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Design of an Automated Switch Control for SCADA Based Power Distribution System of Primary Substation by Using PLC Automation

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DESIGN OF AN AUTOMATED SWITCH CONTROL FOR SCADA BASED POWER DISTRIBUTION SYSTEM OF PRIMARY SUBSTATION BY USING PLC AUTOMATION

by

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Abbas HASAN ISMAEL

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ABSTRACT

TITLE OF THE THESIS/DISSERTATION

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For the monitoring and collection of data of industrial processes, SCADA systems are commonly used throughout the industry. The project is based on a microcontroller and configuration software and has been designed to track the power distribution system SCADA. The machine uses CT (Current Transformers) and PT (Current Transformers) to achieve distribution line electrical parameters. The serial interface circuit will be used to pass it to SCADA. This study explains the automatic switch control for the SCADA-based primary substation electrical distribution network using PLC. The aim of this investigation is to transform Myanmar's manual control system into an automatic switch control system. Four key elements of the SCADA-based electrical distribution network. They include automated control, interface devices, monitoring and networking systems. This work highlights the automatic control system. The PLC ladder diagram can be used to accomplish this scheme. The automated distribution systems evaluate a secure, reliable and convenient management resource which can use remote terminal units. (RTUs). The automated system based on simulations is shown in this study. The results of the simulation show that the PLC automatic control system proposed fulfills the desired high-performance control environment. This system for traditional power distribution in Myanmar is effective and reliable via SCADA-driven technology. SCADA systems are capable of reducing the output by 1,1% to 0,3% by 6% and 1% by 396-352 minutes, and reducing production costs by 6.71% by 6. SCADA systems are willing, respectivamente. The findings of this research into SCADA systems using PLC and HMI would improve quality and production cycle efficiency.

Keywords: Smart grid, Micro-grid, Virtualization Storage, energy Renewable sources

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LIST OF ABBREVIATIONS

AC	:	Alternating Current
PLC	:	Programmable Logic Controllers
SCADA	:	Supervisory Control And Data Acquisition
HMI	:	Human-Machine Interface
RTU	:	Remote Terminal Units
ISC	:	Industrial Control System

1. INTRODUCTION

Electricity is being used more and more as the world population increases and the generation of electricity needs to increase in order to meet the demand for electricity, produced primarily by thermal power plants which generate very low power in a solar power plant[1]. There is actually an acute power shortage. The average power deficit is between around 3600 MW and 2200 MW respectively in peak and non peak hours,. This deficit is due to all MSEB sources, including the buying of expensive electricity, being considered. The lack of power during peak hours is highly severe.

A computer controlled development process management and automation programming framework is the power delivery system SCADA. The data acquisition module is used for monitoring and control of the operation of field instruments in order to capture, manage, calculate, adjust parameters and various signal alarms. The SCADA power distribution system offers many advantages such as knowledge integrity, reliability, accurate understanding of device status, and acceleration of decision-making. It has become an important instrument for transmitting power.

SCADA refers to the combination of telemetry and data collection. (The SCADA system). SCADA involves the collection of data through RTUs, transfer of information back to the central site and any necessary review or control, which are then displayed on a variety of operator displays. SCADA includes the collection of this information. A SCADA device collects data from remote sensors and instruments. Subsequently, it transmits data to a central monitoring server. Automation systems are used through the exchanging of high labor costs for low computer system costs to improve the efficiency of process control. They also help boost efficiency by benefiting from quicker computer control rather than human response times. The automation system is often referred to as SCADA systems, and the widespread usage of these devices makes these systems essential in order to operate many physical processes safely, reliably and efficiently.[2] In real world physical signals analysis the data acquisition system plays a crucial role. The systems can be divided widely into two groups, the stand-alone systems for data acquisition and the computer-based systems for data acquisition. If the signal is received by the system, there are several methods of communication for data transmission to the computer for further processing. Commonly used data transfer networking interfaces are serial (RS232 port), parallel ports, USB ports, Ethernet and wireless networks [3].

A networking device like radio, cable, mobile, satellite and so on. SCADA consists of a user interface system in one or more fields (RTU or PLC). Extreme or severs (also referred to as the SCADA or MTU). A central host computer. Normal and/or custom applications (HMI) array. Custom apps. Includes critical physical structures, vital infrastructure networks. The automation systems integrating individuals, computers, communications and procedures are used to manage these procedures. Automation systems are used by trading high labor costs for the low computer system costs to boost the efficacy of process management. They also improve efficiency by using quicker computer control than human reaction times. These automation systems are also known as PCS or SCADA systems and because of the widespread implementation of these systems they are critical for the safe, effective and efficient use of many physical processes. [4].

Things are becoming easier and simpler for us with advancing technology. In order to minimize the need for human labor in the manufacture of goods and services, automation is the use of control systems and information technology. Automation is a step beyond mechanization with respect to industrialization or the power sector. Mechanization offered equipment to managers to support them with the muscles.

Job conditions, automation, and human sensory and mental demands are significantly reduced. In the global economy and in everyday practice, automation plays an increasingly important role. Instead of the manual system, automated systems are favored. We tried to demonstrate automatic fire alarm and substation control system via this project.

1.1 NEED OF AUTOMATION

Earlier, when we discussed automation equipment that could do something at the instigation of a driver, we looked into the future, but today it is a reality. Automatic machinery can replace a large number of people employed, human beings are more likely to commit error and error is-, whereas automatic machinery can operate with vigilance, flexibility and virtually zero error under intensive conditions. Replacement of human operators in physical or monotonous work activities. Replacement of human beings in work performed in hazardous environments (e.g. fire, space, volcanoes, nuclear plants, undersea, etc.);

Work beyond human ability of height, weight, speed, endurance, etc. Enhancement of the economy. In businesses, society or the majority of human beings, automation may improve. For example, a business that has invested in automation technology recovers its investment, or an automation industry like Germany or Japan in the twentieth century increases its profits. This is why the project focuses on the design and installation of a hardware device to manage the sorting of various objects.

1.2 PROBLEM STATEMENT

In contemporary society, electricity is the booming marvel. We can do nothing in the world without electricity. The key components of the power grid are generation stations, transmission lines and distribution networks. It also needs to be mindful that load flows can not be achieved without proper preparation, scheduling and monitoring. The system must work in a way that reduces losses and costs of production.

As we have adopted the concept of interconnected power system, the role of substation is become more important. Substation connects generation station to the distributor or to the end consumer via transmission system depending upon the types of substation. Activities like switching of transmission lines, parameter measurement, fault detection and storing of historical data are carried out in each of the substation premises. Earlier time this all activities was carried out manually, as complexity of system increase the role of substation become crucial and we need to move towards the use of IEDs and Automation. Activities carried out at substation can broadly classify in to three term i.e. supervision, control and Data acquisition. In an automated substation this all three will done using Programmable Logic controller and SCADA. For system monitoring or supervision data is given to controllers from RTU. Control command according to system parameter is produced by PLC and SCADA provides a human machine interference. Substation automation systems make their control and monitoring possible in real time and maximize availability, reliability and safety of the system

1.3 MOTIVATION

The substations are a vital component for the management of low voltage, medium and high voltage electricity delivery systems with electrical supply and load control. Most utilities use SCADO systems to control and ensure that substations and associated devices, such as line-built switches and condensers, operate properly and automatically. But older plants may also benefit from the installation of a SCADA system or by updating a current SCADA system to benefit from newer technologies. In addition to improved monitoring and control of a new or updated SCADA system, it may prolong the life of substations and associated machinery by supplying current data to fix minor issues prior to escalation. In addition, SCADA systems' comprehensive historical data may enhance preventive maintenance planning and the related decomposition [5]

SCADA (system of data collection and control controls) refers to the combination of the acquisition and processing of telemetry. The SCADA involves information collection via an RTU, the transfer back to the central location, any review and control required, and the presentation of that information on a variety of operator screens or displays. SCADA is the first to collect information via an RTU. A SCADA device collects information from remote sides from sensors and instruments. It then transmits data to a central control process management site. A means of communication including radio, mobile, cable, satellite and so on. Extreme or sever central host computers (also called an MTU or SCADA Master Thermal Unit). The machine is composed of one or more interface field data devices (RTUs or PLCs). Normal and/or custom applications (HMI) array. Custom apps. Includes critical physical structures, vital infrastructure networks. The automation systems integrating individuals, computers, communications and procedures are used to manage these procedures. Automation systems are used by trading high labor costs for the low computer system costs to boost the efficacy of process management. They also improve efficiency by using quicker computer control than human reaction times. These automation systems are also known as process control systems (PCS or SCADA) and are important for safe, effective and efficient operation of many physical processes due to the widespread use of such systems.

Owing to the lack of resources to meet the demands at various times and the hard way to find a simple alternative to produce energy from other sources, the solution proposed is a control and centralized management system that can be implemented to distribute energy uniformly.

1.4 THESIS OBJECTIVE

The main objectives of our thesis are:

Transforming manual system management into an automated system control. You may use the Interface to execute the monitoring method. This GUI app environment [2] makes it easy to monitor the use. The goal is to turn the manual control system into an automatic control system. The PLC ladder diagram can be used to achieve this control system [3]. With the support of the computer (PC), current and power factor are monitored and managed with the use of SCADA software in the electrical distribution system. [4].

To generate a large control panel, the distribution substation and large rooms are monitored. A dedicated PLC performs data processing and control tasks in these systems. All the data and control data collected will be shown in Lab-VIEW on the Computer. The temperature control system is connected to a PLC with a temperature monitoring sensor and the control relays for the temperature maintenance. The voltage sensor and current sensor device are both used to measure voltage and current.

1.5 THESIS CONTRIBUTION

This study substitutes for large panels in big rooms. It's all put under one Screen, which makes it extremely competitive and economical at the same time. The monitoring and data collection of the various parameters available in a substation shall be carried out. More interconnection provides an incredibly simple way to access and monitor data from a shared point of view. This lowers workforce and delay. In SCADA-based electrical distribution system there are four main parts. They include automatic control systems, controllers, security systems and networking systems. This research highlights the automatic control system. The PLC ladder diagram can be used for this system. A reliable, replenished and realistic management tool for the use of remote terminal units (RTUs) is tested for this automated distribution system. This research illustrates the simulation-based automated approach method. The proposed automated PLC control system fulfills the desired control environment with a high efficiency level based on the simulation results. For traditional electrical distribution systems in Myanmar, this system is efficient and confident using SCADA-based technology.

1.6 THESIS OUTLINE

The thesis is organized as follows:

Chapter 1 Introduction: Problem definition and its solution are discussed here.

Chapter 2 Theoretical background: The theory of the whole project is discussed in this chapter.

Chapter 3 Implementation and design: In this chapter , the system design in terms of design goal implementation and components are covered .

Chapter 4 Results:. This chapter covers results obtained from the project .

Chapter 5 Conclusion: Conclusions and recommendations for future work are presented in this chapter.

2. BACKGROUND

This chapter provides the general background and related work on the topic of power systems and on networks used for monitoring and control. The operation of power distribution systems is explained in detail, with a special focus on the interaction between the physical process and the control network. Security of SCADA systems is at the core of this thesis; hence, we outline security practices currently implemented in SCADA systems and discuss real-life incidents that have happened in power distribution systems. We review existing intrusion detection techniques that have been proposed for SCADA systems, to understand if they were capable of pre-venting the mentioned incidents. Developing dedicated intrusion detection methods for SCADA systems requires a good understanding of different concepts in place, as well as their interplay. Hence, this chapter aims at introducing the power distribution system, SCADA systems, threats to these systems and network traffic monitoring.

2.1 SUBSTATIONS

A substation is part of a transmission and distribution system where voltage is converted through transformers, from low to high, and vice versa. Transformation can take place at several stages in a row, beginning at the power station, where the voltage is increased for the transmission and then gradually reduced to the voltage needed for household usage. The term substation was published in the days preceding the distribution system. The first substations were only connected to one site, where the generator was present and relied entirely on this, hence the name.

For an up-to - date transformer, a substation raises voltage and the current decreases, while a down-to-date transformer decreases voltage while increasing domestic and industrial flow. The purpose of the substation is to reduce the voltage from the transmission level to local-distributed values. It is easier to transfer power over long distances at very high voltage.

Substations can be situated on the surface in fenced and enclosed enclosures, in specially built structures, on power poles, or situated in the service areas of the structures it serves. Subdivisions in the buildings they represent are particularly relevant in the high-rise buildings.

2.2 SUBSTATION AUTOMATION (SA)

Automation substations (SA) (see figure 2.1) are used in substations management, security and surveillance. SA systems, at least theoretically, consist of three levels: the station level with the host substation, the HMI substation and the Gateway (GW) to the central control center, the bay level with all control and security units and the process level with more or less sophisticated software interfaces with the transmission network. Extended deployments all three IED-equipped levels, where a typical RTU, for example, contains all three in one device. The serial communications links connect all implemented levels. It does not only have vertical communication between levels (for example between the levels of the bay and the station), but also horizontal communication within the level.

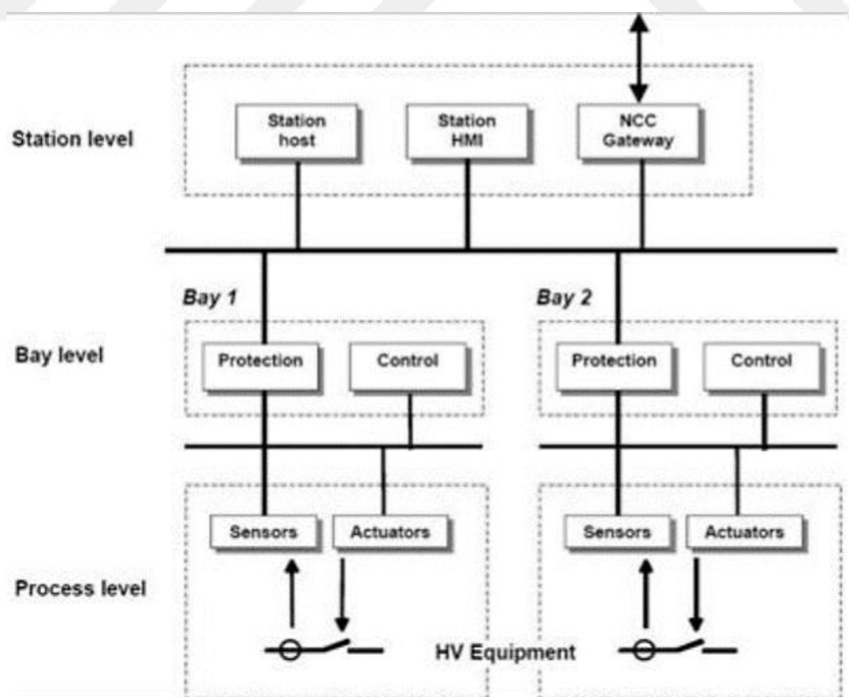

Figure 2.1: Logical scheme of the three levels of a Substation Automation system

Automation of substations may mean various things to various power supplies. On the one side, a remote monitoring and control system (SCADA) could be attached to a typical substation with simulator panels and an advertiser. The imager and the advertiser can also be replaced with an HMI interface for a human machine station. A third utility may use substation automation to bypass any interlocks, cutouts and other controls in order to perform and track all station controls using a microprocessor-based combination of relays, substation controllers and HMIs. Finally, a company might interpret the term more literally, and describe it as real station automation, including things such as automatic voltage control, power failure behavior, smart load transfer between stations, load tap.

