Smart Water Tank Management System for Residential Colonies Using Atmega128A Microcontroller

Yogita Patil, Ramandeep Singh

Abstract--In this paper we present the idea of smart water tank management system operated with Atmega 128A microcontroller, which is the prime component of this project. A prototype has been made for this project. So, in this way manual intervention is not required for continuous water supply. This system can also be used for any other fluids in chemical industries or factories. The main aim of this project is to provide optimal water distribution and moreover reduce manpower involved in it.

Index Terms— Atmega128A microcontroller, Water Tank, contact sensors, LCD, water pump, Relay, water level

1 INTRODUCTION

Almost 70% of earth's surface is covered with water and from that also about 2% of the planet's water is fresh. So, conserving this available water resource is a provoking issue, to be pondered upon [1]. It is found that much of the water is wasted due to the inefficient and poor water allocation and lack of integrated water management systems [2]. Thus, sophisticated and precise water management systems need to be invented [3]. Measuring water level is an indispensable task from government and residence perspective. So water level management system makes potential significance in home appliances [4]. The current project helps to automate the system [5], [6]. Engineering always aims at reducing the work and having more leisure time.

This paper is organized in the following manner. Chapter two concentrates on the basic concepts of system design. Chapter third focuses on design and implementation part. Fourth chapter deals with block diagram and its architecture. Fifth chapter deals with flowchart. Pin consideration is specified in sixth chapter. Embedded Interface screen is given in seventh chapter. Eighth and ninth chapter focuses on application area and advantages. Tenth chapter focuses on conclusion and future work. Eleventh chapter of acknowledgement is dedicated to the people and institute.

2 BASIC CONCEPT

We have proposed two tank prototype in this paper and a reservoir [7]. These tanks have water level indicators for each of them. Contact sensors are used for water level sensing purpose. Provision has been made for the display of current status of water level on the LCD. Individual water pumps are attached to each tank. As soon as the tank is empty the water pump will draw water from the reservoir until the tank is full. There are three water levels considered in this case, these are low, medium and high. Low level indicates that the water pump should be on. High level indicates that the water pump should be off. This water tank management system will display the current water level in the tanks, will automatically switch on the corresponding motor to fill the tank and will also switch off the motor when tank is filled [8]. Contact Sensors are deployed to detect the water level [9]. Information displayed on 16x2 LCD. Relay is used for automatic switching of the water pump.

3 DESIGN AND IMPLEMENTATION

For this project, we have been using microcontroller, a reservoir, water tank and water pump. Water pump has been controlled using relay and contact sensor. Six homemade contact sensors are used (three for each tank) are used to detect water level. The simulation of entire project is done in Proteus V7.2 software. We have used WinAVR's Programming Notepad software for the code simulation.

4 BLOCK DIAGRAM/ ARCHITECTURE

Initially, LCD will display the current status of the two tanks. The water pump1 will be switched on using relay1 as sensor1 of tank1 has detected a low water level then LCD will flash the low water level of the tank 1. Water pump1 will draw water from reservoir. Now as soon as the water level reaches the brim, sensor3 will sense the water level and using relay1, the water pump1 will be automatically turned off. The current water level and the status of the water pump will be displayed on LCD. Similarly, if tank2 also detects a low water level using sensor1 of tank2 then water pump2 will draw water from reservoir using relay2 till the tank2 is full. We have also kept an intermediate water level sensor for both the tanks to show that the tank is half full. An intermediate level is kept to have a check on required water levels in the tank. This is how the embedded system will work.

- *Yogita Patil is currently post graduate student pursuing Masters of Technology in Embedded Systems from ITM University, Gurgaon, India. Her area of interest is Low power Embedded Systems. PH-08527746764 .E-mail: patilyogita2011@gmail.com*
- *Ramandeep Singh is an Assistant Professor in EECE Department of ITM University, Gurgaon. He is pursuing Ph.D in embedded systems from ITM University, Gurgaon. India His core research areas are low power embedded systems, robotics, FPGA based embedded systems and SCADA. Prior to joining ITM University he has worked with NXP Semiconductors, Bangalore. PH-09818767123. E-mail:ramandeepsingh@itmindia.edu*

