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Implementation of Simulated Water Level Controller

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Abstract— Water is the most important Nature's gift to the mankind. Without Water there is no life. Now man understood its importance, especially where water is not easily available. Now this is being managed by the proper manner in city areas where the use of water is more than its availability. 'Water Level Controller' as clear from it is the top level of the overhead tanks in houses or in industrial areas. This controller can automatically switch ON and OFF the domestic water pump set depending on the tank water level. In this paper an effort is made to design a circuit used in water level indicators which can control the storage level of water in a tank to provide water throughout the day without any wastage. This Water Level Controller is designed, implemented & analysed using Multisim tool.

Keywords— Level controller, Sensor, Indicator, Multisim

I. INTRODUCTION

Generally switch ON the pump when their taps go dry and switch OFF the pump when the overhead tank starts overflowing. This results in the unnecessary wastage and sometimes non availability of water in case of emergency. Here a circuit is designed which can make this system automatic, i.e. it switches ON the pump when the water level in the overhead tank goes low and switches it OFF as soon as the water level reaches a pre-determined level. Water Level Controller employs a mechanism to detect and maintain the water level in a tank or any other container by switching it ON/OFF the motor automatically when needed. The level sensing is done by sensors which are placed at different levels on the tank wall. Hence this water level controller is one of the cheapest & simplest devices which prevent wastage of both electricity and water [1]. This paper is organized as. Section II: Explained about Water Level controller with simple circuit. Section III: Explained about Multisim, Simulated water level controller circuit with simulated Result. Section IV: Design and Simulation Steps. Section V: Explain about Components used in this circuit. Section VI: is our Conclusion and Future work.

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Figure 1 shows the block diagram of a water level controller which contains a water pump, overhead tank, water level indicator and a control unit.

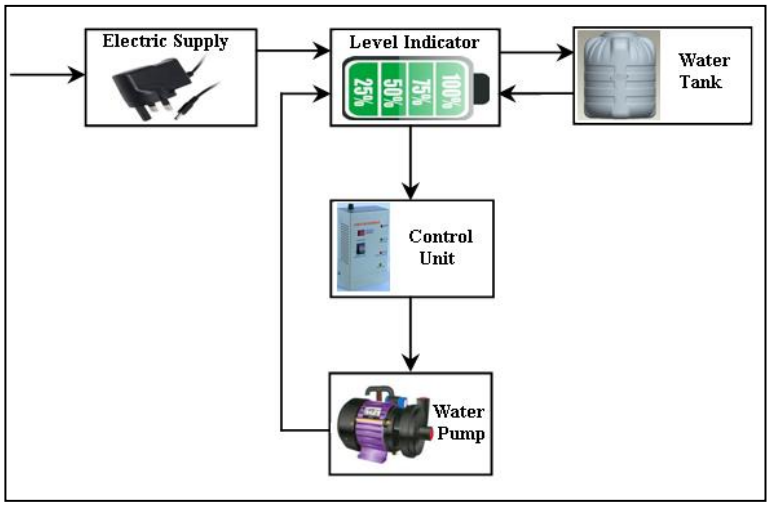

Figure 1 Block diagram of Water Level Controller

II. WATER LEVEL CONTROLLER

Water level controller circuit which controls the pump automatically. Water level controller will have series connection with the pump starter which ensures constant water storage on tanks. Water level controller is used to automatically fill the over head tank as and when it gets empty and monitor the water level in it.

Automatic water level controller switches ON the motor when the water level in the overhead tank drops below a pre fixed level (ON point) and switches OFF the motor when the water level rises to another pre fixed level (OFF point). The water level controller completely stops overflow of water from the over head tank or dry running of pump, thereby saving electricity and water. These losses can be prevented if the tank is regulated automatically by incorporating a feed-back control mechanism, which would be capable of tripping the pump ON or OFF as required.

A simple feed-back control mechanism circuit (water level controller circuit) as shown in Figure 2

