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Automatic Dry Protection of Water Pumps

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ABSTRACT: Water Level Measurement & Control forms an important part of any process in the industries as well as domestic purposes. It is generally observed that the measurement and control of liquid level is done either with the help of various continuous control strategies employing Proportional-Integral (PI)/Proportional-Integral-Derivative (PID) Controller in many plants where as in many other applications discrete control of pump starting and stopping is done for both for industrial & domestic purposes. Here in this particular work we propose a automatic liquid level monitoring & modified control strategy in the control algorithm which helps the pump not to operate when there is no water in the underground tank thus preventing the dry run of the pump helping in conservation of energy, preventing water wastage as well as protecting the pump from operating under dry run condition by switching the pump off. The system designed uses Arduino UNO as the Microcontroller board actuating the control action via a relay circuit to turn on or off a operating Dc pump as a prototype model.

KEYWORDS: Water Flow Sensor, Water Pump, LCD, Microcontroller, Arduino.

I. INTRODUCTION

We use pumps everywhere from our houses to industries. Major purpose of a pump is to pull liquid from one place to another place. Generally in our homes, we pull water from an underground reservoir tank to a terrace mounted overhead water tank. In this process it is kind of a hassle to keep the records of when the overhead tank is empty, when to turn on the pump, when the overhead tank is full, when to turn off the pump, whether if the underground reservoir tank has water or not and many more things. This full process of keeping an eye on all the things and timely turning on or off the pump is somewhat time consuming, irritating and a big hassle. In this work we focus on developing a discrete water level control system which serves for namely three purposes firstly saving water at large by preventing the overflow, energy conservation by switching off the pump in certain appropriate conditions & last but not least the objective is to also prevent the dry run of the pump enhancing the longevity of the operating pump. The automatic water pump controller also finds its application in agricultural farms, industries, offices, households and all places where discrete monitoring & control of liquid level is performed.

In pumps water acts as coolant to cool off the heat generated by the impeller that heats up other parts. But when the pump runs dry without water, air acts as the working fluid which doesn't act as a coolant. So, the pump is overheated, the impeller will melt along the shaft and impeller seizes to the shaft. Overall, the pump seizes. Then the pump has to be taken apart and its cost almost half the cost of the pump to get it refurbished. When there is very low flow or no flow is recognized by the microcontroller, it then triggers the relay which then breaks the circuit of the pump. Thereby reducing the risk of severe damage. The microcontroller is turned on as the pump is turned on. The microcontroller has a program written in it which waits for 45 seconds to ensure that there is no flow before triggering the relay to break the motor circuit. If the pump is run dry for less than 45- 60 seconds, the pump should not suffer any damage.

II. EXISTING SYSTEM

In existing system Control systems are also classified as sequential, continuous or discrete. Hence various conventional & advanced schemes has been proposed for the control of level of the liquid in domestic and industrial applications for continuous level monitoring & control where various advanced techniques like fuzzy , IMC as well as Fractional based Proportional-integral-derivative control schemes are applied on Level control loops for effective control of the liquid level in industrial applications. On the other hand discrete control is widely applied across in domestic & industrial areas for sequential as well as discrete control of water or liquid. Researchers have also monitored the level of liquid over the network for efficient Liquid or water level management. We use pumps everywhere from our houses to industries. Major purpose of a pump is to pull liquid from one place to another place. Generally in our homes, we pull water from an underground reservoir tank to a terrace mounted overhead water tank. In this process it is kind of a hassle to keep the records of when the overhead tank is empty, when to turn on the pump, when the overhead tank is full, when to turn off the pump, whether if the underground reservoir tank has water or not and many more things. This full process of keeping an eye on all the things and timely turning on or off the pump is somewhat time consuming, irritating and a big hassle.

