iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IV **Month of publication:** April 2022

DOI: https://doi.org/10.22214/ijraset.2022.41745

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

Automated Liquid Dispenser

Namrit Sheth[1], Shrey Sheth[2], Smita Nayak[3], Vedatma Kriti[4]
[1, 2, 3, 4]*Electronic Engineering, K.J. Somaiya College of Engineering,* Mumbai, India

Abstract: ***Automation has had a significant impact on a wide range of industries outside of manufacturing. In the production of goods and services, automation decreases the demand for human labor. Automation is a must-have in today's world. The process of mechanization tends to be minimized as technology advances. While mechanization offers machinery to assist human operators with the muscular demands of their jobs, automation drastically reduces the need for human interaction. Bottle filling is done by a machine that packages liquid products like cold drinks or water in the beverage industry. This procedure is far superior to the manual process in terms of safety and precision.***
Keywords: proteus programming, automation, manufacturing and packaging management, conveyor bottle, beverages filling.

I. INTRODUCTION

In most of the small scale industries bottle filling operation is done manually. The manual process has many disadvantages like spilling of water, delay in work due to human error, quantity of water which we require may not be filled properly etc. To eliminate all these problems faced by small industries, we took up this project.
This project is specially designed for small scale industries. This project reduces the labor effort and makes work more accurate and reliable. And it will also eliminate the chances of inaccuracy in the quantity of water which is very common in the manual process. As it also reduces the operation time, it will increase the production as more bottles can be filled in less time. All the operations in this system are executed through a program that is designed to do the entire operation. Talking about the safety, this model is extremely safe to use, as there are least possible components used to achieve the goal, thus minimizing the chance of any errors. Workers may easily operate these machines.
The project's goal is to create an arduino rev3-based automatic bottle filling system that can detect the presence of a bottle and fill it to a predetermined level. We used an infrared proximity sensor and an ultrasonic sensor to detect the presence of a bottle and the level of water in this project. This project assists in the automatic filling of bottles without the need for human intervention. This method can be used to fill any form of liquid.

A. Background

Small scale beverage industries which use packaged liquids as their products, mainly employ workers in the factories for manufacturing the products. This has been a conventional practice in this sector. But as growing technology is making human effort easier and easier, it was a great idea to implement an automated bottle filling mechanism that these small scale industries could adopt and gain great advantages.
The precision and timing of a machine is much better than humans, which guarantees a better and uniform quality of the product. Implementing this model will save a lot of human effort, and would exponentially benefit the industry. While thinking about this, we analyzed many research papers which helped us shape this project and guided us properly.
We went through similar projects and saw how the circuitry works, which helped us understand the project better. It helped us get an insight on different types of sensors that have been used in the model. All these contents were quite informative and helpful for the implementation of the project.

B. Motivation

Automation has contributed to a higher level of living, such as a longer and more varied existence, more efficient use of commodities and materials, and a greater understanding of the world we live in. Automation has enabled numerous previously unimaginable actions and events, such as worldwide colour television and man's first flight to the moon, thanks to communication, computation, and control. For a packager, switching to an automated packaging system is a major move, but it's one that's often necessary owing to product demand. However, automation has a lot of advantages in addition to the potential to produce more things in less time.

C. Objective

This project aims to design and create an automatic liquid filling system which will be used to sort bottle of different heights. The existing machines tend to fill only a specific type of container up to certain volume and the quantity of liquid filled is not to the current requirement . Development of a machine that can fill a range of vessels according to different parameters is the motive . It is useful in various industries like oil, pharmaceutical, etc.

D. Scope

The need for labor is reduced as a result of automation. The machines are designed to fill any type of bottle with soft drink or water. The filling operation can be tailored to the size, shape, and weight of the bottles.

