveled, the mini USB adapter as the sender of the voltage source to the timer module, the reset switch button as the restart time on the module, and 2 jumper cables connecting 2 IR Obstacle sensors that serve to the start and stop switches on the module. The timer module display can be seen in Figure 5.

Figure 5. Timer Module

Stage IV: Assembling components

In this stage, researchers assemble components that have been designed and prepared. The timer module component is placed at the lower end of the slope path. The sensor component is placed on the IR Obstacle sensor trajectory mount so that it can be shifted and adjusted in distance. The IR Obstacle sensor is connected to the timer module with a spiral cable and jumper cable through the bottom of the trajectory. The arc component is placed perpendicularly at the top end of the trajectory, and the earrings are hung with strings right at the center of the arc to indicate the slope of the plane. On the slope path is affixed to the meter to set the distance of the start sensor to the stop sensor.

Stage V: Finishing Props

In the finishing stage of props, researchers improved props by painting on wood and structuring components on the tool as a whole. The wood on the slope board is given a brown color and coated with pelitur to make it more attractive. Spiral cables and jumper cables that are not organized and shorted are arranged and repaired. This repair can be done by lining the cable using burn cable duct tape to prevent circuit shorting. The final product view of the props can be seen in Figure 6.

Figure 6. Final Product Props

Due Diligence

Due diligence is conducted by validators to assess products based on props assessment rubric consisting of quality, implementation and display assessment components. The validation results of props by validators are presented in the average score table of each component shown in Table 2.

Table 2. Prop Validation Average Score Result

No.	Components	Average	Criteria
1.	Quality	3.56	Excellent
2.	Implementation	3,56	
3.	Props View	3,50	
	Average	3,54	

Student Response Test

This response test was conducted by class X MIA as many as 16 students as respondents. The assessment component in the response questionnaire includes quality, execution, and appearance. The results of the student response presented in the average score table of each component are shown in Table 3.

Table 3. Average Results of Student Response Score to Props

No.	Components	Average	Criteria
1.	Quality	2,88	Agree
2.	Implementation	2,79	
3.	Props View	3,06	
Average		2,91	

CONCLUSION

Design physics props based on arduino sensor obtained feasibility assessment with excellent criteria and the response of learners obtained a response assessment with the criteria Agree so that it can be said that the props are worth using for physics learning. Based on the results of this study, it is suggested that these props can be used as a medium in physics learning on GLBB materials and can also be used for frictional material. For further research development can be integrated with smartphones.

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