Remote Monitoring Application for Automatic Power Supply System in Telecommunication Network

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Abstract. The source of backup power supply at telecommunication BTS is only temporary because its power only depends on the generator and battery capacity used. However, on the other hand, the backup power system is rarely monitored due to a lack of resources such as human resources and the remote location of the equipment/site. Meanwhile, the use of Android which is open source is now widely used by the public for many things, but there are still not many Android applications used to control the power supply system. The purpose of this research is to design and analyze the automatic backup power system on the integrated power system in the telecommunication network by adding an Android application to monitor the occurrence of faults in the system. The communication used in this research is the connection of the automatic backup power control circuit, the microcontroller, the webpage, and the android application itself. Automatic backup power control circuit in the form of a main power transfer control circuit, for example, the power from State Electricity Company (PLN), if a problem occurs it will switch to the back-up power in the form of a generator and battery. The results show that the design of the automatic power system device can work properly.

1. Introduction

Telecommunication companies have a backup power system so that if the main electricity supply, for example from the State Electricity Company (PLN), turns off, the telecommunication equipment will not immediately shut down because of the backup power system, namely from the battery which will supply electricity to the equipment without any dead pauses for the equipment so that a Telecommunication transmitter or what we usually call the Base Transceiver System (BTS) is still operating even though the electricity from PLN is dead. However, this backup power source is only temporary, the power of which depends on the capacity of the battery used and also on the size of the load from the BTS. Therefore, in addition to having a battery as backup power, a BTS also has a backup power system, namely from the generator that works when the PLN as the main electricity is off or not functioning.

Installation of this generator depends on whether a transmitter or BTS is important or not for the smooth running of the telecommunication network, if it turns out that the BTS is only a complement or there are only a few subscribers connected to the BTS then the Telecommunication company will not install a generator on its BTS but only sufficient. install a battery for backup power [1]. Conventional automatic backup power systems rely a lot on Relay, timer, and contactor work systems that work interdependently with each other so that if one component has a problem, the automatic system will not work but we can quickly find out. Meanwhile, the Semi Compact one has added a module called Automatic Mains Failure (AMF) which functions to replace part of the timer and relay so that it is...
compacted in one module but in one system there are still Relay and Contactor components. And the last one is a Full Compact system so that in this system all control systems are in one module so that in this system there is only voltage input and output and the controller output to the Auto Transfer Switch (ATS) which functions to transfer the main power source both from PLN and from Generators automatically set by this Full Compac System. inside there is a PLC, Microcontroller. Android is an operating system based on open source so that users can contribute to developing the operating system device that is now very popular with the community.

The use of Android which is now widely used by the community can be used for many things, one of which is controlling the lights automatically using Android. The communication used is the output LAN connection from the microcontroller and connected to the server then Android which is connected to the server with the Application Programming Interface (API) which is already integrated into the Android operating system, where this API application will later communicate with the Server and Microcontroller. The method in developing the communication theory between Android and the Microcontroller itself is carried out by the action research method, where we directly test the Android and Microcontroller communication theory whether it can happen or not.

Android and microcontrollers can communicate with each other through this intermediary API which is connected to the server, and currently, the author is trying to take advantage of cloud computing technology so that it can be more integrated with the system that has been tested so that the hope that this technology can be used anywhere This study aims to determine and analyze the possibility of communication between Automatic Power back-up control, microcontroller, Internet and Android so that it can be used to monitor power systems on telecommunication networks. A generator is a tool that works using Faraday's experimental principle, namely rotating the magnet in the coil or vice versa, when the magnet is moved in the coil, there will be a change in the magnetic flux (change in the direction of the spread of the magnetic field) in the coil and it penetrates perpendicularly to the coil causing a potential difference between the ends of the coil which generate electricity [2].

Cellular Mobile Communication System is a communication system with wireless transmission media (free space), which is able to provide a good degree of mobility to the user/mobile station (MS). The moving user causes the random character of the signal on the transmission channel. This system is cellular, which means that network coverage is divided into several cells. Meanwhile, data communication is the process of exchanging data or sending data from source to destination. The important thing in data communication is the type of communication used, whether using a cable, infrared, or using a certain frequency [3].

