

AUTOMATED BOTTLE FILLING SYSTEM

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Abstract - Liquid filling machine is used in beverage and bottling industries. Some of the filling machine is commercialized as water vending machine where by Reverse Osmosis water can be brought from by using money. The machine found in the market is high in price, requires complex changes in hardware and program configuration if varied liquid volume is required to be filled and most of the time; it is not fully automatic. The purpose of this project is to develop an automatic liquid filling machine. Microcontroller is used as the controller to control the automatic operation of this machine where the machine consists of conveyor system and filling stations. Microcontroller 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 automatic liquid filling machine is developed to be lower in price compare to the other filling machines in the market. The machine is also easy to operate and user friendly, where simple steps are needed to operate the machine. The machine controller is also portable and can be attached with conveyor system or can be left standalone.

Key Words: Bottle Holder, chain conveyor, microcontroller, relay, sensor, solenoid valve.

1. INTRODUCTION

In small industries bottle filling operation is done manually. The manual filling process has many shortcomings like spilling of water while filling it in bottle, equal quantity of water may not be filled, delay due to natural activities of human etc. This problem faced by small industries compels us to take up this project. Our project is meant for small industries. 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 workers cost and operation time. The system operates by the program that designed to do the operation.

2. DESIGN AND DEVELOPMENT OF AUTOMATED BOTTLE FILLING SYSTEM

In order to implement the smart solar irrigation system, a control system is designed and developed. The previous discussion of this study involves the need for the study and

review of literature involving similar control systems. After going through previous research papers a tentative design is prepared. The basic block diagram and working of the entire setup both are explained in the subsections below along with the detailed list of components and their specifications. After designing the block diagram and deciding the features of the control system, hardware required for implementing the setup was studied. The components, circuits and other miscellaneous hardware was enlisted, bought and fabricated. For testing, one sensor was interfaced with its comparator, then subjected to varying moisture conditions with the help of a sponge under energized condition. The voltage signals from sensor were observed with the help of Multimeter, and found to be consistent with respect to different moisture content inside the sponge.

2.1 Flowchart and Working

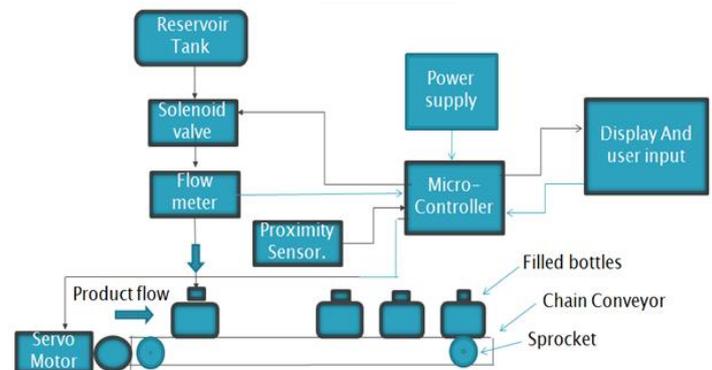


Fig -1: Flowchart of assembly

The components of the Bottle Filling System are controlled by the Microcontroller. The figure 2.1 gives the pictorial representation of the various components of the bottle filling system controlled by the means of the Arduino based Microcontroller. The bottle filling process starts with the user input given through keyboard. The user input is fed into the microcontroller. The microcontroller subsequently triggers the dc motor drive circuit. This switches on the DC servo motor. The conveyor system starts moving until the proximity sensor detects the presence of bottles, thereby stopping the chain conveyor. The proximity sensor is capacitive in nature and triggers the microcontroller to actuate the solenoid valve, switch off the motor and start the valve to fill the liquid. When the required volume is filled, the microcontroller cuts off the excitation current to the solenoid

valve and simultaneously starts the dc motor. Thus the same process repeats for the filling of next bottles until the batch quantity is satisfied.

2.2 Components Selection

The Automated Bottle Filling System will comprise of the various components which are controller by the Microcontroller. The proximity sensor will be used to detect the presence of bottle. DC servo motor will be responsible for effective transfer of bottles by the means of conveyor system. Solenoid Valve will control the amount liquid filling the bottle. The input and output display devices will act as the interface between the system and user. The entire system will be controlled by the Microcontroller unit. The details of the various components will be given the following sections.

2.2.1 Arduino 2560 Mega Micro Controller

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 do 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 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. 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.

