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Water Consumption Control and Quality Monitoring System

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Abstract: Water is an important parameter for the survival of living thing in our earth. Human bodies are made up of more than 60 percent water. Humans use clean water to drink, grow crops for food and many other domestic purposes. Water is vitally important to every aspect of lives. Thus, water conservation has to be a part of our life. Similarly, monitoring the quality of surface water will help protect our waterways from pollution. Our motivation is to prevent the water by using Instrumentation technologies and the monitoring system uses daily life device like laptop or mobile phone. By using Sensor Technology, it could avoid the huge amount of water is being wasted by uncontrolled usage. A Smart Water consumption control and quality monitoring method is the efficient method for providing a better water management process for the society. The method must be user-friendly and should easy access for the people to know about their resource availability and its proper usage. Sensor Based Water Pollution Detection, it will check the water quality by using these parameters such as the pH level, turbidity and temperature are measured in real time by the sensors and it will be monitoring by an agent.

Keywords: Consumption Control, Quality Management, Sensor, Arduino.

I. INTRODUCTION

It is a difficult a task to know how much water is available at resource for the usage and to have proper calculation at real time. Also, the water that is available for us may not be as usual water components, it may vary due to different reasons. After many literature reviews, we could find that sometimes after heavy raining the turbidity of water may changes. So, by implementing an automatic water management system would help us to have a proper knowledge of water at our source such as open-well, bore-well.

The problems that authors aims to solve:

- Unawareness of water level in our source
- Wastage of water
- Water Consumption Control
- Water Quality Management

Objectives of this work:

- Measure the water level with level sensor and that measurement is compared with the preset value. If in case the level is decreased then the water providing through the pipe lines will be controlled by actuating the control valve.
- Water quality is measured and monitors it if needed. The system uses sensors to measure qualities of water. Eg; pH, Turbidity, Conductivity, Total dissolved oxygen.

II. METHODOLOGY

On the basis of water usage, the whole household water consumption is categorised into three.

- Highest priority
- Medium priority
- Lowest priority

Taking the case of water usage in kitchen, which is needed more in a house which cannot be sacrificed at any cost, such categories of usages came in highest priority. In the high priority usage the consumption is not controlling in any sort. The water is provided through the pipelines to kitchen as normal as ever. The second part is for medium and least priority usages. Here the actual control implements. Includes the usages like bathing and cleaning purposes. In the medium priority cases the water outlet from the tank is controlled in such a way the water level inside the resource is decreasing. In least priority cases the outlet will b mostly fully closed, if level of water in source is less than the preset value, flow rate is controlled

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III. PROPOSED MODEL

The whole system is divided into three parts which is the high priority, medium priority and low priority

3.1 Highest priority

The high priority category under the domestic purpose is the major usage of water in home, ie; for the kitchen purpose especially regarding cooking and drinking water. Water usage in kitchen, which is needed more in a house which cannot be sacrificed at any cost. There will be no flow rate control through the pipelines. Flow rate will be at maximum rate irrespective of level of water available in the resource.

