Fault Detection and Alert System using Micro-Controller

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Abstract—The reliability of power supply is negatively impacted by the occurrence of faults. The importance of power system fault detection is illustrated in this paper, along with the procedures used to locate and identify a fault scenario. An Arduino based micro-controller is used for alert signal detection along with circuit breaker modules which trip, signaling the relays to act. SMS module has also been used to alert the proper authority through a GSM module, and a GPS module is used to detect the SMS location.

Index Terms— Fault, GPS, GSM, Micro-controller

1. INTRODUCTION

The duty of fault detection is significant and crucial, without which the power system may experience several issues and harm. Since creating a fault is a dangerous and harmful, our strategy will be to simulate it instead. The reduction of unwanted expenses and damages depends on fault detection. Early process flaw detection helps prevent the escalation of abnormal events. Early detection of process flaws is necessary to meet the growing demands on the dependability and safety of technical facilities. Methods that enable earlier defect identification in processes than traditional limit and trend checks based on a single process variable have been developed.

By modelling a fault, we examine the depth of fault detection in this research and discover how to alert a system and safeguard a load.On transmission lines for electrical power systems, problems must first be identified, correctly diagnosed, and repaired as quickly as feasible. The relays that protect the electrical system from blackouts can be started using the transmission line protection system. The purpose of fault detection, according to generally accepted nomenclature, is to identify or pinpoint faults in a process or system. Then, the problematic process or variable should be isolated because doing so provides a more relevant information about the problems, such as the root cause of a fault. This paper demonstrates the significance of power system fault detection and the steps we will take to identify the faults and transmit an alert to the micro-controller based module.

2. METHODOLOGY

The Arduino Uno micro-controller will show the appropriate data onto the LCD when a malfunction is found. The circuit breaker is then tripped by the micro-controller by sending a signal to the relays. Via a GSM module, a SMS is used to notify the appropriate authority. Moreover, a GPS module is employed to pinpoint fault position. Programming in the Arduino Language has been done using the Arduino IDE. Prior to using the LCD function, which is a component of the Liquid-Crystal library, data transmission and reception via the ports require initialization. The method used is fault detection using Embedded Systems and Fault Detection and Alert Systems using a micro-controller which is explained as follows:

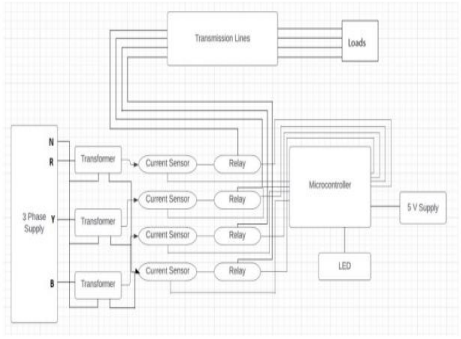

Fig. 1. Block Diagram of Fault Detection Module.

2.1 Construction and Working

By taking a 220V three phase AC supply we are connecting it to three 12V/3A step down transformers which steps the input supply to 12V. The neutrals of the three transformers are connected in star. The voltage that is stepped down by each of the three transformers is connected to the common terminal of

three relays. The star connected common neutral is connected to common terminal of the fourth relay. The NO terminals of the four relays are connected to the current sensors. The Vcc, OUT, and GND terminals of the current sensors are further connected to the analog inputs A0, A1, A2 of the Arduino Uno micro-controller. A Corsair Power supply(5V) is used to provide DC power to the Arduino Uno, GSM Module and GPS module. SIM800C GSM Module is connected to the 3.3V pin of the Arduino Uno and the J10 pin of the GSM module is connected to pins 8 and 9 of Arduino Uno. The J2 pin is connected to LCD display. The Vcc of the U-BLOX NEO-6M GPS Module is connected to 3.3V pin of Arduino and Rx, Tx pins connected to pins 10 and 11 of Arduino. Its ground is common-ed and given to LCD display. Eleven 0.7V/150mA LEDs are used to represent the loads connected to the transmission lines. The GSM module sends an SMS to the concerned authority and the GPS module is used to send the location of the occurrence of the fault. A 16x2 LCD display is connected to the Arduino Uno pins and is powered by the Corsair Power Supply which displays the type of fault and the location at which the fault has occurred.

2.2 Fault Scenarios

The following fault scenarios are observed and displayed during the occurrence of a fault: a) Unsymmetrical Faults:

1) No Fault: The circuit is closed by the relay, and power is sent to the load. Every current value in this case is lower than the pickup current.

2) Single Line to ground Fault: A single line is short-circuited with the ground. The system is isolated by a relay, and the LCD shows the malfunction.

3) Line to Line Fault: This type of fault occurs when any two lines are shorted together and the current in both lines exceeds the pickup current. An LCD shows the type of fault and where it is located.

4) Double Line to Ground Fault: In this case, any two lines that are connected to ground and short-circuited have currents that are more than the pickup current. As a result, the LCD shows the fault.

b)Symmetrical Faults: Three phase faults: The line currents on their own are bigger than the pickup current. Here all the three phases are shorted together.

3. HARDWARE

The following components were used:

1) 12 V 3 Amp transformer (3 Nos): Each of the 3 phases is connected to one of these transformers. It steps down the 220V AC supply to 12V DC supply.

2) ACS712 current sensor 5 Amp (4 nos): The NO terminals of the four relays are connected to the current sensors. The Vcc, OUT, and GND terminals of the current sensors are further connected to the analog inputs A0, A1, A2 of the Arduino Uno micro-controller.

3) 4 Relay Modules: The voltage that is stepped down by each of the three transformers is connected to the common terminal of three relays. The star connected common neutral is connected to common terminal of the fourth relay.

4) 10 Ohm/3 Watt resistors(4 in each line, total 4 lines=16 resistors): There are a total of 16 resistors(4 in each line). It is used to display a resistance of 10 Ohms per 2 kilometers when a fault occurs. These are connected to the current sensors.

5) 0.7V/150mA LEDs: These represent load connected to the transmission lines.

6) Corsair Power Supply: This is used to get a 5V DC supply.

7) SIM800C GSM Module: It is connected to the 3.3V pin of the Arduino Uno and the J10 pin of the GSM module is connected to pins 8 and 9 of Arduino Uno. The J2 pin is connected to LCD display.

8) U-BLOX NEO-6M GPS Module: Its Vcc is connected to 3.3V pin of Arduino and Rx, Tx pins connected to pins 10 and 11 of Arduino. Its ground is common-ed and given to LCD display.

9) Arduino Uno Micro-controller.

10) 16x2 LCD Display: It displays the nature of fault and where it has occurred.

4. ARDUINO UNO AND IDE

The Arduino Uno is a micro-controller board based on the ATmega328P micro-controller chip. It is a popular board among hobbyists and professionals alike due to its simplicity, ease of use, and versatility. The board has 14 digital input/output pins, six analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. It can be programmed using the Arduino programming language, which is based on C and C++. The Arduino

Uno can be used to build a wide range of projects, including robotics, home automation, and interactive art installations. Its open source nature and large community of users and developers make it easy to find resources and support online.

5. RESULTS

The following results are obtained and displayed on the fault detection module:

a) Unsymmetrical Faults: Under these faults, Single-Line to Ground, Line to line Fault, and Double-Line to Ground faults are displayed on the LCD with the respective location and nature of occurring fault.

b) Symmetrical Faults: Here three phase faults are displayed on the LCD.

6. CONCLUSION

Without the crucial and necessary role of fault detection, the power system may experience a variety of issues and harm. The project demonstrates how to represent the location and type of a problem at a particular distance. The detection of symmetrical and asymmetrical defects is the focus of this study. Three fault situations, including Single-Line to Ground, Double-Line to Ground, and Line to Line faults, have been identified under unsymmetrical faults, and their corresponding positions have been shown. The three phase fault has also been identified under symmetrical faults and is given with its corresponding position. Early diagnosis of process problems is necessary to meet the growing demands on the dependability and safety of technological facilities.

REFERENCES

[1] P. A. Gulbhile, J. R. Rana and B. T. Deshmukh, "Overhead line fault detection using GSM technology", 2017 International Conference on Innovative Mechanisms for Industry Applications (ICIMIA), 2017, pp. 46-49, doi: 10.1109/ICIMIA.2017.7975510.

[2] R. M. Shivpuje and S. D. Patil, "Microcontroller based fault detection and protection system for induction motor", 2017 International Conference on Intelligent Computing and Control Systems (ICICCS), 2017, pp. 1187-1191, doi: 10.1109/ICCONS.2017.8250655."

[3] N. Srisuwan and W. Srisongkram, "Faults Detection Simulator of Generator using Internet of Things Technology", 2021 18th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2021, pp. 1010- 1013, doi: 10.1109/ECTI-CON51831.2021.9454794."

[4] T. Gunasekar, V. Aarthi, K. L. Bharanidharan, S. Ashwin, V. Venkat and T. Mohanasundaram, "GSM Based Fault Detection in Three Phase Power Distribution System", 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), 2021, pp. 384-388, doi: 10.1109/ICACCS51430.2021.9442015.