The sequence of events is shown in this figure

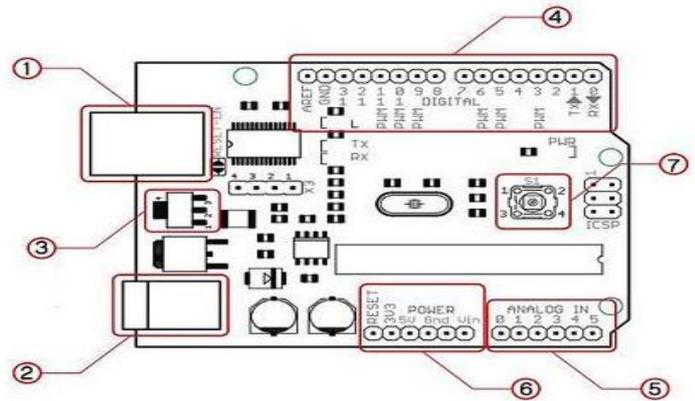


Fig -2: Arduino Pin Structure

The most important parts of the Arduino are highlighted in red. They are as follows:

- 1) USB connector
- 2) Power Connector
- 3) Automatic Power switch
- 4) Digital Pins
- 5) Analog pins
- 6) Power pins
- 7) Reset Switch

2.2.2 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.

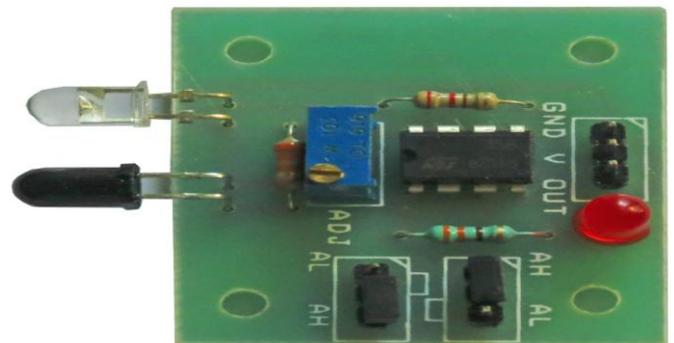


Fig -3: Proximity Sensor

2.2.3 Display

Under laptop's control, microcontroller sends sensor data to laptop that displays numbers and graphic. The Microcontroller is :

Arduino Uno: It will be downloaded with IDE (Arduino developing environment on PC that will install its necessary drivers too. In order to program a microcontroller using a serial port (RS-232) connection it is required need to attend to several things. The microcontroller must already be programmed with some kind of monitor or bootstrap loader program to accept the code required to be transferred and store the program. The microcontroller must also be electrically connected to the serial link using an RS-232 level converter. It will require assistance of software on the laptop that will implement the specific programming protocol required to transfer a program to your microcontroller. The cable connecting the laptop to the microcontroller may require a particular configuration (straight-thru, null modem or some other). Finally, the transfer protocol (baud rate, # of bits, stop bits, parity, handshaking) must be in agreement between PC and the microcontroller. Connect Arduino to the computer through a USB cable and open the editor. Subsequently, loading the required program, open the Serial Monitor. Using the input field in the Serial Monitor type 1 to the Arduino board to turn the built-in LED on, anything else will turn it off. The Serial Monitor displays the value the Arduino sent back (the one it got as the input).

2.2.4 Relay

A relay as shown in figure 2.5 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), or where several circuits must be controlled by one signal.

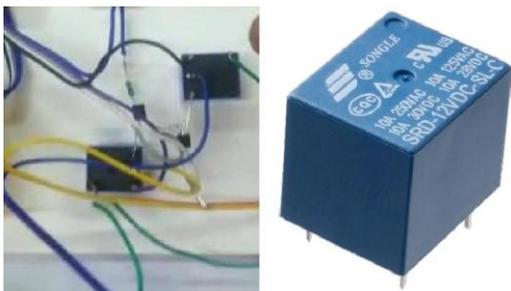


Fig -4: Relay

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.

2.2.5 Battery 12V

A 12V Lead acid battery is used to supply power to different components in the system. An electric battery is a

device consisting of one or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work.

2.2.6 Reservoir Tank

An overhead reservoir tank of capacity 10 litres of dimensions 500 mm diameter and height of 300 mm is used for filling bottles with the help of solenoid valve, attached at the bottom of the tank.