III. PROPOSED SYSTEM

There are several methods for water level monitoring and control presented in various works but mostly designed so far concentrated on the pump switching based on water level content of the overhead tank. This work presents a scheme to monitor the overhead tank water level as well as the underground tank water level simultaneously and then determine the decision of switching the pump on or off. Thus the level of water in both tank together decides in operating the pump helping the entire system to conserve energy, water & also ensure protection of the pump from dry run. The concept can be applied successfully in domestic water level control system with indication of water level along with the prevention of wastage of the most important natural resources ensuring the device protection. A lower limit level of the water will be preset in the program code for the underground tank below which the pump is not allowed to turn on thus preventing the dry run. The controller will check the reading of that supersonic sensors mounted in the underground tank as well as the level of liquid in the overhead tank and then decide the on the operating status of the pump. If the level of water is below the preset limit in the underground tank, the pump won't be allowed to turn on and the buzzer will be triggered for notifying the user indicting the level of liquid in the underground tank. If water is present in the underground tank, the controller will sense the reading of the ultrasonic sensor mounted on the overhead tank. There will be two preset values for lower and upper level for consideration of the overhead tank empty & filled up status. If the reading of the overhead tank is found to be below the lower preset value and the underground tank has water above the lower limit of preset value, the pump is allowed to turn on via the relay module and it will continue to fill up water until the level of water reaches the upper or overflow preset value.

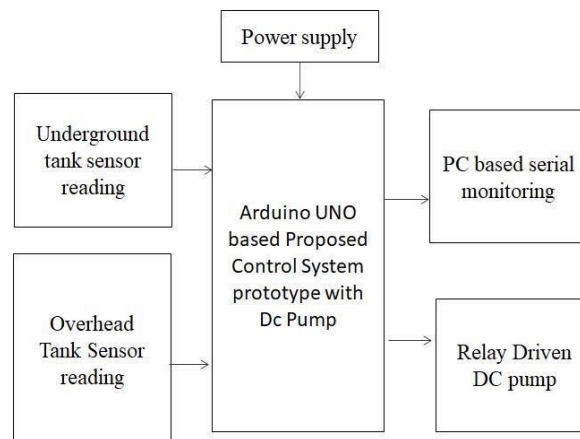


Figure 1: Block Diagram

A. ARDUINO MICROCONTROLLER

Arduino Microcontroller is an open source microcontroller. It can be used in both software and hardware. It is easy to use and for uploading the memory program in the Arduino. It consists of various pins and features for better efficiency. In our project we use Arduino ATmega328 Microcontroller. This microcontroller has 28 pins. It has Electrically Erasable Programmable Read Only Memory (EEPROM). This Arduino ATmega328 feature consists of advanced architecture, good performance, and low power consumption. It operates at a range of 3.3V to 5.5V but we use 5V as a standard. The program is uploaded on AVR micro controller attached on Arduino.



Figure 2: Arduino Microcontroller

B. 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.

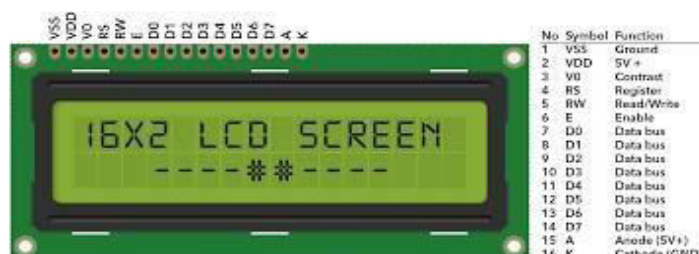


Figure 3: LCD Displays

IV. SIMULATION PROTOTYPE

It is a device that can be operated either manually or automatically. This kind of dual mode can enhance the productivity of crop and continuity functioning of the device. Due to this type of special arrangement the device can be operated without any interruption. Malfunctioning of the device can be rectified immediately by any one of the alternate methods.

PROTEUS 8 SOFTWARE

ISIS: the acronym of Intelligent Schematic Input System. The program allows us to carry out the electric design of the circuit, including all sorts of components such as resistors, coils, capacitors, power supplies, and even microprocessors.

