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IOT Application on Water Intake Pump

Ahdiat Leksi Siregar [a,1,*], Hendra Saputra [a,2], Azhar Basyir Rantawi [a,3], Istianto Budhi Raharja[b,4], Widya Enzely [c,5]

[a] *Mill Processing Study Program, Politeknik Kelapa Sawit Citra Widya Edukasi, Jl. Gapura No.8 Rawa Banteng, Bekasi, 17520, Indonesia*
[b] *Technology Institute of PLN, Jl. Lingkar Luar Barat, Duri Kosambi, Cengkareng, Jakarta Barat, 11750, Indonesia*
[c] *Student of Plantation Product Processing Study Program, Politeknik Kelapa Sawit Citra Widya Edukasi, Jl. Gapura No.8 Rawa Banteng, Bekasi, 17520, Indonesia*
[1]*aleksiregar@gmail.com*;* [2]*endsaputra11@gmail.com;* [3]*azharbr@gmail.com;* [4]*istianto@itpln.ac.id;* [5]*enzely3110@gmail.com*
** corresponding author*

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ABSTRACT

The water needed by the Palm Oil Mill (POM) is obtained from the river that is flowed to the mill using a pump manually by the water treatment station operator, which has the potential to cause human error. This research was conducted at POM PT. Kalimantan Sawit Abadi, Citra Borneo Indah Group on March 1 - March 31, 2024. The purpose of this research is to create a series of water intake pump automation based on the Internet of Things and analyze the impact of the pump operation and workers. From this research, IoT applications are produced for water intake pump operations that can be operated and monitored using Blynk remotely and anywhere. From the use of this IoT application, workers can be allocated to other jobs so that it is more effective than just operating a water intake pump.

I. Introduction

Water becomes a basic need in palm oil factories because of the processing process using steam which is used to boiling TBS and also heating the tanks in the palm oil factory. The source of water needs for palm oil factories usually comes from rivers around the mill area. To be able to meet water needs, tools such as pumps are needed to be able to flow water from the river to reservoirs and then to the palm oil factory [1].

Pumps have an important role in the palm oil mill processing process. One of the uses of the pump in the palm oil mill is to transfer or drain water from the water source to the palm oil mill [2]. Water for palm oil mill processing is usually obtained from the river and then it will be flowed through the reservoir.

The water used for palm oil factories will go through several stages of processing, namely, coagulation, flocculation, sedimentation, filtration, and reservoir. The processing process is carried out manually starting from turning on the water intake pump, distribution pump, and reporting the process results. This causes a human error that results in reporting production results that are not in accordance with the actual conditions, resulting in losses due to inappropriate reports. In addition, manual processing will also incur daily costs in operator salary [3].

One of the tasks of the water treatment station operator is to turn on the water intake pump from the river to the water reservoir. Due to the long distance of the water intake pump, it requires the operator to turn it on and make sure the pump is working properly. In addition, the water flow that enters the PKS reservoir is still less compared to the water needs used for PKS operations. This causes the number of hours of ineffective operator work.

From the existing problems, an automation system is needed to turn on and monitor the condition of the water intake pump so that the working hours are more effective. One of the ways of automation and monitoring on the water intake pump is by using Internet of Things (IoT) based device. IoT is a technology that can expand the use of the internet that is beneficial to life. With the use of IoT can

allow us to connect equipment or machines with the internet [4]. This provides opportunities in the process of monitoring and operating the tool in real-time remotely [5].

Therefore, in this research, the author will discuss automation tools and monitoring of water intake pumps based on the Internet of Things. This system can be used for pump monitoring from Blynk application. In its operation, this application is very easy to use because it has an easy-to-understand user interface. So that no more operators are needed in the water intake pump area. However, a pump safety device is needed to avoid pump damage while operating.

II. Literature Review

A. Water Treatment Plant

Water treatment station in Palm Oil Mill (POM) or commonly called Water Treatment Plant (WTP) is a station that functions to treat water that will be used in the treatment process in the palm oil mill so that the water can meet the standard water standard [6]. Water is a very important supporting need in the FFB processing process in palm oil factories [7]. Therefore, water treatment stations are very crucial in obtaining the quality of water used for the treatment process.

The following is the flow of the water treatment station in the palm oil factory.

