

A Smart Water Management System using GSM and RFID

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Abstract: This paper presents an automatic recording and Water consumption by a consumer and also detection of the leakages in the water distribution system. Water leakage is an important component of water losses. In addition to raising consumer awareness of their water use RFID is also an important way to identify and localize water leakage. Water sensors are used to determine the leakage from municipal corporation pipeline. The objective is to overcome the disadvantages of using current meter technology and make the billing and troubleshooting process faster along with reducing the wastage of water. RFID uses electromagnetic fields to transfer data over short distances. RFID is useful to identify people, to make transactions.

Keywords: water level sensors, flow sensors, Motor, SMS, leakage detection, automatic meter reading, Arduino atmega328, LCD, water pump, water tank, RFID.

1. Introduction

This project divided into two part; in first part leakage detection system is designed and in second part RFID system is implemented for user identification. Water is the basic necessity of economic development, but now days the water distribution and management are controversial issue and so nobody was to take this effort. An operator fills the tank automatically from water resources. The level sensors are placed inside the water tank placed near the source, depending on the level of the water in the tank the motor is made automatically ON or OFF. One of the most important advantages is that water sensors are placed in the pipe, it senses the flow rate and it gives value to GSM, it notifies the microcontroller which varies the rpm of the motor. These sensors give square wave output which is proportional to the quality of the water. These sensors output from GSM is gives message to the owner where leakage is identified. RFID is used for identification of user i.e. to measure amount of water used by consumer and according to uses billing can be done.

2. Related work

Water from the tank will be used when there is a problem with the direct water supply. It is so important where at some government buildings the water level in the tank is being inspected daily to ensure the water level is above the required threshold. However, this task consumes time and energy as the tank is located at the top of the building that cannot be easily accessible. Therefore, there is need to implement an automatic

system that can monitor the level of the water in the tank. If the level is decreasing below the required threshold, the intended personnel will be informed immediately via a smartphone for example. The decrease could indicate a failure in the mechanical system to pump the water into the tank. Results from the experiments show that Radio Frequency Identification (RFID) technology has the potential to be used in monitoring the tank water level although there is drawback such implementation cost due to hardware requirements.

The current paper focuses on smart water management system to overcome above drawback. The RFID is used for user identification. so we can identify how many liters of water uses by consumer. The billing system is done on the basis of amount of water usage.

Paper focuses on an application of wireless sensor networks for leakage detection in underground water pipes to overcome the problem of water dispersion in water distribution networks. Leakage prevention and breaks identification in water distribution networks are fundamental for an adequate use of natural resources. To address this problem, and simplify the leakage identification process, the authors have designed a wireless network system making use of mobile wireless sensors able to detect breaks and save energy, time and cost with having Smart Water Leakage Detection (SWLD) in pipelines, measure water level in tank and control in pump to turn it on when water level is low. It focuses mainly on two parts: The first part is alarm based on Global System for Mobile technology (GSM) to send Short Message Service (SMS) to the owner.

3. Experimental details

In this section, we will discuss the overall system design procedure step by step. These are leak detection and user identification by using RFID.

A. Leak Detection

Leak detection is one of the most advantage of this work. It can save our precious natural resource. The advantage of the GSM make the leak detection very efficiently. Water sensors are used to sense the quality of water through the designed pipe. The water sensors are placed to sense the quality of water and generate square wave output proportional to the quality of water flow. Sensors output is given to GSM modem at the user end

through microcontroller. If any of the leaks occur in the pipes, flow sensor sense the quality of water, but there is a decrease in the quality of water. It results the square wave output proportional to the quality of water become distorted. This value is given to the microcontroller and it send error message to the office through GSM. Also microcontroller notifies which section is complained. Then the operators check the pipeline according to the message. Following circuit diagram shows the components on the breadboard this is the procedure of leakage detection system.

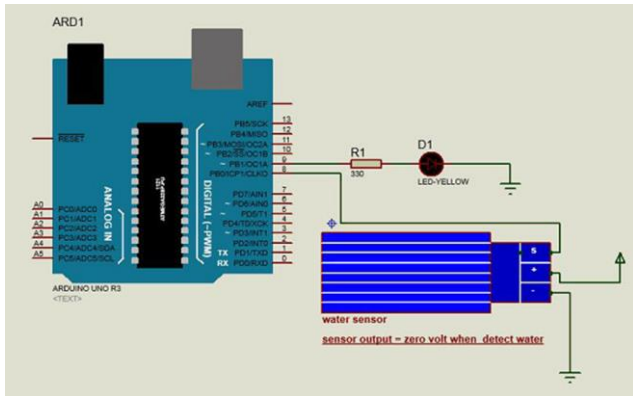


Fig. 1. Mounted leak detection system

B. GSM Modem Interfacing with Arduino

A GSM Module is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer). The board will also have pins or provisions to attach mic and speaker, to take out +5V or other values of power and ground connections. These type of provisions vary with different modules. Lots of varieties of GSM modem and GSM Modules are available in the market to choose from. For our project of connecting a GSM modem or module to Arduino and hence send and receive message using Arduino it’s always good to choose an Arduino compatible GSM Module that is a GSM module with TTL Output provisions.

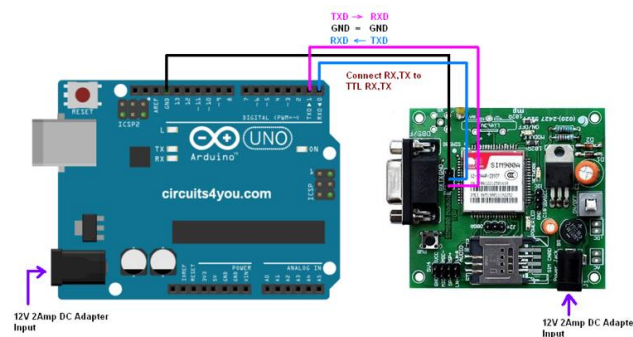


Fig. 2. Interfacing with Arduino

C. Hardware requirement

- a) Water Sensor

- b) AT-mega328p microcontroller
- c) Adapter
- d) GSM
- e) Solenoid Valve
- f) Connecting wires

D. User identification by using RFID

This time we are interfacing an RFID Reader which can read RFID Tags to arduino. RFID is Radio Frequency Identification. An RFID reader is used to read RFID tags (which contain certain unique data stored in a chip). An RFID reader and an RFID tag, both have a coil surrounding them. When an RFID tag is shown near an RFID Reader, it collects the unique tag data (a combination of digits and characters) from the RFID tag. You will be wondering how the chip inside RFID tag gets power? This is made possible via Electromagnetic Induction. I told you, both RFID reader and RFID tag comes with a coil in them. We power the RFID reader from power supply for reading purpose. Now when an RFID tag is shown near the reader, electromagnetic induction will take place between the coils and this powers the chip inside tag. This chip will send data electromagnetically to the reader. The reader will receive this electromagnetically transferred data and outputs it serially. Every RFID reader comes with Serial output pins. We can collect the read data through these serial pins using Arduino or any other micro controller.

E. Hardware requirement

- LCD
- RFID

RFID means radio-frequency identification. RFID uses electromagnetic fields to transfer data over short distances. RFID is useful to identify people, to make transactions, etc. You can use an RFID system to open a door. For example, only the person with the right information on his card is allowed to enter. An RFID system uses:

1. Tags attached to the object to be identified, in this example I have a keychain and an electromagnetic card.
2. Each tag has his own identification (UID).



Fig. 3. Tag Reader (Source: www.m.indiamart.com)



Fig. 4. RFID (www.electronicshobbyists.com)

Table 1
 Pin wiring

Pin	Wiring to Arduino Uno
SDA	Digital 10
SCK	Digital 13
MOSI	Digital 11
MISO	Digital 12
IRQ	Unconnected
GND	GND
RST	Digital 9
3.3V	3.3V

Caution: You must power this device to 3.3V

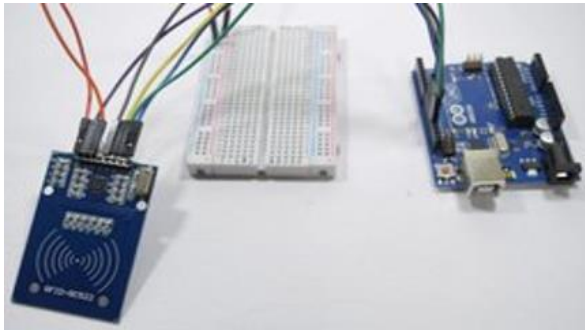


Fig. 5. Interfacing RFID with Arduino Uno
 (Source: www.electronicshobbyists.com)

4. Result and testing

A. Experimental result of leakage detection

After finishing all of the system connections and programming, I have carried out a multiple experiments. The GSM based system gives good response to the sensors and send SMS when it detects leakage in water where the water sensors was fixed. Time taken by the system to deliver the SMS is 1000 millisecond. You will see the indication LED turn ON when the sensor detects water.

Test case 1: when leakage is checked using Arduino software, message is received by to user according to amount of leakage.

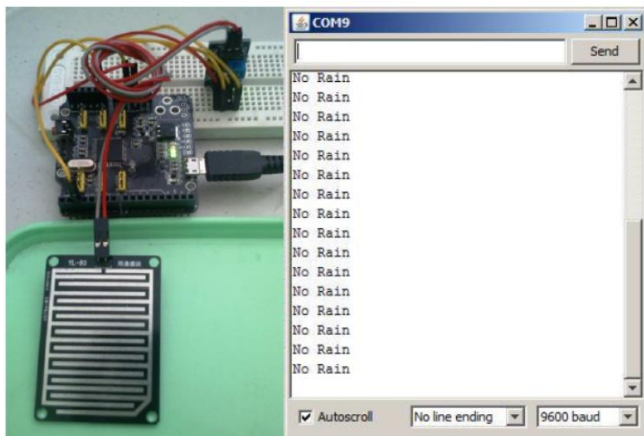


Fig. 6. Result when leakage is not occurring

Test case 2:

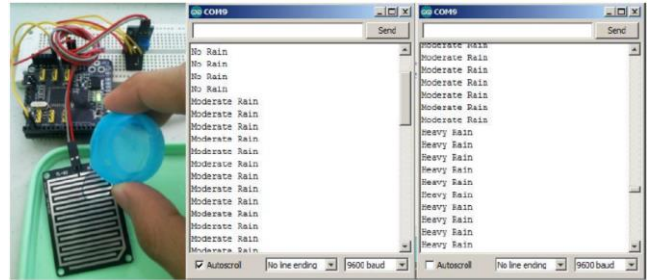


Fig. 7. Result when leakage occur

B. Experimental Result of RFID

For the identification of user, different Id and tag can swipe and according to the user water can be distributed. the reaction of system is as follows:

Test case 1:



Fig. 8. Result before swipe tag

Test case 2:

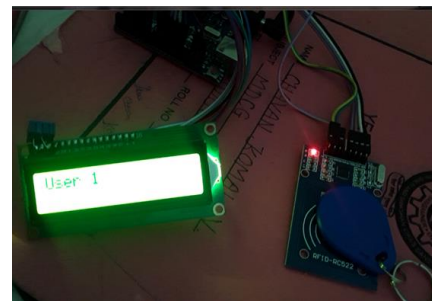


Fig. 9. Result after tag is swiped

Test case 3:



Fig. 10. Result before card is swiped

Test case 4:

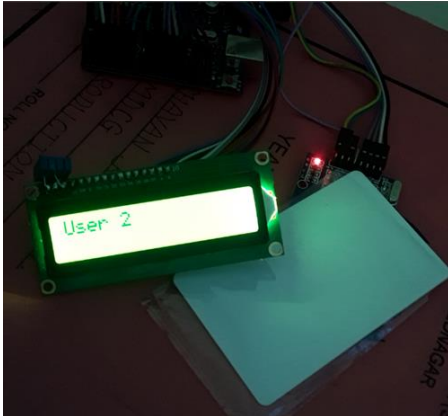


Fig. 11. Result after card is swiped

5. Conclusion

Water is one of the most important basic need for all living beings. But, unfortunately a huge amount of water is being wasted by uncontrolled use and uncontrolled leakage. The main issue that is being addressed in this system is about using RFID and GSM based on water distribution system. Two different ways to monitor the water consumption are user identification and water leakage detection system. Finally, the two parts of project for phase one are completed by using RFID and GSM technology. The system mainly depends on technical method which deals with control, features and effective methods for monitoring the plumbing at homes. Based on microcontroller ATmega 328 and GSM technology the main general purpose of this system, which is water leakage detection and user

identification by using RFID, is achieved. Use of GSM technology makes the work more efficient. Firstly, it makes the home owner able to be notified when leakage occurs and also the solenoid valves will be closed directly. Secondly, using GSM which deals with mobile allows the home owner to close water tap, avoiding the water wastage.

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