Smart Monitoring of Water Management System

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***Abstract*- Water is one of the most vital substances on earth. All living beings must have water to survive. Apart from drinking, water has many other uses like cooking, washing, irrigation and so on. This paper proposes a low cost system for effective household water management system using IOT. The system ensures water conservation by monitoring the amount of water used by the consumer and reporting the total consumption to the user using GSM. Quality of the water is checked using pH meter and the impure water can be purified using RO membrane. Relay is employed to turn off the water pump automatically to prevent the overflow. The system was developed using the PIC microcontroller. Finally the flow rate along with the date and time can be displayed in cloud platform using cloud computing.**

***Index terms*- Water monitoring, PIC microcontroller, GSM modem, purification, pH sensor, internet of things.**

I.INTRODUCTION

Water usage has been increasing worldwide by about 1% per year since the 1980s, driven by a combination of population growth, socio-economic development and changing consumption patterns. Global water demand is anticipated to continue increasing at an identical rate until 2050. This leads to the rise of 20 to 30% above the current level of water use, mainly because of rising demand within the industrial and domestic sectors. Over 2 billion people live in countries experiencing high water crisis and about 4 billion people experience drastic water scarcity during a minimum of one month of the year. As water demand grows, stress levels will till increase and therefore the effects of climate change intensify. The climate will continue to change, thereby affecting the societies mainly through water. Change in climate will influence the quality and quantity of water for basic human needs. The modification in the water cycle will also pose threat for human health, food production, economic development and poverty reduction, thus seriously endangering the achievement of the sustainable development goals. By concentrating on the above issues, the overall system is designed and developed for household water usage monitoring using IOT. In our design, pH sensor and flow sensor measures its corresponding parameters. Water wastage can be prevented by using a level driver IC and the relay.

PIC controller is used as core controller for this design. The values are processed by the Microcontroller and uploaded to the internet by using the Wi-Fi module (ESP 8266). These data can be observed in the internet browser with IOT account. Once the pH value of the water is not suitable for drinking, we have added purifier to the system which purifies the water, if the consumers wish or else the water can be used for any other purpose like washing or gardening. The total consumption can be intimated to the consumer through the message. Analysis we can do by this system is that how much water is used in a particular day or in a month.

II. PROPOSED SYSTEM

In this section, we present the theory on low cost system for real time water flow monitoring using IOT. The overall system consists of two sections namely transmitter and receiver. The transmitter block diagram is illustrated in Figure 1.

Various components are interfaced and the programming language C is used for the software section. The combined usage of hardware and software protocols enables to produce the desired output after the interfacing.

In the transmitter section, the relay is interfaced with level driver IC from which two wires are connected to the overhead tank. It is also interfaced with three devices namely switch, pump in the ground tank and the RFID transmitter. Relay is responsible for controlling the water flow by turning off the ground

tank pump to prevent the overflow. The transmitter and receiver section is not interfaced with each other since the communication between them was in the wireless manner.

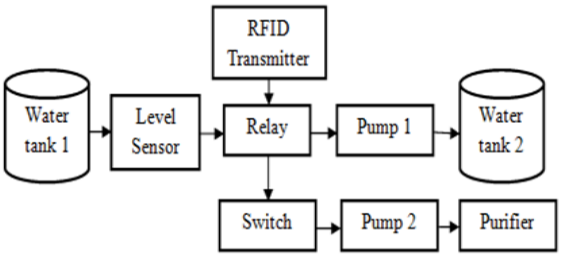

Fig.1 Block diagram of transmitter

The PIC microcontroller (PIC16F877A), is used in the receiver section. In both the sections, step down transformer and bridge rectifier is used to step down the power supply as required for the components. The sensors such as flow sensor and pH sensor are interfaced with microcontroller. Relay is used to switch between Wi-Fi and GSM to transmit the data alternatively. GSM and IOT are utilised to intimate the user about the consumption. The LCD display is interfaced with controller to display the details namely the flow rate, status of the tank and the remaining water available in the tank. Using RFID receiver which receives the data from the transmitter module, the status of the overhead tank can be known. Figure 4.2 shows the receiver block diagram.

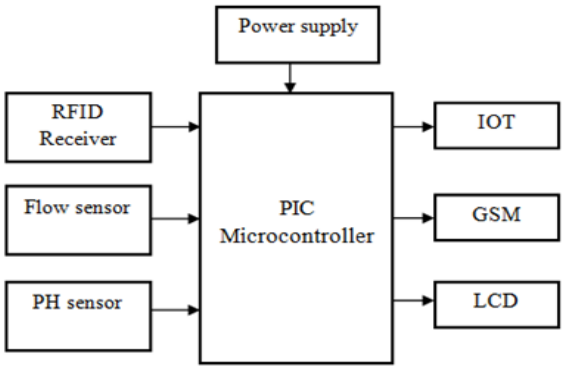

Fig. 2 Block diagram of receiver

III. COMPONENTS USED

Taking about this proposed system, it is clearly shown that it has several components which help to build a water monitoring system.

