Circuit: Jurnal Ilmiah Pendidikan Teknik Elektro
Volume.7 No. 2 March-Agust 2023
ISSN: 2549 – 3698; E-ISSN: 2549 – 3701
DOI: 10.22373/crc.v7i1.13632

The Design of IoT Based Lighting Installation Tools in Electrical Installation Engineering and Microcontroller Systems Courses

Kurniawan[a], Sri Wahyuni[b], Mursyidin[c]
[a,b,c] Universitas Islam Negeri Ar-Raniry Banda Aceh

E-mail: Ajawawan140@gmail.com

Submitted: 31-10-2022 Accepted: 03-04-2023 Published: 10-08-2023

Abstract

Internet of Things (IOT)-based lighting installation development Since teaching aids are an exact science, it is essential to have a tool that can depict the subject covered in the Electrical Installation Engineering course. The teaching tools created are meant to help lecturers better present the topic for electrical installation engineering to their students while also making it simpler for them to comprehend. In order to turn on and off lights and outlets using a smartphone and a manual switch in the event that the wifi network is damaged, this study added Internet of Things (IOT) installation procedures and a swap switch. The Research & Development approach is being used in this investigation. A validation sheet is created by planning and creating research instruments, which is what is done to test the viability of instructional aids by professional validators. According to the results of expert validation, this teaching tool is appropriate for use with media and material experts based on the percentage values of media expert 1 receiving a score of 94.28% and media expert 2 receiving a score of 97.14%, and for material expert 1 receiving a score of 90% and material expert 2 receiving a score of 92%, with the category "Very Eligible".

Keywords*: Props, Lighting Installation, Internet of Things*

Abstrak

Pengembangan Alat Peraga Instalasi Penerangan berbasis *Internet Of Things* (IOT) merupakan ilmu pasti sehingga pada mata kuliah Teknik Instalasi Listrik perlu adanya suatu alat yang dapat memvisualisasikan materi Teknik Instalasi Listrik. Alat peraga yang dikembangkan ini bertujuan untuk alat bantu bagi dosen pengajar dalam menjelaskan konsep materi Teknik Instalasi Listrik juga untuk memudahkan mahasiswa dalam memahami konsep materi instalasi listrik. Pengembangan Alat peraga dalam penelitian ini dengan menambahkan teknik instalasi *Internet Of Things* (IOT) dan saklar tukar untuk menghidupkan dan mematikan lampu/stop kontak menggunakan Smartphone dan secara manual menggunaakan saklar tukar jika tidak stabil jaringan internet *wifi*. Penelitian ini menggunakan metode research & Development dengan merancang dan membuat instrumen penelitian yang dilakukan adalah lembar validasi untuk menguji kelayakan alat peraga oleh ahli validator. Hasil validasi ahli menunjukkan bahwa alat peraga ini layak digunakan dari segi Ahli media dan materi berdasarkan persentase nilai ahli media 1 memperoleh nilai 94,28% dan ahli media 2 memperoleh 97.14%, dan untuk ahli materi 1 memperoleh 90 % dan ahli materi 2 memperoleh 92%, dengan kategori ”Sangat Layak”.

Kata kunci: Alat Peraga, Instalasi Penerangan, Internet of Things

Introduction

Every human being must keep up with the advancement of technology in order to avoid falling behind. One such example is the internet of things (IoT), which fosters the growth of technology that is crucial to modern human existence. It is highly recommended to apply and teach the internet of things (IoT) to the next generation through the application of IOT teaching aids in schools or colleges in order to develop the capabilities that they have. One such application is making a lighting installation teaching aid that has been designed or supported by technology and controlled via a smartphone in the classroom. Therefore, it is crucial to have teaching tools that facilitate collaboration between specific lecturers and students in order to achieve an emphasis on understanding the material in order to achieve the continuity of the learning cycle in Electrical Installation Engineering and microcontroller systems.

