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Design Of Automatic Water Level Controlling System

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Abstract: **The shortage and wastage of water in multistoried building is a common problem. In many houses there is unnecessary wastage of water due to overflow in Overhead Tanks. To prevent this kind of situations we have designed a system that would automatically pump water from the reservoir to the tank whenever there is less or full water in it. The operation of water level controller works upon the fact that water conducts electricity. So water can be used to open or close a circuit. As the water level rises or falls, different circuits in the controller send different signals. These signals are used to switch ON or switch OFF the motor pump as per our requirements.**

Keywords: Water level, pump, microcontroller, control system, cost.

I. INTRODUCTION

Now a days world is highly depend on industrial technology of much production. Day after day the population is increasing whereas the resources to meet the demand of the people are limited. So people have to rely greatly on automatic control. A control system therefore can be defined as a device, or set of devices, that manages commands, directs or regulates the behavior of other device or system. Consequently, automatic controlling involves designing a control system to function with minimal or no human interference. Intelligent systems are being used in a wide range of fields including from medical sciences to financial sciences, education, law, and so on. As a very much important of the human life the proper distribution and reduction of the wastage of water is very important. There are many ways of controlling the level of water. Conventional float system, various types of switching system such as pull-push switching system, relay system, using sensor as a level indicator.

In this project relay switching system was applied to automatic control the pump as well as water level. This device can be installed anywhere in a suitable place so that it can be monitored and necessary action can be taken if required. The function of this device is to start and stop the water pump whenever the preset water level in the overhead water tank reached that means the pump will automatic start when the water level in the tank is below a certain level and stop when it is over a certain level. It Offers saving of electricity and wastage of water. When the upper tank is full then the variable resistance rotate 750 then the connection of the variable resistance is short therefore the pump is off. Again when the water is reduced from the upper tank then the variable resistance rotates with reducing water at a certain level of water of the upper tank the connection of the variable resistance is open therefore the pump is on.

II. THEORY

The water level in an overhead tank can be controlled automatically by implementing the idea as explained in the following figure. The transducer is mounted on the overhead tank as shown. A float is fitted with it in such a way that when the water comes down, the output of the transducer is higher than the reference voltage, which changes the output of the Schmitt trigger to high state. This HIGH output is fed to the driver and relay circuit as shown below. The relay is energized, causing the common terminal connected to the NO contact of it. Thus the motor and the pump are, switched ON, filling water to the tank. In this process, when water level goes high ,the tank is almost full, the floats comes up such that the output voltage of the transducer becomes lower than the reference voltage. Therefore the Schmitt trigger output changes to LOW state. This LOW signal to the driver switches OFF the relay and the motor. Thereby the pump is stopped. The upper and lower level of water to be controlled in this process may be predetermined by selecting proper feedback resister in the Schmitt tagger circuit as explained in the experiment.

