Auto Transfer Switch (ATS) Panel Design based on Internet of Things (IoT)

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Keywords: Control, Full Automatic, IoT, Energy, Main, Backup.

Abstract: The main source of electricity, namely PLN (Perusahaan Listrik Negara) is not always continuous in its distribution, one day there will be a blackout which may be caused by a disturbance in the transmission system or distribution system. To prevent this blackout, need to design an automatic control called Automatic Transfer Switch (ATS). Automatic Transfer Switch is a switch control circuit that is fully automatic. This tool serves to turn on and connect the backup energy source to the load automatically when the main energy source goes out. When the main energy source returns ON, this tool will transfer the mains voltage source to the load from the backup energy source to the main energy source again. In this research, an Automatic Transfer Switch (ATS) panel based on the Internet of Things (IoT). In addition to automatically connecting energy sources, this tool can be monitored and controlled remotely using an Android smartphone via the internet. In addition to this, this tool can also protect in the event of a power source voltage drop that can cause damage to electronic devices. The results of the tests carried out show that the Automatic Transfer Switch works when there is a blackout from the main energy source and transfers the mains voltage source from the backup energy to the load with a voltage reading error of 1.0% and a current of 1.0%. When there is a transfer of electrical energy sources, the smartphone will display text notifications and ring notifications.

1 INTRODUCTION

Along with technological advances in the field of electricity, the continuity of the electric power supply is ordered. The main power supply from PLN is not always continuous, one day there will be blackouts which can be caused by disturbances in the generating system, transmission system and distribution system. Electricity can result in disruption of service continuity, especially in the activities of the trade, hotel, banking, hospital, educational centers, and industrial sectors in carrying out their production and even in residential homes (Doso, 2013).

The control system or control is now starting to shift to the automation of control systems, so that human intervention in controlling is very small. When compared to manual work, an equipment system controlled by automation will provide advantages in terms of efficiency, safety, and accuracy (Indrawan et al., 2016). Automatic Transfer Switch (ATS) is one of the control systems. Automatic Transfer.

Switch (ATS) is an abbreviation of the word Automatic Transfer Switch (ATS), if it is understood based on the meaning of the word, then ATS is a switch that works automatically, but its automatic work is based on the possibility that if the power source from PLN is disconnected or experiencing a blackout, the switch will move to the source. Another example of electricity is generators.

Several studies on the Automatic Transfer Switch (ATS) have been carried out such as the research on Design and Implementation of Automatic Transfer Switch (ATS) Using Arduino Uno and Relay By Robinzon Pakpahan from Telkom University which can monitor the condition of the power source, voltage, and current in the ATS system. via a web browser. Along with the development of technology that is all practical and online, every research on controlling Automatic Transfer Switch (ATS) continues to be developed, one of which is based on Android. This allows the power source and the amount of electricity to be monitored and controlled by an Automatic Transfer Switch (ATS) system using a smartphone. Therefore, to develop an

Faizi, M., Adam, . and Budiyanto, N.
Auto Transfer Switch (ATS) Panel Design based on Internet of Things (IoT).
DOI: 10.5220/0010957300003260
In *Proceedings of the 4th International Conference on Applied Science and Technology on Engineering Science (iCAST-ES 2021)*, pages 963-968
ISBN: 978-989-758-615-6; ISSN: 2975-8246

Automatic Transfer Switch (ATS) system design system, research is carried out with a monitoring and control system for the Internet of Things (IoT)-based Automatic Transfer Switch (ATS) module. The advantage in this study is that the system will be able to monitor and control the ATS module only by using an android smartphone via the internet. In addition to this, this tool can also protect in the event of a power source voltage drop which can cause damage to electronic devices or as a burden and overload that can damage the device itself.

