

Automatic Homeopathy Pills Filling and Capping Machine

Submitted in fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechatronics

by

Asvin Kumar. T (39090004)

Joseph Thambi. K (39090014)



DEPARTMENT OF MECHATRONICS
SCHOOL OF MECHANICAL ENGINEERING

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY – 2023

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Asvin Kumar (3900004)**, **Joseph Thambi Koppada (39090014)** who have done the project work entitled "**Automatic Homeopathy Pills Filling and Capping Machine**" Under our supervision from June 2022 to May 2023.

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Submitted for Viva Voce examination held on ____ May 2023

Internal Examiner

External Examiner

DECLARATION

We, **Asvin Kumar (39090004)** and **Joseph Thambi Koppada (39090014)**, hereby declare that the Project Report entitled “**Automatic Homeopathy Pills Filling and Capping Machine**” done by us under the guidance of **Dr. Ritesh Kumar, M.Tech., Ph.D.** is submitted in fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

1. 

2. 

DATE: ____ May 2023

PLACE: Chennai, Tamil Nadu

SIGNATURE OF THE CANDIDATE

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ABSTRACT

Homeopathy is a 200-year-old form of alternative medicine that claims to stimulate a healing response and strengthen the body's ability to heal itself. There are no known automation systems or technologies in homeopathy, whereas in other medical units there are few advanced technologies. This paper presents an Automatic Homeopathy Pills Filling and Capping Machine. The machine was created to give an efficient and precise solution to the manually intensive process of filling and capping homoeopathic pills. The machine was created to be simple to operate, reliable, and cost effective. This system consists of a hopper, filling mechanism, capping mechanism, and a control system. The hopper stores the homeopathy pills and feeds them to the filling mechanism. The filling mechanism then dispenses the pills into the containers, after which the capping mechanism seals the containers. This machine is a quick and easy alternative to manual homoeopathic pill filling and capping. It improves accuracy and production while decreasing expenses and time.

TABLE OF CONTENTS

Chapter No	TITLE	PAGE No.
	ABSTRACT	v
	LIST OF FIGURES	vii
1	INTRODUCTION	1
2	LITERATURE SURVEY	3
	LITERATURE SURVEY BASED ON FILLING AND CAPPING SYSTEMS	3
3	AIM AND SCOPE OF THE INVESTIGATION	11
	3.1 AIM	11
	3.2 OBJECTIVE	11
	3.3 SCOPE OF CURRENT INVESTIGATION	11
4	MATERIALS AND WORKING PRINCIPLE	12
	4.1 MATERIALS	12
	4.2 WORKING PRINCIPLE	28
	4.3 SOLIDWORK MODELS	30
	4.4 EXPERIMENTAL WORKS	33
5	RESULTS AND DISCUSSION	36
	5.1 EXPERIMENTAL RESULTS	39
	5.2 GRAPHICAL REPRESENTATION	40
	5.3 DISCUSSIONS	40
6	SUMMARY AND CONCLUSION	42
	REFERENCES	43
	ANNEXURE	45

LIST OF FIGURES

FIGURE No	TITLE	PAGE No.
1.1	Process of automatic homeopathy pills filling and capping machine.	2
4.1	Stepper motor	13
4.2	Dc Water Pump	14
4.3	Servo Motor	16
4.4	Dc Motor	17
4.5	Arduino Mega	18
4.6	A4988 Stepper motor driver	20
4.7	LCD Display	21
4.8	Button Switch	23
4.9	Servo Motor (MG996)	24
4.10	Butterfly Valve	25
4.11	9v DC Adapter	26
4.12	DC Gear Motor	28
4.13	Perspective view of Automatic Homeopathy Pills Filling and Capping Machine.	31
4.14	Top view of Automatic Homeopathy Pills Filling and Capping Machine.	31
4.15	Front view of Automatic Homeopathy Pills Filling and Capping Machine.	32
4.16	Right view of Automatic Homeopathy Pills Filling and Capping Machine.	32
4.17	Automatic Homeopathy Pills Filling and Capping Machine	33
4.18	Pills Filling Station	33
4.19	Drug Dilution Filling Station	34
4.20	Capping Station	34
4.21	Dropping Station	35
4.22	Dropping of Pills Bottles at The Output Location	35

5.1	Pills filled in the pills filling station	36
5.2	Drug dilution is filled at the drug dilution filling station	37
5.3	Cap is attached to the bottle	37
5.4	Capping is done at the capping station	38
5.6	Homeopathy pills and drug filled bottle dropped into the tray	38
5.7	Graphical representation of time taken by each process	39
5.8	Graphical representation of Bottles Production	40

CHAPTER 1

INTRODUCTION

Basically, to start this project we need to know what the perfect definition of the automatic bottle packaging system is, “fluid is packed into a bottle, can, or other container with the aid of any machine using the automatic filling and capping technique. When the product is a liquid, such in the beverage and pharmaceutical sectors, filling and capping of bottles is particularly prevalent”. Automatic filling and capping are typically associated with pricey PLC, the essential element of industry automation, and this technology is ideally suited to large-scale manufacturing. But our project aims at small-scale medical industries like medical clinics and medical stores.

Here, the production is low due to the lower number of patients coming to these clinics for check-ups. So, for less production reasons, we are developing a machine which will fill the pills and drugs into the bottles in a specific manner. This will be an automatic pill filling machine where the doctor gives the machine the commands of which size of the bottle, which drug, and how many pills need to be filled. so that the medicines will be filled without any human contact and will be done as if they were human. This will result in lower labour wages for doctors who run the medical clinics. A prominent controller in automation for low-cost derivatives is Arduino, which is typically utilised in small-form applications that may be built at home.

Basically, using Arduino is somewhat complicated thing because we can use only c++ program as command into it so we can't easily write the code without any errors once it is done it will be the most effective interference compared to plc or Scada. Up to now maximum no of automations products themed as bottle filling and capping system are using the interference as plc and Scada because they can perform the process very well and they are expensive too. So, we found an option which perform same operations they do but somewhat economical for small industries machines that is Arduino.

