

Prepaid Smart Card System for Water Supply

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ABSTRACT: To reduce the wastage of water, the system has been designed in such a way that there should be minimum loss of water. In this Prepaid Smart Card system for Water Supply, the memory IC has been used as a smart card on which the recharge is done. Units from the smart card will decrease as the water will pass through the pipe. When this unit reaches zero value, the solenoid valve will close the water supply. In this way the process has been controlled by the microcontroller IC. Thus the concept of prepaid system is used in order to properly use the available water. This system will help the society regarding the awareness of use of water.

Keywords: Memory IC, Microcontroller, Prepaid, Recharge, Solenoid valve.

I. INTRODUCTION

In day-to-days life, the water is supplied by the Municipal Corporation which should be in proper manner so that there should be minimum loss of water. The basic idea behind this system is to use the available resource of water efficiently. In this system the customer will first pay for the water and then he will get the benefit of that prepaid amount. The systems which are used previously have many drawbacks such as more or less billing amount, loss of water, etc. Sometimes the complaints of people have been received by the Municipal Corporation.

The prepaid system can be made for the water as well for gas and electricity. This could be achieved by the use of suitable processor and the interface to that processor. The smart card has been used for the storage of the prepaid data which is secure [1] - [2]. In another system, the water system is implemented in such a way that the generated bill amount will be sent to the administrative office through Short Message Service (SMS) and the use of Global System for Mobile (GSM) network [3] - [5]. The data transfer between the meter system and the providing base station can be made easy by the use of Bluetooth technology with security [6]. In the paper, the meter reading system has been implemented by using the data transfer Zigbee protocol with the help of Wireless Sensor Network (WSN) [7]. The smart meters installed at the various locations need to transfer the data to their remote systems by using different technologies such as different data bus transfer, GSM network, etc., so as to collect the database required for calculating the billing information [8].

The practical survey has been done and it is observed that the mechanical reading meters have been installed at the various cities such as Akkalkot, Kolhapur under the "Srujal Nirmal Abhiyan". These meters have been provided by the Chambal Company. The flow of water has been measured by these meters and the person from the Municipal Corporation takes these readings and calculates the bill amount for each user.



Fig.1.1 Front view of Flow Meter



Fig.1.2 Actual Connection of Flow Meter

II. SYSTEM ARCHITECTURE

In this paper, the prepaid system has been implemented by using the microcontroller IC 89C51 with the help of serial data transfer Inter-Integrated Circuit (I²C) protocol. The Microcontroller IC acts as a main controlling element for the overall working of system. The system is designed in such a way that the memory IC acts as a smart card on which the prepaid amount has been loaded by the user and then he put that IC in the system. After that, the system turns on and makes the water supply on by detecting the number of units on the smart card with the help of solenoid valve. After turning on, the supply of water is continued till the number of units on the smart card reaches zero value. As soon as the unit value reaches zero, the water supply is break through the solenoid valve.

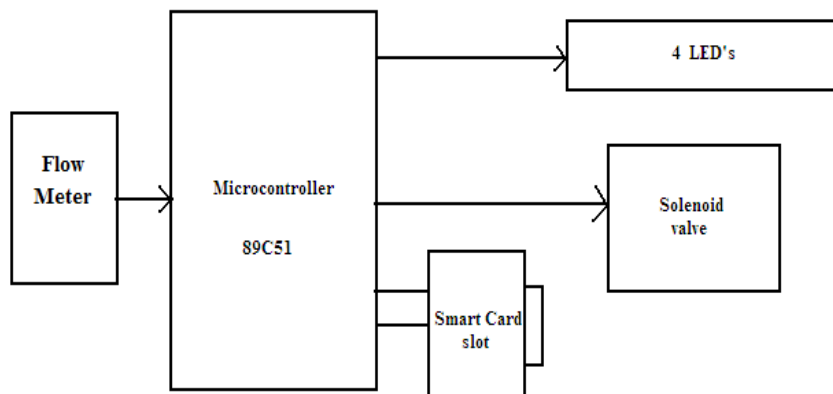


Fig.2.1 Block diagram of prepaid water system

The block diagram of the Prepaid Smart Card System for Water Supply has been shown in the Figure 2.1. Flow meter senses continuously the flow of water from the pipe. This count of water is measured in the unit of Liter and this count is continuously compared with the value on smart card. Also the value on smart card has been continuously decreased till it reaches zero value. After it reaches zero, the solenoid valve is made off and the supply of water has been made off. The four Light Emitting Diodes (LED's) has been connected to indicate the status of the system.