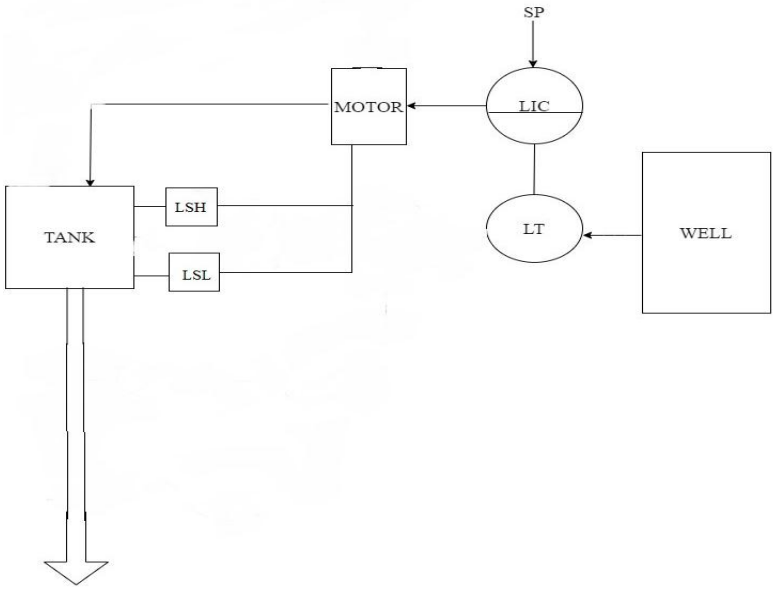

Figure 1: Block diagram for the highest priority usage

As per the block diagram shown below the water from the resource is continuously measures to know the level of water in the resource, but that measurement is not important for this category usage of water. Since the water from the tank to pipeline will be as usual and water will be filled to tank according to the water availability in tank and water resource which will explain later in this paper.

3.2 Medium Priority

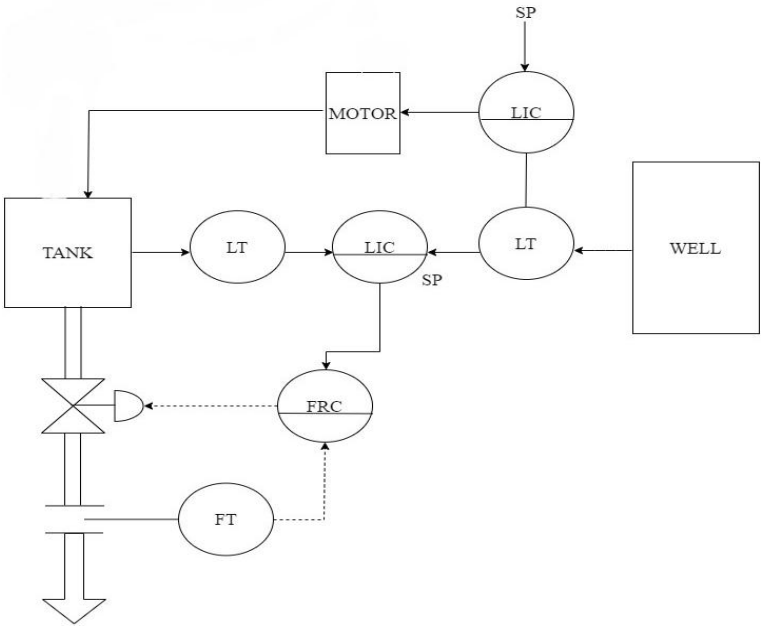

Figure 2: Block diagram for the medium priority usage

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The actual flow rate control happen here. In this category the house core work which is having least priority than the primary one came under here, ie; it consider about the bathing and cleaning purposes. Here the water flow is controlled according to the water level present in our resource. The flow control method is shown in figure 2. From the block diagram it's understood that the water level measurement is considered here for the flow rate through the pipeline. The water level is measured at the water resource similarly the water level is measured at the tank. Both the measurements are considered at level controller and give the output to the flow controller. Since the control accepts inputs form both the level transmitters here it uses cascade control and at flow controller it is of ratio type it actuates the control valve according to the output from the flow controller.

3.3 Lowest Priority

The lowest priority usage of water deals with watering the plants, ie; gardening and washing vehicles etc. Such need of water is not an essential for the survival of a human life. Thus such thing can be avoided or postponed for another day. So, here the water flow through pipelines is controlled by an ON-OFF mechanism of the control valve if the water in the resource is lessening under the set point value given.

