FINAL YEAR PROJECT REPORT

Real Time monitoring of Transformer by using WSN

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Abstract

Power system protection is a branch of electrical power engineering that deals with the protection of electrical power systems from faults through the isolation of faulted parts from the rest of the electrical network. The objective of a protection scheme is to keep the power system stable by isolating only the components that are under fault, whilst leaving as much of the network as possible still in operation. Thus, protection schemes must apply a very pragmatic and pessimistic approach to clearing system faults.

Transformers are a critical and expensive component of the power system. Due to the long lead time for repair of and replacement of transformers, a major goal of transformer protection is limiting the damage to a faulted transformer. Some protection functions, such as over excitation protection and temperature-based protection may aid this goal by identifying operating conditions that may cause transformer failure. The comprehensive transformer protection provided by multiple function protective relays is appropriate for critical transformers of all applications.

The type of protection for the transformers varies depending on the application and the importance of the transformer. Transformers are protected primarily against faults and overloads. The type of protection used should minimize the time of disconnection for faults within the transformer and to reduce the risk of catastrophic failure to simplify eventual repair. Any extended operation of the transformer under abnormal condition such as faults or overloads compromises the life of the transformer, which means adequate protection should be provided for quicker isolation of the transformer under such conditions.

In our project we integrated the PIC16F877A microprocessor/controller to the transformer. We install the program in to the microprocessorusing the special language which could be understood and compiled by the microcontroller. The microcontroller based circuit protects the transformerfrom :

Overvoltage
Over current
Overheating
Internal Faults

The limits can be set into the microcontroller using the buttons given on the designed PCB for the faults described. Any abnormal condition sensed by the microcontroller immediately

trips the relay and sounds the alarm on the circuit, in this way the abnormal condition can be rectified. The PCB has also the extra feature of controlling the voltage and the current manually using the variable resistors given. The variable resistors are provided both at input and output.

In this project a real time monitoring through data logging scheme is designed and implemented on a Power Transformer. Since the monitoring of any machine ultimately leads to justify its healthy operation so knowledge of the parameters of the machine is very important. In this project we will monitor the transformer by monitoring its. We are sending our data through Xbee Transceiver. We are using two Xbee devises, one as a transmitter which is transmitting data from microcontroller and one as a receiver which is receiving data and then we serially communicate this data to the computer for real time monitoring. We have also used LCD to show all the constraints for the functions according to which the system works.

Dedication

We all dedicate this project and our all efforts to our respective and beloved **Parents** and our teachers especially **Muhammad Arif Saeed** and **Other Technical Persons** who have been source of inspiration and motivating force behind us.