2.3 DISTRIBUTION AUTOMATION

The DA definition consists of an organization of devices for remote or automatic monitoring, preparation and operation of the distribution network. Automation increases delivery network reliability and efficiency and lowers operating costs. Automation of delivery offers the ability for automated features, such as automated failure management and automatic tension control. [3] Because automated defect handling methods are the main purpose of the thesis, an introduction into the definition for a DA will be required. A hierarchical structure can be seen from distribution companies to the customer level with the comprehensive distribution automation principle, as shown in Figure 2.2.

There are different tasks and functions at each automation level. The roles at corporate level concentrate on the management and use of the knowledge generated by different IT systems NIS, CIS, DMS, SCADA, for instance. Primary business operations include, for example, management of network information and collections of customer information.

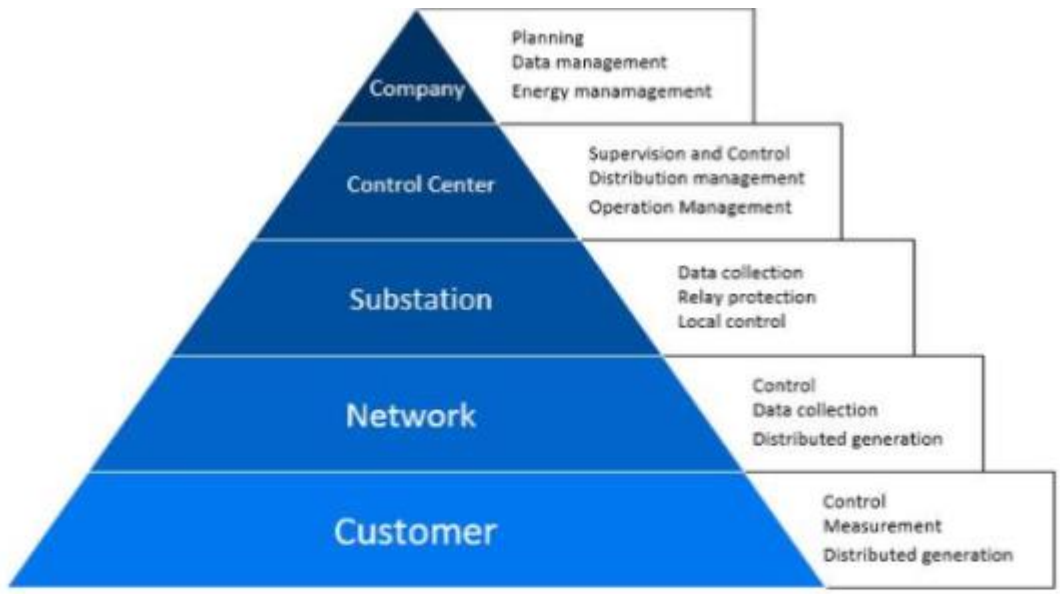

Figure 2.2: The distribution automation hierarchy adapted from [6].

The automation stage of the Network Control Center (NCC) uses DMS and SCADA systems for real time monitoring and control of distribution networks. In the event of a failure, operations staff are responsible for planning and coordinating steps, as well as for customer support and field crew management. Substation level consists of the monitoring of the switching machines, safety relays operation and different types of measurements. Automation of substation also protects e. g. Compensation system control and key tap changer transformer. Substitution can also be able to use SCADA locally if there is no remote use of NCC. Remote-controlled switching system, fault indicators and feeder measurements are part of network automation. One of the main tasks of network automation is to reduce delivery network interruptions in terms of length and scope. The automated meter reading (AMR) and tariff monitoring are included in customer automation. [4] The smart grid principle enables advanced systems in consumer automation to cope, e.g., with growing energy resource penetration (DER) [7].

2.3.1 Electricity distribution system

A supply system of electricity is a primary and secondary operation. The primary process involves networking equipment including transformers, communication cables, switching devices and equipment for compensation, and the secondary process includes devices used for primary process monitoring and management. The popular term used for secondary process systems, including safety relays, defect sensors and control systems, is Smart Electronic System (IED). [6] Figure 2.3 shows the primary and secondary processes of the distribution system. Figure 2.3. The primary and secondary electricity distribution system explained. [6]

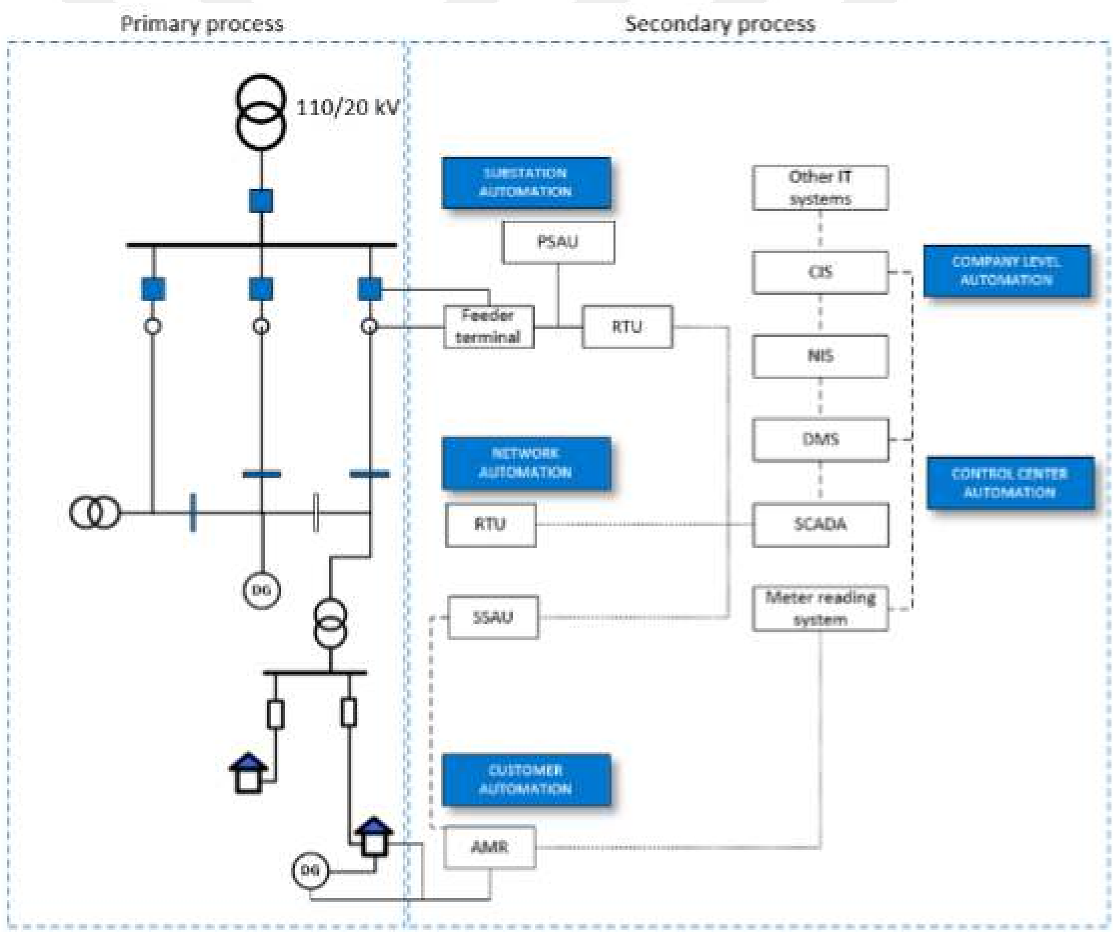

Figure 2.3: The primary and secondary processes of the electricity delivery system are explained. According to [6].

Differentiated by voltage level in high voltage (HV), medium voltage (MV) and low voltage networks(LV) are the main delivery mechanism. The regional network operators usually consider the HVD network to be a 110 kV sub-drive (RNO) network. The MV network typically uses 20 kV, but for historical purposes, other voltage levels are often used, especially in urban networks. The LV network consists of 0.4 kV customer connection lines to distribution stations, but in rural areas 1 kV distribution grids have also become more frequent and partly substitute 20 kV medium voltage branches. [8]

The medium-voltage network can be called the critical fault management component because about 70 % to 80% of customer failures come from the MV network. [10] Average voltage is typically used as a mesh but as a radial feeder with open areas, for potential backup connections. under normal operating conditions. Due to the easier process of network protection and operation, radial operations are of benefit. MV networks operated by Ring become more common, in particular in urban distribution networks because of the advanced protection systems and increased network automation.[8]

The nature of the distribution network is also affected by the increasing number of distributed generations (DGs). In the transmission system connected with the electricity generation, the unilateral flow from the primary substation to customers is traditionally centralized., with 2-way power fluctuations and multitudes of fault current due to the connection of DG with MV and LV networks. These conditions have created new challenges for network protection and voltage control, and opportunities, for example, in micro grid operations in major disturbances. [11]

2.3.2 Network Control Center automation

The Network Control Center (NCC) is responsible for the management and monitoring of the distribution system. The NCC usually has Uninterruptible power supply (UPS) due to its critical roles in the network delivery operation. Network Control Center may be located at a single central point or there can also be multiple NCCs responsible for a certain distribution network area or as NCC backup in the event of primary NCC disruption The Network Control Center concept may also include the mobile NCC where the network is carried out from a laptop operator 's device. The NCC 's principal tasks are:[8]

•Fault management and reporting •Maintenance management and management •Planification and execution •Planification of exchange •Customer support and information.

In a major disruptive scenario, the importance of the NCC is stressed. There are more and more mistakes to deal with and the number of customers resupplies well-oriented and efficient procedures. The electrical safety of maintenance staff working on site is also responsible for the network control center. Consequently, the operator of the network control center must confirm all switching actions in the medium-voltage network. [23]

2.4 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

The data acquisition and monitoring system is an information system that is used to monitor the distribution system in real time. This provides information on the status of the distribution network, as well as controls for circuit breakers and remote-controlled disconnectors (RCD), for example, and for communications with substation and network automatic systems through remote terminal units (RTUs). The main functions of the SCADA system are according to [8]:

•Event data management •Remote control •Remote measurement •Remote configuration •Remote reportage •Manager of network switching status

Event data management provides information on safety relay operation, system change condition and detector functioning. Event data management. When event data is paired with a network model, the switching status of the delivery network can be preserved on the system. The SCADA process database provides detailed descriptions for primary and substation equipment only, whereas the distribution system is usually called a condensed schematic view of links between main and remotely controlled switching devices. [6].

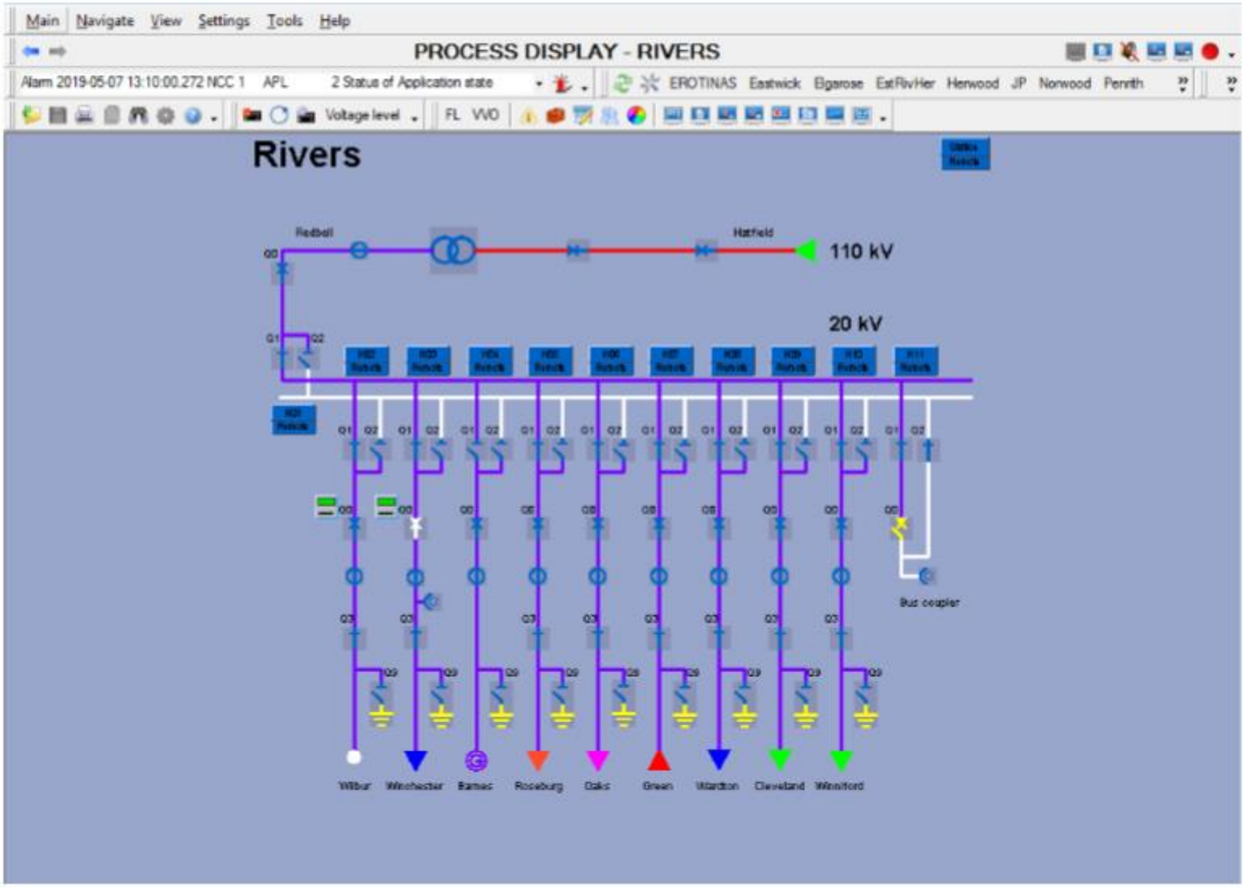

Figure 2.4: Process display of the SCADA system

Three hierarchical processes define the main phase of SCADA framework, Tracking first, second monitor and data collection finally. Figure 2.5 shows this process.

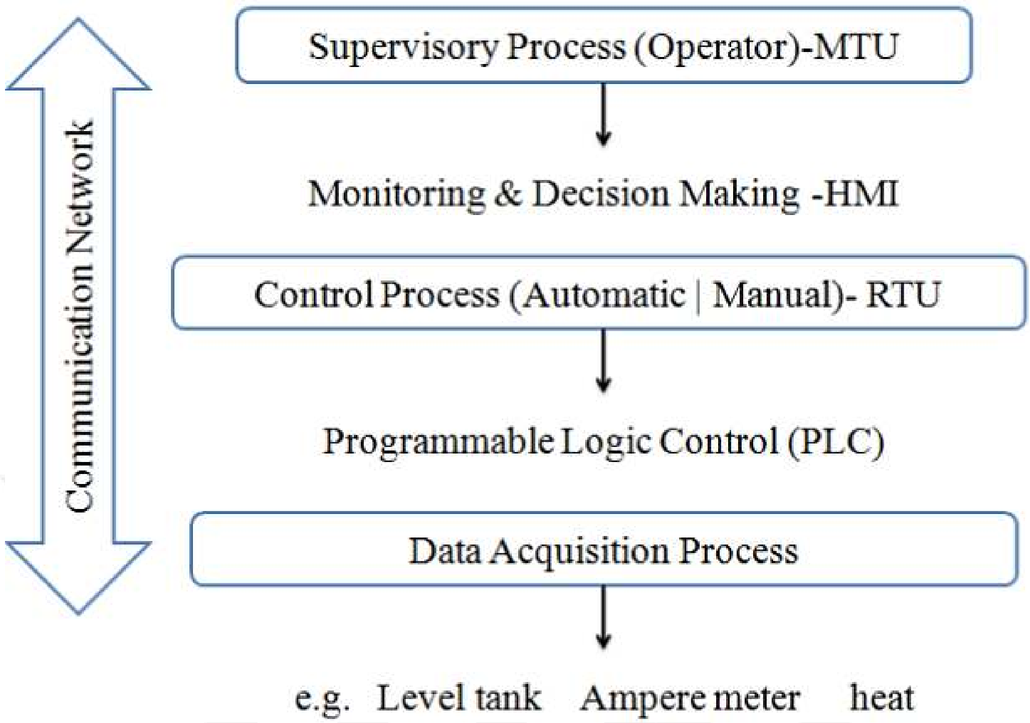

Figure 2.5: SCADA System Structure

Operator: Operator who controls the SCADA system and conducts remote-plant monitoring functions.

