An Internship Report On

"BOTTLE FILLING FOR DIFFERENT MEASUREMENT"

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"TECHNOCLOG LLP"

A dissertation work Submitted in the partial fulfillment for the Award of the degree of

Bachelor of Engineering
In
Electronics & Communication Engineering

Submitted by

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RAMANAGARAM-562159

CERTIFICATE

This is to certify that the Internship entitled **"BOTTLE FILLING FOR DIFFERENT MEASUREMENT"** is a bonified work carried out by **VISHWAS V (1GC17EC029)** of Ghousia College of Engineering in partial fulfillment for the award of Bachelor of Engineering in **Electronics & Communication Engineering** of the **Visvesvaraya Technological University, Belgaum** during the year **2020-2021.** It is certified that all the corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The Internship report has been approved as it satisfies the academic requirements in respect to the technical part prescribed for the above said degree.

Signature of internal Guide	Signature of external Guide	Signature of the HOD
Mr. C.K VENKATESH	Mr. MOHAMMED SALEEM JAVEED	Dr. SIRAJ AHMED T

Name of the Examiners	Signature of Examiners with date
1……	……
2……	……

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At the outset, I would like to thank Almighty for making me as I'am. In particular, I would like to take this opportunity to express my Honor, Respect, Deepest Gratitude, and Genuine regards to our principal **Dr. MOHAMMED ZAHED AHMED ANSARI,** Ghousia College of Engineering Ramanagaram, for providing all facilities and environment to work in.

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Cordially,

VISHWAS V
(USN:1GC17EC029)

INTERNSHIP CERTIFICATE

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CHAPTER 1

COMPANY PROFILE

TECHNOCLOG LLP culminated into one of the leading training institutes in Moodabidri, Dashan Kannada for advanced training. We carry a blend of less theoretical and more practical subjected training.

Serving more than 2000 fresher(s) and professional(s) on comprehensive training programs, we have upgraded their career in core related technical fields.

Ensuring industry relevant training to engineers & diploma holders, TECHNOCLOG LLP provides wide range of professional, short term and certification oriented courses and corporate training in vivid domains designed by our experts after deep and careful market research and study. With the support of industry pioneers, TECHNOCLOG LLP has successfully mastered and is following a well-crafted seasoned curriculum to fulfill the career objectives of every individual.

Vision

Our vision is to see TECHNOCLOG LLP, become a globally recognized smart-automation & Java based company excelling in all the latest upcoming technologies, and provides the same to every individual to make them a better engineer and boost their professional proficiency.

Mission

Our mission is to provide quality, cost effective & sustainable engineering services in the competitive edge to our valued candidates/customers exceeding their expectation. Impart professional oriented & quality based technical training.

Quality

The one thing TECHNOCLOG LLP is fanatical about is quality and will not compromise on the quality of content delivered in any form either verbal or written. We take pride in the fact that we go to any length to ensure that our products and services exceed your expectations.

Maintaining Relationship

TECHNOCLOG LLP is like a family, we discuss, and debate! When you associate with us, you become part of the group. Our association does not end with delivery of a service or product in fact that just the start!

1.1 Services of the company

TECHNOCLOG LLP resources are focused on innovation, quality, and superior value for our customers. We work closely with our customers to understand their requirements. Which enable us to provide innovative solutions to meet their specific needs. TECHNOCLOG LLP significant growth is an indication of our track record of success upon this commitment. It has separate business divisions with dedicated focus to offer the best possible solution. They are

- IEEE project
- Internship
- Training
- Education consultation
- Placements

TECHNOCLOG LLP is a total virtual instrumentation service provider offers cutting-edge solutions for small and medium business segment. It has been catering for various clients in this segment. The company has implemented several turn-key systems and system integration projects for various organization. The services to range from custom application services, package implementation services to infrastructure services on a multi-tier platform, which includes analysis, development and deployment. Verticals comprise of almost the entire spectrum of small and medium business segment.

1.2 Bridging the gap with academic projects

TECHNOCLOG LLP, programs bring industry and academia together. Industry partners can drive the development of new technologies based on break through coming from the fundamental research being performed at institutions. In return, the universities get market insight and can draw on the industry experience of our partners to help focus their research activities.

TECHNOCLOG LLP is innovation in the field of education, a challenge to not just keep up but outsmart and set new industry standards. India’s talent shortages are hitting the bottom line of business and are reflected in the increase in attrition rates of skilled manpower and wage inflation in various business verticals. This situation is compounded by the increase in demand for skilled and semi – skilled manpower in various sectors. The biggest uncertain in the economy growth of a country is the lack of quality trained professional. In India we definitely do not lack in the number but we lack a lot in level of professional education.

A 'research attitude' is missing amongst faculty and students. They should be "soaked in the research culture." Industry is willing to give projects to faculty if the required domain knowledge/skills of staff are specified. At times undergraduates, graduates and even working professional may feel the need to upgrade them self and keep up with latest technologies

1.3 Academic projects

TECHNOCLOG LLPs, a premier technology firm invite all the budding professionals to quench their thirst for innovative academic projects. They are one of the leading firms in India that provides Project Assistance to M.Tech/B. Tech/BCA//Diploma graduates and technical training in various programming languages.

INDUSTRIAL AUTOMATION

- Programmable logic controller (PLC): A programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process fault diagnosis.
- Supervisory control and data acquisition (SCADA): SCADA is a control system architecture that uses computer, networked data communications and graphical user interfaces for high-level process supervisory management. But uses other peripheral devices such as PLC and discrete PID controllers to interface with the process plant or machinery.
- Human-machine interface (HMI): A human-machine interface is a user interface or dashboard that connects a person to a machine, system, or device. While the term can technically be applied to any screen that allows a user to interact with a device, HMI is most commonly used in the context of an industrial process.
- Variable frequency drive (VFD): A variable frequency drive has greater functionality and operation capabilities. In addition to adjustable speed control, variable frequency drives offers protection like phase, under and over voltage protections like phase, under and over voltage protections. Software and interfacing options of the VDF's allow the user to control the motors at desired levels.

CORPORATE JAVA

- CORE JAVA: CORE JAVA is the basic of JAVA programming technology concept. This basic concept's in JAVA is normally referred as 'CORE JAVA' programming.

The core java comprises the single tier architecture. The core java programming interfaces are the basic foundation of the java platform, standard edition.

- ADVANCE JAVA: Advanced JAVA is the next level of java programming. It is two tier architecture i.e client and server advance java programming covers the swing, socket, awt, thread concept as well as collection object and classes. Advance java is used for web based application and enterprise application.
- SPRINGS: Spring makes use of inversion of control and dependency injection to promote good software coding practices and speed up development time. The spring framework is an application framework and inversion of control container for the java platform.
- HIBERNATE: HIBERNATE is a java framework that simplifies the development of java application to interact with the database. It is an open source, lightweight, tool. Hibernate implements the specifications of JPA for data persistence.

MECHNICAL DESIGNING TOOLS

- AUTO CADD: AutoCAD is an old and long-established CAD application, and probably has the most existing drawing files of any. It's very flexible and used in lots of different ways, not just mechanical design.
- ANSYS & SOLIDWORKS: ANSYS and Solid works are very different programs that are designed to accomplish different things. ANSYS is a high- level GUI for a number of finite-element- analysis applications. It is primarily intended for detailed analysis of structures and how they respond to external conditions.
- CATIA: CATIA is an acronym of computer-aided three-dimensional interactive application is a multi-platform software suite for computer-aided design, computer-aided manufacturing, computer-aided engineering.
- HYPERMESH: Hyper mesh is pre-processing software, which is important and time consuming process in CAE Analysis. Hyper mesh which is pre- processing software, which has multiple options to make the process easier.
- NX-CAD: NX is the software developed by SIEMENS. Generally known as NX Unigraphics. It is a software having functions of CAD, CAM and CAE. It is PLM software having next generation designing tools and technology.

BUILDING MANAGEMENT SYSYTEMS

- Direct digital control (DDC): DDC is the automated control of a condition or process by a digital device. DDC takes a centralized network-oriented approach. All instrumentation is gathered by various analog and digital converters which use the network to transport these signals to the central controller.
- Heating, ventilation, and air conditioning (HVAC): HVAC is the technology of indoor and vehicular environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality.
- MEP is an acronym that has been used historically to describe the mechanical, electrical, and plumbing systems in building and industrial projects.

PARALLEL TRAINING DOMAINS

- Power system analysis
- Embedded system and IOT
- Data analytics and sap

TECHNOCLOG LLP facilitates students to do their academic projects under the guidance of industry professionals. Selected candidates are offered assistance to do projects in latest technologies in Electronics, Electrical, Telecommunication, Medical Electronics, Instrumentation, Computer/Information Technologies and Civil.

The projects are rated as Best Academic Projects in many reputed Engineering Colleges in South India by virtue of the quality delivery and innovative approach. Students get an opportunity to work on these projects rather than understanding already implemented projects. Thus students undergoing projects in the institute get opportunities to learn various aspects of project lifecycle including requirement analysis, prototyping, architecting, coding, testing, deployment etc. This approach helps to develop students as true professionals, fully equipped with all the needed skill sets required to get employed in top notch IT companies.

TECHNOCLOG LLP will designate a shared Quality Analyst (QA) for this project who will work independently of project development and management team. QA will participate in quality assurance of all phases of the project development life cycle. Designated QA will author the Quality Assurance Plan for this project and quality assurance activities i.e. reviews, verification, etc. will be performed as per this Quality Assurance Plan.

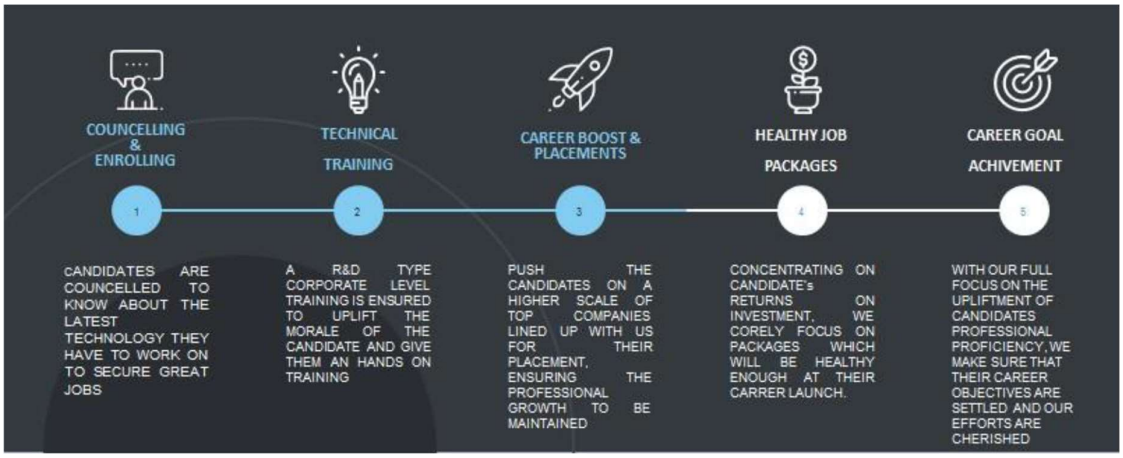
TECHNOCLOG LLPs designated QA for this project will audit the project on a regular basis, no less frequently than once per calendar month. The frequency of the audits will

assure development and verification work complies with the Plans. TECHNOCLOG LLPs QA activities will include audits of work products/deliverables in accordance with TECHNOCLOG LLP checklists.

1.4 Work Culture

TECHNOCLOG LLP offers its employees challenging technical careers in one of the finest year-round climates of the country. Teams at TECHNOCLOG LLPs are young and full of energy. The members are competent professionals who have the drive and initiative to take challenges head on. The teams promote participation and sharing of knowledge in a highly collaborative sprit. They have the capability to help in building skills in Hardware/software based solutions Development in all application areas. Expertise at TECHNOCLOG LLPs has years of experience to select the needed hardware and software for applications. They can assist you in the crucial stages of PLC and SCADA application/ design.

WORK PROCESS



Technical team

Corley focusing over quality training TECHNOCLOG LLP emphasizes on senior and corporate level trainers who are certified. Our trainers are certified by top companies like seimen, Honeywell, allen bradly etc.

Marketing team

Essence of every business is its marketing and business development team. All executives as trained conceller to also maintain the quality of consulting either with the student's delegated college authority/any individuals.

CHAPTER 2

ABOUT THE DEPARTMENT

TECHNOCLOG LLP consists of the following main departments or functions:

- Production
- Research and Development (often abbreviated to R&D)
- Purchasing
- Human Resource Management
- Accounting and Finance.

2.1 The production function

The Production function undertakes the activities necessary to provide the organization‘s products or services. Its main responsibilities are:

- Production planning and scheduling
- Control and supervision of the production workforce
- Managing product quality
- Maintenance of plant and equipment
- Control of inventory
- Deciding the best production methods and factory layout.

Close collaboration will usually be necessary between production and various other functions within the organization, for example:

- Research and Development, concerning the implications of product design for production methods and cost
- Marketing, concerning desired product functionality, appearance, quality, durability and so on
- Finance, concerning the availability of funds for purchase of new equipment and the acceptability of inventory levels. And Human Resource Management, concerning staff motivation implications of job design and production methods.

2.2 Service organizations

Although many of the principles of good management in a manufacturing environment also apply in organizations that provide services (rather than manufacture products), service

businesses, such as banking and professional firms of accountants and solicitors, do have a number of distinctive features which have implications for how they are managed.

1. Services are less easily standardized than manufactured products and so service quality tends to be more variable. This makes human resource management and motivation more critical
2. Services are often 'intangible' (i.e., something that cannot be precisely measured or assessed) and multi-dimensional – what exactly is the service being offered by a bank, a private hospital or educational establishment? This can make attracting customers more difficult as it often depends on promoting an intangible item.
3. Unlike manufactured products, services cannot be stored, but must be consumed as they are produced or they are wasted. This creates additional problems matching productive capacity with customer demand. This is reflected in, for example, the common practice of commercial airlines offering very cheap flights based on marginal cost to fill empty seats – a plane flying empty to New York is a service provided but wasted!
4. Ascertaining the cost of individual services is often also problematic, as the cost structure of many service businesses is such that costs are often shared among different services. This makes, among other things, pricing and the analysis of profitability of different services more difficult than with most manufactured goods.

2.3 The Research and Development function

The Research and Development (R&D) function is concerned with developing new products or processes and improving existing products/processes. R&D activities must be closely coordinated with the organization's marketing activities to ensure that the organization is providing exactly what its customers want in the most efficient, effective and economical way.

2.3.1 The Purchasing function

The Purchasing function is concerned with acquiring goods and services for use by the organization. These will include, for example, raw materials and components for manufacturing and also production equipment. The responsibilities of this function usually extend to buying goods and services for the entire organization (not just the Production function), including, for example, office equipment, furniture, computer equipment and stationery. In buying goods and services, purchasing managers must take into account a

number of factors – collectively referred to as the Purchasing Mix', namely, Quantity, Quality, Price and Delivery.

- **Quantity:** Buying in large quantities can attract price discounts and prevent inventory running out. On the other hand, there are substantial costs involved in carrying a high level of inventory
- **Quality**: There will usually be a trade-off between price and quality in acquiring goods and services. Consequently, Production, R&D and Marketing Functions will need to be consulted to determine an acceptable level of quality which will depend on how important quality is as an attribute of the final product or service of the organization.
- **Price:** Other things being equal, the purchasing manager will look for the best price deal when procuring goods and services, although price must be considered in conjunction with quality and supplier reliability, in order to achieve best value, rather than lowest price only.
- **Delivery:** The time between placing an order and receiving the goods or services, the lead time, can be critical for production planning and scheduling and also has implications for inventory control. Suppliers must therefore be evaluated in terms of their reliability and capability for on time delivery.

In short, the purchasing mix' can be considered as making sure that the organization has the right amount, of the right quality, at the right price, in the right place at the right time.

2.4 Project implementation methodology

2.4.1 Project Initiation

An initial study will be performed by TECHNOCLOG LLPs to understand the SW and HW Test Requirements at student facility. After study, a Kick-Off meeting will be held between the student and TECHNOCLOG LLP Project Stakeholders.

2.4.2 Project Planning

- The TECHNOCLOG LLP will perform the Project Planning for the Schedule Management, Delivery Plan, Configuration Management, Review Plan, Resource Management, Risk Management and Communication Management. The Project Plan / schedule will be shared with student for approval.