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AUTHOR

Table of contents

Abstract iii

Dedication v

Acknowledgements vi

Table of contents 7

Chapter 1 9

1.1 Electric Power Systems 10

1.2 THE STRUCTURE OF THE POWER SYSTEM 11

  1.2.1 Generation Subsystem 11

    1.2.1.1 Generators 11

    1.2.1.2 Transformers 12

  1.2.2 Transmission and Sub transmission Subsystem 13

  1.2.3 Distribution Subsystem 13

  1.2.4 Load Subsystems 14

1.3 XBee Series 1 module 15

1.4 XBee Explorer Serial 15

1.5 XBee Explorer Regulated 16

Chapter 2 .... **Error! Bookmark not defined.**

2.1 INTRODUCTION .... **Error! Bookmark not defined.**

2.2 DEFINITION .... **Error! Bookmark not defined.**

2.3 The nature of relaying .... **Error! Bookmark not defined.**

2.4 Reliability, dependability and security .... **Error! Bookmark not defined.**

2.5 Relay speed .... **Error! Bookmark not defined.**

2.6 Primary and backup protection .... **Error! Bookmark not defined.**

2.7 Single and three phase tripping and reclosing .... **Error! Bookmark not defined.**

2.8 Elements of a protection system .... **Error! Bookmark not defined.**

  2.8.1 Battery and DC supply .... **Error! Bookmark not defined.**

  2.8.2 Circuit breakers .... **Error! Bookmark not defined.**

Chapter 3 .... **Error! Bookmark not defined.**

3.1 INTRODUCTION .... **Error! Bookmark not defined.**

3.2 Fault Detection Schemes .... **Error! Bookmark not defined.**

3.2.1 Level detection .... Error! Bookmark not defined.
3.2.2 Magnitude comparison .... Error! Bookmark not defined.
3.2.3 Differential comparison .... Error! Bookmark not defined.
3.2.4 Phase angle comparison .... Error! Bookmark not defined.
3.2.5 Distance measurement .... Error! Bookmark not defined.
3.2.6 Pilot relaying .... Error! Bookmark not defined.
3.2.7 Frequency sensing .... Error! Bookmark not defined.
CHAPTER 4 .... Error! Bookmark not defined.
4.1. Introduction .... Error! Bookmark not defined.
4.2. Transformer Protection Overview .... Error! Bookmark not defined.
4.3. Transformer Failures .... Error! Bookmark not defined.
4.4. Differential Characteristic .... Error! Bookmark not defined.
4.5 Inrush Inhibit during Transformer Energization .... Error! Bookmark not defined.
4.6 Sensitive Ground Fault Protection to limit Transformer Damage .... Error! Bookmark not defined.
4.7 Overflux Protection .... Error! Bookmark not defined.
4.8 Winding hot-spot temperature protection .... Error! Bookmark not defined.
CHAPTER 5 .... Error! Bookmark not defined.
5.1 Voltages Measurement Circuit .... Error! Bookmark not defined.
5.2 CURRENT MEASURING CIRCUIT .... Error! Bookmark not defined.
5.3 LCD CIRCUIT .... Error! Bookmark not defined.
5.4 RELAY CIRCUIT .... Error! Bookmark not defined.
5.5 BUZZER CIRCUIT .... Error! Bookmark not defined.
5.6 POWER SUPPLY CIRCUIT .... Error! Bookmark not defined.
5.7 Microcontroller .... Error! Bookmark not defined.
5.6 Conclusion: .... Error! Bookmark not defined.

Chapter 1

Introduction

1.1 Electric Power Systems

A complex assemblage of equipment and circuits for generating, transmitting, transforming and distributing electrical energy is called electrical power system.

Electricity in the large quantities required to supply electric power systems is produced in generating stations, commonly called power plants. Such generating stations, however, should be considered as conversion facilities in which the heat energy of fuel (coal, oil, gas, or uranium) or the hydraulic energy of falling water is converted to electricity. The transmission system carries electric power efficiently and in large amounts from generating stations to consumption areas. Such transmission is also used to interconnect adjacent power systems for mutual assistance in case of emergency and to gain for the interconnected power systems the economies possible in regional operation.

As systems grow, the number and size of generating units increase, and as transmission networks expand, higher levels of bulk-power-system reliability are attained through properly coordinated interconnections among separate systems. Each individual utility in such pools operates independently, but has contractual arrangements with other members in respect to generation additions and scheduling of operation. Their participation in a power pool affords a higher level of service reliability and important economic advantages.

Power delivered by transmission circuits must be stepped down in facilities called substations to voltages more suitable for use in industrial and residential areas. That part of the electric power system that takes power from a bulk-power substation to customers' switches, commonly about 35% of the total plant investment, is called distribution.

The operation and control of the generation-transmission-distribution grid is quite complex because this large system has to operate in synchronism and because many different organizations are responsible for different portions of the grid.Power-system operations can be divided into three stages: operations planning, real-time control, and after-the-fact accounting. The main goal is to minimize operations cost while maintainingthe reliability (security) of power delivery to customers. Operation planning is the optimal scheduling of generation resources to meet anticipated demand in the next few hours, weeks, or months. This includes the scheduling of water, fossil fuels, and equipment maintenance over many weeks, and the commitmentof generating units over many hours. Real-time control of the system is required to respond to the actual demand of electricity and any unforeseen contingencies (equipment outages). Maintaining security of the system so that a possible contingency cannot disrupt power supply is an integral part of real-time control. After-the-factaccounting is the tracking of purchases and sales of energy between organizations so that billing can be generated. For loosely coordinated operation of the grid, each utility takes responsibility for the operation of its own portion while exchanging all relevant information. For pool-type operations, a hierarchy is set up where the operational decisions may be made centrally and then implemented by each utility. For a large utility, there may be another level in the hierarchy where the decisions are further distributed to different geographical areas of the same utility. All of thisrequires significant data communication as well as engineering computation within a utility as well as between utilities. The use of modern computers and communications makes this possible, and the heart of system operations in a utility is the energy control center.

