IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

Design and Modelling of Automatic Potting System for Led & Motor Drivers

Abhijit Kumar[1] and Dr. M. J. Sheikh[2]
PG Student/Research Scholar, Department of Mechanical Engineering[1]
Professor and Head of Department, Department of Mechanical Engineering[2]
Bapurao Deshmukh College of Engineering, Sevagram, Maharashtra, India
apdindian@gmail.com and mjsheikh1971@gmail.com

Abstract: *In this Project we will use conveyor belts for large production in small scale industries to fill large quantity of containers easily without creating any messy environment. We will use the proximity sensors to control the flow of containers on the conveyor belt. In project we will use automatic potting machine which will work on programmable logic controller. PLC operates the solenoid valve and conveyor motor. PLC control the main panel and rotation of motor and also give the feedback of rotation so solenoid valve will deliver accurate volume according to our requirement. It may able to work on variable speed as per our requirement, so no foaming problem occurs in operation. It will increase the production rate of the product significantly.*

Keywords: Electronic Gadgets, Potting, Resin, Liquid, etc

I. INTRODUCTION

Automation is very essential part of Industry whether it is big or small. Automation improves productivity of the industry. Now days even small-scale industries are going for low-cost automation or partial automation. Electronic gadgets like power supplies, LED drivers, motor drivers, and solar charge controllers are generally manufactured by SSIs. Small company involved in the manufacturing of above items. All these gadgets are very sensitive and compact. All these gadgets are potted by synthetic resins to improve the reliability and the life. Presently the process is manual, tedious, time consuming and health hazardous. After discussion with the Production In charge a detail plan will be prepare. Time study of the manual process have to perform at the premises. On the basis of rate of production and time study existing data the final time cycle has to decide. The analysis of existing automation system using PLCs have to be perform. The complete design of conveyer based automatic potting system have to do using CAD software PRO-E, 3-D model have to prepare.

II. LITERATURE REVIEW

D. Baladhandabany, et. al. (2015); made study on "PLC Based Automatic Liquid Filling System", Automation is used for all control systems and the technologies in PLC is use to reduce the human work and helps in increasing the production. PLC plays an important role in the world of automation industry. It acts a major function in the automation field which tends to reduce the complexity, increases safety and cost efficient. In this system we have applied a PLC based control system in an automatic bottle filling station. The paper is divided into several sections where the first phase of the paper explains the description of the product. The second phase then gives the functional description of the product. PLC (Programmable Logic Controller) acts as a major function in automation fields where, small PLC have a fixed number of built-in connections for inputs and outputs. A bottle filling system with PLC allows the user defined selection volume in percentage which uses the ladder language. Ladder logic is used to control the process. The filling operation is based on the user-defined volume through which user can choose the volume of liquid to be filled. A sensor which is placed in the conveyor is used to sense the bottle placed under the tank and the corresponding tank is switched on to fill the bottle. Filling is done by using various methods using motor, sensors, conveyor belt, PLC, solenoid valve.

PLC works by a programmable support with some criteria. The PLC is connected with some components and it is made to run with the help of program. PLC executes the program by one instruction at a time, where, if the first input is ON then it should turn on the first output. Hence it already knows which inputs are on/off, from the previous process. PLC updates

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

the status of the outputs. First the PLC checks the input status and it scans the input by user defined programming. Next the process is executed and finally it checks the output status. [1]

Mahesh S. Ghule & Dr. R.S.Bindu (2015); made study on "Design, Development & Analysis of Vacuum Chamber of Potting Machine", Design and Finite Element analysis of vacuum chamber of potting machine designed for electronic ignition coil applications. There are two types of potting methods 1) With Vacuum 2) Without Vacuum. For ignition coil requires vacuum atmosphere to remove moisture and air bubble from the epoxy resin. Vacuum chamber having rectangular shape which operates at pressure of 20 Pa which is below the atmospheric pressure of 101325 Pa, which lead to the compressive forces acting inside the chamber. Analytical design, buckling failure analysis, modeling of vacuum chamber is done. But during trial of machine there is problem of deflection of structure and hence braking of inspection glass window of chamber. Hence added ribbing to the metallic chamber but still problem remains. To solve this problem we Redesign, Development and FEA analysis of vacuum chamber. [2]

Nisarg A Solank el. al. (2015); made study on "Automatic Liquid Filling Machine", this machine is equipment used for packaging of various liquid products, mainly food and cold drinks. Depending on the different products, the different containers to be filled can either be a bottle or bag. These machines are usually found in manufacturing industry to promote quality and efficiency on the manufacturing process. In our proposed technology we suggest automatic liquid filling machine which will work on gear pump. Gear pump will be synchronized with encoder will give command to rotate particular rotation and hence pump will deliver particular volume. Pump will be connected with nozzle to transfer material into bottles. Volume setting from one size to another size will be done by changing command to gear pump. Once it is calibrated, volume setting will be done in seconds. So, it will give more production and will save lot of manpower.

In our proposed project we suggest automatic liquid filling machine which will work on gear pump. Gear pump is operated by encoder and motor. Encode control the main panel and rotation of motor and also give the feedback of rotation so pump will deliver accurate volume according to our requirement. It is able to work on variable speed as per our requirement, so no foaming problem occurs in operation. Pump is connected with number of nozzle and able to deliver different amount of liquid in different nozzle Volume setting and changeover from one size to another size will be done by changing command to gear pump from HMI. Once it is calibrated, volume setting will be done in seconds. It contains in feed and out feed sensor so we can count the number of bottle or container moving on conveyor, if there is no bottle or container it create jam on conveyor and stop the operation of machine. It will increase the production rate of the product significantly. [3]

Bipin Mashilkar et. al. (2016); made study on "Automated Bottle Filling System", Arduino board 2560 Mega is used to write programs & create interface circuits to read switches & other sensors. It controls motors & lights with very little effort. The Arduino programming language is a simplified version of C/C++, if one knows C programming. If one does not know C, no need to worry as only a few commands are needed to perform useful functions. An important feature of the Arduino is that one can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC, and the program will still run from the top each time you push the reset button. Remove the battery and put the Arduino board in a closet for six months. When reconnect the battery, the last program you stored will run. This means that you connect the board to the host PC to develop and debug your program, but once that is done, you no longer need the PC to run the program. The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labelled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches. Each digital pin can sink or source about 40 mA of current. This is more than adequate for interfacing to most devices, but does mean that interface circuits are needed to control devices other than simple LED's. In other words, you cannot run a motor directly using the current available from an Arduino pin, but rather must have the pin drive an interface circuit that in turn drives the motor. A later section of this document shows how to interface to a small motor. To interact with the outside world, the program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to external interface electronics and then to the device being switched on and off. [4]

Bin Hong, el. al. (2016); made study on "Development of Resin Vacuum Potting Equipment", Vacuum potting technology is the key technology to encapsulate the electrical components under the vacuum condition and curing at a certain temperature and pressure conditions. This technology can be achieved on the insulation protection of electrical components and improve the product's pressure rating and moisture- proof shock. This technology, originated in the 1960s,

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

has been widely used in aerospace, automotive, electronics and power industries. And it achieved good economic and social benefits. Vacuum potting products have many advantages, such as high reliability, low leakage coefficient, the small partial discharge, and high dielectric strength. Therefore, the vacuum potting technology is an important means to reduce the risk of electrical component insulation and improve the reliability of electrical systems. The reasonable vacuum potting process is the key of product quality of the electrical insulation products. Discussion of the bubble defects has been a sensitive issue in the industry. Since the bubble defects after vacuum potting are usually found in the tiny gap of the complex cavity of the electrical components, and it is difficult to find the bubble defect by the conventional detection means.

