Design Arduino-Based Complete Sensor Trainer as A Learning Medium

Purnamawati*[1], Muhammad Akil[2], Nuridayanti[3]
Universitas Negeri Makassar
E-Mail: purnamawati@unm.ac.id[1]

Abstract. The use of learning devices in public lectures is an absolute requirement to provide convenience and smooth learning in the teaching process. The purpose of this research is to create a complete sensor trainer based on Arduino. The sensor grouping used in this trainer consists of light sensors, temperature sensors, tilt sensors, colour sensors, sound sensors, GSM & GPS, and Accelerometers. The overall research procedure is to start from the manufacture of box trainer design, PCB layout design, box trainer creation, PCB layout creation, module trials, repair, and module installation. Based on the research procedure, the creation of this trainer consists of two parts namely hardware and software. Trainer trials are conducted by examining the voltage source on the power supply and connecting it to each sensor module according to the required amount of voltage. The sensor module is in good condition and works when the indicator light on the module is lighted. Next, create a basic Arduino IDE-based sensor value reading program to ensure that the sensor module can function as in its usability. The development of this trainer can be done by connecting sensor and controller devices with the internet so that the monitoring and controlling process can be done based on IoT

Keywords: *Design, Arduino-Based Complete*

INDONESIAN JOURNAL OF EDUCATIONAL STUDIES (IJES)

E-ISSN: 2621-6736
P-ISSN: 2621-6744

Submitted : 14th October 2021
Revised : 10th December 2021
Accepted : 1st February 2022

INTRODUCTION

The production of learning media in the form of trainers requires an idea in the form of the design of the shape and quality of the materials to be used. The shape and quality of the material are very closely related to the character or behaviour of the learner as a user of the media. Several important aspects need to be considered in the creation of trainer learning media, namely design, material, material, and user comfort aspects. The design, material, and user comfort aspects are part of the development of the most commonly used media Setiawan, A. L. and N. Yuniarti (2017); Ibrahim, M., M. Nur, and K. A. (2010).

The design is used as a reference in the process of creating a media trainer, in that aspect, there are trainer dimensions, content (trainer content), and overall appearance (layout). Trainer design is based on an in-depth analysis of learning objectives to improve the effectiveness of learning Cikarge, G. P. and P. Utami (2018). The material aspect relates to the materials used in the manufacture of trainer learning media, the purpose of selection of materials with good quality will provide strong durability so that the length of use of trainers is longer. Aspects of this material include electronic components and box trainer manufacturing materials.

The material aspect includes the content of the learning media related to the science contained in the course or subject to be taught. Surely this aspect is more focused on the content of practice lectures with some examples of experiments in them. The last aspect is the convenience of using media trainers. One form of comfort using trainers is that the user can reach all the surface of the trainer, the availability of all the necessary equipment, there are indicators and clear instructions in the use of trainers, and ease of use.

A lot of research has been done by creating learning media designs in the form of trainers. Research is called Based on the aspect of the need for the use of learning media in their respective learning environments so that the direction of research making media trainer becomes one of the research roadmaps, especially in educational institutions. Some examples of research that make trainers based on aspects of media needs analysis include Setiawan, A. L. and N. Yuniarti (2017); Suryania, F., M. Sukardjo, and M. Yusro (2019). Susilo and Suyitno (2017). The research is mostly done to meet the practical needs of some types of courses or practice lessons.

The use of learning media in practical lectures is one of the keys to the success of students in mastering the practical materials submitted. The use of media trainers can improve participants' skills and knowledge quickly and efficiently Jefiza, A., F. Okmayura, and R. W. Novchi (2019) ; Agustio, W. (2019); Hanifah, S. B. and E. Yundra (2019), caused by the activities and behavior of practicum participants directly able to sense, view, measure, and analyze the components or tools contained in the trainer. Another advantage is that practicum participants can carry out the practicum process independently by following practical instructions or job sheets. This condition will indirectly make students or students more motivated in learning using trainers Marwanto, D. and A. P. Budiono (2016); Fivia, Eliza and Dwoprima Elvanny Myori (2017).

Based on the exposure of the condition and advantages of the use of training media trainers it encourages our intention to develop trainer learning media in one of our on-site practicum courses. The Study Program of Mechatronics Vocational Education Faculty of Engineering, Universitas Negeri Makassar is a new study program so that practical facilities in some subjects are still very limited, one of which is in the subjects of sensory practicum and transducer. During this time, sensor and transducer practice was implemented in a simulated way using one of the electronic simulation software that supports the availability of several types of sensors and Arduino-based. However, not all types of sensors are contained in the software library, only some types of sensors are commonly used so this is an obstacle for students who are unable to continue practicum in a simulated way.

