AUTOMATION OF POWER DISTRIBUTION

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ABSTRACT

Nowadays uninterrupted electricity supply has become an important aspect of life. These power supply can be disturbed due to some fault in the power distribution system. The below paper provides a smart solution for such faults. Let us take a distribution system consisting of 3 phases connected to a single transmission line. so the other two phases also turn off even if there is no fault in the other two phases. Therefore to solve this problem our project "Automation of Electricity Distribution". In this project even if phase 1 turns off the other phases automatically shift on other lines through the relay.

Keywords—Programmable Logic Controller(PLC), Current Transformer(CT)

INTRODUCTION

Lately, there are many techniques that are used for the coordination of relays. Many protective devices are used in coordination with each other to keep the distribution system safe from faults. So many circuit breakers and relays are required to protect the system. A relay is used for switching purposes. A Programmable logic controller(PLC) which is an important device for automation is used in this project.

The main objective of these projects is to provide an alternate supply for another phase connected to the same distribution line even if there is a fault in one phase to ensure an uninterrupted power supply and also to protect the distribution transformer from the fault that occurred in any phase.`

In older times the movements of machines in industries were controlled through relays. However, over time PLC replaced the relay control system. The main operation of PLC was to carry out the linear operations which were implemented through relays. In our, project PLC is used for automation and also provides instruction to relays. Whenever there is a fault in the phase or an overload condition, this data is sent to PLC and hence PLC sends instructions to relay to turn OFF supply for the phase in which the fault occurred and the supply to other phases remains uninterrupted from a standby power supply. This also helps in the protection of the distribution transformer of our power system.

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PROBLEM STATEMENT

Mostly the common problem in the system is the overload condition which creates a fault in operation and might damage the system. Also, Fault analysis is an important requirement for the electric power system to become more accurate. Hence as to avoid such cases we designed simple and economical equipment which will give a solution to the problem.

OBJECTIVES

- The Main objective of the project is to build a smart solution for the protection of the distribution transformer from the fault in the overhead line of any phase.
- This system can also be used in industries that work on multiple power sources and also can use to avoid tripping and to manage overload conditions.
- PLC makes it easier to automatically sense the overload condition and trigger the relays.

LITERATURE SURVEY

A. *Application of PLC for the control and protection of future distribution networks.*
Author : Robert Benato , Robert Caldon.

Description: The paper focuses the attention on the need for new strategies of control protection of future distribution networks with high penetration of distributed generators and points out how PLC is one of the supreme technologies that can be used.

B. *Relay Coordination for the Distribution system.*
Author: Anu Priyaa K and Sabari Karthiga T C.

Description: They proposed that when protective apparatus installed in series have certain characteristics, which provide a specified operating sequence, they are set to be coordinated or selective. The main goal of coordination of the protective relay is to not lose sensitivity and also to achieve selectivity and the time for the fault clearance should be below.

C. *Using PLC and SCADA for automation in Power Transmission Control.*
Author : T. Vignesh, J. Kirubakaran.

Description: They proposed that in this project the basic idea behind substation control project the switchyards in a substation. In ssubstationsmany relays and circuit breakers are used when anyone breaker is trip because of the problems, we can monitor and control the SCADA window so When power consumption increases, then substation monitoring is essential to control hardware and software optimization using ladder logic systems with PLCs.

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Overhead Line Protection with Automatic switch by using PLC automation.
Author: Ajit Bacchav, Nikhil S. Sarode, Ms. Harshada Gagre, Ms. Dipti Shirsath, and Ms. Rajashree S. Kadam.
Description: They proposed that Transmission lines are an important factor in the power system. Transmission and distribution lines are a good contribution to the generating unit and consumers to obtain the continuity of electric supply. Following is the list of Researchers who have worked on fault detection of induction motor by using wavelet transform.