Firstly, the overall design scheme of vacuum encapsulation equipment is expounded to determine the key technical parameters and equipment compositions. Then, the equipment is developed through the design and research of the key technologies, such as mixing technology, degassing technology and control technology, Development of Vacuum Potting Equipment. [5]

Ameer L. Saleh et. al. (2017); made study on "PLC Based Automatic Liquid Filling System for Different Sized Bottles" an 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.

An automatic water filling machine system for different sized bottles by using PLC has been developed and implemented. The PLC is used in this system to get more productivity with less time high reliability for and flexible in work. The system is designed to working with different sized bottles by simply change the program. The ladder diagram language is used in this paper because this language is very useful and has a lot of functions so that most of the industrial application uses this language. [6]

2.1 Summary on Literature Review

The automated bottle filling system was beneficial in reducing work, time and cost of filling. The fabricated model of Automated bottle filling system can be used where high precision is not necessary and time limits not bound.

An automatic water filling machine system for different sized bottles by using PLC has been developed and implemented. The PLC is used in this system to get more productivity with less time high reliability for and flexible in work.

III. Objectives And Methodology

3.1 Objectives

Filling machines are set to fill up the cartons, plastic bags or bottles with the exact amount of product designated to each of them with accurately and effortlessly. There are several types of liquid filling machine are used in various packaging industry. The types which are commonly utilized in the production of goods are liquid filling machine, paste filling machine, powder filling machine and granular filling machine. Liquid filling machine is applied in the production of the liquid-based products such as carbonated drink, perfume, alcoholic beverages, and shampoo etc. It is convenient to use and easy to hold for any kind of operator.

There are many of liquid filling machine which work on the different working principal according to the requirement. Only one type of filling machine is not suitable for all kind of liquid because of the viscosity. Viscosity is different for every liquid so we should have to consider it while designing the machine. Mostly liquid filling machine working on the positive displacement of piston arrangement, some time we used hopper mechanism to fill liquid or some time we used gravity force to fill the liquid in containers. There are so many types of liquid machine in the market we observed every type of liquid machine try to understand the behaviour of every liquid machine and try to understand the working principal and mechanism of it and try to design a liquid filling machine which is easy to use for everyone and compact in size and also economical.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

Mostly liquid filling machine are working on the piston cylinder. so, we observed the most of liquid filling machine which are working on the piston cylinder and try to understand the working mechanism. Presently, they have liquid filling m/c working on piston-cylinder. It is Piston based machine is working on suction and discharge principle. It is operated through cam arrangement which is connected with gear-motor. During suction stroke liquid is sucked in cylinder and during discharge stroke liquid is filled into container.

Since the liquid we are using is high in viscosity called epoxy resin which is a polymer compound. It is economical to use dead weight operated piston cylinder mechanism instead of hydraulic press. It will reduce the cost of electric energy utilized and cost of setup. Since most of small industries pour the liquid by hand, there is uneven layer and amount of resin in the container contain air bubbles which is the major defect observed in manual pouring process. One more problem associated in the resin mix is that mixing process is done in separate compound which on mixing needs to use as early as possible.

The maximum settling time of the mixture is about one and half hour which is a very short duration for filling all the container in given time. So, our designed machine first task is to fill a single container as soon as possible. Our objective is to fill 15 containers in one-minute time span.

The scope of this project is as wide as possible because most of time the process is done manually which is time consuming and also increases the labour cost. This will widely use not only for poring potting mix but we can modify it with some technical chances to also use it in tooth paste, cosmetics, form filling process which will be beneficial for both the processes.

3.2 Methodology

The methodology of this project analysis was defined these steps. The production was observed data of small-scale industries. The suitable material for the fabrication was selected and assembled. The experiment has been done for potting system for led & motor drivers. The potting should be done properly for led & motor drivers. The feedback should be provided by PLC system. To achieve the above objectives, the following methodologies are used

- To Study the existing liquid filling mechanism.
- To Analysis of Automation Systems for new potting machine.
- Design calculation for new model
- Preparation of CAD modeling
- Analysis of CAD model.

IV. Basic Components of Machine

4.1 Conveyor Belt Table

A conveyor belt is the carrying medium of a belt conveyer system (often shortened to belt conveyor). A belt conveyor system consists of two or more pulleys (Sometimes referred to as drums), with a closed loop of carrying medium the conveyer belt, that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler pulley. There are two main industrial classes of belt conveyers.

- Those in general material handling such as those moving boxes along inside a factory and,
- Bulk material handling such as those used to transport large volume of resources and agricultural material such as grain, salt, coal, ore, sand, over burden and more.

In our project we are going to use the first type of conveyer belt.

As per the design specification of our model is concerned the length of our conveyer belt should be at least 1.83 meters and its height from ground level should be 0.817 meters. We are going to use two C- channel which are each 1.83-meter-long and covered with thin steel sheet from the upper and bottom position.

The basic design of table is as simple as possible for easy manufacturing of same it looks like a simple table which consist of four legs for perfect balancing of the weight of material which is moving on the belt.

The material use in manufacturing of the conveyor table is mild steel. We have made use of mild steel because it had excitant strength to weight ratio and is easily available in local market.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

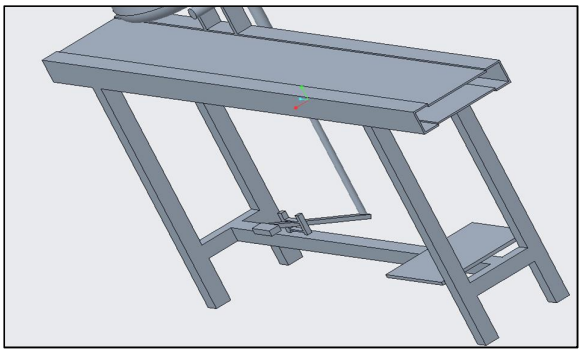

Figure 1: 3D Model of Conveyor Belt Table

4.2 Idler

Idlers are an important component in any conveyer system as they are used to support the conveyer belt and the load carried on the belt. They have low friction sliding surface over which on endless conveyer belt is dragged by the driver pulley. We have used a very simple design of idler which easy to manufacture and widely used in many industries for material handling process. In this model we have used two idlers one is driver and other is driven i.e. its free to rotate as per the direction of driver.