2.2.7 Chain Conveyor

Conveyors supply a reliable means when bulk material needed to be transported continuously. This device is the most economical if the handling rate and total quantity warrant is concerned. The lifting and conveying machine can be divided into two categories. The categories are intermittent motion and continuous motion. Intermittent motion consists of cranes and lifts. Continuous motion includes conveyors, pneumatic and hydraulic means. Conveyors are used to convey different types of bulk and unit loads along horizontal and slightly inclined paths. It also used for transporting articles between different types of operation in production lines. Conveyors can be categorized into many types. Those types are chute conveyors, slat conveyors, bucket conveyor, screw conveyor and pneumatic conveyor.

In this project, the type of conveyor chosen is chain conveyor. Chain conveyor is a machine with a moving chain. The parts involved are conveyor bed where the size chosen according to the requirement. The figure 2.6 below shows the conveyor bed.

A pulley is like an iron pipe which is placed at each end of the bed. Each pulley has steel shaft through it. The shaft turns on a bearing and the pulley turns with the shaft. Bearing uses little steel balls that allow the different piece of metal attached together through it to turn freely. Motor is used to drive the pulley. A Sprocket is put on the drive pulley shaft. Sprocket is metal steel with teeth on the outside. This is used to turn the chain which allows the pulley to turn and thus it can carry material placed on it horizontal or at slightly inclined paths. The Figure 2.7 below shows the motor configuration that drives the conveyor and the sprocket.



Fig -5: Chain conveyor

2.2.8 DC Permanent Magnet Geared Motor

A DC motor of 1800 rpm, 0.5HP is used to run conveyor. 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.

2.2.9 Solenoid valve

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid. A two-port valve is switched on or off. It is timer operated and is used to control the amount of liquid to be filled. Its switching is controlled by the microcontroller. It can be operated at the maximum pressure of 10 bar. Material used for the solenoid valve is brass. The following figure shows the solenoid valve.



Fig -6: Solenoid valve

2.2.10 Assembly of Components

The following fig. shows the assembly of all the components of bottle filling system.



Fig -7: Assembly of system

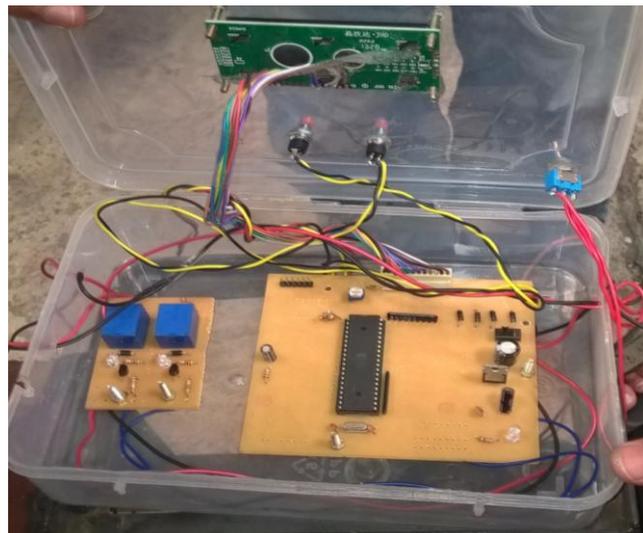


Fig -8: Electronic circuit

2.2.11 Procedure and Results

- 1) The bottles are placed in the bottle holder on the conveyor.
- 2) Establishing all the connections of the components with the microcontroller, the power button is switched ON.
- 3) The readings are taken for variable volumes.
- 4) The following results were obtained for 100 ml volume. The valve remains open for 10 seconds to fill 100 ml.

Table -1: Results obtained

| Sr.no | Volume to be filled (ml) | Actual volume filled (ml) | % Error |
|-------|--------------------------|---------------------------|---------|
| 1 | 100 | 98 | 2 |
| 2 | 100 | 97 | 3 |
| 3 | 100 | 97 | 3 |
| 4 | 100 | 96 | 4 |
| 5 | 100 | 97 | 3 |

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3. Conclusion

As the control system and the field unit has been successfully installed and the testing was carried out under specified conditions, it was found that the system efficiently works with the help of solar power, using the appropriate amount of water to irrigate the field. This saves the water without wasting and also doesn't use electricity, thus saving power.

4. References

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