2.4.3 Project Execution

- The scope of activities in this work include,

- Design and development of PLC ladder diagram
- Generation of design documents and interface document
- Assembly and Wire Harness fabrication
- Shipment of Test hardware and software to CLIENT location
- Site acceptance Test (SAT) and demonstration at CLIENT location

2.4.4 Project Monitoring & Control

- Project Status Tracking in Weekly Status Report
- Action Items and Issues Logging and Tracking
- Risk Identification, Analysis, Planning and Control
- Send status report to CLIENT stakeholders on every week.
- TECHNOCLOG LLPs and CLIENT will have weekly status call.

2.4.5 Milestone / Project Closure

- CLIENT to provide Acceptance for each Delivery performed by TECHNOCLOG LLP
- CLIENT to provide Acceptance for each Milestone completed by TECHNOCLOG LLP
- CLIENT to provide the Project Acceptance / Sign Off after all milestones are completed.
- A Closure Meeting will be held between the Project Stakeholders of CLIENT and TECHNOCLOG LLP.

2.4.6 Execution methodology

The project will be executed in following phases:

1. Planning and Evaluation
2. Preliminary Design
3. Detailed Design
4. Programming
5. Acceptance.

2.5 The Human Resources function

The Human Resources function is concerned with the following:

- Recruitment and selection. Ensuring that the right people are recruited to the right jobs.
- Training and development. Enabling employees to carry out their responsibilities effectively and make use of their potential.

- Employee relations. Including negotiation over pay and conditions.
- Grievance procedure and disciplinary matters. Dealing with complaints from employees or from the employer.
- Health and safety matter making sure employees work in a healthy and safe environment.
- Redundancy procedures administering a proper system that is seen to be fair to all concerned when deciding on redundancies and agreeing redundancy payments. Organizations are dependent on their employees. Consequently, their recruitment and selection require careful management. In recent years, the Human Resources function has attained a more important status as there has developed an increasing need (especially in service organizations) to get the most from employees, in terms of customer service, for the benefit of the organization.

2.6 The Accounting and Finance function

The Accounting and Finance function is concerned with the following:

- Financial record keeping of transactions involving monetary inflows or outflows.
- Preparing financial statements for reporting to external parties such as shareholders. The financial statements are also the starting point for calculating any tax due on business profits.
- Payroll administration paying wages and salaries and maintaining appropriate income tax and national insurance records.
- Preparing management accounting information and analysis to help managers to plan, Control and make decisions.

2.7 The organizational environment

Organizations exist in an environment – everything that surrounds the organization physically and socially. The constituents of the organization‘s environment are likely to have an important impact on the management of the organization. An organization‘s management must systematically analyze its environment in formulating plans to achieve organizational objectives.

The major environmental factors impacting on an organization can be grouped under four headings: political/legal, economic, social/demographic and technological.

2.7.1 Economic environment

Economic variables such as inflation, interest rates, savings patterns, economic growth, exchange rates, the levels of taxation and government spending all influence the amount of money people have to spend. This is likely to have an impact on most organizations. Businesses will experience, for example, varying levels of demand for their products or services and charities will experience varying levels of donations, as the amount of money people have to spend fluctuates in response to variations in major economic variables.

CHAPTER 3

TASKS PERFORMED

3.1 Industrial automation.

Industrial automation is the use of control devices such as PC/PLCs/PACs etc. to control industrial processes and machinery by removing as much labor intervention as possible, and replacing dangerous assembly operations with automated ones. Industrial automation is closely linked to control engineering.

Automation is a broad term applied to any mechanism that moves by itself or is self dictated. The word 'automation' is derived from ancient Greek words of Auto (means '*self*') Matos (means '*moving*'). As compared with manual systems, automation systems provide superior performance in terms of precision, power, and speed of operation.

In industrial automation control, a wide number of process variables such as temperature, flow, pressure, distance, and liquid levels can be sensed simultaneously. All these variables are acquired, processed and controlled by complex microprocessor systems or PC based data processing controllers.

Fig 3.1 Industrial Automation

3.2 Structure of Industrial automation.

Structure of the industrial automation explains various levels of operation. These include sensor level, automation control level (Unit, cell, process controls),supervision level and

enterprise level .Pyramid structure indicates that, as you go up the tip , the information is aggregated and while coming down it is dissolved. This means we will get the detailed information for a particular variable at the bottom. Industrial automation doesn't mean that all the levels are automated like enterprise level need not be automated.

Sensor level is also called as process layer. It uses the sensors and actuators to get the values of the process variables in continuous or periodical manner. These act as eyes and arms of the industrial processes. Some of these instruments include pneumatic instruments, smart instruments, etc.

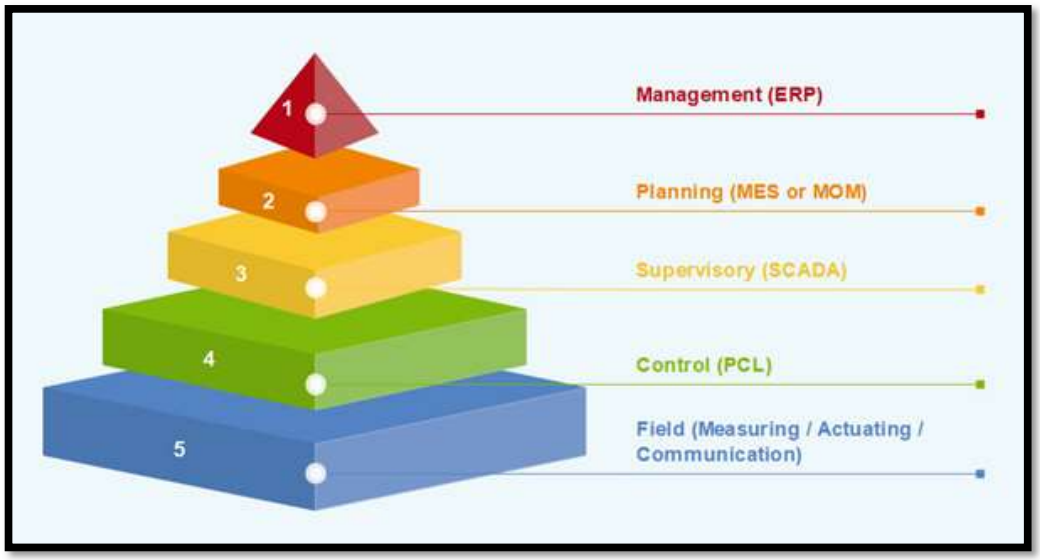


Fig 3.2 Layers of Automation Pyramid

3.3 Advantages of Industrial automation.

Manufacturers face many challenges in today's globally competitive business landscape. Some of these challenges include harsh manufacturing environments (in a world which is increasingly focused on safety – and rightly so), increasingly complex supply chains, meeting the latest energy efficient standards, and competing with companies with very small marginal costs.

The advantages to Industrial Automation include:

- Increased labor productivity
- Improved product quality
- Reduced labor or production cost
- Reduced routine manual tasks

- Improved safety
- Assisted remove monitoring

3.4 Relay definition and types of relay control.

A relay is an electrically operated switch. It consists of a set of input terminals for a single or multiple control signals, and a set of operating contact terminals. The switch may have any number of contacts in multiple contact forms, such as make contacts, break contacts, or combinations thereof.

The Different types of relay control are:

- Co-axial Relay
- Force-guided contacts relay
- Latching relay
- Machine tool relay
- Mercury relay
- Mercury-wetted relay
- Multi-voltage relays
- Overload protection relay
- Polarized relay
- Reed relay

3.4.1 Parts of Relay Switches.

Basic parts of Relay Switches include:

- **Frame:** Heavy-duty frame that contains and supports the parts of the relay.
- **Coil:** Wire is wound around a metal core. The coil of wire causes an electromagnetic field.
- **Armature:** A relays moving part. The armature opens and closes the contacts. An attached spring returns the armature to its original position
- **Contacts:** The conducting part of the switch that makes (closes) or breaks (opens) a circuit.

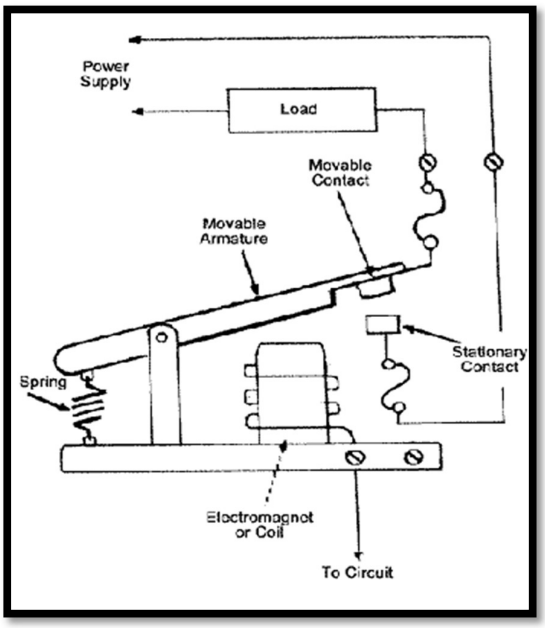


Fig 3.3 Parts of Relay Switches

3.4.2 Working of Relay.

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state.

Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps. Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched by the contacts.

Protective relays can prevent equipment damage by detecting electrical abnormalities, including overcurrent, undercurrent, overloads and reverse currents. In addition, relays are also widely used to switch starting coils, heating elements, pilot lights and audible alarms.

3.4.3 Layout of electromechanical relay switches.

Electromechanical relays open and close electrical contacts to turn a load off and on. Most electromechanical relays contain a moving component called an armature that is attracted by the magnetic field the coil generates. They are often used because they cost less than corresponding electronic switches. But some or their qualities are superior to those of SSRs. For example, electromechanical relays can have numerous contacts electrically isolated one from another. Electromechanical relays also have a contact resistance that tends to be lower than that of SSRs (tens of milliohms versus about 100 Ω). Contact capacitance is also less, which may benefit high-frequency circuits. Electromechanical relays are less likely to be turned on by transients than SSRs and may be less easily damaged by brief short circuits or overloads.

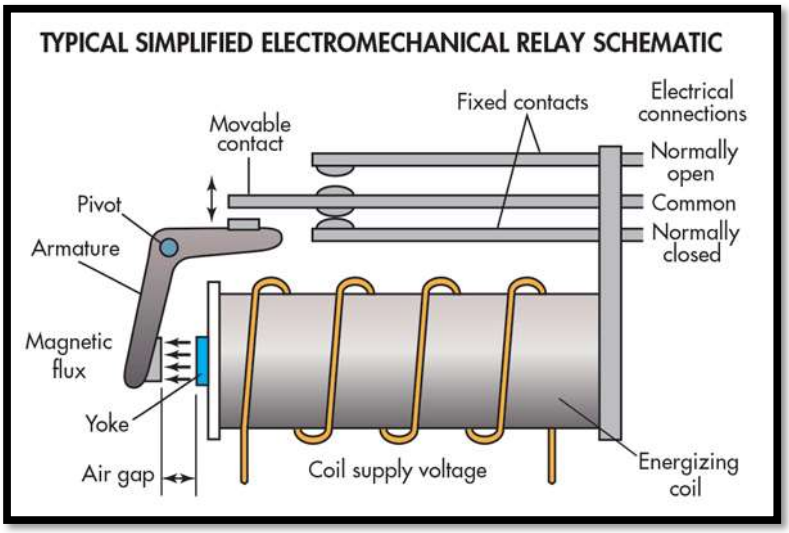


Fig 3.4 Layout of Electromechanical relay switches.

3.4.4 Testing of relay

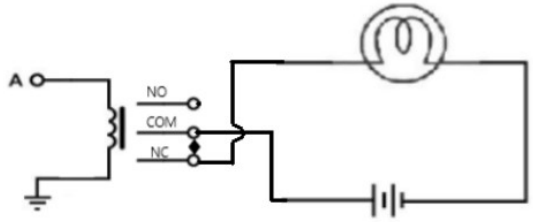
The following steps can be used to perform the testing of the relay :

- Keep the multimeter in the continuity check mode.
- Check for continuity between the N/C contacts and pole. Check for discontinuity between N/O contacts and the pole.
- Now energise the relay using the rated voltage. For example use a 9V battery for energising a 9V relay. The relay will engage with clicking sound. Now check for continuity between N/O contacts and pole.
- Also check for discontinuity between N/C contacts and pole.

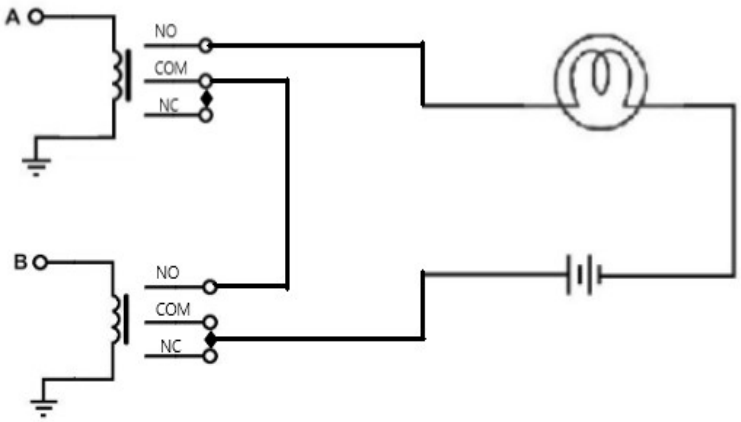
- As a final test, measure the resistance of the relay coil using a multimeter and check whether it is matching to the value stated by the manufacturer.

3.4.5 Relay Logic circuit for basic gates.

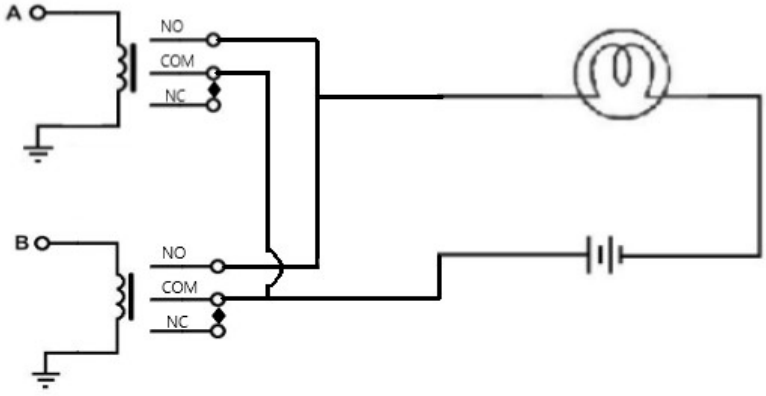
- **NOT Gate.**



- **AND Gate**



- **OR Gate**



3.5 Programable logic controller.

A programmable logic controller, PLC is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines etc., It is a solid state user programmable control system with functions to control logic, sequencing, timing, arithmetic data manipulation and counting capabilities. It can be viewed as an industrial computer that has a central processor unit, memory, input output interface and a programming device. The central processing unit provides the intelligence of the controller. It accepts data, status information from various sensing devices like limit switches, proximity switches, executes the user control program stored in the memory and gives appropriate output commands to devices such as solenoid valves, switches etc.

Fig 3.5 Programmable Logic Controller

3.5.1 Types of PLC.

1. Size
2. Hardware setup
3. Power Supply

PLC Types Based on Size

The PLCs are further classified depends on the number of inputs and outputs a PLC can handle.

The PLCs are classified based on size are as follows:

- Nano PLC
- Micro PLC
- Medium PLC
- Large PLC
- Very Large PLC

PLC Types Based on Hardware Setup

The PLCs are also classified based on the architecture of a PLC.

- Compact PLC
- Modular PLC

PLC Types Based on Power Supply

PLCs are available with or without SMPS.

- PLC with SMPS (230 VAC)
- PLC without SMPS (24 VDC)

3.6 PLC Operation.

There are four basic steps in the operation of all PLCS which continually take place in a repeating loop.

- Input Scan: Detects the state of all input devices that are connected to the PLC.
- Program Scan: Executes the user created program logic.
- Output Scan: Energizes or de-energize output devices that are connected to the PLC. Depending on the PLC design, this process of updating the output devices may be done at the end of program execution or updated immediately upon execution of its corresponding logic statement in the user program
- Housekeeping: This step includes communications with programming terminals, internal diagnostics etc.

3.7 Block diagram of PLC.

The structure of a PLC is almost similar to a computer's architecture.