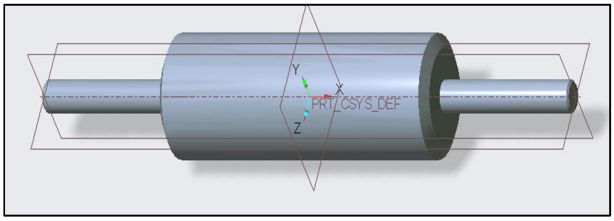

Figure 2: 3D Model of Idler

4.3 Bearing

In this project we have used bearing to constrain relative motion to only desired motion, and reduce friction between moving parts. The design of the bearing may, for example, provide free rotation around a fixed axis.

We have used rotary bearings to hold rotating components such as shafts or idlers within mechanical systems and to transfer axial load from the motor towards the belt conveyers.

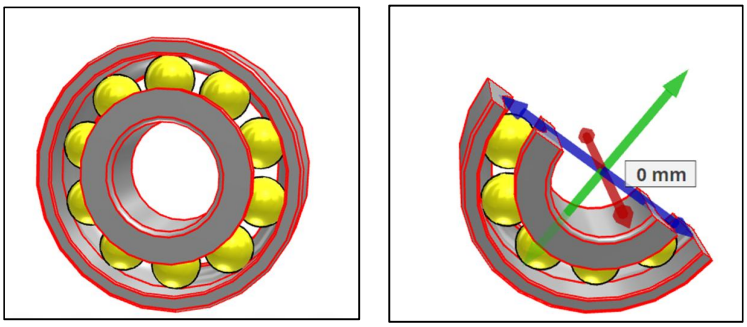

Figure 3: 3D Model of Bearing

4.4 V-Belt Pulley

A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

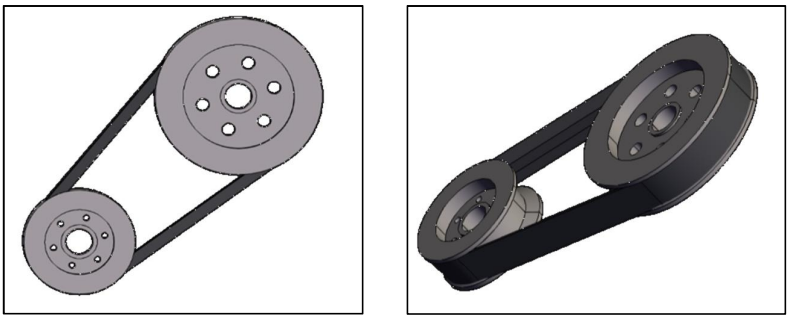

Figure 4: 3D Model of V-Belt Pulley

4.5 Conveyor Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding to generate force in the form of torque applied on the motor's shaft. Electric motors can be powered by direct current (DC) sources, such as from batteries, motor vehicles or rectifiers, or by alternating current (AC) sources, such as a power grid, inverters or electrical generators.

A conveyor motor is mechanically identical to an electric motor, but operates with a reversed flow of power, converting electrical energy into mechanical energy.

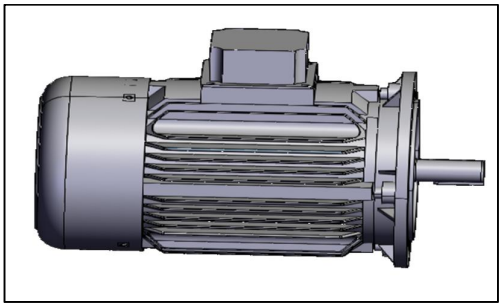

Figure 5: 3D Model Induction Motor

4.6 Hopper

A hopper is a large, pyramidal, and cylindrical or cone shaped container used in industrial processes to hold particulates matter or flow- able material of any sort, like oil, paste, cream, dust, gravel, nuts, seeds etc. and can then dispense these from the bottom when needed.

In our project we are going to use a small hopper which will consist of two parts with will be joint together to form a single unit. Joining and connection of these two parts will be done with the help of self-locking mechanism. This is the upper part of hopper its length is about 0.3 m and its basic geometry is cylindrical.

There is a pouring basin on top of this hopper from which liquid resin is poured inside the hopper which will then be used for feeding it into the small boxes. The main application of this part is that by using it we can pour the viscous resin inside the hopper.

This upper hopper has a teeth housing which is used to lock the lower hopper without any permanent joint this enable its easy opening and closing function for quick cleaning of lower portion of hopper which contain highly viscous liquid resin which will settle down quickly if not cleaned in given time interval. The major force factors are associated with the upper portion of the hopper so the material used in this potion cannot be glass or ceramic therefore we have made use of mild steel sheet.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

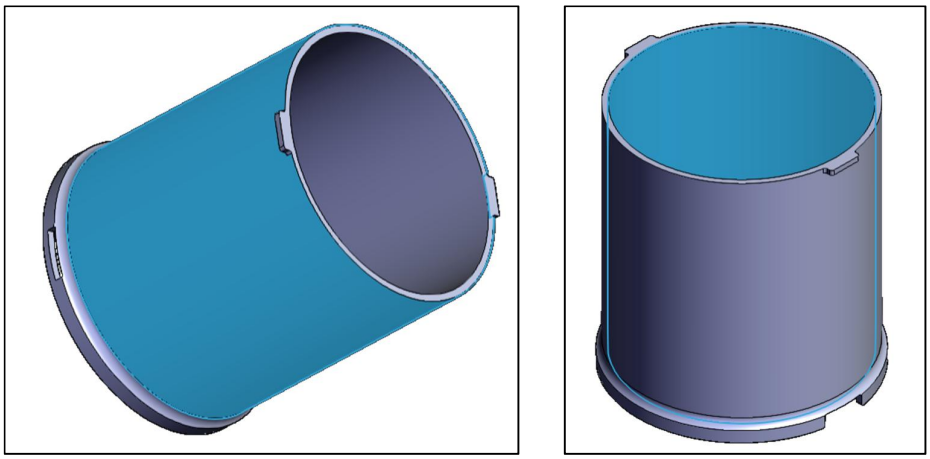

Figure 5: 3D Model of Hopper

The end part which will be connected to upper part is cylindrical in shape can is connected by using an interlocking mechanism usually known as self-locking mechanism. So that there is easy removal of these two parts from each other. The process of easy removal that to be with a great speed it must because the liquid resin which is present inside the hopper will start to settle and will block the passage and the enter assembly will have to be replaced.

So, for quick cleaning purpose the hopper is design in two part which will reduce the weight distribution of the hopper for clean and time required for the same will be very less as compared with single one-piece hopper.

There is a small hole which will start to converts towards the other end of this part and at the external there is a cylindrical shape nozzle like strange which will increase the velocity of fluid. This portion is approximately about 0.17 m long and only contain liquid resin in it.