A. PIC Microcontroller

The PIC microcontroller PIC16f877a is used in this system. The term PIC denotes peripheral interface controller. The coding or programming of this controller is easier. It can able to write-erase as many times as possible because it uses FLASH memory technology. It has 40 pins in total and there are 33 pins for input and output. It has five ports starting from Port A to Port E. PIC microcontroller is an IC. It includes CPU, RAM, ROM, timers, counters and protocols like SPI, UART and CAN which are used for interfacing with other peripherals.

Fig. 3 PIC microcontroller

B. GSM module

GSM modem sends the total consumption to the consumer via SMS. GSM stands for Global System for Mobile Communication. A GSM modem can be used to make a computer or any other processor communicate over a network. A GSM module needs a SIM card to sent messages to the consumer. It operates over a network range subscribed by the network operator.

Fig. 4 GSM module

C. Water Flow Sensor

To monitor the amount of water being consumed, the rate of flow of water has to be measured. A water flow sensor is used for this purpose. Water flow sensor consists of a plastic valve from which water can pass through. When water flows through the valve it leads to the rotation of the rotor inside it. This change is calculated as output as a pulse signal based on Hall Effect.

Fig. 5 Water Flow Sensor

D. Wi-Fi

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol. In this system, wireless networking technology called Wi-Fi that uses radio waves is employed to upload data into the cloud. The IOT Wi-fi Modules are used for data transparent transmission. To establish communication with ESP8266, microcontroller requires an AT commands and each ESP8266 module comes pre-programmed with a set of AT commands.

Fig. 6 Wi-Fi

E. pH Sensor

Fig. 7 pH sensor

A pH sensor is one of the most essential tools that is typically used for water measurements. It can able to measure the amount of alkalinity and acidity in water and other solutions.

IV. METHODOLOGY

The water flow is monitored using level driver IC and the relay is used to turns off the water pump when the tank gets filled. Once the tank gets filled, its status is reflected in the LCD as 'FU' which is in the receiver module through the RFID transmitter.

The flow rate of the water is measured using flow sensor and this information along with the remaining water available in the overhead tank is displayed in the IOT website. At the end of the day or month based upon users wish, the total consumption in the entire day and the billing amount which is generated based on the certain criteria fixed by the house owner can be intimated to the consumer via the message as displayed in figure 10.

The quality of the water is checked using pH sensor and the value can be displayed in LCD as illustrated in figure 9. If the water is not suitable for drinking, the water can be redirected to the purifier by the use of switch. The switch can turns on the water pump which is immersed in overhead tank. The results of the monitoring are seen on the LCD, mobile phones and the IOT website.

V. EXPERIMENTAL RESULTS

In this section, we present the results of sensor values and condition of the monitoring unit. The proposed system can monitor the flow of water on the internet by using cloud computing. The values are stored in separate web server on the cloud. These values can be viewed by using a separate IP address. The figure 8 shows the output results from the web server on the internet.

DATA	Logdate	LogTime
R:W:ML_F.R:_A	03/04/2020	16:15:49
R:W:ML_F.R:_A	03/04/2020	16:18:03
R:W:996ML_F.R:_003A	03/04/2020	16:18:54
R:W:996ML_F.R:_003A	03/04/2020	16:19:44
R:W:996ML_F.R:_003A	03/04/2020	16:20:41
R:W:ML_F.R:_A	03/05/2020	14:01:38
R:W:ML_F.R:_A	03/05/2020	14:02:30
R:W:ML_F.R:_A	03/05/2020	15:03:17
R:W:ML_F.R:_A	03/05/2020	15:04:08
R:W:ML_F.R:_A	03/05/2020	15:05:08

Fig. 8 Web Page

The user can able to see the flow rate according to the particular date and time.

Fig. 9 LCD Output displaying the pH value and indicating that the tank is full.

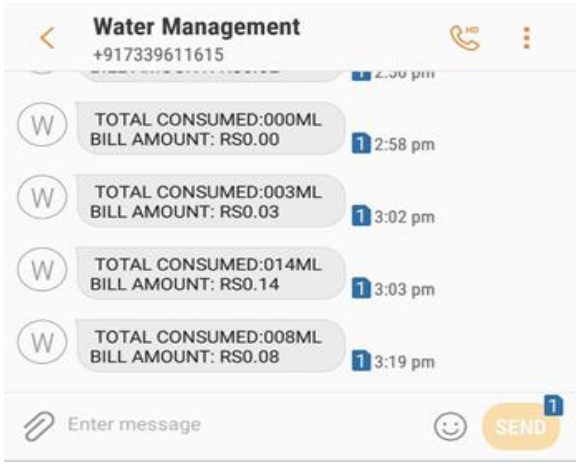

Fig. 10 Message received from GSM

VI. CONCLUSION

In this paper, a prototype for water monitoring system using IOT is presented. PIC microcontroller is used for this purpose. The processed values are sent to the cloud server via Wi-Fi module ESP8266. This monitoring and controlling process can be performed at anytime and anywhere in the world. Since power supply to the system is through the power mains of the house, there are no digital batteries that have to be frequently changed.

The prevention of unnecessary wastage of water from residential areas is a much more efficient task rather than finding methods to replenish the already wasted water. This paper provides an effective method to conserve the water with timely notifications sent to the consumer. This ensures that the consumer is well informed about his water usage and if the usage is high, can take necessary steps to conserve the water.

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