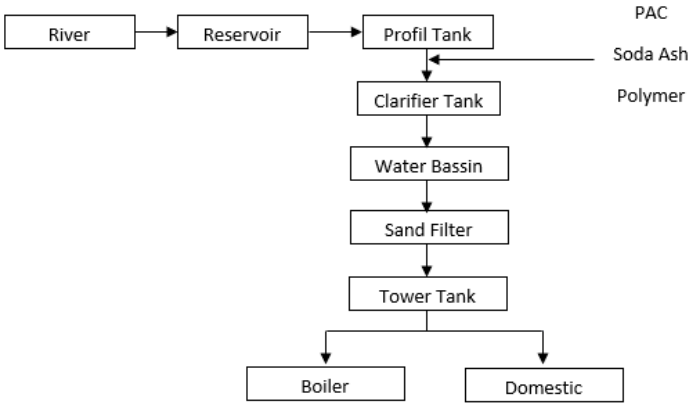

Fig 1. *WTP Station Process Flow*

B. *Internet of Things (IoT)*

Internet of Things (IoT) is a concept where objects in the real world can be connected to each other with internet connectivity [8]. Internet of Things (IoT) was first proposed by Keylin Asthon in his presentation in 1999. Asthon gave a statement that IoT has a huge potential to change the world, as the internet has done which has changed the world [9]. It is proven from the statement that nowadays IoT is growing rapidly and bringing many changes. IoT is an introductory system for the transformation of the use of the internet which previously used the internet from the Internet of People to the Internet of M2M (machine to machine) [10].

C. *NodeMCU ESP 8266*

NodeMCU is an electronic device based on ESP 8266 chip with the ability to perform functions as a microcontroller and also an internet connection [11]. NodeMCU ESP8266 is a microcontroller that is often used in open source IoT systems [12]. NodeMCU ESP 8266 has input and output pins that can be developed in IoT projects [13].

NodeMCU has a total of 13 pins General Purpose Input Output (GPIO) that can be used as input from sensors and actuators that will be used [14].

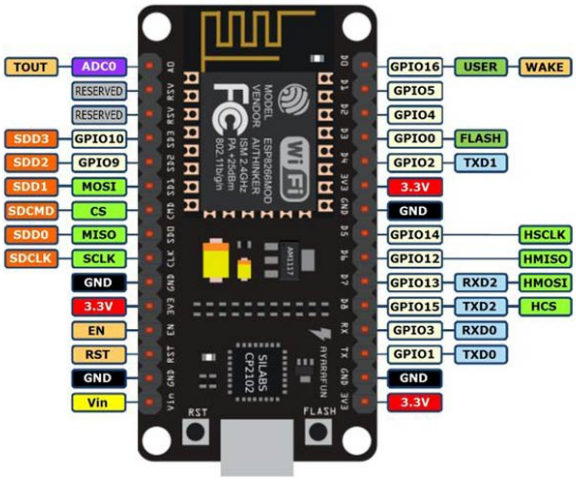

Fig 2. *NodeMCU ESP8266*

D. Relay

Relay is a switch that is operated using electric current that will trigger the components in the relay, there are two main components in the relay, namely electromagnetic and mechanical components [15]. In the use of relays using electromagnetic principles to move the switch contact so that a small electric current can conduct electric current with a higher voltage [16]. There are two contact settings on the relay, normally close and normally open [17].

E. *Blynk*

Blynk is an application used for IoT projects that can be accessed through the web, IOS, and android. This application is used to control or monitor a condition using an internet-based system. In its operation, this application is very easy to use because it has a user interface that is easy to understand. Blynk has a drag and drop feature so that it makes it easier for users to arrange dashboards according to the IoT project that is being worked on [18].

F. Arduino IDE

Arduino IDE (Integrated Development Environment) which means an integrated environment that can be developed. Arduino IDE can be used as an application to include functions that will be used on the microcontroller. Arduino IDE has its own programming language that resembles the C programming language. The programming language used in Arduino IDE is a sketch that has been modified so that it makes it easier for users to use it [19]. Arduino IDE can be used to program microcontrollers such as Arduino Uno, Arduino Nano, ESP 8266, ESP32, Wemos, Mappi32 and so on.