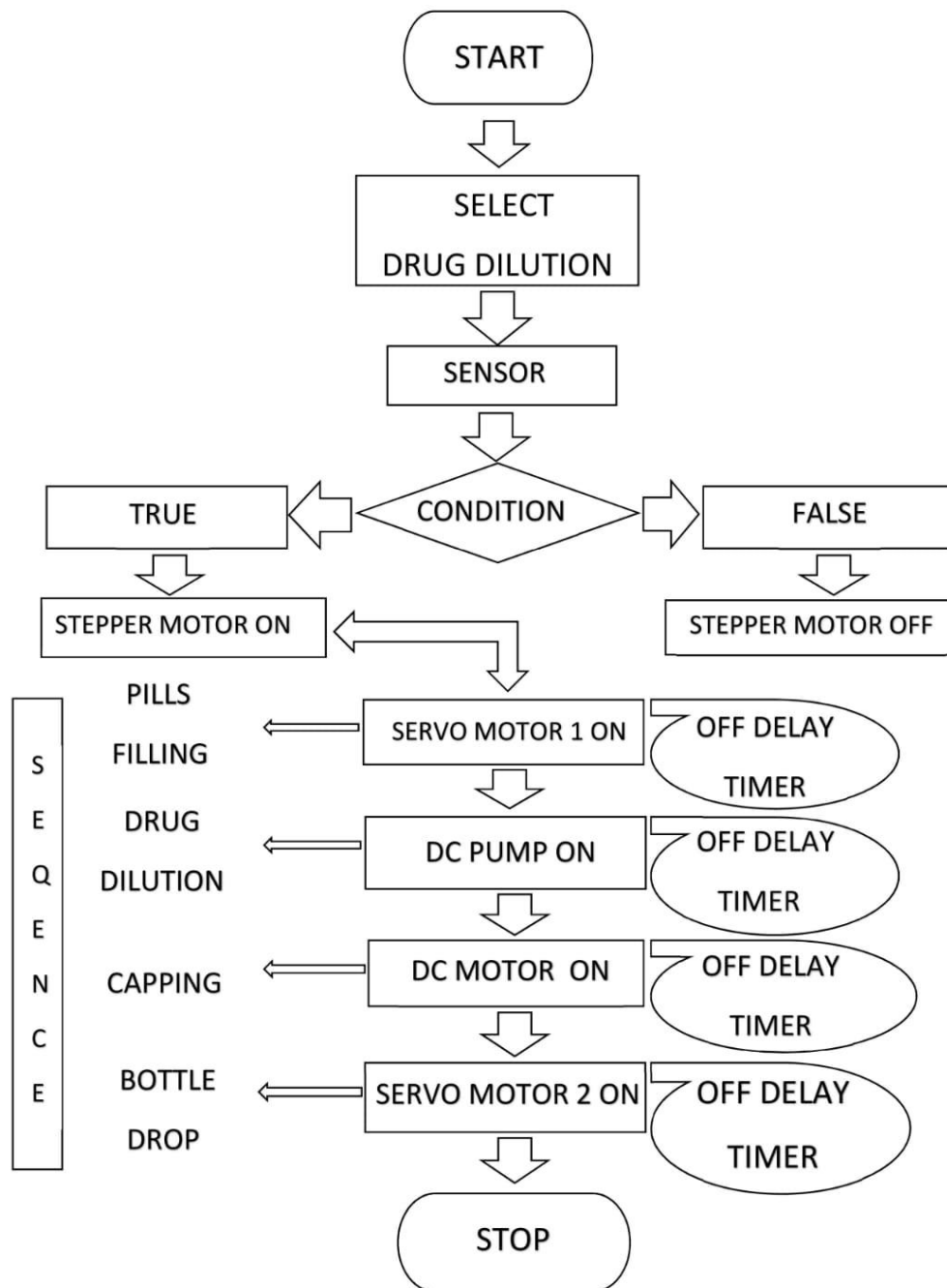


Fig:1.1: Process of automatic homeopathy pills filling and capping machine.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY BASED ON FILLING AND CAPPING SYSTEMS

2.1.1 Fabrication of A Bottle Filling Machine Controller Based on PLC.

Demand for drinks and medications has risen quickly as the food and healthcare industries have expanded. These beverage containers must be filled precisely. Non-precision will endanger consumer health in the healthcare sector as well as cause financial losses in the beverage business. Precision and speed in filling operations are necessary in a typical production facility of this type and achieving both manually is a laborious effort. Workers' safety is a problem while operating manually in hazardous chemical industries. It is now necessary to create automated bottle filling machines that can fill bottles quickly and accurately. PID controllers and PLC programming can aid with this. This article explains the use of PID controllers and PLC programming in the field of bottle filling operations. In this work, a PLC is employed together with a variety of sensors as the system's input, while valves are used as the system's output. This essay discusses the reasoning that was built to determine whether a bottle was filled or not based on its location on the conveyor belt and its state. This will provide precision regarding the quantity to be filled and will significantly shorten the cycle time to fill one bottle, thus achieving any manufacturing facility's aim of quantity with quality. his paper also discusses the variables that must be regulated, such as a liquid's level and flow. The Programmable Logic Controller (PLC) is to be used to regulate these parameters, and SCADA is to be used to further control the entire process. The error is reduced using a PID controller. When necessary, the user can alter the set values of various parameters via a Human Machine Interface (HMI).

2.1.2 Smart Controlled and Monitoring of Bottle Filling System.

A system for automatic filling of bottle by employing, PLC has been proposed in 2015. The functioning of the system is controlled by using PLC. All the bottles are filled at a time simultaneously. In this bottle of same shape, size and weight have been taken. Operation of liquid filling in bottle and then capping the bottle by using PLC along with SCADA has been projected. The system along with PLC permits

for filling the bottle up to a required level of bottle with management of the liquid explained in. Whole system can also be supervised by the application of SCADA. The drawback of this system is a few numbers of bottles can be loaded by the system in one minute and the system is slow. In paper is concentrated on an Operative Wireless technology for Industrialised Computerization with the help of Raspberry Pi. Internet technology and embedded devices in joint make embedded web server. It is projected that a progressive system for development supervision by a single board computer whose size is like a credit card called Raspberry Pi in. The system is intended by using RS232 and a microcontroller which calculates and manages many global constraints. It is discussed the designing and Application of RTU for Observing Weather by using RS485 and Raspberry Pi Interfacing.

2.1.3 An Automated Microcontroller Based Liquid Mixing System.

An automatic liquid mixing system based on a microcontroller, by Dr. A. S. C. S. Sastry. The automatic liquid mixing system built on a microcontroller delivers a very good performance with a small percentage mistake, the author of this article determined. The use of a microcontroller has been made possible thanks to the at89s51 microcontroller. Utilizing three microcontrollers was decided upon to reduce idle time and improve the mixing procedure. Additionally, the use of the different suggested components, including dispensers, sensors, pumps, relays, dc motors, and input devices, was successful. The study that was presented was printed in the International Journal of Computer Science and Engineering (IJCSE), volume 2, issue 8, 2010, pages 2648–2651. In this study, Shaukat N. concluded that this application of automation illustrated a PLC-based totally automated undisturbed liquid filling and mixing system. The system uses the fewest necessary mechanisms to satisfy the demand for high-speed manufacturing. The technique has shown to be successful in preventing unwanted liquid spills or waste. Additionally, the technology offers very high accuracy and precision in the mixing and filling of liquids. Although the suggested method shows how two liquids are combined, any number of liquids may be mixed in different ratios. Although implementing a PLC might be expensive, especially for small businesses, the

benefits far outweigh the costs. This study was presented at the 2002 IEEE Multi Topic Conference.

2.1.4 Automatic Liquid Filling to Bottles Of Different Height Using Programmable Logic Controller.

H.M. Mallaradhy, K.R. Prakash, "Using a programmable logic controller, automatically fill bottles of various heights with liquid. The device has demonstrated its effectiveness in preventing unwanted liquid spills or waste. The technology also offers excellent precision and accuracy in the ratio of liquids combined. The suggested method demonstrates the mixing of two liquids, although any number of liquids may be combined in a variety of ways. Although using PLCs might be expensive, especially for small businesses, they have several benefits that outweigh this. The usage of SCADA, which enables remote control of the proposed system, is one of its extra characteristics.

2.1.5 Implementation of Bottle Filling and Capping Using PLC with Scada.

A system for automatic filling of bottle by employing „PLC“ has been proposed in 2015. The functioning of the system is controlled by using „PLC“. All the bottles are filled at a time simultaneously. In this bottle of same shape, size and weight have been taken. Operation of liquid filling in bottle and then capping the bottle by using „PLC“ along with „SCADA“ has been projected. The system along with „PLC“ permits for filling the bottle up to a required level of bottle with management of the liquid explained in.

2.1.6 Microcontroller Based Automated Water Level Sensing and Controlling.

In this paper we introduce the notion of water level monitoring and management within the context of electrical conductivity of the water. More specifically, we investigate the microcontroller-based water level sensing and controlling in a wired and wireless environment. Water Level management approach would help in reducing the home power consumption and as well as water overflow. Furthermore, it can indicate the amount of water in the tank that can support Global Water types including cellular dataloggers, satellite data transmission

systems for remote water monitoring system. Moreover, cellular phones with relative high computation power and high-quality graphical user interface became available recently.

2.1.7 Automatic Bottle Filling System for Different Sized Bottles

Ameer L. Saleh¹, Lawahed F. Naeem describes automation is the utilization of different control techniques for operating equipment's such as operations in factories, aircraft, and other applications with reduced human power. The filling process is a mission performed by a machine that fills liquid products such as water or cold drinks. Traditional bottling methods include placing bottles on a conveyor belt and filling only one bottle at a time. In this paper, it has been designed and implement water filling machine system for different sized bottles by using PLC. Where the water filling machine system includes design and implement prototype of a flat belt conveyor with dimensions (120*70*30) cm and automatic process for water filling machine using the solenoid valve and sensors which gives the appropriate information to control unit then design the controller using PLC. The PLC plays important role to implement automatic filling process by using PLC programming software and ladder diagram language. It was found that the water filling machine using PLC is less operational cost and less power consumption than the traditional control systems, in addition more flexible and time saving.

2.1.8 PLC Based Automatic Liquid Filling System.

D.Baladhandabany, S. Gowtham describes the filling process in which a machine packs the liquid products such as water, cool drinks etc. This method includes placing bottles onto a conveyor belt and filling bottles one at a time. This aim of this paper is to describe the methods for filling more than one bottle at a time. In a conveyor system, stepper motor issued for its efficiency. It includes the user defined volume selection at the desired level. Our system includes a smaller number of sensors, so it is less expensive. Filling is controlled by PLC (Programmable Logic Controller) using ladder logic method. In the bottle filling system, the PLC gets the sensor feedback and controls the solenoid valve timing as well as controls the conveyer belt. By programming the PLC, the entire system

is being controlled. Sensor stands as the most important part for bottle filling. Normally in all automation industries, PLC is considered as the heart of any system. The entire system is made more flexible, time saving and user friendly. Every result led to the conclusion that the operation of PLC in is very inspiring.