Based on the description above, in order to facilitate the use of the Automatic Transfer Switch (ATS) panel, in this study a tool was created that can monitor the Automatic Transfer Switch (ATS) panel that can monitor and control the Automatic Transfer Switch (ATS) panel only by using an Android smartphone via a network. Internet. In addition to this, this tool can also protect in the event of a voltage drop. Thus it is possible for an operator to control and monitor the power source through the Automatic Transfer Switch (ATS), anywhere and anytime as long as it is connected to the internet and as load protection in the event of a power failure.

A Auto Transfer Switch (ATS) and Auto Main Failure (AMF)

In the previous study, it was explained about the design of PLC-based Automatic Transfer Switch (ATS) and Automatic Main Failure (AMF) systems. The design to produce ATS with the controller used is a PLC brand Telemanique SR2B201BD. The results obtained that the transfer of the PLN power supply to the generator power supply with a fast response, where starting for 3 seconds, the transfer after receiving the frequency and voltage sensor input for 6 seconds, the transfer delay 3 seconds (Muhammad Nur Shiha, 2011). The PLC used is equipped with temperature, voltage and frequency sensors.

In the previous study, carried out the basic design of the Automatic Main Failure and Automatic Transfer Switch system for the meeting room of the 71 BATAN Serpong building (Enggar et al., 2011). This design aims to anticipate when PLN fails to supply electricity (blackouts), the generator that will replace the role of PLN to supply electrical resources This design produces ATS which has a large size with many components used, such as a timer relay and a lot of contactors because it uses a generator with a generator power (200 kVA) so that components that have the appropriate capabilities are needed.

In research (Hasaafu et al., 2012), designing Automatic Transfer Switch (ATS)/Automatic Main Failure (AMF) Based on Programmable Logic Controller (PLC). This design is made to make it easier to control the power supply in anticipating the loss of power supply to the load by making a backup power supply transfer device quickly with a PLC. After the PLC- based ATS (Automatic Transfer Switch)/AMF (Automatic Main Failure) design has been completed, it can be concluded that if the electrical energy supply from PLN is interrupted, the electrical energy supply will be taken over by the generator automatically. The process of switching the supply of electrical energy from PLN to the generator takes 25 seconds which is used as a process to prepare the supply of electrical energy from the generator such as starting and heating the generator. When the supply of electrical energy from PLN returns to normal, PLN will again take over the supply of electrical energy to the load, while the supply of electrical energy from the generator will be cut off and the generator will be turned off.

B Contactor

A contactor is an electromechanical component that can function as a connector and circuit breaker, which can be controlled remotely the movement of its contacts occurs because of the electromagnetic force. Magnetic contactor is a switch that works based on magnetism, meaning it works when there is electromagnetic induction. Magnets function as attractor and release contacts. The magnetic contactor will work normally when the voltage reaches 85% of its working voltage, when the voltage drops the contactor will vibrate. The size of the contactor is determined by its current capability limit. There are two kinds of contacts on the contactor, namely the main contact and the auxiliary contact. Meanwhile, according to their work, the contacts are divided into two, namely Normally Open (NO) and Normally Closed (NC). The NO contact is when the contactor does not get an electric power supply, the contact is open, while when the contactor gets an electric power supply, the contact will be closed. While the NC contact is when the contactor does not get an electric power supply, the contact is closed while when the contactor gets an electric power supply, the contact is open (Riki Rizaldi, 2018).

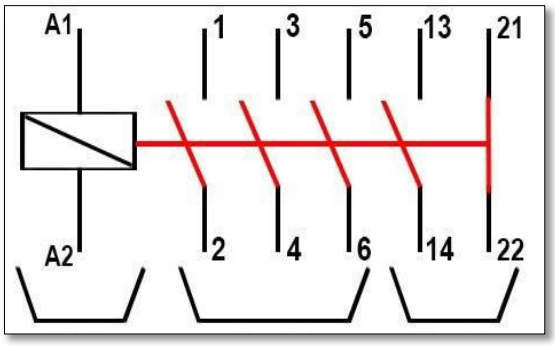

Figure 1: Contactor Circuit (Riki Rizaldi, 2018).

