Automated Drinking Water Distribution using Arduino

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Abstract

Water is the basic need of all living organism and human mankind, without water living is impossible. In recent days the rapid population growth causes insufficiency and wastage of drinking water which leads to scarcity of water and uneven distribution of drinking water. Next issue is that the supplied water is sucked more by individual home unit using suction pump which leads shortage of water to the remaining houses in the locality. In this paper a system has been modeled to overcome the above stated problems. The main aim of this paper is to distribute only required amount of water needed, thus ensuring there is no wastage and block in supply of water. In order to implement the proposed system each home unit must be provided with water flow sensor and water flow switch which is controlled by arduino mega board. Flow sensor generates series of electric pulse through which water utilize by the user, flow rate and the amount of water supplied can be calculated. Along with this arrangements a valve and relay is provided, which controls the supply of water from main tank. The main focus is to avoid usage of drinking water for domestic purpose and reduce scarcity of water in near future.

Keywords—*Arduino Mega, Water flow sensor, Valve, Water flow switch, LCD*

I. INTRODUCTION

Water is the available natural resources on earth, which has to be utilized efficiently. Also it has to be provided without wastage to face the problem of scarcity with appropriate quantity and quality [1] - [3]. Water influences many areas such as agriculture field, domestic purpose, industrial usage etc. Water bodies cover 70% of earth surface out of this only 3% of water is portable and drinkable [2], [4]. Earth consists of 97% of salt water and 3% fresh water, so the water has to be supplied properly at appropriate time without wasting it and ensuring quality [6].

The advanced development of science and technology upgrade the design of flow sensor and flow switch to accomplish proper distribution of water supply through water tanks and pipes[5] - [7]. The required quantity of drinking water may vary for each and every person according to their physical activities, age, health issue and environmental based conditions. Water contributes to 60% and 55% of weight in men and women respectively [9]. Drinking water plays an important role in human metabolism and helps in making the skin healthier, refreshed [10]. It also makes us stay alert of many diseases. The automated water distribution system is used to turn over water from source point to usage point in an efficient way and avoids human error. Automated water supply can be done through embedded system in cost effective way [8], [11].

This paper is organized as follows. Section II tells about the modeling of the automated water supply system and section III discusses about the hardware components utilized in the proposed system followed by implementation of the automated system in section IV. The results and inferences are discussed in section V and conclusion in section VI.

II. MODELLING OF THE AUTOMATED WATER SYSTEM

The drawbacks of existing system such as uneven distribution, water wastage etc., are overcome through proposed method. Automated water supply system also focuses on proper distribution of water to all user ends and arrest water supply when it reaches a particular limit. The flow of water to each home unit is measured using flow sensor. Based on the normal consumption of drinking water per person per day, water is supplied to each home unit. When a particular home unit need excessive water intimation to the main distribution unit should be made to fulfill the need. The flow of water continues until it reaches the selected threshold level and arduino mega calculates the flow rate and also the amount of water to each home unit. By comparing the fixed threshold value with the calculated value, over consumption can be easily detected. Based on the flow sensor calibration factor the number of liters of water consumed is determined. Fig 1 shows the block diagram of the proposed system, in which automated water supply is achieved using arduino and flow sensors. Any discrepancy is intimated to main hub using LCD display connected to arduino board.

III. HARDWARE DESCRIPTION

A. Arduino Mega:

The mega2560 is a microcontroller board based on ATmega2560 which is chosen as a CPU instead of arduino UNO to meet the requirements of the proposed system. It consists of 54 digital input and output pins in which(15 can be used for pulse width modulation output) 16 analog input pins, 4 UART'S, 16MHZ crystal oscillator, USB connection, power jack, an In Circuit Serial Programming header and reset button are present. Out of this 3pins is used for communication purpose and it is interface with flow

sensors, 9 pins from digital side is interfaced with LCD display and 2pins are used for ground and 5v power supply.