Human machine interface (HMI): It provides data to an operator and enables the control of inputs in many formats, such as graphics, schemes, windows, menus, contacts, etc.

Master terminal unit (MTU): A control device with the equivalent of a control / slave arrangement. The MTU shows data to the operator via the HMI, collects data from the remote location and sends control signals to the remote location. The transmission rate between MTU and remote location is relatively small and, because of potential interruptions in time or flow, the control method is typically open loop Figure 3: SCADA System Structure.

Communications means: Communication between the MTU and remote controllers. The Internet, cable, cable or public telephone networks can be used to communicate.

Remote Terminal Unit (RTU): Acts as an architectural master / slave slave. The system sends control signals and data from these devices to the controlled system and sends them to the MTU. An RTU may be a PLC. The device data rate controlled by RTU is very high and the control method is normally closed.

As stated earlier, the SCADA architecture consists of two levels: The control center master level or client level, and the slave or data server level dealing with controllable processes. Both the software and hardware components of the SCADA architecture are essential [13]. Components of SCADA software include two modules, the Client (master) and the Slave (data server), which are linked by communication network to each other.

2.4.1 Basis of a real-time control system (SCADA)

Any real-time controls are based on a SCADE system that collects data from different sources, prepares and stores data in a user-friendly and applicable database[14, 15]:

•Aquiry of results. •Event recording and reporting. •Check. •Archive and analyze data storage. • Support for particular implementation decisions. •Reportation.

2.4.2 Data Acquisition

The SCADA framework is presented with basic information explaining the operating status of the network. It is automatically obtained by equipment at different substations and facilities, manually entered from the operator to show, or measured by field crews, the state of manual operation of non-automated systems. The information is handled in all cases in the same manner [14].

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Configuration indicators reflect the status of switching devises and warning signals. These indications are touch clocks connected to Remote Communications System digital input boards, such as RTU. Figure 2.6 shows single status indications, with two indicators for all switches and two-state indicators.

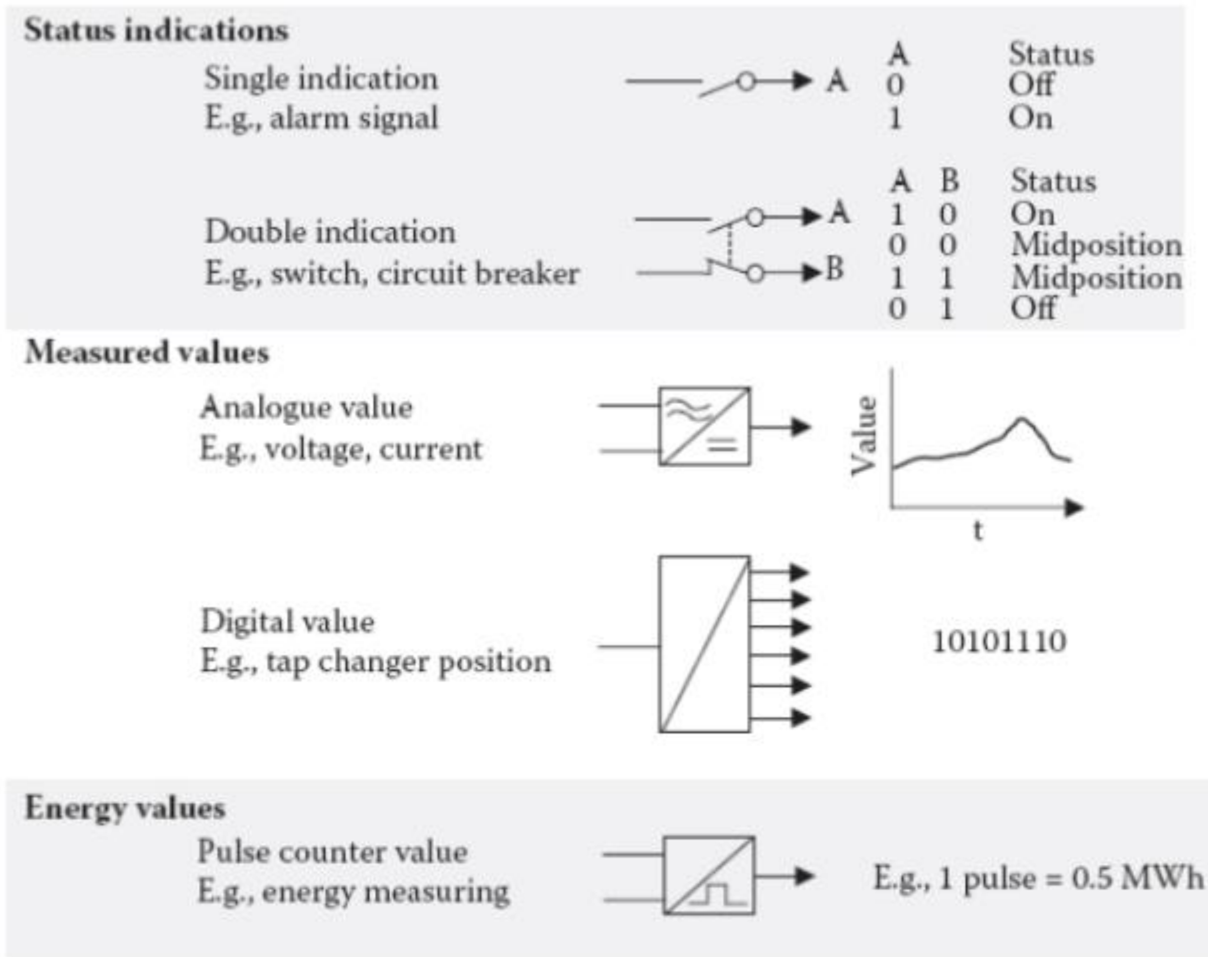

Figure 2.6: Examples of acquired data types

One bit is the near touch, while the other bit reflects the open contact. It allows identification of false and medium values (00 or 11 states), which would result in an alarm failure due to stuck or incomplete switching. Errors may also be found in the control circuits the measured values represent different times of voltage, current, temperature and the power system tap changer. It is divided into two basic forms analog and digital. The A / D converter transforms all the analog signals into a binary format.; they must be normalized before being stored in the SCADA database since they are regarded as momentaries. The analysis (polling) of the calculated value takes place cyclically or only in the event of a shift in value ideology with regard to dead bands (reporting by exception). Digitally encoded values are common for various settings including tap changes and (Smart Electronic Device) IED health checks.

Pulses or IEDs typically have energy values. RTUs with pulse meters, at predefined demand intervals or intermediate points, are instructed to submit the pulse details when necessary. For the time interval specified, the contents of the continuous counter are transferred and the procedure for the next interval is repeated [14].

2.4.3 Monitoring and Event processing

The collection and storage of data produces little information, and therefore it is a fundamental feature of every SCADA system to track all data presented against normal values and limits. In accordance with the different types of data obtained and the criteria of each data point in the system, data management has different objectives. In particular, an event is necessary to process when a change in status or limit is made.

Status monitoring demands that the previous value stored in the database be correlated with each indicator. Any alteration may cause an event that notifies the operator. Status indicators are given a normal state in order to extend the information content; thus, an out of standard state warning is activated. Changes in status can be postponed to allow primary system operational times to prevent unwanted warning messages.

The importance of continuous information to the operators from a multitude of collected data has led to the concept of adding data quality attributes, which in turn calls for a way to flag data in a given color, or symbol, in the display console of the operator.

For all events produced by or induced by monitoring feature, event processing is necessary. This processing classifies and groups events to allow the corresponding data to be transmitted to the various HMI functions, to represent the criticalities of the alarm operator. Event processing is a key feature of the control system and has a significant impact on real-time performance, especially during alarm explosions. The event management product is a linear event and alert lists. Events are grouped into a variety of categories in order to assist the dispatcher, the most relevant being alarms that provide an alarm list. The following are the most popular categories:

- A specific display warning, such as color flashing, is determined by unrecognized and persistent alarm categories and an audible signal is produced in some instances. The alarm remains unaccounted for until the operator is remembered.
- An occurrence connected to a specific type of system where an attribute, such as bus voltage and relay safety operation, is allocated for each data point.
- Reason for the event that happens with a monitoring role assignment (i.e., accidental disruption of a breaker or recorder, a manual or control command). A priority assigned to the grouping of all events into different priorities frequently defined by combining system form and event purpose.

The whole object of these classifications is to separate major events from minor events so that the operator is supported first in the resolution of the most critical problems during multiple activities [14].

2.4.4 Control Function

The operators or software apps trigger control functions automatically and directly influence the functioning of the power system. It can be split into four subclasses. Custom user interface that represents the direct interface open / close for one system.

Control messages for the control systems requesting operations to automatically be performed by the local logic on the computer after the control room has been started, To ensure that operations are within specified limits. Raise or lower tap changer taps are typical examples or send out new points of power generation.

Sequential control includes the automated completion of a linked control set after initiating the start of the sequence order. A number of sequential steps to power restore that predetermined backup configuration characterize the sequential control.

An occurrence or defined time triggering the control action activates automatic control. A common example is automatic voltage regulation by change of load tap that automatically reacts to the voltage point violation. The condenser banks swapped time are another one. The first three control groups above are manually activated, with the exception of the automatic sequential control. The control actions performed manually can be either on a specified pre-operated approval basis or on a direct order [14].

2.4.5 Data Storage, Archiving, and analysis

As mentioned previously, information gathered from the process is saved in real time, to create a current picture on the SCADA application server of the process under monitoring. RTU data are saved on receipt, and any change overwrites old values with new ones.

In providing customers and the regulator with current data about the power quality of segments of the network and the network as a whole, the output statistics obtained from SCADA systems are extremely relevant. This statistic is based on the Stored Event Sequence (SES) list.

Data labelled this time (TTD) is processed every 10 seconds or every hour at cyclical intervals in the historical database. Only modified data are usually stored in order to conserve disk space. For several aspects of strategic preparation, statistical analyses, system loading and performance assessments as well as report output, data can be collected at a later date. [14]

This data mining requirement contributes to more advanced archiving technologies, which can be tailored to identify data and storage events. These historians, storage and recovery systems with complete redundancy and versatile retrieval systems or information storage & retrieval (ISR) systems are now integral components of any DMS. They typically rely on the Oracle or SQL server connecting databases.

2.4.6 SCADA Hardware

On hardware consisting of the multi-channeled front end of communication that controls the data acquisition process from RTUs are implemented SCADA systems. This is generally done through the repeated short intervals (typically 2 seconds) of polling of RTUs. The obtained data is then redirected to the SCADA server via a local area (LAN) network, allowing operators and other applications to be saved and accessed. User consoles that support the control structure and graphic views of the HMI are used to invoke control. SCADA systems have a redundancy mission criticality which standardizes hot standby fronts and dual LAN applications. Figure 2.7 shows the general design of a typical SCADA system. The front end supports efficient communications through WAN to the RTUs, for process data collection and transmission to enhance safety and cost saving control commands. A number of setups are supported by contact front ends. This is the most common usage today:

- Multi-drop is a radial configuration that sequences RTUs via a single channel. This leads to a faster response time approach.
- Point-to-point Specifies a communication RTU channel. Used for large substations or data concentrators with large I / O requirements. With the addition of multiple communication chains, this configuration provides a high degree of response. A further communication path is added for a reliable line-by-line scheme for applications requiring very high reliability.
- Loop functions in an open loop configuration, each of which is a multiple-drop style tube, from two communication front ends. The gain is reliability, since a standard opening point (NOP) can be surpassed by swapping the loss of any communication segment direction.
- Star Configuration is an RTU Data Concentrator Point to Point combination that controls the RTU slave data access as a point-to - point or Multi-drop-settings. Such configurations are used to economically design mixed response time for distribution automation.

There are many communication protocols in the industry and their variations used between the master station and the RTUs. The central method includes all of them above the Communication Level. [14].

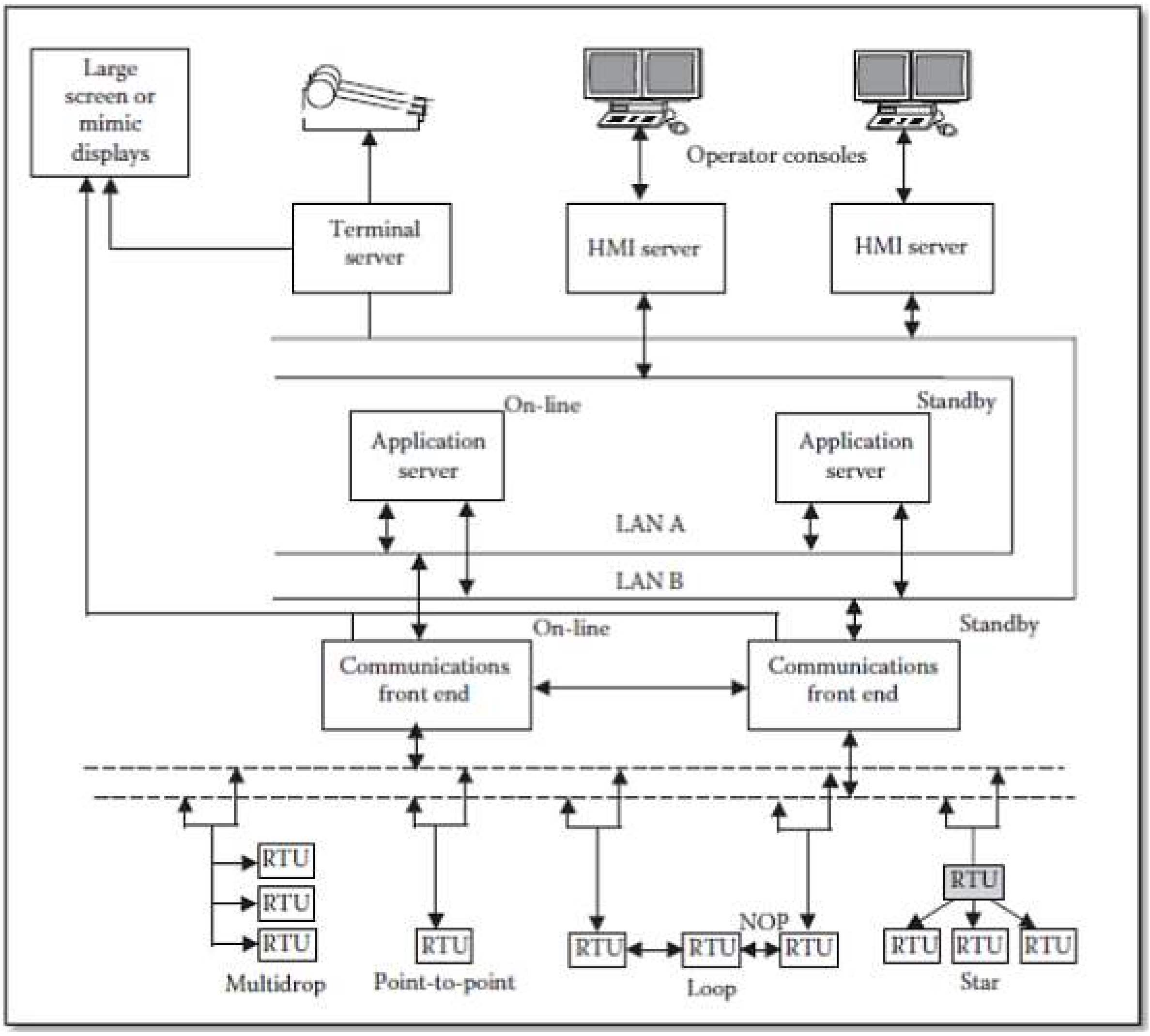

Figure 2.7: Configuration of a typical SCADA system

2.5 SCADA IN ELECTRICAL SYSTEM

The economic strains on the deregulated electricity market have taken the grid closer to the system's limits and components. The Synchronized Phazor Mess technology has been the ideal way of monitoring and controlling power systems, particularly under stress conditions. Based on phasers from PHMUs obtained in real time at 50 or 100 Hz, quick and accurate status estimating and assessment of stability risks and margins is now feasible for a wide-speed measuring device (WAMS), as well as preventive and correctional control steps. However, the number of PMUs is limited for the actual, requested data for communication, storage and processing, and only the main nodes in WAMS must be monitored. Previous research was therefore focused on optimizing the location of PMUs and integrating SCADA and WAMS data.