This condition is what led us to create a study that designed the learning media of sensor trainers and transducers based on Arduino. The manufacture of this trainer refers to the material, material, and shape aspects of the trainer. Specific to the material and material aspects, we provide both commonly used types of sensors (available in simulation software libraries) and other types of sensors related to Sensor and Transducer courses.

MATERIAL AND METHODS

The methods used in this study are design methods with several stages including designing trainer models, making media trainers, testing trainers, repairing, and finishing. To facilitate the entire process of the stage, it takes an overview of the working principles of the tools that can be seen in the block diagram, flowchart system, and software and hardware design.

Diagram Blok and flowchart system

This Sensor trainer and transducer learning medium consists of several sensor modules all of which can be integrated and applied directly using Arduino. The image below can provide a complete description of the working principles of the trainer to be created.

Based on figure 1, there are several types of sensor modules used. Each module consists of several types of sensors that have the same function as different types. The selection of these types of sensors to provide students with a lot of knowledge about the use, programming, and differences of these sensors. The entire sensor is directly connected to the Arduino as a data processing device from the sensor. This Arduino block will process the input signal from the sensor so that it can be displayed by the LCD character, and can also control the relay driver so that it can be connected to the load it wants to control. The creation of this Arduino programming algorithm is done using a computer or laptop. The series simulation process can also be done through the computer to see if the created program can work according to the desired command.

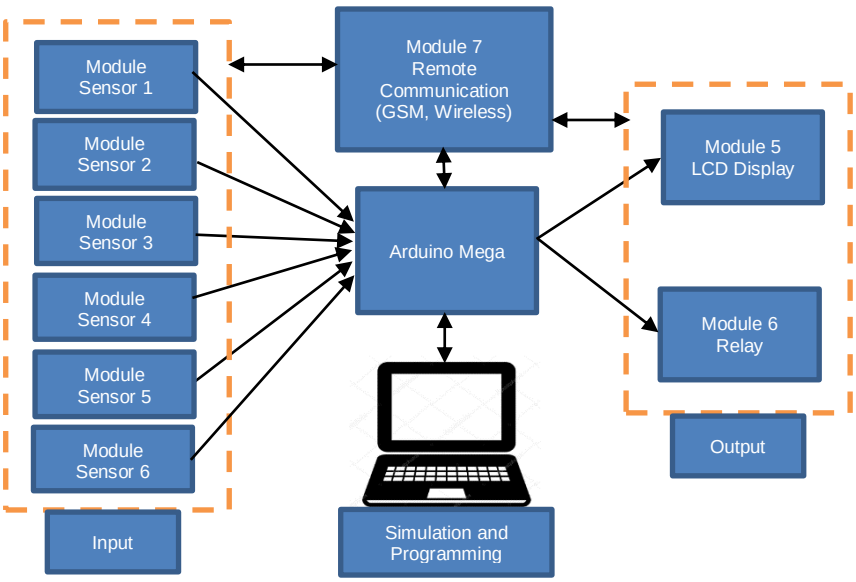

Figure 1. Sensor trainer diagram blocks and transducers

In general, the principle of trainer work can be seen in the following flowchart, the flowchart overview below is a practical implementation procedure using sensor and transducer trainer learning media.

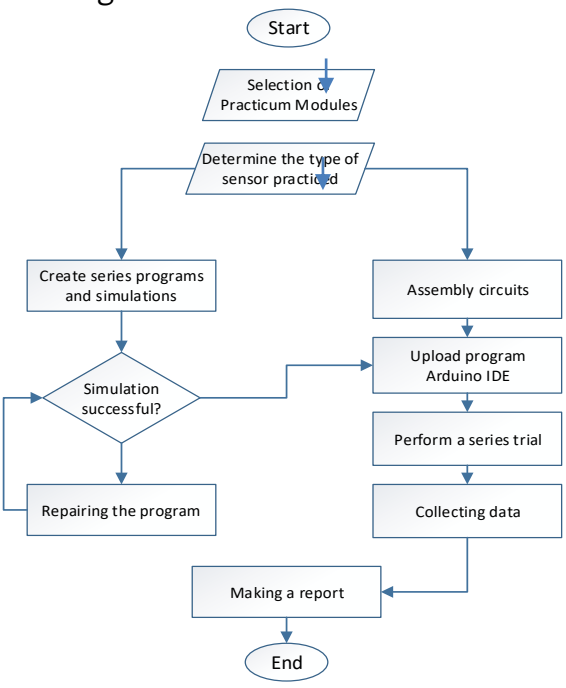

Figure 2. Trainer using flowchart

Design Hardware

The manufacture of hardware design from Sensor trainers and transducers consists of the design of box trainers and PCB design of sensor modules. The design

