SMART DESIGN AND FABRICATION OF FLUIDS FLOW CONTROL VALVES

A thesis

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DEPERTMENT OF MECHANICAL ENGINEERING

SONARGON UNIVERSITY (SU)

JANUARY 2025

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of

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Abstract

“Smart design and fabrication of fluids flow control valves’’ that use digital precision and mechanical reliability to control the flow of liquids and gases. They are used in many industries, including manufacturing and pharmaceuticals, where precise fluid mixing, dispensing, and dosing are critical. Smart valve actuation for dynamic fluid flow control. This abstract discusses how non-linearities in fluid flow control systems can limit perfect reference tracking. Employing smart flow control valves for fast closed-loop reservoir management. This abstract discusses how smart flow control valves can be used to improve reservoir management. Development of Hydraulic Inflow Control Valve for Intelligent Completion Well. This abstract discusses how accurate monitoring of downhole flow control valve opening is important for realizing intelligent closed-loop control. Smart valves can control the flow, pressure, and handling of fluids. Smart valves can be used in microreactors and micromixers. Smart valves can improve the distribution of constituents in micromixers. Smart valves can be used to control the flow of water in my homes.

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List of Abbreviations

SMART

S=Specific

M= measurable

A=Achievable

R= Relevant

T= Time-bond

AC Alternating current

DC Direct current

Notations

To communicate, we sometimes need to agree on the meaning of certain terms. If the same idea is mentioned several times in a discussion, we often replace it with some shorthand notation. The choice of notation can help us avoid wordiness and ambiguity, and it can help us achieve conciseness and clarity in our written and oral expression. Many problems of computer science, as well as other areas of thought, deal with reasoning about things and representing things. Since much of our communication involves reasoning about things, we'll begin the chapter with a short discussion about the notions of informal proof. The rest of the chapter is devoted to introducing the basic notions and notations for sets, tuples, graphs, and trees. The treatment here is introductory in nature, and we'll expand on these ideas in later chapters as the need arises.

Chapter 1

Introduction

“Flow control valves play a key role in on/off the flow of fluids and gases through pipelines, and if we walk into a plant, we can find flow control valves everywhere in the equipment, and they ensure that processes run efficiently and safely. Flow control valves can be found in a variety of industries such as textile mills, water treatment plants, chemical plants, refineries, and power plants. These valves offer several benefits, including improved process efficiency, precise control, reduced energy consumption, and enhanced safety measures’’. Control valve also called final control eliminate are a most important element in the control system of a process plant. It is the last device in control loop.

1.1 Background and significance of the project

Mechanical is in our DNA. Smart flow is not only my leading but also a mechanical department with over 1 year expertise in smart flow related issues. Smart flow blends technical knowledge and mechanical expertise with al tech to deliver through cost saving and property protection in real time 24/7.

1.2Backgrounng

We were at the face of water related issues for our clients , working in many areas such as hospitality , retail , public bodies, care homes and many other commercial businesses and office blocks. Almost all of our clients and businesses in these sectors have the same fundamental core issues -reducing water costs, sustainability, water management and property protection.

1.3 OBJECTIVE

- To learnt about Smart design and fabrication of pneumatic Power can the fluids flow control valves on/off of underground pipeline in Agriculture field irrigation or water reservoir.
- To study about Fluid machinery of the plant and design.
- To know about fluids used long range area covered pressure.
- To about learnt fluid mechanics and Hydraulic

Chapter 2

Literature Review

2.1 Introduction

Water is one of the most precious and irreplaceable natural Resources available on earth. It needs to be managed carefully and efficiently, to be preserved for the coming generations. Water is one of the prime elements responsible for life on earth. Water circulates through the land just as it does through the human body, transporting, and dissolving, replenishing Nutrient sand organic matter. There are a couple of electronic flow measuring devices based on hardware sensors available in markets but software application have not been developed. Water management is a very delicate issue and needs to be dealt with at most care. This project is concerned with the efficient management of the water automatically. The significance of this model is to control the flow of water to suit predefined specifications. The main objective of this project is to develop a flow control device.

2.2 Literature

Here are some literature reviews on smart control valves: Smart-valve-assisted model-free predictive control system for fluids flow. This study uses smart valves to control the flow of air in irrigation plants. The study found that the smart valves could save energy by up to 30% in different types of buildings. A review on the sizing and selection of control valves for thermal: This study discusses the importance of sizing and selecting control valves correctly. The study also provides guidance on how to select the right valves for different applications. On the Potential of a Smart Control Valve System for Irrigation Water Network: This literature review highlights the potential of smart control valves for irrigation water networks. An Innovative Internet of Things (IOT) Based Smart Electric Valve Monitoring: This paper presents an innovative smart electric valve monitoring system that uses the internet of things (IoT). A Literature Review on Smart Well Technology: This literature review discusses the contact mechanical behaviors of radial metal seals for interval control valves in intelligent wells. Smart control valves are valves that use sensors, actuators, and control systems to regulate the flow of liquids or gases. They can be used in heating and cooling systems, irrigation water networks, and more.

Kuganesan Kumar, MoaminA. Mahmoud [1] In this paper, they have developed an online Mobile app that monitors and controls the water flow through taps whenever there is an unusual Reading of the water usage at home. The developed App enables a user in monitoring and Controlling the water flow at home via an online mobile application's graphical user interface (GUI). This makes the monitoring process more efficient and

convenient for house owners. Rasin,Z.;Hamzah,H.;Aras, M.S.M [2] resolves the problem of the manual analytical method Adopted in water flow detection with bad real-time character, this paper introduces a remote Water flow measuring and monitoring system. It has used wireless sensor network based on the ZigBee to realize the water quality parameter remote probing and the real-time monitoring Smart water flow control and monitoring system 2017-2018. Zulhani Rasinand Mohd Rizal Abdullah [3]. In this paper, The application which is particularly Used for wireless networks, specifically a water equitable distribution and monitoring system is Been used. A possible communication system for the water equitable distribution and monitoring. The quality, and describe our channel measurement approach is proposed. Ejio for Virginia Ebere, Oladipo Onaolapo Francisca [4] the microcontroller for the automatic Water level monitor with feedback, having passed her necessary tests with the other components interfaced to it, is here by presented. With this implemented system, it is possible to monitor the water level in an over-head tank, switch on the water pump when the tank is empty and switch off the same pump when the tank is full without any need for human intervention. By so doing, the incidence of water wastage is eliminated and abrupt cut-off of water supply is equally also eliminated. T.Deepiga, A.Sivasankari [5] this paper is about developing an efficient wireless sensor network (WSN) based water monitoring system. Three different ways to monitoring the water such as water level monitoring, water pollution monitoring and water pipe line leakage monitoring. Finally the is water monitoring system of smart homes/office research concept will be completed by using wireless sensor technology. FrankA. Richerand[6]The system will consist of monitors in tandem or as required working in Conjunction with inter face probes reading in multiple locations, and diversion valves directly Operated based on the output of the interface probe sand monitors. The probes relay the water Interface location at multiple locations throughout the process and send that data to a Programmable Logic Controller (PLC) One-time Installation – The Smart Valve is externally adjustable. Once installed it can be quickly and easily adjusted without ever needing to turn off the water or remove the device. Saves time, money and avoids future interruption of water delivery. Adjustable – The Smart Valve now has a wide range of effect settings – from ‘zero effect’ to ‘maximum effect’ and all points in between. The valve is delivered and installed at or near the ‘zero’ setting, where it has little or no effect. Once the water is turned back on, the valve is adjusted to the perfect setting for the system. Adaptable – In the future, if the system pressure or flow rate changes up or down the Smart Valve can be quickly and easily adjusted to maintain maximum savings without the need to interrupt service. Greater Flow Rates – Other flow management valves are often designed to slide inside the pipe in flanged versions, or are male threaded pipe sizes, resulting in reduced interior diameter within the existing pipe, and lowered maximum flow rate. The 2nd Generation Smart Valve is either double flanged (3-inch and larger) or female threaded (2-inch and smaller). Allowing for a much larger interior diameter and no loss in flow capacity. Highly Visible – The Smart Valve is installed on the outside of the water line, ensuring facility personnel and plumbers can easily find and adjust it if necessary. Other flow management valves are installed inside the water pipe, making it difficult to locate if