II. LITERATURE REVIEW

In the paper entitled, "Design and Development of Automatic Bottle Refilling System" by Parth K Patel & Parth D Patel, from Institute of Technology Nirma University, Ahmedabad, describes a PLC & Arduino based design methodology of an automatic bottle filling system. Photoeye detectors and motors are used to get the position of the bottles, and move the bottles on the belt respectively. PLC and Arduino have been used in this project to drive the circuit. Arduino is interfaced with different components like Servo Motor, Stepper motor, DC motor, IR sensor and LCD display. The motors are responsible for moving the conveyor belt on which the bottles are placed, and the IR sensor is responsible for detecting the position of the bottle. A prototype of automatic bottle filling system ensures low human effort and high productivity.

The paper entitled, "Automatic Bottle Filling Using Microcontroller Volume Correction" by Ashwini P. Somawanshi, Supriya B. Asutkar & ,Sachin A. More from Amrutvahini College of Engineering, Sangamner (Pune University), describes a microcontroller-based embedded control design methodology for automatic bottle filling. A special purpose computer handles embedded control, which is constrained by real-time processing restrictions. The task is broken down into two stages. The water level in the tank is checked, and if it meets the minimum requirements, the second stage can begin. Three sensors are employed in the second stage. The existence of an empty bottle will be detected by the first sensor. When an empty bottle is identified, the motor activates the conveyor belt, which moves the empty bottle forward. A second sensor is installed to detect the bottle in the right filling position. The conveyor belt will halt and the pump will remain on for 15 seconds if the second sensor detects the presence of a bottle. As soon as the pump is shut off once the bottle has been entirely filled, the conveyor belt will begin. The bottle will now advance to its final location once more. A third sensor is installed in the final position to detect the presence of a filled bottle. The bottle count will be displayed on the LCD after passing past this point. This operation is repeated until all of the bottles have been filled and the circuit has been turned off.

The paper entitled, "Automated bottle filling system" by Bipin Mashilkar, Praseed Kumar, Amit Chawathe, Vivek Dabhade, Vighnesh Kamath & Gayatri Patil, from Fr. C.R. Institute of technology, Vashi, Navi Mumbai, describes an Arduino based microcontroller design methodology for automated bottle filling mechanism. The Microcontroller is in charge of the Bottle Filling System's components. The procedure begins with human input via the keyboard, which is then sent to the microcontroller. After that, the microcontroller activates the dc motor, which drives the circuit. The DC servo motor is turned on when this button is pressed. The chain conveyor starts moving until the proximity sensor detects the presence of bottles, at which point it stops. The proximity sensor is capacitive, and it instructs the microcontroller to open the solenoid valve, turn off the motor, and open the valve to fill the liquid. When the desired volume is reached, the microcontroller shuts down the solenoid valve and starts the dc motor at the same time. Thus the same process repeats for the filling of next bottles until the batch quantity is satisfied.

The paper entitled, "Bottle Filling Plant Automation System Using Conveyor Belt" by Harsh, Nivedita Nidhi Roy, Ayush Sharma and Abhishekh Singhal from SRM Institute of Science and Technology, describes an AT89s52 Microcontroller based automated bottle filling plant. In this project, the DC Gear motor was interfaced with the microcontroller using motor driver circuit (L293D) for the movement of the conveyer belt. Two LM339 comparator IC and one LM358 comparator IC were used. 10 IR sensors were used for detecting the bottle that fell within range, rejecting the bottle that did not fall within the range and counting the bottles filled. The LM339 comparator ICs were connected to four IR sensors each to get output of sensors in digital form. And the output of those eight IR sensors is given to microcontroller. The Lm 358 comparator IC was connected to two IR sensors to get the output of sensors in digital form. There was a buzzer at the end of the conveyor belt to know that the filled bottle reached the end. The entire operation would be display on LCD. It would display the bottles within the range, the bottles not within the range and size of the bottle if bottle is within the range and count the number of bottles filled.

III. PROJECT DESIGN

This presents the problem statement, block diagram and the list of components used. It also highlights the software used for the project. It consists of a brief description of the softwares as well as the components used.

A. Problem Statement

To design automatic bottle filling machine using Arduino. To display the level of the tank and the time LCD display is been used to notify the same. The IR proximity sensor is used to detect the position and ultrasonic sensor is used to detect the water level of the tank.