The monitoring and control of a power system from a centralized control center became desirable quite early in the development of electric power systems, when generating stations were connected together to supply the same loads. As electrical utilities interconnected and evolved into complex networks of generators, transmission lines, distribution feeders, and loads, the control center became the operations headquarters for each utility. Since the generation and delivery of electrical energy are controlled from this center, it is referred to as the energy control center or energy management system.

1.2 THE STRUCTURE OF THE POWER SYSTEM

An interconnected power system is a complex enterprise that may be subdivided into the following major subsystems:

- Generation Subsystem
- Transmission and Sub transmission Subsystem
- Distribution Subsystem
- Utilization Subsystem

1.2.1 Generation Subsystem

This includes generators and transformers.

1.2.1.1 Generators

An essential component of power systems is the three phase ac generator known as synchronous generator or alternator. Synchronous generators have two synchronously rotating fields: One field is produced by the rotor driven at synchronous speed and excited by dc current. The other field is produced in the stator windings by the three-phase armature currents. The dc current for the rotor windings is provided by excitation systems. In the older units, the exciters are dc generators mounted on the same shaft, providing excitation through slip rings. Current systems use ac generators with rotating rectifiers, known as brushless excitation systems. The excitation system maintains generator voltage and controls the reactive power flow. Because they lack the commutator, ac generators can generate high power at high voltage, typically 30 kV. The source of the mechanical power, commonly known as the prime mover, may be hydraulic turbines, steam turbines whose energy comes from the burning of coal, gas and nuclear fuel, gas turbines, or occasionally internal combustion engines burning oil. Steam turbines operate at relatively high speeds of 3600 or 1800 rpm. The generators to which they are coupled are cylindrical rotor, two-pole for 3600 rpm, or four-pole for 1800 rpm operation. Hydraulic turbines, particularly those operating with a low pressure, operate at low speed. Their generators are usually a salient type rotor with many poles. In a power station, several generators are operated in parallel in the power grid to provide the total power needed. They are connected at a common point called a bus .With concerns for the environment and conservation of fossil fuels, many alternate sources are considered for employing the untapped energy sources of the sun and the earth for generation of power. Some alternate sources used are solar power, geothermal power, wind power, tidal power, and biomass.

1.2.1.2 Transformers

The transformer transfers power with very high efficiency from one level of voltage to another level. The power transferred to the secondary is almost the same as the primary, except for losses in the transformer. Using a step-up transformer will reduce losses in the line, which makes the transmission of power over long distances possible. Insulation requirements and other practical design problems limit the generated voltage to low values, usually 30 kV. Thus, step-up transformers are used for transmission of power. At the receiving end of the transmission lines step-down transformers are used to reduce the voltage to suitable values for distribution or utilization. The electricity in an electric power system may undergo four or five transformations between generator and consumers.

1.2.2 Transmission and Sub transmission Subsystem

An overhead transmission network transfers electric power from generating units to the distribution system which ultimately supplies the load. Transmission lines also interconnect neighboring utilities which allow the economic dispatch of power within regions during normal conditions, and the transfer of power between regions during emergencies. Standard transmission voltages are established in the United States by the American National Standards Institute (ANSI). Transmission voltage lines operating at more than 60 kV are standardized at 69 kV, 115 kV, 138 kV, 161kV, 230 kV, 345 kV, 500 kV, and 765 kV line-to-lines. Transmission voltages above 230 kV are usually referred to as extra-high voltage (EHV).High voltage transmission lines are terminated in substations, which are called high-voltage substations, receiving substations, or primary substations. The function of some substations is switching circuits in and out of service; they are referred to as switching stations. At the primary substations, the voltage is stepped down to a value more suitable for the next part of the trip toward the load. Very large industrial customers may be served from the transmission system. The portion of the transmission system that connects the high-voltage substations through step-down transformers to the distribution substations is called the sub transmission network. There is no clear distinction between transmission and sub transmission voltage levels. Typically, the sub transmission voltage level ranges from 69 to 138 kV. Some large industrial customers may be served from the sub transmission system. Capacitor banks and reactor banks are usually installed in the substations for maintaining the transmission line voltage.