G. Pump

The pump has the basis of how it works by converting mechanical energy into kinetic energy. The pump functions to move liquids/fluids from one place to another [20]. Based on the type, pumps can be classified into two types, namely dynamic and displacement. Dynamic pump is a pump where energy will be continuously added to increase the speed of the fluid in the machine. Displacement pump is a pump where energy added periodically produces an increase in pressure so that the fluid can move and move. Examples of dynamic pumps are centrifugal pumps and special effect pumps. Examples of pump displacement are rotary pumps and pumps using pistons that move back and forth, depending on the movement of the tool that produces pressure on the pump [21].

III. Metode

This research started on March 1, 2024 until March 31, 2024, which is located at the palm oil mill of PT. Kalimantan Sawit Abadi, Citra Borneo Indah Group.

The tools and materials used in this research are as follows:

Table 1. Tools used

No	Tools	Function
1	Laptop	Designing tools, programs, etc.
2	*Smartphone*	Used to take documentation
3	*Test pen*	Checking the electric current
4	Cutting Pliers	Cutting the cable and peeling the cable

Table 2. Materials used

No	Material	Function
1	Node MCU	Microcontroller used
2	4 channels 5-volt relay module	For automatic control
3	Pilot lamp 220 Volt AC	As a sign of the progress of the program
4	Selector switch 2 position	To set automatic and manual mode
5	MCB 1 phase	For power circuit breaker
6	Panel box	For microcontroller placement
7	Orbital modem	As a WiFi source
8	*Level switch*	For river water level protection
9	*Autonic digital relay*	For measuring the magnitude of the current
10	*Current transformer*	To change the electric current
11	8 feet relay	To reduce electricity burden
12	Cable	Electric conductor
13	Serine	For signal in case of damage
14	CCTV	To monitor the location

The following are the stages of this research:

1. System Identification

At this stage, an analysis and identification of the required system is carried out. The author made an automation and monitoring system on the water intake pump. The system must have a clear purpose and can be used so that it is beneficial for users. In addition, this process also identifies how the system will work.

2. Hardware Design

This stage aims to design and determine what components are used in this system. The hardware design process starts from determining components, designing electronic circuits, and determining component layouts so that the system can function properly.

3. Software Design

At this stage the aim is to design how the software will be made. Software consists of applications that will be used in the system, algorithms, programming languages, and other features. The application that will be used in this research is Blynk, the application was chosen because of the easy use and user interface settings. The programming language used is Arduino IDE (sketch). While the algorithm of this research is that the user gives input from the Blynk application to the microcontroller to turn on or off the pump. In addition, there is also a dashboard camera to monitor the condition of the pump.

4. Testing

After the hardware and software are completed, testing will be carried out on the system. Testing is done to find out whether the system is running properly according to the design that has been determined. The indicator that the system has been running well is that it can turn off and on the device by using the application that has been created and also the camera dashboard in the application can display images of the device condition in real condition.

After these stages are completed and the system that has been made functions and works well without obstacles. It is hoped that the system can be implemented on the tool so that it can help the automation and monitoring process.

IV. Result and Discussion

1. Making Water Intake Pump Automation Circuit

In this research, the system made by the researcher is a series that will run an automation and monitoring system on the Internet of Things (IoT) based water intake pump.

2. Installation of NodeMCU ESP 8266 Microcontroller

In hardware design, there are items that must be prepared in advance, including the following:

a. Prepare the necessary components such as NodeMCU ESP 8266, 4 channel relay, jumper cable, 8 foot relay.
b. Install the components according to the following series:

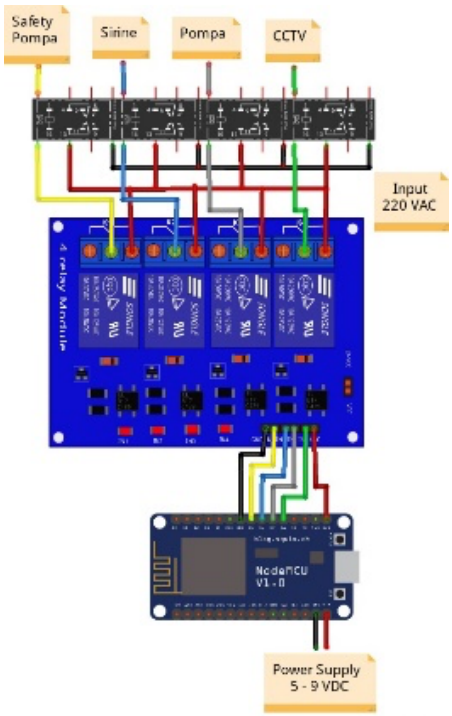

Fig 3. *Hardware series*

c. Application Program Creation
At this stage, a program design will be carried out that will make ESP 8266 able to control the installed tools using the Blynk application remotely. The software used to enter the program to ESP 8266 is Arduino IDE.
d. The Impact of IoT Network Installation
After the installation of the IoT program on the pump, there is a change in the operation of the water intake pump from manual to remote. The change makes working hours more effective because the operator is transferred to another job.

