Design and Fabrication of Water Vending Machine using PLC

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ABSTRACT

Now a day's water vending machines are available and operated on only one coin but we aim to design a water vending machine that is operated on different coins. In India, there is a problem with safe drinking water therefore we are going to provide mineral water. The rapidly rising population and changing lifestyles have increased the need for freshwater. It would be clear that in most rural areas, households are paying far more for water supply than the often-normal rates charged in urban areas.In summer we face the problem of drinking water.This project is based on coin operation. The water vending machine dispenses water on the detection of the right coin. It can be used in public places like Roads, Railway stations, Shopping Malls, etc. It can prove to be of great use and comfort for people.

Keyword: - Water vending machine, Programmable Logic Controller (PLC), Coin Sensor, RFID, Multi Coin operated

1.INTRODUCTION

The rapidly rising population and changing lifestyles have increased the need for freshwater. In summer, we face the problem of drinking water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level. We are going to design a project which is based on coin operation or RFID operation. It has been specially designed for village people. It is also use on Railway station, Bus station, public places etc. This system is based on PLC. The inputs to the PLC are coin and RFID tag and output in the form of water. Looking at the specifications required for water dispensing system and for simplicity of our application, microcontroller was found to be best suited. The machine has numerous input and outputs to provide service to the customer. The main motto of this system is to avoid the environmental pollution and also to avoid the wastage of water with the help of water control valve and give purified water to the customer. We know that the available water resources have initiated towards the end. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water Vending machine is going to be developed in such a way that water will get served to the customers.

Existing Systems In most of the developed countries the vending machines are situated at public places. These machines dispense the snacks, cold drinks, coffee, tea, etc. to the people. Also in developing countries the vending machines are used to provide these things. The basic idea of proposed system is originated from these existing systems. Majorly we are developing a system in which there are two water tanks to provide water to customer. The two major water tanks are as follows 1. Primary Tank (Front Tank) 2. Secondary Tank (Back Tank) Primary tank is only to give the required quantity of water to customers after inserting a coin in machine & secondary tank is connected to the hub tank (Central Tank) through the technique of pipelining[1]. Pipelining is useful to provide the water to the back tank (secondary tank) from the Hub tank (central tank). The Central Tank will be the main source of water to distribute water to secondary tank. Secondary tank will have two water levels empty & full respectively. These two water levels are controlled with the help of IC555 . Here PLC will be interfaced to maintain the constant water in the secondary tank using sensor.

2. TECHNICAL ASPECTS

2.1 PROGRAMMABLE LOGIC ONTROLLER

A Programmable Logic Controller is a solid-state industrial controller that performs discrete sequential logic in a factory environment. It is originally developed to mechanical relays, timers and counters. PLCs are used to perform difficult control operations in a plant. A sequence of instructions is performed by the user to the PLC memory and when the program is executed, the controller operates a system to the correct operating specifications.

A Programmable Logic Controller is currently defined by the National Electrical Manufactures Association (NEMA) as a digital electronics device that uses a programmable memory to store instructions and to implement specific functions such as logic, sequence, timing, counting and arithmetic operations to control machine and processes.

Figure 1 Programmable Logic Controller

2.2 SWITCHED MODE POWER SUPPLY

A switch mode power supply is a power converter that utilizes switching devices such as MOSFETs that continuously turn on and off at high frequency; and energy storage devices such as the capacitors and inductors to supply power during the non-conduction state of the switching device. The supplies have higher efficiencies of up to 90%, are small in size and widely used in computers and other sensitive electronic equipment.

SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronic gadgets. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching “on” and “off” with high frequency.