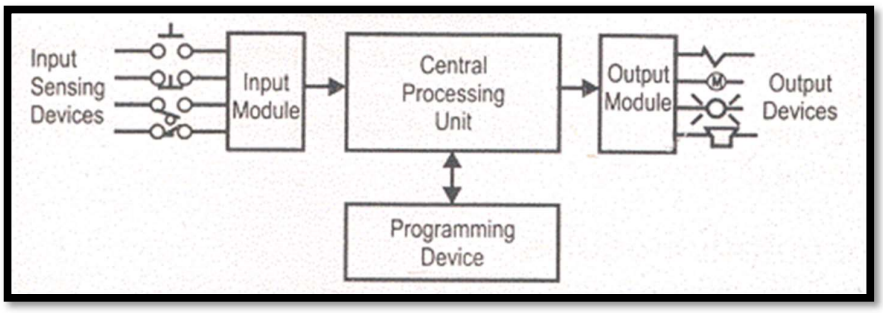


Fig 3.6 Block Diagram of PLC

Programmable Logic Controllers continuously monitors the input values from various input sensing devices (e.g. accelerometer, weight scale, hardwired signals, etc.) and produces corresponding output depending on the nature of production and industry. A typical block diagram of PLC consists of five parts namely:

- Rack or chassis
- Power Supply Module
- Central Processing Unit (CPU)
- Input & Output Module
- Communication Interface Module

Rack or Chassis

In all PLC systems, the PLC rack or chassis forms the most important module and acts as a backbone to the system. PLCs are available in different shapes and sizes. When more complex control systems are involved, it requires larger PLC racks. Small-sized PLC is equipped with a fixed I/O pin configuration. So, they have gone for modular type rack PLC, which accepts different types of I/O modules with sliding and fit in concept. All I/O modules will be residing inside this rack/chassis.

Power Supply Module

This module is used to provide the required power to the whole PLC system. It converts the available AC power to DC power which is required by the CPU and I/O module. PLC generally works on a 24V DC supply. Few PLC uses an isolated power supply.

CPU Module and Memory

CPU module has a central processor, ROM & RAM memory. ROM memory includes an operating system, drivers, and application programs. RAM memory is used to store programs and data. CPU is the brain of PLC with an octal or hexagonal microprocessor.

Being a microprocessor-based CPU, it replaces timers, relays, and counters. Two types of processors as a single bit or word processor can be incorporated with a PLC. One bit processor is used to perform logic functions. Whereas word processors are used for processing text, numerical data, controlling, and recording data.

Input and Output Module

Input devices can be either start and stop pushbuttons, switches, etc and output devices can be an electric heater, valves, relays, etc. I/O module helps to interface input and output devices with a microprocessor

The Input Module of the PLC does four main function:

1. Input module interface receives the signal from process devices at 220 V AC
2. Converts the input signal to 5 V DC that can be used by PLC
3. Isolator block is used to isolate/prevent PLC from undergoing fluctuation
4. After which the signal is sent to the output end i.e the PLC

The output module of PLC works similarly to the input module but in the reverse process. It interfaces the output load and processor. So here the first section would be logic session and the power section comes next.

Communication Interface Module

To transfer information between CPU and communication networks, intelligent I/O modules are used. These communication modules help to connect with other PLCs and computers which are placed at a remote location.

3.8 Programming language of PLC.

A dedicated PLC programming software comes from a PLC hardware of specific manufacturer that allows entry and development of user application code, which can be finally download to the PLC hardware.

Some of the standard programming languages of PLC are basically of two types, which are further sub-divided into several types, which are as follows:

1.Textual language

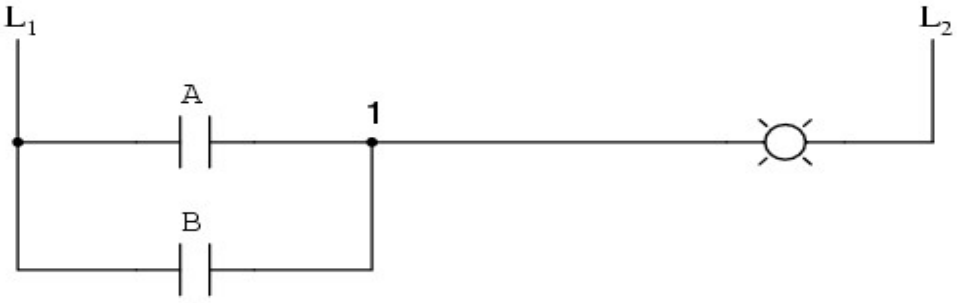
- Instructions List (IL)
- Structured Text (ST)

2. Graphical language

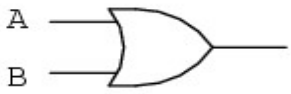
- Ladder Diagrams (LD)
- Function Block Diagram (FBD)
- Sequential Function Chart (SFC)

3.8.1 Ladder logic for basic gates

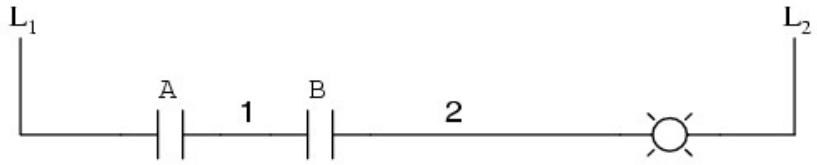
- Ladder logic and Truth table for OR Gate



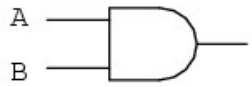
A	B	Output
0	0	0
0	1	1
1	0	1
1	1	1



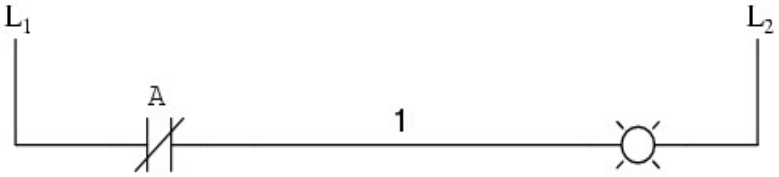
- Ladder logic and Truth table for AND Gate



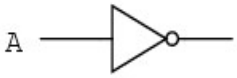
A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1



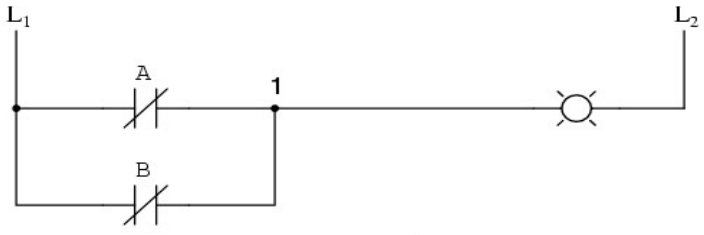
- Ladder logic and Truth table for NOT Gate



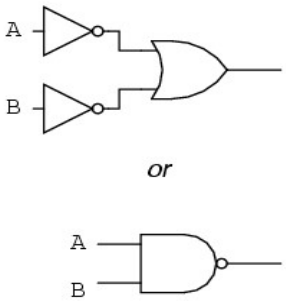
A	Output
0	1
1	0



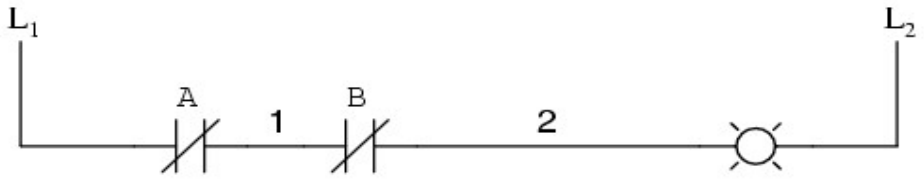
- Ladder logic and Truth table for NAND Gate



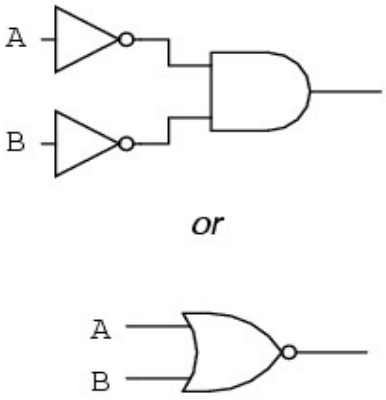
A	B	Output
0	0	1
0	1	1
1	0	1
1	1	0



- Ladder logic and Truth table for NOR Gate.



A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0



3.8.2 PLC Programming Rules

1. Inputs can be used in Series as well as Parallel to form a connection.
2. Outputs (or coil) can be used only in Parallel.
3. One Input can be used in multiple times in one program.
4. One Output cannot be used multiple times in one program, except in Set/Reset and Latch/ Unlatch functions.
5. Input Address cannot be used as an Output Address.
6. Outputs Address can be used as Inputs Address.

3.9 PLC Instructions.

- **Relay-type (Basic) instructions:**
  I, O, OSR, SET, RES, T, C
- **Data Handling Instructions:**
  1. Data move Instructions: MOV, COP, FLL, TOD, FRD, DEG, RAD (degrees to radian).
  2. Comparison instructions: EQU (equal), NEQ (not equal), GEQ (greater than or equal), GRT (greater than).
  3. Mathematical instructions
  4. Continuous Control Instructions (PID instructions).

- **Program flow control instructions:**

  MCR (master control reset), JMP, LBL, JSR, SBR, RET, SUS, REF

- **Specific instructions:**

  BSL, BSR (bit shift left/right), SQO (sequencer output), SQC (sequencer compare), SQL (sequencer load).

- **High speed counter instructions:**

  HSC, HSL, RES, HSE.

- **Communication instructions:**

  MSQ, SVC.

- **ASCII instructions:**

  ABL, ACB, ACI, ACL, CAN.

3.10 Some worked examples on PLC.

- **Explain Communication ports with some examples.**

  It is a hardware device used for connecting peripherals devices with the computer.

It has major functions like:

- Connecting peripheral devices.
- Transmitting data to and from peripheral devices.
- Providing electrical power to the small peripheral devices.

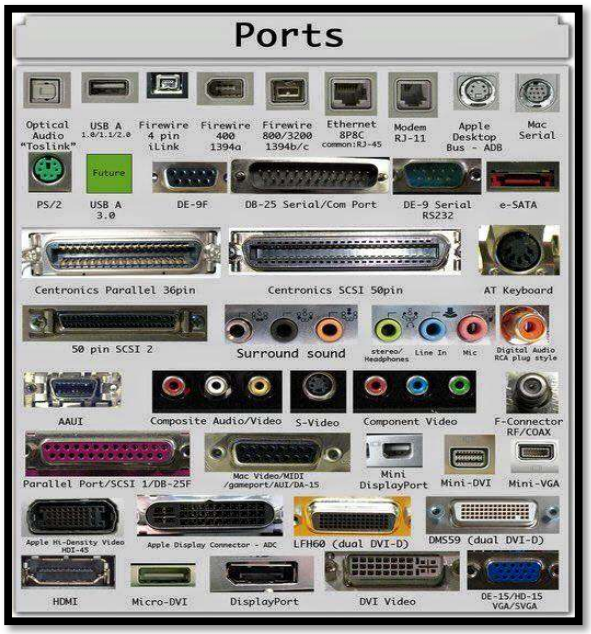
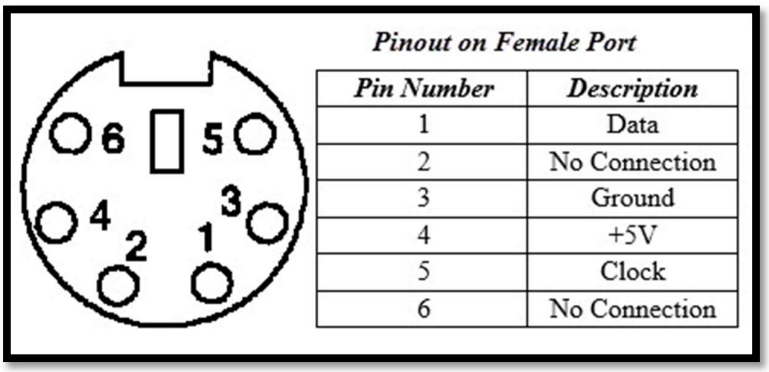


Fig 3.7 Communication Ports

PS/2

PS/2 connector is developed by IBM for connecting mouse and keyboard. It was introduced with IBM's Personal Systems/2 series of computers and hence the name PS/2 connector. PS/2 connectors are color coded as purple for keyboard and green for mouse.

PS/2 is a 6-pin DIN connector. The pin out diagram of a PS/2 female connector is shown below.



Pinout on Female Port

Pin Number	*Description*
1	Data
2	No Connection
3	Ground
4	+5V
5	Clock
6	No Connection

Fig 3.8 Pinout on Female Port

Even though the pinout of both mouse and keyboard PS/2 ports are same, computers do not recognize the devise when connected to wrong port.

Serial Port

Even though the communication in PS/2 and USB is serial, technically, the term Serial Port is used to refer the interface that is compliant to RS-232 standard. There are two types of serial ports that are commonly found on a computer: DB-25 and DE-9.

DE-9 or RS-232 or COM Port

DE-9 is the main port for RS-232 serial communication. It is a D-sub connector with E shell and is often miscalled as DB-9. A DE-9 port is also called as a COM port and allows full duplex serial communication between the computer and it's peripheral.

Some of the applications of DE-9 port are serial interface with mouse, keyboard, modem, uninterruptible power supplies (UPS) and other external RS-232 compatible devices.

The pinout diagram of DE-9 port is shown below.

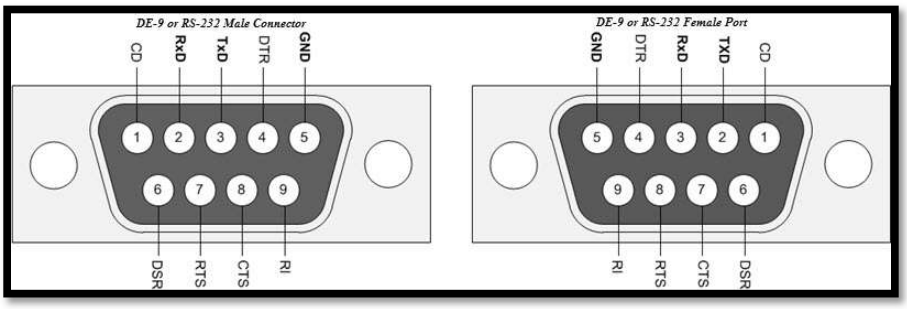


Fig 3.10 Pinout Diagram of DE-9 Port

The use of DB-25 and DE-9 ports for communication is in decline and are replaced by USBs or other ports.

Parallel Port or Centronics 36 Pin Port

Parallel port is an interface between computer and peripheral devices like printers with parallel communication. The Centronics port is a 36 pin port that was developed as an interface for printers and scanners and hence a parallel port is also called as a Centronics port.

Before the wide use of USB ports, parallel ports are very common in printers. The Centronics port was later replaced by DB-25 port with parallel interface.

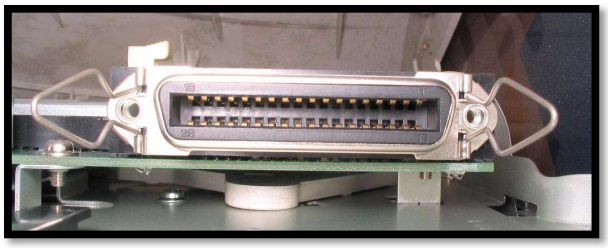


Fig 3.10 Parallel Port

VGA Port

VGA port is found in many computers, projectors, video cards and High Definition TVs. It is a D-sub connector consisting of 15 pins in 3 rows. The connector is called as DE-15.

VGA port is the main interface between computers and older CRT monitors. Even the modern LCD and LED monitors support VGA ports but the picture quality is reduced. VGA carries analogue video signals up to a resolution of 648X480.

Fig 3.11 VGA Port

HDMI

HDMI is an abbreviation of High-Definition Media Interface. HDMI is a digital interface to connect High Definition and Ultra High-Definition devices like Computer monitors, HDTVs, Blu-Ray players, gaming consoles, High Definition Cameras etc. The HDMI connector consists of 19 pins and the latest version of HDMI i.e., HDMI 2.0 can carry digital video signal up to a resolution of 4096×2160 and 32 audio channels. The pinout diagram of an HDMI port is as follows.

Fig 3.12 HDMI Port

USB

Universal Serial Bus (USB) replaced serial ports, parallel ports, PS/2 connectors, game ports and power chargers for portable devices.

USB port can be used to transfer data, act as an interface for peripherals and even act as power supply for devices connected to it. There are three kinds of USB ports: Type A, Type B or mini-USB and Micro USB.

RJ-45

Ethernet is a networking technology that is used to connect your computer to Internet and communicate with other computers or networking devices. The interface that is used for computer networking and telecommunications is known as Registered Jack (RJ) and RJ – 45 port in particular is used for Ethernet over cable. RJ-45 connector is an 8 pin – 8 contact (8P – 8C) type modular connector.