2.1.9 PLC Based Automatic Bottle Filling Station.

P.K. Das¹, V. Kumar² et al describes the Programmable Logic Controller, PLC is a digital computer used for automation. It is an interface between program and the inputs. It is a programmable software. A PLC is an example of a real time application and therefore used to control various devices. The PLC works depending by the inputs given and their state, turning on/off its outputs. The user enters a program, usually through software which gives the results. PLC is used in many real-world applications. For all application programming device. The physical connection between the input and output module is done by the programming unit. Where the PLC acts as an interface to the real world through the input/output modules. All logical and control operations are done by the CPU which is the heart of the PLC. PLC has many programming languages, but the most famous and important language is Ladder diagram language which are used to programming the PLC in this paper.

2.1.10 Automated Bottle Filling & Capping Machine Using Arduino.

The main intention of this paper is to implement automation in small scale bottle filling industries because the small-scale industries go for manual operations to manufacture bottles, filling and capping them. These industries require large amount of labour for operating the machines, and to increase the production rate. The expensive PLC boards that are used in large scale bottle filling industries are replaced by an ARDUINO UNO board which is much cheaper than the Plc.'s manual filling process has many shortcomings like spilling of water while filling it in bottle, equal quantity of water may not be filled, delay due to natural activities of human etc.

2.11 Automatic Multivariate Liquid Filling System & Conveyor Control Using PLC & Scad.

The article "Automatic Multivariate Liquid Filling System & Conveyor Control Using PLC & SCAD" by Pongallu D and Suralkar SR (2014) focuses on the development of a liquid filling system that uses Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) technologies. The system is designed to automatically fill containers of different sizes with various types of liquid and monitor the conveyor system that transports the containers. The article provides a comprehensive overview of the system design, including the hardware and software components used in the system. The authors describe the different components of the liquid filling system, such as the liquid storage tank, pump, flow meter, and valves. They also explain how the PLC and SCADA systems are used to control the filling process and monitor the conveyor system. The article also describes the testing and validation of the system. The authors conducted several tests to ensure the accuracy and reliability of the liquid filling system. They tested the system with different types of liquid and different container sizes, and they found that the system was able to fill the containers accurately and efficiently. Overall, the article provides a detailed account of the design and implementation of an automated liquid filling system using PLC and SCADA technologies. The system is expected to be useful in industries that require accurate and efficient liquid filling processes, such as the food and beverage industry, pharmaceutical industry, and chemical industry. However, the article does not provide a comparison of this system with other liquid filling systems, which could be useful for readers who are interested in evaluating different liquid filling options.

2.1.12 A Review on Automatic Bottle Filling And Capping System.

The article "A Review on Automatic Bottle Filling and Capping System" by Patel et al. (2016) provides an overview of different automatic bottle filling and capping systems used in various industries. The authors focus on the challenges associated with bottle filling and capping, such as accuracy, efficiency, and safety, and review the different approaches used to address these challenges. The article discusses several types of automatic bottle filling and capping systems, including

volumetric filling systems, gravimetric filling systems, piston filling systems, and rotary filling systems. The authors explain how each of these systems works and highlight their advantages and disadvantages. They also discuss the different types of capping systems, such as screw capping, snap capping, and crimp capping. The article provides a critical evaluation of the different systems, highlighting their strengths and weaknesses. The authors note that while each system has its advantages, there is no one-size-fits-all solution for bottle filling and capping. They emphasize the importance of selecting the appropriate system based on the specific requirements of the application, such as the type of liquid being filled, the volume of production, and the required level of accuracy. The authors also discuss the use of sensors and control systems to improve the accuracy and efficiency of automatic bottle filling and capping systems. They describe how sensors can be used to measure the volume and flow rate of the liquid being filled, while control systems can be used to adjust the filling and capping parameters in real-time to ensure accuracy and consistency.

Overall, the article provides a useful overview of different automatic bottle filling and capping systems, highlighting the key features, advantages, and limitations of each system. The critical evaluation provided by the authors can help readers make informed decisions when selecting a bottle filling and capping system for their specific application.

2.1.13 Automatic Bottle Filling and Capping System Using PLC.

The article "Automatic Bottle Filling and Capping System using PLC" by Ismail and Sulaiman (2014) presents the design and implementation of an automatic bottle filling and capping system using Programmable Logic Controller (PLC) technology. The authors describe the hardware and software components of the system and provide a detailed explanation of how the system works. The article begins by discussing the need for an automated bottle filling and capping system in industries such as the food and beverage industry, pharmaceutical industry, and chemical industry. The authors explain how manual bottle filling and capping processes can be time-consuming, error-prone, and inefficient, leading to increased costs and reduced productivity. The authors then describe the different components of the automatic bottle filling and capping system, including the

conveyor system, filling station, capping station, and PLC control system. They explain how the system uses sensors to detect the presence of bottles on the conveyor system and control valves to regulate the flow of liquid into the bottles. They also describe how the capping station uses a motor to apply caps to the bottles and how the PLC control system ensures the accuracy and consistency of the filling and capping process. The article includes a detailed explanation of the PLC program used to control the system. The authors describe how the program uses ladder logic to control the different components of the system and how it incorporates safety features to prevent accidents and protect workers. However, the article does not provide a comparison of this system with other automatic bottle filling and capping systems, which could be useful for readers who are interested in evaluating different options.

2.1.14 PLC Based Bottling System in Industrial Automation.

The paper titled "PLC Based Bottling System in Industrial Automation" by Ashish Tiwary, Nitesh Kumar, Ankita Anil, and Y Saurabh Ranjan, published in the Imperial Journal of Interdisciplinary Research in 2017, discusses the design and implementation of a programmable logic controller (PLC) based bottling system for industrial automation. The authors begin by introducing bottling systems and their importance in industrial manufacturing processes. They then describe the hardware components used in their proposed system, which includes a conveyor system, sensors, a PLC, a human-machine interface (HMI), and a filling mechanism. The paper also provides a detailed description of the software components used in the system, including the ladder logic program used to control the PLC and the HMI software used to provide a user interface for the operator. The authors describe the steps involved in designing and testing the software and provide results of the system's performance in terms of accuracy and speed of filling and capping bottles. The authors conclude that their proposed PLC-based bottling system is effective and efficient in terms of accuracy and speed and can be easily adapted to different types of products and production lines.

CHAPTER 3

AIM AND SCOPE OF THE PROJECT

3.1 AIM:

The aim of the project is to design and develop an automation programmable machine which can fill the homeopathy pills into the bottles and as well as capping.

3.2 OBJECTIVE:

we are going to design and develop an automatic machine for filling both pills and medicine into bottles and then close them using a lid by capping system. This process will need no human help. There are no automation systems or technologies in homeopathy, whereas in other medical units there are few advanced technologies. So, for filling the medicine into bottles we want to develop a machine which will be helpful in the medical department. This project can be used in this pandemic era for filling the bottles with medicine without any contact.

3.3 SCOPE:

The world is increasingly moving towards automation. In the medical industries also so many machines were being introduced for helping doctors and as well as patients, but homeopathy doesn't have any of these machines so why not a medicine filling and capping machine can be introduced into this classic normal field of medicine. This machine can be upgraded to pack a set of C6 medicines which need to be countable and need to be countable when the time of packing, and it can also be upgraded to fill only the drug into the bottle up to certain extent. We don't know whether some other upgradable methods will come in the future, if they come into existence also there is no need to be surprised because this machine can perform the works which a human can do with their hands. Inventing a machine will not decrease the employment or will not leads to some other disasters these can help to the doctors so much which will come in handy. This will increase the popularity of homeopathy medical industry; in the way everyone will start to recognise that there can be also some ways to introduce the technologies into this industry.

CHAPTER 4

MATERIALS & WORKING PRINCIPAL

4.1 MATERIALS:

4.1.1. Stepper Motor:

A stepper motor is a type of brushless electric motor that converts digital pulses into precise mechanical movements. Stepper motors are commonly used in applications where precise positioning and control is required, such as in CNC machines, 3D printers, robotics, and automation systems. The stepper motor works by dividing a full rotation into several equal steps, which are determined by the number of teeth on the rotor and the number of electromagnetic coils on the stator. When a voltage is applied to a specific coil, the rotor moves to the corresponding position and holds there until the next pulse is received. Stepper motors can be classified into two main types: bipolar and unipolar. Bipolar stepper motors have two coils, while unipolar stepper motors have four or five coils. Bipolar motors are generally more powerful and have higher torque, but they require a more complex driving circuit than unipolar motors. One of the main advantages of stepper motors is their precise positioning and control. They can move in very small increments, and the position of the motor can be controlled very accurately. This makes them ideal for applications that require precise positioning, such as in CNC machines and robotics. Stepper motors also have a high holding torque, which means that they can hold their position without the need for a brake or locking mechanism. They are also able to provide a high level of torque at low speeds, which makes them suitable for applications where a high level of torque is required, such as in robotic arms and grippers. However, one of the limitations of stepper motors is that they may not be suitable for high-speed applications. This is because the time required to switch between steps limits the maximum speed of the motor. Additionally, stepper motors may produce audible noise and vibration during operation, which can be a concern in some applications.