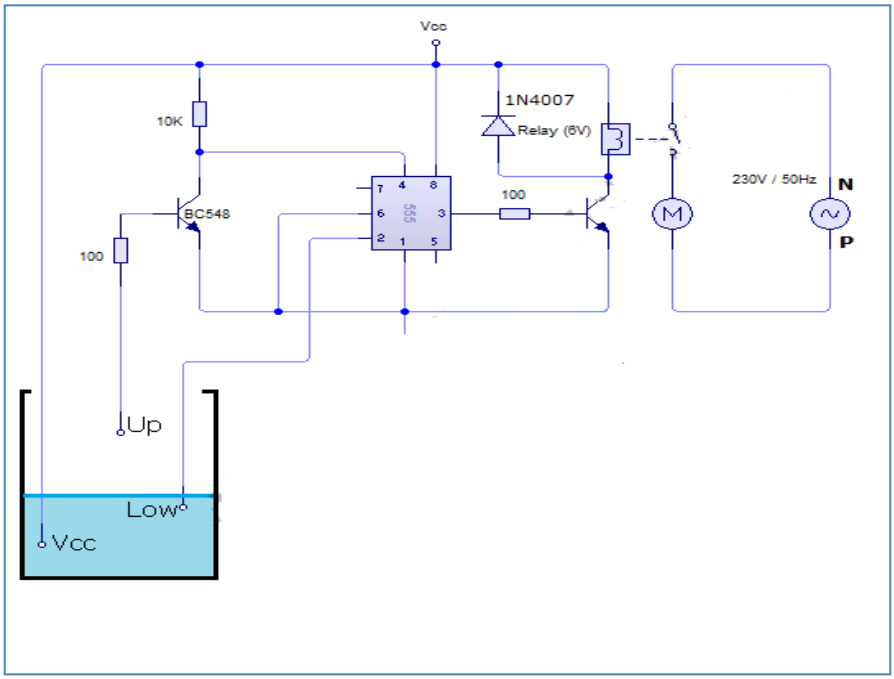

Figure 2 Simple Water Level controller circuit.

In Figure 2 three wires are dipped in water tank. This defines two water levels- Bottom (Low) level and Top (Up) level. One of the wire or probe is from Electric supply (Vcc). The probe from bottom level is connected to the trigger (2nd) pin of 555 IC. So the voltage at 2nd pin is Vcc when it is covered by water. When water level goes down, the 2nd pin gets disconnected(untouched) from water i.e. voltage at the trigger pin becomes less than Vcc. Then the output of 555IC becomes high, while the water level rises, the top level probe is covered by water and the transistor becomes ON. Its collector voltage goes to Vce=0.2(VCC). The low voltage at the fourth pin resets the IC. So the output of 555IC becomes 0 volt. Hence the motor will turn off automatically. For the demonstration of this circuit a DC motor which is directly connected to the output of 555IC instead of relay. For practical implementation relay is used. Rating of relay is chosen according to the load (motor).

III. MULTISIM, CIRCUIT, RESULTS

The Multisim simulator is a software simulation tools which provide an accurate simulation of digital and analog circuit operations. Multisim allows grasping concepts quicker and gaining deeper intuition for circuits. The operating system such as windows XP/ Vista / 64bit Vista supports Multisim software. It has been designed to help hardware designers' gain better understanding of circuit behaviour [2]. Since the quality of simulation results is highly dependent on applied signals as well as analysing and displaying simulation. It helps to close gap between design and practical test. It is easier to interface real world signal from inside Multisim and output data to drive real world circuitry, or display simulation data in a more suitable to form. Using this software it's possible to design projects before it is executed on real components. Multisim provides with an interactive oscilloscope, bode plotter, logic analyser, and power supply, multimeter, function generator, etc. [3] to simulate and analyse the design. It trains creative thinking and innovative abilities. Therefore, the use of Multisim is able to meet the needs of the electronic experiment curriculum design.

The simulator in Multisim has four main stages:

• **Input Stage**—Simulator reads information about the circuit (after builting schematic, assigned values and chosen an analysis). This is the process of net list generation.

• **Setup Stage**—Simulator constructs and checks a set of data structures that contain a complete description of the circuit.

• **Analysis Stage**—The circuit analysis specified in the input stage is performed. This stage occupies most of the CPU execution time and is actually the core of circuit simulation. The analysis stage formulates and solves circuit equations for the specified analyses and provides all the data for direct output or post processing.

• **Output Stage**—Simulation results can be viewed on instruments such as the oscilloscope, on graphs that appear when you run an analysis, or in the log file/audit trail [4].