B. Block Diagram

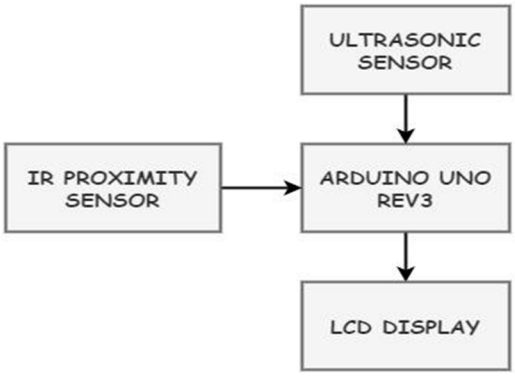


Figure 1: Block Diagram

This is the workflow of the project. The inputs will be taken from the ultrasonic sensor and IR proximity sensors which will be further transferred to Arduino UNO rev3. This data is processed and result is displayed on LCD display.

C. Hardware Description

The given below is the detailed information of the components used in this project.

1) Required Components

Components	Specifications and values	Quantity
Arduino UNO Rev3	---	1
Ultrasonic sensor	HC-SR07	1
IR proximity sensor	---	3
LCD Display	16x2	1
Potentiometer	1k	2
Push button	---	7
Resistor	10k	5
Buzzer	---	1
Diode	1N4148	1
DC gear motor	12V	1
DC pump	12V	1
Relay	5V	1
NPN transistor	C945, D313	1 each
Conveyor belt	---	1

Table 1: List of components

2) *Components Details*

The given below is the detailed information of the components used in this project.

a) *Arduino UNO Rev3:* The Arduino Uno is a microcontroller board that uses the ATmega328P microprocessor (datasheet). It contains 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power connector, an ICSP header, and a reset button. It comes with everything you'll need to get started with the microcontroller; simply plug it into a computer with a USB connection or power it with an AC-to-DC converter or battery. You may experiment with your Uno without fear of making a mistake; in the worst-case situation, you can replace the chip for a few dollars and start over..

Figure 2: Arduino UNO Rev3

b) *Ultrasonic Sensor:* An ultrasonic sensor is an electronic device that emits ultrasonic sound waves and converts the reflected sound into an electrical signal to determine the distance between a target object and the sensor. Ultrasonic waves travel at a quicker rate than audible sound, which humans can hear. Ultrasonic sensors, as their name suggests, use ultrasonic waves to determine distance. The sensor head sends out an ultrasonic wave, which is reflected back to the sensor head. By monitoring the duration between emission and reception, ultrasonic sensors can determine the distance to the target.

Figure 3: Ultrasonic Sensor

c) *IR Sensor:* The term "infrared" refers to a beam of infrared light which is used to detect the presence of an object. It works in the same way as ultrasonic sensors, but instead of using sound waves, it sends out infrared signals. Infrared proximity sensors have an IR LED that emits light and a light detector that detects reflected light. It has a signal processing circuit integrated in that determines an optical spot on the PSD. The IR LED emitter produces infrared light. When a beam of light strikes an object, it is reflected at an angle. The light detector will receive the reflected light. The position/distance of the reflected object is determined by the sensor in the light detector.

Figure 4: IR Sensor

d) *LCD Display:* A liquid-crystal display (LCD) is a flat panel display, electronic visual display (EVD), or video display that uses the light modulating characteristics of liquid crystals. Light isn't emitted by liquid crystals in any way. This arrangement uses a 2-line, 16-character LCD display. It uses a 4-bit interface. The characters showing the process occurring are sent to the screen to display.

Figure 5: 16x2 LCD Display

e) *DC Gear Motor:* A gear motor combines a motor and a gearbox into one unit. When a gear head is added to a motor, the speed is reduced but the torque output is increased. In terms of gear motors, the most significant criteria are speed (rpm), torque (lb-in), and efficiency (percent). To choose the best gear motor for your application, you must first calculate the load, speed, and torque requirements for your application. One of the key advantages of employing DC gear motors is that the gear assembly may be customized to boost torque. Furthermore, gear workings can be modified to reduce the speed to almost any desired result, allowing for great control across a wide range of applications.