3. Water Intake Pump Automation Testing

This series of device can be turned on and off from the application so that there is no need for an operator to maintain it throughout the working operational hours. To turn on and off the pump use the Blynk application where the application will give on or off input so that it is read by ESP 8266 [22] and the pump will turn off or on. For the pump indicator is on, the green pilot lamp will turn on, while if the pump is off, the red pilot lamp will turn on. In addition, there is also a CCTV that functions to monitor the condition of the pump when it is operating and when it is not operating. There is a siren as a sign that the pump will be turned on so that when there are people around the

water intake pump area who are repairing or manually checking the pump can know that the pump will be operated.

This device is also paired with a protection device so that when the river level condition is below the water intake pump pipe, the pump will automatically turn off by itself. The working system of this protection is using a level switch, low load sensor, and 3 phase protection. The low load sensor functions to determine the load on the electromotor, when the load on the electromotor is low which indicates that the pump is not in normal condition. So, the installed pump will be safer.

To run the automation, the microcontroller installation must be done and the ESP 8266 programming must be done to the Blynk application.

4. Installation of Water Intake Pump Automation Installation

Installation of water intake pump installation components as follows:

a. First prepare all the main components that will be used, such as NodeMCU ESP 8266, 4 channel 5volt DC relay module, 220volt AC pilot lamp, 2-position selector switch, 1 phase MCB, and box panel.
b. In addition to preparing the main components, also prepare safety components on the pump and electromotor, such as level switch, automatic digital relay, current transformer, 8 pin relay.
c. Connect the power cable to the Vin NodeMCU pin and the ground cable to the GND pin then connect the two cables to the DC 5-8 Volt adapter which will be directly connected to the AC current.
d. Then connect pin D5 to IN1 relay for pump safety, D6 to IN2 relay for sirene, D7 to IN3 relay for pump, and D8 to IN4 relay for camera. Then connect the ground on the relay to the GND pin and VCC relay to the 3V3 NodeMCU pin.
e. After the NodeMCU circuit with the relay is installed, then connect the output of the NO 4 channel relay and connect it to the power input of each 8 foot 220 AC relay.
f. On the 8 foot omron relay on pin 8 is given 220 VAC standby power, and on pin number 6 (NO) it is connected to each device that will be turned on (CCTV, Pump, Camera and Safety Pump).
g. On the relay path that goes to the pump, the current first enters the level switch (NC) before entering the pump panel to avoid the pump operating when the river water level recedes.

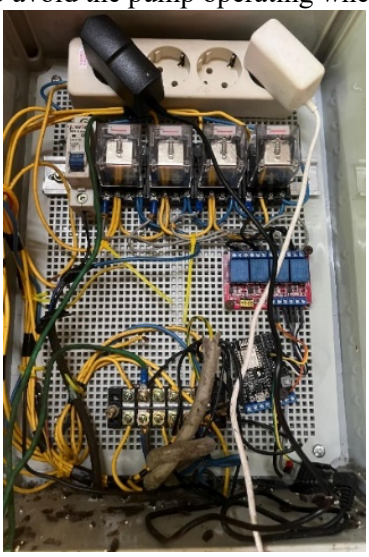

Fig 4. *IoT Network Installation*

5. Application Program Creation

At this stage, the creation of a program that connects NodeMCU ESP 8266 with a relay. The application used to create programs is Arduino IDE. In addition to connecting NodeMCU ESP 8266 with relay, this program also functions to connect NodeMCU ESP 8266 with Blynk application.

