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Automatic Water Pump Controller and Water Level Detector with Microcontroller IC

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Abstract – *A water level indicator may be defined as a system by which we can have information of any water reservoir. This paper presents an automatic water pump controller and water level detector using a microcontroller chip. The circuit that has been designed will monitor the level of water in a water tank. Water level indicator system is quite very useful to reduce the wastage of water from any reservoir, while filling the overhead reservoir. It displays the level of water and when it is at the lowest level; motor is activated automatically to refill the tank. When the tank is filled to its maximum capacity, the motor is automatically shut downed. The aim of this project is to improve the accuracy with which the water level in this tank is measured and accordingly send message to IC to automatically on-off the pump. A sensor, Reed switch, is used to monitor the level of the water in the reservoir. This water level sensor also can be applied in industry where the chemical liquid in the tank can be measured. The microcontroller(IC) ATmega 16A controls virtually all the actions carried out in this design. The display unit in the circuit is used to physically show the current position of water in the tank, the properties of Liquid Crystal Display (LCD) are been used. A motor and some Reed switch which work automatically are shown in the software and hardware design.*

***Key Words*: Microcontroller, ATmega16A, Reed Switch, Motor, Controller Circuit etc**

1. INTRODUCTION

Water is the basic need and it is one of the most important necessities for all living beings. Hence, it is of utmost importance to preserve water. In many houses and offices there is unnecessary wastage of water due to overflow in overhead tanks. The so-called overhead tank installation is mounted in the household for human's life sustenance and domestic activities, as well as farmland for irrigation and in the refineries for oil and gas processes [1, 2, 3]. In this paper, an automatic water pump controller and water level detector system using ATMega 16A IC is proposed to monitor the level of water in the water tank. The system has a water pump motor which works automatically. The automated control and monitoring (ACM) system of water level in the overhead tanks require implementation of an Intelligent Pump Controller Circuit (IPCC) with integration of embedded sensors and wireless technology devices [4, 5].

Automatic water level controller can provide a solution to mitigate water wastage. When water level is low, the IPCC turns on motor automatically and when the water level is full then the motor is automatically goes down. This water pump controller controls, monitors and detects the water level in the overhead tank and ensures the continuous flow of water round the clock without the stress of going to switch the pump manually ON or OFF thereby saving time, energy, water, and prevent the pump from overworking. However, the ACM component includes Reed switch as sensor and other related distance measurement or detection devices. This device (sensor and level indicator controller) is used for adequate monitoring of both liquid and gas volume in the reservoir. Some of the liquid level sensor are made with a metal plate which mounted on the overhead water tank to indicate top and lower level detection for the accuracy, efficient monitoring and to prevent overfilling [6, 7]. Proper monitoring is needed to ensure water sustainability is actually being reached with distribution linked to sensing and automation [8].

In this paper, Reed switch sensors are placed at different level of the tank to monitor the level of water and with the aid of this sensors the micro-controller monitor the level of the liquid; water in this case, at any particular point in time.

2. RELATED WORKS

There are many proposed methods for the liquid level monitoring and control system in literature.

Automatic water level controller can be used in Hotels, Factories, Homes Apartments, Commercial Complexes, Drainage, etc. Automatic water level controller will automatically "START ON" the pump set as soon as the water level falls below the predetermined level and shall "SWITCH OFF" the pump set as soon as tank is full. It can be used to predict flood liquid level indicator in the huge containers in the companies. Fuel level indicator in vehicles [9].

Sensor is a device that responds to a physical stimulus (as heat, light, sound, pressure, magnetism, or a particular motion) and transmits a resulting impulse (as for measurement or operating a control). Sensor is important for taking input from the environment to the microcontroller. The specific input could be light, heat, motion, moisture, pressure, or any one of a great number of other environmental phenomena. The output is generally a signal that is converted to human-readable display at the sensor location or transmitted electronically over a network for reading or further processing [10]. In our project, we have used 'Reed switch' as a sensor.

