ISSN: 2278-4632
Vol-10 Issue-5 No. 9 May 2020

WATER INLET CONTROL & MONITORING SYSTEM USING ARDUINO

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Abstract: ***Water Inlet Control System is an electromechanical project which can automatically control (start or stop) the inlet of water into the air-cooling tanks according to the level of water present inside the tank. Also, it contains a display which can show the readings of temperature and water consumption inside the tank. In heavy manufacturing plants there needs to be proper management, balancing and treatment of water. This project has been implemented to automate this process. After installing this system between the pipelines of running water, there will be no need to turn on or off the industrial valve manually since a solenoid valve is used to do this work automatically. The system is based upon the technology of automating the flow of water inside various tanks by just acknowledging the level of water present in those.***

Keywords: ***Solenoid Valve, Industry4.0, Electromechanical Device, Automation.***

1. INTRODUCTION

The process of automating various machineries and processes in any industry with the help of control system such as robots or computers, which reduces the need of human resources, is known as Industrial Automation. It is the next approach beyond mechanization in the modernization of industries. In this system, an ultrasonic sensor is used to detect the level of water inside the tank. There is another alternative which can be used to detect the water level that is magnetic float switch. The main brain of circuit used inside this system is Arduino. Although, we can also use Raspberry Pi here but Arduino works just fine in this case and it is also cost efficient. Then, we have the major mechanical equipments like Solenoid Valve, Water flow Sensor and electrical/electronic components like Temperature Sensor, ultrasonic sensor or magnetic float switch, LCD, Buzzer Alarm, Relay etc.

2. COMPONENT DESCRIPTION

2.1 Solenoid Valve

Solenoid Valves are electromechanical devices which are used to control the rate of flow of inlet or outlet of any liquid or gas in machines or tanks. A solenoid valve can be two-way, three-way or four-way. Majorly, solenoid valves can be divided into direct acting valves and pilot-operated valves. A direct acting valve uses magnetic coil which opens the valve directly. A pilot-operated valve uses a smaller pilot valve which is used to open a larger valve which operates at considerably higher pressure. Solenoid valves are named so because it uses coil with ferromagnetic core which is generally known as 'Solenoid'.

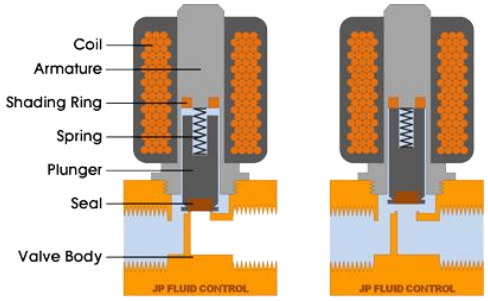


Figure 1. Solenoid Valve

In this project, a direct action solenoid valve has been used. The diaphragm used is made of Buna Nitrile which moves up or down within the valve body. Due to the moving of diaphragm, the valve opens or closes against a hard seat, thus allowing or restricting the fluid or gas to pass through it. The solenoid used is very economical and efficient since it takes 230 V AC voltages for its operation and has 1 inch diameter. It is made up of stainless steel and can easily operate on pressures between 0.5 to 12 Bar.

ISSN: 2278-4632
Vol-10 Issue-5 No. 9 May 2020

2.2 Water Flow Sensor

There is huge need of water supply in industries and for this public water supply system is used. The water used must be measured to get an idea about the requirement of water and how can it be made more efficient to reduce the cost of water and conserve it. For this purpose, the rate of flow of water is to be measured after which we could calculate the amount of water by doing calculations taking the size of the pipeline though which the water is flowing through.

Figure 2. Water Flow Sensor

A water flow sensor also uses a valve which is generally made up of plastic. A spinning wheel or rotor is present inside the sensor which rotates and creates a hall effect. There is a metal contact on the surface of water flow sensor which can be treated as the Hall Effect sensor and it is wired to take the output to Arduino where water flow can be measured according to the suitable code written in it. Water flow sensor is also mounted in between the pipeline at the inlet of water. There is also the need of a display to show all the measurements. This sensor is suitable for flow rate between 1 to 50 litres per minute and can withstand pressure up to 1.75 Mega Pascal.

2.3 Magnetic Float Switch

Magnetic float switch is one of the most popular level switches used for detecting the whereabouts of liquids in industrial applications. It uses the principle of magnetism and buoyancy for detecting liquid in any tank or vessel. The switch consists of a magnetic float which rides up or down on its stem when the level of water inside the tank increases or decreases following the buoyancy principle.

