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Training For Selection of Internet of Things Devices as A Media For Remote Information Sender For Vocational School Teachers and Students

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ABSTRACT

Selection of devices for IoT needs can be determined based on the range from the shortest to the furthest, and on the internet access or Wi-Fi availability, which can be considered in advance and adjusted to the needs. In line with this, a training was carried out at SMKN 1 Cimahi, involving several groups of experts in the Electrical Engineering family to open insight and understanding regarding the needs of devices that can be used to build internet-based or IoT systems. This training also introduced several observation schemes with various platforms, that are available in both free and paid choices. The training activities were carried out for 16 hours face-to-face, and 16 hours of independent projects that consisted of 10 modules. Out of these activities, it is expected that the participants can improve their thinking skills and carry out system programming processes according to needs and readiness.

Keywords: *Internet of Things, IoT Platform, IoT Architecture,*

1. INTRODUCTION

Support from the government is good news with a role or role of readiness to enter the era of the 4th industrial revolution. One of the mainstays of industry 4 or industry 4.0 is the Internet of Things (IoT). Several strategic sectors such as those related to technology, such as food, textile, automotive, agriculture, livestock, and electronics, can be integrated by building IoT-based industries **(Aburukba, 2015**). Implementing this role will be related to the provision of infrastructure and information & communication technology including IoT, cloud storage, Artificial Intelligent (AI), mobility, and visual **(Angelova, Kiryakova, and Yordanova, 2017)**. IoT refers to a network of physical devices that are integrated with electronic devices, software, sensors, actuators, and connectivity that allows them to connect to the internet network and collect or exchange data **(Biswas and Giaffreda, 2014)**.

Innovation is an absolute thing to survive as an attitude and smart solution to face industry 4.0 which will continue to change following lifestyles, ways of working and relating to one

another. Technology is always changing as if it never ends, especially in the field of IoT such as wireless mesh network (WMN) technology **(Fahmi and Saputra, 2019)**. Other popular terms include wireless sensor network (WSN) **(Najmurrokhman, Zainal, and Sari, 2014; Karthikeyan *et al.*, 2020)** and wireless node (WN) **(Tahtawi, Andika, and Harjanto, 2018; Saputra, Ahkam and, Iskandar, 2021)**. This technology is becoming popular because it can reach the bottom-up from the field such as field devices, sensors, and actuators to analysis such as data interpretation. WMN is integrated through the connection between devices. The self-forming capability provides reliable communication at a relatively affordable price without a fixed (modular) infrastructure. WMN's technological capabilities will be even more reliable when integrated with an Artificial Intelligent (AI) algorithm. AI, which is one of the characteristics of industry 4.0, can be integrated as sensor analysis and predicts the environment and situations, and can take action based on information. The nature of AI can also be adapted to the actions and nature of everyday human intuitive schemes **(Fitriyah and Setyawan, 2019)**.

One of the uses of IoT and AI technology so that service automation can be implemented to meet consumer needs for both business-to-business and business-to-consumer consumers is the development of human resources, knowledge about developments, and applications in various sectors that strongly, support the creation of digital technology-based ecosystems. The utilization of relatively affordable devices and a variety of platforms that support connectivity between devices makes it easier for users to realize IoT-based smart devices **(Najmurrokhman *et al.*, 2018)**. Simplified algorithm support allows all circles, both students and students, to reach and understand the sequence of a programming logic so that it can produce an integrated and useful system for the community.

Middle school students and teachers and the equivalent are no strangers to following technological developments such as IoT. However, there is still a long distance between design and application and various platforms that are suitable for the realization of IoT on a small or large scale. Therefore a series of activities are offered to support the understanding and application of IoT technology in supporting the continuity of smart digital technology which will be continued in the future by teachers, as well as younger students who are currently attending high school level. The IoT curriculum is introduced in schools as a concept for integrating a microcontroller-based system to connect to an internet network. In this training, a schematic with a framework that can be a reference is introduced which can simplify the process of designing microcontroller systems with IoT that can be accessed locally or publicly.

2. METHOD

2.1 Training

The activity method is carried out offline using a training approach. The training activity consists of 10 modules starting with an introduction to the ESP32 SoC device, then an introduction to the multi-tasking operating system for microcontroller devices, an introduction to the Ubidot platform, an introduction to Node-Red, Installing Node-Red on laptops, the next architecture in designing IoT, tutorials connecting ESP32 with Node-Red platform locally uses laptops and Raspberry Pi as main servers, and closes with mini projects along with IoT challenges according to needs and availability of carrying capacity. Training activities are carried out for 16 hours face-to-face, and 16 hours of independent projects. So from these activities, it is expected to improve thinking skills and carry out system programming processes according to needs and readiness.