of the trainer box is made based on the insight aspect (view) that is more precise with the position of sitting on the standard table. The trainer's display position should be tilted towards the participant or user so that all components in the module can be visible and can be reached easily by simply sitting position without having to stand. Figure 3 shows the design shape of the sensor and transducer trainer learning media.

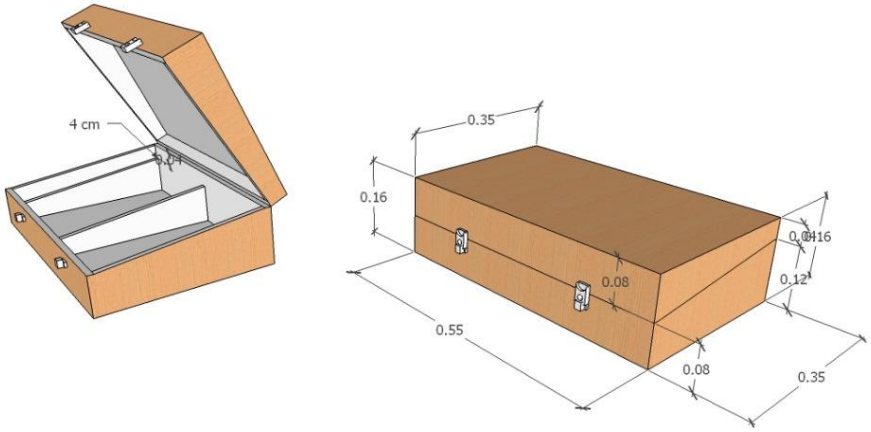

Figure 3. Box trainer design

The creation of electronic PCB design for Sensor and Transducer modules is done using one of the PCB design software. PCB design is divided into 2 layouts and PCB paths. The layout design is done by paying attention to the layout of sensor components, voltage sources, and sensor pins that will be connected to the Arduino. The placement of the input/output pin socket is performed proportionally near the sensor without obstructing the position of the sensor. This section is also given a clear description of sensor pins and voltage sources at each component input/output pin point. PCB path creation is based on the placement of the component layout, if the layout has been set in its position then the next step is to connect each sensor pin to the input/output socket and source via the PCB path.

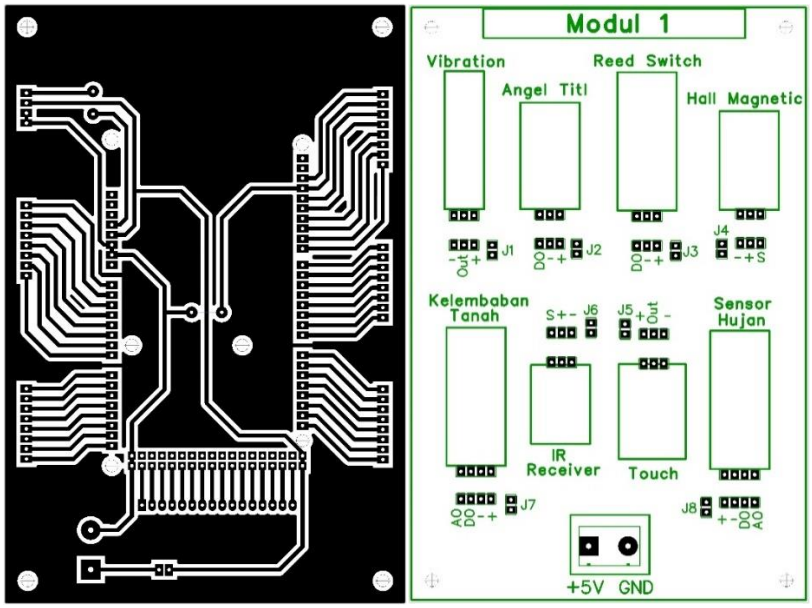

Figure 4. PCB design and sensor module layout

RESULTS AND DISCUSSION

Model trainer design

Sensor trainers and transducers are designed using one of the 3D design software. The design of trainer models is divided into 2 parts namely exterior and interior. On the exterior, the trainer surface is designed in the shape of a rectangular box with a length of 55cm and a width of 35cm. This trainer shape will facilitate the process of stacking with a certain number of restrictions. While the interior part of the trainer is made room with sealing board as well as acrylic surface holder. It is used to install a power supply and as a cable line connecting between power supply modules to all sensor modules.