Fig:4.1: Stepper Motor

Mosaic Part No.: STEPMOT-1

Size: NEMA 17

Drive system: Unipolar

Step angle:1.8° full step, 0.9° half-step

Phase/Windings:4/2

Voltage & Current:12V at 400 mA

Resistance per Phase:30 ohms

Inductance per Phase:23 mH

Holding Torque:2000 g-cm

Detent Torque:220 g-cm max

Weight:0.24 kg (0.5 lbs.)

Max continuous power:5 W

Rotor Inertia:22 g-cm²

Bearings: Ball

Leads:18 in. 26 AWG UL 1007

Insulation resistance:>100 MΩ at 500VDC

Dielectric strength:500V 50Hz/minute

Mounting hole space diagonal:1.73 in.

Mounting screws:3 mm dia., 0.5 mm pitch

Shaft diameter:0.197 in. (5 mm)

Motor footprint:1.7 in. × 1.7 in.

Motor height:1.5 in

Ambient temperature: -10°C to +55°C

4.1.2. Dc Water Pump:

A DC water pump is a type of electric pump that uses direct current (DC) to move water or other fluids. These pumps are commonly used in a variety of applications, including irrigation, aquariums, hydroponics, solar water systems, and other applications where a small, portable, or energy-efficient pump is required. DC water pumps are available in different types, including centrifugal, submersible, and diaphragm pumps. Centrifugal pumps use a spinning impeller to create a flow of water, while submersible pumps are designed to operate underwater and are often used in wells, ponds, and fountains. Diaphragm pumps use a flexible membrane to pump water, making them ideal for applications where a constant flow of water is required. One of the main advantages of DC water pumps is their energy efficiency. They consume less power than AC pumps, making them a suitable choice for off-grid applications and other applications where energy efficiency is a priority. DC water pumps are also available in a range of sizes, from small, portable pumps to larger pumps that can handle high volumes of water. Another advantage of DC water pumps is their flexibility. They can be powered by a variety of sources, including batteries, solar panels, and other DC power sources. This makes them ideal for use in remote locations, as well as in applications where a reliable power supply is not available. However, one limitation of DC water pumps is that they may not be suitable for applications that require high flow rates or high pressure. They may also require more maintenance than AC pumps, as the DC motor may wear out faster due to the higher current and voltage that it requires.



Fig:4.2: DC Water Pump

Flow rate: 100-350 litres per hour (L/h)
Maximum head (lift height): 1-2 meters (m)
Operating voltage: 9V DC
Current draw: 150-300 milliamps (mA)
Power consumption: 1.35-2.7 watts (W)
Noise level: less than 40 decibels (dB)
Operating temperature range: 0-60 degrees Celsius (°C)
Ingress protection rating: IP68 (fully waterproof)
Pump type: submersible or inline

4.1.3. Servo Motor:

A servo motor is a type of electric motor that is designed to rotate to a specific position and hold that position, as opposed to spinning continuously like a conventional motor. Servo motors are widely used in a variety of applications, such as robotics, automation, manufacturing, and model making. A servo motor consists of a motor, a control circuit, and a feedback mechanism. The feedback mechanism typically consists of a potentiometer, which is used to measure the position of the motor shaft. The control circuit receives signals from the potentiometer and adjusts the motor's rotation to achieve the desired position. One of the main advantages of servo motors is their precision and accuracy. They can rotate to a specific angle or position with a high degree of accuracy, making them ideal for applications that require precise motion control, such as robotics and manufacturing. Servo motors also have a high torque-to-weight ratio, which means that they can produce a significant amount of force relative to their size and weight. This makes them suitable for applications that require high torque, such as in robotic arms and grippers. Another advantage of servo motors is their ease of use. They can be controlled using a simple pulse-width modulation (PWM) signal, which is commonly used in microcontrollers and other electronic devices. This makes them easy to integrate into a wide range of applications. However, one limitation of servo motors is that they can be more expensive than other types of motors, particularly for high-end models. They also require more complex control circuitry than other types of motors, which can increase the complexity and cost of the overall system.



Fig:4.3: Servo Motor

Torque: 1.5 - 15 kg-cm

Speed: 0.1 - 0.2 seconds/60 degrees

Operating Voltage: 4.8V - 6V DC

Current Draw: 100 - 1000 milliamperes (mA)

Dead Band: 5 microseconds

Operating Temperature: -10°C to 50°C

Rotation Angle: 0-180 degrees

Dimensions: varies depending on model and manufacturer

Weight: varies depending on model and manufacturer.

4.1.4. DC Motor:

A DC motor, or direct current motor, is an electric motor that converts direct current electrical power into mechanical power. DC motors are widely used in a variety of applications, such as industrial machinery, automotive systems, robotics, and consumer electronics. DC motors consist of two main components: a stator and a rotor. The stator is the stationary part of the motor and contains the field coils, which produce a magnetic field. The rotor is the rotating part of the motor and contains the armature, which is connected to the motor shaft. When direct current is applied to the field coils, a magnetic field is produced that interacts with the magnetic field produced by the armature. This causes the rotor to rotate, generating mechanical power that can be used to drive a load, such as a fan, pump, or conveyor belt. One of the main advantages of DC motors is their

simplicity and reliability. They are relatively simple to control and can operate at high speeds with good efficiency. DC motors also have a high starting torque, which means they can generate a lot of force when starting up, making them ideal for applications that require high torque.

Another advantage of DC motors is their wide availability and affordability. They are widely used in a variety of applications and are available in a range of sizes and power ratings, making them suitable for a wide range of applications. However, one limitation of DC motors is that they require a direct current power source, which can be more difficult to obtain than an alternating current (AC) power source. They also require more maintenance than AC motors, as the brushes and commutators that contact the armature can wear out over time.



Fig:4.4: DC Motor

Operating voltage: 12V DC

Nominal current draw: 1 - 5 amperes (A)

Nominal power output: 10 - 100 watts (W)

No-load speed: 500 - 10,000 revolutions per minute (RPM)

Stall torque: 0.5 - 10 Nm

Motor shaft diameter: 3 - 6 mm

Motor body length: 30 - 80 mm

Weight: 100 - 500 grams

4.1.5. Arduino Mega:

The Arduino Mega is a microcontroller board based on the ATmega2560 microcontroller. It is one of the most popular boards in the Arduino family and is widely used in a variety of applications, such as robotics, automation, and data logging. The Arduino Mega has 54 digital input/output pins, 16 analog inputs, and 4 UARTs (hardware serial ports), making it suitable for a wide range of projects. It also has a USB connection, which allows it to be connected to a computer for programming and communication. One of the main advantages of the Arduino Mega is its versatility and flexibility. It can be programmed using the Arduino integrated development environment (IDE), which makes it easy to get started with programming even for beginners. It also has a large number of input/output pins, which allows it to interface with a wide range of sensors, actuators, and other electronic devices. Another advantage of the Arduino Mega is its affordability. It is relatively inexpensive compared to other microcontroller boards with similar capabilities, making it accessible to hobbyists and students. However, one limitation of the Arduino Mega is its size. It is a relatively large board, which can make it difficult to fit into small projects or enclosures. It also has a limited amount of memory compared to other microcontroller boards, which can be a limitation for some applications.



Fig:4.5: Arduino Mega

Microcontroller: ATmega2560

Operating voltage: 5V

Input voltage (recommended): 7-12V.

Input voltage (limits): 6-20V

Digital I/O pins: 54 (of which 15 provide PWM output)

Analog input pins: 16

DC current per I/O pin: 20 mA

DC current for 3.3V pin: 50 mA

Flash memory: 256 KB of which 8 KB used by bootloader.

SRAM: 8 KB

EEPROM: 4 KB

Clock speed: 16 MHz

The Arduino Mega also includes various communication interfaces, including:

USB: for programming and serial communication

ICSP header: for in-circuit programming and debugging.

UART: 4 hardware serial ports

SPI: on the ICSP header and 50-pin header

I2C: on the 4-pin header

The board measures 101.52 mm x 53.3 mm and is compatible with most shields designed for the Arduino platform.