There is a requirement of the smart card programmer so that the smart card can be recharged easily. This has been shown in the Figure 2.2. This system consist of microcontroller IC 89C51, smart card slot where

the smart card to be inserted, different switches for recharging the smart card and Liquid Crystal Display (LCD) for display of recharge status. The LED has been connected to show the status of the overall system.

2.1 I²C protocol

The I²C is a multi-master multi-slave protocol. This is the serial data transfer protocol used for the communication purpose between the microcontroller IC and the smart card. This protocol uses the two pins Serial Clock (SCL) and Serial Data (SDA) for the data transfer in between the system. This data transfer protocol can be used for data transfer between field programmable gate array (FPGA) and the system. This can be implemented with the help of VHDL coding [9] - [10].

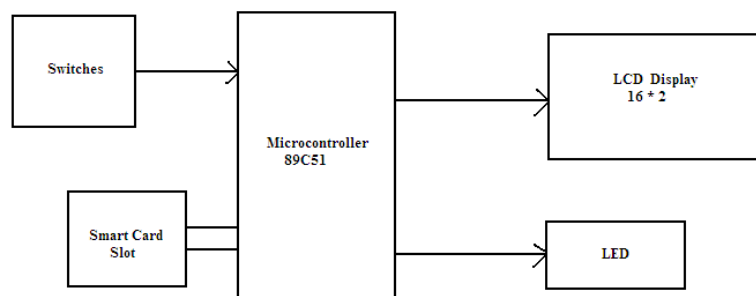


Fig. 2.2 Block diagram for Smart card programmer

2.2 Algorithm for the prepaid system:

1. Insert the smart card in the smart card slot.
2. Read the value on smart card.
3. Turn on the water supply with the help of solenoid valve.
4. As water passes through the pipe, count the units of water passed and continuously decrease the units on the smart card.
5. When the units on smart card reaches zero, turn off water supply by closing the solenoid valve.

2.3 Algorithm for the smart card recharge system:

1. Insert smart card in the slot.
2. Display the current status of smart card on the display.
3. Enter the units on smart card with the help of switches.
4. Display the status of smart card on the display.
5. Remove the smart card.

III. RESULT AND DISCUSSION

The system implemented in this paper uses the I²C bus serial data transfer protocol for the communication between the smart card and microcontroller IC. The main advantage of this system is that the customer first pays and then gets the benefit of the prepayment. Thus the issues such as overbilling, inaccurate calculation of bill amount and supply cut off from Municipal Corporation have been reduced. The different systems have been used various protocols for the data transfer from the user end system to the main base station system. These systems have the drawback of propagation delay for the data transfer. Sometimes it has been observed that due to malfunction in the system, the readings has been changed and those are being transmitted which leads to complaints from the customers. The different technologies used such as Zigbee protocol [7], GSM network and Bluetooth technology works efficiently and correctly but they are adding the complexity to the overall system.

Thus by using the system implemented in this paper, the customer can manage the monthly expenses of his family. Also there will be the proper use of available water resources. The system is very simple to use as it is user friendly.

IV. CONCLUSION

The system designed in this project can be implemented and used easily. As the system is user friendly it can be applicable for electricity and gas. In this paper the system has been used for one application. Further in future development the system can be implemented for more than one application such as electricity and gas supply in one smart card. Then the user can increase credit either on electricity, water or gas with the single smart card. The user can avoid the trouble for paying different bills every month and can save lot of time. Thus the system designed will be convenient for the users to plan their monthly expenses since the electricity; water and gas bills are already paid before using.

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