The findings of online questionnaires administered by the researchers' Google Form revealed that many Electrical Engineering Education students who had taken the Electrical Installation Engineering course believed that it was crucial to have teaching aids in this subject. The average justification for this belief was that the material is difficult to comprehend. Regarding some earlier studies on electric lighting fixtures or domestic electrical installation components. A research of " Building information modeling for sustainable design and LEED® rating analysis," by [1], was created as the final project for the Mechatronics Department at the Polytechnic of Malang City. By including an exchange switch that allows one light to be turned off from another location, this teaching tool illustrates the installation of a complete electrical installation. A research of " Design and Fabrication of Smart Home With Internet of Things Enabled Automation System," by [1] designed to finish the department of industrial engineering's final project. This tool is designed to accelerate technological advancement in the area of installing lighting in homes. Which is where a smartphone may be used to turn on and off lights and electronic devices at home. The findings of [2] study, "Miniature electrical installations to increase student understanding," indicate that the two classes, namely classes without media and classes with media, have different average values. that the inclusion of tiny media improves students' comprehension.

The research will differ from other studies in that it won't just simulate a lighting installation powered by the Internet of Things (IoT), where a number of instructional aids may be managed via a smartphone. However, the researchers also incorporated an exchange switch into a number of lighting fixtures in this investigation. To solve the issue of a downed WIFI network, an exchange switch was built, rendering a number of lighting installations, such as lights and outlets, inaccessible to smartphone control. The lights and sockets can now be manually turned on and off thanks to an exchange switch. The final section of this study focused on "Design of Internet of Things (IoT)-Based Lighting Installation Tools in Electrical Installation Engineering and Microcontroller Systems Courses" [3]. Designing and implementing an Internet of Things (IoT)-based lighting installation toolkit can speed up learning, enhance the effectiveness of

instruction, and inspire lecturers' creativity when it comes to fostering a learning environment.

Methodology

Research-Based Development (R&D) or research-based development, which refers to research techniques used to create certain goods and evaluate their efficacy, is the research paradigm employed in this study. [4] provides a systematic overview of the processes the researcher used to ensure that the product he produced meets an eligibility requirement in the development model. Because the research was only intended to examine the viability of an Internet of Things-based lighting installation teaching tool in the Electrical Installation Engineering course, it was only used up until the product validation stage.

The absence of internet of things (IoT)-based teaching resources in the Electrical Installation Engineering course is the possible issue that is examined in the first step [5]. The first step taken to get information and data is to post a link to a google form questionnaire filled out by Electrical Engineering Education level 18 who have taken electrical installation engineering courses. The second stage collects data from observations and literature studies. Information gathered from observations about the need for teaching tools in current electrical installation engineering courses. 92.9% (13 people) of those who participated in the observation said it was crucial to have teaching aids for this subject because, on average, it was difficult to understand because it was just theory and an overview of electrical installation circuits; however, if there were props, it would be simpler for us to understand; only 7.1% (1 person) said it was not crucial. Then look for reading materials pertaining to the issue at hand, such as library books, articles, websites, and others, assisted by consulting programmers. The final stage is designing, which combines the circuits for each block to create the instructional aids as a whole. The ESP8266 functions as the Arduino Uno's control center, processing incoming data and generating output commands. The Blynk application is unable to instruct the relay to turn lights or sockets on or off if there is a WiFi network interruption due to the use of an exchange switch [6]. Because the exchange switch's operating system is identical to the relay's, which has 1 input and 2 outputs, it may be projected onto the relay as shown in Figures 1 and 2. This design requires the usage of an exchange switch.