RJ-11

RJ-11 is another type of Registered Jack that is used as an interface for telephone, modem or ADSL connections. Even though computers are almost never equipped with an RJ-11 port, they are the main interface in all telecommunication networks. RJ-45 and RJ11 ports look alike but RJ-11 is a smaller port and uses a 6 point – 4 contact (6P – 4C) connector even though a 6 point – 2 contact (6P – 2C) is sufficient. The following is a picture of an RJ-11 port and its compatible connector.

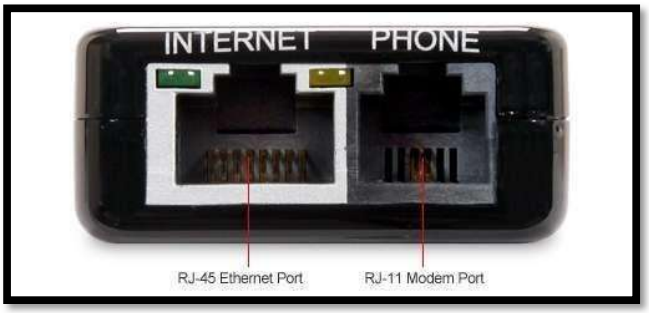


Fig 3.13 Figure to compare RJ-45 and RJ-11 ports.

➢ What is Subroutine?

A subroutine (also called a subprogram) is an abstraction of a process that is called. The caller passes arguments to the subroutine which accepts them as parameters. While the caller waits, the subroutine executes (or evaluates) its body, which may cause side effects to the global system state, and optionally returns results to the caller. A function returns a value or values and is called from within an expression. A procedure returns no values and is called in a statement, not an expression. But some languages have no statements (only expressions). The languages use some mechanism like "void context" or employ a special return value like nil or () to make functions look like procedures. A method is a subroutine defined on an object in an object-oriented context.

Here's the order what happens in a subroutine:

1. The Rungs of a Calling Routine run until it reaches a Subroutine Call
2. Data is passed from Calling Routine Tags to Subroutine Tags (optional)
3. Subroutine runs until it reaches a **Return** statement
4. Data passed by reference is passed from Subroutine Tags to Calling Routine Tags (optional)
5. The Calling Routine continues with the rung that follows the Subroutine Call.

- Inside the Subroutine you must have at least 1 Return statement. This tells the Subroutine to return to the Calling Routine. It is possible to have more than one Return statement, if you need more than one thing to trigger a return.
- Often it is possible to use Tags inside the Subroutine that come from the Main Program without passing them. This is using **Global Tags**. While this is allowed, they will make your Subroutine less re-usable. If you want to bring the Subroutine into another project it will be necessarily that the project has all the Global Tags used in your Subroutine(s).

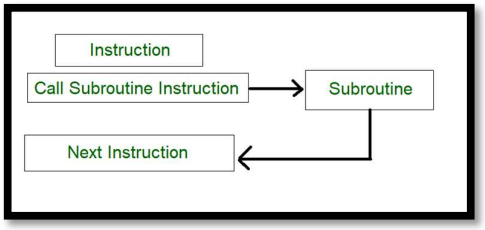


Fig 3.14 Figure showing Flow of Subroutine.

- **Explain the comparison instruction in WPL Soft.**

API		CMP		S_1 S_2 D	Compare	Applicable models		
10	D		P			ES	EP	EH
						✓	✓	✓

	Bit devices				Word devices										
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F
S_1					*	*	*	*	*	*	*	*	*	*	*
S_2					*	*	*	*	*	*	*	*	*	*	*
D		*	*	*											

• Note: If operand S_1, S_2 use with device F, it is only available in 16-bit command.
Operand D occupies 3 continuous devices.
Refer to each model specification for usage range.
ES series models do not support the pulse execution command (CMPP, DCMPP).

16-bit command (7 STEPS)
CMP Continuous execution CMPP Pulse execution

32-bit command (13 STEPS)
DCMP Continuous execution DCMPP Pulse execution

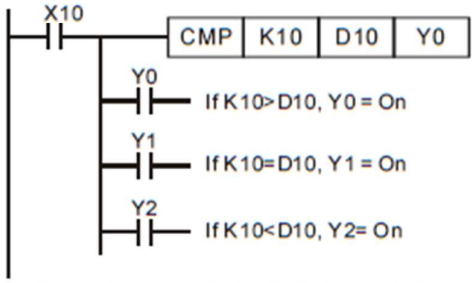
• Flag: None

Command Explanation

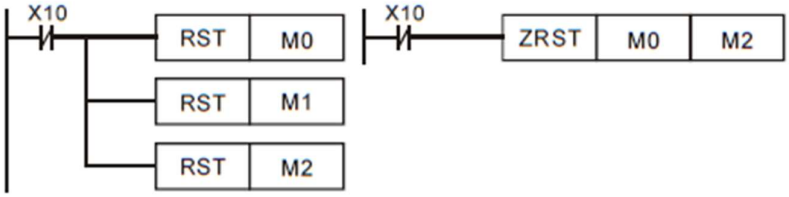
- S_1 : First comparison value S_2 : Second comparison value D : Comparison result.
- The contents of the comparison source S_1 and S_2 are compared and D denotes the compare result.
- Two comparison values are compared algebraically and this function compares the two values that are considered binary values. If b15=1 in 16-bit command or b31=1 in 32-bit command, the comparison will regard the value as the negative of the binary value.

Program Example

- If D is set to Y0, then Y0, Y1, Y2 will work as the program example as below.
- When X10=On, CMP command is driven and one of Y0, Y1, Y2 is On. When X10=Off, CMP command is not driven and Y0, Y1, Y2 remain in the previous status.
- The comparison result of ≧, ≦, ≠ commands can be got by the parallel connection of Y0~Y2.



- Please use RST or ZRST command to reset the comparison result.

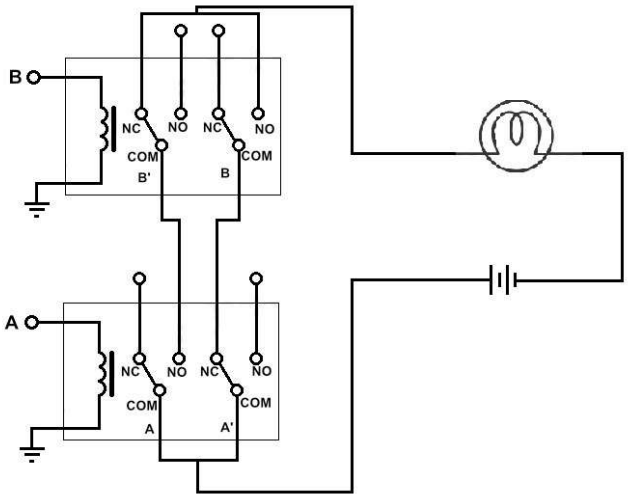


- **Draw relay wiring and circuit diagram for XOR logic gate.**

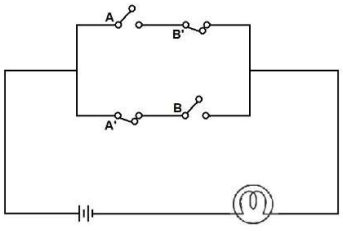
  - **Truth table of XOR Gate**

INPUT		OUTPUT
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

  - **Relay wiring for XOR logic**



  - **Circuit Diagram for XOR gate using Switches**



- **Difference between Modular and Fixed type PLC.**

Modular type PLC	**Fixed type PLC**
In Modular PLC, the number of input and output are not fixed. Inputs and outputs can be added to the modular PLC systems by the user.	In Fixed PLC, the number of inputs and outputs are fixed. Because I/O capabilities are decided by the manufacturer but not by the user.
In this PLC, several components are fitted on chassis or rack or bus with different slots.	It has inputs and outputs modular fitted with CPU..
Modular PLC is easy to maintain and repair as compared to compact PLC.	Compact PLC is not easily repaired.
It has more memory and capabilities to store more data.	It has fewer memory capabilities to store data/information.
It is used for industrial purposes and also for future industrial expansion and growth.	It is useful for smaller applications and most suitable for domestic purposes.
It occurs in a large size with I/O connectivity, power supply, computing capabilities, etc.	It is smaller in size.
It is costlier than Fixed PLC	It is an economic model.

3.11 Applications of PLC.

- The PLC can be programmed to function as an energy management system for boiler control for maximum efficiency and safety.
- In automation of blender recliners
- In automation of bulk material handling system at ports.
- In automation for a ship unloaded.

- Automation for wagon loaders.
- For blast furnace charging controls in steel plants.
- In automation of brick molding press in refractory.
- In automation for galvanizing unit.
- For chemical plants process control automation.
- In automation of a rock phosphate drying and grinding system.
- Modernization of boiler and turbo generator set.
- Process visualization for mining application.
- Criteria display system for power station.

3.12 Advantages of PLC.

- Very fast
- Easy to change logic i.e. flexibility
- Reliable due to absence of moving parts
- Low power consumption
- Easy maintenance due to modular assembly
- Facilities in fault finding and diagnostic
- Capable of handling of very complicated logic operations
- Good documentation facilities
- Easy to couple with the process computers
- Analog signal handling and close loop control programming
- Counter, timer and comparator can be programmed
- Ease operator interface due to colourographic and advisory system introduction

3.13 Top most used PLC system.

PLC has been designed to bear numerous inputs and output activities at the same time, diverse range of changes in the temperature, protection from electrical noise and vibration and their impact. The non-volatile or battery-backed-up memory is the storage point of programs used to control operation of machine. PLC is a type of hard real time system. This is so because the output produced is done so owing to the various inputs that the computer receives and also it is very important that the output be generated within the specified time which is usually very short. If this is not done as such and the output generation exceeds the

time appointed then favorable results will not be produced leading to malfunction in the machine operation.

- A total of 80% of the controllers are sold by top 7 companies of the world and the contribution that each company has would be as below:
- Siemens has the greatest share in the market with a contribution of as much as 30.7% towards the total contribution.
- Top second contribution is made by Rockwell Automation with 21.6% share.
- At third number comes Mitsubishi which contributes 13.9% to the total score.
- 8.9% of the share belongs to the company Schneider Electric.
- Omron falls at fifth rank providing 6.6% controllers in the market. · Another company, GE Fanuc has a total share of 4.0%.
- The last company in the list is Moeller with the contribution to market of 2.3%. Some other companies which have application in various industries along with their positive and negative factors are being accumulated in the list mentioned below.
- SIEMENS AG provides PLC to Chemical, Petro-chemical, Off-Shore, FPSO and BMS industry. It is much recognized because the PLC processes inputs with a fast response time. But the negative point on their front is that during the functioning if even one component fails to act properly then the system becomes unavailable as a result of which the machine stops functioning which may lead to further issues.
- Moore Process Automation is another company with reach to the Chemical, Off-Shore and FPSO industries only. The strength of their provided PLC is that it has fully structured programming software along with the facility to manually select the outputs requiring shut down. However its drawback is that the structured programming is not favorable to process safety critical circuits which can be a problem.
- HIMA is another company dealing in PLC and attracting a decent market as well. HIMA has market in Chemical, Petro-chemical, Off-Shore and BMS business. The promptness of the company personnel in helping the customers solve their problems through fast response in short interval is a positive point of the company. HIMA has managed to attract customers from across the world. Another benefit of working with HIMA is that the customer gets the option to get the PLC configured as per demand proving to be much cheaper than others. But the thing holding the company back is that it is dependent on other bigger and powerful companies for financing and discounts when the consideration is for big projects.

3.14 WPL soft 2.4.6.

- WPL Soft is software for Delta PLC (Programmable logic controller). When PLC is in operation, use the software to monitor the set value or temporarily saved value in timer (T), counter (C), and register (D) and force On/Off of output contacts.
- WPL Soft has designated in advance the type of document it produced as "* .dvp", and will set beforehand the currently created filename as "dvp0.dvp".
- The soft is free software, you can download, install also simulate the PLC program without any licence.
- System requirement: Same with Windows Operating System requirement.

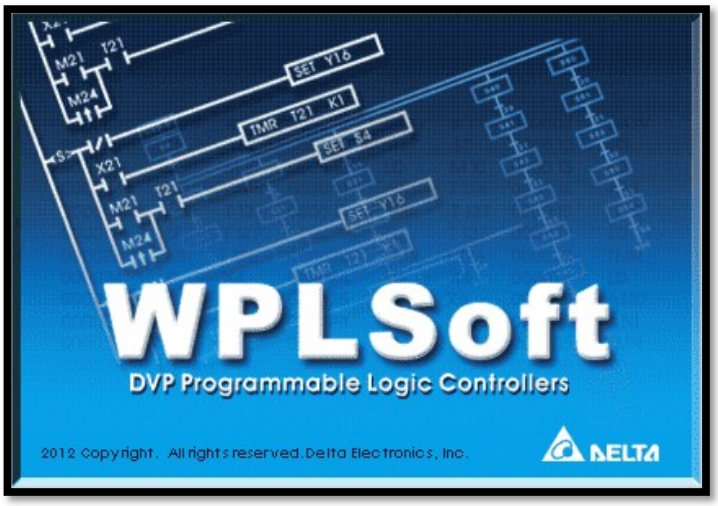


Fig 3.15 WPL Soft 2.4.6

3.15 SCADA.

SCADA stands for Supervisory Control And Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hard-ware to which it is interfaced, in general via PLC. SCADA systems are now also penetrating the experimental physics laboratories for the controls of ancillary systems such as cooling, ventilation, power distribution, etc. More recently they were also applied for the controls of smaller size particle detectors such as the L3 moon detector and the NA48 experiment, to name just two examples at CERN.

SCADA systems have made substantial progress over the recent years in terms of functionality, scalability, performance and openness such that they are an alternative to in house development even for very demanding and complex control systems as those of physics experiments.

3.16 History of SCADA.

In the year 1960, the first computer-based supervisory control system came into existence. And that was designed on mainframe computer technology. This was old technology and still not considered as SCADA. However, after that SCADA systems came into existence and replaced previous technology and SCADA provided the specialized feature for computational and logical operations.

As in the late 1960s itself, IC was invented that can help in designing complex as well as a sophisticated electronic device. So, by the use of available technologies, SCADA systems were built that facilitated the presence of a human operator. According to the design of the system, this operator can update the information in real-time relative to the remote processing being monitored.

3.17 SCADA block diagram.

The block diagram of SCADA system shown in the figure represents the basic SCADA architecture. The SCADA (supervisory control and data acquisition) systems are different from distributed control systems that are commonly found in plant sites. When distributed control systems cover the plant site, SCADA system cover much larger geographic areas.

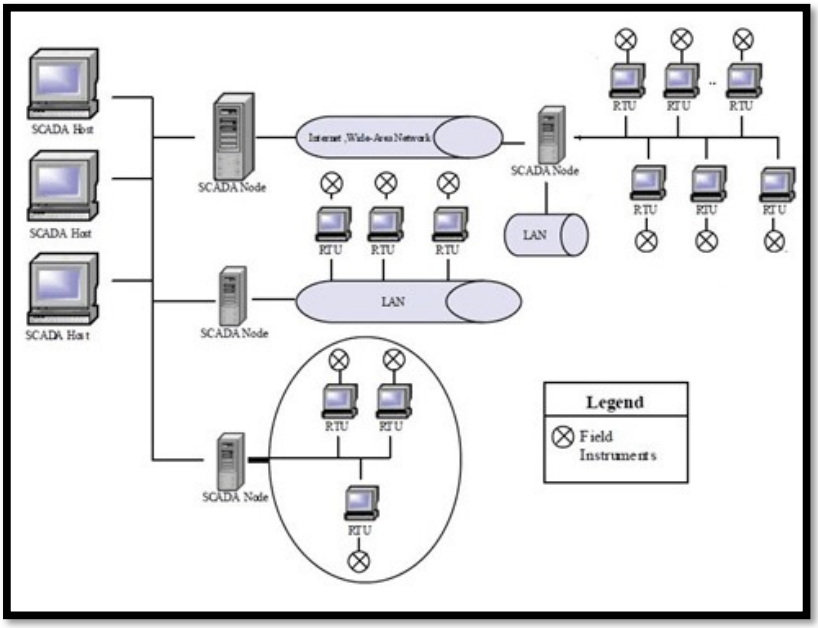


Fig 3.16 Block Diagram of SCADA

Above figure depicts an integrated SCADA architecture which supports TCP/IP, UDP and other IP based communication protocols as well as industrial protocols like Modbus TCP, Modbus over TCP or Modbus over UDP. These all work over cellular, private radio or satellite networks.

