The Use of Robot Technology for Blended Learning in Pandemic Situations

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Abstract. Nowadays we are still in the virus covid 19 pandemic situation. The pandemic condition forces the learning process to be carried out online to reduce the spread of this virus. One of the other efforts used is hybrid learning. One of the robot technologies that can support lectures work in hybrid learning is a teaching assistant robot. This technology can be used to help lecturers or teachers carry out their duties properly. This study aims to develop robotic technology for blended learning. The developed robot has a function to help hybrid learning where the robot is equipped with a camera, microphone, microcontroller, and electric motor. This robot has the advantage of using a wireless connection, it can move to display the material presented by the lecturer so that hybrid learning is optimized.

Keywords: Robot · Pandemic · Blended Learning

1 Introduction

Nowadays we are still in a situation of the coronavirus (Covid-19) pandemic, which causes learning that cannot be carried out directly with the crowd. The occurrence of the global Covid-19 pandemic requires all educational institutions to implement digital learning models to maintain the quality of education. The home learning policy instructed by the government to all educational institutions, especially in Indonesia, indirectly requires educators and students to adapt to this change. Conditions that used to be worrying and required online learning to be carried out are now getting better, with the vaccination program, learning has begun to be carried out directly in the classroom, but not all students are allowed to enter the classroom. One of the efforts made to prevent the transmission of the virus during classroom learning is a hybrid learning effort.

Hybrid learning is learning that can combine all forms of learning, for example online, live, or face-to-face (conventional). Hybrid learning makes students learn independently, and continuously, so that learning becomes effective, efficient, and interesting [1–5]. Hybrid learning can improve the digital literacy skills of elementary school students in the affective, cognitive, and psychomotor domains. Digital literacy skills in the affective domain can be seen from the attitude of cooperation, independence, and responsibility. In addition, the affective domain in the hybrid class can collaborate with cooperative, responsible, and independent affective attitudes. The second result of digital literacy skills in the hybrid class is cognitively able to improve critical thinking skills

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which are reflected in 3 phases, namely the phases of seeking information, obtaining information, and synthesizing knowledge [6]. However, it must be noted that hybrid learning is inseparable from various problems [7]. Problems encountered during the implementation of hybrid learning include the imbalance of the internet network and access to technology between big cities and remote areas.

The Learning Process in the Department of Mechanical Engineering, Faculty of Engineering, State University of Semarang has implemented hybrid learning. Several rooms were found to be unavailable for supporting facilities such as 4K cameras and other supporting facilities. The price of a 4K camera itself is very expensive so it burdens lecturers. Besides being expensive, the image quality during learning is not necessarily good and visible to online participants because of the fixed camera position, and the lighting settings are not optimal. So that learning can run optimally, robotic technology can be created to help the learning process. One of the innovations that can be created is a teaching assistant robot to support hybrid learning.

In the learning process, supporting facilities are needed. Supporting facilities that can be used are robots. The robot is a unit in the form of mechanics or physical or virtual that has intelligence. The nature of the robot is that it can be programmed, has a certain intelligence, and can move with one or more axes to rotate and move [8]. Robotics technology has entered various fields such as medicine, industry, and education. in the field of Education, they use robotics technology in various parts such as learning systems and libraries [9]. The robot is a modern prototype that uses artificial intelligence technology that is designed to help humans work in all fields. Robots can be applied to various fields and places, ranging from housing, industry, offices, hospitals, military, education, and learning. Robotics and automation machines have colored the development of science in the academic fields of education and industry. However, in the academic field, the introduction of robotics is usually only limited to the technological sophistication of the robot itself [10].

The development of mobile robots is increasing and is predicted to occupy a position where robots will do almost all sectors of human work better and cheaper [11]. In contrast to industrial robots, mobile robots themselves are robots that do not stay in one place and have functions like humans. Mobile robots can move using navigation and controls that have been pre-arranged by the robot maker [12]. The navigation and control can be in the form of algorithms and or signals received by the robot which will move the robot automatically. A control system robot can use a Programmable Logic Controller or Arduino [13], and a DC motor can be used to drive the robot [14]. Applications of control system methods on robots include PID, fuzzy logic, adaptive, and artificial neural networks [15–18]. Current robot control can also use the internet of things [19]. Innovations in robots that can also be developed are by using renewable energy sources and also low energy consumption [20].

This article discusses the design of robots used in the hybrid learning process, knowing how robots work that can be used for the hybrid learning process.

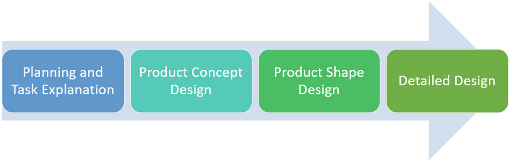

Fig. 1. Research design

2 Methods

The focus of this research is the analysis of the This study used the Pahl and Beitz design method. Design research and the stages of designing a hybrid learning assistant robot product are shown in Fig. 1.

In the first stage, the researchers identify and plan the needs in the hybrid learning process. The need for facilities that support learning such as cameras, microphones, whiteboard pens, electric motors, and connections.

The second stage is to design the concept of robot work. At this stage, the robot is designed to be able to display the focus of the material presented by the lecturer and can rotate towards the speaker during class discussions. The third stage is to design the shape of the robot using the help of Computer-Aided Design but in the form of a sketch and not yet detailed. At this stage to find out the shape of the robot, the dimensions of the robot, and other components. The fourth stage is to make product details, both in the form of working drawings and product specifications.