4.7 Nozzle

A nozzle is a device designed to control the direction or characteristics of a fluid flow (specially to increase velocity) as it exits (or enters) an enclosed chamber or pipe. A nozzle is often a pipe or tube of varying cross-sectional area, and it can be used to direct or modify the flow of a fluid (liquid or gas). Nozzles are frequently used to control the rate of flow, speed, direction, mass, shape, and/or the pressure of the stream that emerges from them. In a nozzle, the velocity of fluid increases at the expense of its pressure energy.

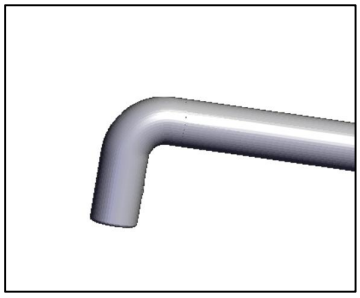

Figure 6: 3DModel of Nozzle

V. Selection of Electronic Element

5.1 Programmable Logic Controller (PLC)

A 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.In other words, the PLC is an electronic(solid state logic elements) device designed to operate as industrial computer which reduces the need for manpower and increases productivity with less time and cost. All types of PLC are consist of a power supply, central processing unit (CPU), memory, input/output(I/O) modules and programming device.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

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 . PLC is a distinctive type of computer which has functions like controlling and operating manufacturing process and machinery in various industries. The PLCs are behaving as heart as well as brain of the automation systems which are designed and implemented in various domains of the applications such as factory, home, industrial plant, etc.

A PLC is an example of a real time application, and therefore used to control various devices simultaneously. These systems carry out many services such as provision of different analog and digital input and output interfaces, processing of signal, conversion of data, etc. PLC can execute a program by executing at a time single instruction. For instance, when the first input is set ON, then it will turn the first output ON. Further, it knows which input is already on/off, so with respect to the previous process, PLC modifies the value of the outputs accordingly. PLC analyzes and scans the input by a user-defined program. The whole process in terms of program is executed, and finally it checks the output status.[7]

5.2 Operations of PLC

PLC works by a programmable support with some criteria. The PLC is connected with some components and it is made to run with the help of program. PLC executes the program by one instruction at a time, where, if the first input is ON then it should turn on the first output. Hence it already knows which inputs is on/off, from the previous process.[1] PLC updates the status of the outputs. First the PLC checks the input status and it scans the input by user defined programming. Next the process is executed and finally it checks the output status.[8]

5.3 Selection of PLC

There are some main factors to choose a PLC for any application. They are

- Input and output.
- Memory Size.
- System speed.
- Compatibility of HMI.
- Easily Communicable.

5.4 Sensors

A. Infrared Sensor

An Infrared sensor is a sensor which is able to detect the presence of nearby objects without any physical contact. An Infrared sensor emits an infrared signal or a beam of electromagnetic radiation (infrared), and looks for changes in the field or return signal. The object being sensed is often referred to as the Infrared sensors target. Different Infrared sensor targets demand different sensors. For example, a capacitive or photoelectric sensor might be suitable for a plastic target; an inductive proximity sensor always requires a metal target. The maximum distance that this sensor can detect is defined "nominal range". Some sensors have adjustments.[9]

B. Photoelectric Sensor

It is a device that determines the distance of object and also checks for absence or existence of the object on the conveyor belt by using a photoelectric transmitter and receiver. They are mostly used in industrial practices. Operating voltage is 6–36 V DC and its output current is 300 mA.[7] Its response frequency is 0.5 kHz and output type is n-p-n 3-wire (Black, Blue and Brown). It is usually made of brass or plastic. Diffused photoelectric sensor is used so as to sense the existence of bottles on the conveyor belt. However, various sensors are used to check presence of the object on the basis of appearance such as opaque, transparent or coloured object.

Features of photoelectric sensor are as follows

- Long distance measuring.
- Quick response time.
- Non-contact sensing.
- Easy adjustment.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

- Color Identification.
- High resolution.
- Almost no sensing object constraints.

C. Proximity Sensor

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation (infrared, for instance), and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. A proximity sensor consists of two parts transmitter and receiver. A transmitter emits infrared radiation and based on the principle of reflection it is sensed by the receiver.

D. Solenoid

A solenoid works by producing an electromagnetic field around a movable core, called an armature. When compelled to move by the electromagnetic field, the motion of that armature opens and closes valves or switches and turns electrical energy into mechanical motion and force Or When the electric current is passed through the coil, an electromagnetic field is created. This electromagnetic field causes the plunger to move up or down.[10]

For being such a large part of our world, solenoids are simple mechanisms that require only a basic grasp of physics most of us learned in middle school. Understanding them is not difficult, and you don't have to know any mathematical formulas to learn their secrets.[7]

In this project Solenoid drives a mechanism which controls the opening of fluid flow in a valve. It is operated to control pouring of liquids in a specific time by automatic engages and disengages motor speed to external crank which is connected with resin deliver system. Several types of applications are accomplished by using this solenoid.

D. Relay and Motor

A relay is an electrically operated switch which depends on the magnetic field strength that develops within the coil. This device can be very easily understanding with the help of NC (normally closed) and NO (normally open). Since under normal condition, this switch is NO and as the input is fed to the switch, a field is developed which changes its position to NC which in turn switch ON the machine connected at its output, i.e., DC motor. DC motor is a type of rotatory electrical machine which convert electrical current into mechanical motion.[7]

In this project, DC motor is exercised to start the conveyor belt (in rotating motion) to shift the bottle under the valve first and later after filling, it will shift further away from valve. DC motor is type of rotary electrical machines that convert electrical current into mechanical motion. A DC motor is used to rotate the conveyor belt to move the bottle first under the valve and after it filled move it away from valve. This DC motor operate with gear box which is used to increase the torque and reduce the speed as required . A DC motor is an essential part in the conveyor system. A motor is a rotary mover that allows for precise control of angular position, velocity and acceleration.

It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with motors. DC motors are a specific class of motor although the term motor is often used to refer to a motor suitable for use in a closed-loop control system. Dc motors are used in applications such as robotics, CNC machinery or automated manufacturing operations.[11]

E. Arduino 2560 Mega Micro Controller

Arduino board 2560 Mega is used to write programs & create interface circuits to read switches & other sensors. The power of the Arduino is not its ability to crunch code, but rather its ability to interact with the outside world through its input-output (I/O) pins. The Arduino has 14 digital I/O pins labeled 0 to 13 that can be used to turn motors and lights on and off and read the state of switches. Each digital pin can sink or source about 40 mA of current. This is more than adequate for interfacing to most devices, but does mean that interface circuits are needed to control devices other than simple LED's. In other words, you cannot run a motor directly using the current available from an Arduino pin, but rather must have the pin drive an interface circuit that in turn drives the motor. To interact with the outside world, the program sets digital pins to a high or low value using C code instructions, which corresponds to +5 V or 0 V at the pin. The pin is connected to external interface electronics and then to the device being switched on and off.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

The most important parts of the Arduino are as follows

- USB connector.
- Power Connector.
- Automatic Power switch.
- Digital Pins.
- Analog Pins.
- Power Pins.
- Reset Switch.