In every IoT project, many parameters determine its success. This success can be started by a good planning process, compatibility of various devices and platforms, and cost issues. Building resources need to be carried out continuously (performed continuously), accompanied, and given regular and systematic simulations. The community has a pressing need for assistance for community service programs in the form of instruction, mentorship, introduction, and implementation of new technologies. If the group views and feels the advantages of adopting an IoT-based system architecture design in support of various initiatives, they will become engaged, start to be engaged, and do it on their own. Therefore, the group as a whole will actively carry out, develop, or disseminate it.

2.2 Training Activitiy

The workshop is carried out in the form of training at SMKN 1 Cimahi West Java by involving several groups of experts in the Electrical Engineering family including the TEDK, TOI, EIN, TKJ, and IOP expertise groups. The training participants included 10 teachers and 30 students who were divided into 20 groups. One of the important points in the technical aspect of an IoT project is scalability. Assuming that the IoT solutions created for the future will continue to grow and there will continue to be an increase in IoT devices, you must be prepared to manage the increasing volume of data, therefore IoT scalability must be a major concern. This activity is carried out in the form of a workshop with the following agenda can be explained in Table 1.

Table 1. Training Schedule

Date	Activity	Total (Hour)
14/12/22	ESP32 introduction	2
14/12/22	FreeRTOS introduction	2
14/12/22	Ubidots introduction	2
14/12/22	Node-Red introduction	2
15/12/22	Instalasi Node-Red	3
15/12/22	IoT design and architecture	3
15/12/22	Connecting Node-Red with ESP32 using Laptop/PC	4
15/12/22	Connecting Node-Red with ESP32 using Raspberry Pi	4
21/12/22	Mini Project	6
22/12/22	IoT Challenge	4

3. RESULT AND DISCUSSION

This workshop will be served by a community service team formed of Electrical Engineering lecturers at the Unjani Faculty of Engineering. The training activity consists of 10 modules starting with an introduction to the ESP32 SoC device, then an introduction to the multi-tasking operating system for microcontroller devices, an introduction to the Ubidot platform, an introduction to Node-Red, Installing Node-Red on laptops, the next architecture in designing IoT, tutorials connecting ESP32 with Node-Red platform locally uses laptops and Raspberry Pi as main servers, and closes with mini projects along with IoT challenges according to needs and availability of carrying capacity. Training activities are carried out for 16 hours face-to-face, and 16 hours of independent projects. So from these activities, it is expected to improve thinking skills and carry out system programming processes according to needs and readiness.

This community service activity is Training on the Selection of Internet of Things Devices as Media for Remote Information Transmitters for Vocational School Teachers and Students. The purpose of this community service activity is to build competence in the field of Internet of Things design. so by adopting an appropriate architecture for the project, it will provide

convenience for the future more than that it is crucial to choose a solution that has a finish line, in this activity the selection of the IoT protocol and architecture plays a role.

3.1 Presentation of Materials

The activity began and was opened on December 15 2022 by the vice principal for industrial relations and cooperation. Activities are divided into two groups, namely classes for teachers and students as shown in Figure 1 to Figure 3.

Figure 1. Opening of training

Figure 2. Class for student

Figure 3. Class for teacher

3.2 Training Program

Today the IT market is full of new concepts such as data science, data analytics, artificial intelligence, and the IoT. The focus this time is IoT which refers to the interconnection of various kinds of devices, such as wearables, watches, tablets, remote controls, sensors, household appliances, and others depending on the user. Specifically, IoT is a solution that retrieves data from various devices, which will later be sent to data centers and servers for further analysis that will control automation and actions. The following is the IoT architecture that was presented in the training activities and practiced by the participants shown in Figure 4.

