

# Planning and Realization of Learning Modules as Extracurricular Activities of Biped Robot

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## Planning and Realization of Learning Modules as Extracurricular Activities of Biped Robot

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**Abstract.** Biped Robot is a tool that designed in such a way as to have human-like mobility. It has structures like human legs that have joints of legs, knees, and hips. Biped Robot is used as a learning module on extracurricular activities at St. Andreas High School. Extracurricular activities are conducted outside of school hours, which is held 2 weeks, during 8 meetings. The biped robot is able to run forward and the basic material of the robot uses the PLA filament. To personalize it in extracurricular activities, the modules used in the manufacture of biped robots are processing modules, liaison modules, and drive modules. As for assisting learners in making the robot, a practical module is used to guide learners to make it easier for them to understand and create a system for each meeting. Based on the test results, this robot that uses several modules can work well and the biped robot can run forward. In addition, any material submitted at each meeting, more than 60% of the participants of the extracurricular activities already understand every material delivered and overall, more than 80% of the number of learners stated that this extracurricular activities can run well and smoothly.

### 1. Introduction

As we know, the development of technology can develop very rapidly. Therefore, the school has a very important role to prepare students for the development of technology [1], [2], [3]. Schools are given the freedom to choose strategies, methods, and effective learning and teaching techniques. This is tailored to the characteristics of subjects, teachers, and conditions of the real resources available in school [4]. One of the most prepared preparations by each school is the extracurricular activities. Extracurricular activities conducted outside of lesson hours (face to face), both performed at school and outside school hours as did the SMP Santo Andreas which adds to the extracurricular activities of biped robots. The biped robot is a robot that moves like a human foot that has a leg, knee, and hip joints [5]. According to Mrs. Maria Sugiyanti, as the principal of SMP Santo Andreas, the addition of extracurricular activities is expected to add talent and interest and ability for students. Therefore, Santo Andreas High School works with the University of Tarumanagara's electrical engineering study Program to create a learning module implemented on biped robot extracurricular activities.



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## 2. Theory

Biped Robot designed as learning module using 8 servo. The Servo has speed so that the biped robot can run well. In addition, the servo in the robot must have a very fast response, so that the robot can run in a balanced way. Servo should also be able to withstand the weight of the robot [6]. The robot is designed to be made from a filament Poly lactic Acid (PLA) base with a diameter of 1.75 mm. To move the robot requires 8 driving modules (servo). Each servo has different functions. This robot movement is done by changing the angle of the servo. This robot is made so that the robot can run forward. So that the robot can run well, it takes several modules or components to be integrated with each other. The modules are: processing modules, connector modules, drive modules and practicum modules. The robot movement system is set by changing the angle of the drive module arranged by the processing module. The extracurricular activities were carried out by 8 meetings, followed by 19 students in grade VII and VIII. Each meeting is divided into several robot projects that apply various electronic components. Each project has its own challenges and learners must understand how the project works [7]. The biped robot design can be seen in Figure 1.

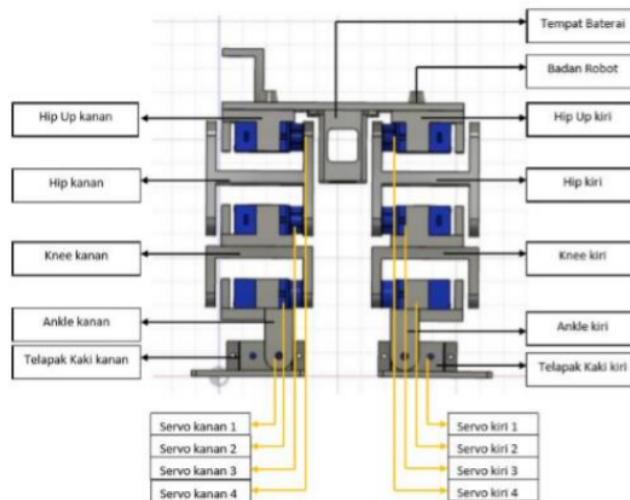


Figure 1. Biped Robot Design

### 2.1. Processing Modules

The Arduino processing module is an open-source single-board micro controller, derived from the wiring platform, designed to facilitate the use of electronics in various fields [8]. This processing module is done by creating a program that will be run on the processing module to run the biped robot. The created Program serves to perform processing of the drive module. The processing module will be programmed to move the servo motor according to the desired angle. Such a move and angle change will be utilized so that the robot can run. The processing modules can be seen in Figure 2.