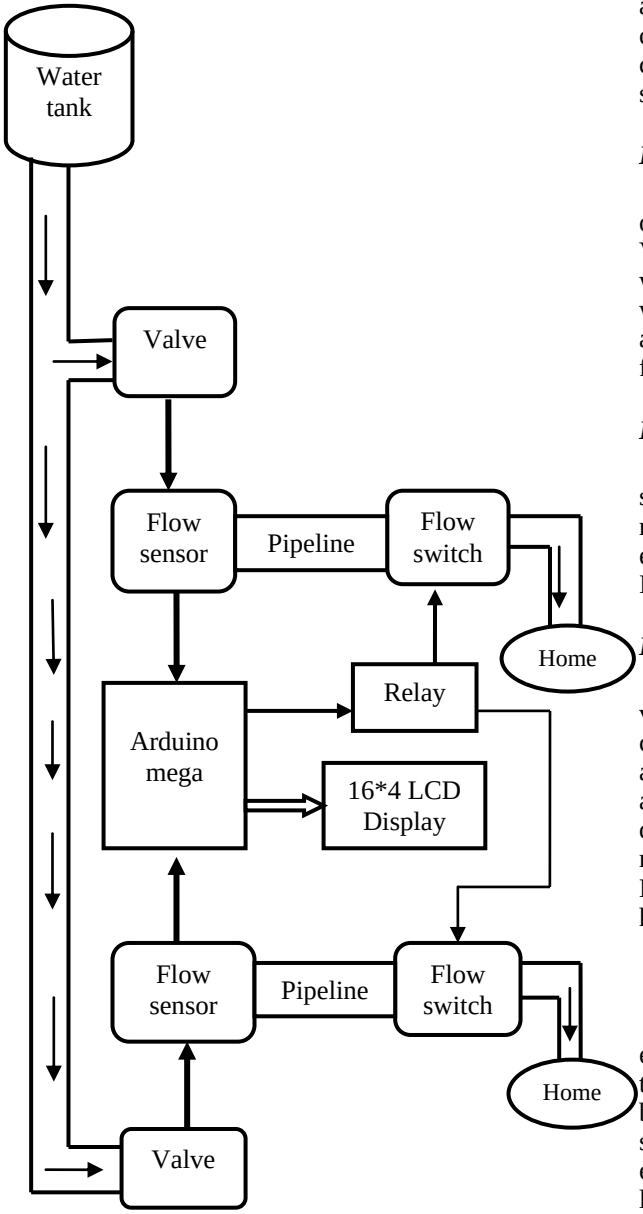

Fig. 1. Block Diagram of the Proposed System

B. Flow Sensor

Flow sensor plays a vital role next to arduino mega board in automated water system. The water rotor in the flow sensor rotates when the water flows through it and its speed changes with different rate of flow. Out of the three wires in the flow sensor, black wire is connected to ground, yellow wire is connected to LCD for displaying values and red wire is connected to arduino mega communication pin. Flow sensor generates a series of output pulse proportional to instantaneous flow rate. Counting the pulses generated from the output of sensor, the flow rate is calculated using suitable conversion formula mentioned in section IV.

C. Flow Switch

The water flow switch sends an electrical signal at specific flow rate. Flow switch operate only at 230v power supply. Out of two wires, one is connected directly to power supply and another wire is connected to relay for controlling the low power signal.

D. Valve

Valve is used to control or regulate the flow of liquid by the mechanism of opening or closing. Valve is used in case of any breakage occur in the water flowing pipeline it can easily be rectified without wastage of water. Valves are perfectly secured and once it is closed they never allow the water to flow through it.

E. Relay

Relays are used to control a circuit by a separate low power signal or where in several circuits must be controlled by one signal and it utilizes an electromagnet to mechanically operate a switch. Individual relays are used for each flow switch.

F. LCD

A 16*4 LCD is utilized for displaying the values of the sensors and other discrepancies which, consist of 16 characters with 4 rows chip on board alphanumeric display. Out of these 16pins the LED+ and LED- pin are connected to power supply; three digital pins are used and is interfaced with Arduino mega digital pins. VCC is connected to power supply. LCD displays the amount of usage of water to each home unit individually.