needed. Smart Valve is designed with high-quality materials and precision manufacturing and is covered. The Smart Valve has all the same benefits as the Generation, PLUS: Greater Flow Capacity – The Smart Valve has nearly three time the capacity of any previous design! More Adjustable – The Smart Valve now has an even wider range of effect settings to ensure that we can find the PERFECT setting for every system. Ease of Calibration – Whereas the requires a little muscle to adjust it, the Smart Valve can be calibrated with the strength of a fingertip.A new, innovative, all-electric, flow control valve (FCV) is now a reality for smart completions. This can support any well penetration scenario including multiple zones per lateral in maximum reservoir contact wells and multitrip completion in extended-reach wells. Each zone is equipped with a permanent intelligent flow control valve, allowing real-time reservoir management and providing high-resolution reservoir control. Valve actuation is semi-instantaneous and field data has shown that the frequency of updating such valves is at least 50 times compared to conventional valves, enabling near continuous closed-loop reservoir management. However, such a high-frequency optimization demands computational efficiency as it challenges existing optimization applications, particularly when multiple realizations are considered to account for reservoir uncertainty. we present a framework to support fieldwide implementation of smart FCVs and hence maintaining a fast closed-loop reservoir management. The framework consists of history matching using Ensemble Kalman Filters (EnKF), where smart FCV data is assimilated to condition a suite of representative reservoir models at a relatively high frequency. Thereafter, a reactive optimizer utilizing a nonlinear programming method is applied with the objectives of maximizing instantaneous revenue by determining the optimal positions of the downhole valves under user defined rate, pressure drop, drawdown, and setting constraints. This optimization offers production control planning suggestions with the intent of immediate to short-term gain in oil production based upon the downhole measurement and the performance of the near wellbore model. At the same time, a proactive optimizer can be used to determine valve-control settings for longer-term objectives, such as delaying water/gas breakthrough. The objective of this optimization is equalization of the water/gas front arrival times based upon generation of streamlines and time-of-flight (TOF) analysis. Both modes of optimization are performed efficiently, such that a single optimization run is sufficient per geological realization. We use the olympus reference model, a water flooding case, to demonstrate the workflow.

2.3 Summary

Smart flow control is a technology that can refer to a variety of systems, including:

Autonomous actuators: These actuators combine valve capabilities with flow, pressure, and temperature measurements. They are suitable for advanced, autonomous operating factories and can be used in both greenfield and brownfield projects.

Microreactor flow rate: Smart flow control can help achieve a precise flow rate in a microreactor, which can lead to high reaction efficiency.

Micromixer distribution: Smart fluid control can help improve the precise distribution of every constituent in a micromixer.

Fish handling system: Smart Flow connects Vaki Smart Pumps, Graders, and Counters to provide a full overview and control of the fish handling system.

Roof drainage outlet: Smart Flow Control (SFC) is a system that must be sealed over a roof drainage outlet. A qualified electrician must carry out the electrical connection and testing of the device.

Water metering: smart flow monitoring is a system that helps users manage what they measure.

Wind tunnel drag reduction: NASA and others have investigated the drag reduction of riblets with different cross sections as part of their smart flow control research. Flow control is a method used in computer networks and telecommunications to regulate the rate of data transmission between devices.

Chapter 3

Theoretical model

3.1 Introduction

Control valve also called final control element are a most important element in the last device in control loop. Valve sizing and selection are crucial for optimal performance. Considerations include understanding application requirements, evaluating valve functionality and type, calculating flow rates and pressure drops, considering valve Cv or Kv values, accounting for material compatibility, factoring in valve actuation and control, and ensuring compliance with industry standards. A control valve is a variable orifice used to regulated the flow of a process fluid in accordance with requirement of process.

3.2 Futures of control valves

There are four futures of control valves:

Capacity

Rangeability

Characteristics

Pressure drop

Capacity: The capacity is normally measured as flow co-efficient, Cv which is defiend as: “The number of US gallons per minute of water at 60°F that will flow through a valves with 1psi pressure drop.

Rangeability: Rangeability of a control valve is the ratio of the maximum to the minimum controller flow.

Characteristics: The relationship between control valve capacity and valve stem travel is known as the flow characteristic of the control valve.

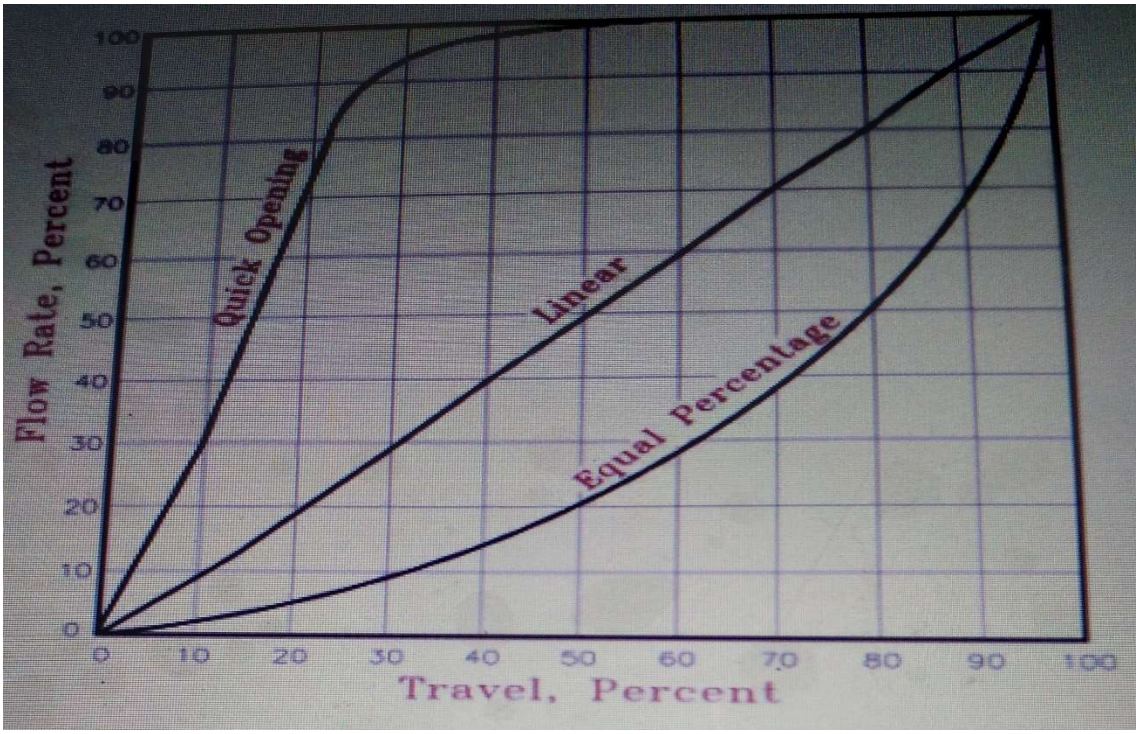


Figure: 3.1 Inherent flow Characteristics

The curve shown are based on constant pressure drop across the valve and called **Inherent flow Characteristics.**

3.3 Quick opening characteristic

Provides large characteristic in flow for very small changes in lift or in which a maximum Cv is achived with minimal closure member travel. It has high valve gain .

Large increase in flow with a small change in valve stroke.

Quick opening valve are usually specified for “ON-OFF” service such as sequential operation in either batch or semi continuous process and in Pneumatic actuated control valve. When maximum valve capacity must be obtain quickly.

Cage- A part of a valve that surrounding the closure member and can provide quick opening flow characterization.



