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Fault Detection in Three Phase Transmission Line with Location

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Abstract: *Power transmission is a major issue in Electrical Engineering after Power generation. Fault in transmission lines is common and major problem to deal with in this stream. This paper presents a technique to detect the location of the different faults on a transmission lines for quick and reliable operation of protection schemes. The simulation is developed in Proteus to generate the fundamental component of the transient voltage and current. Proteus software is used to simulate different operating and fault conditions on high voltage transmission line, namely single phase to ground fault, line to line fault, double line to ground and three phase short circuit. Effects of variations in the fault resistance (Rf), distance to fault (Lf) have been studied broadly on the voltage, current and its relation to impedance of the system which creates the logic for detection, classification and location of faults. Phase absence is a very common and severe problem in any industry, home or office. Many times one or two phases may not be live in three phase supply. Because of this, many times, some electrical appliances will be on in one room and OFF in another room. This creates a big disturbance to our routine work. Power Failure is common problem. it hampers the production of industry, construction work of new plants and building. It is often noticed that power interruption in distribution system is about 70% for single phase faults while other two phases are in normal condition. Thus, in any commercial or domestic power supply system where 3 phases are available, an automatic phase selector system is required for uninterrupted power to critical loads in the event of power failure in any phase. There is no requirement of backup power supply in that case. also there is no time consumption as the phase is changed automatically within a few seconds.*

Keywords: Transmission Line faults, Transmission Line Protection, Detecting and Locating faults in overhead transmission lines, Fault Analysis in transmission line

I. INTRODUCTION

Generally, we are transmitting power from the generating station through the transmission line.Mainly, there are two type of transmission lines.

1. Overhead transmission lines
2. Underground transmission lines

Different type of fault in 3 phase is
1. L-L Fault (Line to Line Fault)
2. L-G Fault (Line to Ground Fault)
3. 2L-G Fault (Double line to Ground Fault)

Is a fault which is cleared by the immediate tripping of one or more circuit breakers to isolate the fault, and which does not recur when the line is re-energized?

Faults tend to be less transient (near the 80% range) at lower, distribution voltages and more transient (near the 90% range) at higher, sub transmission and transmission voltages.

Thus, transient faults can be cleared by momentarily de -energizing the line, in order to allow the fault to clear. Auto reclosing can then restore service to the line that's why we make this made this project.

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The project is designed to develop an automatic tripping mechanism for the three phase supply system. The project output resets automatically after a brief interruption in the event temporary fault while it remains in tripped condition in case of permanent fault.

In this paper, RELAY module is used to detect Fault in Transmission line and locate the Distance in LCD display.

II. BLOCK DIAGRAM

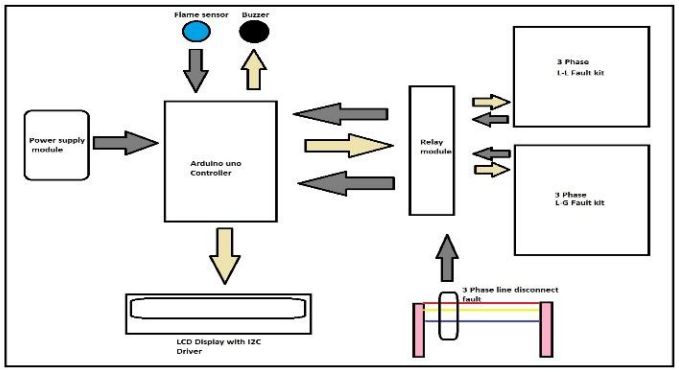

Fig 2.1. Block Diagram

2.1 Block Diagram Description

Transmission line representation: The resistance of 1 kilohm represents the transmission line length. Each kilohm of resistance corresponds to 1 kilometer of line length.