Media trainer production

(a) (b)

Figure 5. Trainer interior and exterior view

After the trainer design process, it is continued with the manufacture of trainers. Based on the design of trainer models, there are 3 main parts of trainers namely Box, Trainer Board, and Electronic Circuit. The trainer box is made of multiplex material with a thickness of 9mm then made pieces as in the drawing design. The surface of the trainer box is coated with HPL (High-Pressure Laminated) material with a brownish colour. The HPL coating simultaneously protects the multiplex surface from heat and rainwater, making the trainer's durability even longer. While on the interior of the trainer is coated with white HPL so that dust dirt can be seen.

The trainer board is made of white 3mm thickness acrylic material and is located on the inside of the trainer. This trainer board functions as a PCB mount Sensor module, power supply voltage source socket, and where to store voltage value information stickers. The trainer electronic circuit is made using PCB FR4 with a thickness of 1.6mm one-sided copper coating. Each sensor module is made of PCB with a size of 15cmx10cm. On PCB surfaces are coated with stickers containing component layout images, input/output pins, and voltage sources. The description is used as information to connect with the voltage source, sensor pin function, and component name description.

Figure 6. Sensor trainer modules and transducers

Trainer testing

Sensor trainers and transducers are tested by providing a DC voltage source to each sensor module. In some types, the sensor has an indicator light indicating the action or not of the sensor. However, other sensors need to be programmed to see if they work properly or not. Such sensor testing should use the Arduino as a controller, and the LCD module as a sensor reading data viewer. If the sensor readings are in accordance with the program commands entered then it is considered that the sensor is working.

Table 1. Sensor testing

Number	Sensor name	Input Voltage (DC)	Testing	Output voltage without testing (DC)	Output voltage (DC)	Output signal
1	Vibration Sensor	5V	Vibration	0V	2V	Digital
2	Angel Titl	5V	Angle	5V	0V (LOW active)	Digital
3	Reed Switch	5V	Magnet	5V	0V (LOW active)	Digital
4	Hall Magnetic	5V	Magnet	3,5 V	0V (LOW active)	Digital
5	Soil Moisture	5V	Soil	5V	0V (LOW active)	Analog & Digital
6	IR Receiver	5V	Remote Infrared	4V	3,5V	Bergetar
7	Touch Sensor	5V	Touch	5V	0V	Digital
8	Rain Sensor	5V	Water	4,8V	0V	Analog & Digital
9	LDR	5V	Light	4,8V	0V	Digital
10	Photodiode	5V	Light	4,8V	0V	Digital
11	Flame Detector	5V	Fire	1,6V	0V	Analog
12	Speed Counter	5V	Cutting of Rx-Tx	0V	4,8V	Analog & Digital
13	PIR	5V	Motion	3,4V	0V	Digital

Based on the results of sensor testing in table 1 it appears that all sensors provide output signals in the form of digital voltage after testing. The average sensor delivers an output voltage of 0V from the normal voltage without testing of 5V. This provides information that the sensor is Low Active and must be adjusted to the defining of the Input/Output pin on the Arduino. After testing the entire sensor can be seen that all sensors can function properly.

Discussion

The design and manufacture of Sensor trainers and transducers have been carried out until the establishment of a trainer that is feasible for both students and students in practicum. The eligibility criteria of a trainer to be used as a medium is a topic of other research problems as has been done by many research development learning media such as. The average results obtained in media development research in the form of trainers get a value above 80% with a very worthy category Chandra, A. (2018).Nur, F. A. and B. Suprianto. (2017).Habibie, N. H. (2018).. The eligibility of the trainer is determined by the validation results by some media experts and the response of the results of use by students. But previously some stages had to be fulfilled that trainers had to function properly. Testing of a trainer's function is done by delivering voltage directly to the sensor module and testing the sensor's performance by combining the Arduino as its controller.