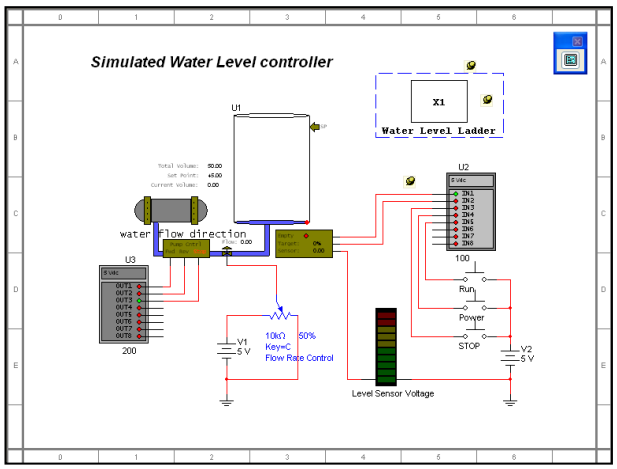

Figure 3 Simulated Water Level controller circuit

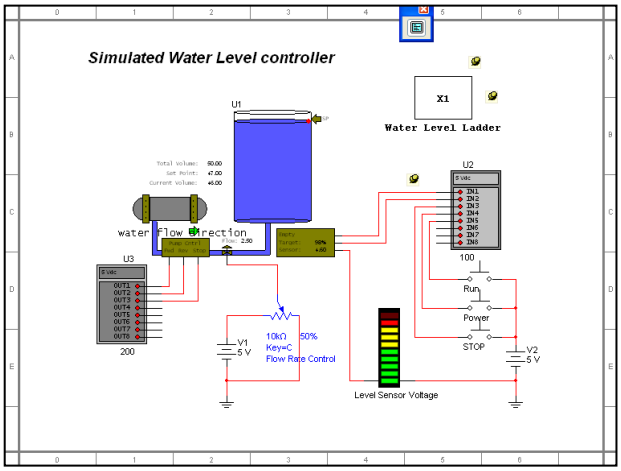

Figure 3 a. Simulation Result for filling tank

Figure 3 shows an example of a logic diagram that drives a circuit that and its showing Water level in Lever Sensor.

IV. STEPS TO ACTIVATE THE CIRCUIT AND DESIGN

1. Select **Simulate/Run** to begin simulation.
2. Click Power ON switch This sends 5 V to pin Input Module which in turn energizes Input Contact X23(Figure 3b) in the Power Lock-up Rung of the ladder diagram. Relay Coil M1 is energized, causing all Relay Contacts with **Relay Device Reference** = M1 to energize. To run Water Level circuit: Activate the circuit as described above and enable Run switch to activate the Run temporary switch. As the simulation proceeds, the tank begins to fill. When the level of the fluid in the tank gets to the **Set Point**, fluid stops being pumped. After a delay of five seconds, the tank begins to empty. When the tank is empty, the flow stops. To turn OFF the power at any point in the simulation, enable stop switch. When Stop switch is enabled, X20 is also temporarily energized, which in turn temporarily energizes Output Coil which sends a pulse to pin Out3 of Output Module U3. This is wired to the **Stop** pin of the tank stops filling or emptying which is show in Figure 3a and Figure 3c.