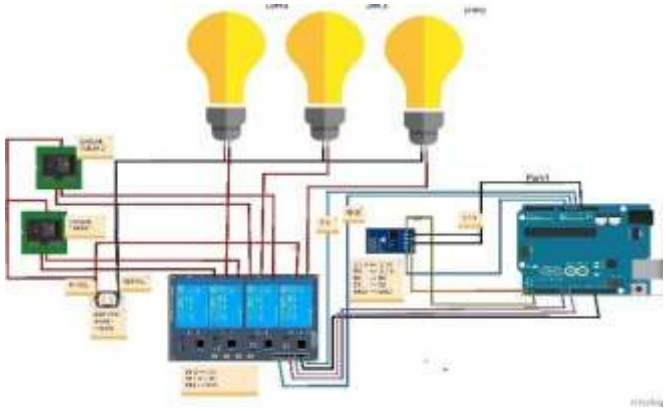

Figure 1. The Overall series of Internet of Things (IOT) Based Lighting Installations

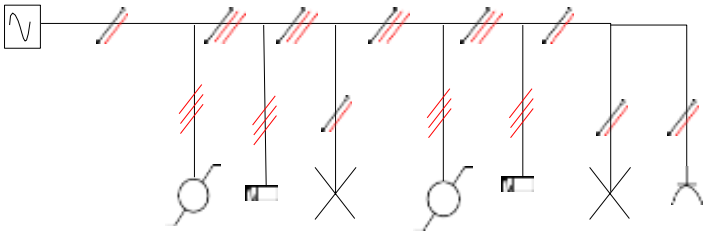

Figure 2 Single Line Diagram of the Relay Module and Exchange Switch

Programming configuration is very important for what is sent from a smartphone to Arduino which is used as a command to turn on and turn off lights, fans or other electrical equipment. In this study, the products used in assembling Internet Of Things-Based Electrical Equipment Using Microcontrollers include: Arduino IDE 1.8.6: This software application is used to create coding programs. We can see in Figure 3.

Figure 3. Coding in the Arduino IDE Software

The on/off lights that have been designed are controlled via the Android app BLINK. To connect to the Arduino program, we first create a mydevice project in the blynk application [7]. After that, we create three ON/OFF buttons to control the lights on the props, as seen in figure 4.

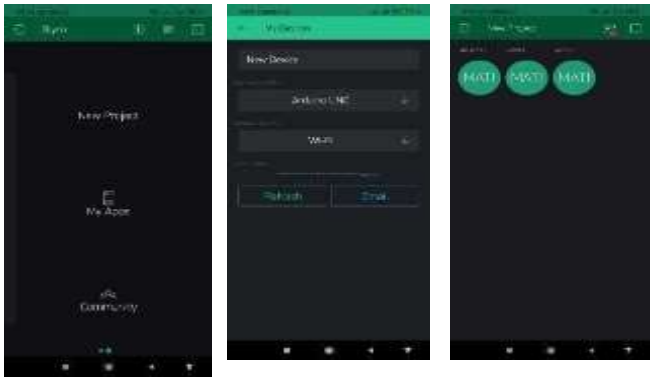

Figure 4. Display of Control Devices in the Blynk Application

In designing an Internet of Things (IOT)-based lighting installation, a workflow is first created. For more details, we can see the Flowchart in Figure 5.