4.1.6. A4988 Stepper motor driver:

The A4988 is a bipolar stepper motor driver that is widely used in various applications that require precise control of stepper motors. It is a complete micro stepping motor driver that can operate in full-step, half-step, quarter-step, eighth step, and sixteenth-step modes, providing a wide range of step resolutions. The A4988 driver is designed to operate bipolar stepper motors, which require a current in both directions to drive the motor. It can deliver up to 2 A of current per phase, making it suitable for driving a wide range of stepper motors. The driver also includes built-in protection features such as thermal shutdown, under-voltage lockout, and over-current protection, which help prevent damage to the driver and the motor. The A4988 driver uses pulse-width modulation (PWM) to control the speed of the motor. It has a step input that accepts pulse signals from a microcontroller or other control circuit, and a direction input that determines the direction of rotation of the motor. The driver also includes a sleep mode that reduces power consumption when the motor is not in use. The A4988 driver is

compatible with a wide range of microcontrollers and other control circuits. It can be controlled using a simple step and direction interface, making it easy to integrate into existing designs. The driver is also available in a compact, easy-to-use module that includes all the necessary components for driving a stepper motor. Overall, the A4988 stepper motor driver is a versatile and reliable driver that is widely used in various applications that require precise control of stepper motors. Its high current output, wide range of step resolutions, and built-in protection features make it suitable for driving a wide range of stepper motors in different applications.

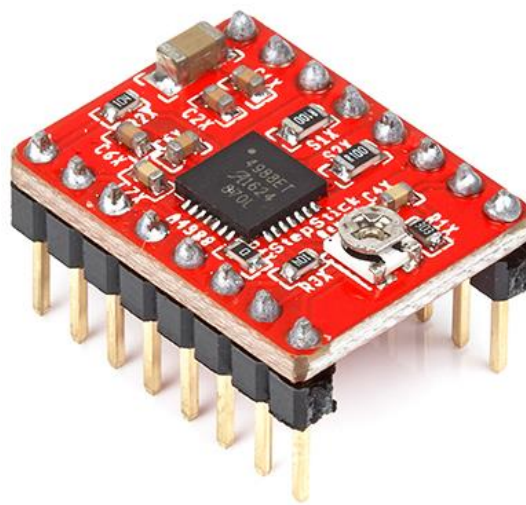


Fig:4.6: A4988 Stepper motor driver

Maximum current output: 2A

Operating voltage: 8 - 35V

Micro step resolutions: Full step, Half step, 1/4-step, 1/8-step, 1/16-step

Thermal shutdown circuitry: Yes

Overcurrent protection circuitry: Yes

Step and direction control: Yes

Output enable control: Yes.

Adjustable current limiting: Yes

Dimensions: 20 mm x 15 mm

Weight: 1.4 grams

4.1.7. LCD Display:

An LCD (Liquid Crystal Display) is a type of flat panel display commonly used in electronic devices such as calculators, digital watches, smartphones, and televisions. It is a thin, lightweight display that uses liquid crystals to display images or text. An LCD display consists of two sheets of polarizing material with a layer of liquid crystal material sandwiched between them. When an electric current is applied to the liquid crystal material, it changes its molecular structure and alters the amount of light that passes through the polarizing layers, creating the desired image or text. LCD displays can be monochrome or colour, and they come in different sizes and resolutions. They are widely used in various electronic devices that require a low power consumption, high contrast ratio, and fast response time. One of the main advantages of LCD displays is their energy efficiency. They consume much less power than other display technologies, making them ideal for battery-powered devices. LCD displays also have a high contrast ratio, which means they can display sharp, clear images even in bright environments. Another advantage of LCD displays is their flexibility. They can be used in a wide range of applications, from small handheld devices to large displays in public spaces. They are also relatively inexpensive and easy to manufacture, making them a popular choice for many consumer electronics manufacturers. However, LCD displays also have some disadvantages. They can suffer from image persistence or "burn-in" if static images are displayed for too long, and they have a limited viewing angle, meaning that the display can become difficult to read from certain angles. They also require a backlight to illuminate the display, which can add to the overall cost and complexity of the device.



Fig:4.7: LCD Display

Display format: 16 characters x 2 lines.
Character size: 5 x 8 dots
Backlight type: LED or EL (electroluminescent)
Operating voltage: 4.5V - 5.5V DC
Operating temperature: -20°C to 70°C
Contrast ratio: 5:1 to 10:1
Power consumption: 1 - 2 milliamperes (mA)
Interface: parallel or serial
Dimensions: 80 mm x 36 mm x 11 mm

4.1.8. Button Switch:

A button switch, also known as a push button switch, is a type of switch that is activated by pushing a button or switch actuator. It is a simple yet widely used component in electronic circuits and devices. Button switches can be normally open (NO) or normally closed (NC). In a NO switch, the circuit is open when the switch is not pressed, and it is closed when the switch is pressed. In an NC switch, the circuit is closed when the switch is not pressed, and it is open when the switch is pressed.

Button switches come in a variety of sizes and shapes, from small tactile switches used in handheld devices to larger push button switches used in industrial machinery. They can also have different actuation forces, travel distances, and lifetimes depending on the application. Button switches can be momentary or latching. A momentary switch only makes contact when it is pressed, and the circuit returns to its original state when the switch is released. A latching switch, on the other hand, stays in its current state after it is pressed until it is pressed again to switch it back. Button switches can be used for a wide range of applications, including turning on and off devices, selecting options in a menu, or triggering an action in software. They are easy to use and reliable and can be integrated into a variety of electronic devices and systems.



Fig:4.8: Button Switch

Switch type: momentary or latching.

Operating voltage: up to 250V AC or 50V DC

Maximum current rating: up to 10A

Contact resistance: 50 milliohms or less.

Insulation resistance: 100 megohms or more

Operating force: 50 - 500 grams

Operating temperature: -20°C to 70°C

Mechanical life: 50,000 - 100,000 cycles

Dimensions: varies depending on the specific switch type

4.1.9. Servo Motor (MG996)

The MG996 is a type of servo motor widely used in various applications that require precise control of position, speed, and torque. It is a high torque metal gear analog servo motor that is capable of rotating 180 degrees. The MG996 servo motor is designed to operate with a voltage range of 4.8V to 7.2V, and it can deliver up to 11 kg-cm of torque at 6V, making it suitable for a wide range of robotic and automation applications. It uses pulse width modulation (PWM) to control the position of the motor, and it can be controlled using a microcontroller or other control circuit. The MG996 servo motor has a standard 3-pin power and control cable, which makes it easy to integrate into existing electronic systems. The motor includes a feedback mechanism that provides precise position control, and it also includes built-in protection features such as over-current and over-temperature protection. The MG996 servo motor is widely used in various

applications such as robotics, automation, and remote-control vehicles. Its high torque output, precise position control, and easy integration make it a popular choice among hobbyists, students, and engineers. One of the main advantages of the MG996 servo motor is its high torque output. It can deliver up to 11 kg-cm of torque, making it suitable for applications that require high torque and precise position control. It also has a metal gear construction, which makes it durable and reliable. However, the MG996 servo motor also has some limitations. It can be relatively noisy and may produce vibration when in operation, which can affect the performance of some applications. It also has a limited rotational range of 180 degrees, which may not be suitable for some applications that require a greater range of motion.



Fig:4.9: Servo Motor (MG996)

Operating voltage: 4.8V - 7.2V DC

Stall torque: 9.4 kg-cm (131.09 oz-in) at 6V DC

Operating speed: 0.17 seconds/60° at 6V DC

Control system: Analog

Rotation angle: 180 degrees

Dimensions: 40.7mm x 19.7mm x 42.9mm

Weight: 55g

Gear type: Metal

Connector wire length: 300mm

4.1.10. Butterfly valve:

A butterfly valve is a type of quarter-turn valve that is used to regulate or isolate the flow of fluids (liquids or gases) in a pipeline. The valve gets its name from the butterfly-shaped disc that rotates to control the flow of fluid. The butterfly valve operates by rotating the disc (which is attached to a stem) either parallel or perpendicular to the direction of flow, depending on whether the valve is in the open or closed position. When the disc is parallel to the flow direction, the valve is open, and the fluid can flow through the valve. When the disc is perpendicular to the flow direction, the valve is closed, and the fluid flow is blocked. Butterfly valves are commonly used in industrial applications, such as in the oil and gas, chemical, and power generation industries, where they are used to control the flow of fluids in pipelines. They are also used in HVAC systems, water treatment plants, and in many other applications. One of the main advantages of butterfly valves is their simplicity and ease of operation. They require minimal maintenance and are easy to install and operate. They also have a compact design, which makes them suitable for applications where space is limited. Another advantage of butterfly valves is that they can be used to regulate the flow of fluids over a wide range of pressures and temperatures. They are also available in a range of sizes, from small valves used in residential plumbing systems to large valves used in industrial applications. However, one of the limitations of butterfly valves is that they may not be suitable for applications that require precise flow control. This is because the flow rate through a butterfly valve is influenced by the position of the disc, and there may be some variations in the flow rate as the valve is adjusted. Additionally, butterfly valves may not be suitable for applications where the fluid contains solids or abrasive materials, as these can damage the valve disc or seat.