- Reading fault values: The line-to-line fault input is connected to analog pin A0 of the Arduino, and the line-to-ground fault input is connected to analog pin A1. The Arduino continuously reads the voltage values from these pins.
- Flame sensor: The flame sensor is connected to digital pin 2 of the Arduino. It detects the presence of a flame or fire.
- Line disconnection detection: If the transmission line gets disconnected, the fault signal is connected to digital pin 3 of the Arduino. The Arduino monitors this pin for a change in status.
- Buzzer: The buzzer is connected to digital pin 4 of the Arduino. It is used to produce an audible alarm in case of a fault or line disconnection.
- LCD display: The Arduino is connected to an LCD display using an I2C driver. The LCD display shows information about line-to-line faults and line-to-ground faults, along with their corresponding kilometer-wise locations.
- Fault detection and relay control: To read fault values one by one, you have connected three relays for line-to-line faults and three relays for line-to-ground faults. The relays are controlled by the Arduino. Each relay is activated sequentially to read the fault value and transmit it to the Arduino for further processing.
- Data display on LCD: The Arduino processes the fault values and displays the information on the LCD display. The LCD shows the fault type (line-to-line or line-to-ground), along with the kilometer-wise location of the fault.
- Fault indication: If a fault is detected, the Arduino triggers the buzzer connected to digital pin 4, generating an audible alarm to alert the user about the fault condition.
- Flame detection: The Arduino continuously monitors the flame sensor connected to digital pin 2. If a flame or fire is detected, the Arduino can take appropriate actions based on your programming, such as shutting down the system or activating safety measures.

In summary, your circuit uses various components such as resistors, Arduino controller, flame sensor, relays, LCD display, and a buzzer to detect line-to-line and line-to-ground faults in an overhead transmission line. The Arduino reads the fault values, processes them, displays the information on the LCD, and triggers the buzzer in case of a fault or flame detection

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III. FAULT DETECTION METHOD

Transmission lines operate spreading power from a generating station to remote load centers. Due to the existence of lightning strokes, the system has some miss-operation like a short circuit with this problem line could be overloaded hence it can damage the equipment. Due to the occurrence of a fault, the phase voltage does decrease and enormous current flow, which could damage the equipment. In this condition, fault detection play important role which can interrupt in the system very quickly. In the transmission line, the fault is comprised of ten parts that could interrupt in the three phase system, single line to ground, line to line fault, double phase to ground and the last one is three phase fault. A single line to ground fault occurs when it makes contact with the ground during the occurrence of fault the impedance. Z fag, has some value it could not be considered zero impedance but still less than the impedance line. The magnitude of the fault current is frequently increased as compared to the normal current that is operated, but the magnitude of voltage remains unchanged frequently. Table 1 shows the occurrence of each type of fault.

The series compensation is more efficient on transmission voltage that is essential to know because in series compensations have faced some technical problems when it is operated mainly with this problem is occurred like slow voltages and also high voltages. These operational problems occurred due to a different type of caused like as line loading conditions and voltage control adjusted. In series compensations system has used a capacitor. This capacitors one side has to effectively controlled

Fault Category	Design	Occurrence %	Simplicity
Line-Ground	L to G	85	Very Low
Line-Line	Lto L	8	Low
Double line - Ground	L-L-G	5	Moderate
Three Phase	L-L-L	2	Very High

otherwise it will be based on voltage problems. For this reason, we can use series compensation for decrease voltage problems otherwise most probably overvoltage can cause these problems. On the other hand, in series compensation increase the voltage when the lines are heavily loaded and also low voltages occurred on the line. And flashovers occur due to high voltages or shrink the lifetime of devices and caused short circuits. We can use series compensation as a flows control of power. On the other hand, in a series compensated line based on current and voltage inversions each other.

The fault identification scheme for the series compensated by the fault and its magnitudes change in fault voltages as a positive sequence and terms of fault current change as a positive sequence. When in series compensated lines developed by the algorithm for fault currents and phase voltages to get the decisions by using EMTDC/PSCAD. We can use a capacitor or don't have used capacitor regarding the testing process of series lines by just changing the source capacity, fault resistance, the fault inception angle, power flow direction those are the different system condition.

During the measure of current signals and voltage signals in both cases used fault location algorithm, two subroutines applied for locating faults and also for generalized fault loop model by taking help using different formulas. The fault is occurred in anywhere the fault doesn't maintain any distance of the parameters. The using of parameter both-end signals for measuring asynchronously compensating bank and it mainly depends on the location of the bank. In the special types of faults can be recognized by used to ATP-EMTP for the compensated of double-circuit series line. By using the method to verify the detected the fault in the transmission line is described on a double-circuit line. Moreover, this method is appropriate for the protection of uncompensated double circuit lines, and also series- compensated double circuit lines through the applied phase currents can measure. To get the simulation result we of cognitive software of ATP-EMTP. Measurement channels the SCs & MOVs banks are developed by a complete model of the transmission line. The proposed algorithm used for two subroutines those are used to detect unbalance and balanced lines currents and approximately 99% correct fault categorization by symmetrical parallel line but in case of the line is unbalanced more than 85-95% ac

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IV. SYSTEM COMPONENTS

4.1 System Hardware

- Arduino UNO
- LCD Display
- Relay
- Buzzer
- Switches
- Power Supply Adapter
- Flame Sensor
- Software
- Arduino IDE
- Proteus Software for simulation

Arduino UNO

Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments.

