

**Sri Lanka Institute of Advanced Technological  
Education  
(SLIATE)**

**A proposal on**

Automatic Bottle Filling System using Arduino

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## **1. Introduction**

This project proposal is submitted “to meet the Arduino system development requirements of Individual project module conducted by the” Sri Lanka Institute of Advanced Technological Education (SLIATE), Batticaloa, 2019.

The project named “Automatic Bottle Filling System”, a bottle filling system is using Arduino concept.

In today’s world the importance of automation has immensely increased. The industry has now shifted its purpose of automaton to broader level. Our project works on automatically filling bottles using Arduino controller, its counting and packaging. It is less costly, cheap and widely used technology. This project looks on reducing the cost of automation in small scale industries.

A simple automated device has been designed and constructed in order to fill the tank with a given volume of the liquid. This preliminary study indicates that the ultrasonic sensor releases an ultra-sonic wave to measure the distance between the water level and the sensor. The water level can be adjusted by the device and the tank will be filled up to that volume. The device is programmed to switch off the solenoid automatically. Microcontroller is used to control the automatic operation of the filling system. It is selected as the controller because it is easier to learn and the compact size makes it easier to attach it with the system. The main advantage of this filling system is that we can fill the tank with exact volume which is needed. This can be mainly used for laboratory purposes (to take an accurate volume of a liquid). In large scale this system can be used in industry. The system that is designed to improve accuracy, enhance safety and efficiency.

For counting of bottles we have used IR sensors which are more accurate in working and cheap as well for transportation of bottles in the factory we are using conveyor belt. The material used in belt is rubber which rotates on three DC motors. To fill bottles of 250ml, we have used DC pump which takes 30 seconds to fill the bottle.

## **2. Background and Motivation**

Automatic Bottle Filling Machines are most commonly used in beverages and soft drink industries. These machines use a conveyor belt which is an economical and fast way to fill bottles. Mostly PLCs are used for Automatic bottle filling machines, but you can make a very basic and versatile bottle filler using an Arduino. You can program the Arduino to automatically detect the bottle using IR or ultrasonic sensor and allow the bottler to fill by stopping the conveyer belt for some time. Then again move the belt and stop when the next bottle is detected.

Here we are going to design a prototype for Automatic Bottle Filling Machine using Arduino Uno, conveyor belt, solenoid valve, IR sensor, and Stepper motor. Belt conveyor is driven by a stepper motor at a constant preset speed. The stepper motor will keep driving the belt until an IR sensor detects the presence of a bottle on the belt. We used the IR sensor as an external trigger. So whenever the IR sensor goes high it sends a trigger to Arduino to stop the motor and turn on the solenoid valve. A preset required delay is already entered in the code for bottle filling. The Arduino will keep the solenoid valve on and stepper motor off until that specified time. After that time, the solenoid valve turns off the filling, and the conveyor starts moving so that the next bottle can be filled.

We previously used Arduino with Solenoid valve, IR Sensor and Stepper motor, so to learn more about basic interfacing of Arduino with some components,

It aims to eliminate problem faced by small scale bottle filling system. . With this system that operates automatically, every process can be smooth and the process of refilling can reduce the man power cost and operation time.

### **3. Literature survey**

In order to get an idea on the basic fundamentals in the present study an extensive literature review has been carried out.

We have referred to three research papers VIZ “Automatic Water Tank Filling System Controlled using Arduino TM based Sensors for Home Application”, “Faculty of Electronics and Instrumentation Engineering Institute and Technology” and “International research Journal of Engineering and Technology (IRJET)”. This research papers provided knowledge about Arduino programming, filling the bottles, running the bottles using conveyors, and its packaging, etc.

Rajesh G. Khatod, Chandrashekhar Sakhale[2] in their paper worked on touch screen operated liquid dispenser machine for chemical, pharmaceutical industries. The research paper emphasized on reducing complexity and cost involved in present liquid dispenser machine. The research paper aimed to improve metering quality of dispenser machine. The microcontroller used was AT89C52. The system is controlled by microcontroller programming. Also, the research paper gives information about working of system and measurement of process variables.

A.S.C.S. Sastry, K.N.H. Srinivas [3] in their research paper introduced a systematic approach to design and realize a temperature and volume based liquid mixing system using three low cost microcontrollers. The primary function of this system is to mix different liquids of required ratio and temperature. In this paper the electronic sub system is developed with the help of three AT89S51 microcontrollers for controlling. Two LM35 sensors are used for sensing temperature. The mechanical sub system consists of two geared DC motors to allow the liquids in required ratio for mixing

## **4. Aims and Objectives**

### **4.1 Aims**

Aim of our project is to develop a Automatic Bottle filling system, to eliminate problem faced by small scale bottle filling system. . With this system that operates automatically, every process can be smooth and the process of refilling can reduce the man power cost and operation time. Identify the problems and reduce the workloads, mistake and process time made by manual process with the use of IT Solutions

### **4.2 Objectives**

To overall objective of this project is to establish a System for industries, So as to improve the performance and efficiency of industries management. The main objective of this system is to maximize profit by increasing efficacy and decreasing overheads without compromising customer satisfaction. There are some specific objectives should be implemented.

