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Empowering Human Resources through Digitization and IoT Training: Development of Remote Home Lighting Control System Using IoT

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Abstract

Purpose: This research paper focuses on the empowerment of teenagers in the Renggong hamlet through the development of a remote home lighting control system using IoT technology. The study addresses the implementation process, teenage responses, and the impact on their quality of life, shedding light on the significance of technology in their daily lives.

Method: The method used a qualitative approach. The study conducted surveys during outreach in the Renggong hamlet. The research design involved the development of an IoT-based lighting control system, with data collected through participant responses and engagement. Qualitative analysis techniques were utilized to interpret the findings.

Practical Applications: The research demonstrates practical applications of IoT, enhancing teenagers' awareness and skills. Its insights benefit education, technology, and community development programs, facilitating digital empowerment.

Conclusion: This study highlights IoT's transformative role in promoting digital literacy and skills among youth. Its findings enrich our understanding of technology's potential, benefiting educational and community initiatives significantly.

Introduction

Real Work Lecture (Kuliah Kerja Nyata or KKN) is an activity where students interact with their local communities. It stems from students' interest in contributing to the development process involving various disciplines like technology, agriculture, economics, and law (Wora et al., 2022). The goal is to apply this knowledge to enhance rural living standards. KKN assists communities in utilizing local natural resources and human potential to address specific challenges within a set timeframe (Dwimawati et al., 2019). In today's globalized era, technological proficiency indicates a nation's progress. Nations with high technology adoption rates are considered advanced, while those struggling to adapt are often seen as lagging (Laksono & Muharam, 2021) (Kadi & Awwaliyah, 2017). With the rapid development of information technology, electronics have become increasingly sophisticated, including recent advancements in the Internet of Things (IoT) (Vaishnavi & Manhar, 2020). IoT enables interconnected physical devices to communicate, offering substantial benefits. This technology is applied to creating smart homes controlled through smartphones, enhancing efficiency, automation, security, and energy conservation (Rokonuzzaman et al., 2022) (Ahdan & Susanto, 2021).

Digitalization integrates digital technology into various aspects of life, such as business, education, governance, and public services. IoT, a pillar of digital technology, connects physical objects, opening new opportunities for data collection and analysis aiding better decision-making. Empowering human resources through digitalization and IoT training is crucial in facing these changes (Anggraeni, 2020). IoT's role extends beyond convenience; it revolutionizes our interactions with the world, enabling innovative solutions like remote home lighting control via Android applications. Using tools like MIT App Inventor, users without programming backgrounds can create applications, facilitating seamless control of electronic devices through the Internet (Dewi & Fikri, 2023).

Youth and the internet represent resources with both positive and negative potential. Therefore, they must be managed effectively to avoid harm (E. Z. L. Astuti, 2019). With appropriate understanding and training, community groups and rural youth can develop the skills necessary to contribute to the development and implementation of IoT technology. This training not only transforms how we interact with devices but also opens our eyes to numerous opportunities across various fields and sectors in society. A deep understanding of IoT is key to enhancing human resources' quality in facing challenges and opportunities in our increasingly connected world. It is expected that youth use internet technology wisely, not just for entertainment but also for productive and constructive activities in building their communities, thereby avoiding the negative impacts of technology use (Astuti & Subandiah, 2020).

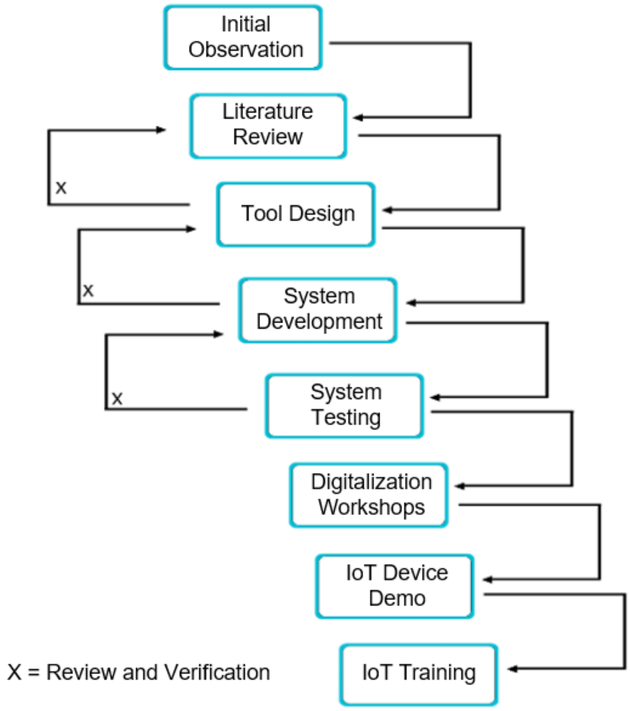
In this article, we will identify the impact of IoT technology training on community development and explore IoT's potential role in education and technology awareness in our increasingly digitalized society. Through careful research, we will delve deeper into How IoT training, specifically using automatic lighting control systems via intelligent apps, can enhance human resources' skills and understanding in implementing IoT systems across various sectors of society. How can we trigger public awareness regarding the importance of technological education through digitalization and IoT training?