As the ancestor of WAMS, SCADA is a widely used method of monitoring. In general, a SCADA consists of a control center master station and a set of RTUs in substation and energy plants. SCADA has been installed at a control center. RTUs calculate voltage, current, frequency and compute active and reactive power at every substation and factory. Those data are transmitted through a communication network to the SCADA master station in the control center. The large number of substations and power plants to track as well as the limitation on a small bandwidth of communication can be modified with a 3/4 s interval. It is normally too slow to record dynamics of the system during disturbances. The SCADA 's prevalence is strongly preferred to encourage the SCADA to represent the current infrastructure-based system dynamic, so the dispatchers in the control center, however, can easily detect the oscillation and act on schedule, even if they are 3-4s delayed. In recent years this has become a feasible objective with a much improved SCADA power. First of all, RTUs have the technological feasibility of collecting phasers from electronic instruments transducers inside a substation by the advent and development of the automated substation automation system using IEC 61850. Secondly, the widespread use of optic fiber has greatly strengthened SCADA's communication capacity, although a communication bandwidth of between 50 and 100Hz is still overwhelmed. There is, therefore, a limit to the amount of information to be sent from the RTUs to the SCADA server, and the complexities of the system on a basis of the current infrastructure may be mirrored.

2.6 PROGRAMMABLE LOGIC CONTROLLER(PLC)

A digitally operated electronic system that can be used in an industrial environment by means of programmable internal storage memories to store user orientations for carrying out specific functions like logic, sequence, timing, counting, and arithmetic” [6]

An electromechanical process control unit, such as a machinery control, fun rides or light fixtures on factory assembly lines, is a logic controller (PLC) programmable or a programmable controller. In its functions, including sequential relay control, motion control and process control, the Audi A6 has evolved over the years. Some modern PLCs, for data management, storage, computing power and communication use, are almost the same as desktop computers. PLC-like programming enables a computer in conjunction with I / O hardware to overlap PLCs in some applications. PLC is equipped with numerous input and output schemes, extended temperature ranges, noise, vibration tolerance and impact resistance compared to general computers. The technology of the PLC has grown over the years, including the following: sequential relay management, motion management , process control, distributed control and networking systems. In storage , processing and networking, some modern PLCs are approximately equivalent to the desktop computers. SPC-like programming with remote I / O hardware can overlay certain PLCs with a desktop computer in some applications.

The first programmable logic controller (PLC) was created by a group of engineers at General Motors (1968). Hundreds or thousands of relays, cam timers and drum sequencer, and dedicated closing-loop controllers were used to control, sequence and safety interlock logic for automotive manufacture, prior to the PLC. The process of upgrading such equipment for the annual model transition was very long and costly, as professional electricians had to rewire the relay systems. Today PLC technology has evolved, with many other essential functions and language programming capabilities. Today's PLCs offer faster scanning times, usable input / output space, and special interfaces for directly connecting non-traditional devices to the PLC. They can not only interact with other control systems; they can also carry out investigations and diagnose their own faults and a computer or process malfunction.

2.6.1 Operation of PLC

A PLC consists of 2 basic sections: the CPU and the I / O system. The PLC consists of two basic sections. The processor and memory system will further break up the CPU which controls all PLC activities. The input / output system is interface between the CPU and input and output / checkable devices (outputs) connected to a field device (e.g. switches, sensors).

The input module purpose is to transform income signals and send these into a central control unit, which can be processed through the PLC. An output module does the reverse job. In conjunction with the program stored in the memory, the PLC signal will become signal acceptable for the actuators.

The CPU uses its input interfaces to "read" input data from connected field devices, then "runs" or executes the control program saved in the memory register. Programmed, a language that closely resembles a relay-based cable scheme, is normally generated with ladder logic and loaded into the CPU memory before it is used. Finally, the PLC writes or upgrades output devices via output interfaces on the basis of the software.

The aim of this new standard was to specify and standardize the design and functionality of a PLC and the vocabulary required to program it so that the users could use various PLC systems without particular difficulties. IEC 61131-3 was the first IEC published in December 1993.:-

FBD (Function block diagram): A diagram is a function block, which defines a process between the input and output variables. A set of elementary blocks is defined as a function. Linked blocks by link lines are the entrance and the output variables. A block output may also be related to a block input. House inputs and outputs with connecting lines or connections are wired. The connection is oriented, so that from the left to the right, this line carries associated data. The link line's left and right ends must be of the same sort.

LD (Ladder diagram): Ladder logic is a programming language that demonstrates a structure based on the diagrams of relay logic. It is used primarily to develop software for industrial control applications for programmable logic controllers (PLCs). The name is because the programmers look like ladders with two vertical rails and horizontal lines between them in this language. Many of the first PLCs used basic ladder logic to convey all decision-making logic similar to the electronic diagrams. This notation was selected to minimize training requirements for current technicians.

ST (Structured text): The structured text is a block-structured high-level language that looks like Pascal.

IL (Instruction list): It is a language of the low level and looks like a montage. IEC61131 Basic Elements shares all languages. The variables and the function call are specified by the common elements, so that in the same program various languages can be used. The file format is now PLC-opened with XML.

SFC (Sequential function chart): SFC programming provides a graphical framework for program organization. Measures, acts and changes are the three key components of the SFC. Steps are just logical chunks, i.e. a programming logic unit which performs a specific control task. The interventions are the various aspects of the mission. Transitions are the processes used to switch between tasks. Control Logic is programmed in one other language, such as Ladder Diagram or Structured Text for each move, action and transition.

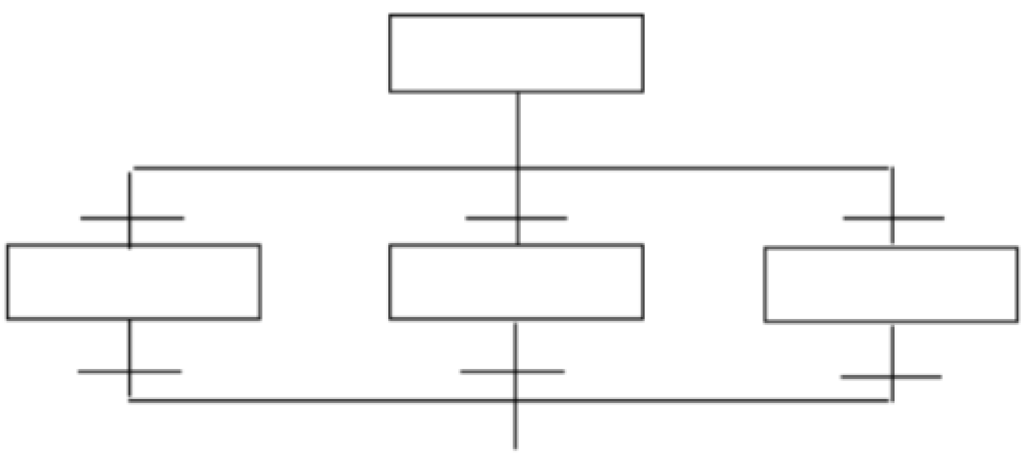

Figure 2.8: SFC chart symbol

2.6.2 PLC Life Cycle

As shown in the project development diagram (Figure 2.9), the construction of the control system can be separated in different stages. Based on time and resources availability, a management decision is taken as to the optimum process for obtaining competitive tenders from specialist contractors for remaining design, procurement and installation. The first step is to detail the framework to be managed carefully and potential future criteria for expansion. In this initial overview, hardware and software interfaces should be explained in depth and questions like system place, control links, engine or actuator loads and physical enclosure safety should be discussed. The second stage is a succinct and detailed summary of the operating control specifications. It is important that, at this second level, there are extensive consultations between operators and maintenance crews and engineers to ensure that user wishes are properly represented and identified. These descriptive control needs are then transformed into a series of logical events in a specific format. A specification for both the hardware and the software is next prepared (sometimes called the functional design specification or FDS).

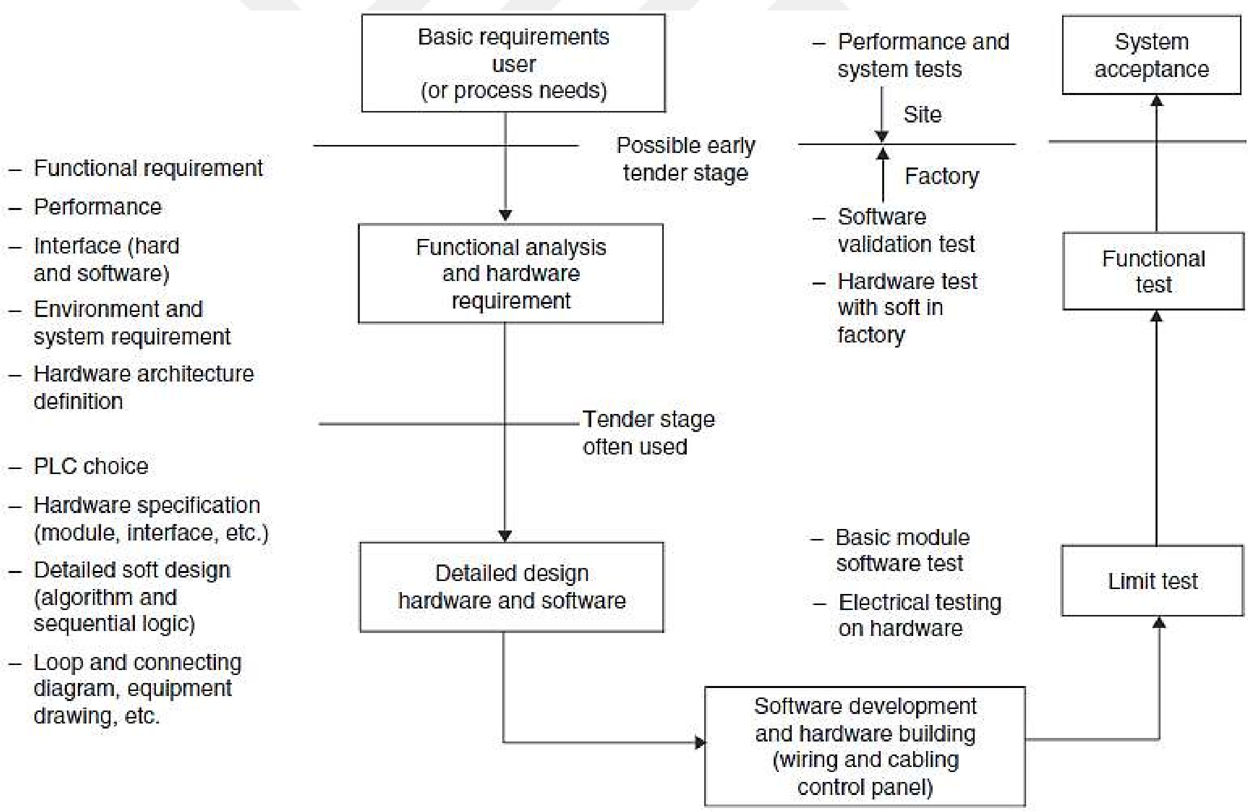

Figure 2.9: PLC system development lifecycle

2.6.3 PLC compared with other control systems and its benefits

The key difference is that PLCs are blinded for extreme conditions (for instance dusts, humidity, heat, cold) and have a comprehensive input / output (I / O) facility. The input / output arrangements can be integrated into a single PLC, or external I / O modules can be connected to a network of computers connecting to PLC. Electrical design is necessary and the design problem is based upon the desired operating order of the lever (or function chart), and the control and input systems consistent with industrial pilot equipment and control are also included in the PLCs. PLC implementations are also highly optimized systems, which reduce the expenses of a PLC package in comparison to the cost of a custom controller.

The production costs (design of electrical supplies as well as input / output hardware), which could spread over multiple sales, and where the end user does not have to alter the monitoring system, will be acceptable when hundreds of thousands of units are made. Automotive applications are an example; million units are installed every year and very few end users change their programming.

The additional input / output, analog, positioning and communication modules can be used for expansion of several PLCs. PLCs typically have 9-pin RS232 and optionally RS485 and Ethernet built-in communication ports. Modbus, BACnet or DF1 are normally part of a communication protocol. Other fieldbuses, including System Net or Profibus, may also be included. Most advanced PLCs can connect to other systems through a network, such as a device that runs a SCADA system or a web browser.

2.7 CONTROL OF SUBSTATION USING PLC AND SCADA REVIEW

In her field of theoretical and application so many researches has been done that are briefly discussed in this section.

They demonstrated the efficiency and high performance of substation automation and optimization method. The short idea of SCADA-based substation automation was presented in [3]. Finally, the paper presents some applications of the technique made by the author in the real world. The basics of sub-station automation and the techniques and problems related to it were presented in [15] John McDonald, Substation automation Basics. [16] This journal shows the features and hardware of GE Substation Automation System Solutions. In [17], BSES New Delhi 's Project Report, which presents the information regarding the requirement and efficiency of this system in this area. [18] Royal Institute of Material Automation Systems Technology Nicholas Honeth. The SCADA is a device that allows remote monitoring, management, control, operation and acquisition of the transmission, distribution and distribution elements, equipment and in real-time mode from a remote site for analysis and planning by a control center. In this brochure you can see how the ABB substation Automation Systems are built and configured. [19].

[20] In the first part of the paper Tom Wilson summed up the main concepts used for PLC & SCADA sub-station automation by providing examples and case-studies for selecting a Control System Integrator. [21] The GETCO Annual Report on Technical T&D for Gujarat gov contains the detailed account for the overall substation of the Gujarat state and the age-sensitive list for substations and the manually operated and automated percentage of substation.