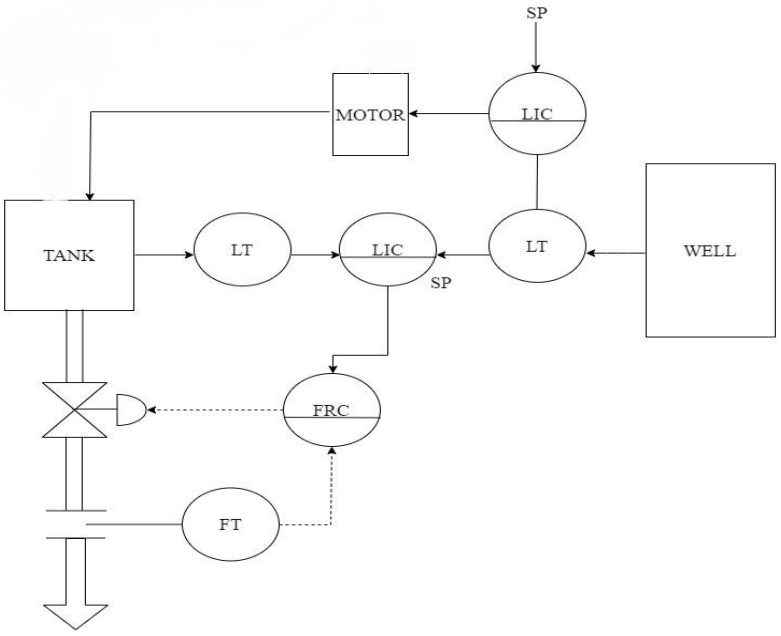

Figure 3: Block diagram for the lowest priority usage

3.4 *Automatic Water Tank Level Controller With Dry Pump Run Protection Using Arduino:*

If the level of water in overhead tank is empty, level switch activates, hence the pump turns on automatically. If level of water is full, level switch deactivates, hence the pump turns off and thereby prevent the overflow. If overhead tank is empty and also water level in sump tank is less, the pump doesn't run and also the buzzer gives indication of low water level. The LED connected to the circuit also glows for indication [8].

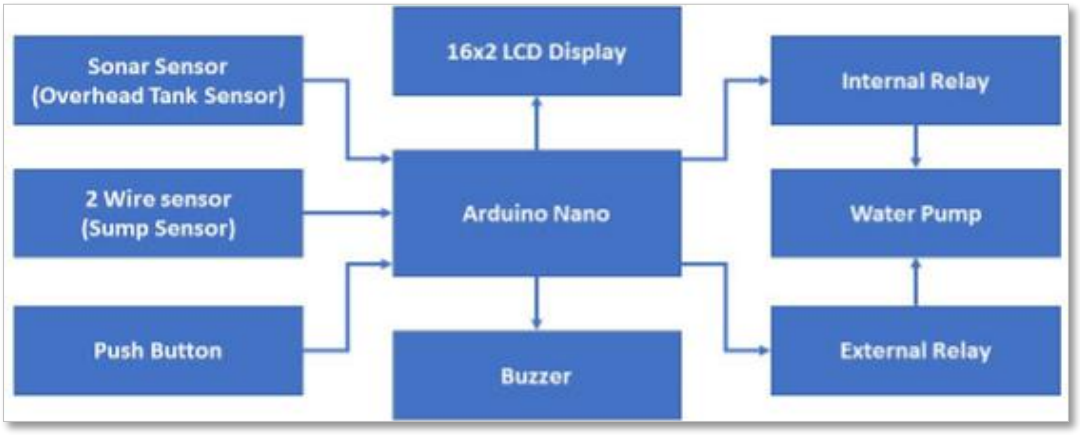

Figure 4: Block diagram of automatic pump operation

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The first block is Arduino Nano; Arduino is the brain of this project. It will take input from the sensors and control all other units according to the value received. The second block is 16x2 LCD display. This unit will display the Water Level in percentage as well as in Bar Diagram; it will also show the Pump status. This section will also notify us whenever the Sump tank is empty. The third block is the Sonar Sensor. This is used to measure the water level present on the overhead water tank. Sonar Sensor emits an ultrasound at 40 kilohertz, which travels through the air, and if there is an object or obstacle on its path, it will bounce back to the module. Arduino will use the echo pin, present on Ultrasonic sensor to measure sound wave travel time in microseconds. Considering the travel time and the speed of the sound, you can calculate the distance using the formula shown here. The fourth block is the Sump Water level sensor. These are two copper wires which are dipped in to the Sump Water Tank. And Analog pin present on the Arduino Nano will be used to sense the presence of water.