ARES: the acronym of Advanced Routing and Editing Software. It's the tool aimed at the design of printed circuitboards or PCBs, with routing, location and editing functions for electronic components.

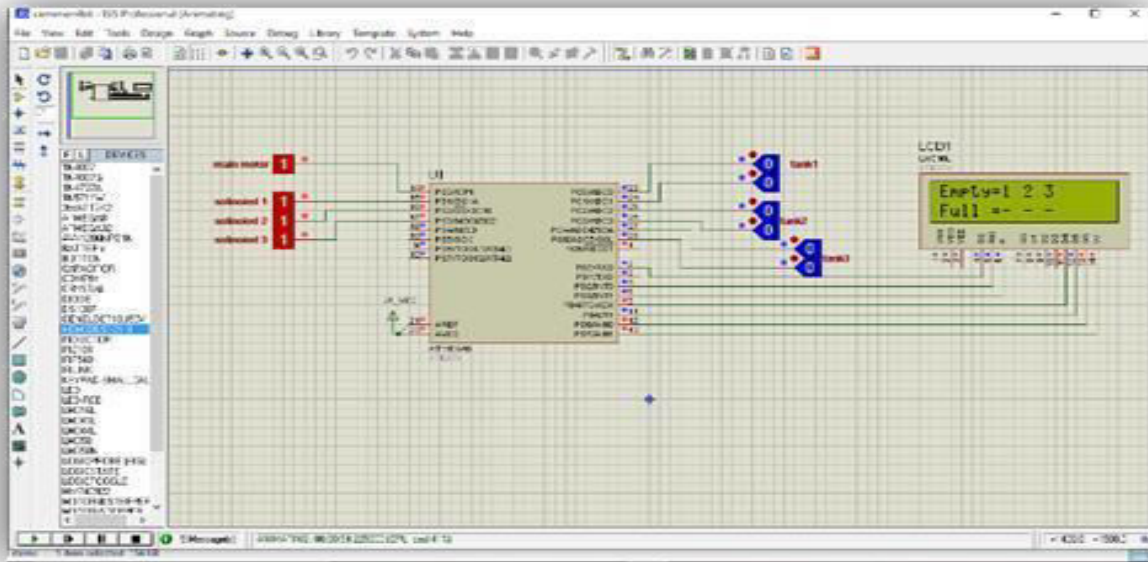


Figure 4: Simulation prototype

V.RESULTS AND DISCUSSIONS

Initially Tank 1 is fully filled with water. And Tank 2 and 3 is Empty.