Method

This article's method combines qualitative analysis with practical training to explore the positive impacts of digitization, specifically IoT technology, on rural populations. Beginning with initial observations and data collection, literature reviews, tool system design, system development, and Android and IoT-based system testing are conducted. If errors are detected during testing, the process reverts to the previous stages (Akbar et al., 2022). Once the materials and systems are completed successfully, digitalization workshops and IoT device demonstrations are organized. The final phase involves training rural youth in IoT Control

System design.

Figure 1. Research Workflow



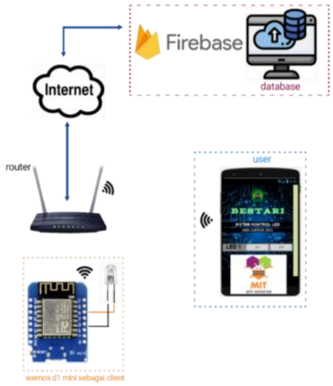
The first step in this research involves initial observations in a hamlet in Cijeruk village. These observations aim to identify issues related to technology usage and the implementation of technology, particularly IoT related to home lighting control. Our team collects data on the extent of technology penetration in the hamlet, the operation of home lighting systems, challenges faced by residents in controlling their lights, and their understanding of IoT concepts.

After identifying the initial issues, our team searched for relevant references, materials, and data on technology and digitization, including IoT concepts and remotes in lighting control system design. It involves reading articles, literature, and books related to the research topic (Alfianti & Purbaningtyas, 2022).

The next stage of this research involves designing a remote home lighting control system using intelligent apps with IoT. This system will be used as a demonstration tool for IoT devices and as a training platform for device design. The system will utilize IoT components (hardware and application programs) and the creation of an Android application system using MIT App Inventor.

a. Circuit Diagram

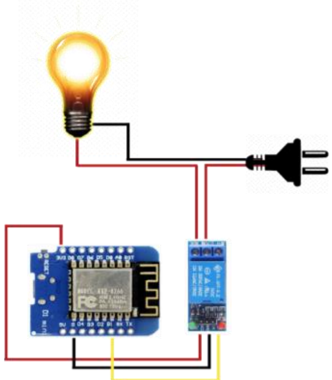
Figure 2. Network Topology



In the system of the device developed in this research, there is an IoT system comprising various components of hardware and software. The schematic will employ the esp8266 module, specifically the Wemos D1 Mini, as the microcontroller equipped with Wi-Fi features. The Wemos D1 Mini will connect to a router linked to the internet. Program code will be written in the C programming language using Arduino IDE and uploaded to the Wemos board. The Wemos D1 Mini board will retrieve real-time data from Firebase to determine the status of the home lights, whether they are on (HIGH/1) or off (LOW/0) (Agung et al., 2020).

Users can control the lights via an Android application created using MIT App Inventor. Even when users are away from home, they can still control the home lights utilizing internet connectivity. Through the available application, users will send instructions to turn the lights on or off to Firebase. In real-time, this data will be retrieved by the microcontroller, issuing commands to the home lights to turn on or off (Akbar et al., 2022).