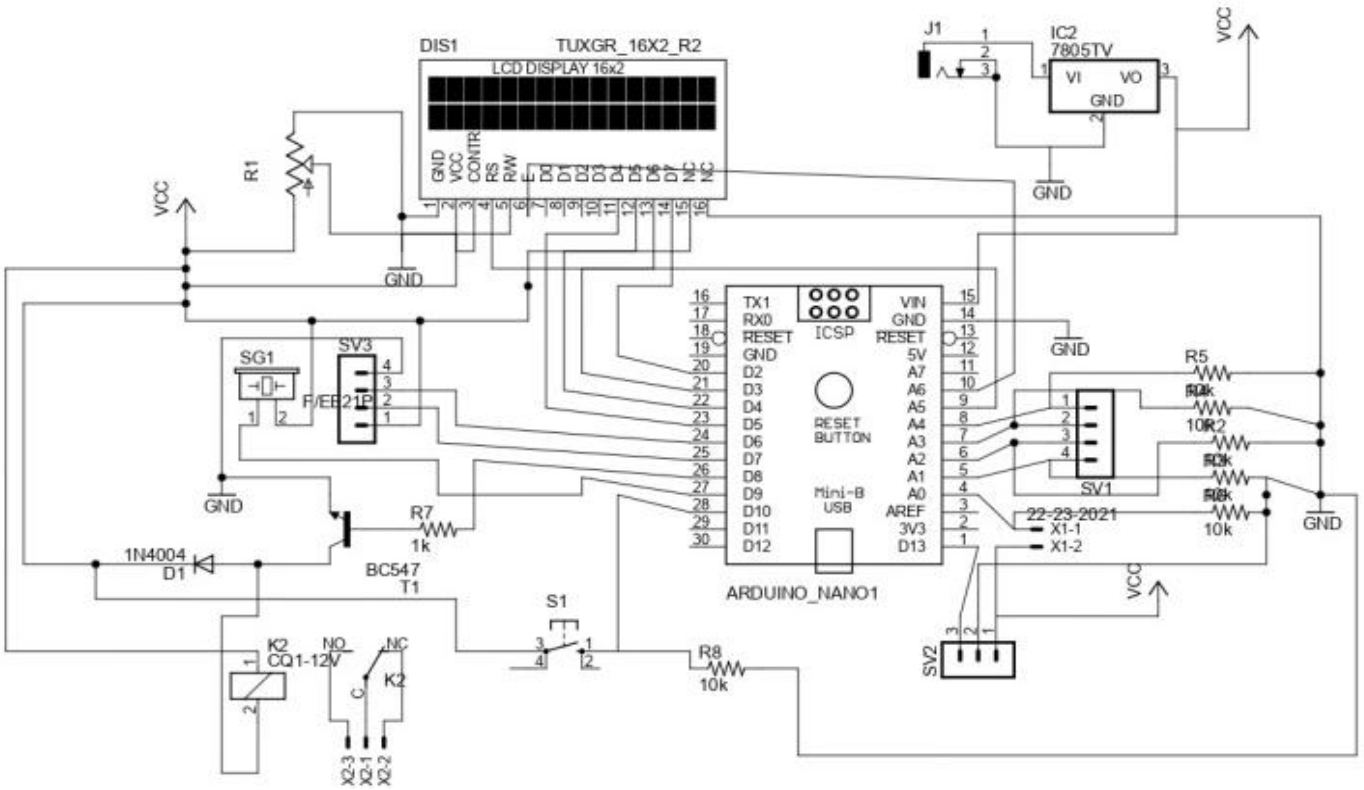

Figure 5: Schematic of the system

The fifth block is the push button; this is used to measure the Tank height at the time of installation of this Circuit. This can further used if you wish to replace the water tank with a new one. The sixth block is the Internal Relay plush Water Pump. Arduino will control the Water pump using the internal relay. The relay present on the circuit can be used to start any kind of 1 HP single phase Water pump without starters. The Seventh block is also the used for the same purpose; you can use this section to replace the internal relay with any relay which is operating in 5V DC to get better power. The Eighth block is the Buzzer, this is used to notify when the sump tank is empty.