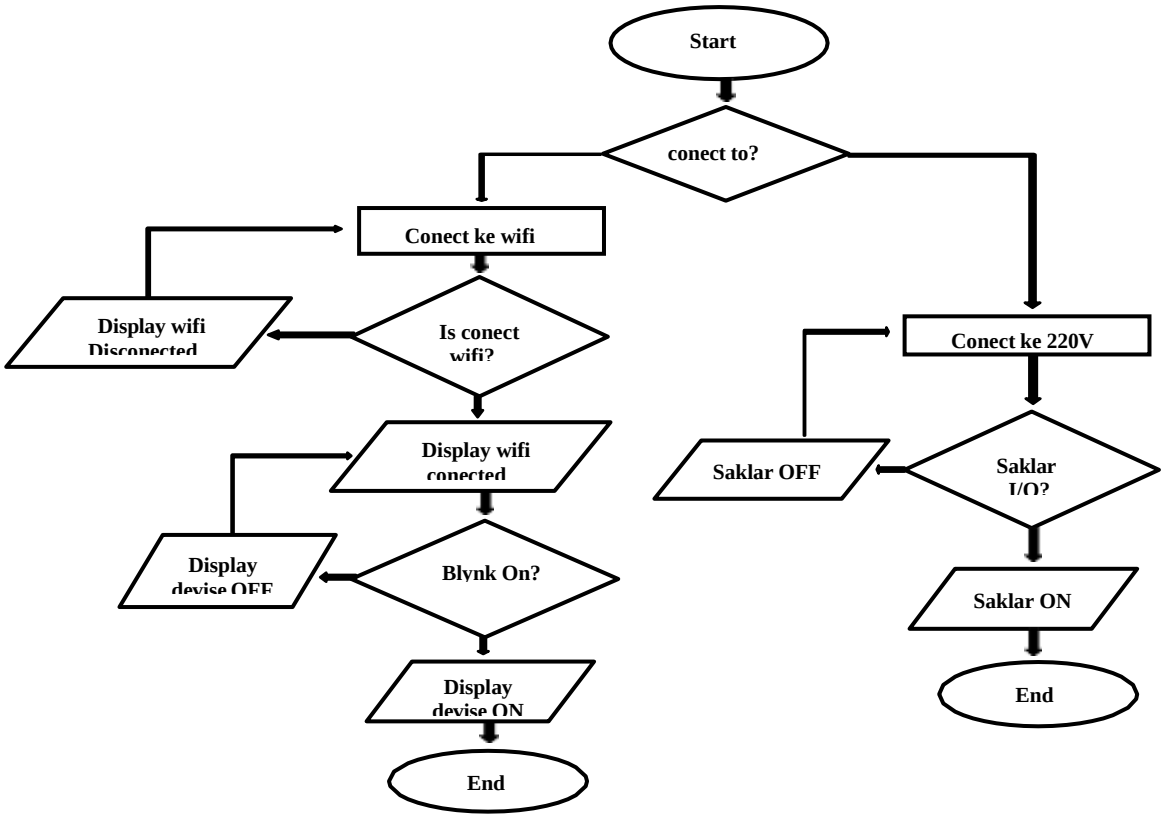

Figure 5 Flowchart of Internet of Things (IoT)-Based Lighting Installation Workflow

Media experts and material experts must conduct the fourth stage of validating the teaching aids to determine their viability. The implementation of this study took place from May 2021 to November 2021 on the campus of the Ar-Raniry Banda Aceh State Islamic University. The goal of validation is to assess a teaching aid's viability in terms of the materials and media that have been created before being utilized as a teaching aid. In this study, the validation sheet was a tool, and respondents who completed it included material and media experts. Of the five alternative answer criteria,

the expert provided a checklist for one of the values. The validation sheet in this study used a Likert scale measurement to determine the results of expert perceptions with answers ranging from very appropriate to very inappropriate for a teaching aid. alternative standards of evaluation for scale responses. likert on the validation instrument and the meaning of each score can be seen in Table 1.

Table 1. Scores for Answer Criteria and Research Validation Assessment

Answer criteria	**Criteria Value / Score**
Very Worthy	5
Worthy	4
Neutral	3
Not feasible	2
Very Unworthy	1

Regarding the expert validation sheet, it was used to determine whether instructional aides were media and material-compatible.

Researchers conduct prop presentations before material experts and media experts while handing out validation sheets to each expert as a tool for feasibility testing in terms of material and media teaching aids for lighting installations based on the Internet of Things (IoT). This is done in order to analyze expert validation data collection techniques. In order to determine the validity of a teaching aid from the responses of respondents, the total score of the answers obtained divided by the total score of the maximum answers set will be used in a descriptive analysis of the respondents' answers to determine the feasibility of the props. Based on the percentage level of responses in table 2, the categories of expert validation results were determined.