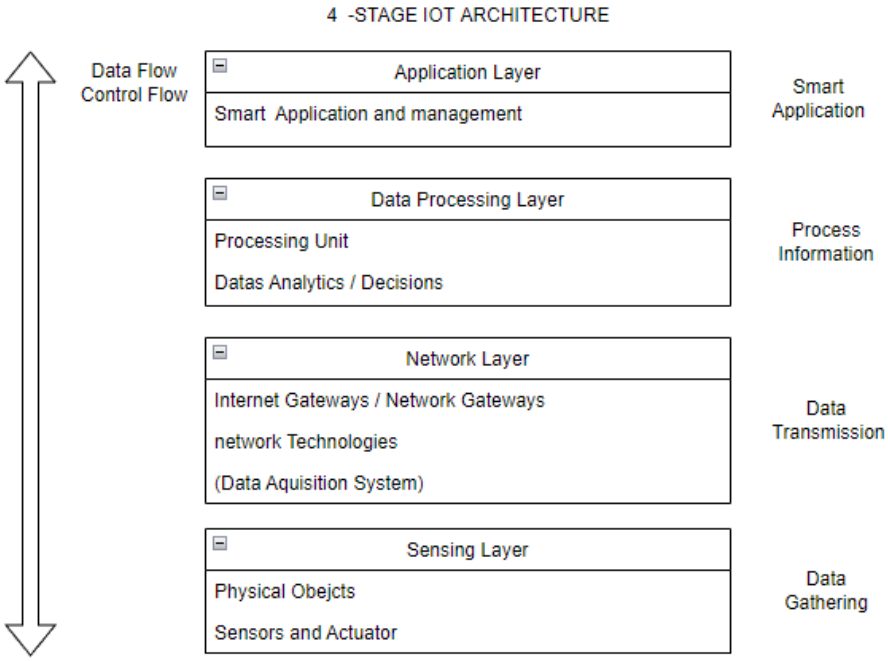

Figure 4. IoT layer application

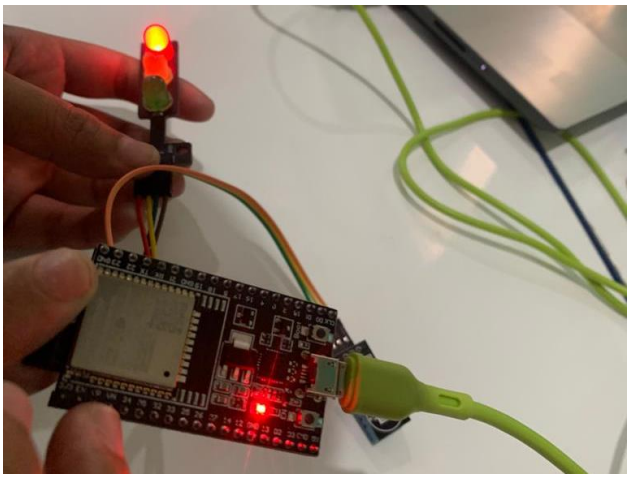

Figure 5. Result of the sensing layer

a. Sensing layer
   The first layer of the IoT system has "Things" or a tool that works as a link between the physical world and the digital world. Sensing refers to the physical layer, which includes sensors and actuators that can collect, receive, and process data. Sensors and

actuators can be connected wirelessly or by a wired connection. In the training process, participants carry out an experimental process based on the module that has been prepared and connects the sensor to the microcontroller used. This training also introduced a system based on multi-tasking using the freeRTOS library. The following activities are carried out when the activity takes place which is shown in Figure 5.

b. Network layer

The Network Layer provides an outline of how data is transferred throughout the application. This layer contains Data Acquiring Systems (DAS) and internet/network gateways. A DAS essentially performs data aggregation and conversion of functions from existing sensors. So at this layer, devices will be assigned to connect and communicate with servers, smart devices, and network devices, as well as this layer, handles all data transmission for devices. At this stage, participants get to know several communication protocols such as the MQTT protocol and create their respective MQTT servers and display them on the MQTTX application as shown in Figure 6. Participants can prepare topics to be sent by the microcontroller or received at the data processing layer.