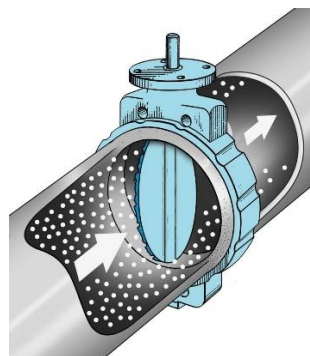


Fig:4.10: Butterfly valve

4.1.11. 9v DC adapter:

A 9V DC adapter is a power supply that provides a constant 9 volts direct current (DC) to an electronic device. It is commonly used to power a variety of electronic devices, such as small appliances, musical instruments, electronic toys, and DIY projects. The 9V DC adapter typically consists of a transformer, a rectifier, and a voltage regulator. The transformer converts the high voltage alternating current (AC) from the wall outlet to a lower voltage AC. The rectifier then converts the AC to DC, and the voltage regulator regulates the output voltage to a constant 9 volts. There are various types of 9V DC adapters available on the market, such as wall adapters, plug-in adapters, and desktop adapters. They are available in different current ratings, which determine the maximum current that the adapter can supply to the device. When selecting a 9V DC adapter, it is important to ensure that the output voltage and current rating are compatible with the electronic device that it will be powering. Using an adapter with a higher or lower voltage or current rating can damage the device or cause it to malfunction. One advantage of using a 9V DC adapter is that it provides a constant and stable power supply to the device, which can help to prevent damage or malfunction due to fluctuations in voltage or current. It is also a convenient and cost-effective way to power electronic devices that require a 9V DC input. However, one limitation of using a 9V DC adapter is that it requires an AC power source, which means that it cannot be used in locations where there is no access to AC power, such as outdoors or in remote locations. Additionally, some 9V DC adapters may generate heat during operation, which can reduce their efficiency and lifespan.



Fig:4.11: 9v DC adapter

Input voltage: 100-240V AC (vary depending on the region)

Output voltage: 9V DC

Maximum output current varies depending on the specific adapter, but usually ranges from 100mA to 2A or higher.

Polarity: typically, centre positive

Connector type: varies depending on the specific adapter, but common connector types include barrel connectors, USB connectors, and RCA jacks.

Efficiency: typically, 70% to 90% or higher

Overload protection: most adapters have built-in overload protection to prevent damage to the adapter or the device being powered in case of a short circuit or overload.

4.1.12. DC Gear motor:

A DC gear motor is a type of DC motor that is designed to produce high torque at low speeds by incorporating a gearbox into the motor assembly. The gearbox allows the motor to produce higher torque than it would be able to without the gearbox and reduces the speed of the output shaft. DC gear motors are widely used in a variety of applications, such as robotics, automation, and electric vehicles, where high torque is required at low speeds. They are also used in applications where precise control over motor speed and position is required, such as in servo motors. DC gear motors can be either brushed or brushless. Brushed DC gear motors use brushes and a commutator to transfer electrical power to the motor's armature, while brushless DC gear motors use electronic commutation to control the motor's operation. Brushless DC gear motors are typically more efficient and have a longer lifespan than brushed DC gear motors but are also more expensive. One of the main advantages of DC gear motors is their high torque output at low speeds. This makes them ideal for applications where a lot of force is required, such as in lifting heavy objects or moving machinery. They are also relatively easy to control using a motor controller, which allows for precise speed and position control. However, one limitation of DC gear motors is their speed range. They are typically designed to operate at low speeds and may not be suitable for applications that require high-speed operation. They also require

regular maintenance, particularly in the case of brushed DC gear motors, where the brushes and commutator can wear out over time.



Fig:4.12: DC Gear motor

Motor Type: DC with Gear Box, Metal Gears

Base Motor: DC 3000 RPM

Shaft Type: Circular 6mm Dia with Internal Hole for coupling, 23 mm shaft Length

Maximum Torque: ~3 Kg-cm at 12V

RPM: 100 RPM at 12V

Weight: 130 Gms

Max Load Current: ~330mA at 12V

4.2 WORKING PRINCIPAL:

An Arduino-powered automatic homoeopathic pill filling and capping machine typically consists of several components, including a hopper for storing the pills, a dispenser for releasing the pills, a gripper for transporting the pills to the drug dispenser station and then to capping station, and a capping station for sealing the pills in their respective bottles.

The machine's operation is based on the usage of an Arduino microcontroller to operate the various components of the machine. The Arduino receives input signals from sensors that monitor the filling and capping process and utilises this information to fine-tune the machine's operations.

Here's a quick rundown of how the machine works:

- This machine has a control panel which has different switches like start button, emergency stop button, and buttons numbered 1,2,3 and 4 to

select the drug dilution to be filled. All these are controlled by Arduino Mega, which is the brain of this machine. An LCD display is also fixated in the control panel to communicate with the model.

- First, the container is placed in its slot. Then we press the start button. The system will ask us the specific drug location, which is to be filled, e.g., tank 1 with the help of LCD monitor. Once we give the location, the system checks if there is any drug left or not with the help of IR sensor. If there is some drug dilution left in the tank, the process will start. Or else, the process comes to halt.
- So now, if the IR sensor detects the presence of the bottle, the centre part mechanism is actuated, and the stepper motor will turn on. Now the stepper motor will move and stop under the hopper.
- The hopper is full of homoeopathic pills, and the dispenser is programmed to release a certain amount of pills at a time. The hopper is situated on the top of the machine. It has a small valve in the bottom, and by actuating that valve with the help of a servo motor, we can control the amount of pills to be filled in the bottle. A off delay timer is used.
- Once the container is filled with pills, the centre part mechanism is activated. It has a rotating type of gripper which is used to hold the container and send it to other stations. The gripper is controlled by a servo motor and the centre part mechanism is controlled by a stepper motor. The gripper is triggered, and the pills are moved to the drug dispenser station.
- In this machine, there are four separate tanks to fill in the drug dilutions. Each tank is connected to its specific DC pump. These DC pumps are used to fill the drugs into these containers. All four tanks have their own separate DC pump. The pills are then moved under the valve of selected drug dilution type with the help of stepper motor. A off delay timer is used.
- Then, the gripper sends them to the capping section. Here, the Arduino detects when a bottle is ready to be capped and triggers the capping mechanism to seal the bottle. The capping mechanism is done with the help of a dc motor.

- After capping is done, the machine takes the bottle to an output location for collection. Here, the gripper leaves the bottle into a tray at the output location.
- For mixing the solution with pills, vibrations are created in the tray with help of a dc motor for a particular time delay.

The Arduino continues to monitor the process and adapt the machine's operations as needed to guarantee precise and efficient homoeopathic pill filling and capping. Overall, the Arduino-powered automatic homoeopathic pill filling and capping machine combines precision, speed, and efficiency to simplify homoeopathic pill production.

4.3 SOLIDWORK MODELS:

The SolidWorks software is used to design the model of this project. SolidWorks is a popular 3D computer-aided design (CAD) software used by engineers, designers, and manufacturers to create and visualize product designs. With the programme, users may develop technical drawings and documentation as well as 3D models of components and assemblies, which replicate their performance.

The parametric modelling function in SolidWorks, which enables users to modify the design while keeping connections between features, is one of several tools available for building complicated geometry. The programme has tools for producing realistic drawings and animations of designs, making it a useful tool for advertising and sales.

In conclusion, SolidWorks is a strong and adaptable tool for developing and visualising product designs. The SolidWorks model include the model dimensions, tolerances, and materials specifications that comply with minimal small industry standards, and it may be used to simulate the machine's operation to ensure that all components are working together correctly.

