DESIGN OF INTERFERENCE MONITORING SYSTEM IN 20KV NETWORK BRANCH FEEDER

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Abstract - Monitoring has a very important role in electric power services from generation to distribution to consumers. With the working area of PT. PLN (Persero) which is very broad causes several parts such as network branching, distribution substations, and disturbance data collection to be neglected. Even when there was a blackout and the branching PMCB tripped, it was only discovered after a consumer reported it. In addition, the monthly SAIDI SAIFI data is also inaccurate because it only relies on disturbance data from the feeder substation. To overcome this problem, a voltage monitoring system is needed on the PHB-TR, and a 20kV cubicle. This tool detects the presence or absence of voltage with an input voltage range of 50 to 220 volts AC. In the condition of loss of voltage or input voltage, this tool will automatically send information via SMS to several numbers that have been previously inputted. Thus, information regarding blackouts can be reviewed in real time which results in lower undistributed kWh values. SAIDI SAIFI is even more accurate because the blackout data is automatically recorded with the output in the form of an excel file. With a relatively low cost, this tool can provide substantial savings if it is implemented at a feeder branch which is located quite far away. In addition, this tool is also able to speed up response time in the event of a disturbance due to faster information.

Keywords: Monitoring; response time; Disturbance.

I. INTRODUCTION

PT PLN (Persero) as a government-owned company that aims to provide electricity to people throughout the country has a very wide service area. The wide area causes several parts that play an important role in the distribution of electric power such as branching, distribution substations, and fault data collection to be unmonitored. This has the potential to cause losses from undistributed kWh values due to unmonitored blackouts.

The distribution of electric power to consumers who are spread over a wide area results in network branches where the branch locations are spread over relatively long distances. The relatively long distance makes monitoring the branching points difficult. In addition, the distribution substations cannot be monitored directly because there are so many of them and the locations are spread out. All of these points, both at branch points and at distribution substations, play a very important role in distributing electricity to consumers. Due to the absence of monitoring, when there is a disruption, information is only received after complaints from the public. This has an impact on the response time to disturbances that are getting longer.

The disturbance data collection also did not work properly which resulted in inaccurate SAIDI and SAIFI values. With inaccurate SAIDI SAIFI data, the performance of a region cannot be solely determined by the existing SAIDI SAIFI value. In addition, the evaluation of the company's performance can also not be on target. [1]

Based on these problems, we need a tool that can automatically monitor the network so that each part can be monitored in real-time. Therefore we provide a solution to make a tool for monitoring each branch on a 20 kV feeder, it is hoped that this tool will narrow down the search for fault locations and make officials quickly deal with disturbances that occur.

II. LITERATURE REVIEW

Monitoring is something that has a very important role in maintaining the distribution of electricity from generators to consumers. Unfortunately, there are many equipments that are not monitored directly due to the wide service area of PT. PLN (Persero). As a result of the lack of monitoring, several problems arise, including :

1. SAIDI SAIFI is not accurate
2. Branching and distribution substations are not monitored
3. SOP for normalizing disturbances is not monitored

Microcontroller ATMEGA328

ATMega328 is an 8-bit AVR microcontroller which has a smaller physical size, but the memory and other peripherals are not inferior to other AVR families. ATMega328 has 3 main PORTS namely PORTB, PORTC, and PORTD with a total of 23 input/output pins. These PORTs can function as digital input/output or function as other peripherals.[2]