Raymond W. and others. In 2000, the use of the WAP (Wireless Application Protocol) architecture was discussed in order to provide wireless access to the database operating on a SCADA distributed system of network protocols. They developed Distributed Network Protocol (DNP), which is currently connected through a local network area in the SCADA systems Terminals and RTUs. In a process plant the conditions are severe and the site remote. Data communication resources are difficult to obtain in the environment, and cellular communication via a wireless channel is practical and efficient. A wireless WAP device can access and operate resources available within a SCADA system via the mobile service within the DNP protocol. [7]

2.8 CONCLUSION

During increasing complexity and efficiency of delivery networks, automated functions must be incorporated in daily operations. In particular rural distribution network operators are unable at least for the next few decades to secure a fully weatherproof network due to dilapidated distribution areas. In this chapter we present a global view about related works and basic concept that will be used for our system in the next chapter

3. PROPOSED SYSTEM

The substation is a to be integrated system for the analog and digital automation of distribution system for customers and user functions . As we have adopted the concept of interconnected power system, the role of substation is become more important. Substation connects generation station to the distributor or to the end consumer via transmission system depending upon the types of substation. Activities like switching of transmission lines, parameter measurement, fault detection and storing of historical data are carried out in each of the substation premises. Earlier time this all activities was carried out manually, as complexity of system increase the role of substation become crucial and we need to move towards the use of IEDs and Automation. Activities carried out at substation can broadly classify in to three term i.e. supervision, control and Data acquisition. In an automated substation this all three will done using Programmable Logic controller and SCADA. For system monitoring or supervision data is given to controllers from RTU. Control command according to system parameter is produced by PLC and SCADA provides a human machine interference. Substation automation systems make their control and monitoring possible in real time and maximize availability, reliability and safety of the system. The project aims to automate an intermediate station. The aim is to detect losses of electricity when transmitting power between substation and soil. This loss of energy could come with theft or some other factor in energy loss.

3.1 PROPOSED SYSTEM

In this study, For the monitoring and collection of data of industrial processes, SCADA systems are commonly used throughout the industry. The project is based on a microcontroller and configuration software and has been designed to track the power distribution system SCADA. The machine uses CT (Current Transformers) and PT (Current Transformers) to achieve distribution line electrical parameters. The serial interface circuit will be used to pass it to SCADA. This study explains the automatic switch control for the SCADA-based primary substation electrical distribution network using PLC. The aim of this investigation is to transform manual control system into an automatic switch control system. Four key parts of the electrical distribution network based on SCADA. They include automated controls, interface devices, surveillance and networking. This work highlights the automatic control system. The PLC ladder diagram can be used to accomplish this scheme. A safe, reliable and practical control resource which can use remote terminal units is evaluated by automated distribution systems (RTU). The automated system based on simulations is shown in this study. The results of the simulation show that the PLC automatic control system proposed fulfills the desired high-performance control environment. This system for traditional power distribution in Myanmar is effective and reliable via SCADA-driven technology. SCADA systems are capable of reducing the output by 1,1% to 0,3% by 6% and 1% by 396-352 minutes, and reducing production costs by 6.71% by 6. SCADA systems are willing, respectivamente. The findings of this research into SCADA systems using PLC and HMI would improve quality and production cycle efficiency.

3.2 SYSTEM OVERVIEW

For the proper functioning and synchronization of individual processes, the SCADA-based method is used. The read-aware PLC performs data collection and control operations in these systems. The SCADA-based systems principle is crucial because any system can run dependent and that other systems are shut down if not in operation. The analysis integrates different protocol deployments, rising the use of an integrated graphical user interface in a PLC-based unit of process control. This paper replaces large panels which have been replaced in big rooms. All is put under one PC that makes it very dynamic and cost-effective. In a substation, several parameters can be accompanied by control and data acquisition. Further interconnection enables quick access to and analysis of data from a common perspective. This limits people's power and delay.

This controls the plant in the control room and provides user-based access. It is cost-effective and clean. We can quickly switch to PLC and SCADA if there is some change and potential expansion. Most switches are used in sub-stations, if a trip takes place in one switch, the specific region can easily be found. Automatic power device parameters monitoring and regulation. In this job, the virtual computer and graphical interface unit are used. Figure 3.1 displays the proposed device block diagram.

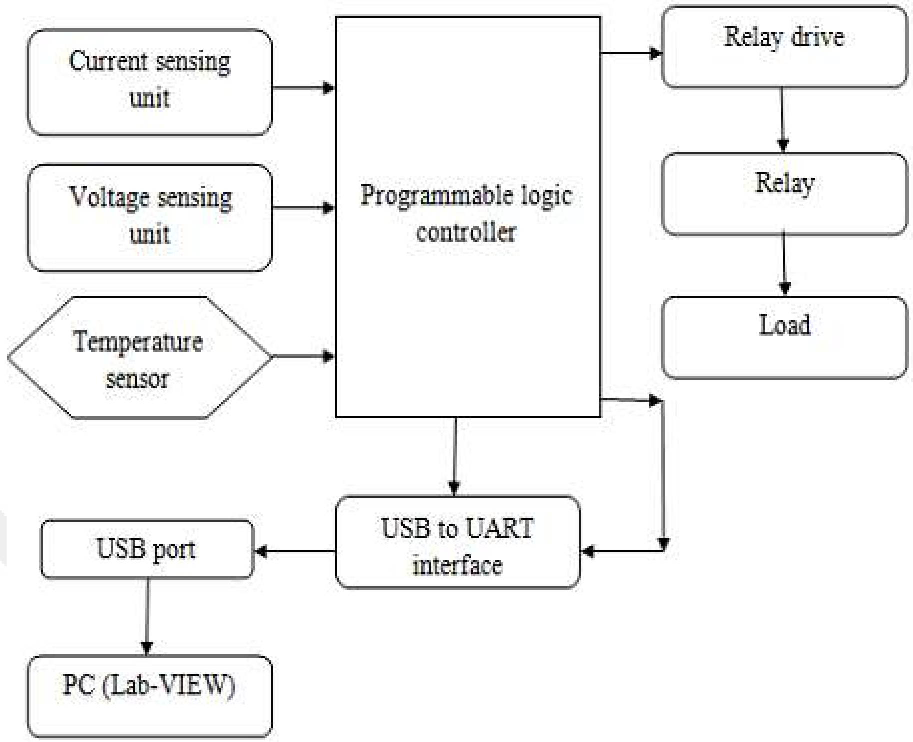

Figure 3.1: Block Diagram

3.2.1 PLC

The software control is a software that can automate standard operations, such as installation line controlling machinery, entertainment and power lights, for example. In several industries and computers, PLCs are used. SPPs are designed to handle multiple analog Digital inputs and output structures, wide temperature ranges, vibration and resistance to noise. Battery or non-volatile memory normally stored computer operating programs. The flexibility of the PLC has improved over the years to include sequence relay control, movement control, monitoring of systems, remote control and networks. Most modern PLCs have the same level of data management, storage, computing power and communication capabilities as desktop computers. The key difference is that the PLCs are coupled with a broad input / output (I / O) power in severe conditions (like dust, humidity, wind, cold)

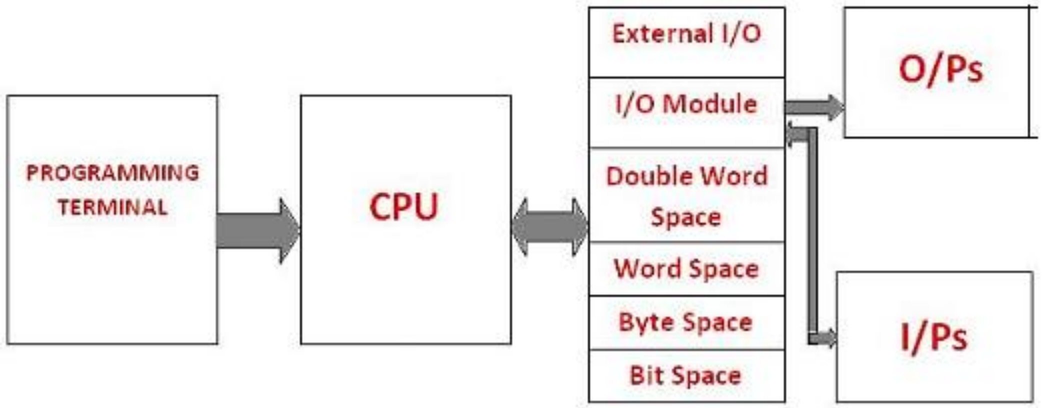

Figure 3.2: Basic block diagram of PLC

The figure 3.2 above shows a simple logic controller (PLC) block diagram. PLC's CPU is normally programmed via personal computers or specialized HMIs via a programming terminal. The basic CPU modules are external modules, I / O modules and memory addressing locations with bit, byte, word and double word. A PLC is an example of a tough system in real time because in response to input conditions output results are generated in a limited time.

3.2.2 SCADA Based Substation Automation System

The SCADA consists of processing data by RTU, which is transported back to the central location, and which is displayed in various control screens and monitors, for critical re-examination and monitoring. SCADA (Supervise Control And Data Acquisition System) is called the SCADA system. SCADA are highly distributed systems, often spread over several thousand square kilometers in order to manage geographically dispersed assets, Where the collection and management of centralized data is important in system operations. Which are found in wastewater treatment facilities and storage systems, pipelines for oil and gas, power grid networks and transport systems.

SCADA Control Center provides centralized monitoring and control of field sites via long-distance communication networks, including data monitoring and data saving. On the basis of data received from remote stations, control controls that are automatically on remote control systems also referred to as field devices, or operator controlled systems can be switched on. Local operations such as opening and closing valves and breakers, data collection and local warning monitoring for sensor systems are performed by field instruments. A SCADA framework collects data from remote-side sensors and computers. It then transmits controller tracking data at a central location. Trading high staff cost for better process control performance at low computer system costs is used for automation systems. Such devices for automation are also known as PCS or SCADA., and the wide-ranging use of these systems makes them necessary if many physical processes are to function safely, effectively and efficiently.

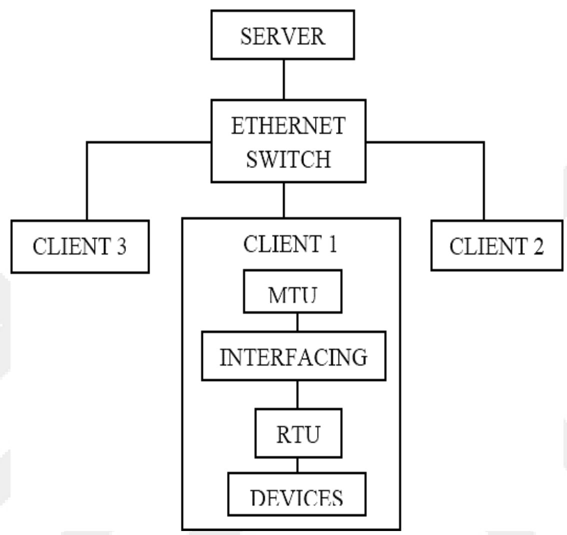

Figure 3.3: SCADA diagram

The SCADA 's broad architecture requires physical equipment such as switches, pumps and other structures that the remote unit can control. Dual functions for human operators are available on master machines, including meter readings and unit state, in a digestible format, and by means of operators who use consoles to communicate with master computers through a network, monitor the field equipment and connect to the device.

3.2.2.1 Master Terminal Unit (MTU):

Allows operators to monitor the status of all equipment aspects and improves the connection between the most operators and the alarm. It offers information on process status, alarms and other ways.

3.2.2.2 Interfacing

Allows the attachment of communications equipment from different manufacturers. For the communication of two computers, the RS- 232 or RS-485 interface is built. Two devices called: DTE communication with a DCE device, data transfer and data receipt transmission, and DCE transfers data between DTE and physical data communication link. Electronic communications equipment transmits electronic DTE data.

3.2.2.3 Remote Terminal Unit (RTU):

It is intended for a microprocessor to connect data streams into data streams. RTU can be fitted with a battery or adapter chain. The voltage is used or the current source. It is done. It is over. RTU collects the data in the SCADA method, codes the data in a master format and explicitly implements the process from the master. RTUs come with input channels, power output channels for sensing or measuring.

3.3 IMPLEMENTATION OF PROJECT

3.3.1 Working Process

The system involves joint assembly of SCADA and PLC, generating power with the induction engine, supplying 3-phase power to PLC and tracking progress and status of power generated with PLC. In the event of any fault in any three-phase section, it can be fixed with PLC. Relaxes can be used to fix defects for electro-mechanical automation switching. Monitation section is fitted with an HMI system that can be operated by the Supervisor in a control room with an Ethernet cable for manual engine control in case of an emergency. In order to manage operation and track the performance of the plants, we build a window for above hardware. Control switches start 1, begin 2 and begin 3 to begin plant 1, plant 2, and stage 3 respectively are given in the control room. The move stops the whole plant. If an operator manually starts these machines, we also give the manager the facility to use STOP 1, STOP 2, and STOP 3 respectively to stop one or more units. The reservoir displays the current water level and temperature of the site. We also provide a monitoring room. Such criteria are demonstrated in six boxes called WLR, SVW, ETV, and TSPV. WLR displays the actual water level in the container and SVW sets the water level point value in the container. STY (Set Temperature Appreciation) and TSPV show the supervision of the temperature setpoint appreciation. Three presentations are also available, TPl, TP2 and TP3, in particular. For hydropower plants, solar and hot power plants, TPI, TP2, and TP3 show the time period. Three additional indicators, known as OLI (Overload Indicator), ULI (Under Load Indicator), and LTV (Low Temperature Indicator) are in the control space. Figure 3.5 display Circuit diagram and connected component of proposed automation system.