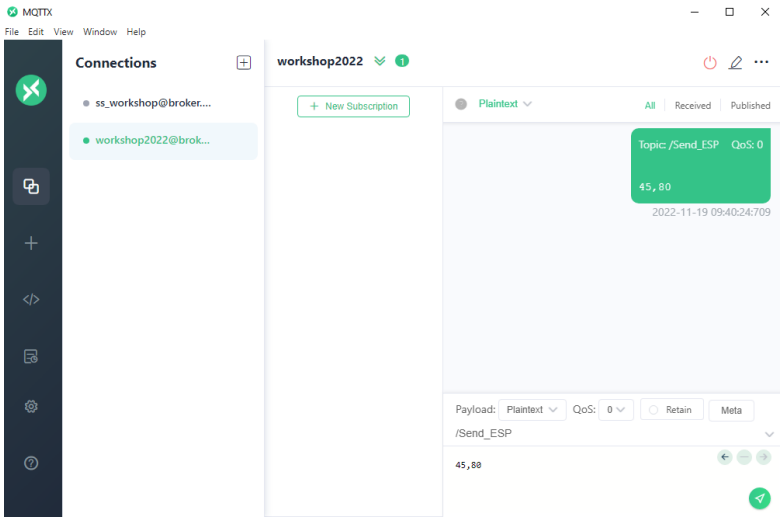

Figure 6. Result of network layer

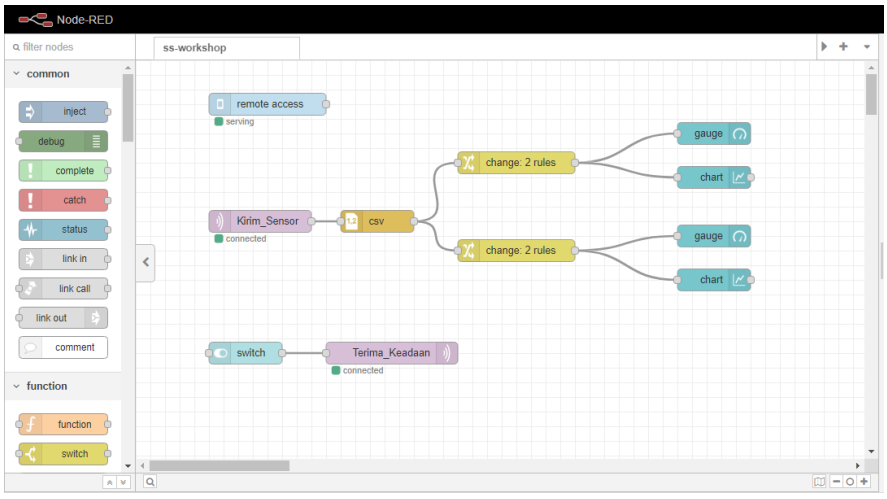

Figure 7. Result of the data processing layer

c. Data processing layer
Node-Red is a browser-based tool for creating Internet of Things applications whose visual programming environment makes it easy for users to create applications as "flow". In the data processing layer, participants are expected to be able to perform data processing such as filtering and separating data which can then be displayed on the dashboard as shown in Figure 7. Data read by esp32 is then sent using the MQTT protocol and then processed to separate some of the data that will be doing the visualization process on a dashboard.

d. Application layer
User interaction is at this layer which provides specific application services to the user, for example in this training an automatic plant watering system application where the user can execute watering commands or turn on the water pump by pressing a button on the screen or dashboard that shows the status of the tools available on the system. Participants can create a simple dashboard with the Node-Red application and display it as shown in Figure 8.

Figure 8. Result of the application layer

This activity can add to students' expertise in the practice of creating IoT architectural systems. This activity can grow participants' abilities in practicing and implementing IoT architectures. Participants can scale up from the system they already have by considering various aspects of needs and cost availability. Based on the results of the questionnaire given to the participants, there were positive testimonials such as *"Many new things were learned from this training, MQTT, Node Js, and how to configure each application"* and such as *"Learn a lot of new material, about coding and many others, getting to know new apps like MQTTX and Node-Red".* Participants in this activity may get firsthand knowledge that has never been attained in their classes before, and they may go on to create and popularize the activity. This task is an excellent first step toward creating an easy-to-use framework for IoT-based solutions. Furthermore, by building up autonomous server services at schools, activities that aim to integrate large-scale systems can be carried out.

There should be more than just this activity during the IoT architecture workshop. The following exercise may be carried out to improve and build system design capabilities with IoT architecture, and teachers can incorporate it into the teaching and learning process. The visiting teacher program is the next one that can run continually. The visiting teacher program is one that schools organize by inviting professionals from academia or industry in the context

of knowledge transfer so that students will always be more focused and the school can prepare needs based on each student's program of expertise with various cases adjusted based on program competence. The school may plan this program, and students must participate in these activities. Additionally, attempts to integrate massive systems might be carried out by establishing standalone server services at educational institutions.

4. CONCLUSIONS

The activity which was attended by 10 teachers and 30 students went well. The participants can implement the IoT architecture properly. Several things can be considered, namely the process of installing various software that supports the realization of IoT-based systems. In this activity, 90% of the participants were able to realize according to the modules made. As for those who have not been able to realize them, some of the compatibility of devices such as laptops and drivers are still not supported. The activity consists of 10 modules which are divided into 4 sections according to the IoT architecture so that participants can explain each aspect and need of the sensing layer using ESP32 with RTOS-based multi-tasking programming techniques, network layer using the MQTT protocol, data processing and application layer using Node-Red and Node-Red dashboard. This training is an excellent starting point for developing an intuitive framework for IoT-based applications. Furthermore, efforts that aim to integrate large-scale systems can be carried out by setting up independent server services at schools.

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