Figure 2. Processing Modules

### 2.2. Connector Modules

A connecting module in the form of a biped robot board is a module used to integrate the electronic components of the processing module and the drive module, so that the drive module can move. For the

connecting module used in the form of a printed printed circuit board (PCB). Before printing the PCB, the components are in the frame to connect to each other. Figure 3. is an image of a PCB set on biped robot.

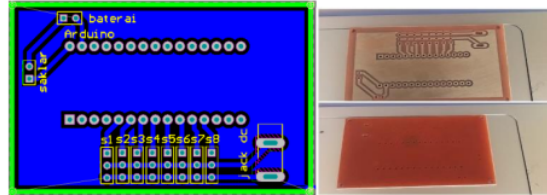


Figure 3. a PCB set on Biped Robots

### 2.3. Drive Modules

The drive module is a module used to drive a biped robot. The drive module used is a MG90S-type servo motor, which is discontinuous. The Servo is used by 8 pieces that have the function to move the different parts of the robot. The servo movement is capable of moving in two directions, i.e. the Clock Wise (CW) and the counter Clock Wise (CCW) where the direction and angle of the movement of Rotor can be controlled by simply providing a duty cycle setting of the Pulse Width Modulation (PWM) signal in the control pin part. The robot's movement system by changing the angle of the drive module arranged by PWM on the microcontroller module [9],[10]. Figure 4. is an image of MG90S servo motor and pinout

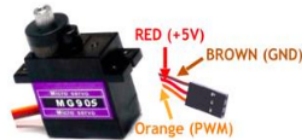


Figure 4. MG90S Servo Motor and Pinout

### 2.4. Extracurricular Activities

Extracurricular activities are additional learning activities that are conducted outside of school tuition (face to face). This activity is done to further enrich and broaden the knowledge and capabilities that students already have from different fields of study [11]. This activity was carried out in the school environment and under the guidance and supervision of the school parties. The extracurricular activities were conducted at St. Andrew's Junior high School, with address Jl. Kedoya Utara Kedoya Selatan, South Jakarta Kebon Jeruk DKI Jakarta, RT. 1/RW. 4, North Kedoya, Kebun Jeruk District, City West Jakarta, special Capital Region of Jakarta. Extracurricular activities held on Tuesdays, at 14.30-16.30 WIB. Number of students attending activities. As many as 19 extracurricular participants consisting of classes VII and VIII. Extracurricular activities are held every 2 weeks once during 4 months with a total meeting 8 times. Extracurricular activities can be seen in Figure 5.



Figure 5. Extracurricular Activities

### 3. Results and Discussion

To find out if the whole system can work well, do some testing. Overall, testing is conducted to determine if the overall extracurricular activities and the system can run well. The overall testing for this system, which is the creation of a biped robot that can run forward aims to know the ability of the system to be worked well or not. This test is done after all the modules used in this design, both processing modules, liaison modules, drive modules and laboratory modules. The robot movement flowchart can be seen in Figure 6

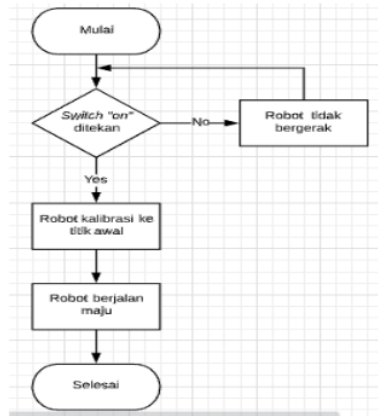


Figure 6. Flowchart How Robot Works

The way work is done by pressing the switch on/off so the Arduino can work. Then the Arduino will give the command to the drive or servo module, then perform a few void steps in accordance with the created robot program and the biped robot can run forward. The biped robot image can be seen in Figure 7.