Figure: 3.2 A part of a valve that surrounding the closure member and can provide quick opening flow characterization

3.4 Compares of valves

Table 3.1 Compares of valves

Smart control valve	**Riser flow valve**	**Surge tank flow valve**
Smart phone control	Manually control	Manually control
Very more expensive	Less expensive	More Less expensive
Time less control	More time control	Very more time control
Pneumatic actuation	Manually rotation	Manually connection & disconnection to pipe
Less distance of control	No less distance	No Less distance

3.5 Block Diagram

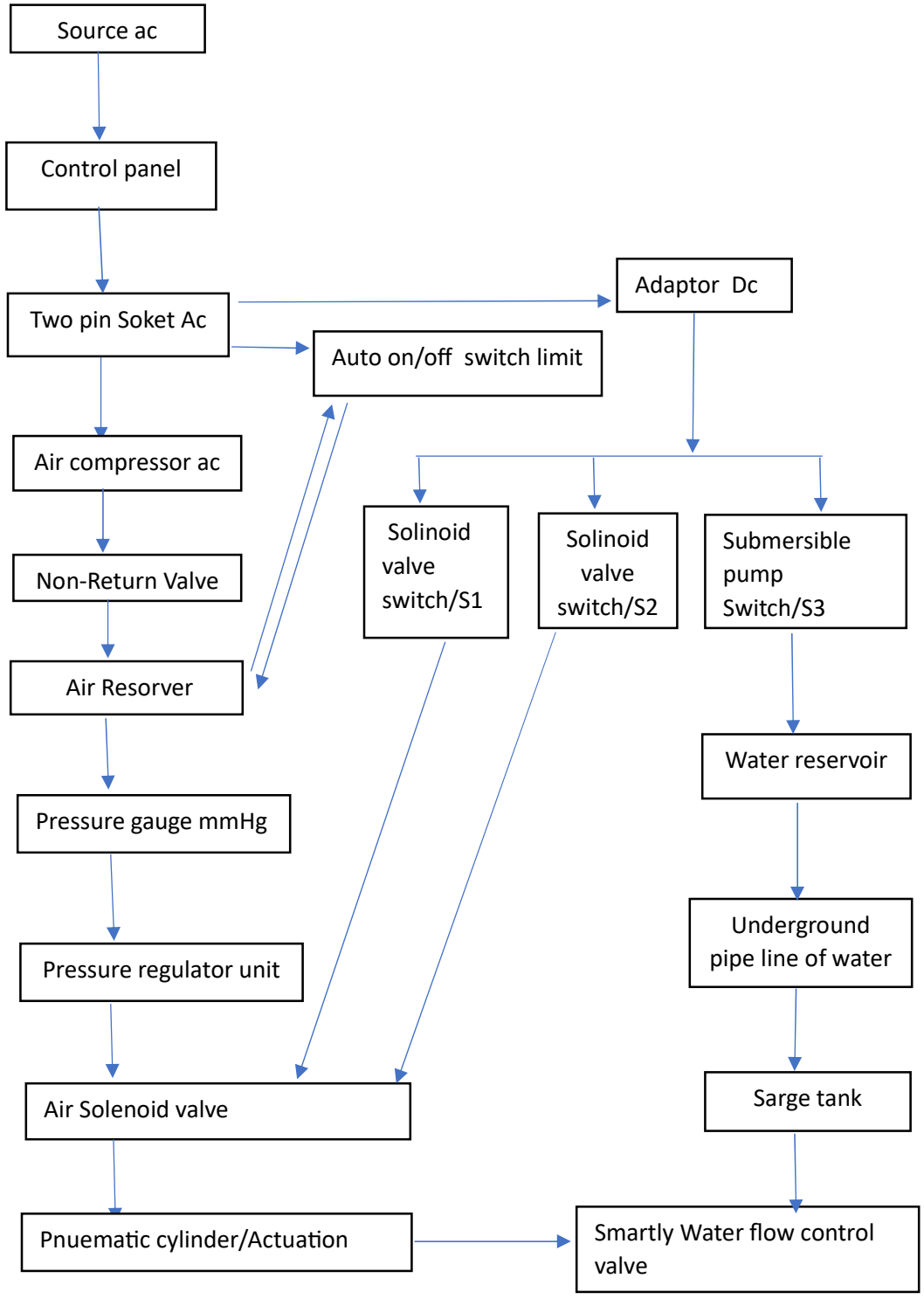


Figure: 3.3 Block diagram of smart design and fabrication fluids flow control valves

3.6 Circuit Diagram

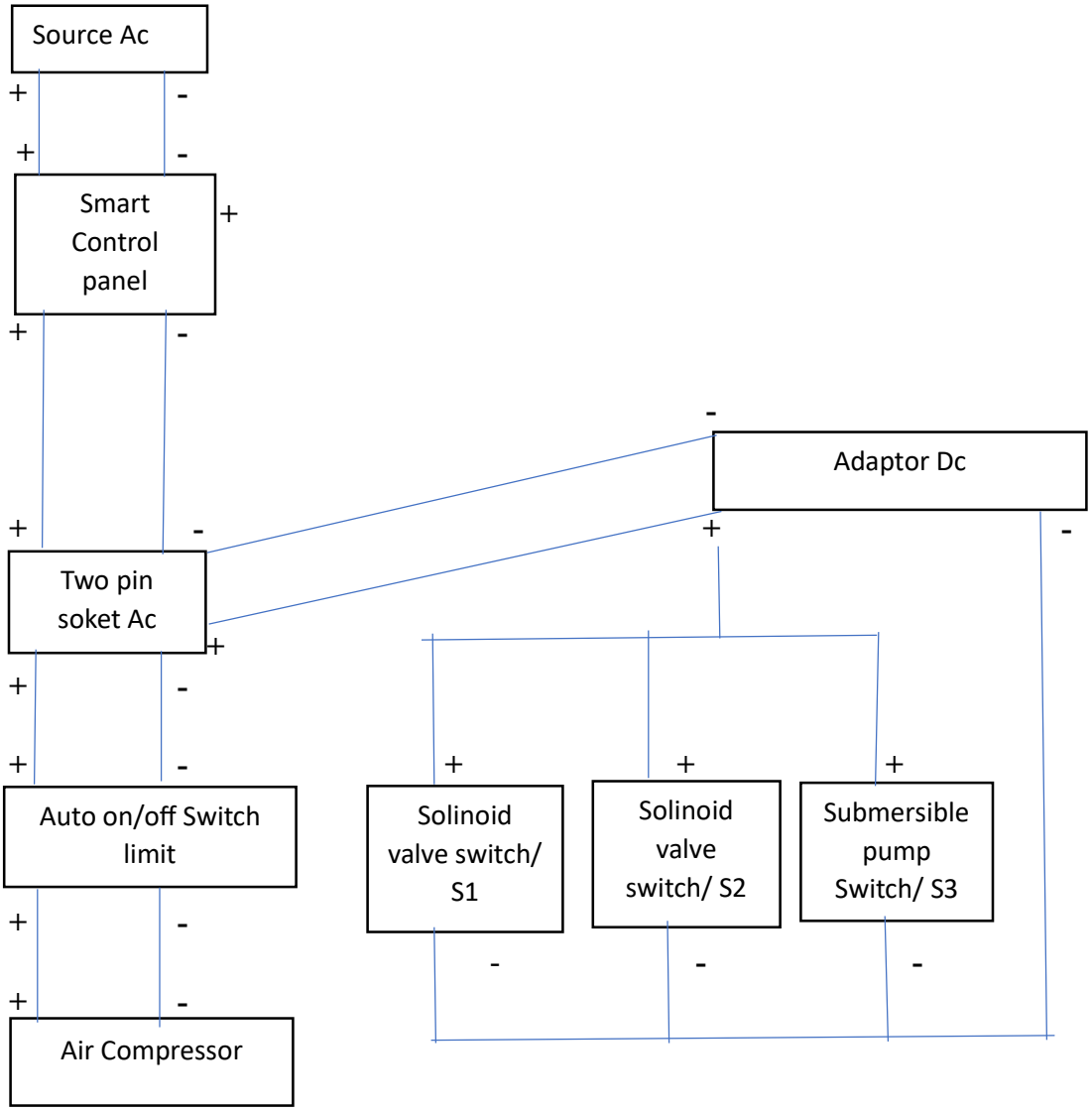


Figure: 3.4 Circuit Diagram of smart design and fabrication fluids flow control valves

3.7 Working principle

It absorbs the proper amount of pressure drop to maintain system balance under all operating.