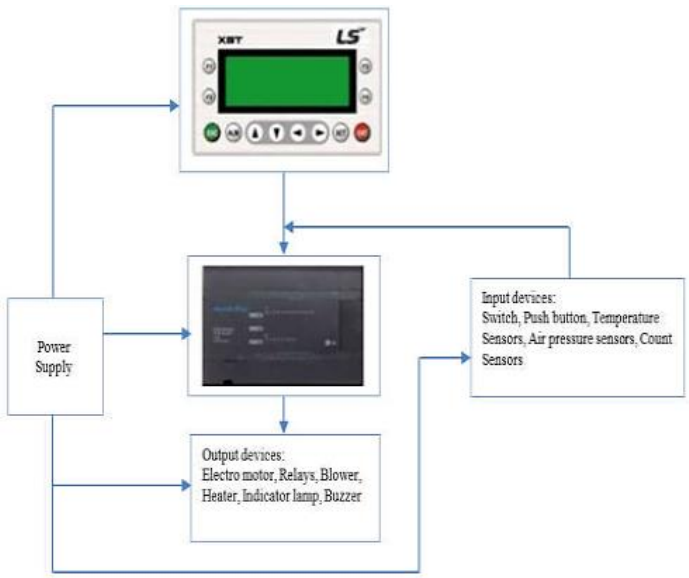

Figure 3.4: Connected SCADA systems

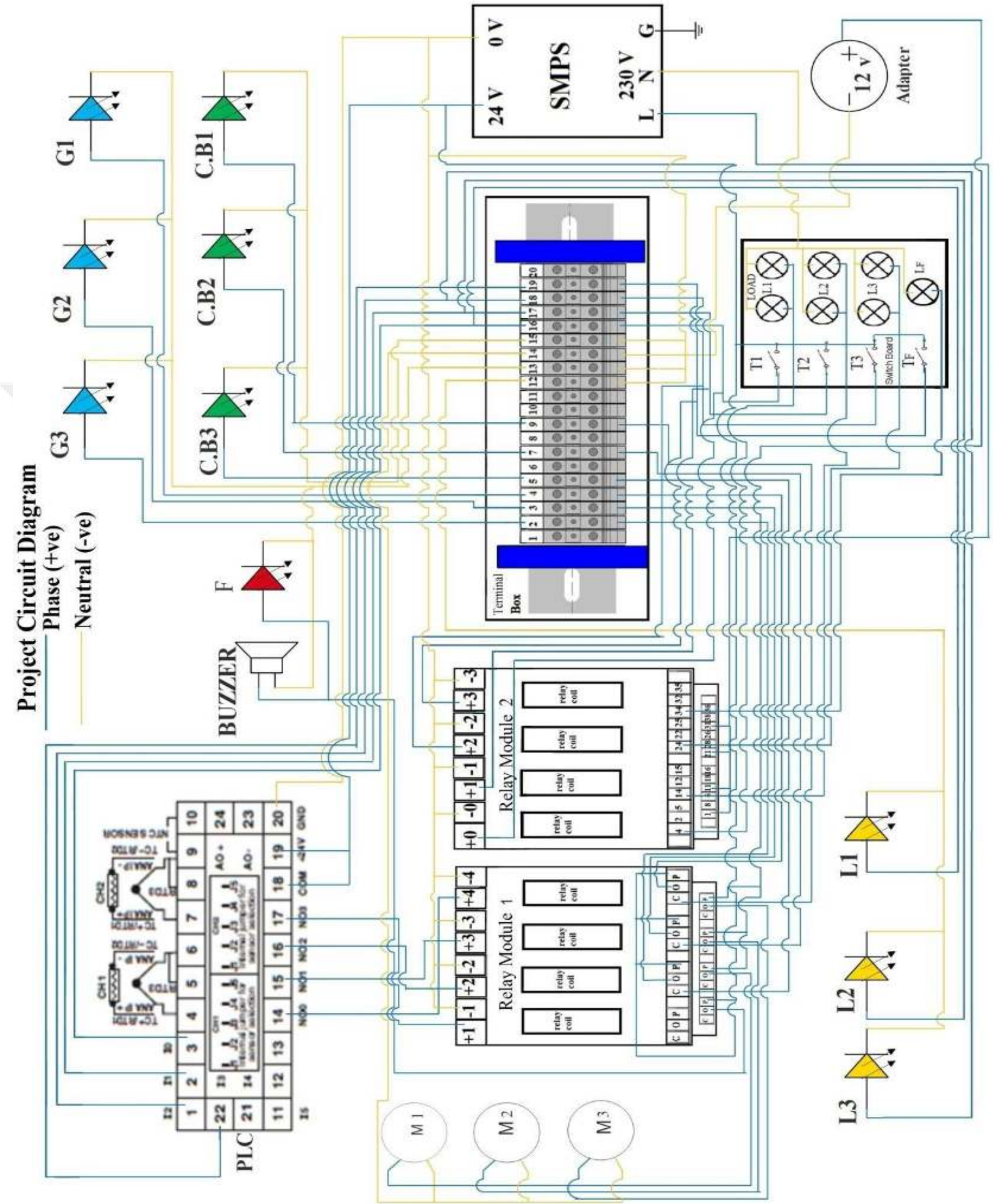

Figure 3.5: Circuit diagram of project

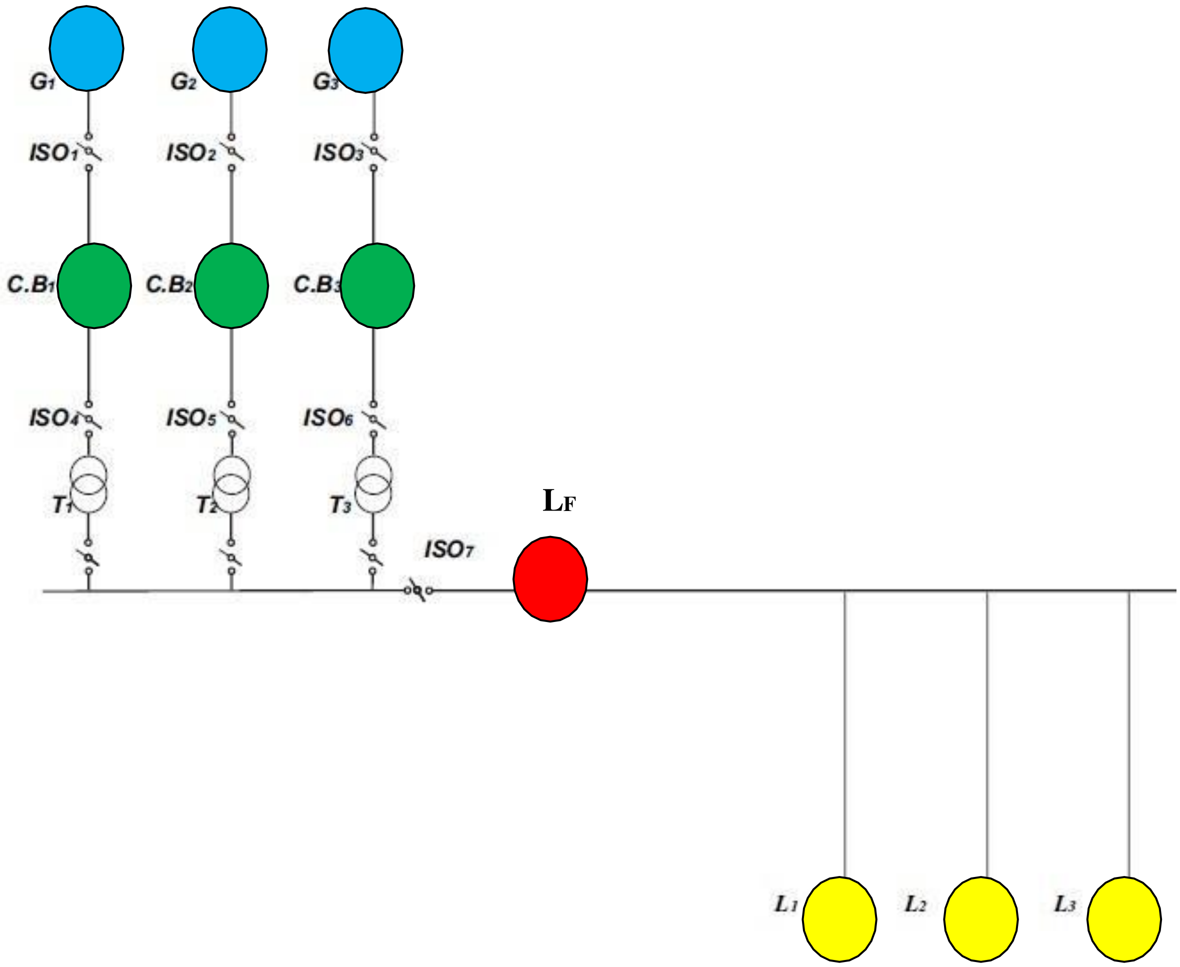

Figure 3.6: Project circuit layout single line diagram

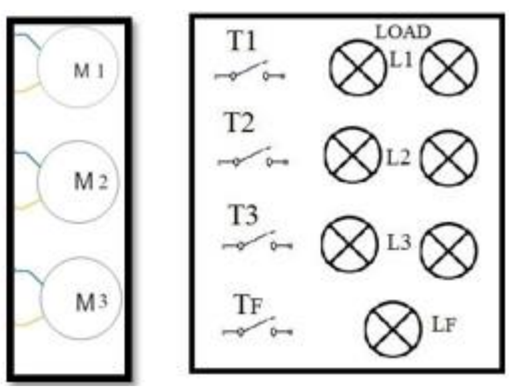

Figure 3.7: (a) Motors (b) Switch board

3.3.2 Circuit Working

Step1: Switch ON supply , circuit runs at default condition. Initially All ISO are connected and M1,G1,CB1 will simultaneously ON.

Step2: Switch ON T1 then L1 will ON.

Step4: Switch ON T2 then L2,G2,CB2,M2 will simultaneously ON. Step5: Switch ON T3 then L3,G3,CB3,M3 will simultaneously ON. Step6: Switch ON TF then LF, Buzzer will ON and all CB are turned OFF

Note: In the case of if T1 & T2 or T1 & T3 or T2 & T3 are ON then From G1 or G2 or G3 there will be Two either G1 & G2 or G1 & G3 or G2 & G3 will Operate at the same time respectively

Table 3.1: Component list

Sr. No.	Component	Rating/Size	No. of Units	Price (Rupees)
01	PLC	12V	1	6000
02	Relay Module	230V	2	1600
03	SMPS	24V	1	1000
04	Adapter	12V	1	150
05	DC Motor	12V	3	390
06	Indicator LED	24V	10	400
09	Toggle Switch	5A	4	60
10	Switch Board	25*30 cm^2	1	90
11	Panel Board	2*2.5 ft^2	1	350
12	DIN Rail	1 ft	1	200
13	Terminal Block	-	As required	50
14	L Clamp for DC Motor	-	3	30
16	Buzzer	24V	1	15
19	Connecting Wire	10 A /0.5 mm^2	As required	150
21	Guidance Charge	-	-	6000
Total Price (Rupees)				17255/-

3.3.3 Data Sheet

3.3.3.1 Relay Module

A relay is an electrical device. Many relays use an electromagnet to mechanically manipulate a switch, although others are often used, including solid state relays. Relax are used where a low-performance signal is required to control a circuit (with full electrical separation between controller and controlled circuits) or where there must be one signal control over many circuits.

An electrical motor or other charge controller type is referred to as a contractor, which can handle the high power required to control directly. Solid-state relays monitor traffic power without moving parts rather than use a semiconductor to move. Circuit energy is regulated from overload and failure using controlled operating features and, often, multiple operating coils. These functions are performed in modern energy systems by digital instruments sometimes referred to as safety relays.".

3.3.3.2 SMPS

An electric supply that includes an electrical control mechanism for efficiently transforming power is a switched power mode (switch, SMPS or swiper). SMPS is a source of electricity much like other energy sources., for example , power supply, which transfers power and current features to a load like a personal computer. Unlike a direct power supply, the switching mode supply transistor continuously switches between low, maximum or complete states and spends very little time with fast dissipation transitions, minimizing waste energy to a minimum. Ideally, electricity is not transmitted by a switched-mode power supply. The stress control is obtained by adjusting the on-off time ratio. A linear power supply controls the power output voltage in the pass transistor by continuously dispersing electricity. This higher efficiency is a key advantage of the power supply switched mode. Switched power supplies can, because of a smaller size and weight, be considerably smaller and lighter than a linear power supply.

A linear control unit dispensing ohms loss of excess energy (for example, in a resistor or in a collector-emitter area in active mode) provides the necessary output voltages. A linear regulator tracks output voltage or current by heat removal of surplus energy, which is why the actual output / voltage is zero because the voltage difference has been lost.

The switched modal power supply either controls output voltage and power by turning in the different electrical configurations the ideal storage components, such as inductors and condensers. If "closed," the ideal elements of the switching system (i.e. transistors that operate outside the active mode) do not withstand and do not produce a current when "open," so the converters will ideally perform at 100 per cent performance .

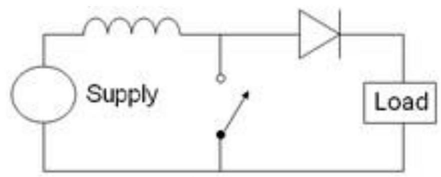

Figure 3.8: Schematic diagram of a booster converter

The basic schematic of a boost converter.

In order to achieve this, the waveform maximum voltage measured through the switch, Where an electrical supply source and inductive device are installed and the switch is powered by a square wave. The inductor reacts to change in current by blocking changes in current with the own voltage, and this voltage increases the voltage of the source when the switch is being opened. If a diode/ condenser combination is built in parallel with the switch and the condenser can be used as a DC source with a voltage output higher than the DC voltage. The maximum voltage can be stored within a capacitor. This improves the transformer as a step-up signal for the DC transformer. Similarly, it operates with an output voltage in terms of the input voltage polarity. Additional buckling circuits increase the average output current by reducing the voltage.

The output flow of the SMPS depends on the input power signal (e.g. duty cycle pulses width modulation) as well as the storage element and circuit topologies and on the patterns used to transfer the switching components. The spectral densities of these waveforms are relatively high in energy concentrations. As such, a small LC filter can be used to filter the transient and rib switches on the outgoing waveforms.

3.3.3.3 DC Motor

-- engine needs two magnetic fields, one of which is stationary (standard or field) and one of which is rotating (rotor or armor). Either the new spindles are winded, or the permanent magnets. This can be connected in a variety of ways if the field is a wire coil, resulting in various motor characteristics. The fundamental law of an engine, which is why it turns, is regulated by the left-hand rule of Fleming (see figure below). This shows us the position of the force on a thread, which is in a magnet field carrying a current.

3.3.3.4 Panel LED Lighting

Light emitting diodes are useful for projects since they are visual. As the current passes through LEDs, a particular material is used that emits light. Unlike lamps, once their current cap is surpassed, LEDs will not flame out. A 0.02 Amp current (20 mA) to 0.04 Amp (40 mA) for LEDs is a decent range. Like normal diodes, they have a positive leg and a negative leg. Check for a metal line within the LED to find the positive side of the Lead. Seeing the line can be challenging. The optimistic part of the LED is nearest to that side. The good side of the screen is also to see a flat area at the edge of the LED. This flat position is negative.

The positive leg tension is about 1.4 volts larger than the negative side tension as a current pass through an LED. Note that the current is not resistant so that a resistor must be used in the LED series to stop it being lost. It features high light indicators in various colors such as red, green , yellow, blue and white with different lighting panels. Broad range of volts in LED indicator lamps. He's been long. There are various 24v, 110v, and 220v volts.

3.4 RESULT AND DISCUSSION

3.4.1 PLC Software

3.4.1.1 Programming of PLC Ladder logic

Initially, the logic of Ladder was written for the design and design of relays for the construction and control of processes. The symbol indicating connections between each system in the relay rack can be shown in the ladder diagram. Furthermore, the ladder diagram will also display other components outside of the relay carrier such as pumps, heaters and more. See the logic of relay. The logic of Ladder has been built into a formal programming language based on the hardware logic diagrams. The ladder software used to develop applications for the industrial control framework for programmable logic controllers (PLCs). Its name is based on the programmers are the same in these language ladders with two vertical rails and a number of horizontal bars.

Although ladder diagrams once were the only programmable controller programs to register, today IEC 61131-3 standardizes other types.

PLC: The ladder software is used to create software on programmable logic controllers in industrial control applications (PLCs). Every device in the relay rack is represented by a symbol with connections between the devices shown on the ladder diagram.

3.4.1.2 Project PLC programming

Ladder logic is typically used for PLC programming when sequential process management is needed. For easy yet vital systems or the re-working of old hardwired relay circuits, ladder logic is useful. The more advanced programmable logic controllers are also used in very complex automation systems. In combination with a computer workstation running the HMI software ladder logic is also used.

The aim of representing the ladder diagram 's sequential control logic is to allow plant engineers and technology managers to develop software to learn a language like FORTRAN or other general machine language without additional training. Because of their similarity to common relief hardware systems, production and maintenance is simplified. Ladder logic implementation has features like sequential execution and control flow support that make the hardware comparison unprecise. This is less important since most ladder logical programmers have a more traditional programming language history. In addition, ladder logic systems are typically supplied to the programmable logic controller manufacturers. Usually the languages of the ladder are not fully consistent between two manufacturers; rather than one language the structure of the ladder can be seen as a collection of closely related languages. Even in the different models of programmable controllers within one family the ladder rating is different , which means that programs cannot be seamlessly interchanged among models.

Instead of the procedural language as a rule-based language, loader logic can be interpreted. The rule in the ladder is a "rung". The various laws "run" simultaneously and instantly when used by relays and other electromechanical instruments. Usually rules are followed sequentially by software in a continual loop, if applied in a programmable logic control (scan). If the loop operates faster than "scan time" and typically several times a second the simultaneous and immediate output effect is achieved is taken into account in all program rungs. The proper use of programmable controllers calls for an appreciation of rungs' output order constraints. [19] SELPRO consists of a ladder editor compliant with IEC61131-3 international standards and an HMI calible facility. This programming interface features a full library of functions and functions, an auto-declared version of the auto-reading and auto-saving functions, representing the physical E / O of your selected structure. It also has a broad range of hardware, updated protocol support (MM3010, MM3030-2), as well a capability for online and offline simulation. [18] Lab-VIEW: Laboratories are a highly efficient medium to communicate with real world knowledge and/or signals such as science and technology for customized applications;.