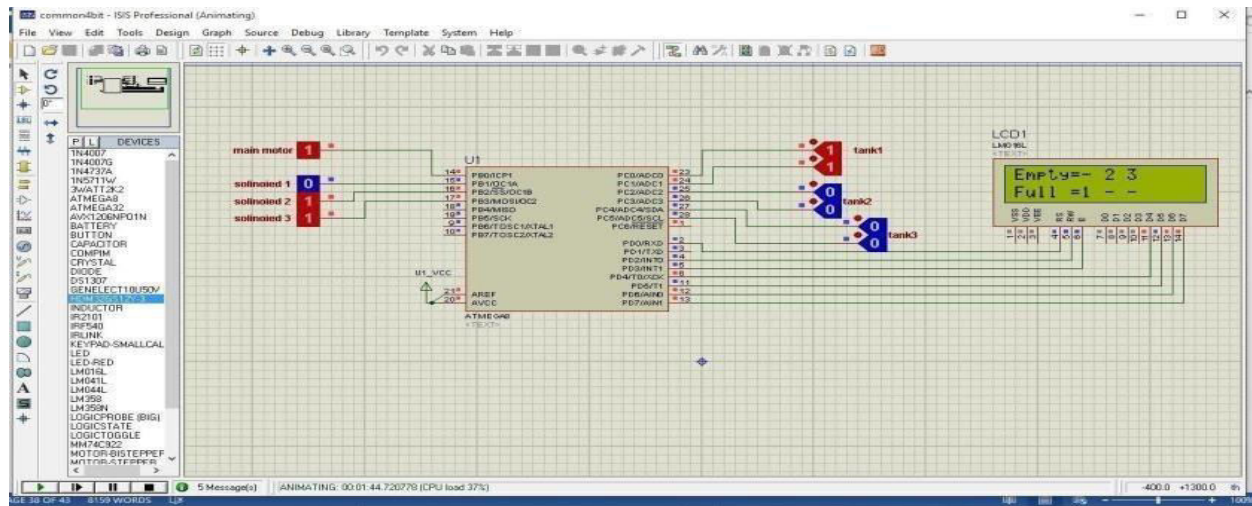


Figure 5 : Tank 2 and 3 Empty

Transfer Water from Tank 1 to Tank 2.

Now Tank 1 is empty, the water of tank 1 is moved to tank 2. Make Tank 1 dry, we clearly see in stimulation Tank 1 is dry

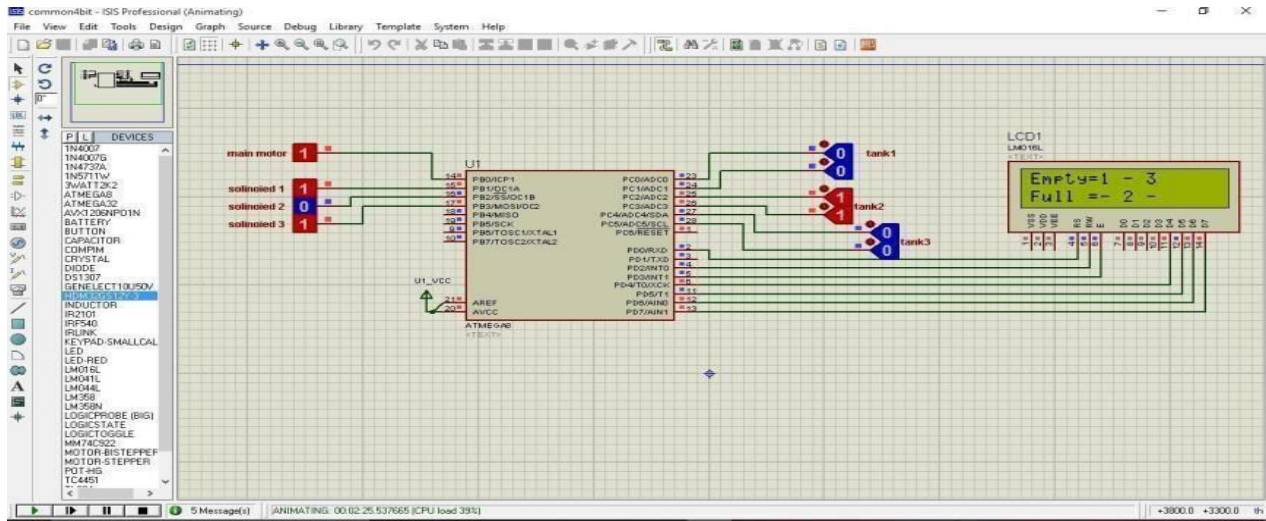


Figure 6 : Dry Tank 1

Finally Dry Tank 2 and Transfer water from tank 2 to tank 3. Now we can see this process in Stimulation through LCD Display. Display is connected, which shows the result of the given output.