To connect ESP 8266 with the Blynk application, an auth token on the dashboard has been created with the following steps:

1. In the first stage, make the display of the Blynk application in accordance with the planned plan. Download the Blynk application on your phone.
2. After the Blynk application is installed, log in with the existing account.
3. Then make a dashboard on the Blynk application according to the plan that has been made. Here are the steps to create a dashboard on the Blynk application:
   a. Enter the developer zone then click new template
   b. After the template is made, insert the switch that will be used to turn on and off the pump, siren, camera, and low load sensor.
   c. Create a data stream that will be used on each switch by clicking the settings on the switch then select create data stream. Choose the virtual pin type.
   d. Choose the integer data type and the pin to be used is V0 for safety device, V1 for siren, V2 for pump, and V3 for camera.
   e. Then press create after that press save. Then press save on the web dashboard tab to save the template that has been created.
   f. Go to the devices tab, press new devices and select from template. Use the template that has been created.
4. After the dashboard is completed, the next step is to integrate Blynk with Arduino IDE using the auth token on Blynk.
5. Insert the auth token in the Arduino IDE program.
6. Impact on Operations
   Before the installation of the remote system on the pump, the employee's working hours were not effective because the distance of the water intake pump that was far from the PKS did not allow employees to do other work. This is because the water intake pump must remain to meet the water needs during the process. The pump water flow that flows into the reservoir is 55m³/hour where the water requirement during the process is 72 m³/hour. The average processing hours of the mill are 16 hours so that the water needed is 1152 m3/day while the water supplied from the water intake is 880 m3/16 hours. To meet the water shortage, it is necessary to add pump operational hours to 21 hours/day. This is not effective because the employee cannot do other work because the pump is far from the factory.

The following is the average data of mill processing hours and employee working hours for 3 months before the equipment installation.

Table 3. Employee Working Hours Before Device Installation

Month	Average mill processing hours	Working hours before IoT	
		Employee A	Employee B
January	16	11	10
February	17	10	10
March	16	10	11

And here is the average data of mill processing hours and employee working hours after remote installation on the water intake pump.

Table 4. Employee Working Hours After Device Installation

Month	Average mill processing hours	Working hours after IoT	
		Employee A	Employee B
April	17	-	-
May	16	-	-

After the installation of a device that can monitor the pump remotely, it is no longer necessary for employees to maintain the water intake pump continuously. This leads to more effective working hours because the employees are transferred to other jobs in the factory.

V. Conclusion and Suggestions

The following is the conclusion of the research results that have been carried out:

1. A series of IoT applications can be used for pump operation and monitoring from anywhere and anytime as long as it has an internet connection.
2. With the installation of this tool, turning on the water pump manually becomes remote, and the operator can be transferred to other jobs that are more productive.

This On/Off by Remote Water Pump Panel is still in the development stage, will be implemented on WTP operations, and fences and danger signs will be added around the pump house. In addition, this control system can be used for other parallel automation such as used for POME delivery of biogas system and synchronization between engine gas with turbine and generator.

Reference

[1] E. Sari, "Konsumsi Air Dan Potensi Penghematan Pada Proses Produksi CPO PT. Perkebunan Nusantara V Pabrik CPO Sei Galuh." [Online]. Available: http://www.kpbptpn.co.id.

[2] J. Teknologi and M. Uda, "Perencanaan Mesin Fluida (Pompa Centrifugal) Untuk Mengalirkan Minyak Kelapa Sawit Dari Tangki Harian ke Storage Tank Dengan Kapasitas 5,28 Ton/Jam," 2022.

[3] R. Priyatna and A. Andang, "Model Sistem Otomatis Water Treatment Plant Menggunakan PLC Berbasis Wireless," 2021.

[4] D. Irvin, S. Bach, O. Saziati, and J. Teknik, "Rancang Bangun Sistem Monitoring Kualitas Air Boiler Berbasis IoT Pada Pabrik Kelapa Sawit di PT. Sasmita Bumi Wijaya," 2024. [Online]. Available: https://jurnal.untan.ac.id/index.php/jtinUNTAN/issue/view/2162-26-

[5] A. Mahfud and M. S. Ariansyah, "Prototype Monitoring Vibrasi, Temperatur dan Jam Kerja pada Elektromotor Berbasis IoT," *Jurnal Citra Widya Edukasi*, vol. 15, no. 3, 2023.

[6] R. Putra Pratama, U. Muhammadiyah Riau, and J. Tambusai Ujung, "Implementasi Logika Fis Tsukamoto Untuk Menentukan Takaran Zat Kimia Pada Proses Pengolahan Air di Pabrik Kelapa Sawit," *JOISIE Journal Of Information System And Informatics Engineering*, vol. 5, no. Desember, pp. 90–97, 2021.