3.8 Complete Project image

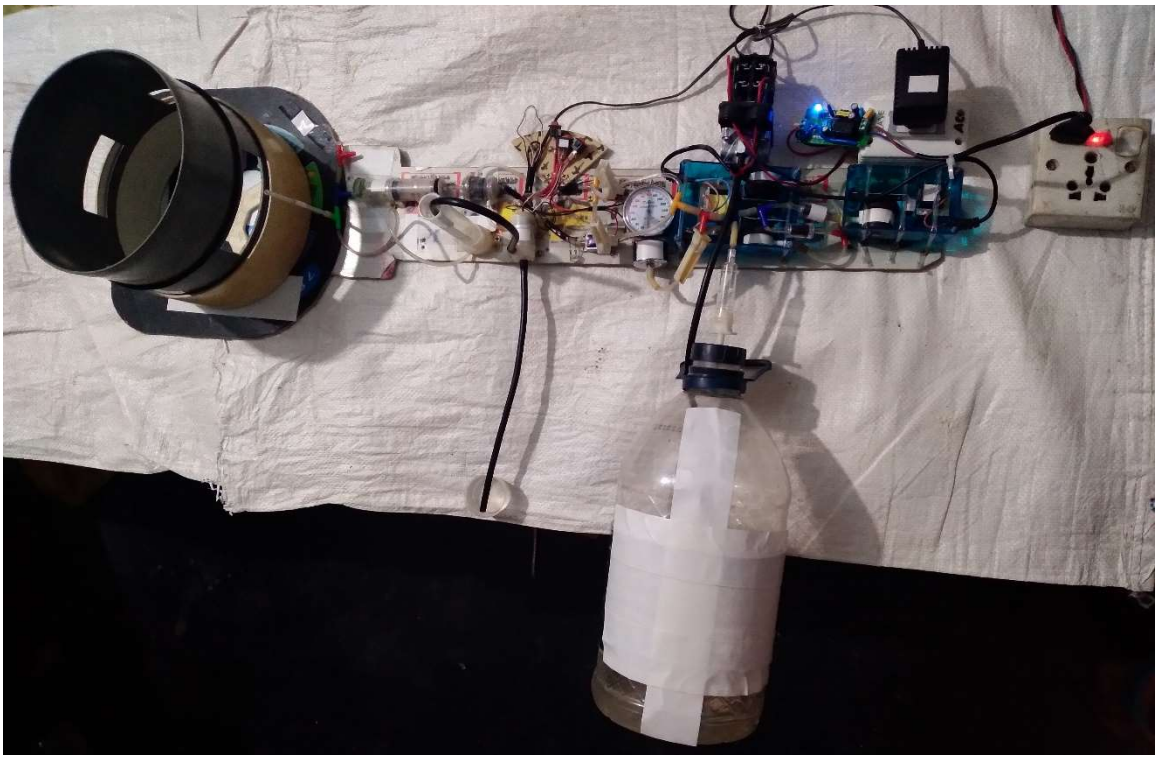


Figure: 3.5 Complete Project image

3.9 Component list

3.9.1 Smart Control panel



Figure: 3.6 Smart Control panel

Smart Control Panel Design makes electrical engineering intelligent, digital and consistent. At the push of a button, your control panel's branch circuits can be automatically sized with the correct components for the application - in compliance with both IEC and UL/NFPA standards.

3.9.2 Rubber ‘O’ ring



Figure: 3.7 Rubber ‘O’ Ring

Seals are one of Betech's core areas of expertise, and we dare to say that whatever your needs, we can find a seal that will do the job - whether it's static or dynamic.The popular O-ring is both the easiest and most versatile rubber seal - used either alone or in conjunction with other types of seals. Static and dynamic seals. We used seals in many types, materials and dimensions. In addition to standard types, Betech offers individually designed seals with special installation dimensions, as well as spring-activated special seals and other specialized solutions for demanding applications:

O-rings, D-rings and X-rings

Clamp gaskets

Bonded Seals

Oil seals and V-rings

Activated PTFE seals

Braided gaskets and mechanical shaft seals

Hydraulic and pneumatic seals

3.9.3 Pneumatic cylinder



Figure: 3.8 Pneumatic cylinder

Pneumatic cylinder, also known as air cylinder, is a mechanical device which uses the power of compressed gas to produce a force in a reciprocating linear motion.[1]:85 Like in a hydraulic cylinder, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved.[1] :85 Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage.Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics are used to prevent fluid from dripping onto people below the puppets.

1millilitter=1cubic centimeter

Pneumatic Cylinder Stock length=1millilitter

So Every time valve on/off when drop pressure=1cubic centimeter

3.9.4 Pneumatic solenoid valve

Solenoid valves are electromechanical valves that control the flow of fluids by using an electromagnetic coil to open or close a valve orifice: How it works A small electrical current passes through a coil, creating a magnetic field. The magnetic field moves a plunger, which opens or closes the valve The valve can be controlled by an electrical switch or a control board

Energized: When an electric current passes through the solenoid's coil, it generates a magnetic field that pulls a plunger or armature against a spring. This movement opens the valve orifice, allowing fluid to flow.

De-energized: When the current is cut off, the magnetic field collapses and the spring returns the plunger to its original position, closing the valve orifice. Solenoid valves are used in a variety of industries and applications, including water treatment, food processing, and automotive. They have several advantages, including: Versatility Pneumatic solenoid valves are electromechanical devices that control the flow of air or process gas. They are mostly used for controlling pneumatic actuators such as cylinders, turbines (pneumatic motors), diaphragms, and tubes. Advantages Fast and responsive, Low energy use, Cost-effective to maintain, and Can operate in extreme temperatures. Disadvantages Sensitive to voltage fluctuations, Require a continuous supply of electricity, May only last a few years, and Not designed for high-pressure applications. Actuating tools and cylinder, Controlling pneumatic actuators such as turbines and diaphragms, Regulating the flow of compressed air in industrial, commercial, and automotive contexts, Efficient flow control, Low cost, wiring, and effort, Can be controlled remotely and automatically. Direct-acting valves require no differential pressure to remain in their rest state and in the NC version, they will only allow flow once energized. These valves are very robust and can be used in a process line for simple isolation purposes of for safety purposes. The can also be used on the outlet to a tank where sometimes pressure can get very low but the valve needs to remain open.