Arduino Mega 2560 is a microcontroller board based on Atmega 2560. Arduino Mega 2560 has 54 digital input/output pins, of which 15 pins can be used as PWM output, 16 pins as an analog input, and 4 pins as UART (hardware serial port), 16 MHz crystal oscillator, USB connection, a power jack, ICSP header, and reset button. This is all it takes to support the microcontroller. Simply plug it into your computer via a USB cable or plug it in with an AC-DC adapter or battery to start turning it on. Arduino Mega 2560 is compatible with most of the shields designed for Arduino Duemilanove or Arduino Diecimila. Arduino Mega 2560 is the latest version that replaces the Arduino Mega [4].

2. Methodology

This study uses an experimental method to the prototype of the tool made. The main control circuit used is a simple Auto Transfer Switch (ATS) circuit that is connected to a Microcontroller as a liaison and controller that can also connect to the Web and Android applications. The microcontroller will be used as a link between the Web and the ATS Control. The block diagram for this system shows the control process using the closed-loop control method.
The stages of this research consist of a) Designing the process, b) Designing ATS and Microcontroller control circuits, c) Designing a Web Server, d) Designing Android Applications, e) Designing tools, f) Coding and g) Testing. While the components used in making Back-Up Power tools with the Web and Android as a monitoring system include power supply, relay, contactor, MCB, Arduino ATMega 2560.

The simulation circuit is shown in figure 2, with the function of each block:

- CPU: Carry out ATS / AMF functions and provide reports via LAN
- Relay AC 1, Relay AC2, Relay AC3: To detect whether the PLN Electricity is On / Off
- Relay AC 4, Relay AC5, Relay AC6: To detect whether the Generator Output Electricity is On / Off
- Contactor 1: To Connect / Disconnect PLN Electricity to Load
- Contactor 2: To connect/disconnect the generator output electricity to the load
- Relay DC 1: To select Electricity to Load whether from PLN or from the generator by controlling Contactor 1 and Contactor 2 by toggle (if Contactor 1 is ON then Contactor 2 is OFF and vice versa)
- Relay DC 2: To Connect / Enable Choke on Genset (CK)
- Relay DC 3: For Starter / Ignition Genset (IG)
- Relay DC 4: For ON / OFF Genset (ON)
- Mini UPS: As a DC Power Supply (for CPU and DC Relay Systems), it is held as a backup Power Supply because the CPU and DC Relay must always be ON even though the electricity from the PLN and the Genset is dead
- Relay Driver: For conversion from the output (data) from CPU to DC Relay directly (If Pin OUT 0 relay ON if Pin OUT 1 Relay OFF)
- Relay Driver FF (Flip Flop): For conversion from the output (data) from CPU to Relay DC Indirectly (in the driver there is a buffer to store the last position of the command to the relay)

The system works by:

a) Initial conditions, PLN electricity ON Genset OFF
   1. Relay AC 1 ON, Relay AC2 ON, and Relay AC3 ON (IN1 ON, IN2 ON, and IN3 ON / CPU Detects PLN electricity turns on all phases)
   2. Relay AC 4 OFF, Relay AC5 OFF, and Relay AC6 OFF (IN4 OFF, IN5 OFF, and IN6 OFF / CPU Detect Electricity from Genset is all phase)
   3. Relay DC 1 is turned OFF by the CPU (OUT1 OFF / Contactor 1 ON, Contactor 2 OFF)
   4. Contactor 1 ON = Electricity load supplied by PLN
b) Electricity PLN OFF
   1. Relay AC1 OFF or Relay AC2 OFF or Relay AC3 OFF (IN1 OFF or IN2 OFF or IN3 OFF / CPU Detects PLN electricity is off at least in one of its phases)
   2. CPU turns ON Relay DC 2 (OUT2 ON / Choke activated)
   3. CPU turns ON DC 4 Relay (OUT4 ON / Genset is ON)
   4. CPU provides a pulse for 5 seconds to Relay DC 3 (OUT 3 Pulse / Ignition Start)
   5. If the generator is on normally:
      a. AC4 ON Relay, AC5 ON Relay, and AC6 ON Relay (IN4 ON, IN5 ON, and IN6 ON / CPU detects Genset Power On all phases)
      b. CPU turns OFF DC 2 Relay (OUT 2 OFF / Choke disabled)
c. CPU Set Timer 5 minutes just after Relay AC 2 ON (For warming up Genset)