Table 4. Eligibility Percentage Category

Category	Percentage (%)
Very Decent	81 – 100
Decent	61 – 80
Neutral	41 – 60
Not Worth	20 – 40
Very Inadequate	0 – 20

Result and Discussion

After conducting study, the researchers created a lighting installation tool based on the internet of things (IoT), which combines the circuits previously outlined. This created teaching tool can be used in microcontroller system courses, specifically in the topic "input and output," and electrical installation engineering courses, namely in the material "electrical installation design," as shown in Figure 6.

Figure 6. Internet Of Things (IOT) Based Lighting Installation Tools

Validation is carried out with media experts with the aim of obtaining information, criticism, and suggestions from or validators regarding the feasibility of Internet of Things (IoT)-based lighting installation technique teaching aids so that they meet the feasibility test in terms of media and can be developed into quality teaching aids. from a media standpoint. The validation of the media in teaching aids by media experts 1 was tested by a Lecturer at the Negri Ar-Raniry Islamic University Banda Aceh, whose name was Muhammad Ihsan S.T, M.T. he has a background as a Lecturer in the field of Electrical Engineering Education. Meanwhile, media expert 2 was tested by a Lecturer at the Negri Ar-Raniry Islamic University Banda Aceh named Akbarul Kautsar M.Pd. he has a background as a Lecturer in the field of Electrical Engineering Education.

Media experts' endorsement of instructional tools in the media On November 12, 2021, face-to-face 1 was completed. media experts' endorsement of instructional tools in the media On November 15, 2021, face-to-face 2 was completed. As shown in table 5.

Table 5. Results of Validation Test of Media Expert 1 and Media Expert 2

No	Indicator	Butir Pernyataan	Score		Total
			Expert 1	Expert 2	
1	General View	The shapes of the props are both interesting in terms of color and others.	4	4	8
		The props are of the appropriate size	5	5	10
		The displayed props can present the concept of material	5	5	10
2	Practical	The tools and materials used are simple	5	5	10
		The tools and materials used are easily available	5	5	10
3	Quality	Props have long term durability	4	5	9
		Props are simple and easy to manage	5	5	10
		Total	33	34	67
		Percentage			95,71%

Recap The results of the media expert validation based on table 5 show the total score obtained is 65, with a maximum total score of 70 obtaining an eligibility percentage of 95.71%, the media expert's validation of the eligibility of teaching aids in terms of media is also in the "very feasible" category.

Then, two material experts whose aim is to obtain information, criticism, and advice from experts or validators regarding the internet of things (IoT)-based lighting installation engineering material that meets the feasibility test in terms of material and can be developed into quality teaching aids in terms of material. Two Material validation expert of lecturer Muhammad Rizal Facri, S.T, M.T and Raihan Islamadina, M.T., has tested the props on November 9 2021. Table 6 displays the findings of the validation test conducted by Material Experts 1 and 2. Table 6 summarizes the results of the material experts' validation, which yielded a feasibility percentage of 91% and a total score of 91 out of a possible 100. The media expert's validation of the eligibility of teaching aids in terms of media also fell under the "Very Eligible" category. In this investigation, the researchers ran an experiment with two stages, the first of which involved 10 trials of utilizing the Blynk application to manage the lighting system. The second test uses exchange switches with 10 trials to control lighting fixtures like lamps. This experiment's goal is to determine how long it takes to turn on and off lights when utilizing the Blynk app and the exchange switch, as shown in table 7.

Table 7. Experimental Results Controlling Lighting Installations Using the Blynk Application and Exchange Switches

No	Testing Using the Blynk Application		Testing Using Exchange Switch	
	Testing	Delay	Testing	Delay
1	Testing-1	2 Second	Testing -1	0.1 Second
2	Testing-2	0.5 Second	Testing-2	0.1 Second
3	Testing-3	0.2 Second	Testing -3	0.1 Second
4	Testing-4	0.1 Second	Testing -4	0.1 Second
5	Testing-5	0.5 Second	Testing -5	0.1 Second
6	Testing-6	0.1 Second	Testing -6	0.1 Second
7	Testing-7	1 Second	Testing -7	0.1 Second
8	Testing-8	0.5 Second	Testing-8	0.1 Second
9	Testing-9	0.1 Second	Testing-9	0.1 Second
10	Testing-10	0.2 Second	Testing-10	0.1 Second
	Max delay	2 Second	*Max delay*	0.1 Second
	Rata rata	0,4 Second	Rata rata	0.1 Second
	Min delay	0.1 Second	*Min delay*	0.1 Second