Figure 6: DC Gear Motor

f) *Conveyor Belt:* Conveyors provide a dependable technique of transporting bulk materials in a continuous manner. When it comes to handling rate and total quantity warrant, this gadget is the most cost-effective. The type of conveyor used in this project is a chain conveyor. A machine having a moving chain is known as a chain conveyor. The conveyor bed is one of the components involved, and the size is determined by the requirements.

Figure 7: Conveyor Belt

g) *Relay:* A relay is a switch which is initiated or stopped by electricity. Many relays use an electromagnet to mechanically activate a switch, however solid state relays and other working principles are also used. Relays are employed when a low-power signal is required to control a circuit (with perfect electrical isolation between the control and controlled circuits), or when multiple circuits must be controlled by a single signal.

Figure 8: Relay

D. Software Description

The given below is the detailed information of the softwares used in this project.

1) *Arduino IDE:* The Arduino Software (IDE) includes a text editor for writing code, a message area, a text console, a toolbar with buttons for basic functions, and a series of menus. It communicates with the Arduino and Genuino devices by connecting to them and uploading code. Arduino sketches are programmes made with the Arduino software (IDE). These sketches were created with a text editor and saved with the.ino file extension. The editor allows you to cut/paste, as well as search for and replace text.. The message section indicates faults and provides feedback while storing and exporting. The Arduino Software (IDE) outputs text to the console, which includes detailed error messages and other information. The configured board and serial port are displayed in the window's bottom right corner. You may validate and upload programmes, generate, open, and save sketches, and open the serial monitor using the toolbar buttons.
2) *Proteus:* The Proteus Design Set is a proprietary software tool suite that is primarily used to automate electrical design. Electronic design experts and technicians use the programme to develop schematics and electronic prints for printed circuit board manufacture. It was created by Labcenter Electronics Ltd in Yorkshire, England, and is accessible in English, French, Spanish, and Chinese. The Proteus Build Suite is a Windows tool that allows you to record schematics, simulate them, and design PCB layouts. It comes in a variety of forms, depending on the size of the designs being created and the microcontroller simulation needs..An autorouter and basic mixed mode SPICE simulation capabilities come standard with every PCB Design product. The Proteus Design Suite's schematic capture feature is utilised for both simulation and design phases of PCB layout projects. As a result, it's an essential component that comes standard with all product configurations.
3) *Eagle:* EAGLE is a scriptable electronic design automation (EDA) application with schematic capture, printed circuit board (PCB) layout, auto-router and computer-aided manufacturing (CAM) functions. A schematic editor is included with EAGLE for creating circuit diagrams. Parts are defined in device libraries with the .lbr extension, while schematics are kept in files with the .sch extension. Parts can be stacked on many sheets and connected via ports. Board files with the extension .brd are saved in the PCB layout editor. Back-annotation to the schematic is possible, as is auto-routing, which connects traces automatically depending on the connections provided in the schematic. Gerber and PostScript layout files, as well as Excellon and Sieb & Meyer drill files, are all saved by EAGLE. Because EAGLE's typical user base consists of small design firms and amateurs, many PCB fabricators and assembly businesses accept EAGLE board files (with extension.BRD) directly to output optimised production files and pick-and-place data. For editing, project administration, and customising the interface and design parameters, EAGLE provides a multi-window graphical user interface and menu system. The system can be operated using the mouse, keyboard hotkeys, or a command line embedded in the system. Hotkeys on the keyboard can be customised by the user. Script files can include several repeating commands (with file extension .SCR). It's also feasible to use an EAGLE-specific object-oriented programming language to investigate design files (with extension .ULP).
4) *Tinkercad:* Tinkercad is a free online 3D modelling programme that runs in a web browser and is noted for its ease of use. It's a popular platform for producing 3D printing models as well as an introduction to constructive solid geometry for beginners. Tinkercad builds models using a simplified constructive solid geometry method. A design consists of primordial shapes which are either "solid" or "hole" in form. By combining solids and holes, new shapes can be constructed, each of which can be assigned the solid or hole property. A built-in JavaScript editor allows users to create new form generators in addition to the standard library of primitive shapes.