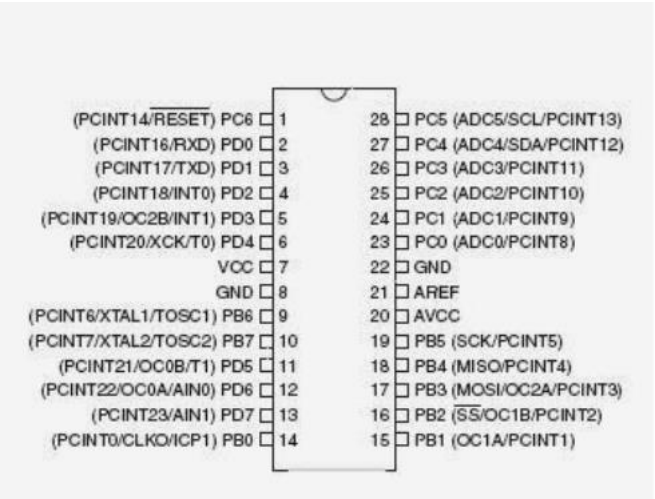

Figure 1. ATMega328 Microcontroller Pins.

GSM Module SIM800L

The SIM800L GSM/GPRS module is the part that functions to communicate between the main monitor and the cellphone/smartphone. AT Commands are commands that can be given by GSM/CDMA modems such as sending and receiving GSM/GPRS-based data, or sending and receiving SMS. SIM800L GSM/GPRS controlled via AT commands. AT+Command is a set of commands that are combined with other characters after the character "AT" which is usually used in serial communication.

Figure 2. GSM Module SIM800L

Relay Module

The relay functions as a light switch. The working principle of the relay is electromagnetic to change the condition of the switch which can conduct electric current with a higher voltage. [3]

There are two types of relays namely:

1. Normally Close (NC) with the initial condition the switch is always in the closed position (close).
2. Normally Open (NO) with the initial condition the switch is always in the open position (open).

Voltage Sensor

The ZMPT101B sensor is a voltage sensor that can measure voltage from 0-1000V. The working principle of this sensor is to lower the input voltage using a step down transformer, then enter the op-amp and get a stable output value depending on the input value. Each feeder has a PT which functions to convert medium voltage to low voltage. From the PT output it is converted to a 5 volt DC voltage using a HP charger. As an indicator of whether there is voltage, an LED is installed so that the LED can light up when the feeder is under voltage. The 5 volt output is then connected to a signal conditioning circuit so that it can be processed by the microcontroller.[4]

Backup Power Supply

Backup power supply is an emergency power supply provided to power this tool when the main 220V AC supply is lost. This tool is equipped with a backup power supply that comes from a 2 x 6 volt battery that is connected directly to the tool's supply. Thus, when the AC power supply goes out, the tool will automatically use the power supply from the battery. Meanwhile, during normal operation, the battery will be charged using an AC source.

Matrix Keypad

The tool that we make is also equipped with a matrix keypad. For destination cellphone numbers, you can enter them manually using the matrix keypad. However, for security reasons, we must enter the security code before changing the settings of the equipment. For the maximum number of destination numbers, namely 10 numbers with a composition of 1 server number and 9 other numbers.

Figure 3. Matrix Keypad Module

Liquid Crystal Display (LCD)

The display used is a 16x2 LCD. The 16x2 LCD maps 16 character lines and has 2 display lines per character to display in a 5x7 pixel matrix. This type of LCD has two types of registers, commands and data commands. The LCD is used as a display for calculating sensor readings that have been processed by the microcontroller. [5]

Figure 4. LCD 16x2

III. RESEARCH METHODS

In this study we used Fishbone analysis, which is a structured approach that allows a more detailed analysis to be carried out in finding the causes of a problem, discrepancies, and existing gaps. [6] From the problems encountered, it can be analyzed that monitoring in real time is necessary to obtain reliable performance of electric power distribution. These problems can be presented in several sections, namely man, machine, method, and material.