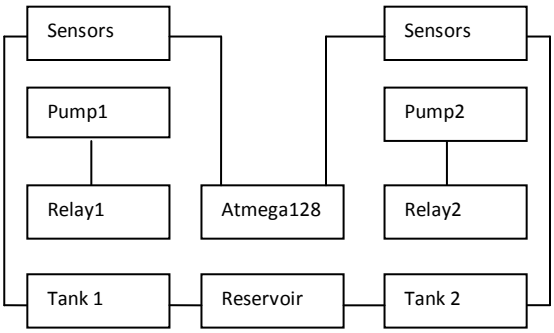

Figure1: Block Diagram of proposed system

5 FLOWCHART/ ALGORITHM

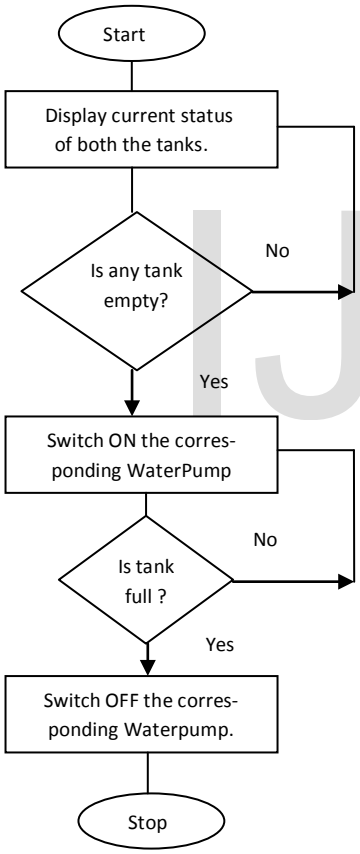

Figure 2: Flow Chart of proposed system

The flow chart is depicted for the project. In this initially, LCD will display the current status of the two tanks. There are three different levels specified for the water tank.

These levels are low, half and full. The first line of the LCD will display the status of tank1 and the second line for tank2. If any amongst the tank1 or tank2 is empty then water pump corresponding to that tank will be switched on with the help of relay i.e Water pump1 for tank1 and water pump2 for tank2. Then again there will be a polling for whether the tank is full or not. In between that as the water level goes on rising, the corresponding water level will be displayed on the LCD. For instance the LCD will display empty, intermediate and full level. As soon as the tank is full, then the water pump will be automatically stopped with the help of relay. The relay used is a solid state relay working on 12V,its operating voltage.

6 PIN CONSIDERATION

Here a brief description regarding the pin consideration is provided for reference.

Table1: Pin Consideration of the Atmega128A microcontroller

Pin Number	Function	Type
PD5(Port D -fifth pin)	Relay is attached	Output
PB0(Port B- zeroth pin)	LCD pin	Input
PB1(Port B- first pin)	LCD pin	Input
PB2(Port B- second pin)	LCD pin	Input
PC0-PC7 (Port C pins)	LCD pins	Output
PA5-PA7 (Port A pins)	Sensors attached	Input

7 RESULT

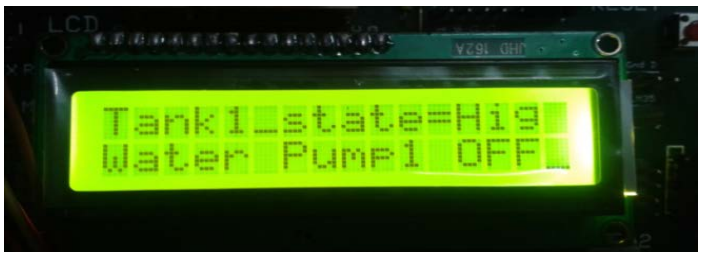

Figure 3: Screen Shot of LCD

Here it can be seen that as the water level reaches the brim of the tank1 then the topmost sensor will detect a high water level and the corresponding water pump1 will be turned off. These details of the tank and the water pump will be flashed on 16x2 LCD. Same is the case for tank2 also. As the water level in tank2 reaches the brim then the water pump2 will be turned off and the status will be displayed to the user.

We have practically designed this Smart water tank management system in our laboratory and have got successful results.

8 APPLICATION AREAS

As its title suggests, it can be very well used for the residential colonies. This system can be used in chemical industries where fluids are filled in big tanks and their monitoring is required [10]. It can also be used in nuclear plants where monitoring fluid filled tanks is mandatory as well as should be optimized [11], [12].

9 ADVANTAGES

The biggest advantage of this model comes into picture when it is implemented for overhead tanks. First and foremost there is no need to climb the stairs again and again to check the water level in the tanks. Secondly no need to go for switching on the water pump as it is automatically done by relays attached to water pump so this in turn reduces manpower involved in monitoring. Thirdly it has a display screen which shows the current status of the two tanks water level indicating not only the maximum and the minimum water level but also an intermediate level of the water.

10 CONCLUSION AND FUTURE WORK

Water is quintessential for one and all. But it is a fact, that much of the precious water is wasted due to the lack of well monitoring systems [13]. Our sole intension of undertaking this project was to establish a cheaper, viable and simple configurable device which can solve our water wastage problem [14]. We have very successfully implemented this system. It is a promising application made by the use of Atmega128A microcontroller.

This system can be implemented using Level sensors which would render an accurate water level and it can be operated using Smart Phones [15].

ACKNOWLEDGEMENT

I am deeply obliged and thankful to my Mentor who encouraged me and had faith in me. I would also like to express my gratitude towards Professors, Lab assistant and the entire Electrical, Electronics and Communication Department of the ITM University, Gurgaon for their constant support and assistance in our project. Finally, i would like to thank all the authors whose projects provided me a helping hand.