1.2.3 Distribution Subsystem

The distribution system connects the distribution substations to the consumers' service-entrance equipment. The primary distribution lines from 4 to 34.5 kV and supply the load in a well-defined geographical area. Some small industrial customers are served directly by the primary feeders. The secondary distribution network reduces the voltage for utilization by commercial and residential consumers. Lines and cables not exceeding a few hundred feet in length then deliver power to the individual consumers. The secondary distribution serves most of the customers at levels of 240/24 V, single-phase, three-wire; 208Y/120 V, three-phase, four-wire; or 480Y/277 V, three-phase, four-wire. The power for a typical home is derived from a transformer that reduces the primary feeder voltage to 240/24 V using a three wire line.Distribution systems are both overhead and underground. The growth of underground distribution has been extremely rapid and as much as 70 percent of new residential construction is via underground systems.

1.2.4 Load Subsystems

Power systems loads are divided into industrial, commercial, and residential. Industrial loads are composite loads, and induction motors form a high proportion of these loads. These composite loads are functions of voltage and frequency and form a major part of the system load. Commercial and residential loads consist largely of lighting, heating, and cooking. These loads are independent of frequency and consume negligibly small reactive power. The load varies throughout the day, and power must be available to consumers on demand. The daily-load curve of a utility is a composite of demands made by various classes of users. The greatest value of load during a 24-hr period is called the peak or maximum demand. To assess the usefulness of the generating plant the load factor is defined. The load factor is the ratio of average load over a designated period of time to the peak load occurring in that period. Load factors may be given for a day, a month, or a year. The yearly or annual load factor is the most useful since a year represents a full cycle of time.

The daily load factor is peak load

Daily Load factor = average load / Peak load ……1.1

Multiplying the numerator and denominator of (1.1) by a time period of 24 hr,We obtain

Daily load factor = (average load x 24hrs)/ (Peak load x 24hrs) = (energy consumed during 24hrs)/Peak load x 24hrs

Annual load factor is given by

Annual L.F = total annual energy / Peak load x 8760hr

Generally there is diversity in the peak load between different classes of loads, which improves the overall system load factor. In order for a power plant to operate economically, it must have a high system load factor. Today’s typical system load factors are in the range of 55 to 70 percent. Load forecasting at all levels is an important function in the operation, operational planning, and planning of an electric power system. Other devices and systems are required for the satisfactory operation and protection of a power system. Some of the protective devices directly connected to the circuits are called switchgear. They include instrument transformers, circuit breakers; disconnect switches, fuses and lightning arresters. These devices are necessary to de-energize either for normal operation or on the occurrence of faults. The associated control equipment and protective relays are placed on switchboards in control houses.

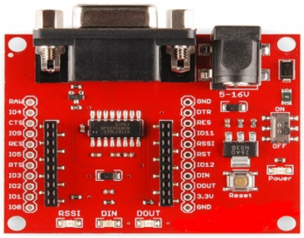
1.3 XBee Series 1 module

This is the most popular XBee wireless module: the series 1 802.15.4 protocol 1mW with wire antenna. Its good for point-to-point, multipoint and convertible to a mesh network point. We use this module for the transmitting and receiving of data. If there are two XBees in the same area they will automatically 'sync' and pass serial data back and forth without any additional work or configuration.

What we like about the Series 1 modules is that they are so easy to get set up. If we have two in range, they will automatically form a serial link with no configuration, so you can send TTL serial data back and forth. We can also configure the baudrate, as well as sleep modes, power modes and tons more stuff using the Digi XBee tool. We are sending our data through Xbee Transceiver. We are using two Xbee devises, one as a transmitter which is transmitting data from microcontroller and one as a receiver which is receiving data and then we serially communicate this data to the computer for real time monitoring.

1.4 XBee Explorer Serial

This is a simple to use, RS232 to serial base unit for the XBee line. This unit works with all XBee modules including the Series 1 and Series 2.5, standard and Pro version. Plug the unit into the XBee Explorer, attach a RS232 cable, and you will have direct access to the serial and programming pins on the XBee unit. The board also supports DTR communication so you can reprogram and configure the XBee unit.



1.5 XBee Explorer Regulated

The XBee Explorer Regulated takes care of the 3.3V regulation, signal conditioning, and basic activity indicators (Power, RSSI and DIN/DOUT activity LEDs). It translates the 5V serial signals to 3.3V so that you can connect a 5V (down to 3.3V) system to any XBee module. The board was conveniently designed to mate directly with Arduino Pro boards for wireless bootloadingand USB based configuration.