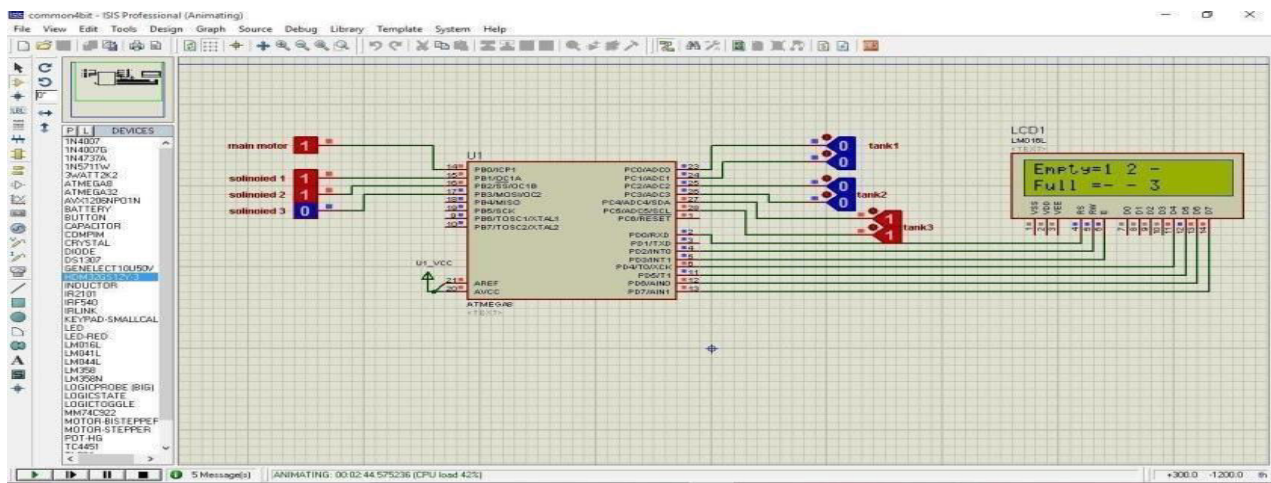


Figure 7: Tank 1 and 2 Empty

VI. HARDWARE IMPLEMENTATION

The hardware setups are shown in the figure. The input power receives from the power supply. Here we use a step down transformer which converts the 230 V AC input to 12 V AC output. Fuel Level Sensor (Float based) which has FLS Hall Position Type which reads the data from the tank, it transfers data of (Y-axis) readings. Arduino is connected in the given setup. When water gets dry the buzzer starts sound.

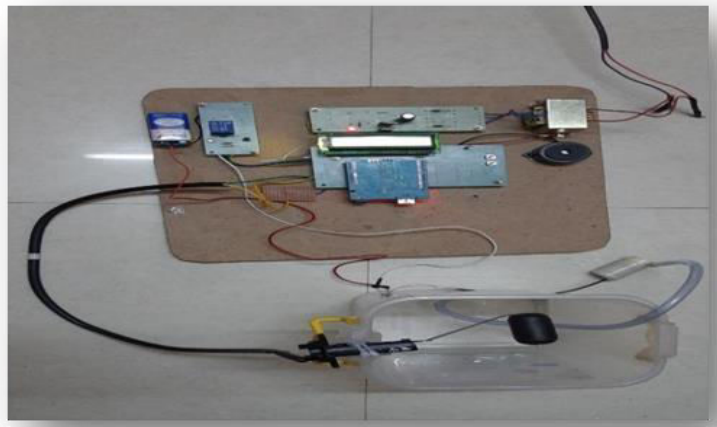


Figure 8: Hardware Setup

VII.CONCLUSION

The designed prototype system has been successfully tested & verified & the results obtained ensured that the control system designed is capable of obtaining three distinct advantages: Efficient utilization of electrical energy, Device/Pump Protection by preventing the dry Run and Non wastage of water This whole prototype system will be made out of inexpensive components and will be cheap to make. Low powered components in this system will use a very minimal amount of power to run and save electricity. The automation system will reduce the everyday hassle of the user. The entire system is designed for a DC motor based pump. . It can be designed for an ac motor based pump with proper driver circuit.

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