VI. CONSTRUCTION AND CALCULATION

Conveyor Belt Table

Objective: - To Fill 15 container per min.

Time required for one container cycle= 60/15 = 4 sec.

∴ Time required fill one container = 2 sec. (Assumed)

Time required to transport one container = 2 sec.

∴ Time required transport 15 container = 2 *15 =30 sec.

Let us assume the dimension of one container to be (100*100) mm

The largest length of conveyor belt which contains 15 container = 1500 mm.

So, hence we decided to adopt 1800mm - 2000mm conveyor belt.

Let us assume the dimensions of one container to be 100mm×100mm

The largest length of conveyor belt which contain 15 containers at a time be = 1.8m

So, the linear velocity of conveyor belt = $\frac{Lenght\ of\ conveyor}{time\ interval\ of\ travel}$

$v = \frac{1.8\ meter}{30\ sec}$

$v = 0.06\ m/sec$

Let us assume the diameter of idler pulley to be = 100 mm

Angular velocity of idler pulley will be $\omega = \frac{2\ \pi N}{60}$

Relationship between angular velocity and linear velocity is as

$v = \omega * r$

$v = \frac{2 * \pi * N * r}{60}$

$0.06 = \frac{2 * \pi * N * 0.05}{60}$

N = 11.45 rpm

Total resistance force on conveyor belt is given by

$$F = c * f * L * g * [2 * m_i + (2 * m_b + m_m) \cos\delta] + (H * g * m_m)$$

Where, c = Secondary resistance factor (standard value = 1.37)

f = Friction between idler and belt (assume value = 0.2)

L = Length of conveyor belt in meter.

g = Acceleration due to gravity (standard value = 9.81 m/sec2)

mi = Mass of one idler in kg.

mb = Mass of belt in kg/meter (standard value 6 unit)

mm = Mass of material on conveyor in kg.

□ = Angle of inclination in degree.

Length of conveyor belt in meter.

L = 1830mm = 1.83m

Height of conveyor from ground in meter.

H = 750mm + 67mm = 817mm = 0.817m

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

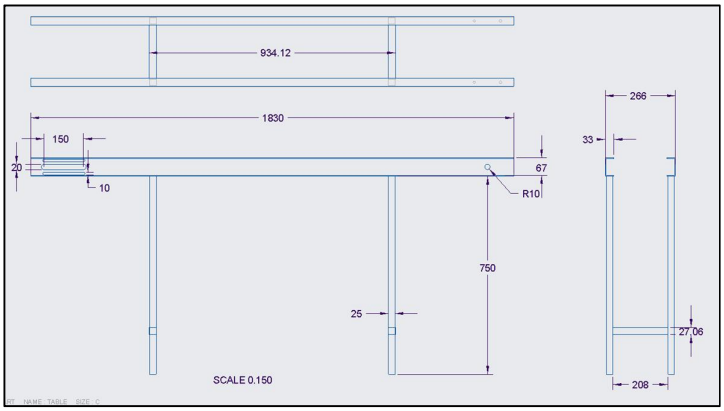

Figure 7: 2D Drawing of Conveyor table

Angle of inclination in degree = □ = 0º
Material on conveyor = Assume 2.5kg
Mass of one idler in kg = m_i = 5kg (Standard)

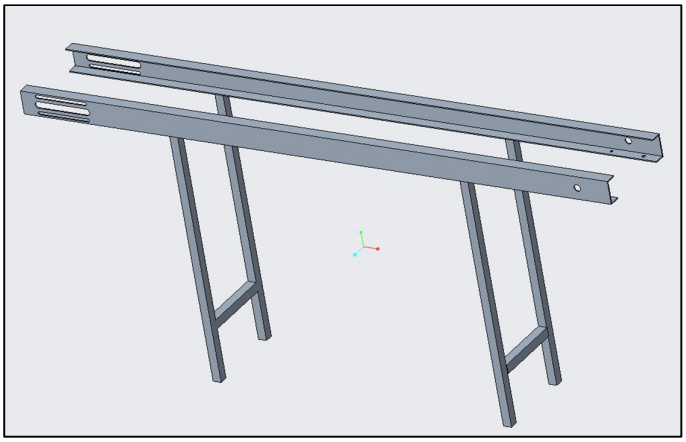

Figure 8: 3D Drawing of Conveyor table

Why C-Channel?

In its most widespread form, C channel is used to hold bridge decks and other heavy gadgets. This channel can absorb flex and other forces and it will not disbalance the bridge desk if we put heavy load. Channel is a versatile product that is obtainable in various sizes and widths.

So, Now

Total resistance force on conveyor belt

$$F = c * f * L * g * [2 * m_i + (2 * (m_b + m_m) \cos \delta] + (H * g * m_m)$$

$$F = 1.37 * 0.2 * 1.83 * 9.81 * [2 * 5 + (2 * (6 + 2.5) * \cos 0] + (0.817 * 9.81 * 2.5)$$