C NodeMCU ESP8266

NodeMCU is an open source IoT platform. Consists of hardware in the form of System On Chip ESP8266 from ESP8266 made by Esperessif System. NodeMCU can be analogous to an Arduino board connected to the ESP8622. Implement the NodeMCU ESP8266 module for smart home. NodeMCU is a versatile wifi module because it is equipped with GPIO, ADC, UART and PWM. In this study the NodeMCU ESP8266 functions as a client and controller for fans and lights. NodeMCU ESP8266 will receive input from sensors to control fans and lights according to the condition of the DHT11 and LDR sensors, send home condition data to the server and receive data from the server to determine whether the PIR sensor is active or not. While on the server side, in addition to displaying information, the server can also send notifications to the user's e-mail. Applications are made on the server side using the PHP programming language and MySQL database (Mochamad Fajar Wicaksono, 2017).

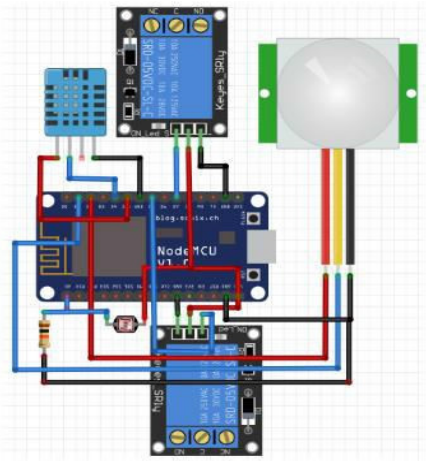

Figure 2: Smart Home Circuit with NodeMCU. (Mochamad Fajar Wicaksono, 2017).

2 METHODS AND DISCUSSION

A System Design

The overall system block diagram design of the Internet of Things (IoT) based Auto Transfer Switch (ATS) panel is shown in Figure 3.

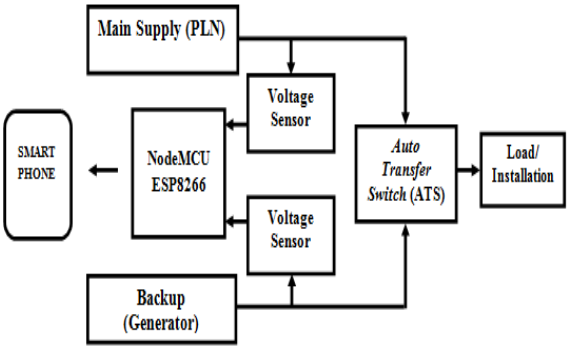

Figure 3: System Block Diagram.

From the block diagram, it can be explained that when the main power supply is interrupted which results in the cessation of electricity, the Auto Transfer Switch (ATS) will work by diverting the supply of electrical energy to a backup power supply and vice versa, when there is no electricity supply from PLN and restore switch to the main switch when the mains supply is available and both supplies can be monitored.

B Hardware Design

The hardware or mechanic design in this research consists of making mechanical Auto Transfer Switch (ATS) panels made of iron plates or box panels. This Auto Transfer Switch (ATS) panel is equipped with a security system with relays and fuses. This operating system is very easy, because it has been arranged in such a way. Next is the design of the voltage sensor. This voltage sensor is made as an input to the NodeMCU ESP8266 module. All output received by the NodeMCU ESP8266 will be sent to the server which was previously processed on a web page created using the PHP language. NodeMCU ESP8266 will also read commands that have been sent by the Blynk Server in TCP/IP format which will then be changed by giving a logic "HIGH" or "LOW".