The PLC code in Figures 3.9, 3.10, 3.11 and 3.12 shows the M100 register is worked accordingly. The voltage , current and temperature parameters should have three registers for the whole operation, ON and ON. Figure 3.9. PLC programs are normally written on a personal computer in a special application and only accessed through a cable or a PLC network. The software is either stored in a RAM battery or in some other non-flat flash memory on the PLC. A single PLC may also be configured to substitute thousands of relays.

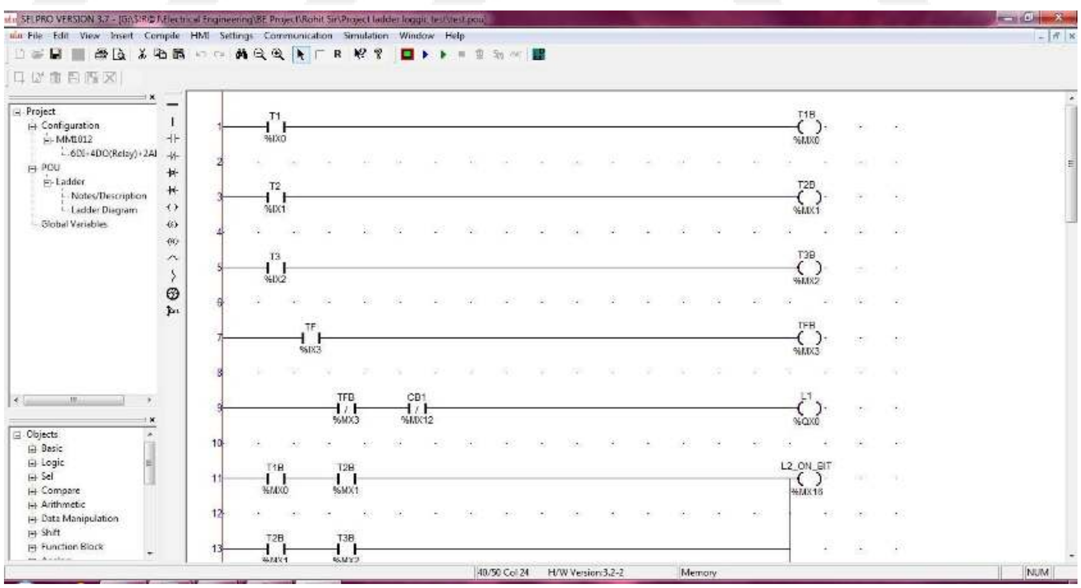

Figure 3.9: Project Ladder diagram screenshot 1.

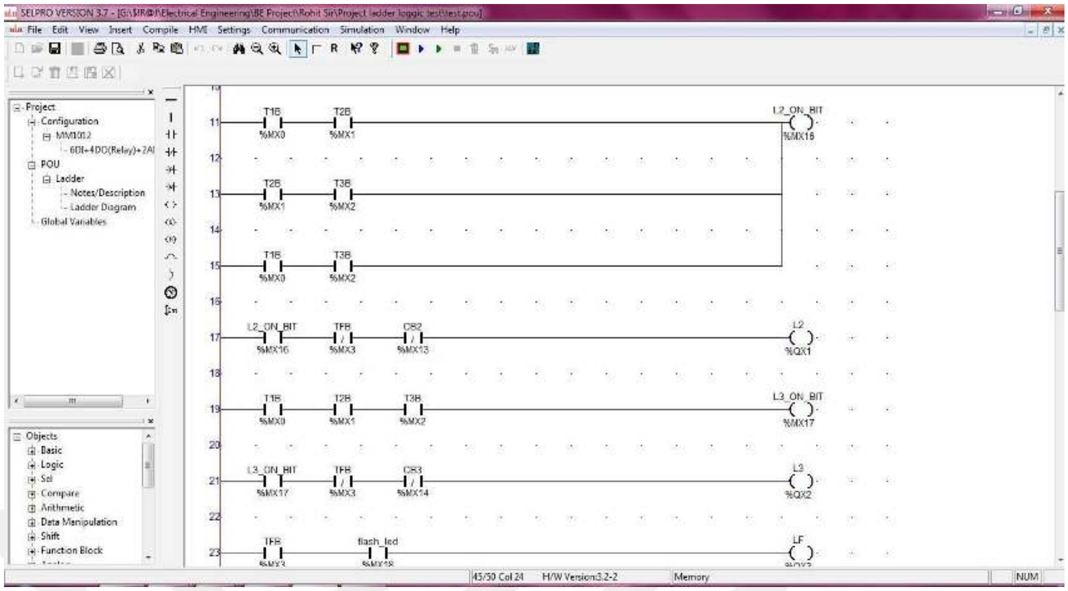

Figure 3.10: Project Ladder diagram screenshot 2

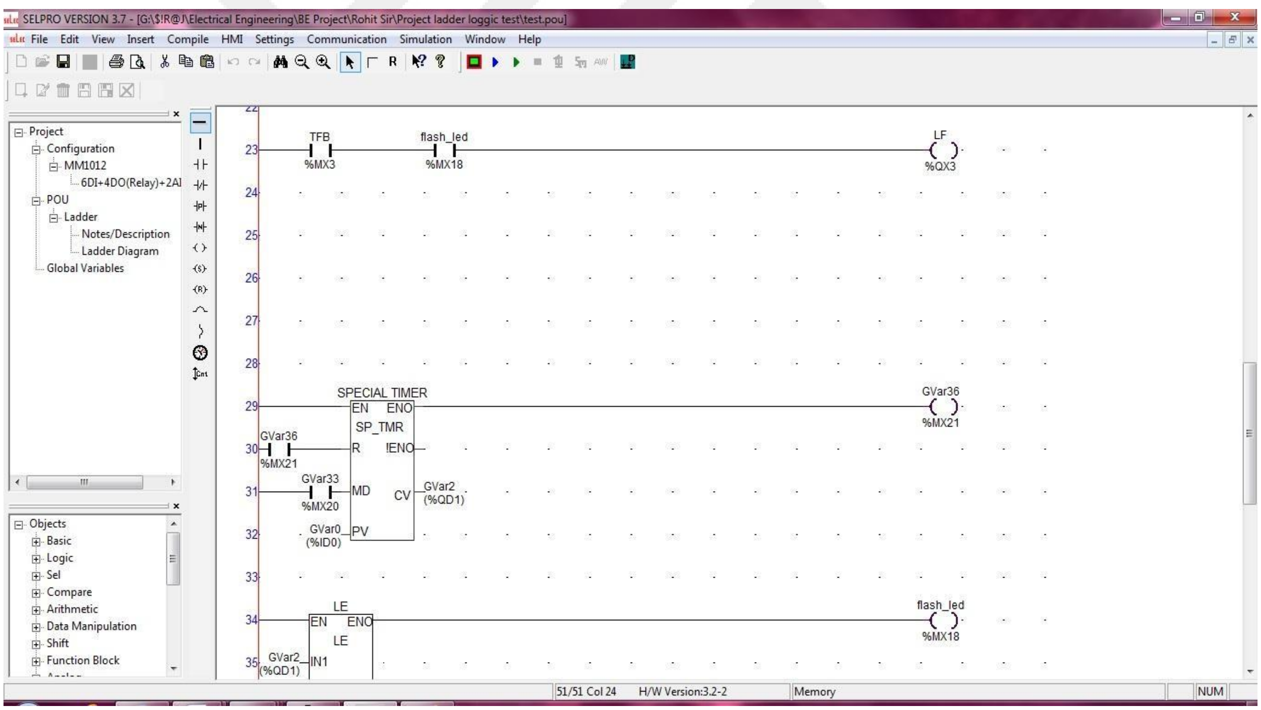

Figure 3.11: Project Ladder diagram screenshot 3

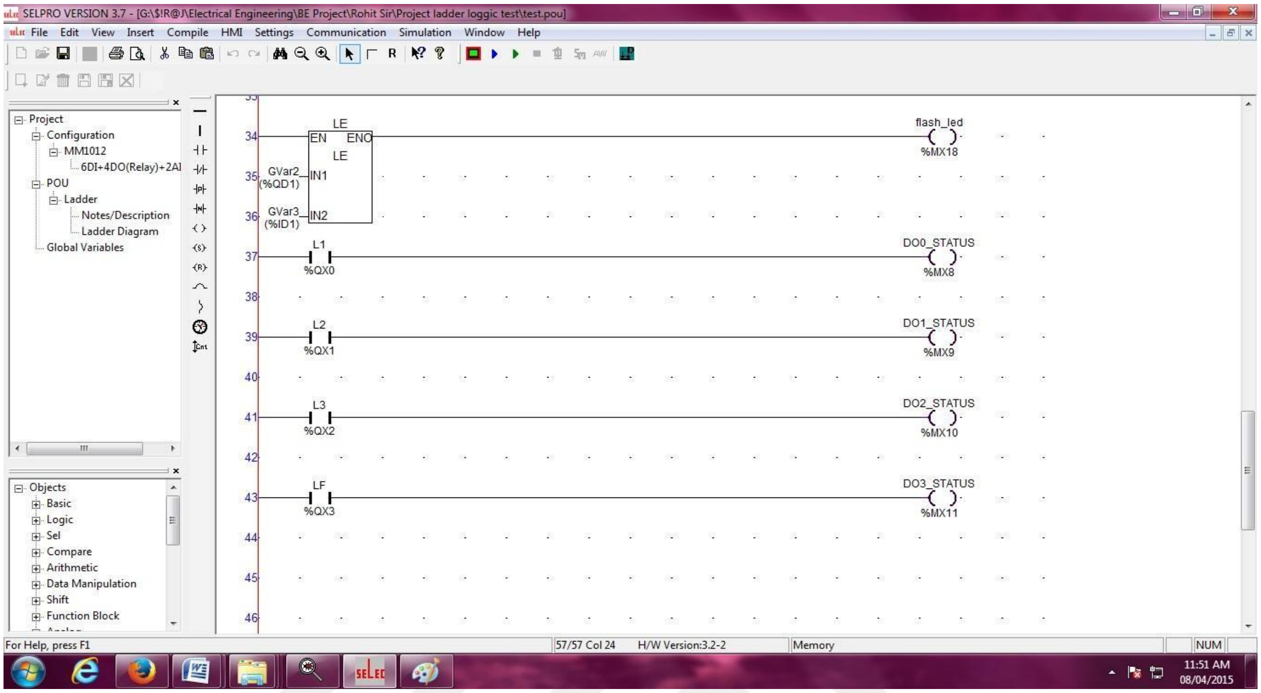

Figure 3.12: Project Ladder diagram screenshot 4

3.4.2 SCADA Software

For a wide range of applications and industries NI LabVIEW software makes answering the query a difficult task: "What is LabVIEW? "Over the years I have encountered many contrasting views and discussions, so I found it fitting to use this opportunity to address LabVIEW. LabVIEW is a platform for highly efficient creation for developing custom applications interacting with real data and signals in the fields of science and engineering.

The programming G language is important for LabVIeW, therefore it is also called 'LabVIEW programming' which helps us to rapidly link data collection, analysis and logical activities with the use of this programming language and understand how data are changed. From a technological viewpoint, G is a graphical data stream language in which nodes (operations or functions) are used when data are accessible in place of a line-by-line sequence. We graphically view the 'flow' of data through the application with wires connecting one node output to the other.

The graphic approach has a practical advantage as it primarily focusses on data and processes and outlines several of computer programming technical difficulties, such as memory allotment and language syntax. New programmers normally report shorter learning curves with G since G code can be represented in diagrams and other common process visual representations. Experienced programmers may use advanced programming techniques such as object-oriented design, encapsulation, and code profiling to maximize efficiency by working at a higher abstract level. The result for the SCADA interface linked to our device is shown in Figure 3.13.

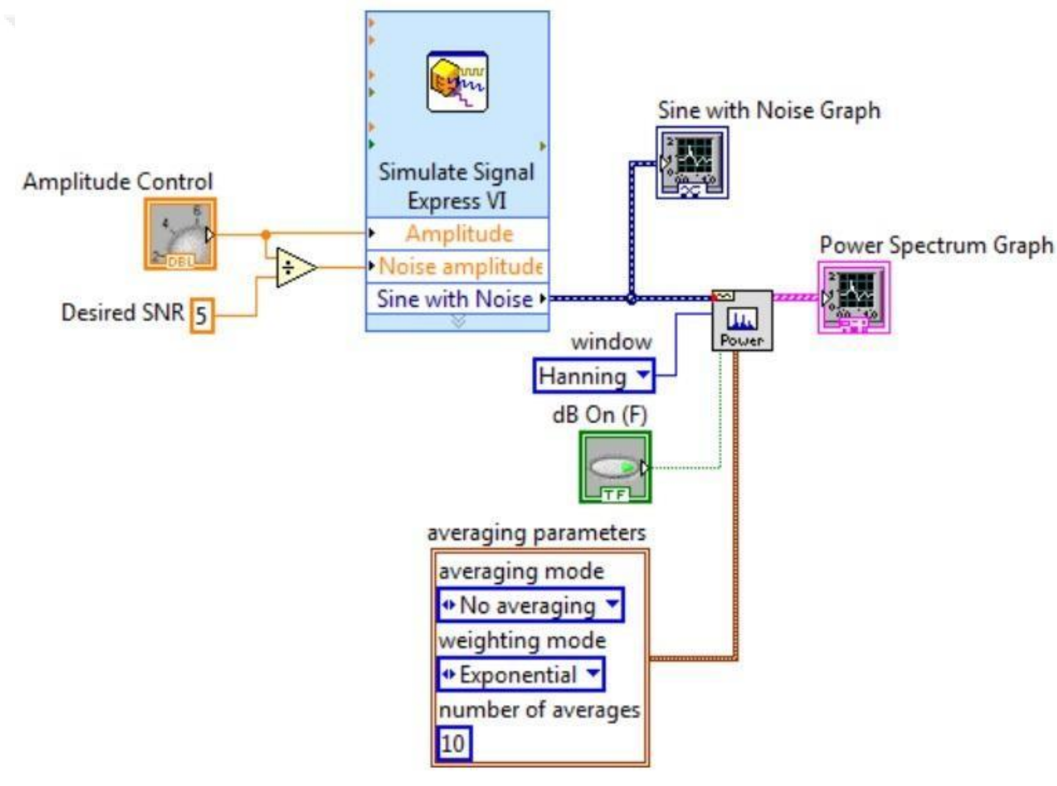

Figure 3.13: Block diagram of self-documenting G code

LabVIEW provides a powerful compiler for evaluating our block diagram and generating a powerful machine code to prevent an interpreted or compiled language output penalty. The compiler can also identify code segments without data dependencies and divide our program into multiple threads, which can be run simultaneously on multimedia processors and therefore test and monitor with much faster sequence than with a single threaded application. (i.e., the linking wires are not).