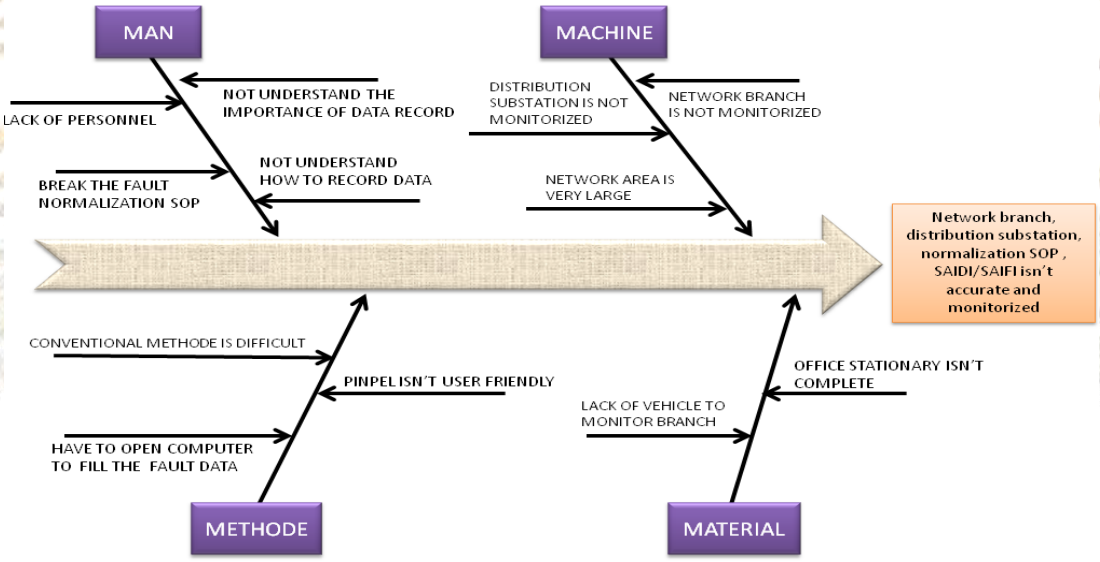

Figure 5. Fishbone diagrams

The problems encountered can then be described as follows:

1. Man: This factor is caused by a lack of officers to monitor the disturbances that occur. Apart from that, the staff's indifference to SOPs for normalizing disturbances also has an indirect impact on reduced service life and network security.
2. Method: Basically a program for monitoring disturbances already exists, but the program is done manually and must be updated every day. Due to the complexity of this program, officers often forget to update the program, so that the disturbance data becomes incomplete and the program does not run as it should.
3. Machine : The service area is very wide resulting in some parts of the electric power coating equipment not being monitored. Equipment such as distribution substations and branches when there is a disturbance requires a long response time because the information is only based on community reports.
4. Materials: Supporting equipment in monitoring disturbances such as vehicles is felt to be lacking resulting in losses in the

number of kWH not channeled being greater when a disturbance occurs.

Based on the analysis process from the previous problem identification, the following solutions can be proposed:

1. Monitor disturbances regularly
2. Need a system for monitoring disturbances that is simpler
3. A tool is needed that can monitor and record disturbance data along with the causes and locations of disturbances automatically
4. The tool must be able to monitor disturbances that occur both at branching networks and at distribution substations.

To overcome the above problems, a simple technology with low cost and easy implementation is needed so that disturbances that occur can be monitored and recapitulated as a whole.

SYSTEM PLANNING

This tool consists of several tools that are integrated in it. As the brain is using the AT Mega8535 microcontroller. This tool can detect the presence or absence of voltage on each feeder. The PT output of each feeder is directly connected to the cellphone charger so that when the feeder operates it will produce an output voltage of 5 volts which is input to the microcontroller. For the voltage sensor used, namely the cellphone charger, it can operate at a fairly wide voltage range, namely between 50 volts and 220 volts AC. Furthermore, the microcontroller processes the input data from several feeders and when there is a change in conditions either from open to closed or closed to open, the microcontroller will instruct the GSM module to send SMS to several numbers that have been input.

This tool is also equipped with a backup power supply that comes from a 2 x 6 volt battery that is connected directly to the tool's supply. Thus, when the AC power supply goes out, the tool will automatically use the power supply from the battery. Meanwhile, during normal operation, the battery will be charged using an AC source.