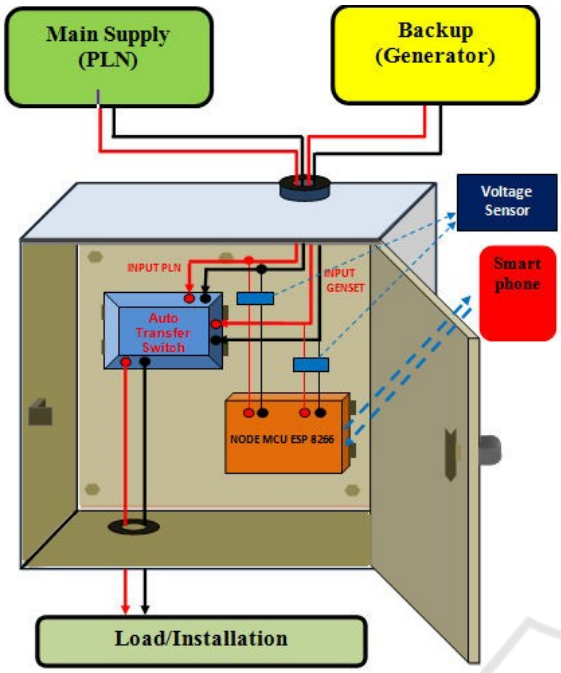

Figure 4: Hardware Design.

C Auto Transfer Switch (ATS) Panel Design

In this study, the design and manufacture of an Auto Transfer Switch (ATS) control system includes hardware and software. Hardware is the stage of work in the production process for making panels and preparing the equipment and supplies needed for ATS panels. In addition, a wiring design drawing is also made on the ATS panel. While software is an installation work and setting settings on Internet of Things (IoT) software so that the control system can operate according to predetermined settings.

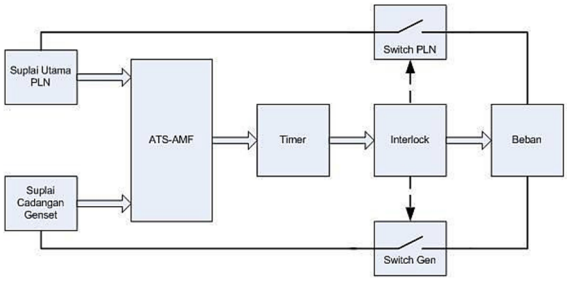

Figure 5: Circuit of Auto Transfer Switch (ATS).

3 RESULT

A Hard Ware Assembly

The manufacturing process starts from making a series of Auto Transfer Switches for automatic supply transfer control. Next is the control panel. Figure 6 shows the Auto Transfer Switch panel created by this research.

Figure 6: Auto Transfer Switch Panel.

B NodeMCU ESP8266 Testing

NodeMCU is an electronic board based on the ESP8266 chip with the ability to run microcontroller functions and also an internet connection (WIFI). NodeMCU is usually analogous to an Arduino board that is connected to the ESP8266 into a board that has been integrated with various features like a microcontroller so that in programming only a USB data cable is used.

Because the main source of NodeMCU is ESP8266 especially ESP-12 series which includes ESP-12E. So the features owned by NodeMCU will be more or less similar to the ESP-12.

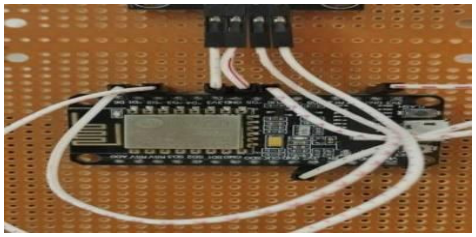

Figure 7: Testing NodeMCU esp8266.

In testing NodeMCU, that is by entering the program that has been made and then uploading it. Indicates the program has succeeded or failed in the upload process. As in Figure 8 and Figure 9.

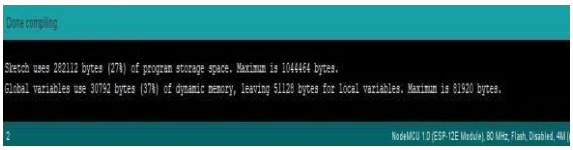

Figure 8: Program Uploaded Successfully.

Figure 9: Programs Failed to Upload.

C ZMPT101B Voltage Sensor Testing

Voltage sensor testing is carried out to see sensor error percentage. This test was carried out 10 times. Table 1 is a test of the ZMPT101B Voltage Sensor.

Table 1: A test of the ZMPT101B Voltage Sensor.

