Automatic Water Refilling System

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Abstract- ***This project is to implement automatic water filling system using reed switch. The circuit of the system is fully supported Magnet sensor. The system's operation is automatically switched ON/OFF the pump motor due to the driver circuit of sensor by means of floating magnet inside the pipe. The magnet sensor is sensed for water level and transistor circuit for switching the pump ON when the water level falls below a set level and therefore the pump OFF when the tank is full. A magnet sensor, ULN2003IC, and an electromagnetic relay are used for driving the control section. This system's circuit is very simple, cost-effective, and reliable.***

Indexed Terms- ***automatic system, electromagnetic relay, floats switch, Magnet sensor, pump motor***

I. INTRODUCTION

In many sites of reigns, water consumption is very high, especially in urban areas. Using automatic control for a water filling can significantly reduce water consumption to some extent. Therefore, automatic and affordable devices that can fill water into the container are required. The growing population is a serious risk in the world. This makes a big requirement for clean water ever increasing. There is needed to carry clean water around easily from now to ever. Technological advancement allows for automatic water filling with the help of a modern technique. With automation, product quantity and quality can be improved, and in turn, profit will rise. Automatic control functions to compare actual value from plant output to reference input (desired value), determine deviation, and produce a control signal that will reduce zero deviation or small value. The way a controller generates automatic control is known and control the action. Construction of an automatic control can make use of the sensor as the control system.

II. LITERATURE REVIEW

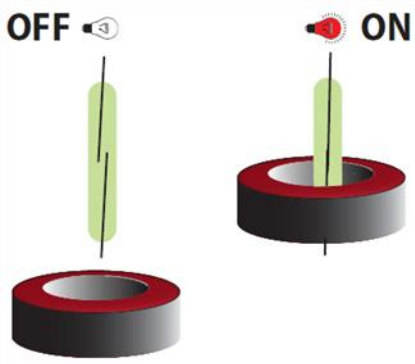

Figure 1: Configuration of Reed Switch

When measuring discrete levels of liquids such as automobile brake fluid, reed switch technology is simple, inexpensive and reliable. The principle involves a magnet mounted on a float that closes an adjacent magnetic reed switch as the magnet approaches the switch. Typically, the reed switch is mounted and sealed in a plastic or non-magnetic metal tube, and a ring magnet mounted on a float rides up and down the tube depending on the liquid level. Since the tube is non-ferrous, it does not impede the magnetic field, so the switch operates when the field intensity reaches a threshold level. Thus the reed switch is protected from the fluid being monitored. The tube should be designed so that the point of entry of the sensor leads is above the highest liquid level. Typically, a magnet made with inexpensive plastic bonded ferrite with an energy product of about 16 KJ/m^3 can be used.

Although there are many different kinds of filling technologies, there are relatively few that are versatile, practical, and cost-effective to own and operate. The choice of filling machine depends on the range of viscosities, temperature, chemical compatibility, particulate size, foam characteristics, and hazardous environment considerations. A control

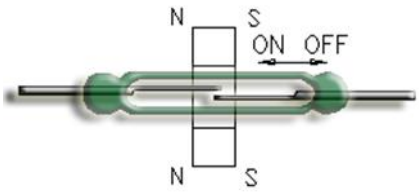

Figure 1: Reed Switch

system is interconnections among components that make up a system configuration that provides desired system response. This means that components can be controlled based on the input-output relationship of processes. Hence, a control system processes input signals to generate output signal variables. Here the model consists of motor, sensor and solenoid relay, mechanism of the water tank, etc.; the motor is operated to fill the water. The sensors are used to identify the position of the water level. Then the solenoid relays are used to open the motor to fill the water in the tank for a particular time.