A switch is like a drawbridge in an electric circuit. When the switch is closed, the "bridge" is up and no current flows. So the purpose of a switch is to activate or deactivate a circuit at a time of our choosing [5].

The reed switch is an electrical switch operated by an applied magnetic field. It was invented at Bell Telephone Laboratories in 1936 by W. B. Ellwood. It consists of a pair of contacts on ferromagnetic metal reeds in a sealed glass envelope. The contacts may be normally open, closing when a magnetic field is present, or normally closed and opening when a magnetic field is applied. The switch may be actuated by a coil, making a reed relay, or by bringing a magnet near to the switch. Once the magnet is pulled away from the switch, the reed switch will go back to its original position [6].

3. SYSTEM DESIGN

A traditional water level controller with switching device requires human assistance which is a tedious job. In this paper, an automatic water level detector and accordingly water pump controller with switching device is designed using microcontroller, ATmega 16A, IC to refill the water tank without human support. The system design was carefully arranged according to the following block diagram approach (Fig.-1). Here, a sensitive automatic water level detector, Reed Switch, will send a message to ATmega 16A IC informing the status of the water level into the tank. When water get low to a certain level into the tank pump starts any time; red LED on; to refill the tank and finally the system automatically shut down the water pump; green LED; when the tank is full again. In this paper, the circuit is designed to display 3 different levels of water; low, medium and high, using three sensors; reed switch; to monitor the level of water in the tank.

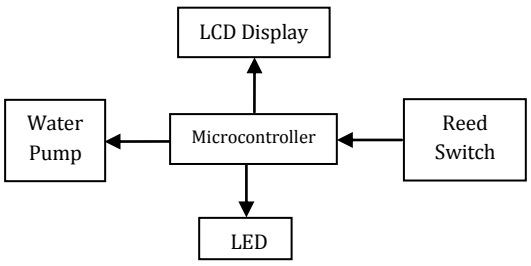

Fig-1 Block diagram of the project

The operation of the micro-controller based water level detector and control system is summarized as follows:

1. The LCD display unit displays the level of water. When the level is low the microcontroller passes a signal to the pump. The pump then automatically starts "ON" which is indicated by "Red" LED.

2. When the LCD monitor displays the level of water as "Mid" and motor keeps "ON" and glow the "Yellow" LED for its on state of the pump.

3. The micro-controller closes the pump automatically when it glows "Green" LED which means the level of water is Full.

An analog circuit is enough to get the desired output. However, to avoid the complexity of the circuitry a micro-controller will be the best option based on the circuit to be design with less hardware connection and flexibility. In writing a program that performs a desire function accesses the ability of the micro-controller. The flow chart shows how the controller and detector system works (Fig.-2).