Figure 3. Network Topology



The hardware design itself requires several components for both input and output. These include the Wemos board as the microcontroller, a relay used as a switch that provides voltage input to the lamp, a 220-volt AC power source, and the lamp as the load. As seen in the above diagram (Figure 3), the wiring connections will be as follows:

1. Wemos Vcc pin to relay Vcc pin
2. Wemos ground (GND) pin to relay ground (GND) pin
3. Wemos digital pin D1 to relay input pin
4. Neutral wire to fitting (body)
5. Phase wire to relay NO (Normally Open) input
6. Relay NO output to fitting (coil)

b. Application Design

Figure 4. Login screen design on MIT App Inventor

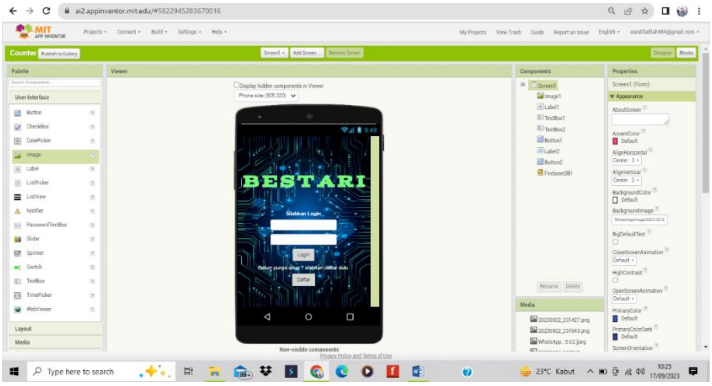
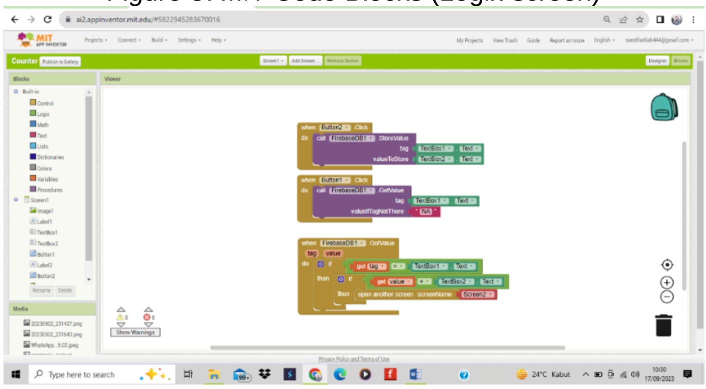


Figure 5. MIT Code Blocks (Login screen)



On the application's first page, a user security system will be implemented, namely a login screen designed as shown in Figure 4 above. It will be configured with Firebase and coded as depicted in Figure 5. Users will be directed to register first to access the main screen.

Figure 6. Main screen application design on MIT App Inventor

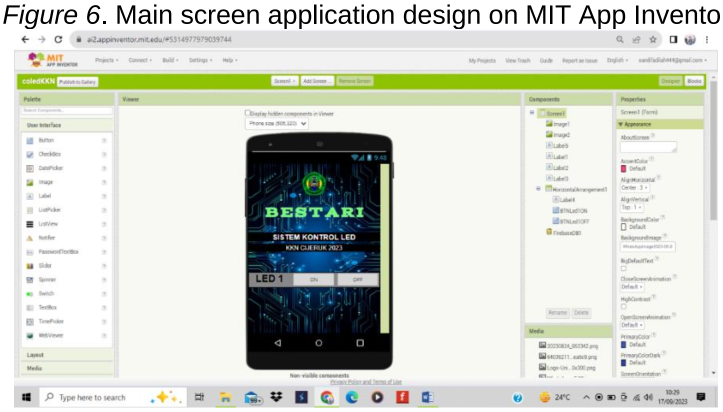
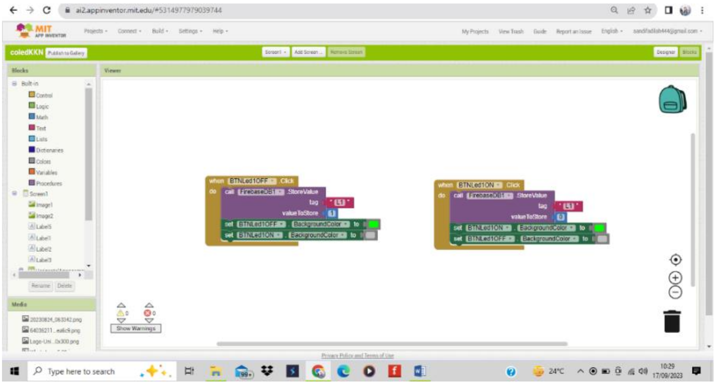