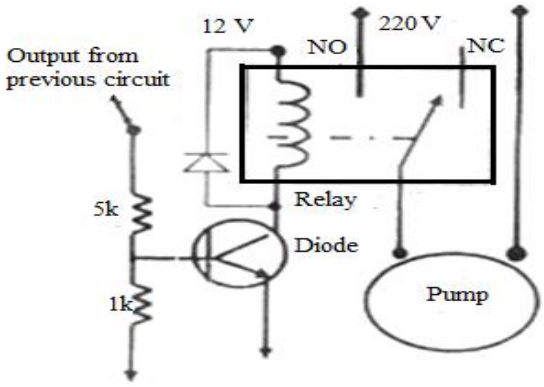

Fig. 1: *Schematic diagram for the circuit*

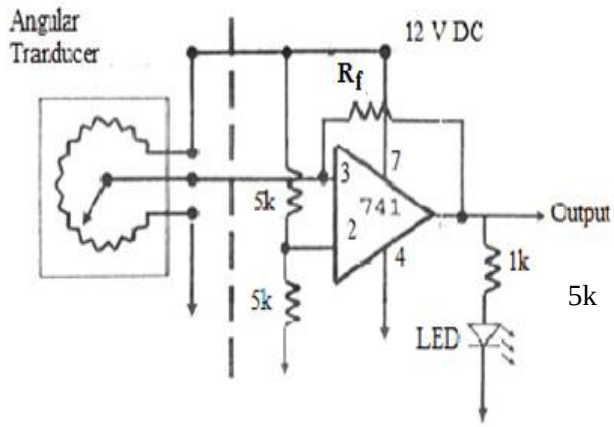

Fig. 2: *Schematic diagram for the circuit.*

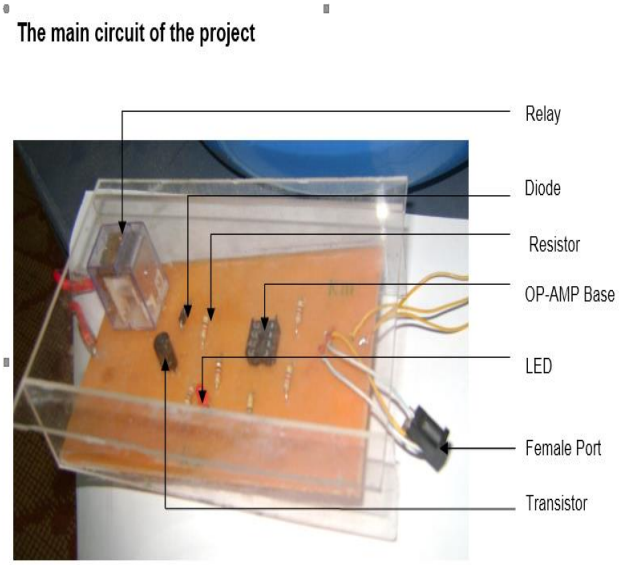

Fig. 3: *The different parts of the main circuit*

III. Design of Tank, Float and Arm

Let the capacity of the tank is 18 litres, then the volume of water,

$\pi r^2 h = 18$

or, h = 11.6 inch = 0.2937 m

So, distance from lower level to upper level = 9.0 – 3.5 = 5.5 inch or 0.1397m.

Discharge Q = 8.56/28.46 = 0.301 litres/second.

Velocity of flow, v = 1.183 m/s

Then, $Av = 0.301 \times 10\text{-}3$

Or, $\pi \times d^2/4 \times 1.183 = 0.301 \times 10\text{-}3$

Or, d = 0.018 m or 0.7 inch.

Hence the diameter of the delivery pipe is 0.7 inch.

Again,

1. Pressure acting on the bottom surface of the tank, [10]

$P_1 = wAx. = 9.81 \times \pi \times 0.13972 \times 0.2286 = 0.137$ kN

2. Pressure acting on the side wall of the tank,[10]

$P_2 = wH^2/2 = 9.81 \times 0.22862/2 = 0.256$ kN.

Total pressure of water on the tank = 0.137 + 0.256 = 0.393 kN.

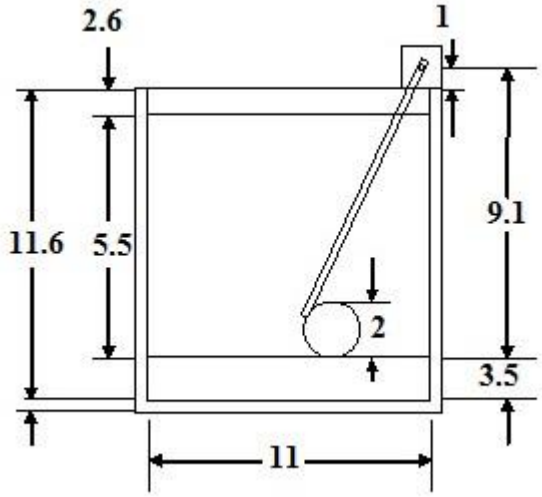

Fig.4: *Design of tank*

A. Length of arm

Let diameter of the float be 2 inch and the arm is pivoted at 1 inch above the top of the tank.

Then from the figure,

$\cos 7.50 = 9.1/x$, x = 9.18 inch.

Length of arm = 9.18 – radius of spherical float =8.18 in.

But clearance at two ends of the arm for pivot is taken as 0.5 in.

Then the length of arm = 8.18 + 0.5 × 2 = 9.18 inch.

Hence the length of arm is 9.18 inch.