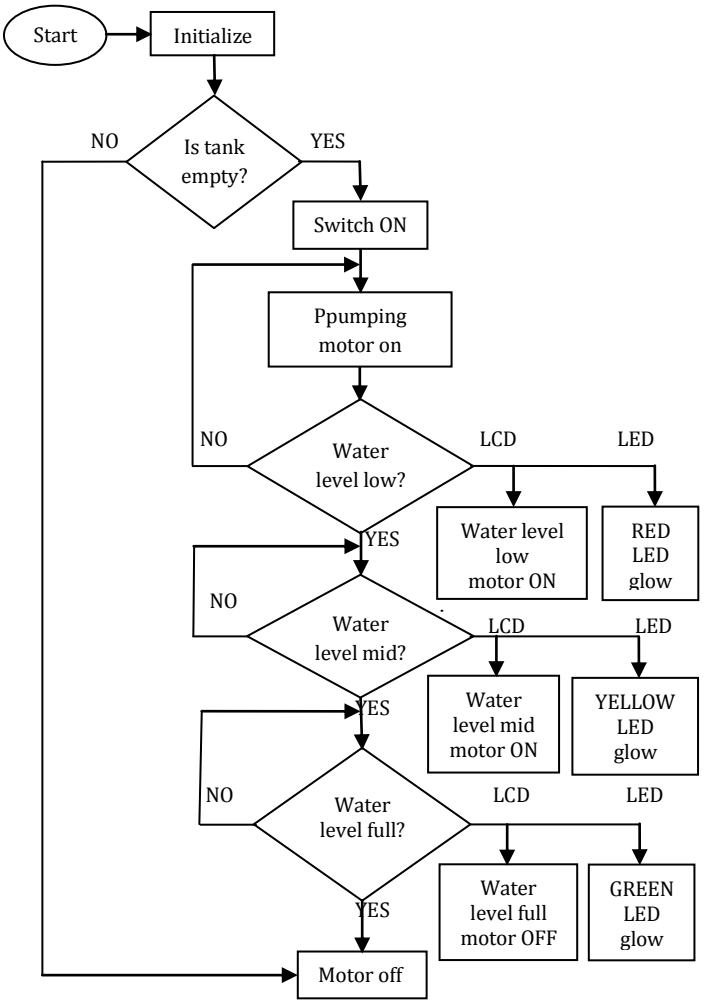

Fig -2 Flowchart of the project

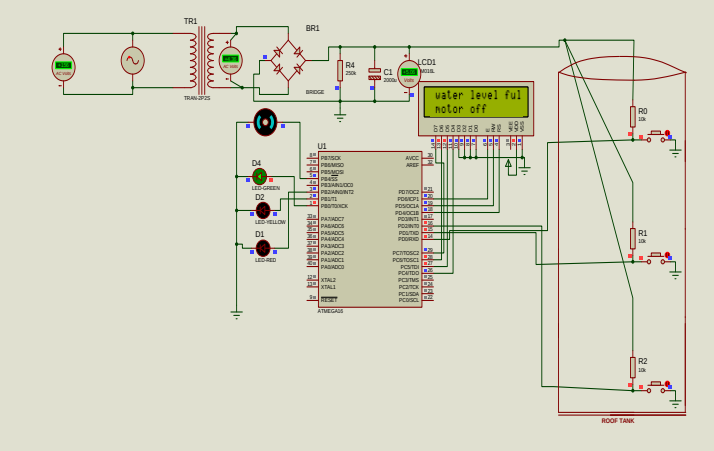

Fig -3 Schematic diagram of the circuit

In the schematic diagram, Fig.-3, the 5V is generated by rectifier circuit for the Atmega 16A IC. Sensing the level of the water by Reed switch, microcontroller IC will pass a very mili ampere current to glow different LED lights which in turn indicate the pumping motor status; whether it is ON of Off.