E. Working

To automate bottling operations, we should first understand what is happening in the bottling system. The bottle filling system's process is as follows:

1) *Bottle Detection using Sensors:* Bottles are held in place in their corresponding holders, which are attached to the input conveyor. The presence of bottles in the holder is detected using infrared sensors. The filling procedure is carried out based on the output of the sensors. To set the state of the bottles, a time delay is given. If a bottle is present at the start, the conveyor belt begins to move. The Arduino receives the outputs from these sensors, and the filling procedure for the bottles is controlled by this output. If all of the bottles are present on the input side, the sensor sends the corresponding output to the, which then turns ON the corresponding pumps, allowing the filling operation to begin. If a bottle isn't present, the pumps for that bottle are turned OFF.

2) *Filling Operation:* As soon as the bottles are identified on the input side, the conveyor motor turns on and begins moving ahead. The bottles then reach the desired filling position, and the conveyor comes to a halt. The appropriate pumps in the process tank turn on, and the filling process begins. For example, if a bottle is present near a water outlet, the pump will turn on, and the filling procedure will begin.
3) *User-Defined Volume:* A user-defined volume selection option is included with the filling operation. The required volume is fed into the Arduino, and the volume determines how much liquid is filled. Timing activities are used to fill the container. As a result, the pump runs for the duration of the timer's programmed value before turning off. The conveyor resumes movement once the filling operation is completed.
4) *Depth Sensing:* Since the bottles are filled through an outlet that is connected to a tank, it is also required to determine the level of the tank in order to avoid wasting time. The water level in the tank is detected using an ultrasonic sensor, and if the water level is going to fall below the minimal level, the buzzer will sound to alert you. The tank's water level will be displayed on the LCD in percentage form so that the user is aware.
5) *Relay Mechanism:* Relay module is used to operate the water pump. The relay module will get the command to turn ON the switch through the Arduino, when the IR sensor detects that the bottle has reached the desired position then the bottle will be filled till the given time and then as soon as the bottle is filled up to the required mark the relay is turned OFF.

IV. IMPLEMENTATION ON SOFTWARE AND RESULTS

The given below presents the working of the system with the help of Proteus software. It also holds the schematics created on other softwares like EAGLE and Tinkercad for a proper functioning of the system.