IV. SELECTION OF COMPONENTS

4.1 Components Required:

- Arduino uno
- Control Valves
- 2 wire Diaphragm type level sensor
- Water tanks
- Controller Circuit
- pH Sensor
- Turbidity Sensor

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4.2 Specifications:

4.2.1 Arduino UNO:

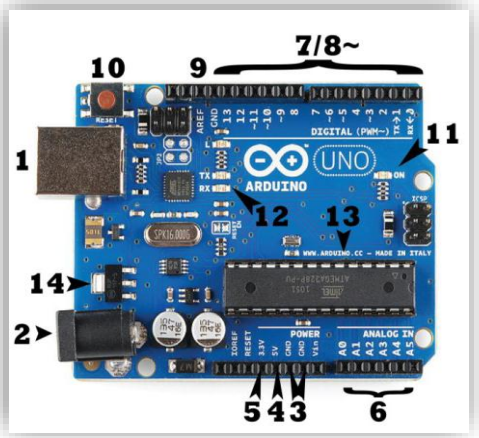

Figure 6: Arduino UNO

Power (USB / Barrel Jack):
Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. In the picture above the USB connection is labelled **(**1**)** and the barrel jack is labelled (2).

Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF):
The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire. They usually have black plastic 'headers' that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labelled on the board and used for different functions.

 GND (3): Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground your circuit.

 5V (4) & 3.3V (5): As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power.

 Analog (6): The area of pins under the 'Analog In' label (A0 through A5 on the UNO) is Analog In pins. These pins can read the signal from an analog sensor and convert it into a digital value that we can read.

 Digital (7): Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input and digital output.

 PWM (8): You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM).

 AREF (9): Stands for Analog Reference. Most of the time you can leave this pin alone. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins

Reset Button:
Just like the original Nintendo, the Arduino has a reset button (10). Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times. Unlike the original Nintendo however, blowing on the Arduino doesn't usually fix any problems.

Power LED Indicator:
Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON' (11). This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong, then we have to recheck our circuit.

TX RX LEDs:
TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication.

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Main IC:
The black thing with all the metal legs is an IC, or Integrated Circuit (13). Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the ATmega line of IC's from the ATMEL Company.

Voltage Regulator:
The voltage regulator (14) is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board.

4.2.2 Two-Wire Diaphragm type level sensor:
We need to measure the water level in a well down to 200 meters to protect a well pump by ensuring that it always stays under water. The level which we will be measuring could be up to 200 meters of H2O, and the special vented cable should be 250 meters long. We will need to send 4/20mA output, a compact display and switch contact output as well.

- SKU ID: s1-lmp307-0002
- Part No: 451-2002-1-1-1-1-3-2-250-000
- Sensor Type: Level only
- Level Sensing Range: 0 to 200
- Units: mH2O
- Reference Type: Gauge / Vented (atm to +P)
- Output Signal: 4-20mA, 2 wire
- Accuracy: 0.35%FS (11-12bit res)
- Installation Type: Submersible probe with removable nose cone
- Housing Material: Stainless Steel 316L
- Diaphragm Material: Stainless Steel 316L
- Media Exposed Seals: FKM
- Cable Type: PUR (70degC max)
- Cable Length: 250
- Cable Length Units: Metres (m)

Figure 7: Two diaphragm type level sensor

V. FUTURE WORK

Primary goals for future directions, the first goal is to extend the proposed system to include temperature control and quality monitoring system as well. In the present proposed system, the future scope lies in improvement of proposed the block diagram. The second one is to make less cost and more efficient to make more people friendly to this system.

VI. CONCLUSION

Authors hope that by introducing such a system to our daily life it could help to control our consumption rate for water with respect to the availability of source. The major factor of this is cost of the system since it is aimed on the household purpose, thus it has to cheaper and very cost effective and we hope that the system requires very little maintenance.

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