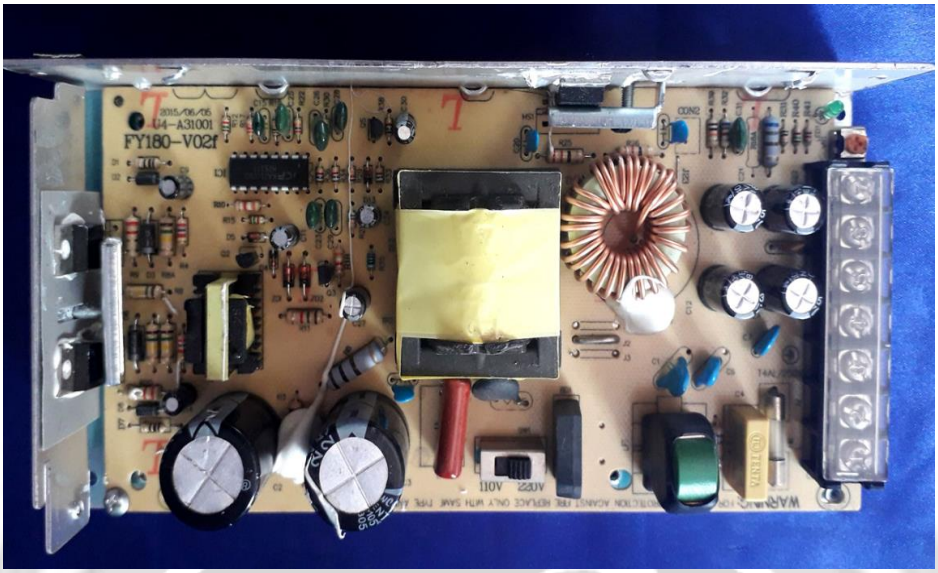

Figure 2 Switched mode power supply

2.3 COIN SENSOR

Coin sensor is the device which is used to detect the correct coin. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. CH-926 is a multi-coin selector, can accept up to 6 kinds of different coins at the same time. This type of coin selector is widely used in Vending machine, Arcade Game, Message chair, and other self–management system. CH-926 is mainly based on material, weight and size to identify coins. It has the most up to date algorithm to design software. Therefore, CH-926 is very stable and accurate even when environment changes such as temperature, and humidity etc. In order to increase the accuracy, we suggest different version of coins use different channel to set up.

Figure 3 Coin Sensor

2.4 RFID SENSOR

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader.RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.RFID tags have not replaced bar codes because of their cost and the need to individually identify every item.

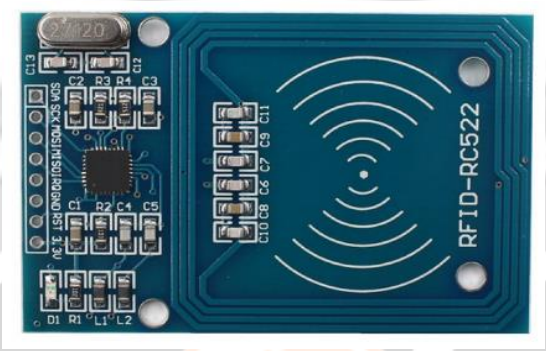

Figure 4 RFID sensor

2.5 SOLENOID VALVE

This is simple on\off type 9V dc supply valve. This type of valve is used in motors. This module consists of interface between vending machine and water output valve with the help of PLC. The switch is "Normally closed". (Automatic flush and shut off, auto power cut-off when filling, extends pump duration) when you connect it with high pressure switch. It shuts off the water supply when the tank is full. Normally controlled in the RO system by the booster pump High pressure switch.

Figure 5 Solenoid valve

2.6 PUMP

This water pump is use to take water from water tank or well. This water pump is connected between the water tank or well and tap where we can get water. In our project we use 0.5 HP, 0.37 kw monoblock water pump. Featuring brass impeller and copper winding, the special motor design of this water pump can work on UPS as well. This water pump is capable of priming up to 3 meters static suction lift without a foot valve at rated head and discharge. Well known for high performance, durability, efficiency, and reliability, this water pump can withstand with wide voltage fluctuation from 180 to 240 volts. With 33.6 LPM water flow and 50 hertz frequency, this water pump is applicable for use at household as well as commercial places.

Figure 6 Pump

Pump specification

Phase	Single phase
Motor body	Cast iron
Discharge	35 LPM
Suction delivery	25×25 mm
Voltage	230 volt
Motor power	0.5 HP
Frequency	50 Hz
Current	2 A

2.7 LCD

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

Figure 7 LCD

3.DESIGN AND IMPLEMENTATION

3.1 Working Principle

This water vending machine is specially designed for village people to provide purified water. Machine is operated with the help of two sensors that are coin sensor or RFID sensor. The RFID sensor is designed for village, industry, company where people use this machine daily. So they have not to insert coin daily, they just need to scan their

RFID card and get water. Whereas the coin sensor operated machine is use every public place like Bus station, Railway station, garden or highways. They use coin of Rupee 1, 5 or 10.