III. TYPES OF SENSOR

A. Reed Switch

A reed switch is an electromagnetic switch using to control the flow of electricity in a circuit. They are made from two or more ferrous reeds encased inside a within glass tube-like envelope, which become magnetized and move together or separate when a magnetic field is moved towards the switch. The switch effectually works like a gate, or a bridge, in an electric circuit so when the two reeds are in contact, electricity can flow around the circuit operating a device. Unlike mechanical switches they do not have to require something or someone to physically flick them on or off, they are controlled completely by invisible magnetic fields.

Reed switches are used in fluid level sensors for brake fluid reservoirs and to monitor motor oil levels. They are also used in speed sensors for engine control and power steering. Automatic door locks, airbags, parking brakes, seat, door, and hood proximity sensors also utilize reed switches.

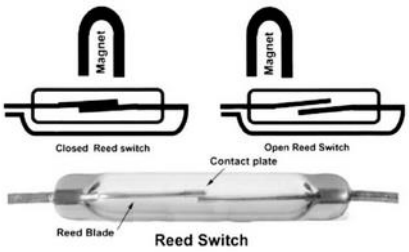

Figure 2: Operation Principle of Reed Switch

There are many profits for using magnetically operated reed sensors, including:

- No mechanical wear – because there is no physical pressure applied to the switch, there is no mechanical wear and tear.
- Operated through a non-magnetic material – sensors can be developed with such sensitivity that they can be embedded deep within an assembly out of sight but still actuated by a reasonably strong but discreet magnet.
- No supply of voltage – as they are triggered by magnetism, there is no voltage required.
- Compact – reed switches are incredibly compact compared to mechanical switches
- Atmospheric corrosion – as the contacts of a reed switch are sealed within a glass tube they are protected from atmospheric corrosion.

B. Float sensor or Float Switch Sensor

A Float sensor, or float Switch Sensor, is a device used to determine the amount of fluid in a tank. A Reed switch is an electrical switch that operates in a magnetic field. The main purpose of this Water Float Switch is to turn the circuit open or close because of the rise or fall of the fluid. Most of the float switches are in the "commonly closed" position. That means the two wires coming from the top of the switch complete a circuit when the float is at its bottom position (for e.g. when a tank is empty). Afloat switch uses a magnetic reed switch to open or close the circuit. The reed is enclosed in a glass tube, it is cemented into a plastic or stainless-steel stem with epoxy.

C. Magnetic Float Sensor

This Magnetic Float Sensor encases a sealed magnet, which moves up and down along the length of the stem as the fluid level fall or rises. When the magnet comes near to the two contacts, it allows the current to pass through and when the magnet moves away, the

contacts separate and demagnetize, hence breaks the circuit. A properly used float switch can send millions of ON/OFF cycles, for years of operation. Failures are commonly due to overloading, caused by frequently spiking voltage. The float switch can use to actuate a pump, an alarm, an indicator, or other devices. Since the current that the switch can carry is much little (0.5A), When connecting a load, the relay must be used. The switch can be easily changed from normally open to normally close by inverting the float.

Here a Reed switch is used to determine the level of water inside the tank. The float switch consists of two wires. One wire of the float switch is connected to the output pin of the control circuit, and the other wire is connected to the ground. The value of the float sensor is run by the control circuit. If the value is "HIGH", the tank is full and the value "LOW" is empty. A relay module is connected to the collector pin of the transistor of the controlled circuit, which is connected to the switch of the water pump. When the water level is low the switch is turned ON automatically, and then when the water level is high the switch is turned OFF.

IV. WORKING PRINCIPLE AND MECHANISM SYSTEM

Automatic water level controllers are a product designed to automatically control a motor that helps to maintain water in the storage tank. This automatic water level controller is started or when it is empty, the upper tank is used to automatically fill or check the amount of water it contains.

In this system Reed switch is used for water level sensor. The reed switch sensor units can be assembled at home. The depth of the water tank from top to the outlet water pipe can be taken as the length of the minimum-level sensing unit. The depth of the water tank from top to the desired level which the tank to be filled up to be taken as the length of the maximum-level sensing unit. The two reed switches are fixed at the top and desired bottom level of the tank as shown in Figure 3.