REFERENCES

[1] Ocampo-Martinez, C.; Puig, V. ; Cembrano, G. ; Quevedo, J. "Application of predictive control strategies to the management of complex networks in the urban water cycle [Applications of Control] ". IEEE conference on Control Systems, (Volume:33, Issue: 1) Date of Publication:Feb. 2013 Page(s): 15 – 41 ISSN :1066-033X

[2] Verma, S., Prachi, "Wireless Sensor Network application for water quality monitoring in India". Publisher IEEE. National conference on Computing and Communication Systems (NCCCS), 2012 Date of Conference: 21-22 Nov. 2012 Page(s):1-5

[3] M. Javanmard, K.A. Abbas and F. Arvin, "A Microcontroller-Based Monitoring System for Batch Tea Dryer", CCSE Journal of Agricultural Science, Vol. 1, No. 2, December 2009

[4] Lu Xiu-ru; Pang Hong-jie ; Jiao Xiao-song; Cao Ying-qi, "Innovation and Development on Scientific Management of Water Resources". Publisher IEEE. International Conference on Management and Service Science (MASS), 2010. Date of Conference:24-26 Aug. 2010 Page(s):1-4.E-ISBN: 978-1-4244-5326-9

[5] S. M. Khaled Reza, Shah Ahsanuzzaman Md. Tariq, S.M. Mohsin Reza. "Microcontroller Based Automated Water Level Sensing and Controlling: Design and Implementation Issue" . Proceedings of the World Congress on Engineering and Computer Science 2010 Vol I WCECS 2010, October 20-22, 2010, San Francisco, USA

[6] Xu Jian-Hua; Luo A-Ling "Research on Water Resources Automatic Monitoring and Management System". Publisher IEEE. Fourth International Conference on Computational and Information Sciences (ICCIS), 2012 Date of Conference: 17-19 Aug. 2012 Page(s): 1135 – 1138

[7] Hu Likun; Li Guangping ; Huang Wenqin "Level Control System of Double-Hold Water Tank Based on Inverse System Method and PID". Publisher IEEE. 2nd International Conference on Intelligent Human-Machine Systems and Cybernetics (IHMSC), 2010 (Vol:2), Page(s):129-132, 26-28 Aug. 2010

[8] Jiang Wei, "Intelligent Building Control of Water Tank Based on Fuzzy Theory". Publisher IEEE International Conference on Intelligent Computation Technology and Automation (ICICTA), 2010 (Volume:2) Date of Conference: 11-12 May 2010. Page(s): 549 – 552. E-ISBN : 978-1-4244-7280-2

[9] Russin, E. ;Beaumariage, D. ; Deibel, L.E. ; Zumwalt, B., "A technical development plan for a next generation water level measurement system". Publisher IEEE. OCEANS '85 – Conference on Ocean Engineering and the Environment Date of Conference:12-14 Nov. 1985. Page(s): 242 – 252.

[10] S.Venkatlakshmi, S.Vivekanandhan, S.Revathi, E.M.Shakthi Arul, C.Paramasivam, "Industrial Process Management Using LabVIEW ". IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e- ISSN: 2278- 2834,p- ISSN: 2278-8735. Volume 5, Issue 6 (Mar. - Apr. 2013), PP 46-56.

[11] Rao, H.S. "Modeling of water distribution systems". IEEE Conference on Decision and Control including the 16th Symposium on Adaptive Processes and A Special Symposium on Fuzzy Set Theory and Applications, 1977 .(Volume:16) Date of Conference Dec. 1977 Page(s): 653 - 658

[12] Jervis, M.W. "Control and instrumentation of large nuclear power stations a review of future trends". IET Physical Science, Measurement and Instrumentation, Management and Education - Reviews, IEE Proceedings A (Volume:131 , Issue: 7) Date of Publication: September 1984 Page(s):
481 - 515 ISSN :0143-702X

[13] Harminder Kaur, Ravinder Singh Sawhney, Navita Komal, "Wireless Sensor gNetworks for Disaster Management". International Journal of Advanced Research in Computer Engineering & Technology Volume 1, Issue 5, July 2012

[14] Thenkabail, P.S., "Improving Water Productivity for Agriculture - Predicting and Preventing Crisis in Irrigated Water Use in a Changing Climate". Publisher IEEE Global Humanitarian Technology Conference (GHTC), 2011 Date of Conference: Oct. 30 2011-Nov. 1 2011 Page(s): 176

[15] Tahat, A. ;Abukhalaf, M. ; Elmuhesen, O. "Solar energy water heater remote monitoring and control system". Publisher IEEE International Conference on Electronic Devices, Systems and Applications (ICEDSA), 2011. Date of Conference: 25-27 April 2011 Page(s): 98 – 103 ISSN : 2159-2047