$$F = 152.85\ Newton$$

Now, for calculation of torque we use

T = Force × Perpendicular distance

T = 152.85 × 0.05 = 7.64 Nm

Power required for to drive is calculated by

$$P = \frac{2 * \pi * N * T}{60}$$

$$P = \frac{2 * \pi * 11.45 * 7.64}{60}$$

$$P = 9.19\ Watt$$

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

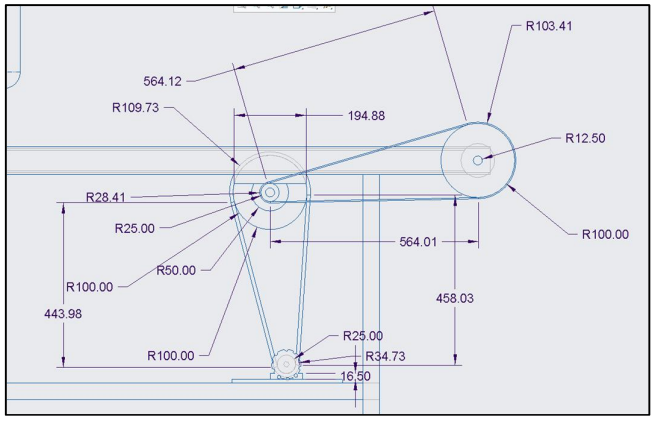

Figure 9: 2D Drawing of Motor-Pulley Arrangement

Dimeter of Belt Pulley D_1 = 100mm = 0.1m

Speed of Belt pulley N_1 = 11.45rpm

So, 2nd Pulley Speed N_2. Where D_2 = 25mm = 0.025 m

$$\frac{N_2}{N_1} = \frac{D_1}{D_2}$$

$$N_2 = \frac{N_1 * D_1}{D_2}$$

$$N_2 = \frac{11.45 * 0.1}{0.025}$$

$$N_2 = 45.8\ rpm$$

Finally Motor Speed N_3, Where D_{21} = 100mm = 0.1 m

D_3 = 25 mm = 0.025 m & N_2 = 45.8rpm

$$\frac{N_3}{N_2} = \frac{D_{21}}{D_3}$$

$$N_3 = \frac{N_2 * D_{21}}{D_3}$$

$$N_3 = \frac{45.8 * 0.1}{0.025}$$

$$N_3 = 183.2\ rpm$$

Hence, Speed of motor pulley be approx. 183.2rpm

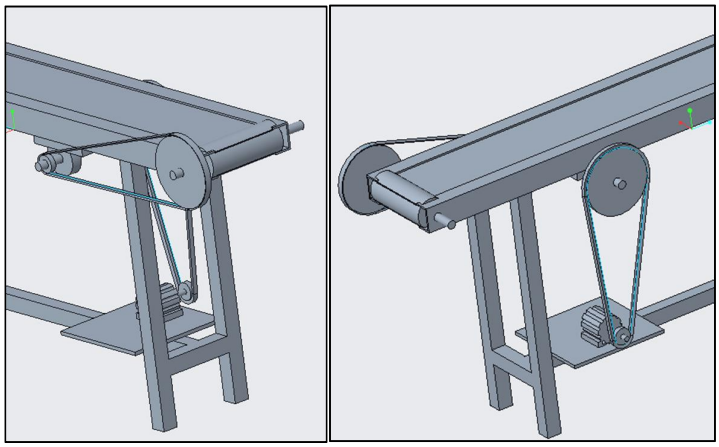

Figure 10: 3D Drawing of Motor-Pulley Arrangement

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

Hopper Calculation

Required capacity of hopper = 9 lit

As per design capacity of hopper is

$$volume = \frac{\pi}{4} * d^2 * h$$

$$volume = \frac{\pi}{4} * 0.2^2 * 0.3$$

$$volume = 0.00942\ m^3$$

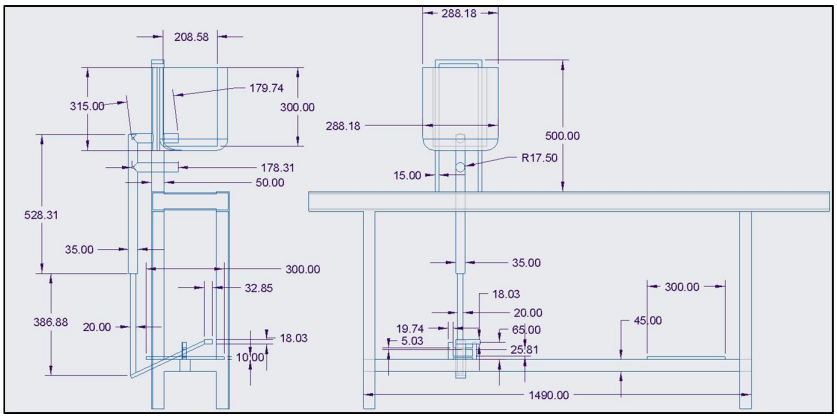

Figure 11: 2D Drawing of Hopper

Volume of hopper = 9.42 lit (greater than required)

Given values of resin material is :

Density= 1500 kg/m3 d = 10 mm

μ =8000 centipoise =8 pa.sec

$$volume\ to\ be\ filled\ per\ sec = \frac{volume\ of\ cube}{time}$$

$$volume\ of\ cube(with\ side\ 100mm) = 0.1^3$$

$$= 1 * 10^{-3} m^3$$

$$Discharge = 1 * 10^{-3} m^3/sec$$

$$Minimum\ area = \pi * r^2$$

$$= \pi * 0.05^2$$

$$= 7.85 * 10^{-3} m^2$$

$$Average\ velocity = \frac{Discharge}{Minimum\ area}$$

$$Average\ velocity = \frac{0.001}{0.00785}$$

$$Average\ velocity = 0.12\ m/sec$$

$$Maximum\ velocity = 2 * Average\ velocity$$

$$Maximun\ velocity = 2 * 0.12$$

$$Maximun\ velocity = 0.24\ m/sec$$

So, Reynold's number

$$Re = \frac{\rho * u * l}{\mu}$$

$$Re = \frac{1500 * 0.24 * 0.5}{8}$$

$$Re = 22.5$$

Re <2000 Hence flow is laminar

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

Resin Delivery System

In this project we have used single acting reciprocating pump for delivery of resin, which consists of a piston which moves forwards and backwards in a close-fitting cylinder. The movement of the piston is obtained by connecting the piston rod to crank by means of a connecting rod. The crank is rotated by means of an electric motor. Suction and delivery pipes with suction valve and delivery valve are connected to the cylinder. The suction and delivery valves are one-way valves or non-return valves, which allow the resin to flow in one direction only. Suction valve allows resin from suction pipe to the cylinder which delivery valve allows resin from cylinder to delivery pipe only.

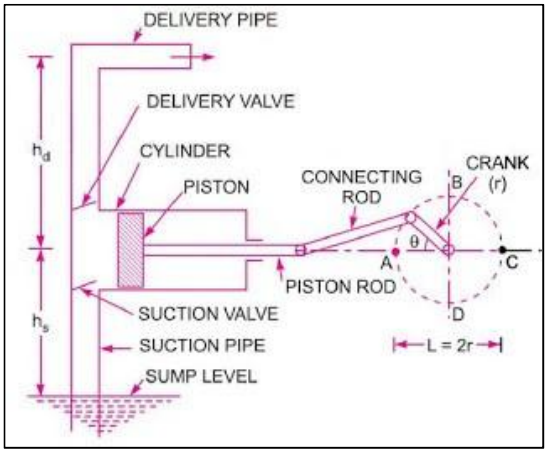

Figure 12: 2D Drawing of Reciprocating Pump

When crank starts rotating, the piston moves to and fro in the cylinder. When crank is at A., the piston is at the extreme left position in the cylinder. As the crank is rotating from A to C, (i.e., from 90° to 0= 180°), the piston is moving towards right in the cylinder. The movement of the piston E towards right creates a partial vacuum in the cylinder. But on the surface of the liquid in the sump atmospheric pressure is acting, which is more than the pressure inside the cylinder. Thus, the liquid is forced in the suction pipe from the sump. This liquid opens the suction valve and enters the cylinder. When crank is rotating from C to A (i.e., from 0= 180° to 8= 360°), the piston from its extreme right position starts moving towards left in the cylinder. The movement of the piston towards left increases the pressure of the liquid inside the cylinder more than atmospheric pressure. Hence suction valve closes and delivery valve opens. The liquid is forced into the delivery pipe and is raised to a required delivery point. [13]

Discharge through a Reciprocating Pump.

Consider a single acting reciprocating pump as shown in Fig. 20.1.