Figure: 3.9 New condition

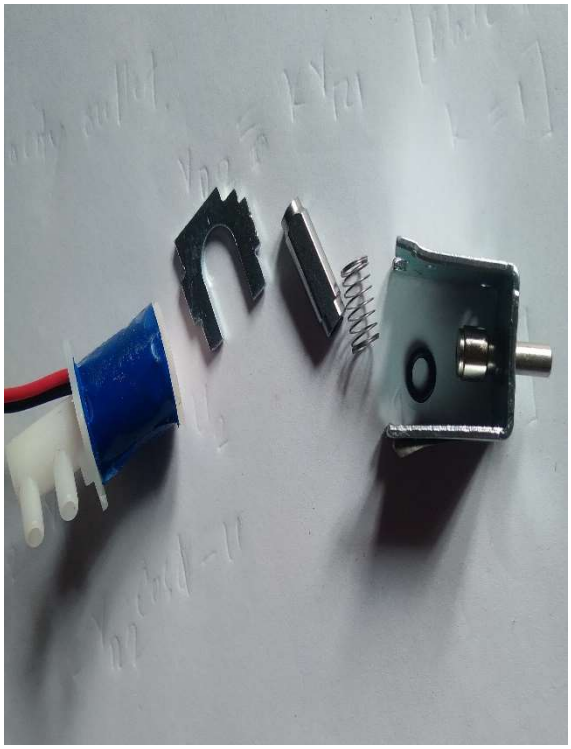


Figure: 3.10 In side condition

3.9.5 Auto air compressor switch

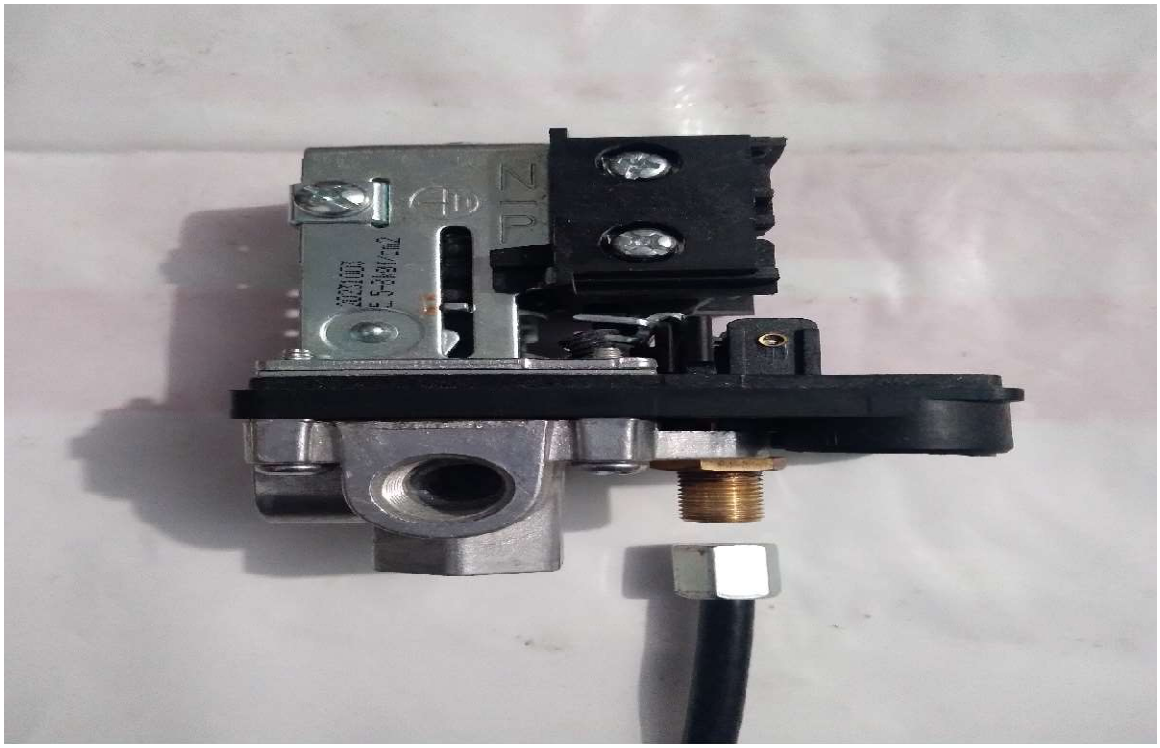


Figure: 3.11 Auto air compressor switch

There is great switch for mini active air compressor. It can help to save electricity energy of the air compressor. Easy to install and convenient to use.

There is a on/off switch knob; Auto control, auto load/unload.

Maximum pressure: 90-120PSI.

Current: 16A

Maximum Voltage:240v

3.9.6 Air compressor

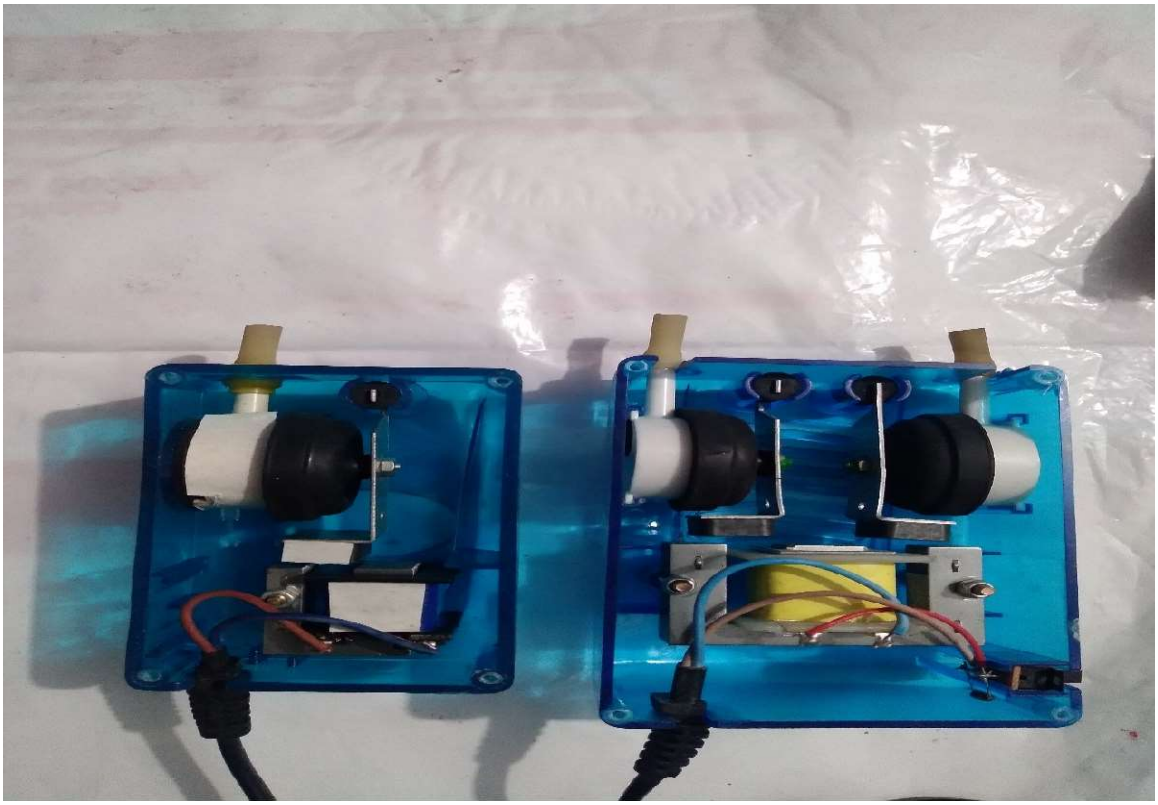


Figure: 3.12 Air compressor

An air compressor is a machine that converts mechanical power into compressed air, which is then used for many purposes:

How it works: An air compressor takes in air from the environment and increases its pressure by reducing its volume. The compressor uses power from an mini transformer or electric motor, diesel engine, or gasoline engine to create the compressed air. The compressed air is then stored in a tank until it's needed.

Uses: Air compressors are used in many industries, including manufacturing, construction, automotive, and HVAC. They power tools and equipment that require high-pressure air, such as pneumatic tools, cutting and welding equipment, and nail guns. They're also used for cleaning, drying, and material handling.

Flow Rate:	480L/hr+240L/hr
Suitable water Volume:	150-300 Litter (40-80 Gallon)+
	75-300 Litter (20-40 Gallon).
Max Output:	2*4.0 L/minute+1*2.0 L/minute
Flow Control :	Yes (high and Low Switch).

Voltage:	AC220-240V.
Frequency:	50/60Hz.
Power:	5W+3W

3.9.7 Pnuematic non-return valve



Figure: 3.13 Pnuematic non-return valve

A check valve, non-return valve, reflux valve, retention valve, foot valve, or one-way valve is a valve that normally allows fluid (liquid or gas) to flow through it in only one direction.[1]

3.9.8 Air reservoir



Figure: 3.14 air reservoir

An air reservoir, also known as a compressed air tank or air receiver, is a temporary storage tank that stores compressed air to meet peak demands. Air reservoirs are an essential part of any compressed air system and help to:

Buffer pressure fluctuations: Air reservoirs act as a buffer between the compressor and the pressure fluctuations caused by changing demand.

Dampen pulsations: Air reservoirs can help to dampen pulsations from discharge lines, resulting in steadier pressure. Reduce energy usage: Air reservoirs can help to reduce energy usage.

Improve productivity: Air reservoirs can help to improve workplace productivity. Save costs: Air reservoirs can help to save significant costs.

Extend compressor lifespan: Air reservoirs can help to extend the lifespan of your compressor by reducing excessive cycling. Air reservoirs work by storing air from a flow valve until it is released at a pre-determined point. The size of the air reservoir should be typically 6 to 10 times the flow rate of the compressed air system.