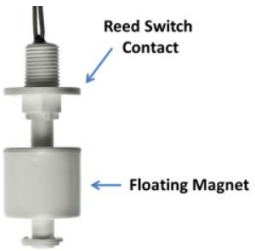


Figure 3. Magnetic Float Switch

2.4 Temperature Sensor

The temperature sensor used in this project is DS18B20 which is a one wire programmable sensor and can be used in harsh environment conditions. It can operate on voltages between 3V to 5V and can be used for temperatures ranging between -55°C to 125°C. It is waterproof and that is why this sensor is suitable for this project.

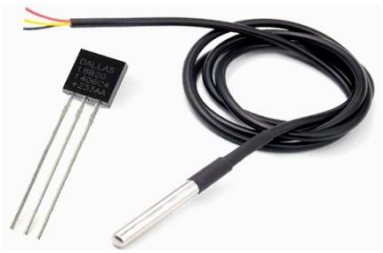


Figure 4. 1-Wire Temperature Sensor

This wire has three pins – Ground, V_{CC} and Data for connecting to the ground of the circuit, supplying power to the sensor and giving the temperature value at the output respectively. This sensor can be easily interfaced with Arduino and the library of this sensor can be used in the program to write the code.

2.5 Arduino Uno

Arduino Uno is a microcontroller board outfitted with sets of digital and analog Input/output pins dependent on the Microchip ATmega328P created by Arduino.cc. "Uno" signifies one in Italian and this word was picked to symbolize the arrival of Arduino programming (IDE) 1.0. It has a 16MHz quartz crystal, a power jack, a USB association and 14 digital input/output and 6 analog information pins that is an aggregate of 20 input/output pins. It might be cconstrained by the USB connect or by an outside 9-volt battery, anyway it recognizes voltages some place in the scope of 7 and 20 volts.

Figure 5. Arduino Uno

The Arduino Uno board is the most well known board as they are too simple in any case, it doesn't require a particular Arduino Uno programming

ISSN: 2278-4632
Vol-10 Issue-5 No. 9 May 2020

rather than that all you need is to choose the Arduino Uno in the gadget alternative before transferring your program.

2.6 16X2 LCD

Liquid Crystal Display, generally abbreviated as LCD, is a display module which can be interfaced with Arduino to provide desirable output at the screen or display area. This LCD works on the technology by blocking light, there are the major two polarized glass that have liquid crystal material in between the polarized glass. The lights are not emitted directly by the liquid crystal backlight or reflectors are used to make images in colour or in monochrome.

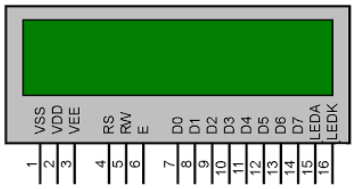


Figure 6. 16 X 2 LCD

A 16x2 LCD is able to display 16 characters per line and it contains 2 such lines and 5x7 pixel matrixes are used to display each character. it has two registers which are command and data.
The commands instructions like clearing its screen, setting the cursor position, controlling display etc given to the LCD are stored in the command register. And the data register are used to stores the data to be displayed on the screen.
This LCD 16x2 is very basic display screen which are used in the various electronics circuits and devices. Costing of the display is low and it can be easily programmed.

3. CIRCUIT ANALYSIS

3.1 Interfacing of Solenoid Valve

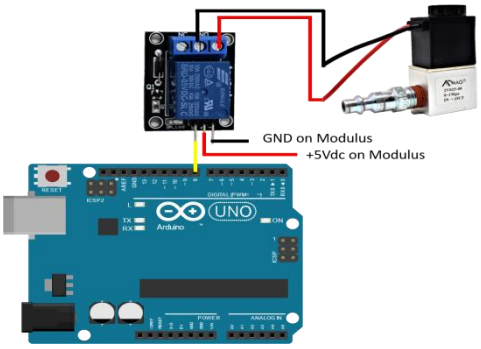


Figure 7. Solenoid Valve Circuitry

Solenoid Valve is interfaced with Arduino through Relay Module. Relay is an electromechanical switch which can open or close any circuit electromechanically. The two modes in a relay are known as Normally Open (NO) and Normally Closed (NC). The Relay module is connected with the Arduino with 3 wires having connections to Ground, V_{CC} Power Supply and input signal. The NO and common pins of relay board is then connected with the two wires of Solenoid valve.