Let D = Diameter of the cylinder

A = Cross-sectional area of the piston or cylinder $= \frac{\pi}{4} * D^2$

r = Radius of crank

N = r.p.m. of the crank

L = Length of the stroke = 2 × r

Volume of resin delivered in one revolution or discharge of resin in one revolution

= Area x Length of stroke= A × L

So as per design

D = 30mm = 0.03m

A = $= \frac{\pi}{4} * D^2 = = \frac{\pi}{4} \times 0.03^2 = 7.068 \times 10^{-4}$ m^2

r = 25mm = 0.025m

N = 183rpm

L = 2×25 = 50mm = .05m

So, Now

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

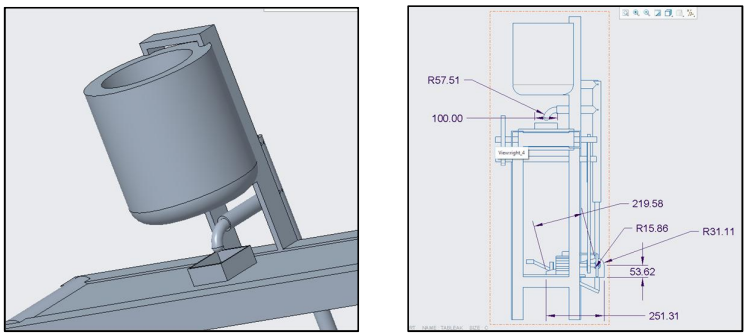

Figure 13: 3D & 2D Drawing of Delivery System

Volume of resin delivered in one revolution $= A \times L = 7.068 \times 10^{-4}$ m2 $\times$ .05m

$= 3.534 \times 10^{-5} m^3 = 0.03534$ L

Number of revolutions per second $= \frac{N}{60}$

Discharge of the pump per second

Q = Discharge in one revolution × No. of revolution per second

Q = A × L × $\frac{N}{60} = 3.534 \times 10^{-5} m^3 \times \frac{183}{60} = 1.077 \times 10^{-4} m^3/s$

Q = 0.1077 L

Now we assemble all automation electronic element with mechanical parts in project.

This assemby consist of

- Two idlers placed at the extream potion of the conveyor belt.
- Two bearing is placed on left side of conveyor table.

Motor and solenoid are placed one side of table legs

- Adjuatable pin is located at the left end of conveyor which is used to move squre flange bearing for increse and decrease tension on the belt.
- Moter is located at the right side and mounted on the steel plated which is fixed on the conveyor table by nut and bolt.
- Pulleys are fixed on the moter and idler.
- Hopper is placed one side of the conveyor table.
- Nozzel is located on mid of the conveyor table.
- Crank / Pistion Cylinder and paddle arrement is placed below the hopper.

This is the entery assembly of the system. All the mechanical element are located as per the design of the system. Some electronic elements like level sensor is located beside the nozzel mounting. Infrared sensor is located in mid of the conveyor table for detecting the container when it comes in front of the nozzel.

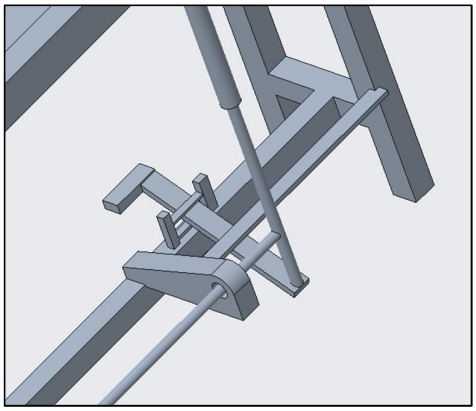

Figure 14: 3D Model Design of Paddle System

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

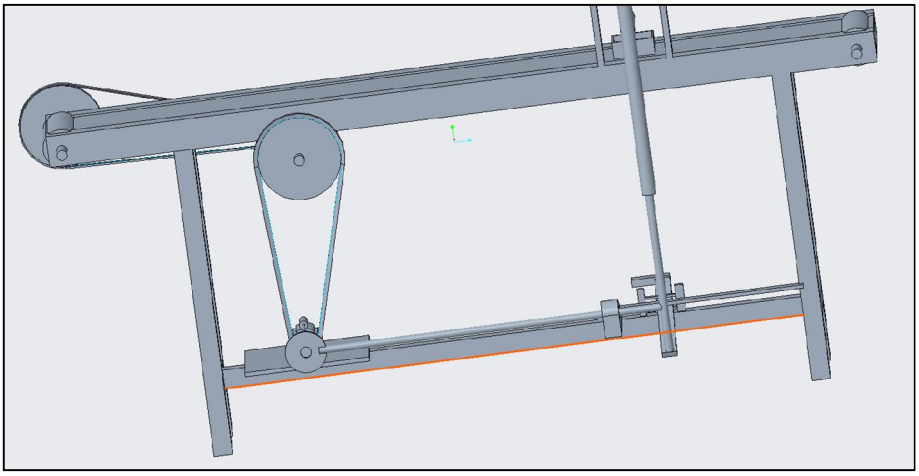

Figure 15: 3D Model Design of Conveyor Table, Induction Motor &Paddle System

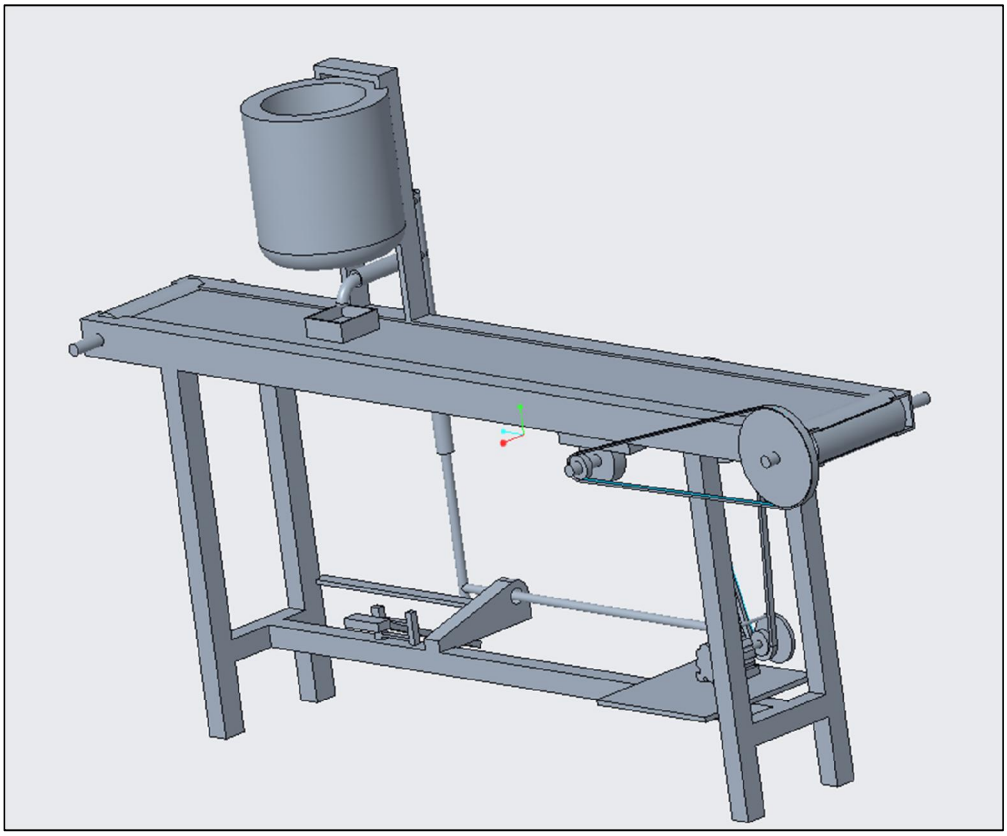

Figure 16: 3D Model Design of All System

VII. Analysis Of Result

In this chapter, we will study about the analysis of the result from the starting point of Journey to the endpoint of the journey. Many of you evaluation or invention are comes from some typical regular and unwanted problems, which is faced by everyone maybe in Industries or in our daily life.