3.9.9 Pressure gauge



Figure: 3.15 Pressure gauge

1 millimeter of mercury=133.322 Pascals

760 mmHg=101325 Pascals

760 mmHg=1 Standard atmosphere

Project working pressure=161mmHg*133.322=21464.842 Pascals

=21465 Pascals

=0.0214649013 MPa

1 pascal=1 Newton/ Square meter

=1 kg/m.s2

1pound per square inch=6894.75729 Pascals

3.9.10 Smart control switch

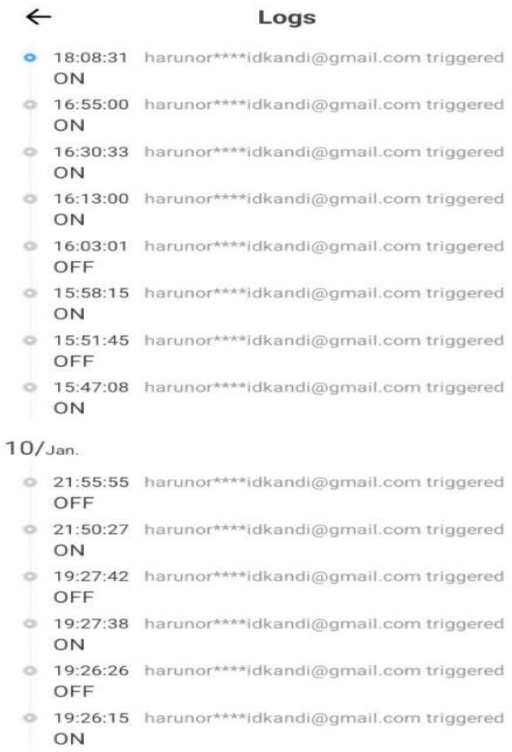


Figure:3.16 screenshot on-off logs

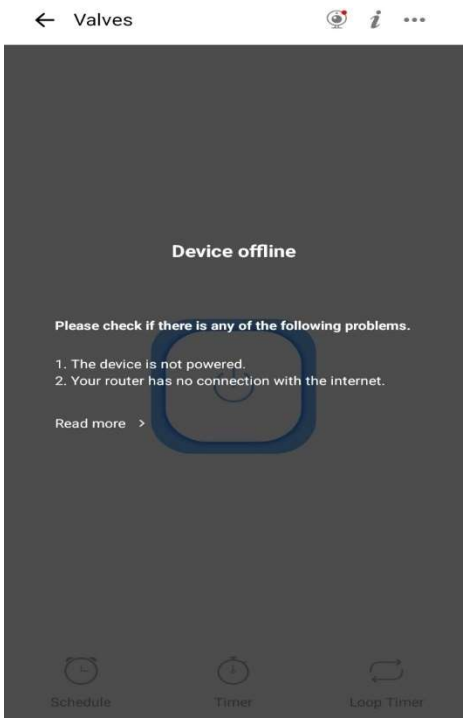


Figure:3.17 Internet symbol

Smart systems are systems (usually computer systems or electronic system) which are able to incorporate and perform functions of internet, actuation, and control in order to analyze a situation, based on acquired data and perform decisions in a predictive or adaptive manner, thereby performing smart actions. In most cases the Intelligence/"smartness" of the system can be attributed to autonomous operation based on closed loop control, resource management, and networking capabilities.

3.9.10 ‘T’ joint



Figure: 3.18 ‘T’ joint

PVC tee fittings are manufactured from polyvinyl chloride (PVC) and are designed to fit over insulated pipe fittings as an added layer of protection. PVC is an impact resistant and durable material that can be used for both indoor, outdoor and underground applications.

3.9.11 surge tank



Figure: 3.19 project T joint



Figure: 3.20 Irrigation use T joint

A surge tank is a storage reservoir or standpipe that absorbs pressure spikes and provides extra water when pressure drops. They are used in a variety of systems, including hydropower plants, oil and pumping systems, and water transmission lines.

Here are some of the functions of surge tanks: Pressure regulation: Surge tanks help regulate fluid levels and pressure in systems. They can also reduce the amplitude of pressure fluctuations.

Water storage: Surge tanks can store water and provide it when needed.

Protection: Surge tanks can protect systems from changes in temperature, concentration, and pressure.

Maintenance: Surge tanks allow one unit to be shut down for maintenance without shutting down the entire plant.

Temperature control: Surge tanks can allow for rapid changes in fluid temperature.

Surge tanks are often located near the powerhouse or at the point where steep and flat sections of a conveyance system meet. They can be placed underground or above ground, depending on the system they are connected to.

3.9.12 Water reservoir

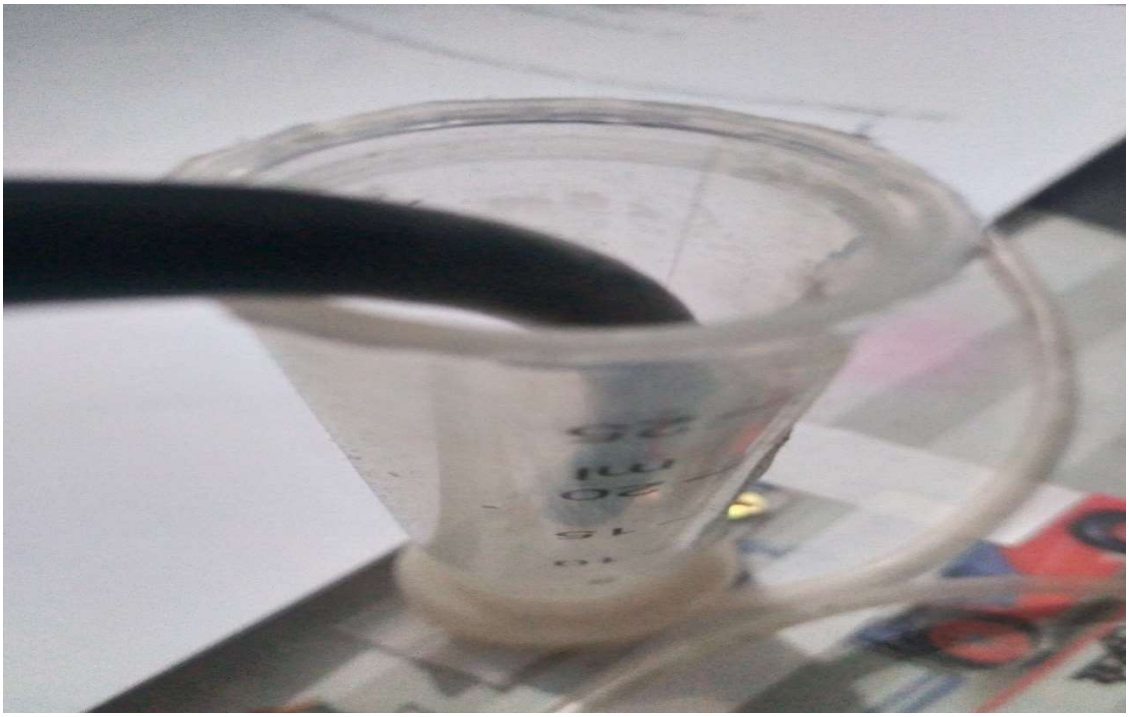


Figure: 3.21 Water reservoir

A water reservoir is a large body of water that stores water for later use. Reservoirs can be man-made or natural, and they are used for a variety of purposes, including:

Flood risk management: Reservoirs collect water during heavy rainfall and slowly release it over time to reduce the risk of flooding.

Water conservation: Reservoirs can provide water to spreading grounds, where surface water can soak into the ground and recharge aquifers.

Water supply: Reservoirs provide a continuous supply of water for drinking, irrigation, and industry.

Aquatic environment: Reservoirs can create an aquatic environment.

Water quality: Reservoirs can change the properties of water. Reservoirs can be created by building a dam across a river or valley, or by using natural depressions. The main parameters of a reservoir are its volume, the area it inundates, and the range of water level fluctuations. Reservoirs have been used since around 3000 BCE, when farmers in Arabia used the craters of extinct volcanoes for irrigation.