3.2 Interfacing of Water Flow Sensor

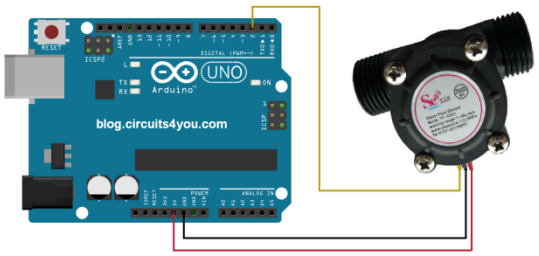


Figure 8. Water Flow Sensor Circuitry

The black and red wires of the water flow sensor are connected to the GND and +5 volt of the Arduino. We use the Interrupt feature of the Arduino in case of water flow sensor so that it gives output only when water is flowing through it and for this matter, only Digital Input/output pins 2 and 3 can be connected to the output of the water flow sensor.

3.3 Interfacing of Magnetic Float Switch

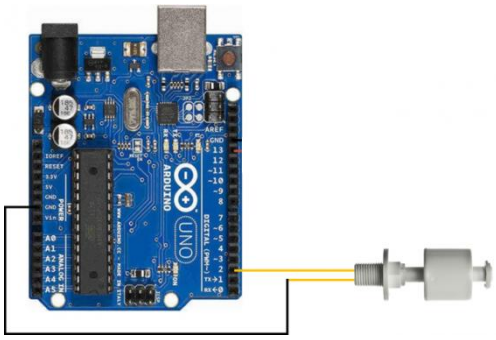


Figure 8. Magnetic float switch circuitry

The two wires of the magnetic float switch is connected to the digital I/O pin 2 and GND pin of the Arduino.

3.4 Interfacing of Temperature Sensor

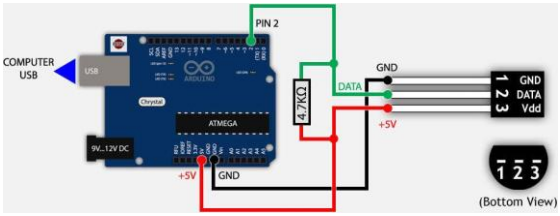


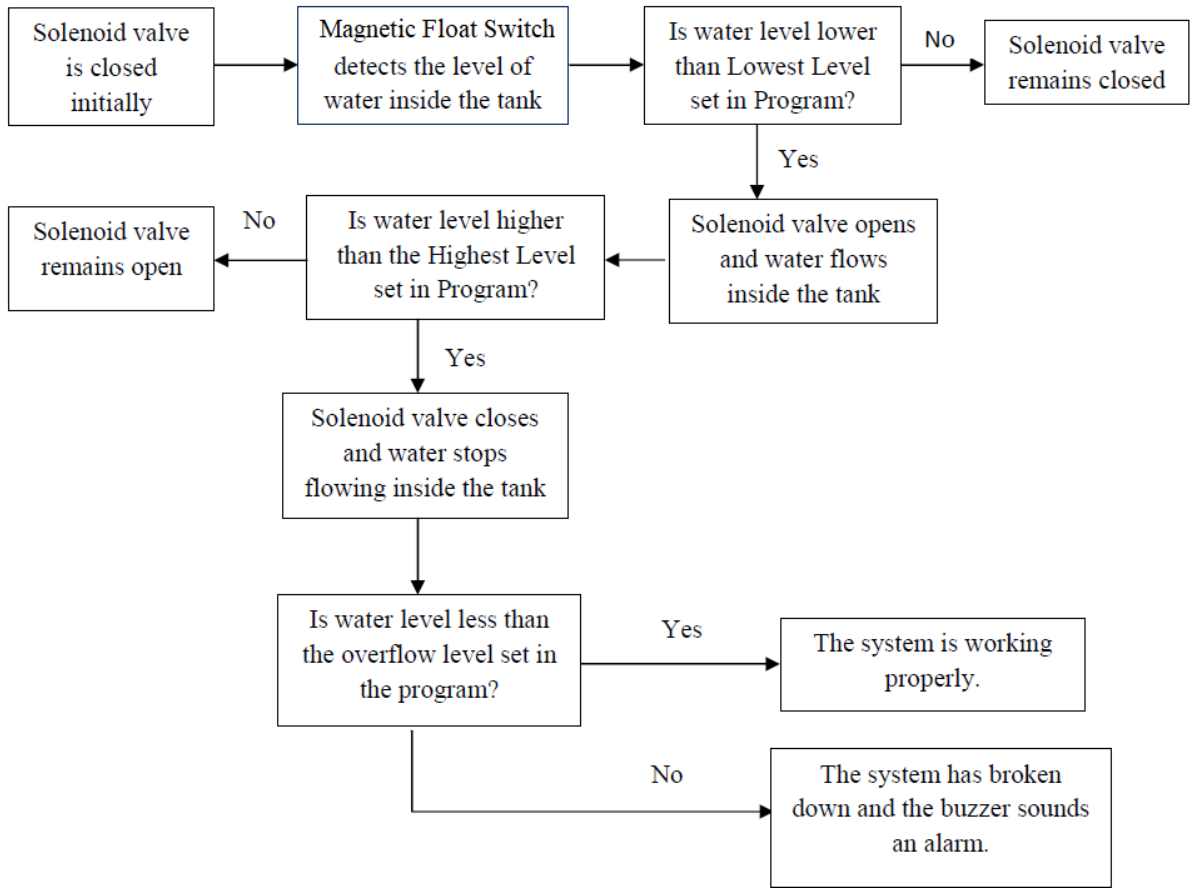
Figure 9. Temperature sensor DS18B20 circuitry