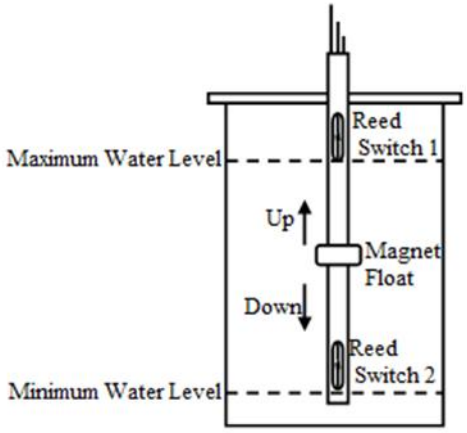

Figure 3.The assmble of tank with reed switch sensor

A. The Sensor Mechanism

Afloat switch with magnet is a device that detects a fluid level (such as water) and activates a set of contacts that may be further integrated into a control circuit for restricting the fluid flow behavior. The advantage of a float switch is that it works without direct contact with the water making the procedure free from all sort's corrosion or mechanical degradation problems.

The proposed float switch assembly is given below:

- 1-inch diameter PVC pipe, length depending on the depth of the water tank.
- Suitable plastic ring (1 inch thick) with a center hole slightly larger than the outer diameter of the pipe.
- A reed switch, the quantity will depend on the type of water level sensing application.
- 1 mm diameter enameled copper wire, 5 meters approximately, or more depending on the tank depth.
- Epoxy seal, for sealing and securing the outer wire terminals from the pipe and to make the pipe watertight

The float mechanism consists of a smooth cylindrical water-sealed plastic pipe, clamped erect inside the water tank's inner base. A plastic water-tight float surrounds this pipe and can slide up/down freely in response to the water level inside the tank. The float is made of plastic floats on the surface of the water, which is pushed upwards or downwards across the plastic pipe depending upon whether the water is being

filled or consumed from the tank. The float also has a permanent magnet on its upper surface.

The plastic pipe has an in-built reed switch assembly at the top and bottom located just near the brim of the tank. The above two counterparts are intended to communicate with each other when the water reaches the upper edge of the tank. When this happens, the magnet in the float is close to the Reed switch, closing its contacts and thereby causing the wire terminals to get shorted across these contacts. The wire ends are sealed with epoxy sealant at the mouth of the pipe so that the pipe becomes watertight and also the wire ends get tightly secured. The free ends must be cleaned, tinned with solder, and used for further integration with the control circuit.

The assembly suits a tank overflow controller system since the reed switch is located at the top of the pipe, near the brim of the tank, similarly, more number of such reed assemblies could be used across the different lengths of the pipe for getting the reading and control over the relevant levels of water.

V. THE OPERATION OF CONTROLLED CIRCUIT

The used components in this circuit are UNL 2003 (U1), transistor (Q1), and (Q2), reed switches (S1 and S2), and a few other components. U1 is configured similar to bi-stable mode, the switch S1 is connected to pin1. The two reed switches (S1 and S2) are affixed at the upper and bottom levels of the tank as shown in Fig. (3). The working of the circuit is quite simple. If water drops below the predetermined level, the magnetic float closes reed switch S2 to pull pin 10 of U1 to ground. Thereby the voltage on pin 2 goes below 1/3Vcc and the output of IC1 goes high. This energizes the relay to activate the motor automatically run and water flows into the tank. When the tank is full, the magnetic float closes reed switch S1. Pin 1 of U1 goes above 2/3Vcc and the output goes low. This de-energizes the relay to deactivate the pump motor to stops the water flowing into the tank.

There are two holes—a drain outlet and an overflow outlet in the water tank. The level-sensing arrangement for the water tank is shown in the figure. A small-diameter PVC pipe is attached to the tank between the two outlets. A magnetic float is put outside the PVC pipe with a hollow float material. One of the reed switches is affixed on the pipe near the drain outlet and the other reed switch near the overflow outlet. The diameter of the magnetic float should be bigger than the PVC pipe's so that it can float freely from bottom to top, or vice versa, based on the water level. If possible, fit the pipe in the tank's inner wall with reed switches affixed externally.