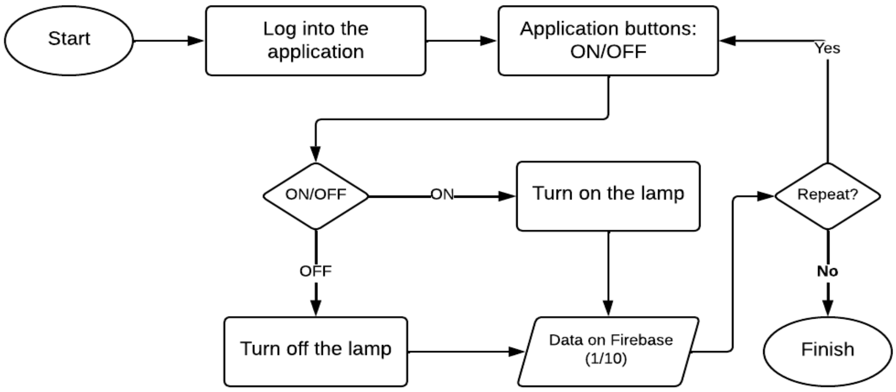
Figure 7. MIT Code Blocks (Main screen)



The main screen features two buttons, ON and OFF, as shown in Figure 6. These buttons will be configured with Firebase and coded as displayed in Figure 7. When a user presses the buttons, the commands will be sent to Firebase, instructing the lamp accordingly.

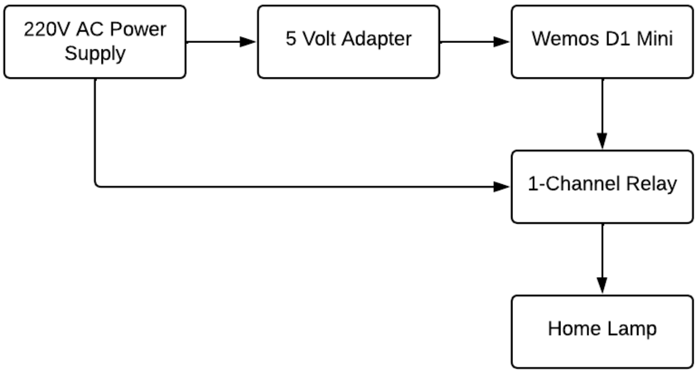
c. Flowchart

Figure 8. Flowchart of the Android application program



In the application program, there are two interfaces. When users access the application, they will be directed to the login screen and must register first. After registration, users will be directed to the main interface, where they can control the lamp using the available buttons. Pressing the buttons will send commands through Firebase to turn on the lamp (ON button) or turn off the lamp (OFF button).

Figure 9. Flowchart of the IoT system hardware



Regarding the electronic components, as seen in Figure 9, the circuit requires two voltage sources to operate. A 220-volt AC power source will be transmitted to the relay, providing input to the lamp. Additionally, a 5-volt DC power source will be supplied by an adapter to operate the Wemos D1 Mini for data processing. The Wemos will then send command values to the relay.

After completing all the preparatory processes, an awareness session was conducted for the residents, especially the youth, about digitization in general. The youth play a crucial role in digitization, given their familiarity with technological advancements. Initially, the internet simplified access to information across different places and times. This progress became evident through social media, digital applications, and the shift of activities into technology. Explanations were provided on how digital technology has transformed the world, emphasizing the importance of adopting technology to support digitization in Indonesia, considering it a crucial aspect (Roziqin et al., 2022). This session aimed to establish a fundamental understanding of digitalization technology among the youth.

In the next step, the research team will demonstrate the IoT device designed to control home lighting remotely. This demonstration will provide a direct overview of how this technology functions and how it can simplify home lighting control. It will help the villagers understand the potential of IoT in addressing their challenges.

The core of this method involves training the village youth in designing and implementing remote home control systems using IoT. The training will cover understanding IoT components, hardware programming, and necessary software configurations. During the training, participants will have the opportunity to practice designing their own IoT control systems.