The interfacing of Arduino with DS18B20 is very simple. The V_{DD} and GND of the temperature sensor is connected with the +5V and GND and the DQ pin is connected to any of the digital Input/output pin of the Arduino.

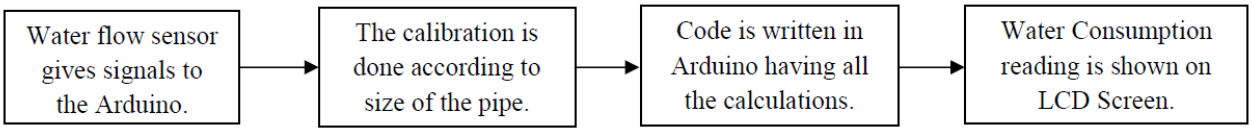
ISSN: 2278-4632
Vol-10 Issue-5 No. 9 May 2020

4. WORKING FLOW DIAGRAM

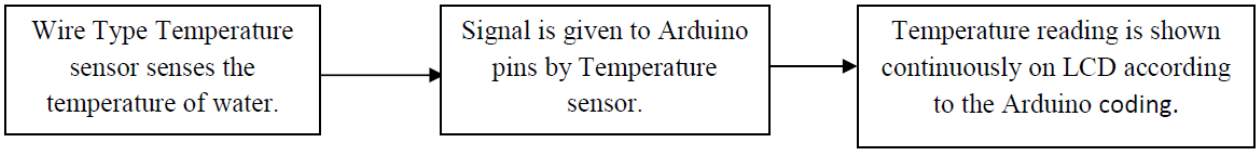
4.1 Inlet Control System



4.2 Digital Water Meter



4.3 Temperature Detector



ISSN: 2278-4632
Vol-10 Issue-5 No. 9 May 2020

5. FUTURE ADVANCEMENTS

GSM Module is an electronic device which can be used for communication between a machine and a mobile device. GSM stands for the Global System for Mobile communication. This system can be easily implemented with the help of and Arduino, A GSM Module and a SIM card. Using this module, we can easily access the data that is being displayed onto the LCD screen right onto our mobile phones through SMS service.

The data can also be stored on a HTML webpage. For that we will have to use Node MCU ESP8266 or Raspberry Pi and do the required coding in it.

A Database can also be created for the data collected from the system. If we need to keep the track of water utilized every day or every hour, then we will have to create a database to store that data and make it accessible in the future.

6. CONCLUSION

The Water Inlet Control System is a modern approach to solve water monitoring and flow problems in industries. This project can be termed as a mixture of Embedded System and Internet of Things. The project incorporates the core idea of making Industries smart and takes a step forward in the direction of fourth industrial revolution known as “Industry 4.0”. All the components used in this project are chosen as per industry standard and the system is made much robust as a motive to implement it in industries. The project uses devices of three major domains that are electronics, mechanics and computer science to create a secure an autonomous system which can sense, analyze, respond and collect data according to the needs. The digital water meter used in this project is designed in such a way that it gives the reading of water passing through the pipeline only if the water is flowing through it otherwise it will just show the level of water present inside the tank and the continuous reading of the temperature inside the tank. The reading of temperature is important since in industries, some machines work on cool water while some others works on hot or moderate water. So, to know the exact temperature of water present inside the tank is very important and that is why a temperature sensor has been used in this project. Due to the implementation of this system, there will be no need to keep an operator to manually open or close the industrial valve to start or stop the flow of water inside any tank. This system will allow the water to pass inside the tank when the water level is lesser than the required level and restrict the water to flow inside it when it reaches a certain level of water. There is an alarm buzzer also installed in this system, in case the system fails. It will, therefore, alarm the staffs nearby that the system has broken and they need to close the industrial valve manually.

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