In complex SCADA architectures, there are a variety of wired and wireless media & protocols involved in getting data back to the monitoring site. This allows implementation of powerful IP based SCADA networks over landline, mixed cellular and satellite systems. SCADA communications can utilize a diverse range of wired and wireless media.

The choice of the existing communication depends on the characterization of a number of factors. The factors are remoteness, available communications at the remote sites, existing communications infrastructure, polling frequency and data rates. These factors impact the final decision for SCADA architecture. Therefore, a review of SCADA systems evolution allows us to better understand many security concerns.

3.18 Working procedure of SCADA.

The primary functions of SCADA systems can be broken down as follows. These functions are performed through a combination of sensors, RTUs, controllers and communication networks.

- **Data acquisitions:**

  Real world systems consist of thousands of nodes, making their management a challenging task. It is vital to have precise information about the status of particular sensors. The accuracy of control systems depends on the quality of data acquisition.

- **Data communications:**

  SCADA systems may use wired or wireless communication technologies between devices and users. Real-time systems have sensors and devices spread over a wide geographical area, making wireless networks the norm. Moreover, for SCADA systems that manage multiple remote areas, internet communications may also be utilized. Generally, SCADA systems have specific protocols and communication takes place through VPNs to prevent intrusions.

- **Information/data presentation:**

  An HMI or Human Machine Interface is employed by SCADA to provide the user with information collected from various networked devices. The information if displayed in a manner that is understandable and actionable, since there may be times when quick user action may be required. The interface usually makes use of graphical pictures of real-world objects such as that of a pump or tank to make processes understandable.

- **Monitoring/control:**

  SCADA systems use different switches for operation of multiple devices and displaying their status at the control area. The processes can be turned on/off or modified based on an analog value through these switches. Most processes are automated against user defined setpoints while others critical tasks may require additional human interventions.

  One of the biggest advantages of SCADA systems is their scalability. Expanding SCADA systems is simple and doesn't require extraordinary efforts. Moreover, these systems have been under development for decades and have therefore reached a level of maturity, making them usable for mission-critical applications.

3.19 Operations and tasks of SCADA.

The main Operations and tasks that a SCADA system must provide are: controlling the field devices of the plant/system (obviously), handling alarms, changing limits, providing more than 1 mode of operation, data file arrangement, event log and the production of graphical trends reports and graphs).

- **Controlling field devices:**

  The remote components of the system are controlled from the master computer. The means for controlling the system can be any or all of the following: positioning of the cursor, function keys, personalized menus and alphanumeric keys.

- **Alarm handling:**

  When an unexpected event generates an alarm, several alarm indicators are provided to the operator (through the software). These indicators can be all or any of the following: audible alarm, the alarm light of the station flashes in the mimic panel,

the last alarm line is updated in all the images, the alarm is inserted in the alarm list corresponding, the object symbol (element) or the value flashes in the station diagram (process image). An automatic dialer / voice unit can be included.

- **Limits changing:**

  The upper and lower limits for a remote measured value (which was previously established) can be changed from the master station. There is a waiting period for the operator to make the change. If the waiting time period expires, the operator must cancel the sequence that he has already entered and restarted the change sequence from the beginning.

- **Operation Modes:**

  The system must provide the following modes of operation: operator mode (normal operation of supervision and data acquisition), programming mode (it is used by programmers/designers to change data, extend the system, maintain the program, generate reports; network control is disabled) Training mode (self-explanatory) and special mode.

- **Data archiving:**

  It regularly samples the values of the measurands and the states of the monitored points in the database and stores them in historical files for a predefined retention period. This task is useful for monitoring networks and generating reports, as well as for providing data to trend facilities.

- **Events logging:**

  It is a list of all events that occur in the system and that are printed chronologically in the recorder. The types of events can be: changes of status of alarms and indications, waiting times, limit violation, operator input and system alarms (loss of communication with remote stations, hardware errors and failures in remote stations).

- **Production of reports & trend charts:**

  A report consists of data that is presented to the user in a predetermined tabular format. It can be produced cyclically from the historical database. The trend function allows the operator to generate graphic screens that show the historical trend of the measured data.

3.20 Manufacturers of SCADA.

Following are the companies which are manufacturers of SCADA Equipments.

- Suzlon
- ITI Limited
- ABB
- NCS
- Control Systems Inc.
- Nota Bene Technology
- Globalcom Satellite Communications

3.21 Features of SCADA.

Following are the Features of SCADA.

- **Analog inputs for live monitoring:**

  Analog inputs allow you to monitor real-time data across your network. Many SCADA systems will only have discrete inputs - which are digital and can only tell you if something is "on" or "off." An analog input will be able to tell you precise values, meaning you can have accurate data about whatever you're monitoring.

- **Control relays (SBO points) for remote access and control:**

  For the most effective network operation, you'll need to be able to remotely control your equipment. By having control relays (SBO points) on your SCADA system, you'll be able to remotely control any device in your network that is normally operated by a button or a switch. You'll be able to start equipment, open or close doors, or turn on lights.

- **Graphical web interface:**

  Monitoring and controlling your network through a text-only interface is tedious and complicated. You'll slave over tables and lists of words, rather than focusing your time on more important tasks. Your SCADA solution should come with an intuitive and easy-to-use interface.

- **Meaningful alarm descriptions:**

  When you receive an alert about a problem with your equipment, you want it to have meaningful information - not a vague description. If you're facing a network

emergency, an alert that says "Relay 267 Out" doesn't help you much. On the other hand, receiving "Site 112 Generator Failure" gives you meaningful detail that helps you respond.

- **Industrial-grade durability:**

  Your SCADA solution should be the most reliable piece of gear in your network. If the system that's supposed to protecting your uptime goes down, what good is it? Don't settle for a solution that's built on anything less than durable, industrial-grade hardware.

3.22 Dynamic process graphics.

- Using this feature, one can develop graphics which can resemble the plant.
- The graphic can include Reactor, Valves, Pumps, agitators, conveyors as well as other equipment and machinery used in the plant.
- The status of the equipment running / stopped can be shown using different color / animations.
- Typically the SCADA Software will have many ready to use symbols for proper representation which can be used in any type of industry.

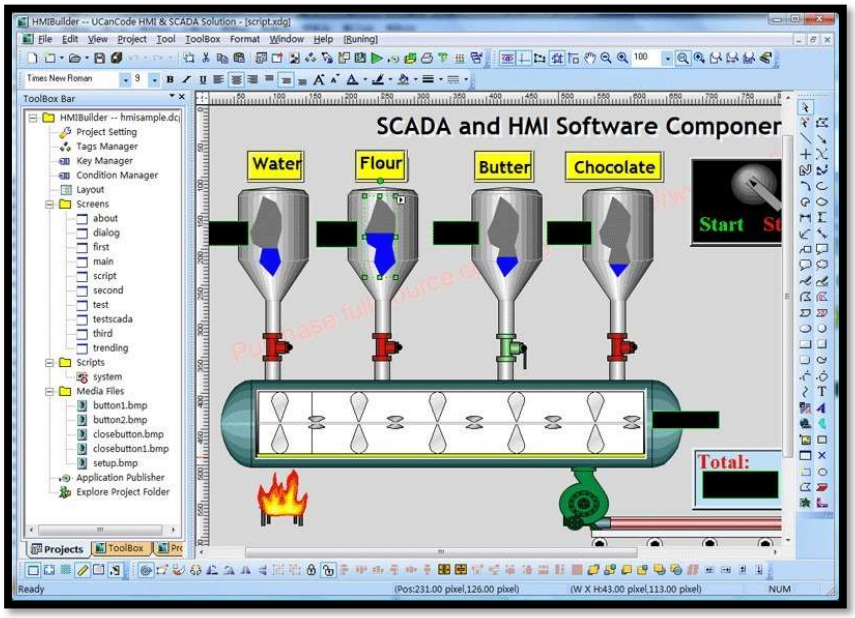


Fig 3.17 Schematic of Dynamic Process Graphics.

3.23 Real time and Historical trends.

- This facility is used for representing the data in graphical form.
- Typically the trends plots the value with reference to the time.
- Real-time data will plot the real-time value fixed period of time while historical data stored value which can be viewed on demand.
- Depending upon the storing capacity of the hard-disk on can specify the no of days the data can be stored .
- Some SCADA software show real-time and historical trends in single graphics while few others use separate tools.

Fig 3.18 Schematic of Trends

3.24 Alarms.

- Every plant need proper monitoring and control of the process parameters.
- Alarms represent warnings of process conditions that could cause problems, and require an operator response.
- Generally alarms are implemented by using the lamps or hooters in field but in SCADA it can be represented using animation.
- In many SCADA software, four type of alarm limits are used ie HI, HIHI,LOW, LOW LOW.

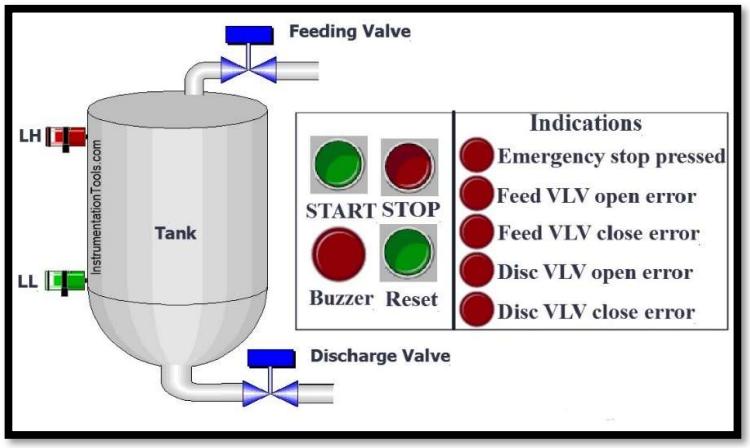
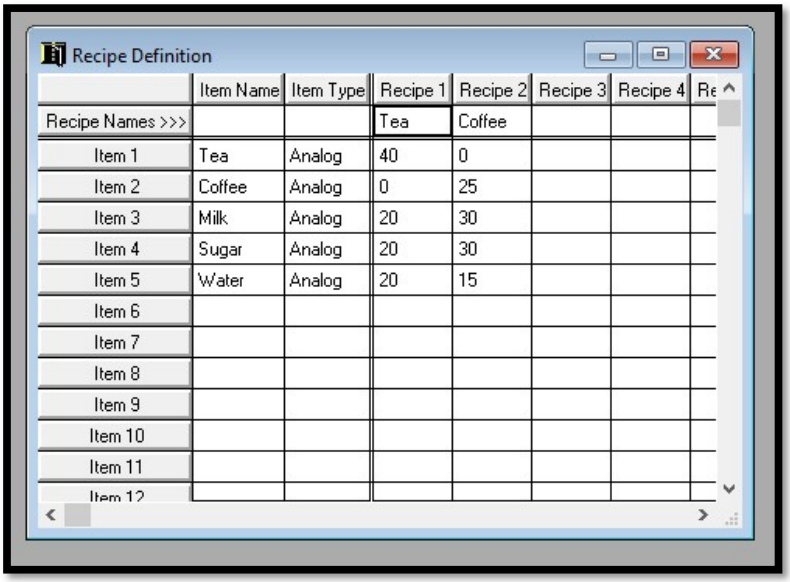


Fig 3.19 Schematic of Alarms

3.25 Recipe Management.

- In many case we use the same plant for manufacturing different product range. for example an oil blending plant can manufacture power oil, transformer oil, automobile oil.
- The recipe management is facility is used to maintain various recipes of different products and implement it on the process.
- The recipe can be stored in a single server and it can be fetched by any client server from any area to run the process.



	Item Name	Item Type	Recipe 1	Recipe 2	Recipe 3	Recipe 4	Re
Recipe Names >>>			Tea	Coffee			
Item 1	Tea	Analog	40	0			
Item 2	Coffee	Analog	0	25			
Item 3	Milk	Analog	20	30			
Item 4	Sugar	Analog	20	30			
Item 5	Water	Analog	20	15			
Item 6							
Item 7							
Item 8							
Item 9							
Item 10							
Item 11							
Item 12							

Fig 3.20 Schematic of Recipe Management.

3.26 Device Connectivity.

- Every Control hardware has its own communication protocol for communicating with different hardware / software. Some of the leading communication protocol include Modbus, Profibus, Ethernet, Dh+, DH 485,Devicenet,Control net.
- The Scada Software needs device driver software for communication with PLC or other control hardware.
- More the driver software available better is the device connectivity. Most of the SCADA software used in the industry have connectivity with most of the leading control system

3.27 Potential benefits of SCADA.

The benefits one can expect from adopting a SCADA system for the control of experimental physics facilities can be summarized as follows:

- The amount of specific development that needs to be performed by the end-user is limited, especially with suitable engineering.
- Reliability and robustness: These systems are used for mission critical industrial processes where reliability and performance are paramount. In addition, specific development is performed within a well established framework that enhances reliability and robustness.
- Technical support and maintenance by the vendor.

3.28 Applications of SCADA.

SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of a municipal water system.
SCADA monitors and controls industrial, infrastructure, or facility-based processes, as described below:

- Infrastructure processes may be public or private, and include water treatment and distribution, wastewater collection and treatment, oil and gas pipelines, electrical power transmission and distribution, wind farms, civil defense siren systems, and large communication systems.

- Facility processes occur both in public facilities and private ones, including buildings, airports, ships, and space stations. They monitor and control HVAC, access, and energy consumption.

Industries that are catered to are:

- Automotive
- Building Automation
- Cement & Glass
- Chemical
- Electronics
- Food and Beverage
- Machinery & Manufacturing
- Aerospace & Defense
- Metals & Mining
- Oil & Gas
- Pharmaceutical
- Power, Utilities & Generation
- Transportation
- Water & Wastewater

3.29 Wonderware INTOUCH 9.0.

Wonderware Intouch is worlds leading supervisory control and data acquisition software .The InTouch software package consist of Tags (Memory + I/O). The package is available in 64, 256, 1000 and 64,000 Tags with the three options:

- D+R+N (Development +Run + Networking)
- R+N (Run +Networking)
- Factory focus

With DRN package one can develop as well as run the application but in case of RN one cannot develop/modify the application. The application can be developed by using DRN package and can be installed on RN package.

3.30 Summary.

The automation PLC SCADA has many advantages such as it supersedes human operators involving in tough or monotonous work that involves physical tension and also replaces humans in tasks that are dangerous. The PLC is a tiny computer that has dedicated os and the operating system processes the interrupts that are incoming in current in fact it is what it is called as a real-time functioning system. Through input lines, the interrupts are given and the output detectors monitor various variables. The PLC program evaluates the input events and builds the output values which are sent via end result lines. So that's why the automation industries use this system and SCADA can be used for controlling and monitoring activities. The machinery field is more adaptable than previously and the PLC programs are sending for monitoring data to a central control place called SCADA. Both of these are essential in automation industries and if you are enthusiastic about pursuing training in software, then learn the Automation PLC SCADA Delhi to enable you to get yourself put in most reputed industries. The industrialist are looking for more volume of individuals for recruitment and the only thing you need to do is you have to be familiar yourself with PLC automation training. In future, this field will have more improvement and event they will consider for individuals in 1000s of figures because a thing that is economical in Mother Nature is more preferred by the industries because it can find them more income and also a good name in the market and in between people. Automation PLC SCADA field is growing and if you put a graph and assess, you can view the graph, it never tends to fall season down and it always increases and will also increase more in future. Make use of this field by learning this automation training in best PLC automation training centers in Chennai so as to get compulsory placement in respected industries. A fantastic path with no thorns between is shown to you and it is in your hands whether you are heading to choose a route with thorn or a path without the thorns.

CHAPTER 4

REFLECTION NOTES

The internship period in TECHNOCLOG LLP was really helpful in many ways. A lot of areas were exploited in a useful manner. There are technical as well as non-technical outcomes that I had from the organization

4.1 Technical assistance in the organization

The internship work is an 8th semester course in Visvesvaraya Technological University (VTU) for the partial fulfillment of "Bachelor of Engineering" degree for the academic year 2020-2021. I took this internship work in TECHNOCLOG LLP. The work of internship was performed in Programmable logic controller and SCADA which mainly deals with programming using ladder logic.

I was assigned with the task of designing the programs using ladder logic. So the first task done was studying of different types of PLC, implementing the ladder logic for logic gates and then I have studied about SCADA

After completing the assigned task which took almost half of the month of October, my job was to implement the internship task with the title "A Bottle filling system For Different Measurements using PLC " Firstly I began with understanding the concept of the assigned of assigned project and their role, understood the benefits of these and how I can implement this using ladder logic.