IV. IMPLEMENTATION

The automated supply of water can be well executed by embedding all the components and fixing the threshold level to the arduino. Arduino mega board plays a vital role and it is interfaced with flow sensor. Flow sensor and flow switch is connected to each home unit separately. Flow sensor is placed in a line of water supply which consists of a pinwheel sensor to measure how much water as passed through it. Hall Effect sensor is placed within the flow sensor which is used to calculate the output pulse. Hall Effect sensor comes with three wires Red/ VCC (5v DC input), Black/Ground (0v), yellow/output (pulse output).

Fig 2 shows the flow chart of automated water supply system. First the flow sensor pulse rate is calculated from which flow rate and amount of water is applied. Once the threshold level has attained the valve get closed automatically. Connections are made such that VCC and ground wire of water flow sensor are connected to 5v and ground of Arduino and link pulse output wire of water flow sensor to Arduino digital pin. Flow sensor generates a series of output pulse proportional to flow rate. The flow switch sends an electrical signal at specific rate. The automated

water distribution unit is built and the flow measurement is calculated using the formula

Flow rate = ((1000/ (millis ( ) - old time)) * pulse count)/ calibration factor

Flow milliliters = (flow rate /60)*1000

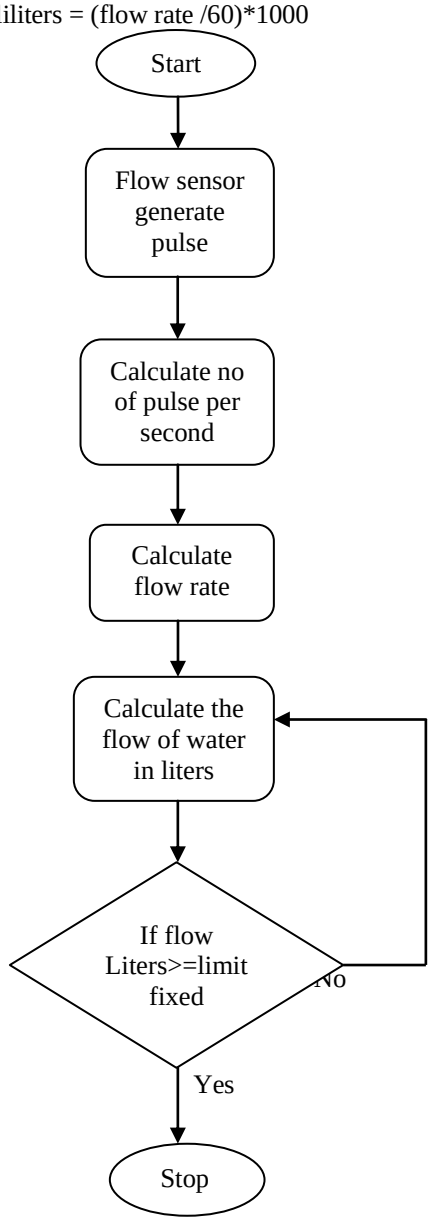

Fig. 2. Flow Chart

Relay is used for power supply to the flow switch, because arduino operate at 5v but flow switch requires 230v supply to operate. Relay has three pins viz., normally open, normally closed and common. Each flow switch is connected to separate relays. When the flow of water reaches the fixed limit it stop supplying water to particular area and flows continues to remaining area until it reaches the fixed limit. LCD is interfaced with arduino to display the amount of usage of water.

V. RESULTS AND DISCUSSIONS

First the automated drinking water system is implemented in simulation using Arduino IDE software tool. The Arduino Integrated Development Environment - or Arduino Software (IDE) – is a text editor tool for writing code, which has a message area, a text console, a toolbar with buttons for common functions and a series of menus. IDE pays a way to upload programs to arduino board via cable. The program written in arduino software (IDE) is called sketches. The console in arduino software (IDE), displays text including complete error messages and other information. Proteus software tool is used for viewing the simulation results. Fig 3 shows the simulation of automated drinking water distribution system in Proteus tool. The threshold level to each house unit is fixed and once the water starts flowing, quantity of water is continuously measured using flow sensor and after a certain value is reached the flow is arrested.