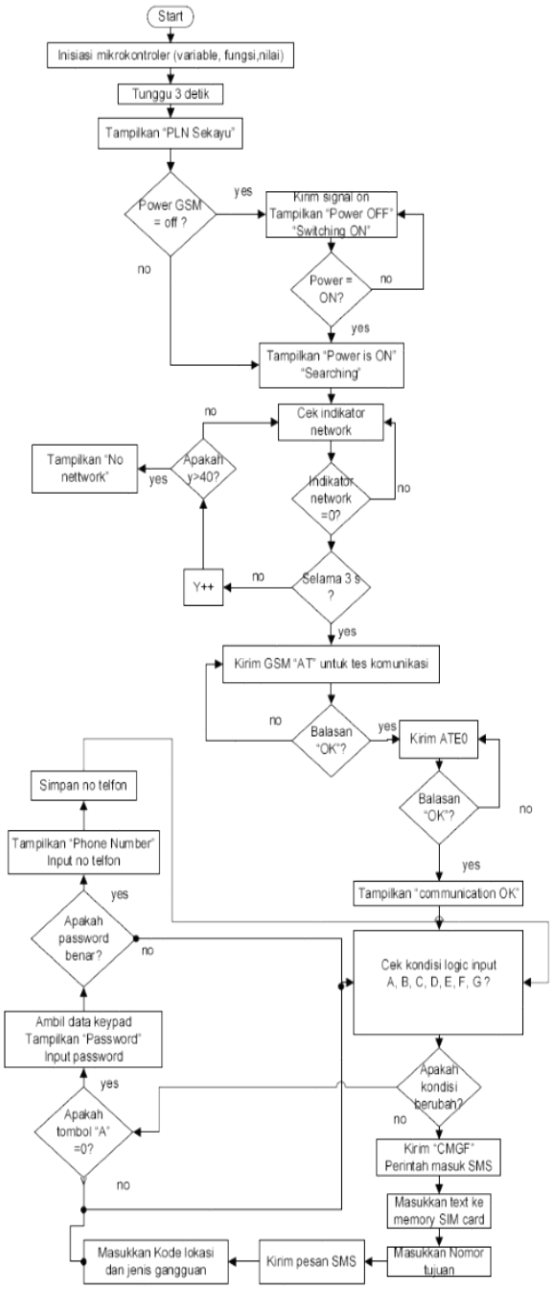

Figure 6. Flowchart System

For destination cellphone numbers, you can enter them manually using the matrix keypad. However, for security reasons, we must enter the security code before changing the settings of the equipment. For the maximum number of destination numbers, namely 10 numbers with a composition of 1 server number and 9 other numbers.

When a blackout occurs on one of the feeders, the tool automatically asks to input the location and cause of the disturbance, each of which is presented with a predefined 2-digit code. Then after the location and cause of the disturbance are entered, the code will be sent to the server number, which is number 0.

This tool is equipped with a program to record fault data. The program used is based on the Ms. Excel. When the destination mobile number receives a message from the device containing the condition of each feeder, then the message can then be recapitulated every month using the Ms. program. Excel that has been created. Before recapping on Ms. Excel, the received message is changed first using the SMS To Excel software. The data that was successfully recapitulated in the Ms. Excel namely:

1. The location of the disturbance.
2. The cause of the disturbance.
3. System Interruption Frequency Index (SAIFI) for each feeder
4. System Interruption Duration Index (SAIDI) for each feeder

From the data that was successfully recapitulated, using the Ms. Excel that has been made, SAIDI and SAIFI graphs can be displayed according to the number of disturbances that occur each month.