- **Abstract**

The objective of our project is to design, develop and monitor “An Bottle filling system For Different Measurements using PLC”. This work provides with a lot of benefits like low power consumption, low operational cost, less maintenance, accuracy and many more. This project is based on Industrial automation and is a vast application used in many industries like milk industries, chemical, food, mineral water and many industrial manufacturers. A prototype has been developed to illustrate the project.

In this Project a bottle filling machine is introduced using Programmable Logic Controller (PLC) based controller in automation industry. The main aim of the project is to design and fabricate a small and a simple filling system using PLC. The belt conveyor is used for moving the bottle. A Filling Machine is set to tank to control the flow of Liquid. The

position of bottle is detected by sensors so that pump can be functioned at right time. When bottle is under the tank, the Filling Machine is started and bottle is filled by Liquid. All the components perform well. This filling machine is cost effective and it can be used in small scale bottle filling systems such as coffee shops, juice shops and other beverage industries.

In our project we have used a smaller number of systems hence the overall cost has been reduced to an extent. Ladder logic has been used for the programming of the PLC, which is the most widely used and accepted language for the programming of the PLC. The PLC used in this system is a Delta PLC which makes the system more flexible and easier to operate.

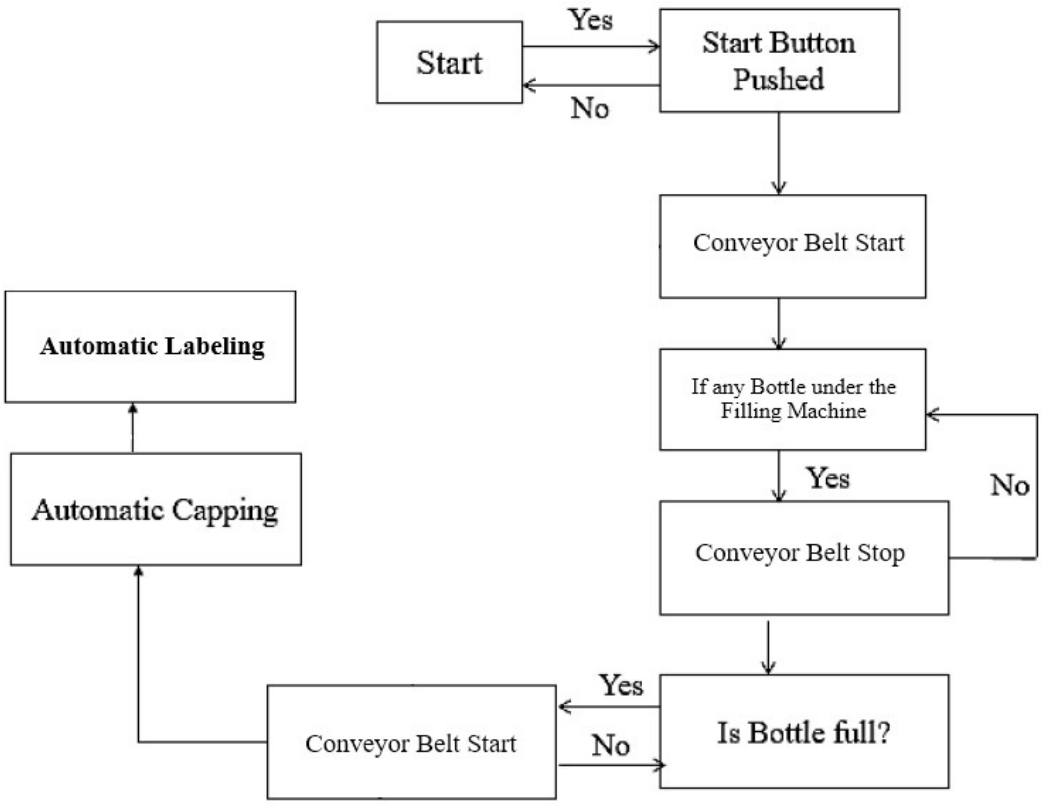
➢ Introduction

Filling is defined as the method in which liquid is packed into the bottle such as water and other beverages. It can be automated by using Programmable Logic Controller (PLC). In the modern world, Programmable Logic Controller (PLC) is used for this purpose. PLC is the major element of the whole process. It is a powerful device to control the production system. It is used as a digital computer to automate industrial activities. It has many input and output unit, a CPU and a memory. It gives output results according to the condition of input. It is prepared for the replacement of relay circuit. The automation process is controlled according to the logics of programmed PLC. For inputs and outputs, PLC has a definite number of connections. The advantages of using PLC are smooth operation, low cost and high filling speed. To improve filling accuracy, it is necessary to apply PLC in automatic filling system. The process is controlled by ladder logic. Filling is controlled by using various methods using motor, Filling sensor, Capping sensor, Labeling sensor, conveyor belt and PLC. This process involves placing bottle on the conveyor and filling the bottle at a time. The purpose of this project is to explain the process of filling bottles at a time.

As the demand of beverage and medicine are increasing day by day, filling is required to fill up this requirement. In health care industry, manual filling operation is dangerous. Manual filling in beverage industry is economical loss. It consumes more time than automatic filling system. PLC plays an important role in various industries for mass production with more accuracy and productivity. The engineers make ladder logic to operate PLC.

The competition among industries is rising day by day with their new products and their brands. In order to keep their product in market and deliver the product timely, automation is essential. They used PLC for this automation purpose

- **Working principle**



Flow chart of working principle is shown above. If the button of the power supply is pressed, the conveyor motor will start to move. When the Filling sensor detects the bottle, the conveyor motor stops to move and the Filling Machine will start to flow the liquid to fill the bottle. After completing the filling operation, the Filling Machine stops. Hence the conveyor motor starts to move and the bottle goes away from the Filling Machine. When Capping Sensor Detects the Bottle, Conveyor will stop and Capping should done. After completing the Capping operation , The Capping Machine stops. Hence the conveyor motor starts to move and the bottle goes away from the Capping Machine. When Labeling Sensor Detects the Bottle, Conveyor will stop and Labeling should done. After completing the Labeling operation , The Labeling Machine stops. Hence the conveyor motor starts to move and the bottle goes away from the labeling Machine. This process will be repeated if another bottle is sensed under Filling Machine The Same Process will Applicable to 1000 ML and 500 ML Bottle.

- **Experiment carried out at Internship.**

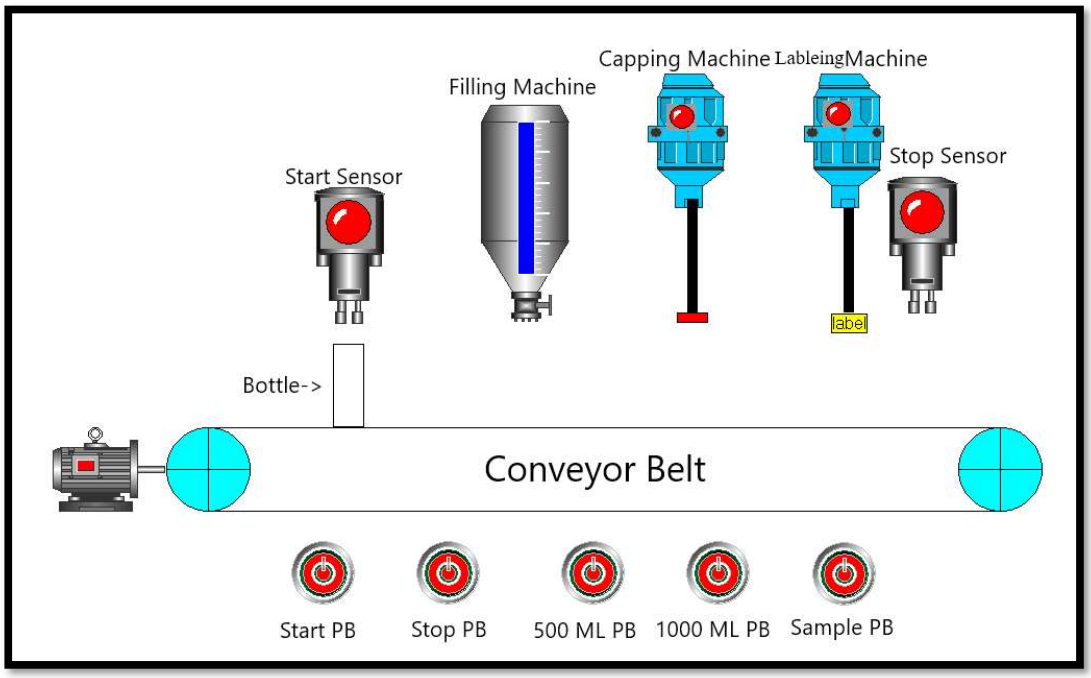


Fig 4.1 Design of Working Principle.

To design a system using Programmable Logic Controller and SCADA Window with the specifications given:

- There are five Push Buttons Start PB,Stop PB,500 ML PB,1000 ML PB,Sample PB.
- One Motor is connected to Conveyor.
- Five Sensors are Start, Stop, Filling, capping and Labeling sensor

The Start Push button is ON and Stop Push Button is OFF is pressed after that:

- If 500 ML PB is ON, Bottle should only fill 500 ML.
- If 1000 ML PB is ON, Bottle should only fill 1000 ML.
- If Bottle Reaches under Start Sensor, Then Conveyor should ON.
- If Bottle Reaches under Filling Machine, Then Bottle will start filling.
- If Bottle Reaches under Capping Machine, Then Bottle should Capped.
- If Bottle Reaches under Labeling Machine, Then Bottle should Labeled.
- If Sample Push Button is ON, Then only filling Should be done.
- After Bottle Labeled, Then stop sensor is ON and Process Restart.

4.1.1 Results and Discussion.

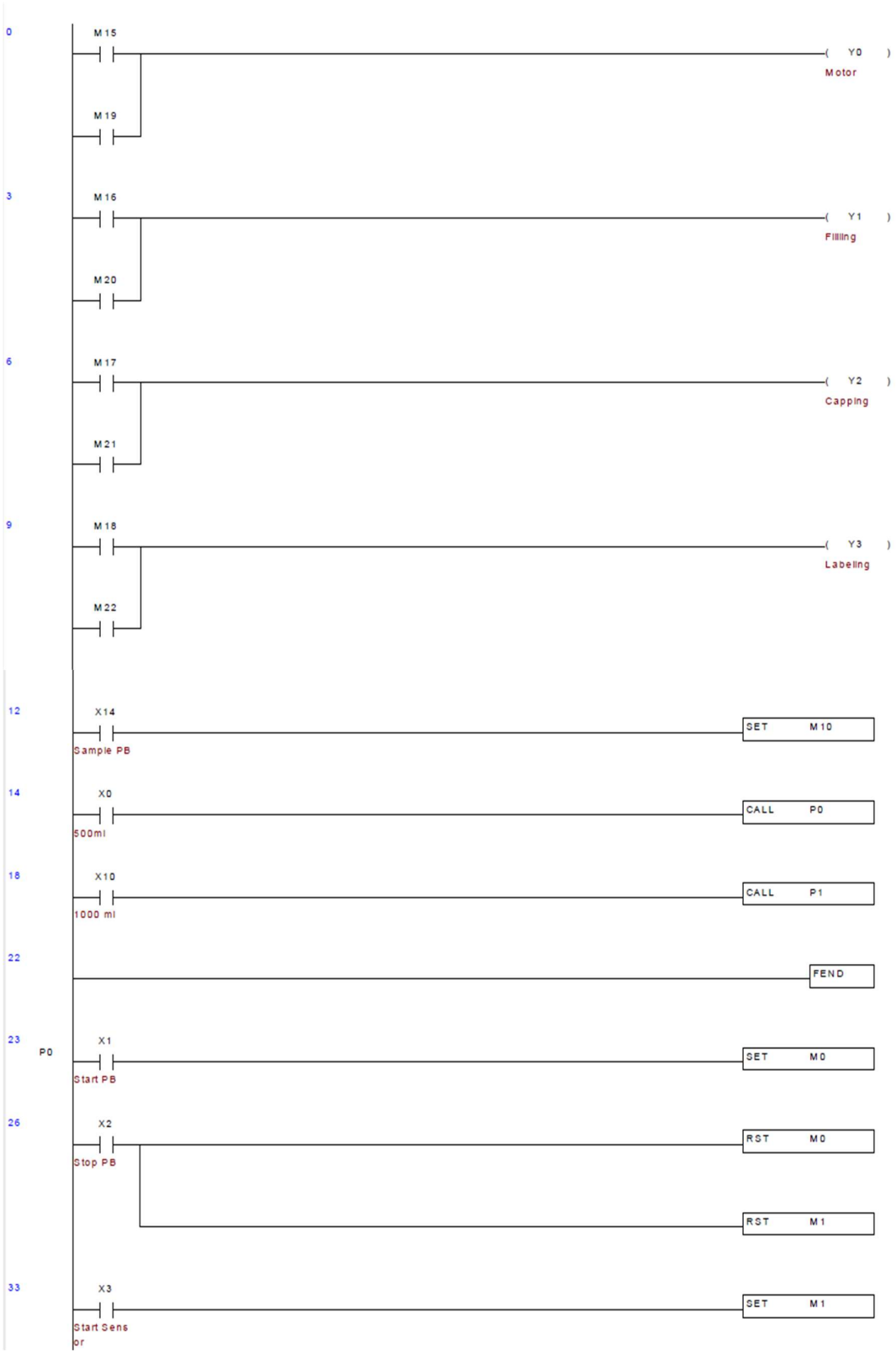
- Hardware Requirements : DVP14SS211R
- Software Requirements :WPLSoft 2.49 , Kingview
- Ladder Diagram.

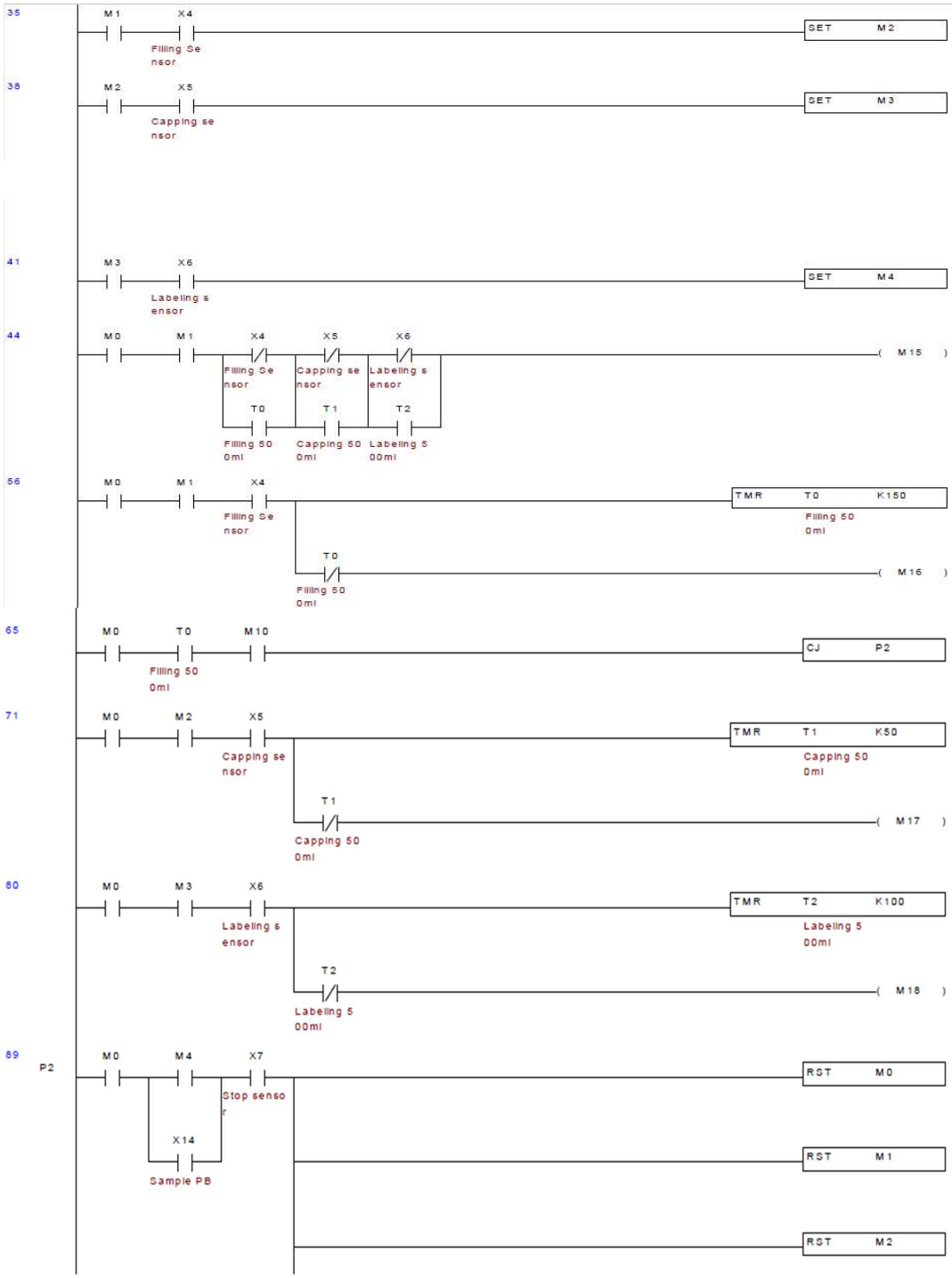
  - I/O Used:

Device	Comment
X0	500ml
X1	Start PB
X2	Stop PB
X3	Start Sensor
X4	Filling Sensor
X5	Capping sensor
X6	Labeling sensor
X7	Stop sensor
X10	1000 ml
X11	Filling sensor 1000ml
X12	Capping sensor 1000ml
X13	Labeling sensor 1000ml
X14	Sample PB
Y0	Motor
Y1	Filliing
Y2	Capping
Y3	Labeling

Fig 4.2 I/O Used in the PLC Programming

- **PLC Programming.**




35
M1
X4
Filling Se nsor
SET M2
38
M2
X5
Capping se nsor
SET M3
41
M3
X6
Labeling s ensor
SET M4
44
M0
M1
X4
Filling Se nsor
X5
Capping se nsor
X6
Labeling s ensor
(M15)
T0
Filling 50 0ml
T1
Capping 50 0ml
T2
Labeling 5 00ml
56
M0
M1
X4
Filling Se nsor
TMR T0 K150
Filling 50 0ml
T0
Filling 50 0ml
(M16)
65
M0
T0
Filling 50 0ml
M10
CJ P2
71
M0
M2
X5
Capping se nsor
TMR T1 K50
Capping 50 0ml
T1
Capping 50 0ml
(M17)
80
M0
M3
X6
Labeling s ensor
TMR T2 K100
Labeling 5 00ml
T2
Labeling 5 00ml
(M18)
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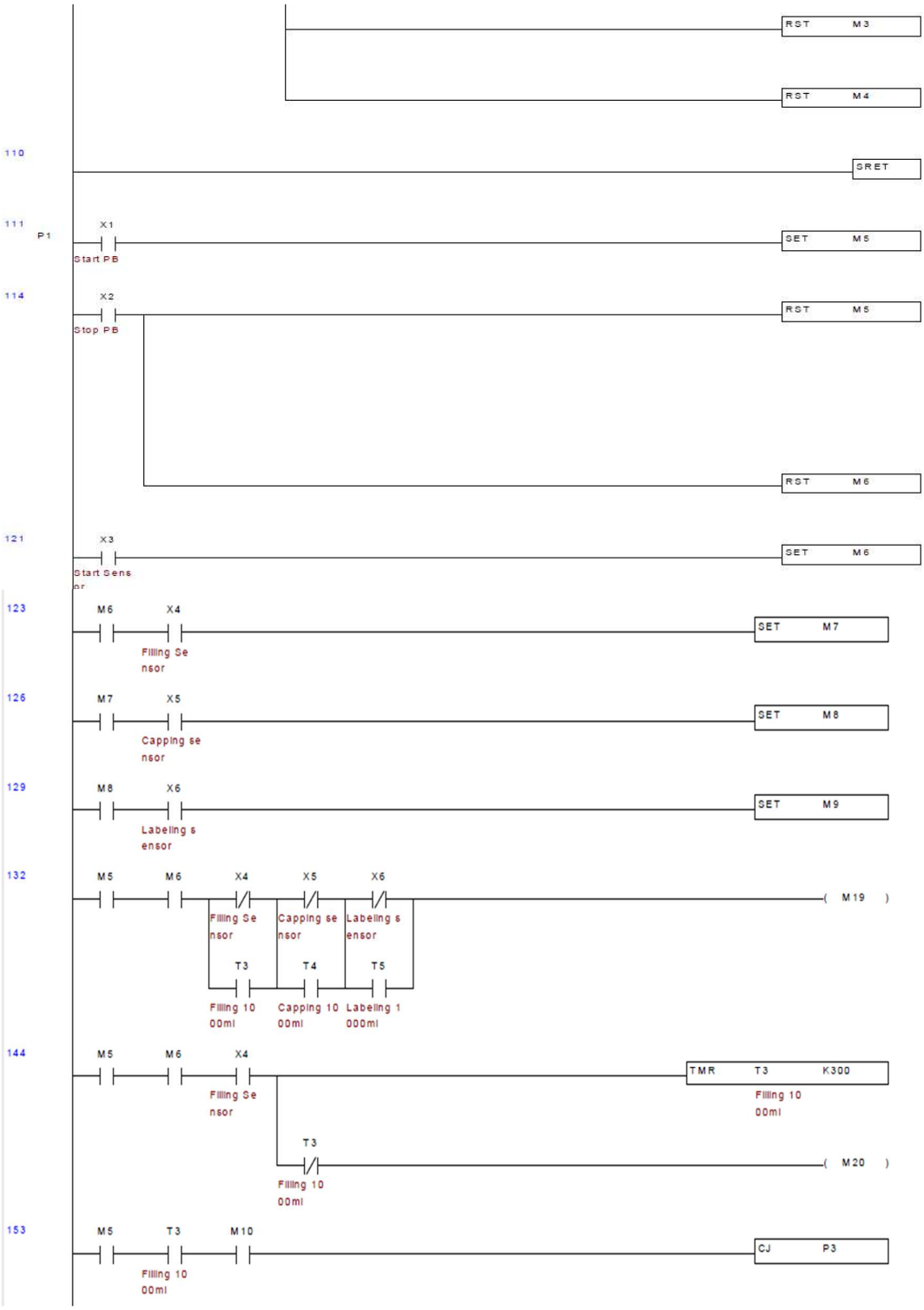
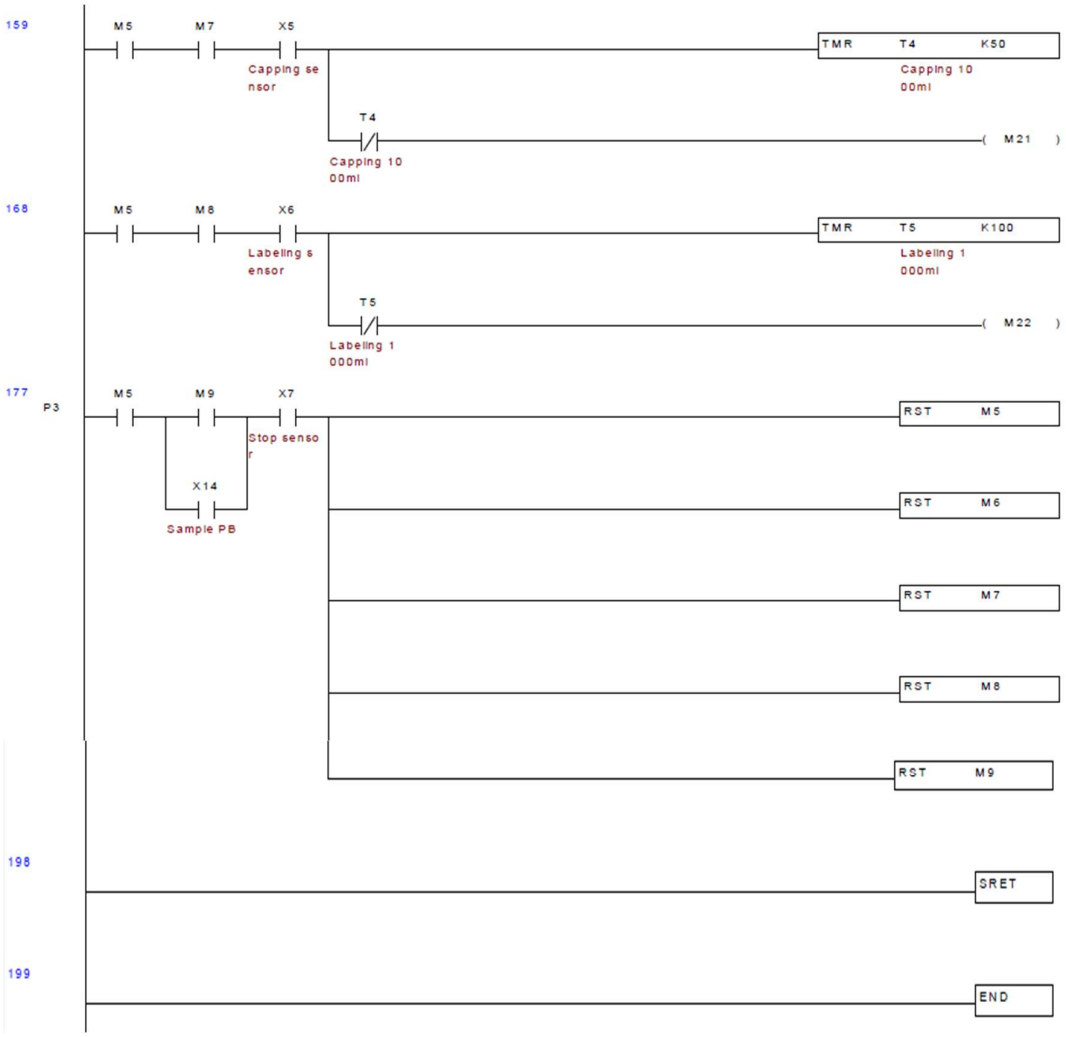
P2
M0
M4
X7
Stop senso r
X14
Sample PB
RST M0
RST M1
RST M2


RST M3
RST M4
110
SRET
111
P1
X1
Start PB
SET M5
114
X2
Stop PB
RST M5
RST M6
121
X3
Start Sens
or
SET M6
123
M6
X4
Filling Se
nsor
SET M7
126
M7
X5
Capping se
nsor
SET M8
129
M8
X6
Labeling s
ensor
SET M9
132
M5
M6
X4
X5
X6
Filling Se
nsor
Capping se
nsor
Labeling s
ensor
(M19)
T3
T4
T5
Filling 10
00ml
Capping 10
00ml
Labeling 1
000ml
144
M5
M6
X4
Filling Se
nsor
TMR T3 K300
Filling 10
00ml
T3
Filling 10
00ml
(M20)
153
M5
T3
M10
Filling 10
00ml
CJ P3



➢ Implementation using SCADA

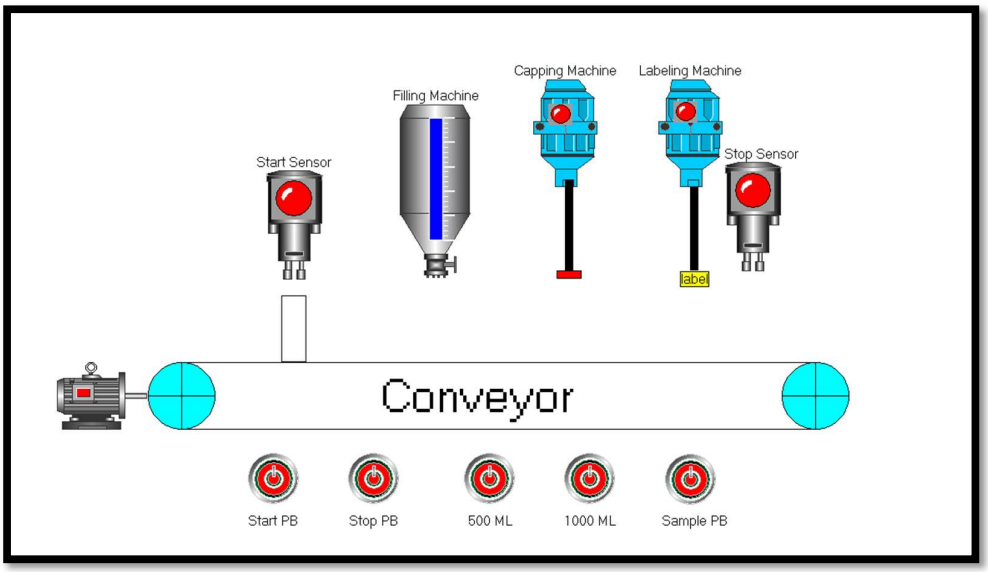


Fig 4.3 SCADA Output Window at Initial stage

Above image shows that when we enter into Switch to view mode, All the process are at the initial stage and process yet to start. We observe that all the sensors and push buttons are OFF and also the conveyor is at rest state.

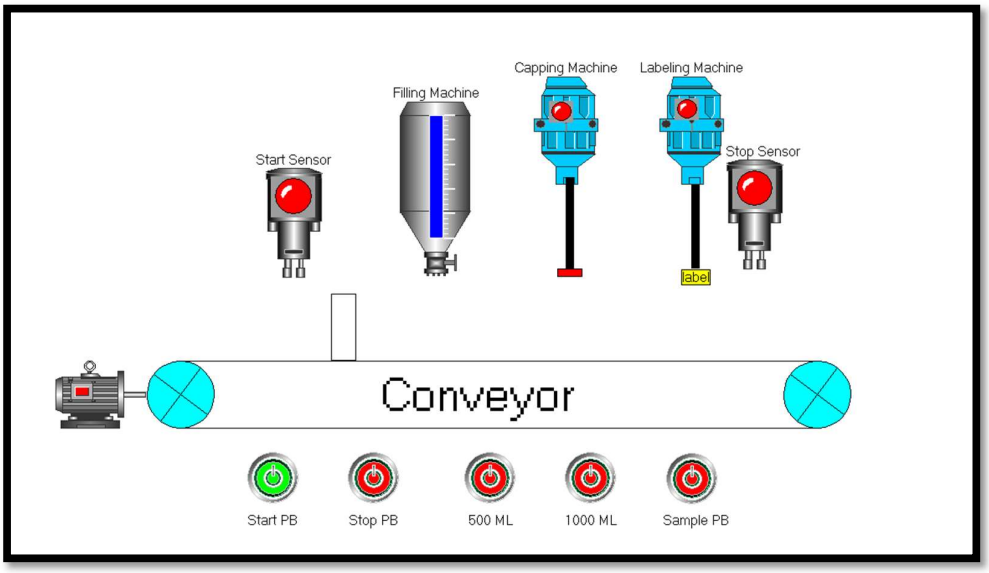


Fig 4.4 SCADA Output when start PB is ON

Initially to Start the process Start Push Button is ON, Then the start sensor is ON and Conveyor is at running state and bottle starts moving forward and it reach towards Filling machine for liquid Filling.

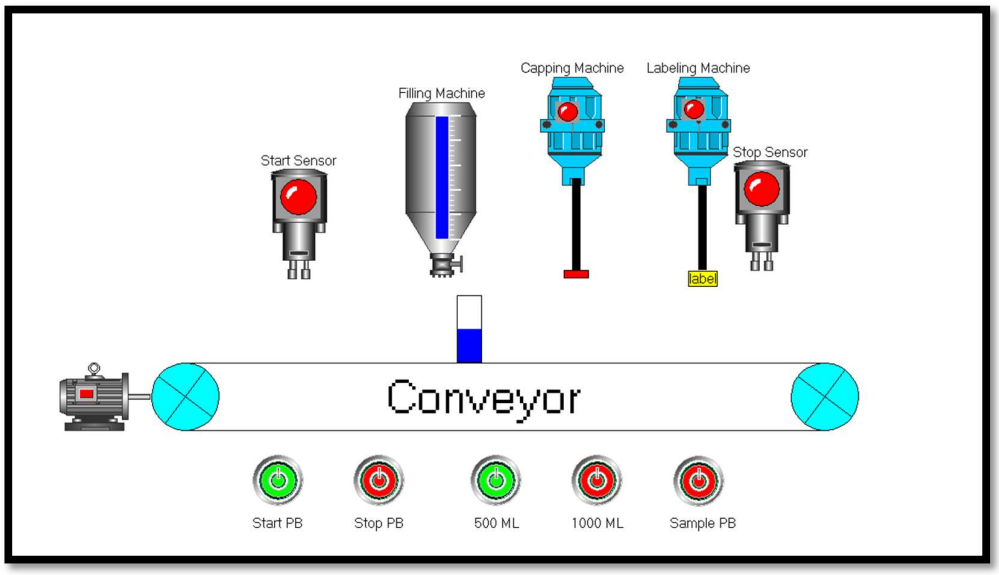


Fig 4.5 SCADA Output when 500 ML PB is ON.