4. After 5 minutes, the CPU turns ON the DC Relay 1 (OUT1 ON)
   a. Contactor 1 (PLN) OFF
   b. Contactor 2 (Genset) ON
   c. Electrical loads are supplied by the generator

![ATS Simulation Circuit](image)

Figure 2. ATS Simulation Circuit

c) Electricity PLN ON Again
1. Relay AC1 ON, Relay AC2 ON, and Relay AC3 ON (IN1 ON, IN2 ON, and IN3 ON / CPU Detects PLN electricity turns on in all phases)
2. Relay DC 1 is turned OFF by the CPU (OUT1 OFF)
   a. Contactor 1 (PLN) ON; Contactor 2 (Genset) OFF; and Electricity Charges supplied by PLN)
   b. CPU Set Timer 2 minutes just after Relay AC 1 ON (For preparation to turn off Genset / Genset Cooling Down)
3. After 2 minutes, the CPU turns OFF the DC 4 Relay (OUT4 OFF / Genset is turned off)

3. Results and Discussion
   The test carried out on this tool is in the form of an experimental process of cutting off the PLN electricity by lowering one of the MCBs on the board. The stages are in the form of testing the control circuit (working with the replacement of the voltage supply) and reading the results of the operation of the control by connecting to the webserver and Android. The first step is to cut off the electricity from one of the phases to prove that the control circuit is working properly.
For reading on the Web Server, after testing the control circuit, if there is a power cut from the PLN source, an alert will appear with the display as follows:

a. Mode 0: Normal PLN (all r, s, and t phases ON), Genset OFF, Load supplied by PLN (PLN contactor ON, Genset contactor OFF)
b. Mode 1: PLN is not normal (phase r, phase s, or phase t is OFF), the load is not supplied by PLN or the Genset (PLN contactor is OFF, Genset contactor is OFF), Genset is ON in order to warm up
c. Mode 2: PLN Abnormal, Genset ON Normally (all phase r, s, t, and Genset ON), Load supplied by Genset (PLN contactor OFF, Genset contactor ON)
d. Mode 3: Normal PLN (all r, s, and t phases ON), Genset ON in order to cool down, Load is supplied by PLN (PLN contactor is ON, Genset contactor is OFF)
e. Mode 4: PLN Abnormal, Generator OFF (Cannot turn ON normally), Load is not supplied by PLN or Genset (PLN contactor OFF, Genset contactor OFF)
f. Mode 5: PLN Abnormal, Genset ON but not normal and in the cooling down process, the load is not supplied by PLN or Genset (PLN contactor OFF, Genset contactor OFF)

![Figure 3. Alerts when power cuts from the PLN](image)

Meanwhile, if on Android an alert will appear as shown in figure 4. In addition, the control circuit system, both from the relay and contactor or from the Arduino microcontroller, still occurs delays, debugs, or hangs so that it does not run properly and needs to be reset from the beginning. The Web server and Android application must be ensured that they are always on the same Internet or server network because if they are different they will not be connected to each other. Server networks, Internet or WiFi around the device and Android should not interfere or be connected to one of the systems, for example from a series or Android because it will cause the system or application to not work properly.
4. Conclusion

Control design with relays and contactors has been carried out. Both are inseparable units so that they can be connected to power devices such as generators. The use of the Arduino microcontroller in this tool is very good and suitable because it has the necessary facilities as well as making coding that is easy to apply. Using a microcontroller can provide convenience in changing control functions without having to change permanent electronic circuits. As for Android with the API application, it is also very helpful in monitoring existing control circuits.

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