A. *Proteus Simulation*

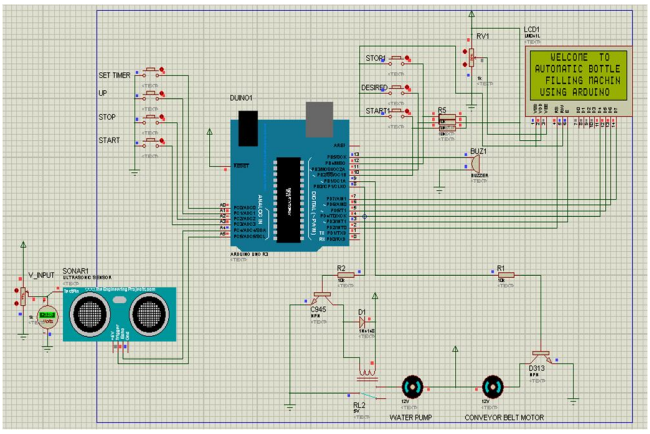


Figure 9: Proteus Schematic

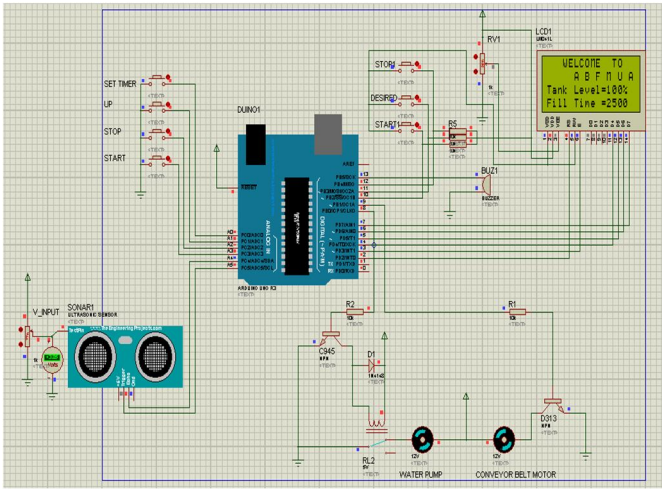


Figure 10: Displaying the water level and time

B. Eagle

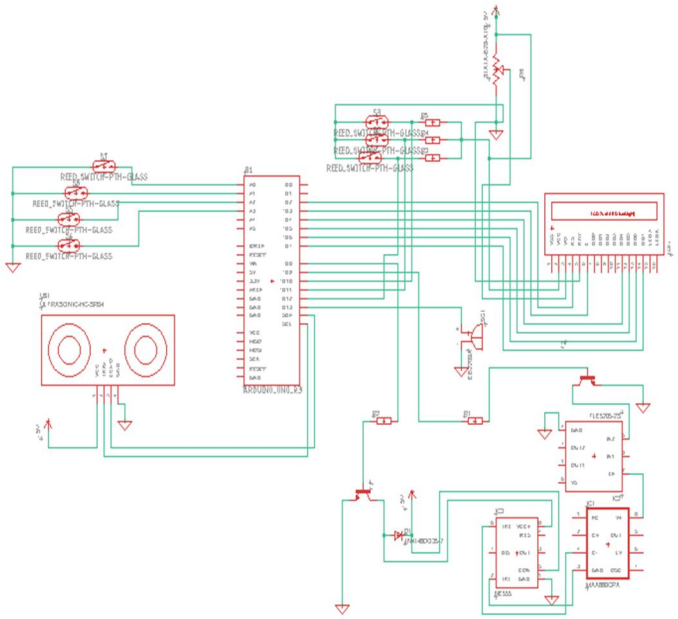


Figure 11: Eagle Schematic

C. Tinkercad

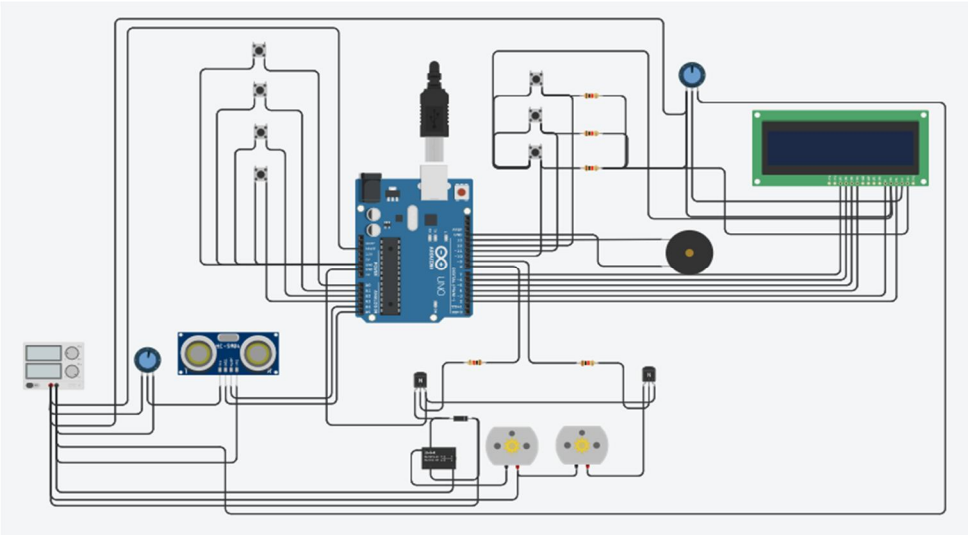


Figure 12: Tinkercad Schematic

V. RESULTS

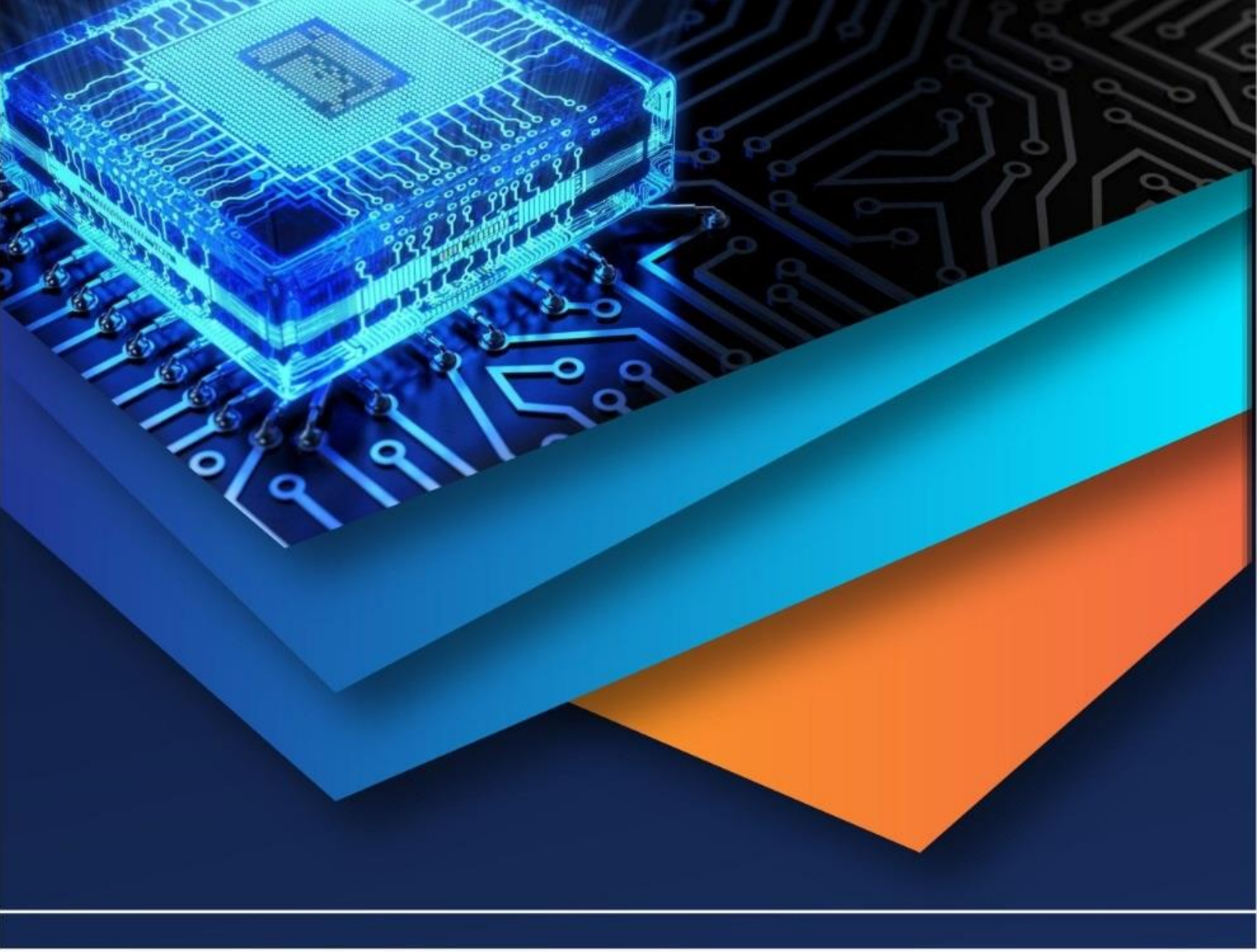
This project was initiated by an idea of reducing work labor, and deploying machines to do the manual work. We had the aim of reducing human efforts in the beverage industry. With this aim, our project is an attempt to implement an automatic bottle filling mechanism, which would require less human effort, with more precision. The current manual process has many disadvantages, like difference in quality of liquid, spilling of bottles due to human error, and also there is a big concern on safety. Talking about the safety, this model is extremely safe to use, as there are least possible components used to achieve the goal, thus minimizing the chance of any errors. Workers may easily operate these machines. Also, these machines work with much more precision than human effort, which makes it quite reliable. This model should be put up to use in small scale industries, to boost their production efficiency. The software tests were successfully conducted and gave positive results. Different platforms were used to test the schematic. The circuit provided desired output.