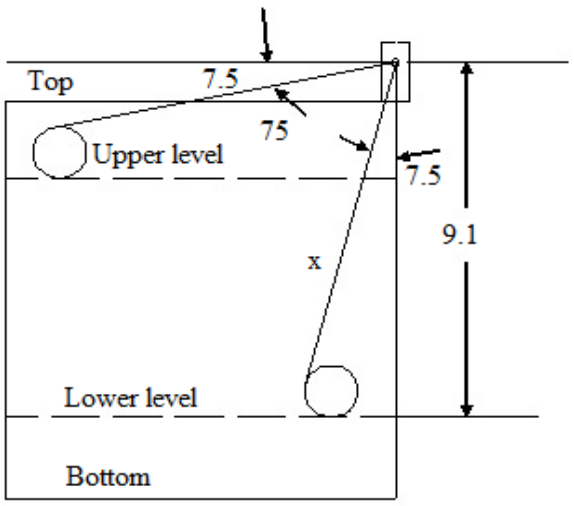

Fig. 5: *Design of arm*

IV. MAIN COMPONENETS OF THIS PROJECT

A. Mechanical Components of This project

I. Pump
II. Base with tanks
III. Tap

B. Electrical Components for Water Level Control

I. Transistor, D400-01
II. Resistor 5k-three-each, 1k-two-each, 100k-one- each.
III. Rely, coil voltage: 12 volt Dc, contact current: 10Ac,contact Voltage : 220v ac-01
IV. Motor pump set-01
V. Diode, D4007-01
VI. Angular position Transducer-01(Variable resistance)
VII. D C power supply unit, 12 volt-01
VIII. Project Board-01
IX. OP-AMP (741)-01
X. Light emitting Diode (LED)-01
XI. D C voltmeter, 0-20-01
XII. Female Port
XIII. Adaptor

V. EXPERIMENTAL SETUP

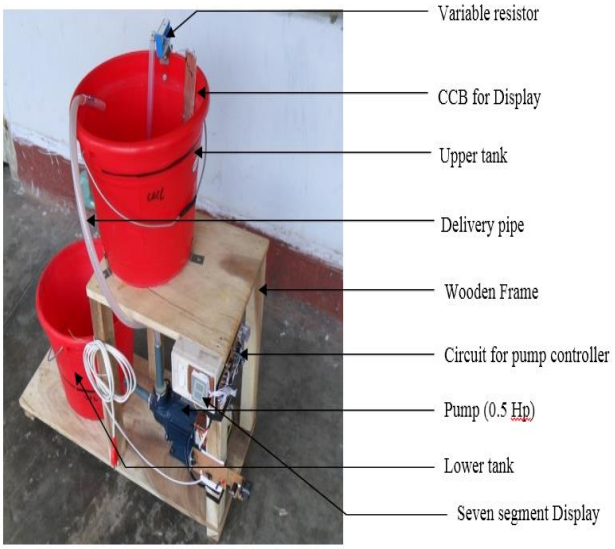

Fig. 6: *Automatic Water Level Controlling System*

VI. PERFORMANCE TEST

Total Capacity of the upper tank = 18 litres
Total discharge from motor start to motor stop =8.56 litres
Time required to fill the tank =28.46 second
Discharge from delivery pipe = 0.301 litres/second

TABLE 1: OBSERVATION OF VARIOUS LEVEL OF WATER.

Obs no	Water Level in display	Water Level in (inch)	Water Level in (m)	Time (Sec) for each level
1.	2 (Start)	3.5	0.089	0
2.	3	4.6	0.117	1.67
3.	4	5.5	0.139	4.19
4.	5	6.4	0.163	7.09
5.	6	7.35	0.187	9.15
6.	7	8.3	0.211	15.5
7.	8	9.25	0.235	19.43
8.	Stop	10.25	0.260	28.46

A. Head Vs Time curve for performance of the project

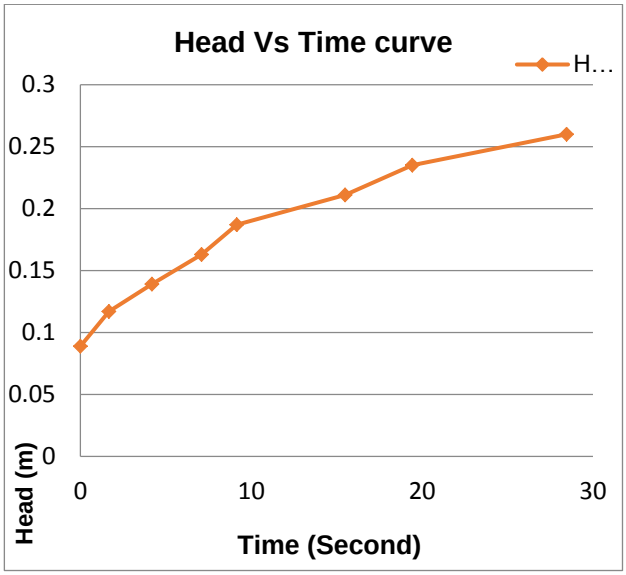

Fig. 7: *Head Vs Time curve*.