The diagram for the block has a similar front screen, the application's user interface. The front panel makes for instance generic controls and indicators such as lines and numbers, buttons and technical controls, including charts, dials, tables, thermometers, dials or scales. All LabVIEW controls and indicators have been created to allow users to enter SI units such as 4 M, by right clicking the scale of the graph and typing a new terminating point, by exporting the data to software such as NI DIAdem and Microsoft Excel, etc.;

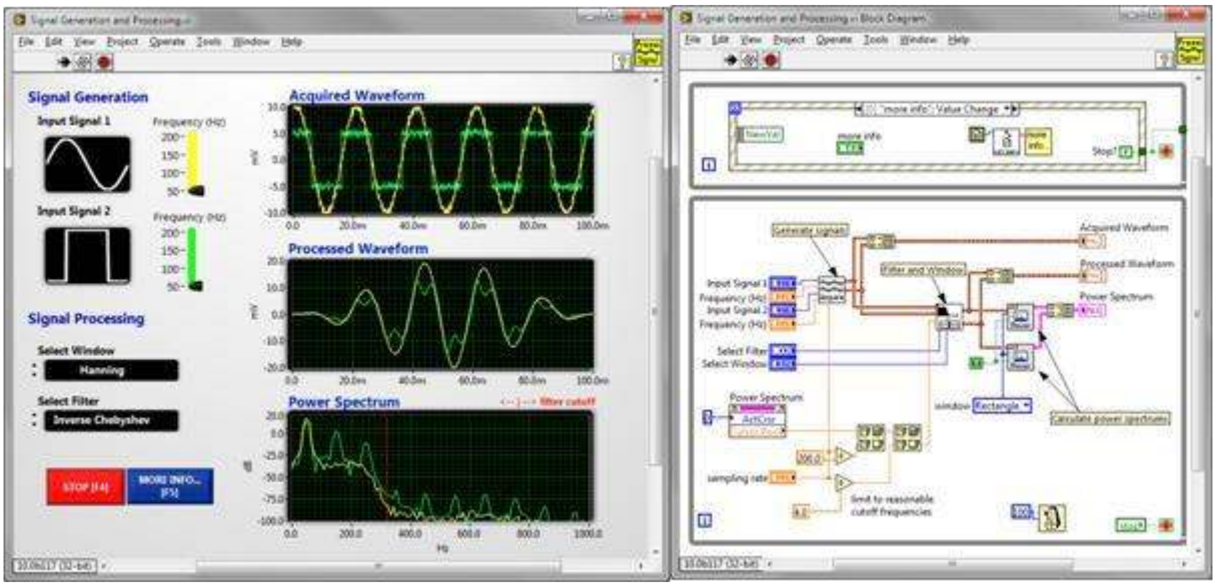

Figure 3.14: LabVIEW block diagram has a connected front panel, like this example for custom UI signal formation.

Controls and metrics can be modified. We can add them either by clicking on the data wire in a palette of controls at the front panel or by selecting "Create power" or "Create indicator"."

LabVIEW provides multiple options for report generation from our test or acquired data in addition to the reports display while our application is being performed. Simple reports can be sent either directly to the printer or HTML file, Microsoft Office documents programmed or incorporated into a more sophisticated reporting system using NI DIAdem. We can publish data on the Internet with the integrated web server via remote front panels and web service support.

3.4.3 Performance Result

The industries benefit immensely from the automation of the substation. The industry will increase its benefit by open access to electricity. The following output review is carried out on the basis of an industrial estimated power plant.

Data acquisition (sensor): Get data from field machinery to find out al-time process status, for example: motor velocity, temperature, p. Data acquisition (sensor): The circuit models are generated and inspected according to a previous arrangement in Figure 3.1, based on the device description provided in the last section. Remote Telemetry United (RTU): RTU / PLC data communication and SCADA master / HMI data communication between RTU / PLC sensors. The RTU is an important connection between sensors and the SCADA network and sends a lay signal to the SCADA master in the protocol format. In this case RTU has the important feature. Data submitting (HMI): The device SCADA will display the user's necessary information in the desired format. Control System (HMI): Continuous process monitoring can be performed automatically or manually, entirely via HMI. Table 3.2 demonstrates the difference between conventional regulation and SCADA.

Table 3.2: Comparison between a conventional control system with the SCADA system.

Process	Conventional system	SCADA system
Data acquisition	To obtain data have to look directly at the position where the measuring instruments	
Data presentation	Data collection and Data input is done manually on the computer, data presentation take a long time	All can be done in one screen (HMI) easily and quickly
Control and Monitoring	Control and monitoring is done directly on the machine	
Troubleshooting	Problem analysis is done by checking one by one on the equipment Count sensor 1	With an alarm system

Figure 3.15 shows results of comparisons in pie chart(a) of the conventional method against the method SCADA, showing the total denied value of the product that is supplied for the standard total rejection method by production 1,1 percent. The SCADA system is higher in barograph(b) than the traditional method, which reflects an improvement in efficiency of 6.1 percent. In barograph(c), the length of the SCADA system is shown as rapid as traditional systems. Compared to the default standard rate, the barograph(d) indicates the cost of the production of traditional systems and SCADA systems in accordance with the current standard costs.

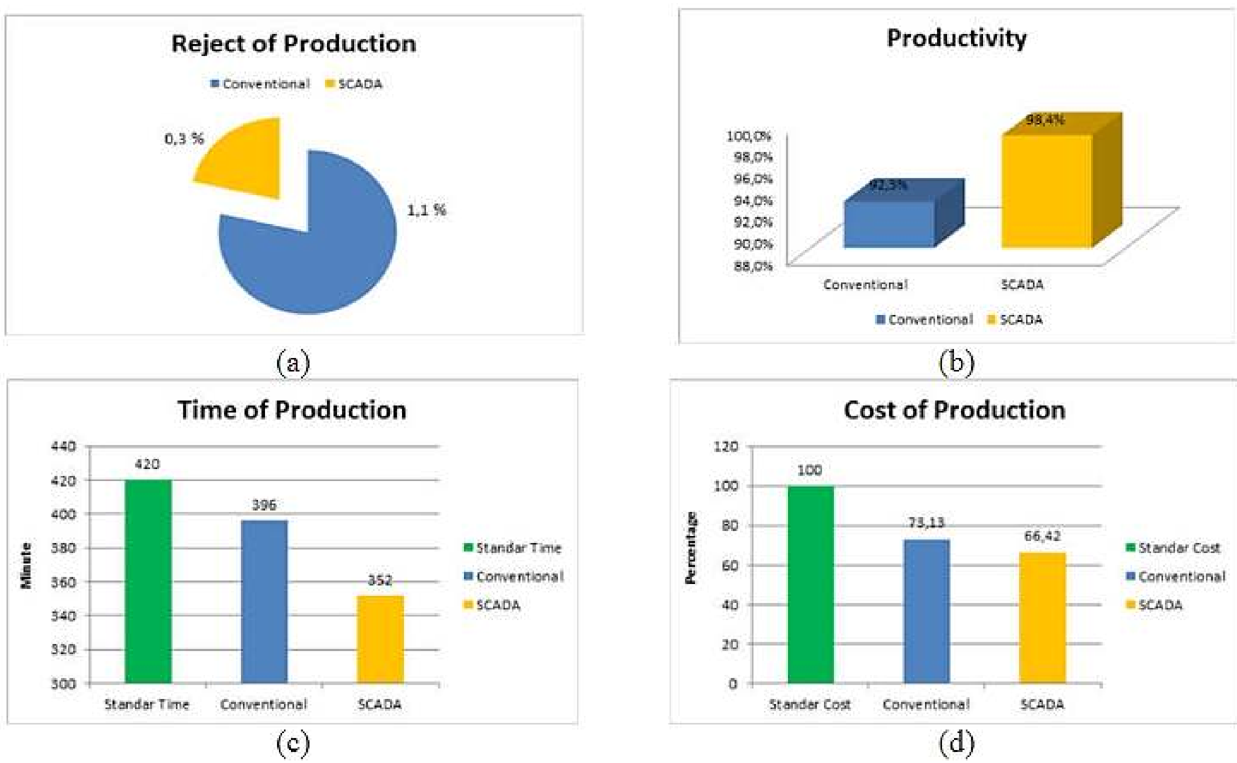

Figure 3.15: Comparison of the conventional system with the system of the SCADA;(a) total value of the rejected product; (b) efficiency of the conventional and the system of the SCADA;(c) the output duration.

The chart in figure 2.16 shows the increase in profit which the industry receives after the industrial substation is automated. The months are determined by the x-axis, and the y-axis marks the profit percentage of the industries, and every month before and after the substation automation the bar graph represents the industry 's profit.

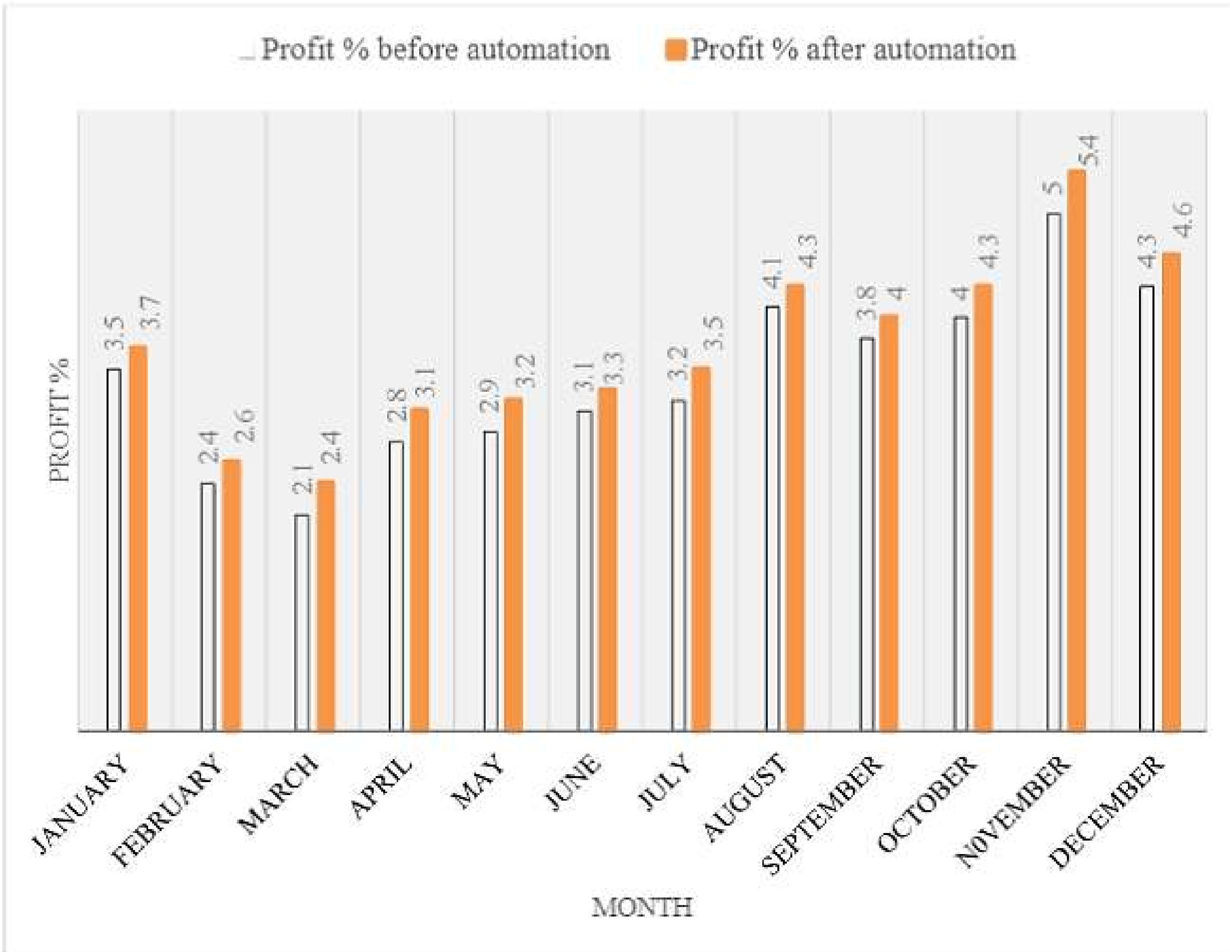

Figure 3.16: Profit analysis graph

3.5 DISCUSSION

There is an essential endeavor to maintain a power supply without a system failure according to the needs of various customers.

Proper voltage: A distribution system's essential condition is that voltage differences should be as minimal as possible at terminals. The voltage variations are normally caused by the device load variance. Low voltage causes revenue loss, inefficient illumination, and potential engine fire. High voltage causes permanent burning of lamps and may cause other devices to malfunction. Therefore, a good distribution system should ensure that customer terminals are tensile variations within acceptable limits. ± 6 per cent of the device terminal value is the regulatory voltage limit. Thus, the maximum voltage of the system does not exceed 244 V while the stated voltage is 230 V while the lowest voltage is available on demand. Consumers must have the resources they need from time to time to be able to use. The electric power company can, for example, start or close motors, activate or disable lights without notice. The legislative voltage cap is ± 6% of the user terminal rated value. Thus, the maximum voltage of the system does not exceed 244 V while the stated voltage is 230 V while the lowest voltage is available on demand. Consumers must have the resources they need from time to time to be able to use. The electric power company can, for example, start or close motors, activate or disable lights without notice.[1]

Reliability: For its service, modern industry relies almost on electricity. Lighting, heating, cooling and ventilation of homes and office buildings is supplied with electric power. Reliable service is expected. Sadly, electric power can never be entirely efficient, like anything other than man-made electricity. Reliability can however significantly be enhanced through the provision of an additional bookkeeping facility [1]e for consumers by (a) an integrated system(b) a secure automatic control system (c). [1]

3.6 CONCLUSION

SCADA offers real-time data monitoring on manufacturing activities and introduces more effective control paradigms, improves the security of plants and workers and lowers operating costs. The protection of SCADA systems depends on successful implementation of the SCADA system's security principles and technology. This study proposes a model that illustrates data groups, roles and interdependencies in a SCADA structure. The model forms the basis for further research into how SCADA systems can best use technical safety checks to reflect their operation and mission. SCADA is one of the largest legacy systems of the intelligent grid networks. The SCADA system for power delivery has been developed with a PLC-based control system. Four criteria exist for the implementation of the proposed framework for PLC simulation studies. All switch control phase conditions are listed. The overall flow diagram is also listed for the proposed control system. This emerged from isolated networks that have no network access

4. CONCLUSION AND FUTURE WORK

SCADA framework is gives business directors the now realities on creating tasks, an instrument all the greater at delivering an impact of control precedents, gets well work force instrument all the greater at delivering an impact of control precedents, gets well work force security, and gets changed to other shape expenses of activity. The offer of the scaled-security, and gets changed to other shape expenses of activity. The offer of the scaled-duplicate that puts light on the gatherings of realities, workings, and Inter subordinate duplicate that puts light on the gatherings of realities, workings, and Inter subordinate relations present in a (SCADA) framework. The great precedent fills in as a base for further relations present in a (SCADA) framework. The great precedent fills in as a base for further research. for how to best send in name for exceptional to some science or exchange controls research. for how to best send in name for exceptional to some science or exchange controls in little station and kept by man dissemination fields.in little station and kept by man dissemination fields.

This goes to individual in power takes to be the equivalent the more odds of computerization application 1 at appropriation level and business administrators. Conveyance mechanization application 1 at appropriation level and business administrators. Conveyance mechanization gives more noteworthy incentive to the doing function admirably and sum delivered of a gives more noteworthy incentive to the doing function admirably and sum delivered of a utilization, and furthermore gives quality and protected, well, prepared supply to the clients. Utilization, and furthermore gives quality and protected, well, prepared supply to the clients. By business prepared (to be utilized) items for dispersion computerization application 1 are By business prepared (to be utilized) items for dispersion computerization application 1 are likewise had an exchange about. Later piece of the go to individual in power has a discourse likewise had an exchange about. Later piece of the go to individual in power has a discourse the inquiries looked by current dissemination robotization framework and requirement for the inquiries looked by current dissemination robotization framework and requirement for expanded conveyance mechanization. Expanded conveyance mechanization.

4.1 FUTURE WORK

Below are the suggestions for future works:

Implementation of other WMNs protocols and comparison among them. Addition of the security issues and technologies to the suggested SCADA system network, and studying their effects on it. Studying other types of SCADA network, (i.e. oil, water, etc.). Trying to build and represent the SCADA system using WSN (wireless sensor network).

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