3.9.13 Submersible pump

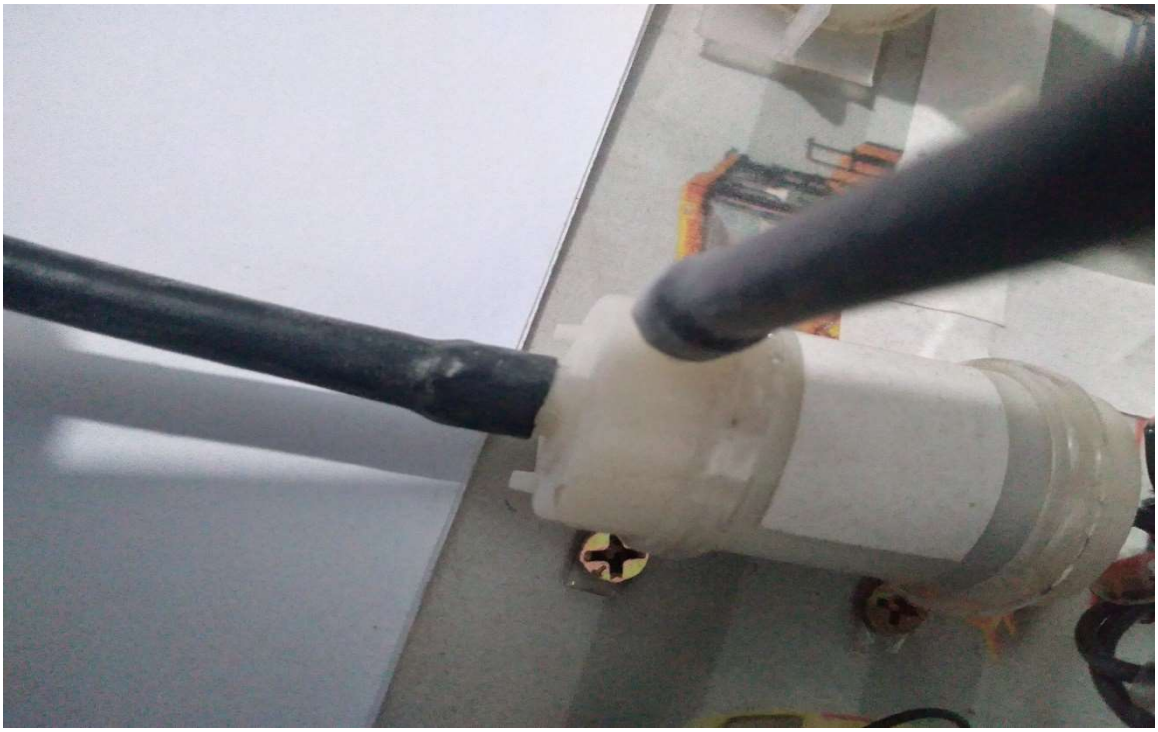


Figure: 3.22 Submersible pump

The components of a submersible pump are a head assembly of main switch and starter, motor and turbine pump, waterproof electric wire to supply power to the submersible motor, and a discharge pipe. The motor is fitted below the pump. The pump consists of either a single-stage or multistage turbine pump depending on the required head. For pumping groundwater, closed impeller is used. Vertical motors of small diameter are used so that they may easily be inserted inside the well pipe. Both oil- and water-lubricated motors are used. Oil-lubricated motors are also known as dry motors which are properly sealed to prevent the entry of water. High dielectric oil under pressure is used to run the motor. The oil fills the cavity inside the motor, submerging the windings, bearings, and rotor. The oil is externally cooled by the flow of water around the motor. Water-cooled motors are also known as wet motors in which the rotor and the bearings operate in the water. The windings of the starter are completely sealed off from the rotor by means of a thin, stainless steel inner liner. To prevent the entry of abrasive material into the motor a filter is provided around the shaft. During installation, water must be filled so that the bearings get sufficient lubrication when the motor is first started. The casing pipe of the well is covered by constructing a small cement concrete structure on the ground level. The starter, main switch, and the meter are placed inside a small enclosure. One delivery pipe assembly used for connecting the pump with

the bottommost pipe is used to connect the head with the topmost pipe. The concrete structure is also used to support the head assembly. The motor pump assembly should always remain inside the water even when the pump runs and drawdown takes place. Accordingly, the length of the casing pipe should be selected and the pump assembly should be lowered inside it. Since motor and pump are placed inside the casing pipe, no pump house needs to be constructed. As stated earlier, the control panel comprising the switch, meter, starter, and oil well safety control in the case of oil-lubricated motor is enclosed in a waterproof box.

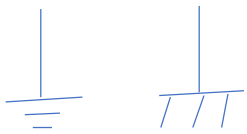
3.9.14 Ac or dc source



Figure: 3.23 Ac or dc source

P	L	N
Phase symbol	**Live or Hot symbol**	**Neutral symbol**

+	-
Positive symbol	**Negative symbol**



Grounding or Earthing symbol

In this article, we are going to see power and polarity-related symbols. In electrical engineering, there are so many important symbols and diagrams. So having a background in electrical engineering and to make a strong knowledge base we must know these symbols and diagrams. In this blog, we have published so many articles based on electrical and electronic symbols. So, you must go to the symbol section and read these articles. In this article, also we will see some important symbols.

Phase Symbol

In the alternating current or AC power system, phase is considered as a higher potential. Although there is no fixed higher potential and no fixed lower potential in the AC system as their polarity changes with time. As the neutral is connected to the ground, in general, its polarity is zero until it makes a closed circuit with the phase or live. But the phase is not connected to the ground, which is why the phase always has a higher potential in normal conditions. The phase is also known as Live or Line or Hot.

P

Line or live Symbol

Although phase is also known as live or line. It has a different symbol. It is denoted by L.

Neutral Symbol

In a three-phase three-wire or delta system, there is no existence of neutral. But in a three-phase star connection system, one terminal of each phase is connected together and also connected to the ground. This common point is brought out as a neutral terminal. In fact, in a single-phase system, there is one phase and one neutral. The potential of neutral is zero. It is denoted by N.

Positive symbol

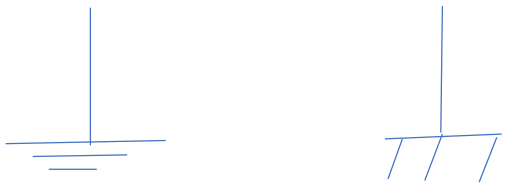
In the DC circuit, the higher potential is denoted by the Positive symbol. The positive symbol can be denoted by a simple "+" sign or by drawing a circuit around the "+" sign.

Negative symbol

In the DC circuit, the lower potential is denoted by the negative symbol. The positive symbol can be denoted by a simple "-" sign or by drawing a circuit around the "-" sign.

Grounding or Earthing symbol

connecting of non-current-carrying part of any electrical system, devices, equipment, or the neutral point to the earth or ground is called earthing or grounding. These same symbols are used in both



3.19.16 Digital clamp meter



Figure: 3.24 Digital clamp meter

A digital clamp meter is a tool that measures current, voltage, resistance, and sometimes frequency in an electrical system without interrupting the circuit or needing to make direct contact. It's also known as a clamp-on ammeter or tong tester.

Here's how a digital clamp meter works: Clamping: The clamp's hinged jaws are used to securely clamp around a wire, cable, or conductor.

Magnetic field detection: The clamp's hard jaws are made of ferrite iron and detect the magnetic field created by the current flowing through the conductor.

Voltage production: A hall effect sensor within the clamp detects the magnetic field and produces a small voltage.

Current measurement: The output voltage is amplified and measured to determine the current. There are three types of clamp meters: Current transformer (ac) clamp meters, Hall Effect (ac and dc) clamp meters, and Flexible (ac) clamp meters

3.10.17 Voltage alert:



Figure: 3.25 Voltage alert

A voltage alert tester, also known as a voltage detector, is a handheld device that detects the presence of electrical voltage in a circuit or piece of equipment. It's an essential tool for electricians, as it helps prevent accidents and makes electrical diagnostics more efficient.

Here's how a voltage alert tester works:

Senses an electric field: The tester's sensor senses the electric field created by the voltage.

Induces a voltage: When the sensor is near a live conductor, the electric field induces a voltage in the tester.

Alerts the user: The tester alerts the user with an audible or visual indicator, such as a beep or light.

3.10.18 Instrument cost analysis

Table 3.2 cost analysis

Serial No	**components**	**Price**
1	Control panale	3090
2	Air compressor	2580
3	Auto on/off limit switch	2850
4	Solinoid valve	3260
5	Submersible pump	2550
6	Adaptor	1100
7	Other	2600
	Total =	**18030 Taka only**

Chapter 4

Results and Discussion

Table: 4.1 Results and Discussion

Air compressor	Flow Rate: 480L/hr+240L/hr Suitable water Volume: 150-300 Litter (40-80 Gallon)+ 75-300 Litter (20-40 Gallon). Max Output: 2*4.0 L/minute+1*2.0 L/minute Flow Control : Yes (high and Low Switch). Voltage: AC220-240V. Frequency: 50/60Hz. Power: 5W+3W
Submersible pump	Flow rate: 80-120 Litter Outlet Inside Diameter: 5mm Maximum lift : 40-110mm Operating Voltage: 2.5-6V Operating current: 130-220mA
Pressure gauge	1 millimeter of mercury=133.322 Pascals 760 mmHg=101325 Pascals 760 mmHg=1 Standard atmosphere **Project working pressure=**161mmHg*133.322=21464.842 Pascals =21465 Pascals =0.0214649013 MPa 1 pascal=1 Newton/ Square meter =1 kg/m.s2 1pound per square inch=6894.75729 Pascals

4.1 Inttoduction

Flow control valves are mechanical components that help regulate the flow rate of fluids within a system. These valves are often used in hydraulic and pneumatic systems and fluid pipelines, allowing operators to control the rate at which fluid flows through the pipeline or system. There are several flow control valves, each with a unique working mechanism and application. In this article, we examine the advantages and disadvantages of flow control valves to help operators make informed decisions when choosing the right valve for their system.A Flow Control Valve is a device used to regulate the flow of a liquid or gas in a system. It works by varying the size of the passage through which fluid can flow, thus regulating its speed and pressure. In short, they are essential components for controlling the flow in many modern industrial systems.