CONCLUSION

In general, the design of Arduino-based Sensor Trainer and Transducer learning media can be completed well. The trainer shape has been made according to the box design, electronic circuit, and sensor component layout. Based on the test results of the sensor module by providing a direct voltage on the module can be seen the response of the sensor when given different treatment according to the sensor type. The result is that each sensor emits both digital and analog signals in response to sensor output after outside treatment. This proves that all sensor components in this trainer can function properly. The development stage of this trainer is to add a supported controller with IoT (Internet of Things) technology so that the distance learning process can be implemented

REFERENCES

Agustio, W. (2019). "Upaya Meningkatkan Hasil Belajar Peserta Didik Melalui Penggunaan Media Trainer Monitor Televisi Pada Mata Pelajaran Perekayasaan Sistem Radio Dan Televisi Tentang Troubleshooting Monitor Televisi Kelas Xi Ea Smk Negeri 2 Kota Bogor," J. Teknol. Pendidik., vol. 8, no. 1, p. 126, doi: 10.32832/tek.pend.v8i1.1735.

Chandra, A. (2018). "Pengembangan Trainer KIT Sensor Berbasis ATMEGA32 Sebagai Media Pembelajaran pada Mata Kuliah Sensor dan Tranduser," JUPITER (JURNAL Pendidik. Tek. ELEKTRO), vol. 03, no. September, pp. 13–18.

Cikarge, G. P. and P. Utami. (2018). "Analisis dan Desain Media Pembelajaran Praktik Teknik Digital Sesuai RPS," Elinvo (Electronics, Informatics, Vocat. Educ., doi: 10.21831/elinvo.v3i1.20509.

Fivia, Eliza and Dwoprima Elvanny Myori. (2017). "Trainer pada Pembelajaran Dasar dan Pengukuran Listrik," J. Teknol. Inf. Pendidik. VOL. 10 NO. 1 April 2017 ISSN 2086 – 4981.

Habibie, N. H. (2018). "Media Pembelajaran Trainer Sensor Dan Transduser Pada Mata Pelajaran Dasar Kompetensi Kejuruan Kompetensi Keahlian Teknik Audio Video Di Smk Negeri 1 Pundong," vol. 7, no. 2, pp. 1–6, 2018.

Hanifah, S. B. and E. Yundra. (2019). "Pengembangan Trainer Penghitung Digital Dua Digit Pada Mata Pelajaran Penerapan Rangkaian Elektronika Di SMK Negeri Sidoarjo," J. Pendidik. Tek. Elektro.

Ibrahim, M., M. Nur, and K. A. (2010). Dasar-dasar proses belajar mengajar. Surabaya: Unesa University Press.

Jefiza, A., F. Okmayura, and R. W. Novchi. (2019). "Penggunaan Media Pembelajaran 'Trainer Arduino' Untuk Meningkatkan Kemampuan Guru Smk Di Pekanbaru," War. LPM, vol. 22, no. 2, pp. 86–97, doi: 10.23917/warta.v22i2.8778.

Marwanto, D. and A. P. Budiono. (2016). "Rancang Bangun Trainer Berbasis Arduino untuk Menunjang Mata Kuliah Instrumentasi Kendali di Universitas Negeri Surabaya," JPTM.

Nur, F. A. and B. Suprianto. (2017). "Pengembangan Trainer Kit Sensor Berbasis Arduino sebagai Media Pembelajaran pada Mata Pelajaran Teknik Pemrograman di SMKN 1 Jetis," Pendidik. Tek. Elektro.

Setiawan, A. L. and N. Yuniarti. (2017).“Pengembangan media pembelajaran trainer kit sistem pengendali elektromagnetik,” Prodi Pendidik. Tek. Elektro.

Suryania, F., M. Sukardjo, and M. Yusro. (2019). “Perancangan Trainer Mikrokontroller Sebagai Media Pembelajaran untuk Meningkatkan Nilai Perekayasaan Sistem Kontrol pada SMK,” JINoP (Jurnal Inov. Pembelajaran), doi: 10.22219/jinop.v5i2.7701.

Susilo and Suyitno. (2017). “Pengembangan Media Pembelajaran Trainer Kelistrikan untuk Meningkatkan Hasil Belajar Siswa SMK Muhammadiyah Kutowinangun,” J. Pendidik. Tek. Otomotif_Universitas Muhammadiyah Purworejo, vol. 10, no. 01, pp. 77–82, 2017.