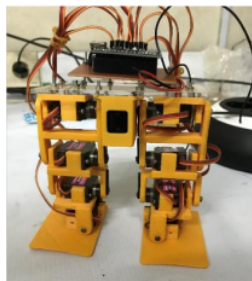


Figure 7. Biped Robot

While to know the students' understanding of the materials provided using the method of Likert scale [12]. The Likert scale is used to obtain a percent index to determine the interval or distance range in order to determine the assessment of each material given in the percentage score performed to the students of SMP Santo Andreas. The percent index is measured from the scale weighted value of the questionnaire filled by the students of SMP Santo Andreas who follow the extracurricular biped robot. Percent index calculations are obtained based on the statement result of each student questionnaire number filled, weighing 1 is determined with a scale of 1 to a weight of 4, with a scale of value 4. The formula of the Likert scale method can be seen in Formula No. 1.

$$\text{Index \%} = \frac{\text{Total Scale Weights}}{76} \times 100 \dots\dots\dots(1)$$

Description:

76 = Total Maximum scale weight

As for the questionnaire that has been disseminated through the Google form to the students of Junior high school Santo Andreas who participated in the extracurricular biped robot activities, obtained data from the filling questionnaire that can be seen in tables 1 and 2.

**Table 1.** Result filling Questionnaire Part 1

Total Weight Statement	Total Weights
1. I already know the electronic components used in the extracurricular biped robot activities, such as: DC Jack, battery socket, Servo MG90S, and Male Header Pin and Female	62
2. I already know the use of Arduino and its application	63
3. I can afford and understand how to drive a Servo MG90S	57
4. I can afford and understand how to drive 3 pieces of Servo MG90S simultaneously and alternately	53
5. I know how to design a robot with AutoCAD software and know the parts or kits of the robot	48
6. I was able to and understand how to assemble a robot biped	56
7. I am able to and understand how to create an early robot program (the Robot can stand strapping)	58
8. I was able to and understand how to make a final robot program (the Robot can run forward)	52

**Table 2.** Result filling Questionnaire Part 1

9. Extracurricular activities as a whole can run well	66
10. With the existence of a laboratory module, it is easy for me to learn and make biped robots	64
11. Praktikum module leads me to program the Arduino	66
12. practicum module useful for me to use all components in connector module	62

From Table 1 and table 2. Calculation to know the percent index as in Formula number 1. The percent index calculation on Part 1 questionnaire can be seen in calculation 1. While the calculation result of percent Index part 2, can be seen in calculation 2. Table of index results percent from filling questionnaire Part 1 and 2 can be seen in table 3.

**Table 3.** Percent Index calculation results

No. Pernyataan	Index %	No. Pernyataan	Index %
1.	81.57	7.	76.31
2.	82.89	8.	68.42
3.	75	9.	86.84
4.	69.73	10.	84.21
5.	63.15	11.	86.84
6.	73.68	12.	81.57

From Table 3. Can be seen that the test results of extracurricular activities to the materials provided (in section 1) are above 60%. This shows an understanding of the material given more than 60% of the number of students being able to understand each desired material.

While the test results of the overall extracurricular activities (in part 2) are above 80%. It is quite high compared to testing extracurricular activities against any given material. From that data, 80% of the total number of students assumed that extracurricular activities can run well and smoothly.

#### 4. Conclusion

The conclusion gained from the design and realization of a learning module as a biped robot extracurricular activities are as follows: processing modules, connector modules, drive modules and practicum modules can work well. The Practicum module which contains the basic theory and the working steps of each meeting made can make it easier in the manufacture of biped robots. It is known from the results of filling questionnaire Part 1. A total of more than 60% of the number of learners already understand every material given each meeting. In addition, based on questionnaires filled by the learners, biped robot extracurricular activities carried out at SMP Santo Andreas are stated to be able to run smoothly. This is evidenced in the results of filling questionnaires in part 2. Where more than 80% of the number of learners stated that biped robot extracurricular activities can run smoothly.

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