Result

The outcome of how the previously designed remote home lighting control system operates will be demonstrated through the testing results presented in the table below:

Table 1. ON Button Testing

ON Button Status: Illuminated	Lamp Condition	Data in Firebase

		https://control-led-a7c34-default-rtdb.firebaseio.com/ COLED L1="1

When the ON button in the Android application is pressed, the button, originally gray, changes to green. Pressing the ON button sends information to Firebase, changing the value of the lamp (L1) to high (1). The Wemos D1 Mini retrieves the high data on Firebase to command the lamp to turn on.

Table 2. OFF Button Testing

OFF Button Status: Illuminated	Lamp Condition	Data in Firebase
		https://control-led-a7c34-default-rtdb.firebaseio.com/ COLED L1="0"

Conversely, when the OFF button in the application is pressed, it informs Firebase, changing the value of L1 to LOW (0). The Wemos execute this data to turn off the lamp. We conducted several comparisons by posing questions to the participants during both the awareness session and the training. Participants, initially having limited understanding of digital technology and IoT, showed improved comprehension, as demonstrated in the data below.

Table 3. Percentage of Correct Answers

Questions	Correct Answers	
	Awareness Session	Training
Positive Impact of Using Mobile Phones?	30 %	80 %
Negative Impact of Using Mobile Phones?	50 %	80%
Examples of Technologies Around Us?	30 %	80%
What is the Internet?	10 %	50 %

What is IoT (Internet of Things)?	0 %	50 %
What components are used in the smart home system project?	10 %	60 %
Why can home lights be controlled through the application?	0 %	40 %
Is IoT only used for controlling home lights?	0 %	80 %

The above percentage is determined based on the accuracy of participants' answers to questions posed by the facilitator. During the training session, participants were able to design and implement remote home control systems using IoT with a success rate of 80% when guided directly by the facilitator. They demonstrated a success rate of 50% when designing the system independently.

Discussion

The establishment of a remote home lighting control system using IoT technology has significantly piqued the interest of young people in the presence of digitalization technology. Notably, using home lighting as the research object has made participants more enthusiastic because lighting is an integral part of their lives. With automation controlling the lights, they are eager to create similar setups. The familiarity with the internet and smartphones in their hands makes this smartphone-controlled lighting project very accessible for them.

Understanding technology and digitalization can be accelerated through direct awareness sessions and training. A comprehensive understanding of digital technology, especially IoT, lays a robust foundation. Participants can explore their capabilities in technology and create innovations in digital technology. Creating questionnaires about technology, digitalization, and IoT for participants before and after the awareness sessions and training provides a comparison of the participants' increased understanding of the discussed topics. This reveals the success achieved through the provided awareness sessions and training.

Through hands-on practice with IoT devices during training, participants learn how IoT systems operate in household lighting. With the skills acquired through the training, participants not only gain the ability to address home lighting needs but also have the opportunity to develop other IoT solutions tailored to their requirements. This positions them as potential pioneers of digitalization in their villages.

Conclusion

In this study, starting from initial observations to IoT system design training, we conclude that technological advancements play a crucial role in enhancing human resources quality. The active involvement of rural youth is essential to usher in a new era of digitalization in villages. Rural youth should become pioneers, initiating significant changes through digitalization. They can develop their skills and abilities, shifting from mere subjects to proactive agents of change.

Through awareness sessions on technology and digitalization, rural youth enrich their understanding of technology, exploring how it can transform their interactions with technology and their environment. Practical training in designing remote home lighting control systems empowers youth to harness the full potential of this technology. The research results demonstrate that IoT training enhances participants' understanding and skills, leading to increased energy efficiency and improved quality of life. Remote home lighting control systems bring comfort, ease of use, and potential for further development.

However, we must acknowledge the potential technical challenges in implementing IoT technology in rural areas. Device compatibility, cybersecurity, and system maintenance need attention to ensure project sustainability. This article underscores the importance of education and training in facing technological advancements. It is a crucial step in empowering human resources, particularly in rural areas. Through continuous efforts and solutions to challenges, we can embrace these changes more effectively, creating a brighter future for all.

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We want to express our gratitude to all those who sincerely contributed to this research. With their support and cooperation, this research was possible. We want to extend our thanks to the villagers who participated in the training and partnered with us in implementing IoT technology. Your cooperation and enthusiasm in embracing technological change are vital to the success of this project. To our field supervisors and the entire research team who worked diligently in designing, testing, and integrating the remote home lighting control system based on IoT, thank you. Your teamwork and dedication made all the tasks more manageable, ensuring the successful implementation of the project as intended.

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