Relay coordination system for Smart Electricity Distribution using PLC.
Author : Rangrez Mushtaque , Mrs. A .N.Shewale, Mr. R.R Karhe.

Description: They concluded that when one load lane is off another load lane attached to the same line, it will be automatically ON through relay.

D. *Power System Protection with Relay Co-ordination.*
Author : Mehulkumar D. Devdhariya, Vibhuti R. Adroja, Kajal M. Rafaliya , Prof. Manan M. Desai.

Description: The important purpose of protective relay coordination in a power system that is interconnected is to attain selectivity and also speed without sacrificing sensitivity and fast fault clearance time. It is possible to identify and correct faults by using appropriate relay coordination.

PROPOSED METHODOLOGY

E. *Automation*

Automation is used in many types of operations nowadays such as machinery, factories, furnaces, heat treatment equipment, ships, and aircraft. Automation brings out advantages such as saving labor costs and improving quality and precision. It is deployed as a pneumatic, electrical, mechanical, and also computer.

F. *Load Management*

Load management involves the process of managing the electrical supply to the grid to the electrical load by adjusting the load which is also known as Demand-side Management. As electricity is an energy that we cannot store it is needed to be produced distributed and consumed in the right way.

G. Programmable Logic Controller(PLC):

A Programmable Logic Controller or PLC is like a digital computer that can be used in Industrial automation, assembly lines manufacturing and many types of electromechanical processes as also as lightning control. It is designed in such that it is unsusceptible to electrical noise. It is also resistant to vibrations and shocks and can handle several tables of analog and digital inputs and outputs, also extended temperature range and insensitivity to environmental variables are a plus. Programs that control the operation of machines are stored in nonvolatile memory.

PLCs are an example of systems that are expected to respond within a certain amount of time depending on the input conditions, since the later the result is, the less useful the device will be.

Before PLC was born, the control, sequencing, and safety interlocking logic was mainly built of relays, timers, sequencers, and dedicated closed-loop controllers. As this could include hundreds or even thousands of components, changing or updating the arrangements will require someone to rewire the system to keep up with the changes in the operating characteristics as the system evolves.

a) Scan Cycle Length: The controlling algorithm normally executes at repeat intervals till the plant is working and is in operation. The current status of input is stored in the memory in form of a table known as the "I/O Image Table".

b) System Scale: PLC has a small fixed number of output and input ports. We can expand if ports are not sufficient to model the process. The extension chasis in Modular PLC is known as Rack. The selection of I/O modules and processes depends on the particular application.

c) User Interface: PLCs are required to interact with humans for alarm, reporting, and everyday control and configuration. hence human-machine Interface (HMI) is used for this purpose.

d) Communication: PLC comes with integrated communication ports usually a pin RS232 or EIA 485 but optionally Ethernet as well.MODBUS is also usually present as one of the communication protocols.

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e) Programming: PLC programs are typically written in a special application for personal computers and downloaded using a direct cable connection Nonvolatile flash memory is used to store the program. To substitute thousand of relays a single PLC can be programmed. There are 5 standard PLC programming languages which are Function Block Diagram, Ladder Diagram, Structured Text, instruction list, and Sequential Function.

f) Reducancy: Some special operations require continuous running and downtime for such systems cannot be accepted. Hence it is necessary to have a system that can tolerate fault and also can handle processes even if modules are partially defective.

H. Relays :

A relay is a type of switch which consist of an electromagnet and a set of contacts. In our projects, SPST(Single Pole Single Line) relay is been used. A relay is an electrically operated switch that is used to control the single or multiple circuits by one signal. We are using the traditional form of the f electromagnetic relay to open or close the contact and protect the circuit.
We are using this relay in the coordination system. It is very challenging to use the relay in modern power systems but it plays an imp aspect in protecting electrical devices and systems. The relay coordination system isolates the fault section from the healthy section.