A customer has to be insert coin in machine or RFID card is scan on sensor. The coin is checked whether the coin is correct or not by the coin sensor. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. The RFID card is sense by the RFID sensor.

Now, when inserted coin or RFID card are appropriate or right the Programmable Logic Controller gives signal to the relay and relay will switch the R.O pump which is connected to the water tank. So the R.O pump will lift the water from water tank. Then water is flowing through the flow sensor. Flow sensor is sensing devices which continuously measure the amount of water. When flow sensor measures that amount of water which is defined for different coins, it will give signal to PLC and PLC give signal to the solenoid valve so valve will be off and water flow is stop. Solenoid valve controls the flow of water automatically. So customer will get purified water in the jug or any other watering vessel. Connection diagram is shown in figure 8.

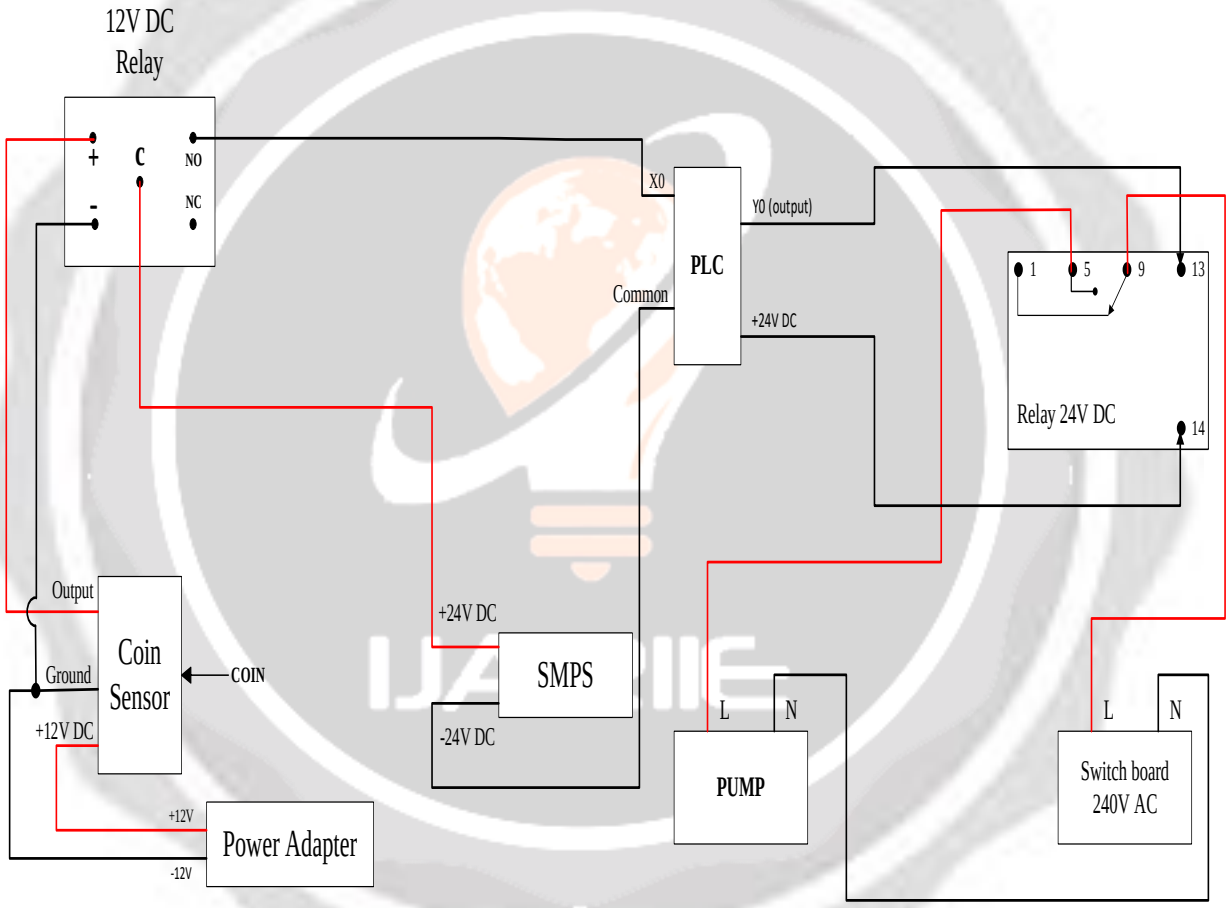

Figure 8 Connection Diagram

3.2 Flowchart of Water Vending Machine

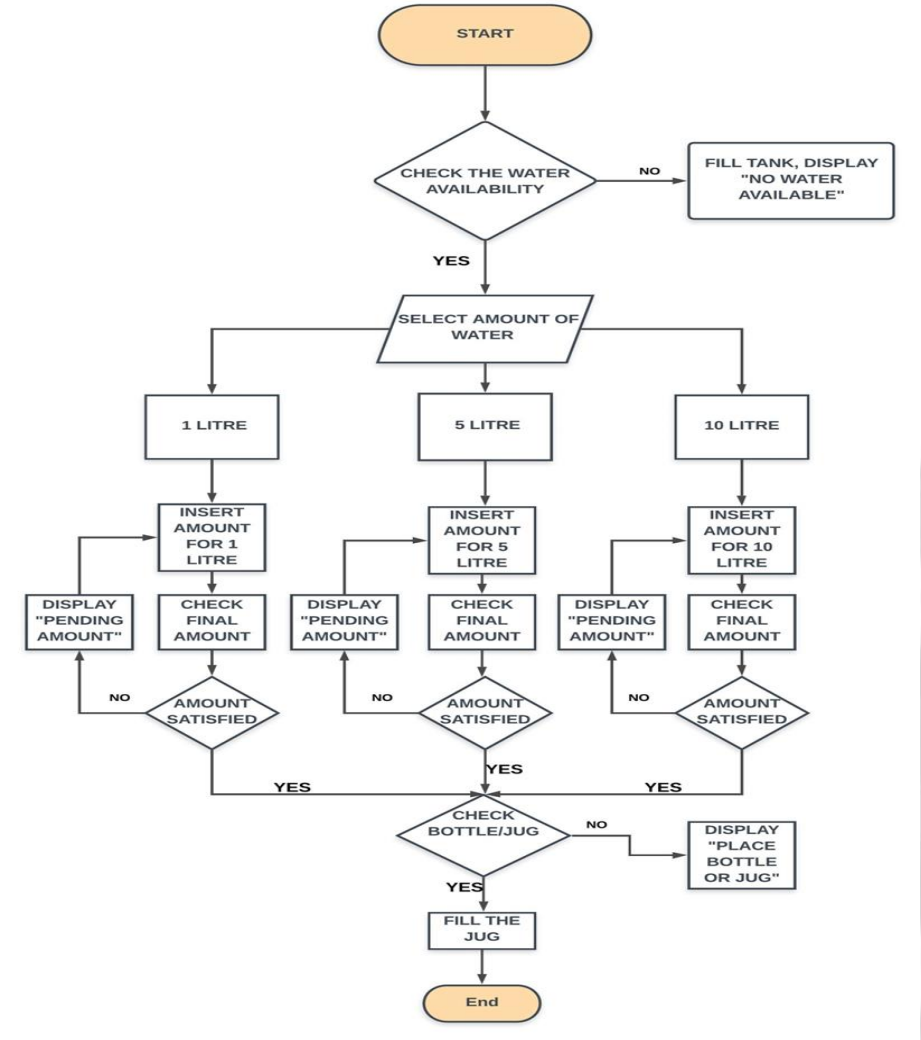

Figure 9 Flow Chart

The flow chart of water vending machine is shown as above. First machine check the status of the water in the water tank if there is no water then the LCD is displaying “Fill tank and No water available” and if water is available then the LCD is displaying “Select the amount of water”. Customer will select the amount of water that are one litre, five litre or ten litre. After that insert coin or scan the RFID card for selected amount of water. Now if the coin is correct then system will check the glass, bottle or jug is placed or not. So system will check whether glass or jug is placed or not. If jug is not placed then LCD displaying message “Place bottle/jug” and if the jug is place properly then water is dispatch into that jug. This way customer will get water and system is complete.

4. SIMULATION AND RESULTS

In this, we have done interfacing of coin sensor with PLC in winproladder software. Win Pro Ladder is easy to learn and use, and allows users of all types, beginner or expert to operate the software in a very efficient manner. For use in a Windows operating environment, completely designed in accordance with Windows environment operation methods. With run time editing feature, during the simulation process the program can be modified without stop the execution.