4.2 Results analysis

Pressure gauge

1millilitter=1cubic centimeter

Pneumatic Cylinder Stock length=1millilitter

So, Every time valve on/off when drop pressure=1cubic centimeter

AIR COMPRESSOR

Flow Rate: 480L/hr+240L/hr

Suitable water Volume: 150-300 Litter (40-80 Gallon)+

75-300 Litter (20-40 Gallon).

Max Output: 2*4.0 L/minute+1*2.0 L/minute

Flow Control: Yes (high and Low Switch).

Submersible pump

Flow rate: 80-120 Litter; Outlet Inside Diameter: 5mm; Maximum lift : 40-110mm

Operating Voltage: 2.5-6V; Operating current:130-220mA

4.3 Advantage

Control valves are crucial for regulating fluid flow and maintaining process parameters. Recent advancements have led to the development of smart valves, integrating electronics for enhanced functionality. These valves offer precise control, remote monitoring capabilities, and seamless integration with control systems, leading to improved performance, efficiency, and automation. The future of flow control lies in smart valves incorporating integrated electronics. These advanced valves enable real-time monitoring, automated adjustments, and seamless integration with control systems. With enhanced functionality, flexibility, and diagnostics, smart valves offer improved efficiency, reduced downtime, and increased process reliability.

Precise Flow Management: One of the primary benefits of flow control valves is their ability to regulate fluid flow accurately. This feature is especially crucial in systems where fluid flow needs to be strictly controlled. Flow control valves provide a reliable and robust mechanism for maintaining constant flow rates and ensure no fluctuations compromise the system's performance.

Reduced Operating Costs: Flow control valves help improve system efficiency and reduce operating costs by eliminating the need for manual operation. Automated flow control valves can be programmed to regulate flow rates automatically, freeing up operator time and reducing the risk of human error. This feature helps to optimize production processes, reduce downtime, and increase productivity.

Control Over Pressure: Flow control valves can help regulate the pressure within a system by controlling the flow rate of the fluid. By regulating the pressure, flow control valves can prevent pressure build-up that can cause damage to the system or even cause mechanical failure.

Versatile Applications: Flow control valves can be used in various applications, including hydraulic and pneumatic systems, water treatment plants, chemical processing plants, and oil and gas pipelines. These valves can handle high flow rates, temperatures, and pressures, making them suitable for nearly every industry.

Efficient Energy Utilization: By controlling the fluid flow rate, flow control valves help improve energy efficiency by reducing energy waste. This feature is particularly crucial in processes requiring high precision and accuracy to minimize energy consumption

4.4 Limitation

Limited Flow Range: Flow control valves are unsuitable for situations requiring large variations in flow rates. These valves are designed to regulate flow rates within a narrow range and may be ineffective if the fluid flow rate varies widely.

Susceptible to Fouling and Corrosion: Flow control valves are susceptible to fouling and corrosion, which can reduce their efficacy over time. Deposits from the fluid can cause blockages, while corrosion from chemically aggressive fluids can degrade the valve mechanisms, reducing the valve's lifespan.

Complex Maintenance: The maintenance of flow control valves can be complex and expensive. These valves sometimes require specialist maintenance or replacement of specific components, which can be time-consuming and require skilled personnel.

Cost: Flow control valves can be expensive, especially if they are required for specialized applications. The cost may deter some operators, particularly small-scale operators, who may need more financial resources to acquire the equipment.

Installation and Configuration: Flow control valves require careful installation and configuration to work effectively. These valves must be positioned and calibrated correctly, following the manufacturer's instructions, to ensure optimal performance. Noise, erosion, and installation and operating costs all limit the maximum and minimum velocities in piping systems. If piping sizes are too small, noise levels, erosion levels, and pumping costs can be unfavorable. If piping sizes are too large, installation costs are excessive. Therefore, pipe sizes are chosen to minimize initial cost while avoiding the undesirable effects of high velocities. Various upper limits of water velocity and/or pressure drop in piping and piping systems are used. These limitations are imposed either to control the levels of pipe and valve noise, erosion, and water hammer pressure or for economic reasons. Type of flow Turbulent flow: Can cause increased frictional losses, higher pressure drops, and increased erosion and corrosion. This can make pumps and pipelines less efficient and increase energy consumption. Laminar flow: Has lower frictional losses than turbulent flow. Pipe size small pipe sizes: Can cause noise, erosion, and high pumping costs. Large pipe sizes: Can cause high installation costs. Fluid properties Viscosity, density, and temperature: Can affect the accuracy of measurements taken with flow meters. Flow profile disturbances: Can occur when fluid encounters obstacles like valves, pipe elbows, or fittings. This can lead to uneven flow patterns and inaccurate measurements. Other limitations Installation constraints: Can make it difficult to install flow meters properly, which can lead to inaccurate measurements. Pressure and temperature restrictions: Can lead to physical damage or inaccurate measurements if exceeded.

4.5 Application

Fluid flow control valves are used in many industries, applications, and settings, including:

Agricultural equipment: Deliver water and fertilizers precisely

Oil and gas: Control fluid movement in pipelines and refineries

HVAC systems: Control airflow and temperature in heating and cooling systems

Chemical processing: Manage the flow of chemicals in manufacturing

Industrial automation: Ensure precise control in machinery and processes

Water treatment: Regulate flow and prevent contamination in wastewater treatment processes

Power plants: Control the flow of steam and other fluids to maintain safe and efficient operations

Food and beverage: Control flow during processing and packaging operations

Automotive and aerospace: Control fuel and hydraulic fluid flow.

Water supply systems: Regulate water flow in homes and municipalities

Fluid flow control valves regulate the flow rate or pressure of a fluid by adjusting the size of the valve opening. The opening can be adjusted manually or electronically.

4.6 Discussion

1millilitter=1cubic centimeter

Pneumatic Cylinder Stock length=1millilitter

So, Every time valve on/off when drop pressure=1cubic centimeter

Materials and Construction: Key Considerations in Valve Design: Valve designers must carefully select materials considering factors such as corrosion resistance, temperature limitations, pressure ratings, fluid compatibility, mechanical strength, and the feasibility of the manufacturing process. Different valve components may require different materials, and adherence to industry standards is crucial.

Valve Standards and Compliance: Meeting Industry Requirements: Valve design must adhere to industry standards and regulations set by organizations like API, ISO, and MSS. Compliance ensures consistency, interoperability, safety, and quality assurance in valve construction and performance.

Maintenance, Testing, and Performance Evaluation: Extending Lifespan and Ensuring Reliability: Proper maintenance is essential to extend valve lifespan, with routine activities including inspection, lubrication, testing, and repair. Thorough testing, including flow, leakage, and pressure tests, ensures reliable valve operation and compliance with specifications.

Future Trends and Innovations in Valve Design: What to Expect: Looking ahead, advancements in materials and coatings, integration of smart technologies, energy-efficient valve solutions, enhanced control and automation, compact and space-efficient designs, and a focus on environmental sustainability are shaping the future of valve design. Manufacturers, engineers, and end-users must stay informed to embrace these trends and opportunities.

Chapter 5

Conclusion and Recommendation

5.1 Conclusion

Flow control valves offer several benefits that make them essential in pipelines and hydraulic and pneumatic systems. Their ability to regulate fluid flow accurately, control pressure, and improve energy efficiency can help operators optimize their processes and reduce operating costs. These valves have many applications and can handle high flow rates, temperatures, and pressures. However, operators must consider the limitations of these valves, including the cost, narrow flow range, and susceptibility to fouling and corrosion. Proper and timely maintenance and correct installation and configuration are essential for achieving optimal performance from flow control valves.

Designed a smart system capable of controlling the water automatically. This project is of low cost and the efficiency of the project is more compared to the previous methods. Using this project, automatic controlling and monitoring the flow of water is done. Thus, required amount of water is discharged. Same methodology can be implemented in case of any fluids in the industries. The disadvantage of the previous systems, that required manpower was eliminated. This real time project represents a solution for easy and automated management of water which helps in preventin wastage of water.

5.2 Future Works

The Future of Flow Control: Smart Valves: The future of flow control lies in smart valves incorporating integrated electronics. These advanced valves enable real-time monitoring, automated adjustments, and seamless integration with control systems. With enhanced functionality, flexibility, and diagnostics, smart valves offer improved efficiency, reduced downtime, and increased process reliability

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