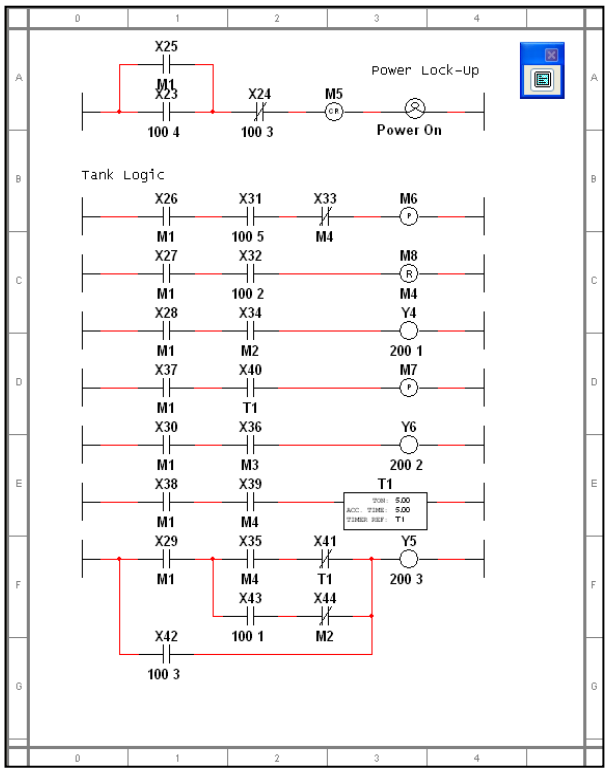

Figure 3b. Ladder program

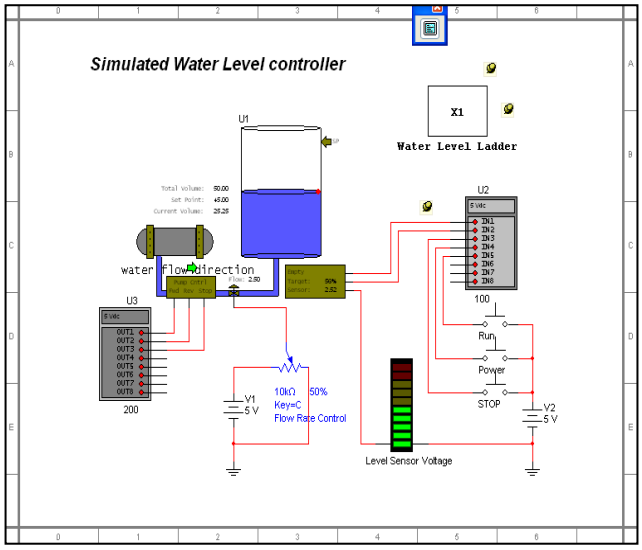

Figure 3 c. Simulation Result for emptying tank

• **Sensor Full Scale Voltage** — the sensor voltage that equates to a full tank. As the tank fills, the voltage shown in the **Sensor** field of the holding tank increases which is show in Figure 3a and Figure 3c.

To set the parameters

1. Double-click on the relay coil and select the **Value** tab.
2. Set the following parameters as desired:

• **Tank Volume (liters)** — capacity of the tank in liters.

• **Level Detector Set Point (liters)** — the level of the **SP** (set point) marker (Figure 3a and Figure 3c)

• **Maximum Pump Flow Rate (liter per second)** — the maximum speed at which the liquid is pumped into the holding tank. If the **Flow** pin of the holding tank (see above screen capture) is unconnected, the liquid only flows at this speed.

• **Flow Rate Full Scale Voltage** — if the **Flow** pin of the holding tank is connected, this is the voltage required at the **Flow** pin to make the liquid move at the maximum speed set value is in the **Maximum Pump Flow Rate** field. For example, if enter 5 V in this field, and then apply 5 V to the **Flow** pin, the liquid will flow at 1 liter per second if the value in the **Maximum Pump Flow Rate** field is 1. If applied 2.5 V to the **Flow** pin, the liquid will flow at half that speed (0.5 liter per second).

V. DEFINING THE COMPONENTS

A. Water Level Indicator: LEDs are used for water level indication. By touching different water levels through water level sensor, LED should be indicated as ON/OFF (i.e. on: yes sensor senses water).

B. Water Level Sensor: To make special water level sensors some convenient materials such as Iron rod, nozzles, resistance, rubber are used. A connecting rod is made by iron or steel. This is connected with ground potential and needs at least four nozzles, which is connected with +5v via a 1kΩ resistance and bind them together by putting a rubber at the joint point which will act as an insulator for every nozzle. When the sensor touches water, nozzles and connecting rod get electric connection using water conductivity [5].

C. Water Pump Controlling System: Water pump can be controlled by connecting with an output pin of microcontroller via a control unit. When control unit sends a positive signal (+5v) or a ground signal (0v) to the motor driver circuit, then the water pump become ON or OFF respectively. A manual switch is also connected to the motor driver circuit to make this system more users friendly.

D. Control Unit: The basic operation of control unit is to control the water pump by microcontroller which is defined by a particular program. Water pump is connected with an output pin of microcontroller via a relay circuit, and is connected with a transistor. The collector of this transistor is connected with the relay circuit and the emitter is grounded. In the relay circuit, a diode is used for sending signal in uni direction and an inductor is for opposing the change of current flow respectively. The output of the relay circuit is connected with motor pump's cable as a negative. The other side of motor's cable connected with AC 220V as positive voltage.

VI. CONCLUSION AND FUTURE SCOPE

Water is one of the most important basic needs for all living beings. But unfortunately a huge amount of water is being wasted by uncontrolled use. Some other automated water level monitoring system is also offered so far but most of the method has some shortness in practice. We tried to overcome these problems and implemented an efficient automated water level monitoring and controlling system. Main intension of this research work is to establish a flexible, economical and easy configurable system which can solve water losing problems. A simulated water level circuit is shown using Multisim. A web based water level monitoring and controlling system can be designed, through which the system can be controlled from any place via internet even with different type of devices [6]. This could have a substantial benefit from this research work for efficient management of water.

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Raghavendra.R Diploma in Electronics and Communication in the year 2000, and currently working in RV College of Engineering, Bangalore, Karnataka, India as a Instructor. His research area of interest is Electronic circuits design and debugging, Microcontroller, General perpose PCB designing, Networking, servicing, soldering and desoldering.

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