Once the Bottle Reaches below filling machine conveyor will Stop for liquid filling. If 500 ML PB is ON, Then Bottle should fill only 500ML. After Filling of 500 ML of liquid to bottle with certain time then conveyor is start once again and bottle move forward towards Capping machine.

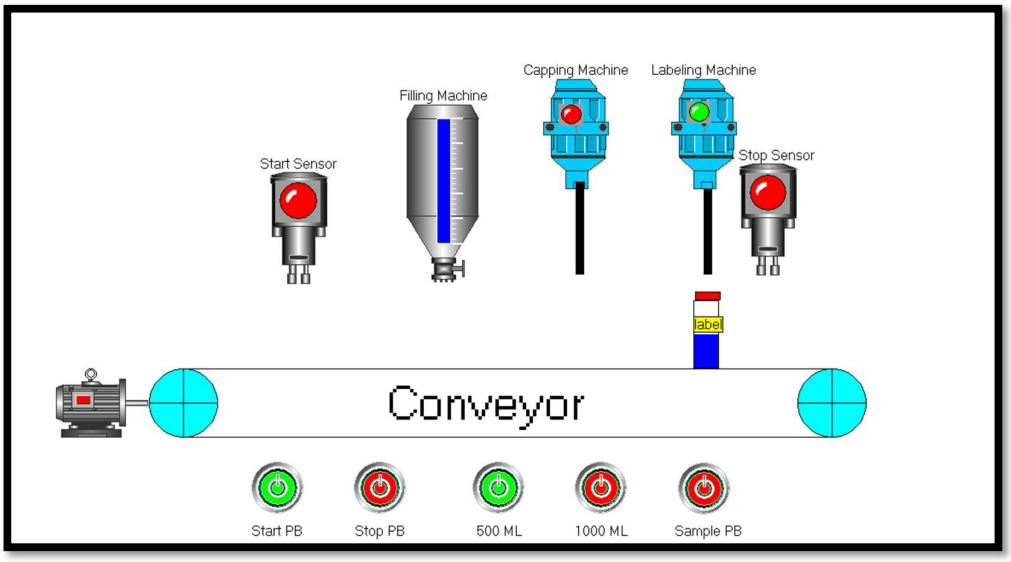


Fig 4.6 SCADA Output when Capping and Labeling done for 500 ML filling bottle.

When Bottle reaches below Capping machine conveyor should stop and Capping sensor is ON to do Capping for 500 ML Filling bottle, After that The Conveyor should start once again. When Bottle reaches below Labeling machine conveyor should stop and Labeling sensor is ON to do Labeling for 500 ML Filling bottle, After that The Conveyor should start once again. When the Bottle reaches Stop sensor whole process should restart.

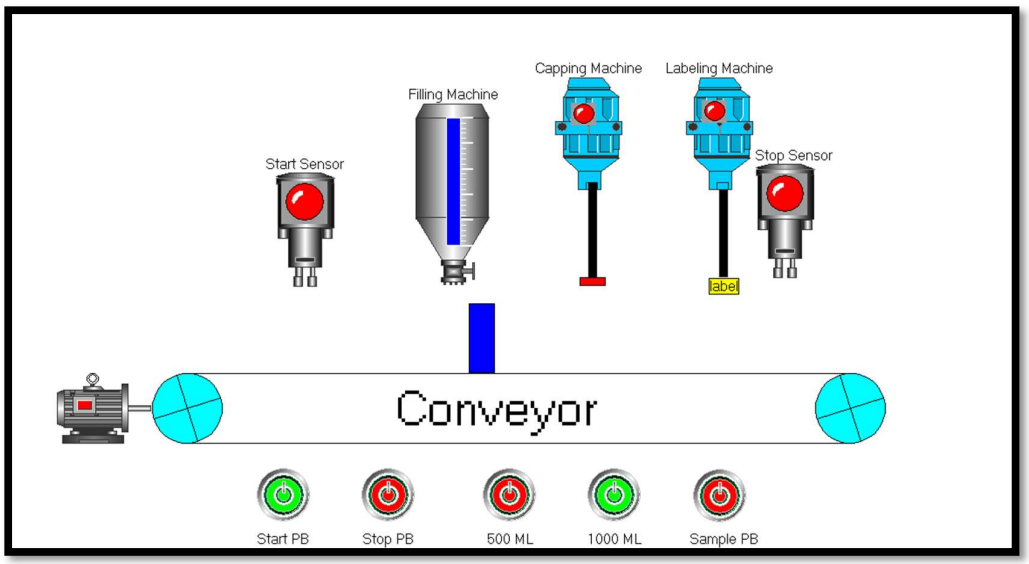


Fig 4.7 SCADA Output when 1000 ML PB is ON.

Once the Bottle Reaches below filling machine conveyor will Stop for liquid filling. If 1000 ML PB is ON, Then Bottle should fill only 1000ML. After Filling of 1000 ML of liquid to bottle with certain time then conveyor is start once again and bottle move forward towards Capping machine.

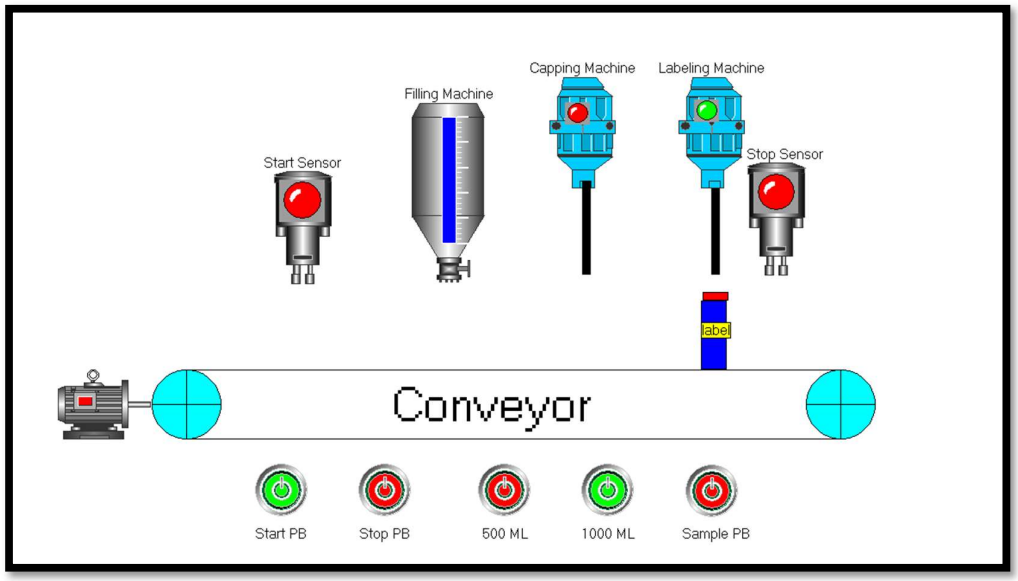


Fig 4.8 SCADA Output when Capping and Labeling done for 1000 ML filling bottle.

When Bottle reaches below Capping machine conveyor should stop and Capping sensor is ON to do Capping for 1000 ML Filling bottle, After that The Conveyor should start once again. When Bottle reaches below Labeling machine conveyor should stop and Labeling sensor is ON to do Labeling for 1000 ML Filling bottle, After that The Conveyor should start once again. When the Bottle reaches Stop sensor whole process should restart.

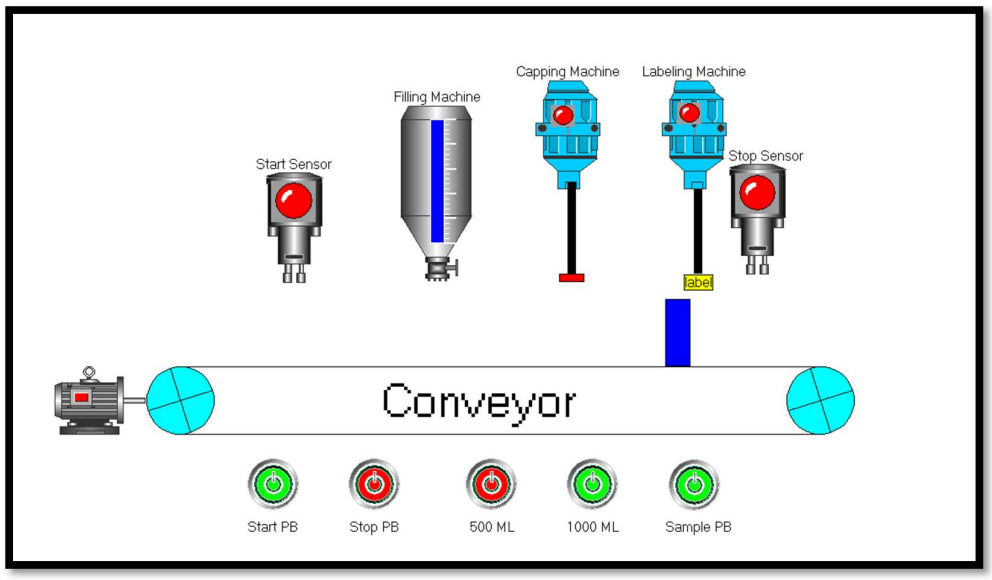


Fig 4.9 SCADA Output when Sample PB is ON

When Sample Push Button is ON, Then Bottle should only undergoes Filling Process and rest of the process are Skipped.

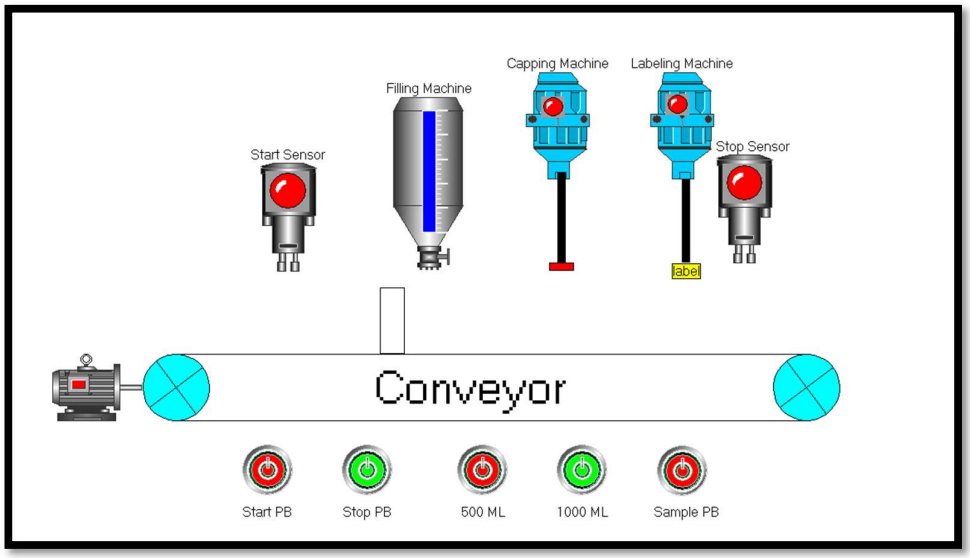


Fig 4.10 SCADA Output when Stop PB is ON.

When Stop Push Button is ON, Then the whole process need to stop and after Stop Push Button is OFF the process should Continue.

- The script written for this project is shown below:

```
\\local\C3=100;
if(\\local\M2==1 && \\local\stoppb==0)\\local\M1=1; else \\local\M1=0;
if(\\local\C3<=10)\\local\C3=\\local\C3+10;
if(\\local\M1==1)\\local\C1=\\local\C1+10;
if(\\local\M1==1)\\local\C2=\\local\C2+10;
if(\\local\C1==100)\\local\C1=0;
if(\\local\C2==100)\\local\C2=0;
if(\\local\M2==1 &&\\local\C4<31 && \\local\stoppb==0 )\\local\C4=\\local\C4+1;
if(\\local\C4==31 && \\local\filling1==1)\\local\fill=\\local\fill+50;
if(\\local\C4==31 && \\local\filling2==1)\\local\fill=\\local\fill+100;
if(\\local\C4==31 &&\\local\M2==1)\\local\C3=\\local\C3-50;
if(\\local\fill==50 || \\local\fill==100 && \\local\M2==1 && \\local\C4<60)\\local\C4=\\local\C4+1;
if(\\local\C4==60)\\local\cap=\\local\cap+10;
if(\\local\cap>100)\\local\cap2=\\local\cap2+3.7;
if(\\local\cap>100 &&\\local\M2==1 && \\local\C4<87)\\local\C4=\\local\C4+1;
if(\\local\C4==87 )\\local\label1=\\local\label1+10;
if(\\local\label1==100 && \\local\M2==1)\\local\C4=0;
if(\\local\label1==100 && \\local\M2==1)\\local\M1=1;else \\local\M1=0;
if(\\local\onlyfilling==1)\\local\cap=0;
if(\\local\onlyfilling==1)\\local\label1=0;
if(\\local\onlyfilling==1 && \\local\C4<87)\\local\C4=\\local\C4+1 ;
if(\\local\onlyfilling==1 && \\local\C4==87)\\local\C4=0 ;
if(\\local\M2==1 && \\local\C4==0)\\local\fill=0;
if(\\local\M2==1 && \\local\C4==0)\\local\cap=0;
if(\\local\M2==1 && \\local\C4==0)\\local\cap2=0;
if(\\local\M2==1 && \\local\C4==0)\\local\label1=0;
if(\\local\C4<2 &&\\local\M2==1 )\\local\M3=1;else \\local\M3=0;
if(\\local\C4==60 &&\\local\M2==1 )\\local\M4=1;else \\local\M4=0;
if(\\local\C4==87 &&\\local\M2==1 )\\local\M0=1;else \\local\M0=0;
if(\\local\C4==31)\\local\M1=0;
if(\\local\C4==31)\\local\C1=0;
if(\\local\C4==31)\\local\C2=0;
if(\\local\C4==60)\\local\M1=0;
if(\\local\C4==60)\\local\C1=0;
if(\\local\C4==60)\\local\C2=0;
if(\\local\C4==87)\\local\M1=0;
if(\\local\C4==87)\\local\C1=0;
if(\\local\C4==87)\\local\C2=0;
```

Fig 4.11 Script written for SCADA Visualisation

4.1.2 Conclusion

"An Bottle filling system For Different Measurements using PLC" has been developed and implemented. The PLC is used in this system to get more productivity with less time high reliability for and flexible in work. The system is designed to working with different sized bottles by simply change the program. The ladder diagram language is used in this Project because this language is very useful and has a lot of functions so that most of the industrial application uses this language. SCADA is used to visualize the working of the Project. The system has the advantages as simple structure and reliable operation. The system is controlled by PLC. This was successfully implemented. We consider this project as a journey where we acquired knowledge and also gained some insights into the subject which we have shared in this report.

4.2 Non-Technical outcomes

4.2.1 Team Work

Teamwork is such an important aspect of running successful company and my internships have taught me how to do this on a business level. Teamwork is the ability to work well with other people and be adaptable in order to deal effectively with the demands placed on team, which I have achieved to an expected extent. Employers will ask us to demonstrate this skill in our application by working with other people and cooperating with them to get the best result.

4.2.2 Problem solving Skills

My internship with Technoclog has been fast paced and challenging and I enjoy the experience I have so far because it motivates me to do a better job. As interns we are all required to participate in an intern final project, which we have to present to the Guide. Given my busy schedule during my internship, I have to work on the project with my teammates during my spare time. However I enjoy the process and I have learned a lot of problem solving skills throughout this Internship project.

4.2.3 Work ethics

Ethical behaviors are extremely important in at place of work as well as your personal life. Ethical behaviors is good in workplace this is where you are able to demonstrate respect for key morals principles. Honesty, fairness, and diversity are among the key morals that we

grow up with. We act and respond to issues with how we feel. We have personal values as well as value held within a company organization and society.

4.2.4 Adaptability

Working as an intern is quite different in a way to learning theory at university. I feel that there is less pressure to learn large amounts of information, as we are dealing with specific topics. Whereas, at university we are required to learn many topics within one field of law. So we get a more general overview of subjects at university. Therefore we are learning more detailed information in the work place, as we are working 'up close and personal' with a job, So we have to Adaptive for work environment.

4.2.5 Responsibility

We discuss progress and engage in discussion of topics relevant to the operation and philosophical perspective of the office and functional area in general and we Fulfill the Assignments and Projects upon time commitments. Additionally we conduct oneself in a responsible and professional manner.

4.2.6 Time management

We Learn that Time management is one of the most important skills we can have in the workplace. Deadlines are important, and while we might not meet all of them, they teach us valuable professional lessons that we will carry with throughout our career.

REFERENCES

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