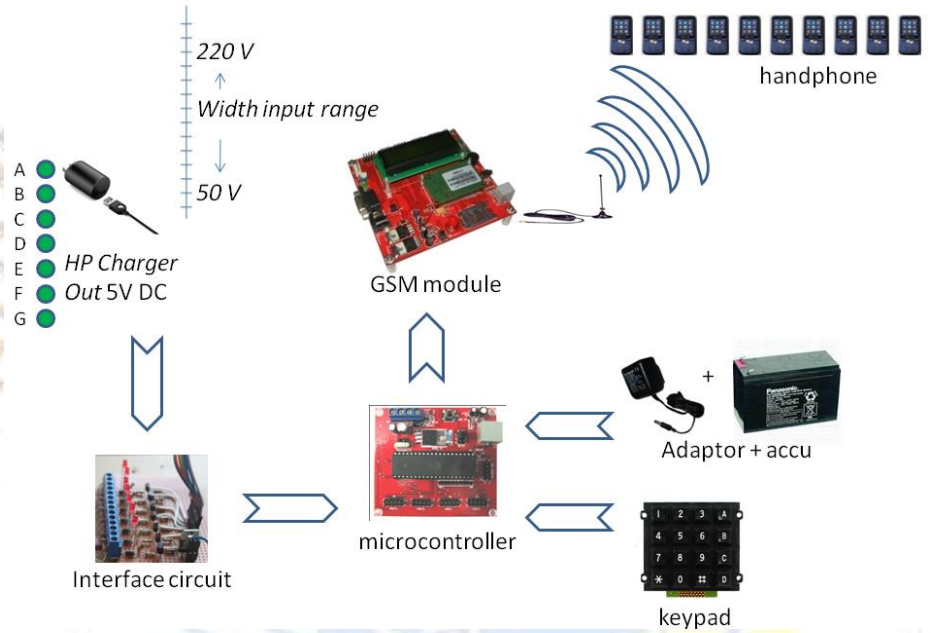

Figure 6. Tool Architecture

Microcontroller Program Flow

To activate this tool, it takes a few seconds to start it. On starting up the microcontroller will retrieve the necessary data such as the destination telephone number, the initial condition of the feeder and other values. After that the microcontroller will check whether the GSM module is active or not. When the GSM module is not active, the microcontroller will activate the GSM module by giving a certain signal. After the GSM module is active, the module will search for networks around it until it is connected to the network and the LCD displays "network found". When the network is not found, the LCD will display that the GSM module is not getting a network. Furthermore, after the network is obtained, the microcontroller will check the communication to the GSM module, if the communication is ok, "Communication OK" will be displayed on the LCD screen. After the communication on the GSM module is 'ok', the equipment is ready for use.

In standby condition the microcontroller will continuously check the condition of each feeder. When one or several of the feeders goes out, the microcontroller will instruct the GSM module to immediately send messages to the numbers that were previously inputted. Likewise, when the feeder is in a recovery state, the GSM module will send a message that the feeder condition has come back to life. In standby mode, you can also set the destination telephone number by pressing the setting button. In this condition, the microcontroller will instruct to enter a password. The password here is intended so that only certain people can change the destination telephone number settings. When the password is successfully entered, then it can be filled in from number 0 to number 9. To delete a number, you can use the delete button. To move the menu to the right or left, use the left or right arrow keys. In addition, this menu also has a shutting down menu, which is used to turn off the tool.

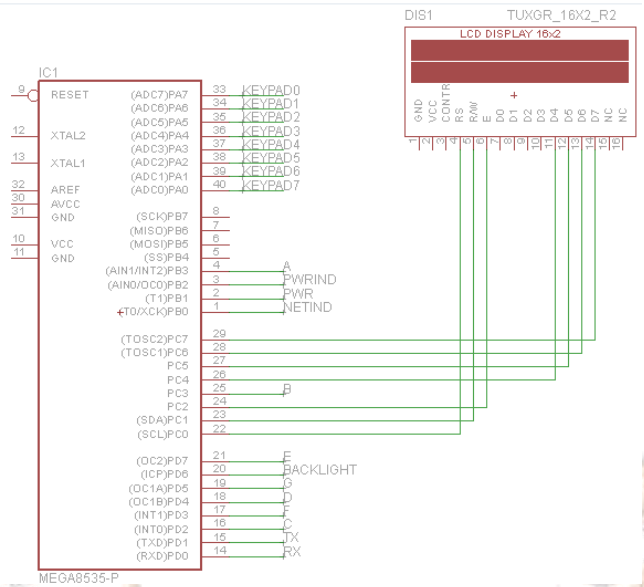

Figure 7. Microcontroller Schematic

IV. RESULTS AND CONCLUSION

RESULTS

Basically this tool can be used in several conditions that monitor the presence or absence of voltage, including:

1. Branching of the 20 kV feeder network
2. PHB-TR

This tool can be installed on the PHB-TR as an indicator that will send a message when the Fuse Cut Out (FCO) attached to the Distribution Substation is broken or the transformer is damaged. When the FCO breaks or the transformer is damaged, officers can only wait for information from local residents because there is no monitoring. This causes the response time to be quite long. However, by installing this tool we can find out the location of the FCO or damaged transformer quickly because this tool will send a direct message to the officers when there is a disturbance that causes the voltage to disappear.

In addition, this tool can also be installed in the Switching Substation. The benefits that will be obtained if applying this tool at the switching substation include:

1. Monitoring disturbances to be under control
2. Make it easier to record interference data
3. Fault data is stored complete with the type and location of the disturbance
4. Data for SAIDI SAIFI is more valid
5. Speed up the response time in the event of a disturbance

CONCLUSION

1. This tool is capable of monitoring disturbances automatically and in real time. In addition, this tool can also send SMS to several pre-determined numbers if there is a change in the condition of the feeder, whether it is an off or normal condition. This tool is also equipped with a battery so that when the 220 volt AC supply goes out this tool can still operate.
2. This tool can be classified as a multifunctional tool, because apart from being installed at a switching substation, this tool can also be applied at branching and at PHB-TR.
3. The benefit obtained from this tool is that it can automatically record disturbance data complete with the type and location of the disturbance so that the data needed for SAIDI SAIFI becomes more valid.

V. REFERENCES

[1] A. Senen, T. Ratnasari, and D. Anggaini, "Studi Perhitungan Indeks Keandalan Sistem Tenaga Listrik Menggunakan Graphical User Interface Matlab pada PT PLN (Persero) Rayon Kota Pinang," *Energi & Kelistrikan*, vol. 11, no. 2, pp. 138–148, 2019, doi: 10.33322/energi.v11i2.497.

[2] F. Laumal, *Implementasi Mikrokontroler Atmega328 Di Bidang Pertanian Dan Industri*. 2017.

[3] A. D. B. Sadewo, E. R. Widasari, and A. Muttaqin, "Perancangan Pengendali Rumah menggunakan Smartphone Android dengan Konektivitas Bluetooth," *J. Pengemb. Teknol. Inf. dan Ilmu Komput.*, vol. 1, no. 5, pp. 415–425, 2017.

[4] K. Bina, W. Jl, H. R. Soebrantas, and S. Baru, "RANCANG BANGUN APLIKASI MONITORING KONSUMSI ENERGI LISTRIK 1 FASA PELANGGAN PLN PASCABAYAR BERBASIS WEB SERVER Mahasiswa Program Studi Teknik Elektro S1 , 2) Dosen Teknik Elektro Program Studi Teknik Elektro S1 , Fakultas Teknik Universitas Riau Email :," *Jom FTEKNIK*, vol. 6, no. 2, pp. 1–6, 2019.

[5] N. Lestari, H. Suwanto, and R. Gunawan, "Sistem Pemantauan Kubikel Tegangan Menengah Berbasis Internet of Things," *Infotronik J. Teknol. Inf. dan Elektron.*, vol. 5, no. 1, pp. 37–42, 2020, doi: 10.32897/infotronik.2020.5.1.5.

[6] F. Hamidy, "Pendekatan Analisis Fishbone Untuk Mengukur Kinerja Proses Bisnis Informasi E-Koperasi," *J. Teknoinfo*, vol. 10, no. 1, p. 11, 2016, doi: 10.33365/jti.v10i1.12.