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means "One" in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

many embedded projects to process the data of the system.Today we are using wide number of data processing tools. The specifications of Arduino UNO board are:

- Operating Voltage: 5V
- Input Voltage(recommended):7-12V
- Input Voltage (limits): 6-20V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40mA
- DC Current for 3.3V Pin: 50mA
- Flash Memory: 32 KB(ATmega328)
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz

Fig 4.3.1. Arduino UNO

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Relay

Relay is one kind of electro-mechanical component that functions as a switch. The relay coil is energized by DC so that contact switches can be opened or closed. A single channel 5V relay module generally includes a coil, and two contacts like normally open (NO) and normally closed (NC). This article discusses an overview of the 5V relay module & it's working but before going to discuss what is relay module is, first we have to know what is relay and its pin configuration.

5V Relay Pin Configuration

The pin configuration of the 5V relay is shown below. This relay includes 5-pins where each pin and its functionality are shown below.

- Pin1 (End 1): It is used to activate the relay; usually this pin one end is connected to 5Volts whereas another end is connected to the ground.
- Pin2 (End 2): This pin is used to activate the Relay.
- Pin3 (Common (COM)): This pin is connected to the main terminal of the Load to make it active.
- Pin4 (Normally Closed (NC)): This second terminal of the load is connected to either NC/ NO pins. If this pin is connected to the load, then it will be ON before the switch.
- Pin5 (Normally Open (NO)): If the second terminal of the load is allied to the NO pin, then the load will be turned off before the switch.

Working:

The relay uses the current supply for opening or closing switch contacts. Usually, this can be done through a coil to magnetize the switch contacts & drags them jointly once activated. A spring drives them separately once the coil is not strengthened.

By using this system, there are mainly two benefits, the first one is, the required current for activating the relay is less as compared to the current used by relay contacts for switching. The other benefit is, both the contacts & the coil are isolated galvanically, which means there is no electrical connection among them.

Fig 4.4.1 Relay model

Switches: -

In this project we are used deep trading red switches.

By using this switches we are created to Circuits Namely Line Ground Fault Circuit and another one is Line Line fault Circuit.

Purpose of this switches is creating fault in Line to Ground Fault Circuit and Line Line Fault Circuit.

Fig 4.5.1 Switches

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V. RESULTS

Prototype model

The prototype model is shown in below figure5.

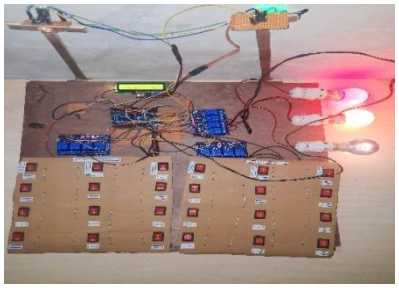

Fig 5.1 Prototype model

This is the Three phase transmission line fault detection with location using Arduino. In system hardware Model, the Arduino UNO board is switched ON with 5V DC supply by using Adapter. The display and other auxiliaries are connected to it.

There are two circuits created namely Line to Line Fault Circuit and Line to Ground Fault Circuit by using Red Deep Trading Switches

Purpose of these switches are for creating the fault by using resistors also here 4 channel Relay module connected in series with these switches and another one is connected for protection purpose toward load side. Load side is R Y B phase connected by Lamp.

Arduino UNO is coded by C programming, thses program is uploaded in Arduino UNO by using Arduino IDE software.

VI. CONCLUSION

This paper presents fault detection in three phase transmission line with location. This technology is identify the fault in transmission line and locate it on LCD display in control room substation. Using this technique, we can save the time at time of fault detection. This simplifies implementation and usage. After identifying the fault then team can be quickly cleared the fault in minimum time

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