[7] H. Sastrohartono and R. A. Renjani, "Studi Pemanfaatan Water Rejected Reverse Osmosis untuk Kebutuhan Air Domestik dan Sebagai Boiler Feed Water," pp. 195–199, 2014.

[8] G. Hergika, "Perancangan Internet of Things (IoT) Sebagai Kontrol Infrastruktur dan Peralatan Toll Pada PT. Astra Infratol Road," vol. 8, no. 2, 2021, [Online]. Available: https://www.esp8266.com/viewtopic.php?p=68657

[9] F. Ilhami and P. Sokibi, "Perancangan dan Implementasi Prototype Kontrol Peralatan Elektronik Berbasis Internet of Things Menggunakan NodeMCU," 2019.

[10] A. Nur Syawaluddin, "Studi Kasus di FTI pada Prodi Rekayasa Sistem Komputer," vol. 6, no. 2, 2019, [Online]. Available: www.hobbytronics.co.uk

[11] A. Herlina, . S., and M. F. Rohman, "Rancang Bangun Sistem Kendali Lampu dan Kanopi Otomatis Menggunakan NodeMCU ESP8266 Berbasis IOT," *Jurnal Sains dan Teknologi (JSIT)*, vol. 4, no. 1, pp. 8–10, Jan. 2024, doi: 10.47233/jsit.v4i1.1422.

[12] M. Habib Al Hudry, F. Fathoni, Y. Ulkhaq, P. Tio Rifki Wijaya, and M. H. Arkan, "Perancangan Sistem Pendeteksi dan Monitoring Ketinggian Air Berbasis IoT Menggunakan NodeMCU ESP8266," vol. 2, no. 3, pp. 87–93, 2023, doi: 10.55123.

[13] B. Satria, "IoT Monitoring Suhu dan Kelembaban Udara dengan Node MCU ESP8266," *sudo Jurnal Teknik Informatika*, vol. 1, no. 3, pp. 136–144, Aug. 2022, doi: 10.56211/sudo.v1i3.95.

[14] H. P. Ramadhan, C. Kartiko, and A. Prasetiadi, "Monitoring Kualitas Air Tambak Udang Menggunakan NodeMCU, Firebase, dan Flutter," *Jurnal Teknik Informatika dan Sistem Informasi*, vol. 6, no. 1, Apr. 2020, doi: 10.28932/jutisi.v6i1.2365.

[15] A. Budiyanto, G. B. Pramudita, S. Adinandra, P. Studi, and T. Elektro, "Kontrol Relay dan Kecepatan Kipas Angin Direct Current (DC) dengan Sensor Suhu LM35 Berbasis Internet of Things (IoT)," 2020.

[16] A. Shafitri and A. Mashuri, "Perancangan Pengendali Lampu Kantor Berbasis Internet of Things," *Prosisko*, vol. 9, no. 1, 2022.

[17] M. S. Pandang, N. Nachrowie, and R. D. J. K. Sari, "Prototype Kendali Arus dan Tegangan Menggunakan Internet of Things (IoT)," *Blend Sains Jurnal Teknik*, vol. 2, no. 2, pp. 191–197, Oct. 2023, doi: 10.56211/blendsains.v2i2.351.
[18] M. Wijayanti, "Prototype Smart Home Dengan NodeMCU ESP8266 With Berbasis IoT," *JUIT*, vol. 1, no. 2, pp. 101–107, 2022.
[19] O.: Septian and P. Aji, "Infusing Monitoring Tools Using Web Online Based ESP8266 With Arduino IDE Programming," 2018.
[20] M. Rizki Angraini and R. Muharni, "Terbit online pada laman web jurnal Analisis Kebutuhan Debit Air Di Gedung C RSUD Kota Bukittinggi," *JURNAL Teknik Mesin*, vol. 14, no. 2, pp. 94–98, 2021, [Online]. Available: http://ejournal2.pnp.ac.id/index.php/jtm
[21] I. J. Karassik, *Pump handbook*. McGraw-Hill, 2001.
[22] D. Saputra and V. Arinal, "Perancangan Home Automation Dalam Mengontrol Lampu dan Kipas Menggunakan Blynk Berbasis NodeMCU," *Sosial dan Teknologi (SOSTECH)*, vol. 1, 2021.
[23] Rater Salya, Balkhaya "The Influence of Social Media Digital Marketing Analysis on New Student Acceptance in a University" J.Inotera, Vol. 8 No. 1, PP. 150-154, 2023.