VI. CONCLUSION AND FUTURE SCOPE

This is a small scale project made for creating an automated bottle filling system. We developed a system wherein it was feasible to fill the liquid into the bottle without manual labor. The bottle can be filled up to the required mark by setting the timer for the amount of liquid we want to be poured into it. Once the bottle is filled the conveyor belt will start moving and the same process will repeat again for the next bottle. This project was created by keeping in mind the problems faced in filling liquids like spilling of the liquid, requirement of manual labor and wastage of time. This present system can be enhanced with new features that can be deployed in the future. Features such as quick liquid filling using a jet nozzle, employing more valves to fill more bottles at a time to increase productivity, usage of sensors for alarms that will show any mismanagement in the process, application of HMI (human-machine interface), and many more are available.. For now it can only fill water in the bottle itself but in future it can upgrade in such a way that bottles can also feed in the conveyor itself. One can also install a capping system in it before storage. In future it can upgrade in such a way to store the bottles. By modifying in CAM (computer-aided manufacturing) design the capacity would be increased.

REFERENCES

[1] Prithwish Das, Krishnendu Mandal, Paromita Das. "Automatic Bottle Filling System Using PLC", RCC Institute Of Information Technology, 2018.
[2] Powell Mlambo, Hickman Chawasarira, Trymore Mambumba, Kelvin Ngandu, Nyasha Bhogodho, Enock Jonathan. "Design of a Flexible Automated Bottle Filling Machine", Department of Mechatronic Engineering School of Engineering Sciences and Technology, Chinhoyi University of Technology, School of Natural Sciences and Mathematics Chinhoyi University of Technology, 2017.
[3] Sagar T. Payghan, Rani H. Deshmukh, Puja P. Magar, Vinod M. Manure. “Automation of Bottle Filling Plant with Industry 4.0”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 2016.
[4] Rehaan Yahya Haji Mahmoud, Khan Bashir Siraj, Shaikh Awesh, Kupe Sufiyan Salahuddin. “Automatic Bottle Filling”, A-I-Islam A.R.Kalsekar Polytechnic, 2014.
[5] Bipin Mashilkar, Pallavi Khaire, Girish Dalvi. “Automated Bottle Filling System”, Fr. C. Rodrigues Institute of Technology, 2015.
[6] Harsh, Nivedita Nidhi Roy, Ayush Sharma, Abhishek Singhal. “Bottle Filling Plant Automation System Using Conveyor Belt Srm”, Institute of Science and Technology, 2018.
[7] Bipin Mashilkar, Praseed Kumar, Amit Chawathe, Vivek Dabhade, Vighnesh Kamath, Gayatri Patil. “Automated Bottle Filling System”, International Research Journal of Engineering and Technology (IRJET), 2016.
[8] Ashwini P. Somawanshi , Supriya B. Asutkar ,Sachin A. More. “Automatic Bottle Filling using Microcontroller Volume Correction”, Amrutvahini College of Engineering, Sangamner, 2013.
[9] Prateek Siroya, Aashiq Mahammad Shah, Rahul Jat. “Designing of Automatic Bottle Filling System using PLC”, International Research Journal of Modernization in Engineering Technology and Science, 2020.
[10] Ashwini P. Somawanshi, Supriya B. Asutkar ,Sachin A. More. “Automatic Bottle Filling Using Microcontroller Volume Correction”, Amrutvahini College of Engineering, 2013.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY