Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

Monitoring and Controlling the Water Leakage using Robotic Arm

J. Anisha John
Department of Electronics & Communication Engineering
SRM University
Chennai, India

S. Nivash
Department of Electronics & Communication Engineering
SRM University
Chennai, India

***Abstract* -- This paper gives details about water monitoring and control system developed, based on the technologies of wireless sensor networks. The monitoring system consists of the Tanks, Arduino microcontroller, Humidity sensor, Solenoid valve that are placed near to the Water Tank. When the water in the tank starts to leak, it will be detected and the information will send to the robotic arm through the Zigbee module and the water leakage will be displayed in the LCD display. Also the buzzer starts alarming automatically. At the same time the Solenoid valve is opened and the water flows to other tank. The Zigbee module will be placed in the microcontroller for transferring the information to the robotic arm. Robotic Arm will move towards the tank and close the water leakage occurred in the tank. The software contains the Arduino IDE for simulation. This system is remotely accessible. The objective is to detect the water leakage and close the leakage without the help of human**.

Keywords—Humidity Sensor, Solenoid valve, Arduino Microcontroller, Zigbee module, Arduino IDE.

I. INTRODUCTION

Nowadays drinking water is the most inestimable and valuable for all the human beings, drinking water services face new challenges in real-time operation. This challenge appeared because of finite water resources growing population, developing infrastructure etc. Hence therefore there is a use of better methodologies for monitoring the water quality system [1].Water services in many parts of the world are facing growing challenges in their attempts to meet the need for drinking water. For example, in the United States also 36 states expect to experience water shortages over the next 10 years [2]. Another major example is China where also 400 of its 600 large and medium sized cities endure from water poverty, with at least 100 cities, including Beijing, actively threatened (Tai, 2004).A few factors are contributing to this position. Climate change, demonstrate by extended periods of drought, is adversely impacting water resources [11]. Population growth caused by exodus to large urban centers and temperate regions is exerting higher pressure on existing water supplies. The problem is amalgamated if water treatment infrastructure is operating near capacity and funds required for development are scarce. Limited treatment capacity can constitute drinking water poverty even in water-rich countries. In these challenges, the improvement of water loss from leaks in transmission and delivery tanks can provide a solution, at least partially, to poverty caused by faulty water resources and /or limited treatment capacity.

Water is lost due to leakage in various components of the networks that include transmission pipes, delivery pipes, service connection pipes, joints, valves, fireplug, and tanks and reservoirs [3]. The water monitoring technologies have made an important progress for source water surveillance and water plant operation. The use of their technologies having high cost combined with installation and calibration of a large scattered array of monitoring sensors. The algorithm intended on the new technology must be relevant for particular area and for large system is not suitable.

II. PROPOSED SYSTEM

This system is proposed to avoid leakage in water tank. It consists of ATMEGA328P microcontroller, Humidity sensor, Solenoid valve, Zigbee module is placed in the water tank. When the humidity sensor detects the leakage, the buzzer starts ringing and also it will be displayed in the LCD module. At the same time Solenoid Valve is open and water flows to the other tank. The Zigbee module will be placed in the robotic module. It will receive the signal, then the Robotic Arm will move to the Tank to close the leakage in the Tank. The Arduino IDE is used as a compiler here to dump the program to the microcontroller.

III. SENSING AND CONTROLLING

A.Transmitter Section

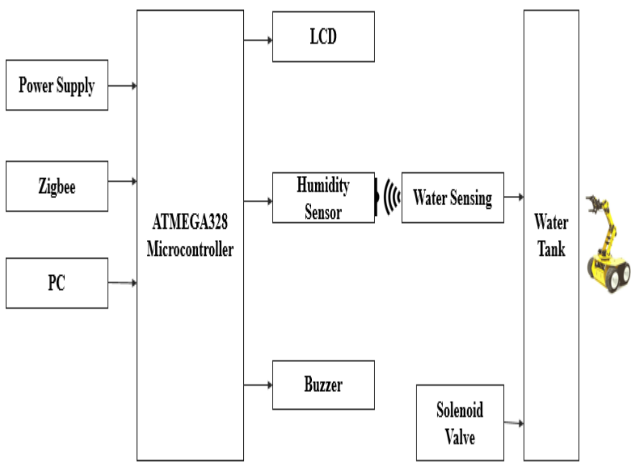

Fig 1: Block Diagram of Sensing Section

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

B.Receiver Section

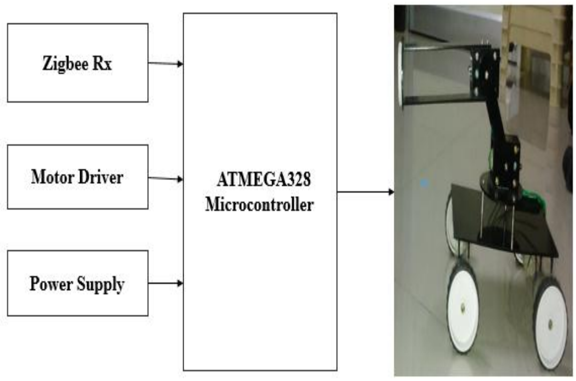

Fig 2: Block Diagram of Controlling Section

There are two section 1.Transmitter Section 2.Recevier Section. Power supply connected to the microcontroller. It is supplies power. Zigbee is used to transfer the information. Code is dumped in PC (Computer).Information displayed the LCD module. Humidity Sensor is used to sensing the water leakage. Motor Driver is used to control and interface of a DC motor with a microcontroller. And Robotic arm is close the leakage.

IV. SYSTEM OVERVIEW

A.Arduino Module

Arduino is a single board microcontroller. It is proposed to make the application of interactive substance or environments more usable. There are many types of Arduino available. The ARDUINO UNO model has been used. The Arduino Uno is a microcontroller board based on ATmega328P. It has 14 digital input/output, 6 analog inputs, USB connection, power jack, ICSP header, and reset button. It consist of everything essential to support the microcontroller; easily connect it to a computer with a USB cable an AC-to-DC adapter to get started [4].

In order to the program, Arduino, Arduino IDE (i.e.) Arduino programming terrace is installed in a Windows Pc. The program is written in the Arduino ide and then transferred to the Arduino with the use of a serial cable Universal Serial Bus straightly connected to the pc. The Arduino will read the information from the Zigbee and convert it as it is programmed. The information that is received from the Zigbee in the form of analog information is converted to digital pulses by Arduino and read it.

B.Zigbee Module

ZigBee Module is a low-price, low-power, wireless mesh networking standard. The low price allows the technology to be generally used in wireless control and monitoring application, the low power-usage allows long life with small batteries, and the mesh networking maintains high reliability and larger range. This module is in line with the Industry common applications of wireless data communication module [2].

Fig 3: Zigbee Module

This module can obtain transparent data transmission between more devices, and it can form a mesh network. This device has the individual of small volume, ultra-low power consumption and low-price. It can be either as a self-sufficient data transmission termination or be comfortably embedded into a variation of commodity to form a short-range wireless data transmission solution.

i. Maximum Transmission Distance:

Internodes Barrier Free: 200 meters.

ii. Wireless Frequency:

2.4G ISM License-free Frequency Band.

iii. Node Type:

Center Node, Routing Node, Terminal Node.

iv.Serial Rate:

1200-115200

v. Send Mode:

Broadcast Send or Destination Address Send

vi. Working Voltage

DC-3.3V.

vii.Peak Current:

40Ma.

viii. Short range:

10~ 200 m.

C.Solenoid Valve

A solenoid valve is operated valve. The valve is controlled by an electric current through a solenoid. Arduino Uno controls the operation of the electro-valve [10]. The image of the electro-valve to control the flow of water is shown in the fig.4. The operating voltage of the solenoid-valve is 12V. The solenoid valve operates at a minimum of around 3 psi and acquiesces around 3 L/min of flow, and it uses enough pressure to operate. It will interrupt the flow until 12V is turn on to the fast-on connectors on the solenoid.

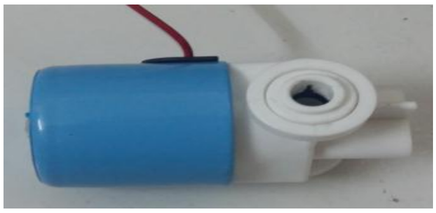

Fig 4: Solenoid Valve

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 03, March-2016

The electro valve is connected to the ON – OFF switches. The Solenoid valve is connected to the Arduino module which the valve to open or close whenever fundamental. When the OPEN switch is activated the valve gets dissimulated and lets the water to flow and when the CLOSE switch is pressed the valve gets stimulated by the Arduino board and it gets closed and does not allow the water to flow [7].

D.Humidity Sensor module

This sensor is used to sense humidity. It facilitates us with analog and digital output. We are using digital output pin to connect it directly with the Arduino to Arduino's digital pin. (pin 7). V_{CC} and GND pins are also connected to Arduino. Fig. 4 shows a DHT11 sensor. DHT11 has a sufficient range temperature compensation, long term stability and calibrated digital signal. The DHT sensors are built of two components, capacitive humidity sensor and thermistor [6]. There is also a very common chip inside that does some analog to digital conversion and spittle's out a digital signal with the temperature and humidity. A high-performance 8-bit microcontroller is combined in the sensor with calibration-coefficient saved in OTP memory to serve accurate temperature readings. With the new 3 pin connector that consists of several soldering pads, plugging in and out the sensor is not going to be a problem anytime. The 3 pin connector is perfect to get it going fast, and extremely easy to use. It is reliable and inexpensive [12].

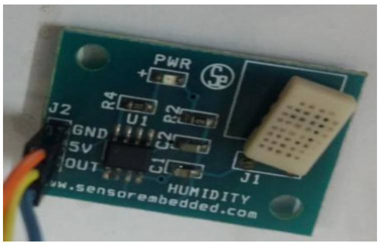

Fig 5: Humidity Sensor

E.DC Motor

When the inductor is powered, it constitutes a magnetic field (excitation flux) in the air gap, directed by the radii of the motor. The magnetic field "enters" the motor on the North Pole side of the inductor and "exits" it on the South Pole side.

Fig 6: DC Motor

When the motor is powered, its maestro located below one inductor pole (on the equal side as the brushes) are cruised by currents in the same direction and so are manipulated to a Lorentz law force. The conductors below the other pole are subjected to a affort of the same strength and in the opposite direction. Both forces constitute a torque which rotates the motor (Fig 7). When the motor is powered by a direct or improved voltage and the rotor is rotate, counter-electromotive effort E is produced. Its value is E = U – RI. RI represents the drop in Ω voltage in the motor. The counter-electromotive force E is relevant to the speed and excitation by **E = k** ω φ where:

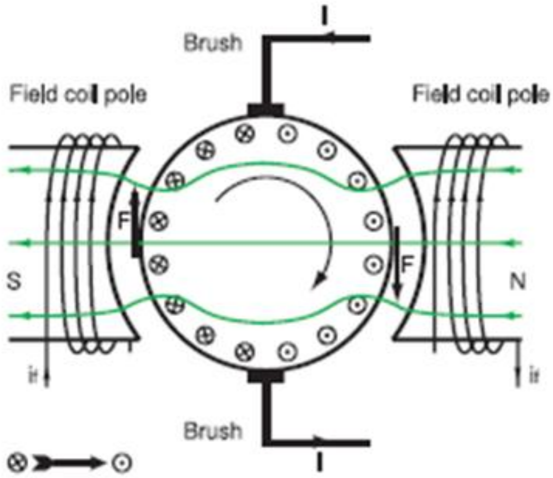

Fig 7: DC Motor working principle

- k is a constant,
- ω is the angular speed,
- φ is the flux.

In this relationship shows that, at constant k commotion, the counter-electromotive force E, proportional to ω, is figure of the speed. The torque is relevant to the inductor flux and the current in the motor by:

$$\mathbf{T = k}\,\varphi\,\mathbf{I}$$

F.Stepper Motor

A stepper motor is rotate one step at a time, unlike those conventional motors, which spin regularly. If we command a stepper motor to rotate some specific number of steps, it rotates incrementally that more number of steps and stops. Because of this basic of a stepper motor, it is widely used in low price, open loop position control systems. Open loop control process no feedback information about the position is essential. This eliminates the need for valuable sensing and feedback devices, such as optical encoders.

Fig 8: Stepper Motor

V. RESULT

Humidity sensor monitor the water leakage and detected the water leakage. Then it is displayed in the LCD module. This result is shown in the figure 9 and figure 10. This detected information is sent to the robot arm through the Zigbee module. The robotic arm has closed the leakage automatically. And the result is shown in the figure 11.

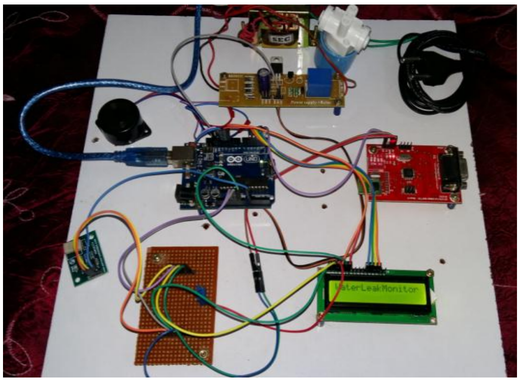

Fig 9: Monitoring the leakage

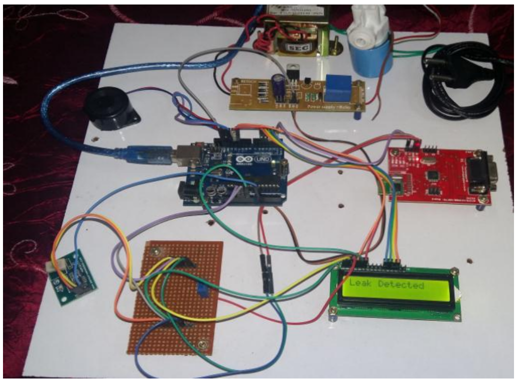

Fig 10: Detect the leakage

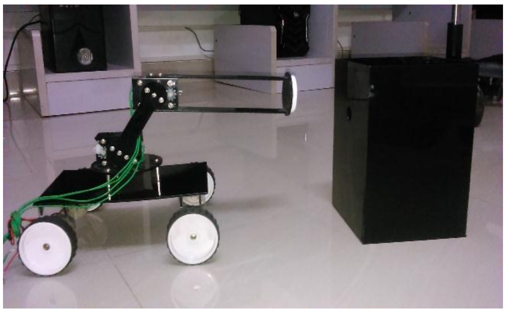

Fig 11: Closing of the Water leakage

VI. CONCLUSION

The design of an embedded device for the monitoring and control of water leakage in the industrial applications is proposed. In order to avoid water leakage in industries, the leakages in the water tanks and any other places are detected with the help of humidity sensor. The buzzer identifies the leakage and it will alert the user which will be displayed in the LCD module and close the leakage with help of Robotic Arm. This monitoring system provides remote monitoring, automatic storage, and real-time display. The hardware implementation is done and the system has been tested and evaluated.

ACKNOWLEDGEMENT

I wish to express my deep sense of gratitude and sincere thanks to our Professor and Head of the Department Dr.T.Rama Rao, for his encouragement, timely help and advice offered to me.

I would also like to acknowledge with much appreciation the crucial role of my project coordinator Dr.P.Eswaran as well as guide, Mr. S.Nivash, Asst.Profesor (S.G)/ECE Dept.as well as panels especially in our project presentation that has improved my presentation skills by their comments and tips.

I expend my gratitude and heart full thanks to all the teaching and non-teaching staff of Electronics and Communications Department and to my parents and friends, who extended their kind co-operation by means of valuable suggestions and timely help during the course of this project work.

REFERENCES

[1] N.Vijayakumar, R.Ramya,"The Real Time Monitoring of Water Quality in IOT Environment", International Journal of Science and Research, ISSN (Online) 2319-7064, 2013

[2] O.Hunaidi, A.Wang, M.Bracken, T.Gambino, C.Fricke, "Acoustic methods for locating in municipal water pipe networks", International Conference on Water Demand Management, Dead Sea,Jordan,May 30-June 3,2004,pp,1-14

[3] Maninder Pal, Neil Dixon and James Flint, "Detecting &Locating Leaks in Water Distribution Polyethylene Pipes, Proceedings of the World Congress on Engineering 2010 Vol II,WCE 2010,June 30-July 2,2010,London,U.K.

[4] N.Suresh, E.Balaji, K.Jeffry Anto, J.Jenith,"Raspberry Pi Liquid Flow Monitoring and Control", International Journal of Research in Engineering and Technology, Volume: 03 Issue: 07|Jul-2014

[5] Watergy: Taking Advantage of Untapped Energy and Water Efficiency Opportunities in Municipal Water Systems; from: *http://pdf.usaid.gov/pdf_docs/ PNACT993.pdf*, accessed on 13/02/2014.

[6] Muggleton, J.M, Brennan, M.J. (2004). Leak noise Propagation and attenuation in submerged plastic water Pipes. Journal of Sound and Vibration, vol. 278, no. 3, p. 527-537, DOI:10.1016/j.jsv.2003.10.052.

[7] Almeida, F.C.L. (2013). Improved Acoustic Methods for Leak Detection in Buried Plastic Water Distribution Pipes. PhD thesis, University of Southampton, Southampton.

[8] Muggleton, J.M., Brennan, M.J., Linford, P.W. (2004).Axisymmetric wave propagation in fluid-filled pipes: wavenumber measurements in vacuo and buried pipes. Journal of Sound and Vibration, vol. 270, no. 1-2, p.171-190, DOI: 10.1016/S0022-460X (03)00489-9.

[9] S. Zhuiykov, "Solid-state sensors monitoring parameters of water quality for the next generation of wireless sensor networks," Sens. Actuators B, Chem., vol. 161, no. 1, pp. 1–20, 2012.

[10] A. Aisopou, I. Stoianov, and N. Graham, "In-pipe water quality monitoring in water supply systems under steady and unsteady state flow conditions: A quantitative assessment," Water Res., vol. 46, no. 1, pp. 235–246, 2012.

[11] Misiunas, D., Lambert, M., Simpson, A., Olsson, G. (2005) "Burst detection and location in water distribution networks," Water Science and Technology: Water Supply, 5(3–4), 71–80.

[12] Stoianov, I., Karney, B., Covas, D.,Maksimovic, C., Graham, N. (2001) "Wavelet processing of transient signals for pipeline leak location and quantification," Proc. Intl. Conf. on Computing and Control for the Water Industry(CCWI), 65–76.