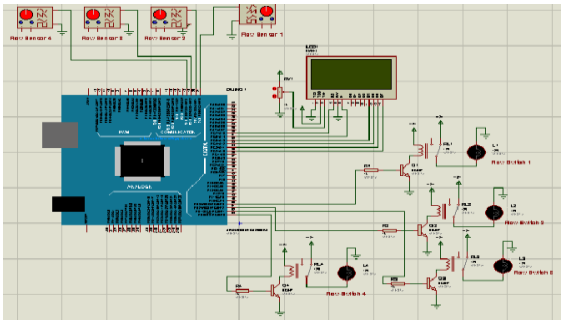

Fig. 3. Automated Water System Simulation in Proteus

After successful implementation of simulation using arduino IDE tool the real time automated system is modeled and arduino mega is placed at the main hub. Fig 4 shows the automated supply of water distribution system is for three home units with help of arduino mega. The program for automated system is written using arduino IDE software and embedded to arduino board. Each home unit is provided with separate flow sensor and flow switch. Flow rate is calculated using flow sensor and arresting of water is done according to threshold level. According to the need of the individual house water supply is provided, and in this scenario 3 liters, 5 liters and 7 liters of water are supplied to house 1, house 2 and house 3 respectively. Water supply is provided until it reaches the limit and when the limit is attained, the flow sensor stops supplying water even though the tap is open. Flow sensor calculates the usage of water and display the quantity in LCD display. The quantity of water can be changed according to the requirements of individual house.

Fig. 4. Automated Model For Three House Units

VI. CONCLUSION

The rapidly increasing population has led to the need for innovative method to manage water supply system. In the proposed system the fixed amount of water is supplied and when it reaches the particular limit it blocks supplying the water. The automated distribution water supply monitoring system ensures proper water supply, avoid wastage of water, and cost efficient. Flow sensor overcomes the basic limitation such as less accuracy and human error. It supplies the fixed amount of water with appropriate quality and quantity at correct time. The future work can be automated billing system and inclusion of GSM module for billing and maintaining the quality. The optimization technique can be used for complex pipeline system and overcrowded area.

REFERENCE

[1] Hegde, Adarsh, et al. "Automated Water flow Control System." National Conference on Product Design (NCPD 2016). 2016.

[2] Bhawarkar, N. B., et al. "Literature Review for Automated Water Supply with Monitoring the Performance System." (2014).

[3] Vinothini, E., and N. Suganya. "Automated Water Distribution and Performance Monitoring System."International Journal of Engineering and Innovative Technology (IJEIT) Volume 3 (2014).

[4] Sharath, V. C., et al. "Smart aqua meter." Advances in Electronics, Computers and Communications (ICAECC), 2014 International Conference on. IEEE, 2014.

[5] Rajeswari, V., L. Padma Suresh, and Y. Rajeshwari. "Water storage and distribution system for pharmaceuticals using PLC and SCADA." Circuits, Power and Computing Technologies (ICCPCT), 2013 International Conference on. IEEE, 2013.

[6] Batista, N. C., et al. "Photovoltaic and wind energy systems monitoring and building/home energy management using ZigBee devices within a smart grid." Energy 49 (2013): 306-315.

[7] Ashok. GaikwadSonali. "water anti-theft and quality monitoring system by using PLC and SCADA." International Journal of Electrical and Electronics Engineering Research 3.2 (2013): 355-364..

[8] Gouthaman, J., R. Bharathwajanprabhu, and A. Srikanth. "Automated urban drinking water supply control and water theft identification system." Students' Technology Symposium (TechSym), 2011 IEEE. IEEE, 2011.

[9] Eswaran, P., and Aswin Kumar. "Conceptual design and development of water metering system for multiple family residential buildings." International Journal of Advanced Computer Research 2.4 (2012).

[10] Shankar, K. Gowri. "Control of boiler operation using PLC–SCADA."Proceedings of the International MultiConference of Engineers and Computer Scientists. Vol. 2. 2008.

[11] Stancel, E., et al. "Urban water supply distributed control system."Automation, Quality and Testing, Robotics, 2008. AQTR 2008. IEEE International Conference on. Vol. 3. IEEE, 2008.

[12] Lam, KaLun, et al. "Zigbee automatic meter reading system-beeline of metering." Microwave Conference, 2008. APMC 2008. Asia-Pacific. IEEE, 2008.