- ❖ Develop a user friendly system by using a microcontroller as the controller so that everyone can operate it with ease and no instructions are required
- ❖ Design the automated liquid filling system with low cost so that this can be applied in small scale industries, to water tanks in houses, in laboratories.
- ❖ Design a system that can fill the container with liquid accurately where the specified volume desired by the user can be achieved with the smallest error possible.
- ❖ Design a system to minimize the water wastage
- ❖ To minimize human error.
- ❖ To minimize the operation time.

## **5. Proposed System**

### **5.1 Design**

A simple conveyor belt will be stretched between two rollers, one roller which pushes it and other roller which pulls belts as the belt moves. The conveyor belt and rollers are accommodated on table frame. The Infrared sensor is fixed at certain position on table frame in such way that it is able detect the bottle. All electrical components are situated on the ply at the bottom of table frame.

The bottles to be filled are arranged on conveyor belt. A tank or sink is placed using support. A rotary pump is controlled by the arduino which dispense metered quantity of water in bottle. A gravity operated filling system has a big difficulty in measuring the correct volume of liquid to be filled. A separate arrangement of a timer operated valve or a secondary tank arrangement requires an extra sensor and valves which adds up unnecessary cost to the system. The pump gets turned on and the bottles are filled. The process is then repeated for particular batch.

### **5.2 Components of bottle filling system**

The automation in bottle filling industry comes with increased electrical components. Essential requirements of each component in the system is important to be studied in ordered to understand how each part works in coordination with other parts in the system.

### 5.2.1 Layout

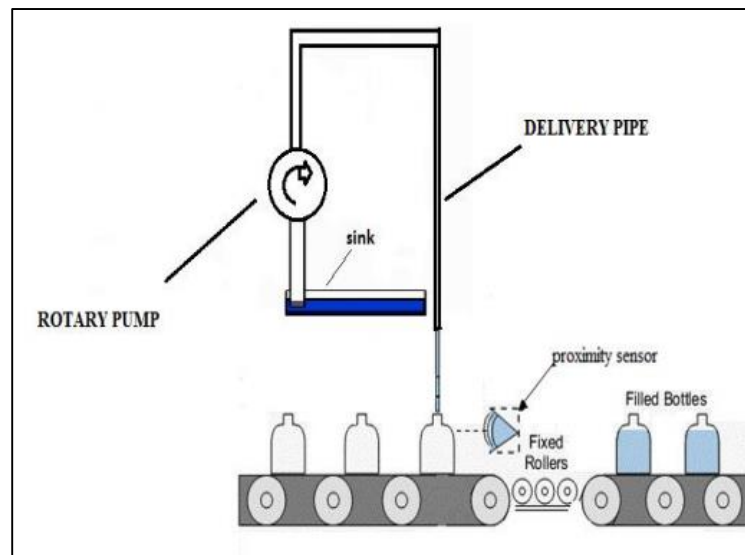


Fig- 1: Automated bottle filling system

Figure 1 shows the layout of automated bottle filling .The Automated Bottle Filling System will comprise of following components.

### 5.2.2 Components

- **Arduino**

The main purpose of the Arduino is to control the program of water bottle filling system. Arduino is a simplified version of c and c++ programs. In Arduino we can burn the program as per project requirement. So using Arduino we can run the project.

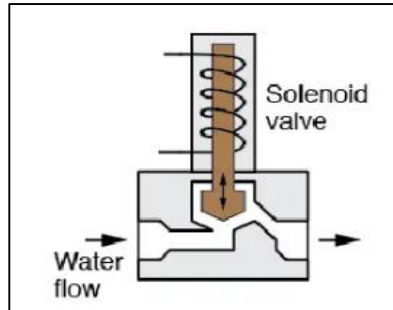
- **Relay**

A relay as shown in figure 6 is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid state relays. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits) The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.



- **Solenoid Valve**

Solenoid valves control the flow of water via the automatic controller. Therefore in this project a solenoid valve is used to control the water flow. This is controlled by a relay.



F2. Solenoid Valve

- **DC rotary pump**

This project, Rotary pump provides a fixed volume of water to flow into the bottle. It is submersible pump. According to user input the time is calculated to fill varying volumes of bottles.

- **IR Sensors(Infrared Radiation)**

IR rays can be used to detect the object. IR sensor consist of two parts which are transmitter and receiver .A transmitter sense the infrared radiations and principle of reflection sensed using receiver. 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.

- **Conveyer belt**

To carry material from one place to another, safely and efficiently, conveyer belts are used. It is most economical way to transport bottles and also the safest. Belt is made up of rubber and consists of three wheels which rotate the belt.

- **Microcontroller**

Microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications.

- **Connecting wire**

Connecting wire is used to connecting one circuit to another circuit. Connecting wire is made of the aluminum or alloy and it is flexible.