The materials needed in this research include software and hardware. The required software includes Computer-Aided Design (CAD), Matlab, and Arduino. Hardware needed includes a camera, servo motor, microphone, Bluetooth, and microcontroller.

The data was obtained from a literature review about the hybrid learning process, the workings of the components of the robot, and the control system of the robot. Descriptive analysis is used to describe the process of using robot technology in the hybrid learning process.

3 Results Discussion

The robot is a set of mechanical devices that can perform physical tasks, either with human supervision and control or using predefined programs (artificial intelligence). The results of the robot design concept are shown in Fig. 2.

Based on Fig. 2, the component of robots is (1) a camera, servo motor, box pen, etc., wheel, electric motor, base & control box (with battery & indicator). The robot has a camera that is used to highlight the material displayed by the lecturer, a whiteboard pen equipped with a remote to move the robot, a microcontroller to control electric motors and servo motors and is also equipped with a rechargeable battery as a power supply for the robot.

Based on Fig. 3, to connect the lecturer's computer to the robot, a connection is needed. Currently, the existing connection uses a cable that connects to the camera and LCD. The challenge, in this case is to make the connection wireless and in one module

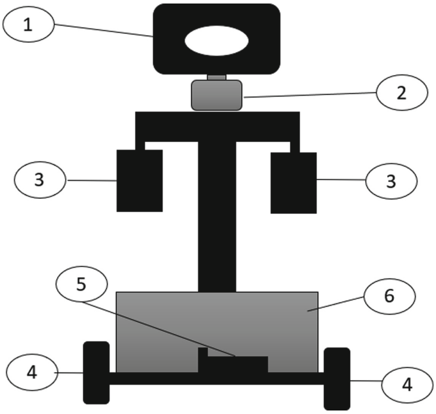

Fig. 2. Robot design

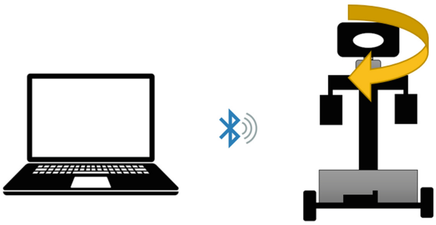

Fig. 3. Robot connectivity design

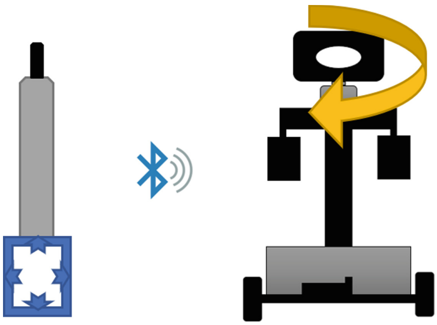

Fig. 4. Remote control design with pen whiteboard

can connect between computers, robots, and projectors. With one connection, it makes it easier for lecturers to connect devices so that time to prepare learning tools becomes more effective.

Figure 4 shows the remote controller connection to move the robot's body position and camera position. This device has a compact design equipped with a whiteboard pen that can be used by lecturers to write material on the whiteboard. The forward design of this pen is also equipped with infrared light as a pointer. By using a remote control,

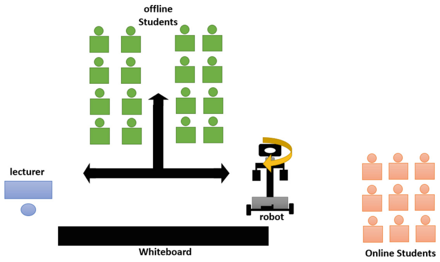

Fig. 5. Robot design remote control

the robot can move positions to enable the delivery of lecturer material to be more interactive. The path of the robot is shown in Fig. 5.

Robots have the advantages of low production costs, and wireless connections, and can be used to assist hybrid learning so that the material presented by the lecturer can be seen by online participants. The robot can be operated manually using a whiteboard pen equipped with a remote which is used to rotate the camera with a servo motor designed to focus on the material presented as well as on students/speakers during class discussions. The robot has the disadvantage of using a battery that is limited in power, if the battery runs out in the middle of learning it takes time to charge, but it can be anticipated by replacing it with a spare battery.

4 Conclusions

The robot has a camera that is used to highlight the material displayed by the lecturer, a whiteboard pen equipped with a remote to move the robot, a microcontroller to control electric motors and servo motors and is also equipped with a rechargeable battery as a power supply for the robot.

Robots have the advantages of low production costs, and wireless connections, and can be used to assist hybrid learning so that the material presented by the lecturer can be seen by online participants. The robot can be operated manually using a whiteboard pen equipped with a remote which is used to rotate the camera with a servo motor designed to focus on the material presented as well as on students/speakers during class discussions. The robot has the disadvantage of using a battery that is limited in power, if the battery runs out in the middle of learning it takes time to charge, but it can be anticipated by replacing it with a spare battery.

The suggestion from this research is class trials are needed to determine the effectiveness of robots in hybrid learning; robot development can use artificial intelligence control.

Further research will be carried out on the fabrication and embedded control system of hybrid learning assistant robots. In the future robots can be controlled with artificial intelligence that can be automated to support hybrid learning. Robots can also be used to monitor students when carrying out the midterm test, and final exams. By using deep learning robots can identify students who cheat on tests.

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