After testing 10 times of controlling using Blynk and an exchange switch, the longest time to turn on the lights using the blynk application controller is 2 seconds, the fastest time is 0.1 seconds, and the average time needed is 0.4 seconds. Meanwhile, if controlling the lights using an exchange switch, the average is only 0.1 seconds. This study aims to design and develop an internet of things (IoT) based lighting installation aid using the Research and Development (R&D) research model. In addition, this research also aims to develop valid and practical internet of things (IoT)-based teaching aids. The data obtained from the expert validation results shows the percentage of eligibility of teaching aids in terms of material and media.

The results of media validation by media expert 1 obtained a value of 94.28% and media expert 2 obtained a value of 97.14%, with the final results of the validation of the two media expert validators obtaining a value of 95.72, while the results of material validation by material expert 1 obtained a value 90% and material experts 2 get a score of 92%, with the final validation results of the two media expert validators getting a score of 91%. According to [8], the author of the book "quantitative research approach" categorizes the eligibility of props ranging from 0% - 20% in the "Very Ineligible" category, 20% - 40% "Not feasible", 40% - 60% “Neutral”, 60% - 80% “Fair”, 80% - 100 % “Very Eligible”. In terms of material and media the feasibility of the Internet of Things (IoT)-based Lighting Installation Toolkit is "Very Feasible. From the results of the expert validation of the feasibility of teaching aids, it was explained that in terms of the media, the teaching aids were also in accordance with the literature review of teaching aids, especially the characteristics of teaching aids in terms of teaching aids material, in accordance with the literature review starting from the technique of installing electrical installations.

Employing the blynk application controller and exchange switches to test internet of things (IoT)-based lighting installation products. Blynk, according to [9], is a brand-new platform for creating user interfaces for managing and keeping an eye on hardware projects from iOS and Android mobile devices. Because using the blynk application is so reliant on an internet connection, the results of tests using the blynk application control show that the delay time varies. For best results, utilize a fast, reliable internet connection. Alternatively, if the internet connection is erratic, there will be a delay in the lights going on, and you might not be able to control the lights using the Blynk application if the internet network does not permit it. While using an exchange switch, you merely physically detach and reconnect the electricity, therefore there are no barriers or delays.

Conclusion

It is important that if the internet connection is lost, you can manually turn on and off the lights using a swap switch. This is why designing teaching aids based on the internet of things (IoT) and projecting exchange switches on the circuit makes the circuit more complete than previous research. Depending on the state of the internet connection speed, different delays are tested when turning on and off the lights. The direct current is linked manually, thus if you use an exchange switch to manually turn on and off the lights, you may claim that it won't be impacted by an internet connection.

Four expert lecturers separated the validation testing into two parts: media validation by two expert validators, and material validation by two expert validators. The final validation results of the two media expert validators obtained a value of 95.71. In contrast, the results of the material validation by expert material 1 obtained a value of 90% and expert material 2 obtained a score of 92%, with the final validation results of the two media expert validators obtaining a value of 91%. Therefore, Internet of Things (IoT)-based Lighting Installation Tools are "Very Feasible" in terms of material and media practicality.

The researcher advises adopting internet of things (IoT)-based lighting installations once the research is complete and the viability of the IoT-based lighting installation concept has been tested. Utilizing a quick and reliable internet connection to get the best results, followed by testing this teaching tool on students enrolled in the Electrical Installation Engineering course to determine whether it actually aids students in understanding the course material.

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