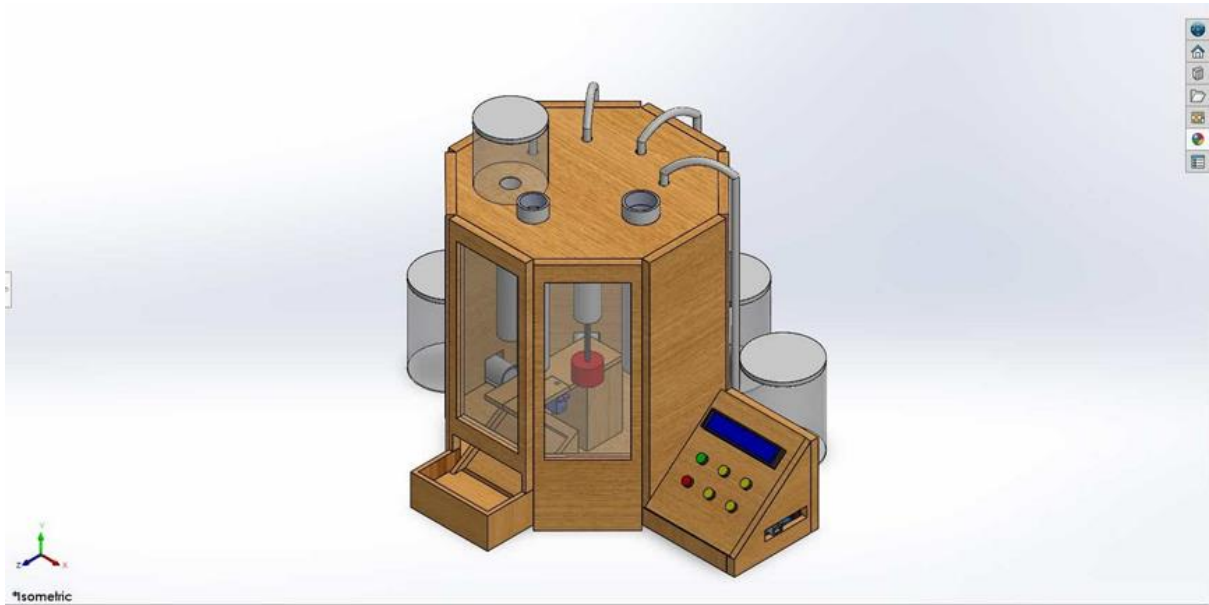


Fig:4.13: Perspective view of Automatic Homeopathy Pills Filling and Capping Machine.

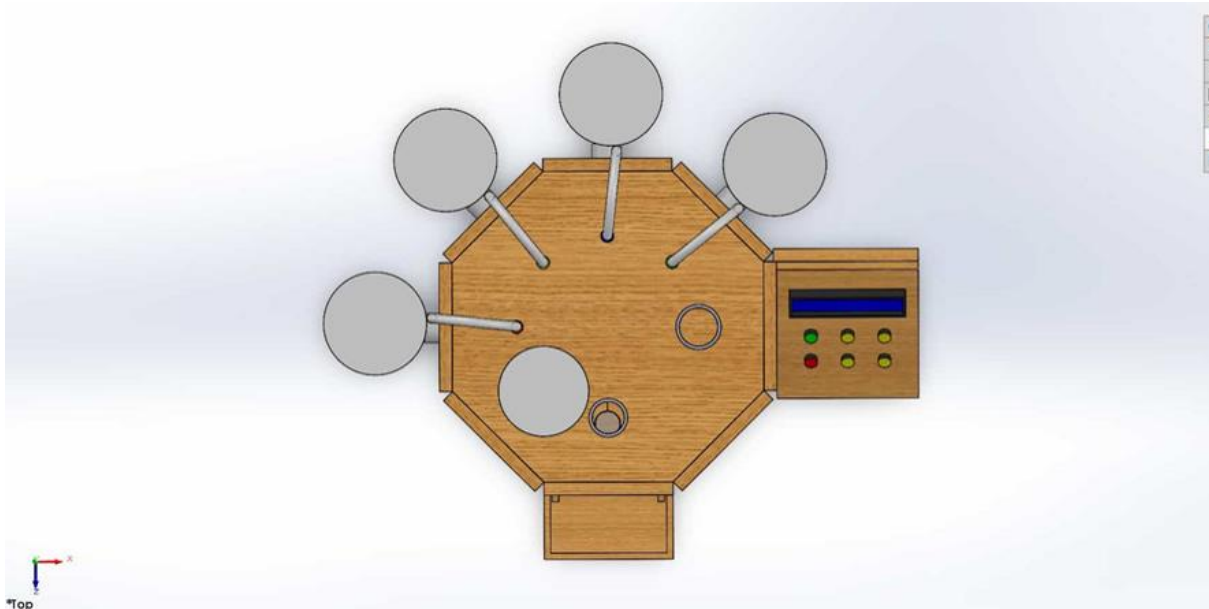


Fig:4.14: Top view of Automatic Homeopathy Pills Filling and Capping Machine.

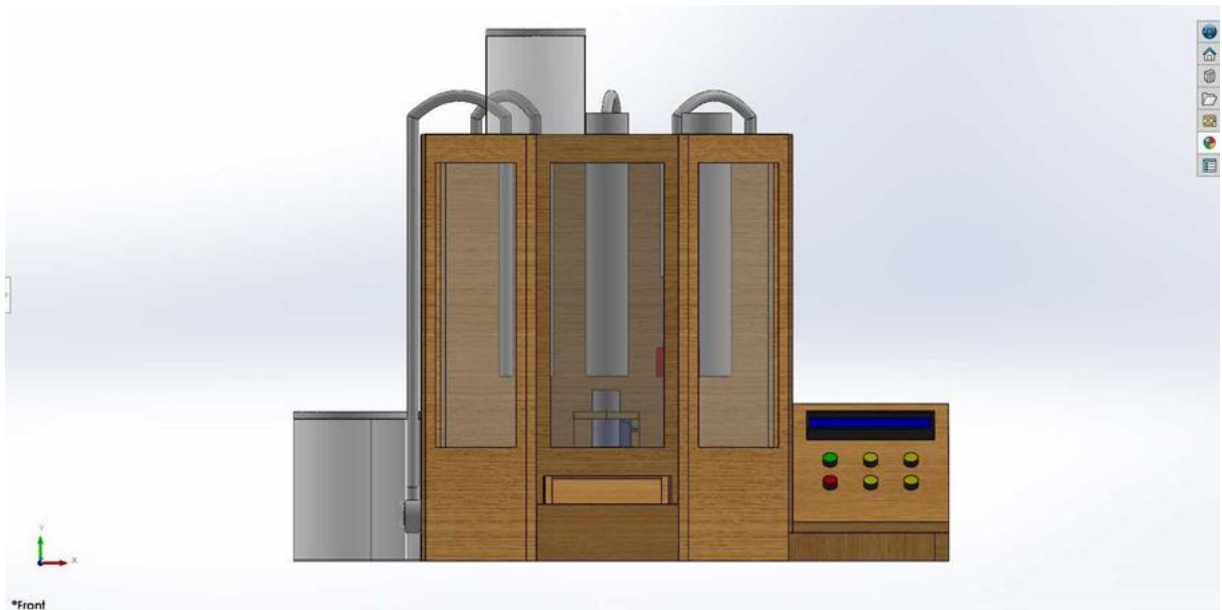


Fig:4.15: Front view of Automatic Homeopathy Pills Filling and Capping Machine.



Fig:4.15: Right view of Automatic Homeopathy Pills Filling and Capping Machine.

4.4 Experimental Setup:

So, the below figures are about the different stages of the process of the Automatic Homeopathy pills filling and capping machine.



Fig:4.17: Automatic Homeopathy Pills Filling and Capping Machine



Fig:4.18: Pills Filling Station



Fig:4.19: Drug Dilution Filling Station

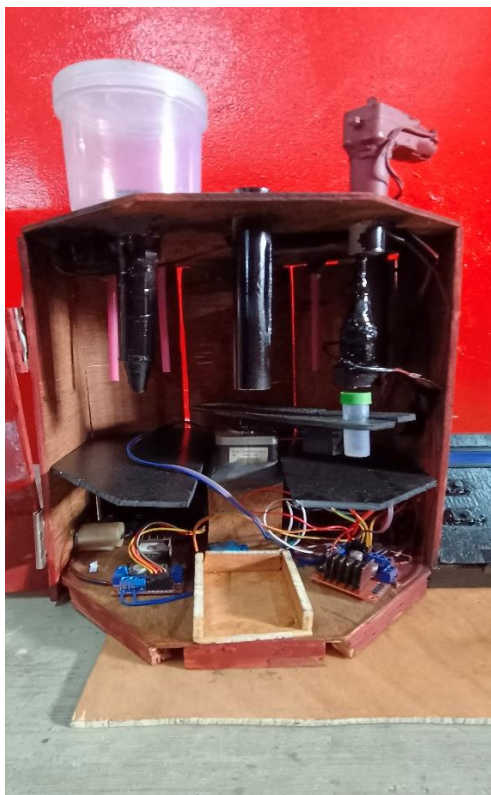


Fig:4.20: Capping Station



Fig:4.21: Dropping Station



Fig:4.22: Dropping of Pills Bottles at The Output Location.

CHAPTER – 5

RESULTS AND DISCUSSIONS

5.1 EXPERIMENTAL RESULTS:

Thus, results of the machine are being attached down and specifically named each figure. These results are obtained after many tests and changing the values in the codes, we done these changes for the better functioning and accuracy for the machine.



Fig:5.1: Pills filled in the pills filling station.