ULN2003 is a seven-step Darlington transistor array network within the IC chip. The Darlingtons are suitable rated to handle current up to 500 mA and voltages up to 50 V. The ULN2003 can be effectively used for making a fully-fledged automatic 2stage water level controller as shown figure. The two

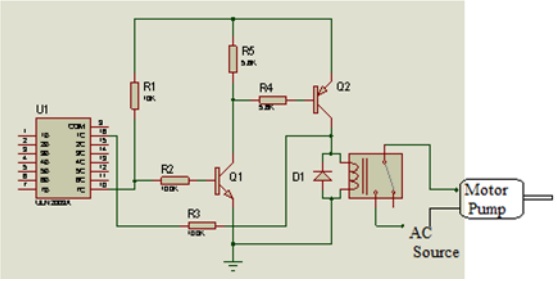

Figure 4. Circuit diagram of controlled system

transistors connected with the ULN2003 is a set/ reset circuit which is attached with the lowermost and the uppermost pins of the IC for the required set-reset actions of the relay and the pump motor.

If the water level is below pin7, the float magnet decent with the water level and the lower sensor reed switch at this level makes contact due to the closing of the float magnet. Therefore, the output pin10 remains deactivated and the output pin 16 of ULN2003IC due to reed switch contact, which in turn allows the positive supply to reach the base of the NPN transistor (Q1) via the 100K resistor.

This makes switches ON stage of the PNP, which instantly latches the two transistors via the 100K feedback across the collector of PNP and the base of NPN. The action also latches the relay switching ON the motor pump automatically. The pump water begins filling the tank, and the water gradually climbs above the pin7 probe level. Pin7 tries grounding the 100K biasing for the NPN but this does not affect the relay switching, since the PNP/NPN is latched through the 100K resistor.

As the water fills and climbs the tank, it finally reaches the highest pin1 probe level of the ULN2003. Once

this happens the corresponding pin16 goes low, and this ground the feedback latch bias of the NPN base, which in turn switches OFF the relay and the motor pump.

The motor operation is driven by the relay unit. The main part of a relay is an electric coil drive by the sensing unit. AC or DC voltage is used to turn this coil on. When current or voltage increases beyond a threshold, relay armature is activated by the coil that functions to connect and disconnect current. The switch mechanism is operated by the magnetic force generated when the coil is supplied with power.

As the coil is energized, it sends information to the switch that makes it connected. The relay compares the current or voltage from the connected transformer and sends information to the switch.

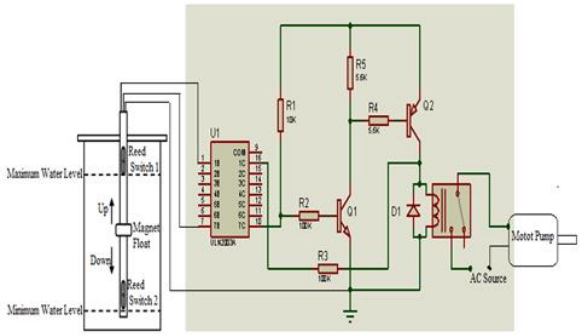

Figure 5. The whole assemble of the system

CONCLUSION

Reed switch is the heart of the control system in designing this automatic water filling device. The transistor drives a relay and motor. It should add a 1µF/25V capacitor across base/emitter of the NPN, otherwise, the circuit will auto-latch on the power switch on and should not use LED on pin 10 and pin 16, because the voltage from the LED may interfere and cause permanent latching of the relay. This circuit system will help to observe and operate the maximum water level and to observe the minimum water level and operate the motor. Also it will be precious to save water from wasting due to overflow. Thereby, it can help to release the tension caused due to human error (forgetting to turn the pump on and filling the water also turn off the motor).

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