The problem generates a large gap towards Victory if we overcome these problems definitely new sun is arrives, which is bright and sharp and give future scope.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

- We all members of our team decides that we first of all find such a problem which changes the performance of whole system. This is our sparking point or Journey point.
- Our team members Start searching about the problems from the daily day-to-day life routines from the college from the source of surroundings. In from the books From the magazines and also form teachers and other friends also.
- During the searching time our teacher guidance sir showed some videos about the industry work and labour system. At the end of the video we see a man is pouring a liquid resin into a small gadgets with its own hands.
- We and all our team members see that problem We think that it must be automatic and we get ieda for which we are searching from near about two weeks. Approximately all members of our group also says that it will be a good problem for us to invent our model which is helpful for industry as well as a for Mega project also.
- Hence, we can say that our model is also comes from typical and regular type of problem faced by most of electronic Gadget industry of small-scale industry, and we goes towards the development of model name as Design and Fabrication of automatic potting machine for electronic gadgets.
- Every industry or Society of Industry have most important social needs is that they have some large output from small input source.
- To maintain this scheme. We established / fabricated the models which increase the output with a small input source.
- Our team start Gathering some data from the books websites and available internet source. For the filling machine which are present in the markets for their components and working Behavior.
- We concluded from the websites, books that there are so many components used in the development of the model which are as given below.
    1. Table
    2. Conveyour Belt
    3. Belt Drive
    4. Motors
    5. PLC/ Aurdino
    6. Nut bolts Clamps
- In above chapters all components and it's types and its advantages and disadvantages are explained in detail
- We study CREO software for Designing purpose. Where designing is the most important part of our model making without designing the model making is impossible. The design process is first of all carried on the drawing sheets with the approximate scaling and figures drawn. Then after we drawn these drawings in the Creo Software which is accurate and gives direct visualization. The 3d effect of the Designing in CREO software provides a realistic look.
- The calculation parts is the spinal cord of our model making in which we study the formulas from the various books that are study from the first year to the final year to get the formuls like Power calculation, Velocity, Acceleration ,Displacements …etc
- The automation process is mainly done by the PLC programming in the industries so that we study the automation process with the help of PLC programming in details with the help of the electrical engineering sources.
- We practice so many times PLC programming and Audino. For development of animation of plc programming. After studying and practicing the PLC programming we make some animation related to our Project.
- At the end we developed animation of PLC programming and done some trials on that animation and it words properly as we wishes .
- All the process and trials give a good and positive response for which we are waiting and says that it is ready to use. We develop a model which works on this small investment of price and use maximum output from the point of start.
- This short points about the energies of the defaults are as follows.
    1. We made the solution of the problem
    2. We decrease the heavy involvement of manpower.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, April 2022
Impact Factor: 6.252

3. We increase the product quality and standard.
4. We increase the safety.
5. We reduce the cost.
6. We increase the productivity level of the company.

REFERENCES

[1]. D. Baladhandabany, S. Gowtham, T. Kowsikkumar, P. Gomathi "PLC Based automatic liquid filling system" Department of EEE, INFO Institute of Engineering, Coimbatore. "IJCSMC, Vol. 4, Issue. 3, March 2015, pg.684 – 692"

[2]. Mahesh S. Ghule and Dr. (Mrs.) R.S.Bindu , "Design, Development & Analysis of Vacuum Chamber of Potting Machine", International Engineering Research Journal Page No 549-556.

[3]. Nisarg A Solanki, Pratik G Raj, Saumil P Patel and Charmish D Rajput, "Automatic Liquid Filling Machine", International Journal of Engineering Research & Technology (IJERT) Vol. 4 Issue 05, May-2015.

[4]. Bipin Mashilkar ,PraseedKumar, Amit Chawathe , Vivek Dabhade , Vighnesh Kamath and Gayatri Patil, "Automated Bottle Filling System", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 04, Apr-2016.

[5]. Bin Hong, Hong-mei Wang, Ju Hu, Qing Liu and Jing Hou, "Development of Resin Vacuum Potting Equipment" International Conference on Applied Mechanics, Mechanical and Materials Engineering (AMMME 2016) ISBN: 978-1-60595-409-7

[6]. Ameer L. Saleh, Lawahed F. Naeem and Mohammed J. Mohammed, "PLC Based Automatic Liquid Filling System for Different Sized Bottles" International Research Journal of Engineering and Technology (IRJET) Volume: 04 Issue: 12, Dec-2017

[7]. KomalManhas, Meenakshi Dogra, Rajinder Tiwari and Jamini Sharma, "Design and Implementation of Bottle Filling Automation System for Food Processing Industries using PLC", International Journal of Power Electronics Controllers and Converters eISSN: 2456-1614 Vol. 4: Issue 1

[8]. Prof. Deepthi. D, Ananya.R. N, Bharath.K, Lekhana.S and Nikhil.D.J, "PLC Based Automatic Bottle Filling System", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE)| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765

[9]. Juliya KV, Mohammed Anas MV , Mubarak and Muhammed Hazil, "Automatic Bottle Filling System", International Journal of Innovative Research In Management, Engineering And Technology, ISSN (Online): 2456-0448, Vol. 1, Issue 4, May 2016

[10]. Electric solenoid valve.com Available: https://www.electricsolenoidvalves.com/blog/how-does-a-solenoid-work/

[11]. P. Vijaykumar and K. Anusha, "Automatic Liquid Bottle Filling System by using PLC", International Journal of Scientific Engineering and Technology Research, ISSN 2319-8885 Vol.07,Issue.03, March-2018, Pages:0424-0427

[12]. Ashwani Kapoor, Vivek Jangir, Jaswant Kumar, and Gaurav Tiwari, "Automated Bottle Filling System by UsingPLC",International Journal of Management, Technology and Engineering, ISSN NO: 2249-7455Volume 8, Issue V, MAY/2018

[13]. Dr. R.K Bansal, Fluid Mechanics and Hydraulic Machines, 9th ed., I.I.T Delhi, 2014