Fig:5.2: Drug dilution is filled at the drug dilution filling station.



Fig:5.3: Capping is done at the capping station.



Fig:5.4: Dropping of the bottle at the dropping station



Fig:5.5: Homeopathy pills and drug filled bottle dropped into the tray.

5.2 Graphical Representation:

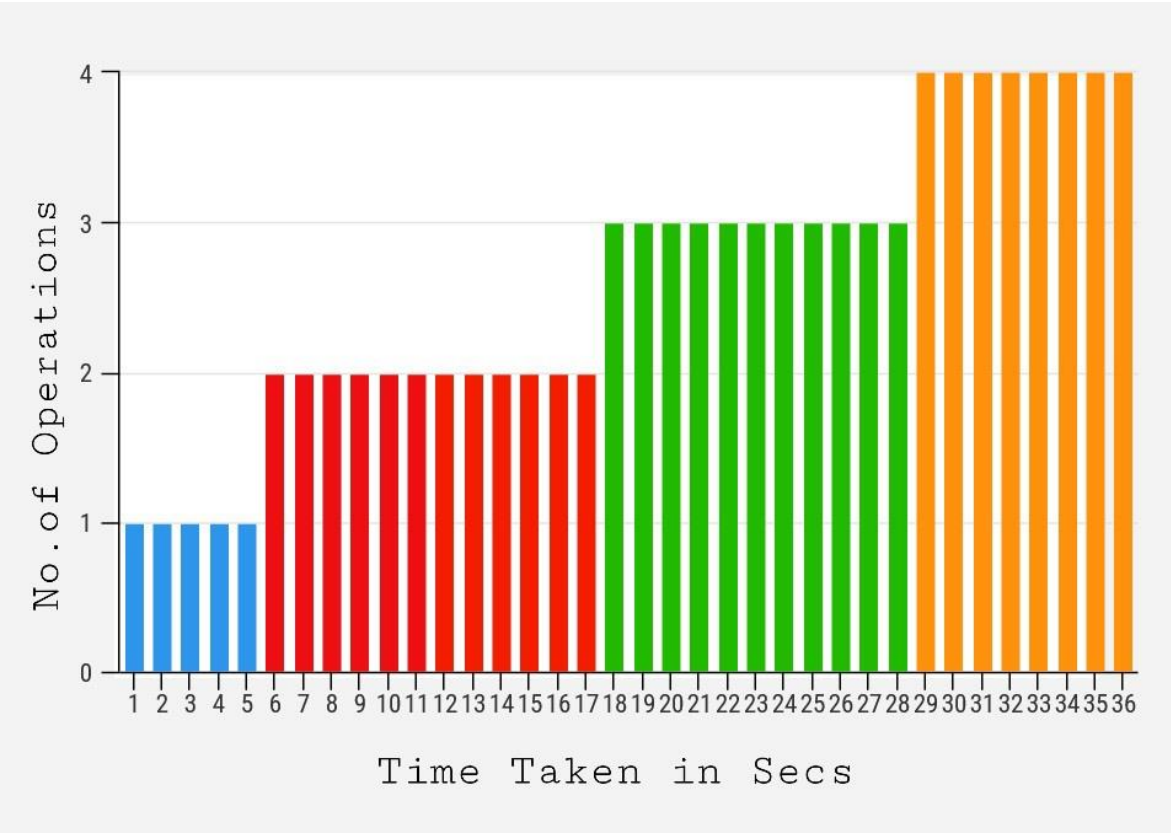


Fig:5.7: Graphical representation of time taken by each process:

-  Time taken for pills filling process.
-  Time taken for Drug Dilution filling process.
-  Time taken for Capping process.
-  Time taken for Bottle dropping.

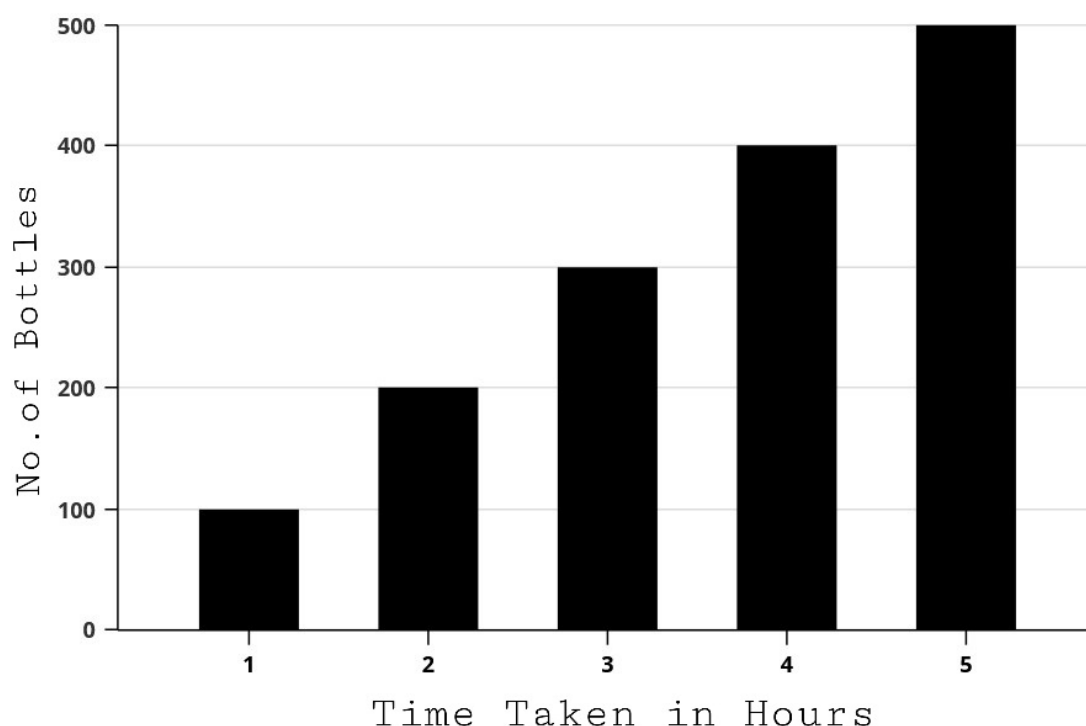


Fig:5.8: Graphical representation of Bottles Production:

5.3 Discussions:

Automatic homeopathy pills filling and capping machines are designed to fill and cap pills with precise quantities of homeopathic remedies. These machines can typically handle a wide range of pill sizes and shapes, and they can be programmed to fill the pills with different dosages of the remedy.

One of the main advantages of an automatic homeopathy pills filling and capping machine is its ability to increase production efficiency and accuracy. The machine can fill and cap pills at a much faster rate than manual methods, and it can ensure consistent dosages across all the pills.

In terms of the technology involved, these machines typically use advanced sensors and computer control systems to accurately measure and dispense the homeopathic remedies. They may also use different filling mechanisms, such as vacuum or gravity filling, depending on the specific requirements of the product.

However, there are also some potential challenges and limitations associated with automatic homeopathy pills filling and capping machines. For example, these machines may require regular maintenance and calibration to ensure they are functioning properly and producing accurate dosages. Additionally, they may not be suitable for all types of homeopathic remedies or pill formulations.

Overall, an automatic homeopathy pills filling and capping machine can be a valuable investment for companies that manufacture homeopathic remedies. By increasing production efficiency and accuracy, these machines can help companies meet the growing demand for natural health products and improve their bottom line.

CHAPTER – 6

SUMMARY AND CONCLUSION

In conclusion, an Arduino-powered bottle filling and capping machine can be an efficient and cost-effective option for automating the process of filling and capping bottles. The machine can properly estimate the volume of liquid to be poured into each bottle and securely cap them using sensors, actuators, and an Arduino microcontroller. The usage of Arduino programming enables for simple machine monitoring and control, which may assist decrease mistakes and enhance overall efficiency. This machine is compact and portable, making it easier to transfer and operate in various places. On customizing, it also gives you more options for the quantity and size of bottles you may fill and cap at any given moment. Furthermore, the use of Arduino provides for greater flexibility and customization in programming the machine to accommodate various bottle sizes and liquid kinds. Overall, an Arduino bottle filling and capping machine may be a worthwhile investment for small to medium-sized businesses aiming to optimise their production processes, increase productivity and decrease labour expenses.

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ANNEXURE:

- Review paper on the title of “A Review: Control and Automation Technology in Medical Field” by Aswin Kumar. T, Joseph Thambi Koppada, Ritesh Kumar has been presented in Chemsart – 22 conference conducted by NIT ROURKELA on December 17th, 2022.
- Review Paper has been communicated to Materials Today proceedings - Elsevier.
- Research Paper has been communicated to mathematical statistician and engineering applications – Scopus.