No	Input Voltage (Volt)	Testing with a multimeter (Volt)	Average Voltage (Volt)	Error (%)
1	190	187 188 189 190 191	189	0.5
2	200	198 199 201 202 203	200.6	0.3
3	210	212 213 214 215 216	214	1.9
4	220	221 223 224 225 226	223.8	1.7
5	230	233 234 235 236 237	235	2.1

D Interlock Test

This test is used to determine the system Interlock according to the state of the sensor readings to find out suitable for know whether the automatic switching of the power supply is appropriate with the program.

Table 2: Interlock when main supply is off.

No	Main Supply	Backup Supply	Time (S)	Description
1	On	Off	-	Main Supply
2	Off	On	0,3	Indicator lights up and sends notification
3	On	Off	0,3	Indicator lights up and sends notification

From table 2 it can be explained that when the main supply is not available then the switch will switch, disconnect the main switch and connect the backup supply switch with a time delay of 0.3 seconds and the system will send a notification to the android.

4 CONCLUSION

After testing in this research, it can be concluded as follows: The designed monitoring system has been tested for 1 hour in data transmission. From all test data can be sent and with the average delivery delay time is 0.49 minutes. It is usage IoT for monitoring system is stated to work well. The average monitoring system test results for the input voltage of 222 Volts, output voltage of 223 Volts. ATS based IoT is relatively affordable than factory-made ATS panels or PLC-based modules. So it is suitable for use by the home industry.

REFERENCES

Autade Prerane, S. G .Galande, An Embedded 1/3 Phase Automatic Transfer Switch Tranfer Switch Controller With Intelligent Energy Management, IJCT,Volume 2, Issue 2, 2013

Bill Brown, P. E., Jay guditis, Critical-Power Automatic Transfer Systems Design and Application, 2006

Doso, 2013, ATS (Automatic Transfer Switch), http://dosooce.blogspot.com/2013/10/ats- Automatic-transfer-switch.html diakses tanggal 03 Mei 2021

Enggar T. Santosa, Maradu S., Suripto, 2011, Rancangan Dasar Sistem Automatic Main Failure dan Automatic Transfer Switch untuk Ruang Pertemuan Gedung 71, Proceeding Pertemuan Ilmiah Rekayasa Perangkat Nuklir PRPN-BATAN

Hasaafu, Ambo, L.O.A.R., Hande, S., 2012, Rancang Bangun ATS-AMF Berbasis PLC, Jurusan Teknik Elektro Politeknik Negeri Ujung Pandang Makassar.

Indrawan, A.W., Hamdani, Nuraminah, 2016, Rancang Bangun Sistem Kendali Dan Monitoring ATS/AMF Dalam Pengalihan Sumber Energi Listrik Menggunakan Mikrokontroler, ELEKTRIKA, hh. 130 – 141. ISSN 1412-8764

Jagra Bagus Haryanto, Perancangan Automatic Main Failure Dan Automatic Transfer Switch DilengkapiDengan 10 Kondisi Display dan 4 Kondisi Back Lighting Menggunakan Zelio Logic Smart Relay (SR), Universitas Diponegoro, 2012

Mochamad Fajar Wicaksono, 2017, Implementasi Modul Wifi NodeMCU ESP8266 Untuk Smart Home, Jurnal Teknik Komputer Unikom – Komputika –Volume 6, No.1 -2017

Muhammad Nur Shiha, 2011, Rancang Bangun Sistem Automatic Transfer Switch (ATS) dan Automatic Main Failure (AMF) PLN-Genset berbasis PLC Dilengkapi Dengan Monitoring, Jurusan Teknik Elektro Industri PENS-ITS, Surabaya 60111

Riki Rizaldi, 2018, Perancangan ATS (Automatic Transfer Switch) Satu Phasa Menggunakan Kontrol Berbasis Relay dan Time Delay Relay (TDR), Journal of Electrical Power Control and Automation, Vol. 1 No. 2 HAL. 59-64