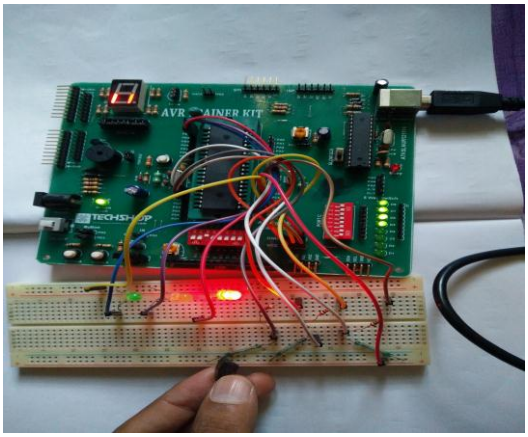

Fig -4 Arduino & Breadboard in test mode at Low water level

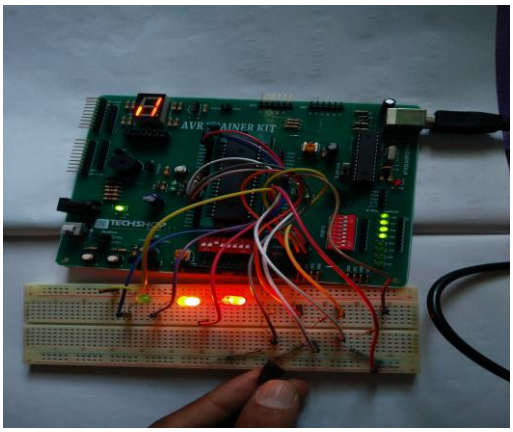

Fig -5 Testing of the project at 'Mid' level of water

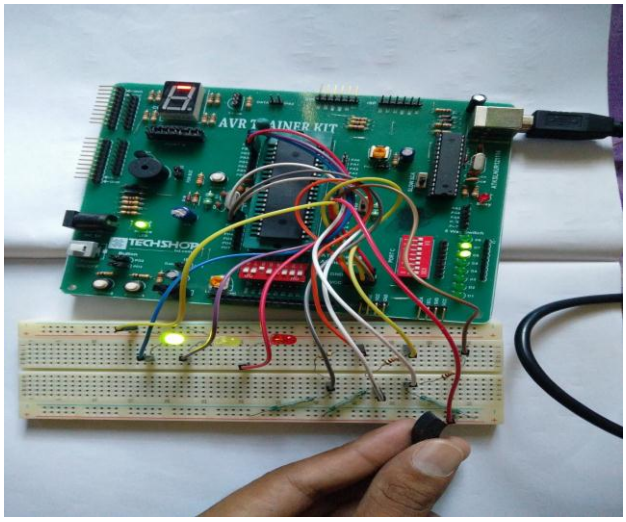

Fig -6 Testing of the circuit at Full water level

4. SYSTEM TESTING, INTEGRATION and RESULT

A DC motor, RS-360 micro-motors small pump, Operating voltage: 4V-12V, Current: 0.8A; is used to test the effectiveness of the circuit and the system replacing the LEDs. In this paper, A DC motor that's RPM is >1000 was chosen for testing purpose only. At active condition, Microcontroller's current is about 1mA which is very low to drive the motor. However, for effective testing of the motor a driving circuit using PNP transistor, BC557, was used to run the motor. The system was assembled using AVR trainer kit and breadboard for testing purpose.

All the various units and subsystems were checked properly for assurance of the functional system. The interface between output/input unit subsystem must be good in this system. When all the modules was integrated together, the system was created and all modules and sections responded to as specified in the design through the power supply delivering into the system designed.

The system was powered and operated upon using several possibilities they include making sure that the pump only start when the water level has gone below the mark, and stops when the water level has reach maximum. The LCD display was also tested to make sure correct level was display on the LCD display screen. The sensors were also tested.

5. CONCLUSIONS

Going through the planning of the system, flow chart process, simulating it in software and finally implementation of the system in hardware was not so easy. The performance of the designed system was really good and we got our desired output. This paper was intended to design a simple automatic dc water pump control and water level detection system. This system, undoubtedly, would prevent the wastage of water. The system implementation is not so expensive. We practically implemented the system for 5V

motor with very minimal wattage. If some modification is made in the system design, it would not be tough to design the controller system for commercial purpose. For 220V ac pump, and for not only domestic purpose used motor but also motor in the various offices can easily use this system with very minor modification.

However, we encountered series of problems in designing the system. Some parts required re-designing to meet the system requirements. We used many connecting wires for our experiment. That increased the system complexity and cost. Reed switch were used as sensor and it was sensitive to physical contact. Some switches broke during experiment.

Main intension of this research work is to establish a flexible, economical and easy configurable system which can solve water losing problems. In the near future as home automation web based water level monitoring and controlling system can be designed, through which the system can be controlled from any place via internet through mobile phone. This could have a substantial benefit from this project work for efficient management of water. If this technique can be implemented into a vast device like submersible pump then it can be placed in market commercially.

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