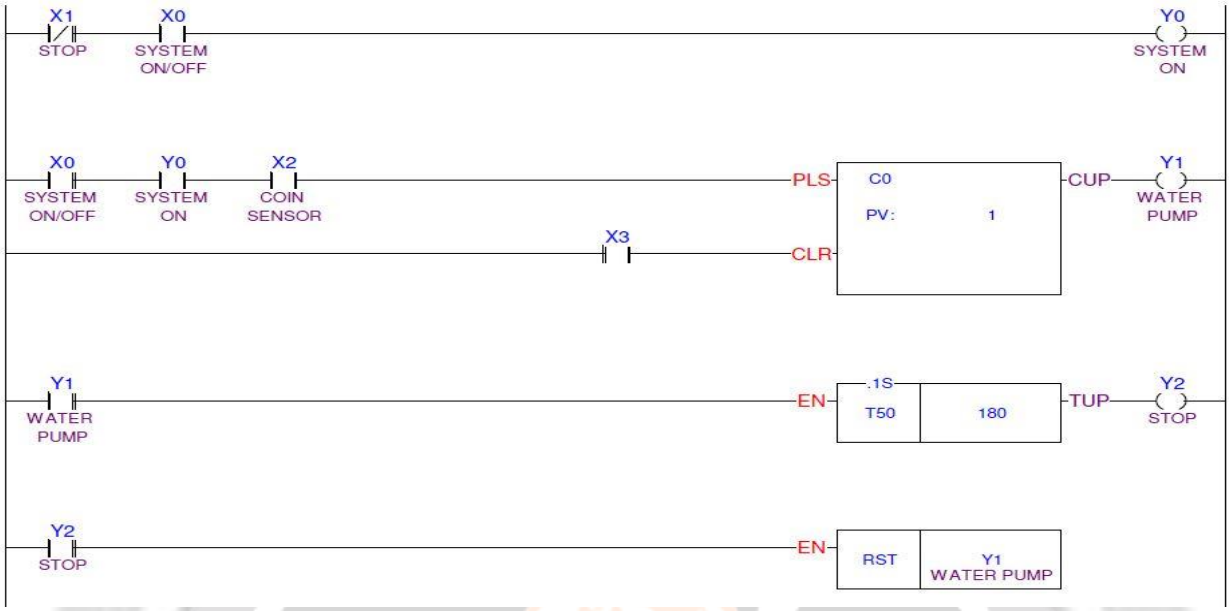

Figure 10 Ladder Diagram of interfacing of coin sensor with PLC

This is the ladder diagram of PLC done on win proladder software.

Here,

X0 = System on/off

X1 = Stop

Y0 = System on

X2 = Coin Sensor

Y1 = Water pump

C_0 = Counter

X3 = Push button for clear function

T50 = Timer

When push button X0 is processed our system is ON i.e. Y0 here X2 is our coin sensor so when coin is inserted it turns On and counter C_0 is increased by 1. So, our water pump Y1 is ON. There is one timer T50. When Y1 is on our timer T50 is ON for 180 seconds. After 180 seconds timer output turned ON the output coil Y2. The output of Y2 is given to reset function. In this reset function when done bit is given to it, the output associated with this function will be off. Here water pump Y1 is associated with reset function so after 180 seconds with the help of reset function water pump Y1 will be off.

In our project we conclude that acceptance ratio is almost 100% and vending machine works on arduino controller To develop low cost water vending machine. To avoid wastage of water.

5.FUTURE SCOPE

An increase in the diameter of the water solenoid valve and pipes would increase the flow rate. Hence, taking lesser time to fill in the tumbler. The whole product can be redesigned for it to be aesthetically pleasing and for its better usability. It can be used for other beverages and drinks also.

6.CONCLUSION

Implementation of Coin-Operated Automatic Drinking Water Machine is the step towards the future technology and it is a step to enter in eco-friendly world. This machine is easy to use and can be easily accessed by the ordinary person .We have developed a water vending machine which is an improved version of the normal water vending machine. This water vending machine reduces human efforts, less time consuming, economical and power consumption of the control system is less. A water vending machine is designed, developed, and demonstrated to give purified water at economical cost. Customers just have to insert coins or scan RFID card. By implementing this type of system, we can provide water at the village, public places like Bus station, Railway station, garden, and isolate place like highways.

7. REFERENCES

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