B. Saving of water

If the diameter of the delivery pipe is about 1 inch, Then the discharge through the delivery pipe = 1.02lt/sec
If time required to stop the pump is 30 seconds for once,
Then wastages of water = 1.02 × 30 = 30.6 litres.
For three times per day,
Wastages of water = 30.6 × 3= 91.8 litres.

Monthly wastages of water = 91.8 × 30= 2754 litres.

In our system, time required to stop the pump is 1.5 sec and monthly wastages of water is 137.7 lt.

Monthly saving of water = 2754 – 137.7= 2616.3 litres.

C. Saving of power

If the rating of the pump is 0.5 hp or 373 watt and time required to stop the pump is 30 seconds.

Then power consumption = 373 × 30/60 =186.5 watt-min
For three times per day,
Power consumption = 186.5 × 3 =559.5 watt-min
Monthly power consumption = 559.5 × 3
= 16.785 kW-min
In our system, time required to stop the pump is 1.5 seconds and monthly power consumption is 0.89325 kW-min.
Monthly saving of power = 16.785 - .83925
= 15.946 kW-min.

VII. COST OF MANUFACTURING

In case of large production, all the components will not be necessary to be installed. That time, some unnecessary parts would be reduced. In our project, main parts are electric circuit, variable resistance (transducer). Electric circuit should be enclosed into an isolated box & also good looking view. The box will be consisted with two ports for connecting the variable resistor one port another port for connecting power supply.

TABLE 2: COST ESTIMATION

S.N	Components	Cost (BDT)
01.	Mechanical Components	3243
02.	Electrical Components	394

VIII. PROJECT OUTCOME

The main purpose of this project is to construct a device, designing a circuit which is capable to sense the desired level and eventually to achieve the desired action of the overall system. The project has been divided into two parts namely “Electrical Part” and “Mechanical Part”. For the sake of proper functioning, variable resistance is set up at the tip point of the top tank. The circuit has been designed to be activated when the level of water is in the saturation condition. The principle of the project is easy to understand, low in cost and gives places for further modifications to bear a lot of fruits in the mass production applications. By the experiment it was observed that sometimes start and shut up time of the pump is varied a little.

As mentioned in the graph the difference of the start and off time is approximately 28.46 seconds. It is caused by fluctuation of water level which makes irregular rotation of variable resistor. The main difference of this project among the previous is the methodology. Here very suitable and effective combination of electrical and mechanical system is established. Most importantly this arrangement can be easily used with the existing household pump without any extra arrangement. As a very low cost project compared with other system it can be commercially used. In addition a seven segment display was added to indicate the various level of water. The head and time were recorded in various levels. Traditional system of automatic water control refers us only the termination of flow. Water level controlling system based on microcontroller is not so cheap and not capable to work with contact of water. In this sense the constructed project is well working and long lasting also concern about the power loss. By this arrangement a reliable automatic switching of pump is established which refers the less human effort and reduction of wastage of water. To avoid the waste of water means not only savings the most essential elements for life to survive but also save huge amount of power loss.

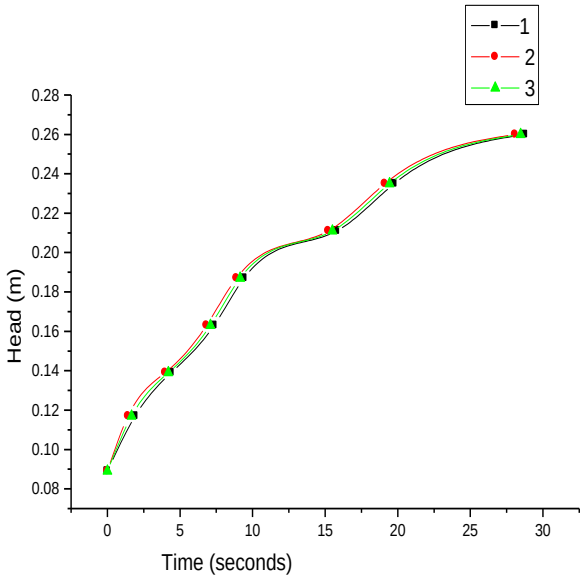

Fig. 8: *Head vs Time curve for various readings*

IX. CONCLUSION

The project work was started with objectives of controlling the level of water and automatic switching of the pump to reduce the wastages of water and power. The project was successfully constructed and it was successfully executed. In this project the water level of upper tank has been automatically controlled. So the effectiveness of constructed electrical circuit is proved. In this project monthly saving of water and power is 2616.3 litres and 15.946 kW-min respectively. By this arrangement huge amount of wastages of water as well as power can be reduced and hence save national revenue.

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