I. Current Transformer:

A current transformer is a type of instrument transformer used to protect and for measurement in a power system. The primary use of the current transformer is to measure the high alternating current in the power system. The core of the current transformer is magnetic and is made of very thin silicon steel. They are used to measure the flow of power and also to provide electrical inputs to the instrument and power transformer. They produce either an alternate voltage or an alternate current that is proportional to the measured current. Wound and toroidal are two types of current transformers. Wound Current Transformer is made of integral primary winding which is inserted in series with the conductor carrying major current. while the toroidal current transformer does not contain primary winding. A current transformer is an instrument transformer in which secondary current is substantially proportional to primary current and differs in phase from it by ideally zero degrees.

J. Power Supply

A power supply is the first and the most important part of our project. For our project, we require a +12V regulated power supply with a maximum current rating of 500mA.
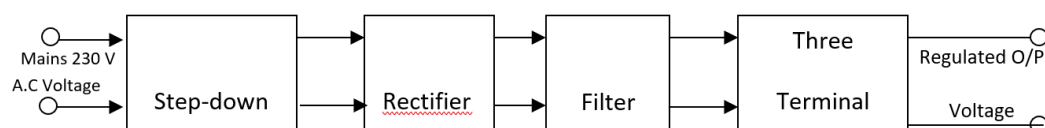
Power Supply

K. Load Lane:

In this project, 9 bulbs are taken as Load consisting of 10 Watt,10 Watt, and 70 Watt. Three Bulbs 10 Watt,10Watt, and 70 watts are connected in each phase.

L. Rectifier Unit:

The Rectifier unit is a circuit. which converts A.C. into pulsating D.C. Semiconducting diodes are generally used as rectifiers because they conduct current only in one direction

WORKING

The Working of our Project can be explained as a 230 V AC supply is provided to the system. This AC supply is connected to a rectifier and a regulated O/P voltage is sent to the circuit. This O/P voltage is further connected to the relay and then to the load bank. A current transformer is connected to the load which continuously measures the current and also a comparator circuit is connected which sends a 24V signal to PLC. When the load bank is switched ON it works perfectly till the Overload condition happens. As soon as the Overload Condition happens the voltage is measured by the current transformer and a 24V signal is sent to the PLC by the comparator circuit. PLC sends an instruction to the relay which trips the relay and the supply for that phase is turned OFF by tripping the relay.

BLOCK DIAGRAM

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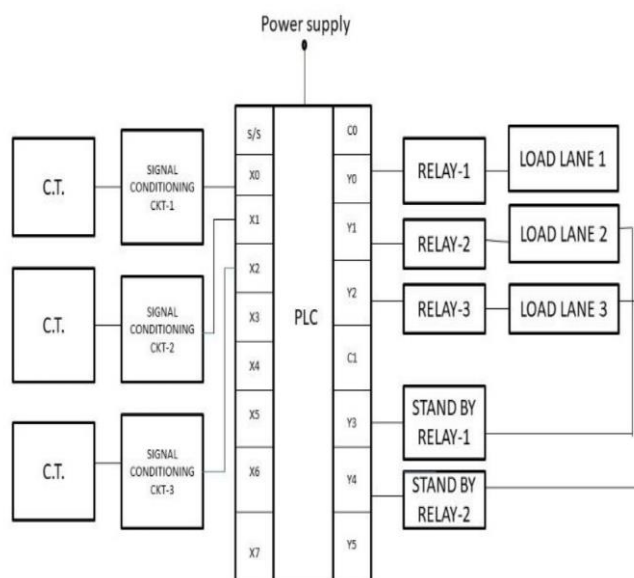
CONCLUSION

Uninterrupted Power Supply has become an important aspect of our life. In older days, if there was a fault in a single line the supply of the whole section got interrupted. This project provides an automated solution to this problem. It ensures that the fault in one phase does not interrupt the supply of another phase. Also, this system protects the distribution transformer so that when there is a fault in the line the fault does not get transferred to the distribution line.

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