- **Roller**

In our project we used two rollers, which is made up of plastic. Roller is used to roll on conveyor belt and provide friction between surface contacts.

- **Plywood**

Plywood is used to mount the electrical component. Relays, DC gear motor, Belt rolling assembly, capping assembly are placed on plywood.

### **5.3 Advantages**

- 1] To reduce human effort
- 2] Time saving
- 3] Saving water
- 4] Reduce worker cost

## 5.4 Disadvantages

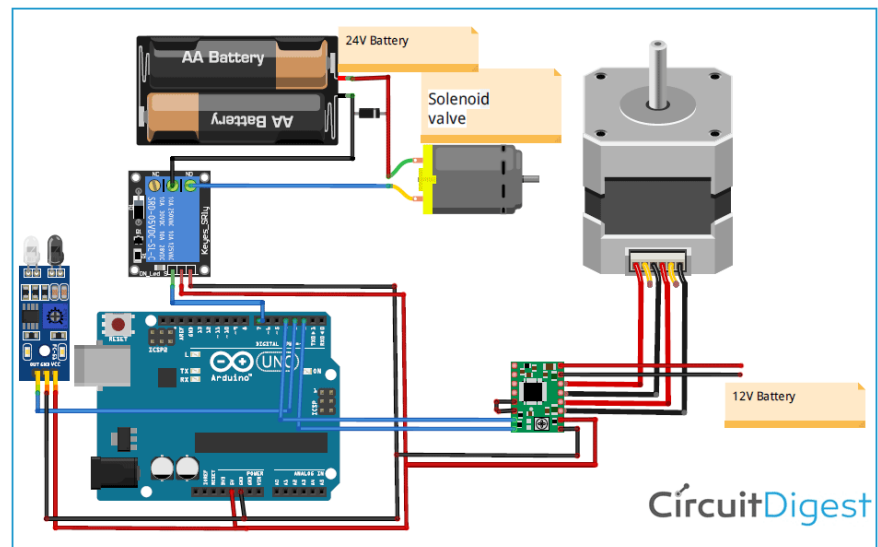
- 1] Volume is limited.
- 2] Work with 230V DC supply

## 5.5 Draw backs of the Liquid System

### 5.5.1 Weaknesses

- Accuracy of the ultrasonic sensor is low.
- Velocity of sound changes with the temperature.
- The speed of the water flow of solenoid is same when the current volume is near to the required volume.
- When the water is filled to the container the surface water level is not in the same level.
- The shape of the beaker which is used to take the measurements is not constant.

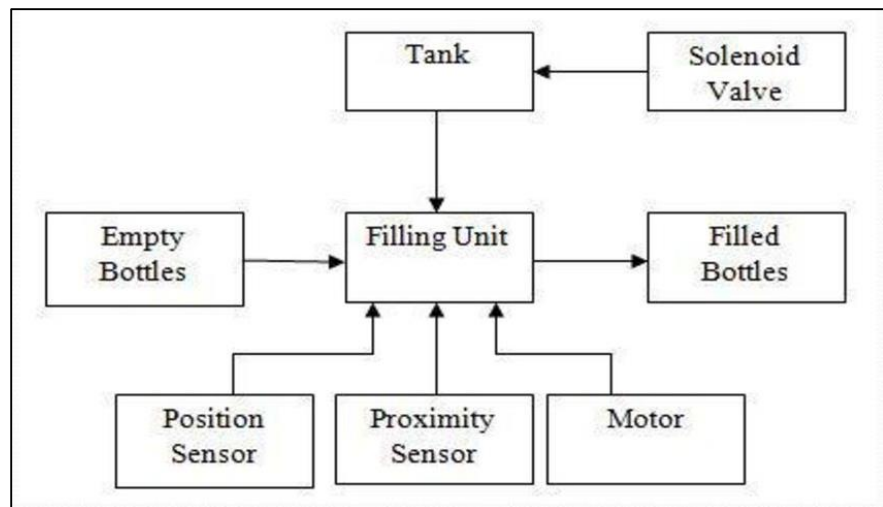
## 5.6 Circuit Diagram



F.3. Circuit Diagram

The circuit diagram for the Automatic Bottle Filling System using Arduino is given above.

## 5.7 Block diagram



F.4. Block Diagram

## 6. Resource Requirements

- It should fill 300 bottles of 1L in an hour and 600 bottles of 0.5L in an hour
- Bottle detection and operation of the filling mechanism shall be within 2s-3s
- It fills bottles different volumes
- It shall be a microcontroller based system

### 6.1 Components Required

- Arduino Uno
- Stepper Motor (Nema17)
- Relay
- Solenoid Valve
- IR Sensor
- A4988 Motor Driver
- Battery

## 7. Reference

- [1] Asutkar, Sachin More(2013), “Automated bottle filling using microcontroller volume correction”, International journal of engineering research and technology (IJERT). (vol 2, Issue 3, march-2013).
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- [5] <http://winkitindia.com>