

Single Phase Differential Transformer Protection Using Arduino

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Abstract-

Transformers are the important parts in the power system. So, development of better protection device for Transformers is essential. Differential relay technique can be employed to protect the Transformers. In this paper we have used differential relay mechanism with Arduino. By programming in the Arduino the protection of transformers can be done. The working of transformer is verified by Arduino every time. It senses the condition of transformer each and every second. If it finds any error then it sends commands to the circuit breakers to trip the main potential transformer. So it is the efficient and best method to protect the transformers under abnormal conditions.

Keywords: Transformers, Differential Current Protection, Arduino Board.

1. Introduction

Transformers are the important equipment's in the power system. Therefore, the continuity of its operation is very necessary. So better protection scheme should develop for transformers. Differential protection technique can be employed to protect the Transformers. In this paper, we have used differential relay mechanism with GSM module and voice announcement circuit. The LCD display circuit is synchronized with Arduino microcontroller. Arduino Microcontroller is very high speed and cost effective device with fine accuracy. By programming in the Arduino the protection of transformers can be done. Programming is quite efficient and easy than 8051 microprocessor used in differential relay mechanism, so it is better to use Arduino place of 8051 microcontroller. The simulation results successfully justified this proposed system in proteus software also.

A fault which occurs beyond the protection zone of the transformer, but fed through the transformer is known as "Through faults". A unit protection of transformer should not operate for through faults. The overload relaying may be provided to operate with a time lag to provide back-up protection. Internal faults are those in the protected zone of the transformer. These faults can be between phase to phase and phase to ground. Generally, they occur due to a failure of insulation due to temperature rise. Incipient faults are initially minor causing gradual damage. These faults grow

into serious faults. Incipient faults include loose connection in conducting path, sparking, small arcing etc.

2. Literature Review

Manishay. Nikwade Et. Al. 2020, Transformers are the foremost important devise within the facility. Therefore, the continual operation is incredibly necessary. Permanently protection should create for transformers. Differential protection technique we are able to use to guard the transformers. During this project, we have got used relay driver mechanism with GSM 800 module. The GSM and IOT are synchronized with Arduino microcontroller. Arduino UNO microcontroller is extremely high speed and low cost device with more accuracy. A recent huge interest in Machine to Machine communication is thought because the Internet of Things (IOT), to permit the chance for autonomous system to use Internet for data exchanging. This work presents design fault detection of transformer and record key operation indicators of a dispersion transformer like load current, voltage. The proposed project system operates with GSM module based hardware. Arduino uno based control system is meant and develop likewise which will results fault identification also because it may be won't to clearing all faults in system. The general cost of this proposed project system is that the more beneficial in regards to the standard system and in IOT.

Keval B Trivedi1 et. al.2017, Transformers are the important equipment's in the power system. Therefore, the continuity of its operation is very necessary. So better protection scheme should develop for transformers. Differential protection technique can be employed to protect the Transformers. In this paper, we have used differential relay mechanism with GSM module and voice announcement circuit. The GSM and voice circuit is synchronized with Arduino microcontroller. Arduino Microcontroller is very high speed and cost effective device with fine accuracy. By programming in the Arduino the protection of transformers can be done.

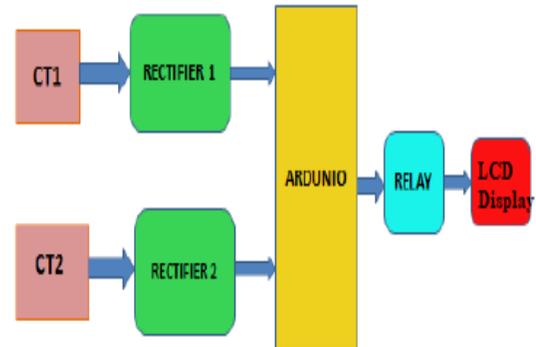
Programming is quite efficient and easy than 8051 microprocessor used in differential relay mechanism, so it is better to use Arduino place of 8051 microcontroller. The simulation results successfully justified this proposed system in proteus software also. The proposed system operates with GSM based hardware. These Arduino based control system is designed and develop which provides fault identification as well as it is capable to clearing the faults. The overall cost of this proposed system is the major benefit in reference to the conventional system.

Amevi Acakpovi et.al. 2019, Distribution transformers are generally provided with advanced control measures that ensure their operation and safety at a high reliability because their failure usually leads to long power outage, increase maintenance cost and unreliable provision of electricity to customers. Despite the protection measures that accompany a distribution transformer, there is still a need to provide extra remote monitoring systems to increase the reliability of operation and the confidence of instantaneous fault reporting. This paper deals with the design and construction of automatic monitoring system for power transformer parameters. An Arduino board coupled with XBEE module were programmed to enable the monitoring of voltage, current and temperature on a typical power transformer. The system was implemented and tested successfully. Results showed that the voltage versus temperature as well as current versus voltage characteristic obtained, were closed to datasheet specifications and therefore confirming the reliability of the proposed design. This system is therefore recommended as an additional protection that should be added to Power Transformers.

3. Aim & Objectives

- To design an efficient single phase differential transformer protection using Arduino.
- To reduce response time needed to rectify and save expensive transformers from damage.
- To increase productivity of technical crews since the time needed to locate will be minimised.
- To ensure stability and reliability of the power supply system in the country to boost economic growth.

4. Block Diagram

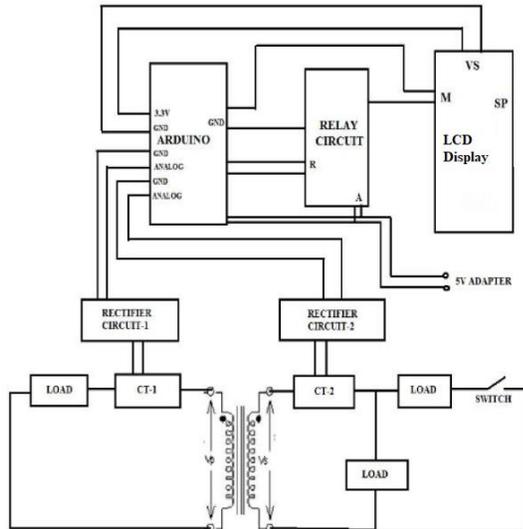


5. Working

Arduino is the main component in this circuit. Above figure shows the circuit diagram of the differential protection of transformer using arduino with voice announcement. Here arduino is used to compare the currents on both primary and secondary. Two rectifier circuits are used in this circuit to convert the AC voltage into DC voltage for the use of arduino. Current transformers also provided one on primary and another on secondary to tap the currents on both sides and to give proportionate voltage to the rectifier circuits. Output of the arduino is connected to the relay. The relay here is 12V DC 1-phase relay.

Under normal operating conditions currents on primary and secondary are same. So, the proportionate voltages generated by the current transformers on primary and secondary are same. These two voltages will given to the arduino. The proportionate voltages generated by current transformers are rectified by the rectifiers in the circuit. Under normal operating conditions these two voltages will be same in magnitude and difference is zero. So, the arduino gives no signal to the relay. Whenever extra load or an internal fault occur in transformer the currents seen by the CT on primary and secondary differs by same amount. As a result voltage sensed by the arduino from primary and secondary differs. As there is a difference in the voltage sensed by the arduino i.e., difference is not zero. Arduino give a signal to the relay according predefined program. As and when the relay is activated by the arduino the relay will activates the LCD display circuit. The LCD display circuit will give output predefined alert to the operator. After three consecutive LCD display Arduino will give trip signal to the relay board and which is connected in series with the supply will open its contacts thus the supply to the hardware setup will be disconnected.

6. Circuit Diagram



7. Advantages

1. Highly sensitive
2. Fit and Forget system
3. Low cost and reliable circuit
4. Complete elimination of manpower

8. Applications

1. Unbalance Caused by the Load Current
2. Faults on LV Side of the Tapped Transformers
3. Magnetizing Inrush Currents
4. External Faults on HV System

9. Results and Discussion

Differential Protection Of Transformer By Using Arduino With Lcd Display:

Initially we give the supply to the power transformer. Here we used two current transformer which is used to measure current flowing in the power transformer both CT'S connected to the hall effect sensor both CT'S has same rating if any changes happen in between two CT'S hall effect sensor is activated it give the signal to the Arduino. Then Arduino will give commands to the relay. Relay can then be triggered and the entire circuit turns off. When no adjustments are made in two CT 'S, the Hall Effect sensor does not activate the Arduino is in the place of rest.

Arduino is used as a brain. The circuit diagram as shown in below diagram. Here we used two current sensor ACS712 is which is connected to the Arduino through A0 and A1 pin. This relay is used to initiate the display circuit

which gives alert. Here we used 12v DC 1-phase relay which is connected to the 13 no pin of Arduino. As we can see display circuit also integrated with Arduino. Under normal operating conditions currents on primary and secondary are same. So, the proportionate voltages generated by the current sensors on primary and secondary are same. These two voltages will be applied to the Arduino. Under normal operating conditions these two voltages will be same in magnitude and difference is zero. So, the Arduino gives no signal to the relay. Whenever internal fault occurs in transformer the currents seen by the Current sensors on primary and secondary differs by some amount.

As a resulting voltage sensed by the Arduino from primary and secondary differs. As there is a difference in the voltage sensed by the Arduino. Arduino give a signal to the relay according to predefined program. And when the relay is activated by the Arduino the relay will activate the voice announcement circuit. The voice circuit will give output predefined voice as alert to the operator. After three consecutive voice alerts Arduino will give a trip signal to the relay board and which is connected in series with the supply will open its contacts thus the supply to the hardware setup will be disconnected. And LCD display will send a message showing a Voltage different and place of which one transformer getting the fault to the operator. And also operator can perform the respective action for faulty transformer from anywhere through sending a message back to the display. Some faults happen to the transformer which is not a harmful for the system, so for that condition power transformer should not isolate from the power system, so here we designed system for such situation.



10. Conclusion

Using Differential protection scheme, transformer is protected from faults with the use of

Arduino operating an electromagnetic relay. Future extension of this project is three phase differential protection of a transformer using Arduino. The future system operates with GSM based hardware. These Arduino based have power over system is considered and come into being which provides to the find fault with identification as favorably as it is accomplished to payment the faults. That in general charge of this future system is the key of profit to that in good word to the conventional system

11. Future Scope

The future system operates with GSM based hardware. These Arduino based have power over system is considered and come into being which provides to the find fault with identification as favorably as it is accomplished to payment the faults. That in general charge of this future system is the key of profit to that in good word to the conventional system.

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