Automated Water flow Control System

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Abstract—With the advancement of engineering and technology, process automation has come into reality with satisfying accuracy. This has reduced the chances of human errors and also helped decrease the need of human interference. In the management of resources like water, a human negligence can cause wastage of large volume of water or an error in the supply management can deny basic facilities to people. With the current existing system of water supply for domestic purposes, there are quite common cases of untimely supply of water and there is a need to automate the monitoring of supply of water. This project helps to automatically monitor the supply of water from the authorities and to get alert regarding it which helps in the proper utilization of it. This will help the masses to fill up their containers even in case of unusual timing of supply with automated procedures. Also, the automation helps to reduce the wastage of water when containers are filled. Since in urban masses where water scarcity is quite common problem in summer, there is need to monitor the consumption of water used for domestic purposes. So that it is possible for judicial usage of water especially in the dry areas.

Keywords—automation, flow sensor, depth sensor, android, cloud database

I. INTRODUCTION

Water scarcity is both a natural and a human-made phenomenon. There is enough freshwater on the planet for six billion people but it is distributed unevenly and too much of it is wasted, polluted and unsustainably managed. Worldwide, more than 1.2 billion people lack access to clean potable water. Water scarcity affects every continent and around 2.8 billion people around the world at least one month out of every year. According to the United Nations Development Programme, the poor management of sufficient available water is found more often to be the cause of countries or regions experiencing water scarcity, as most countries or regions have enough water to meet household, industrial, agricultural, and environmental needs, but lack the means to provide it in an accessible manner. The term automation refers to the technique, method, or system of operating or controlling a process by highly automatic means, as by electronic devices, reducing human intervention to a minimum. Introducing automation in water management system can notably decrease the human errors and thus help reducing the wastage of water. Also with limited supply of water, there is need to monitor the usage which may help people to habit in all geographical conditions. This conservation of the water and to facilitate the proper and fair usage of it with help of automation technology can significantly contribute to the minimization of water scarcity problems.

II. LITERATURE REVIEW AND EXISTING SYSTEM

In this section we present the works carried out by various authors for the improvisation of Water Flow Control System. Authors M.V.N.R. Pavankumar et al. [?] have proposed automation of water distribution and management with technical advances. In the proposed system, the level of water is sensed by a water level sensor. Depending on the level of water, the speed of motor will be varied. The speed of motor is controlled with respect to the tank water level. Here, water distribution in different areas is controlled by mobile and status is updated in the mobile through GSM module. An operator fills the tank automatically from water resources by using AC pump. Level sensor is inserted into the water is sensed by level sensor. If the tank water level is above 90% then AC pump will automatically turn OFF and if the tank water level is at 20% then AC pump will automatically ON. The solenoid valve is control by mobile phone. Read the status of DTMF after connecting mobile to DTMF. The status of DTMF is given to the PIC microcontroller. If DTMF status is 1 then respective solenoid valve1 will turn ON. Using the status of DTMF respective image of the valve is display on the GLCD. Send status of valve to GSM for sending SMS.

Authors J.P.Shi Tharanya et al. [?] have proposed to develop an embedded based remote water monitoring and theft prevention system by recording the flow rates at the consumer/user end. Here, each consumer end is provided with an embedded based water flow monitoring system consisting of a microcontroller to record the flow rate using a flow sensor and to transmit the same to a remote monitoring station using wireless transmitter and it is also provided with an electrically operated solenoid valve to supply water to the consumers. The flow rate is sensed by the signal conditioning unit when the water is passed through the pipeline. The sensor operates under certain predefined value. When there is a variation in the water flow due to any pumping of water through motor, it will be detected by the water flow sensor. The signal conditioning unit is used to give the desired input signal of the ADC. The analog signals generated due to variation in the flow of water sensed by the water flow sensor are converted into digital signals using Analog to Digital Convertor (ADC) and this digital signal is given to Microcontroller. This microcontroller enables the transmitter signal for intimate to water supply board. At the same time they enable the driver unit to closes the solenoid...
valve. The microcontroller does not have the capability for driving the solenoid valve. So here it was designed the driving circuit using TRAIC to operate the solenoid valve for ON/OFF control. The flow rate conditions are displayed by the PC. Here, GSM MODEM is proposed for wireless communication.
so that the information can be passed to many responsible officers cell phone for immediate action. It insures the update of the refurbished water supply urban utilities; it offers new ways of monitoring and optimized exploitation of the water resources and technological equipments. This automated system not only used to monitor the water supply but also used to find and avoid the water theft.

Authors Gowtham.R et.al have proposed an improved method of water distribution system by automization using PLC (programmable Logic Controller) and SCADA (Supervisory Control and Data Acquisition) is explained. And also water theft monitoring is implemented using flow variation sensed by flow sensors mounted on the water pipes. PLC (Programmable Logic Controller) is the central and important part of the system. All the logic functions are carried through PLC, by developing ladder logic program. Sensors and Actuators included in the water distribution network are interfaced to PLCs input and output module. The logic can be easily stored on a disk so that it can be loaded into a PLC .Program logic can be changed according to the requirement of system. PLC is again interfaced to SCADA (Supervisory Control and Data Acquisition) unit so as to monitor and control the water distribution network. SCADA system is designed in order to realize the automatic controlling of valve and parameter transformation such as pipeline pressure and water quality. Actual process takes place within water supply and distribution network. plied to individual home street lines using distribution motors. The PLC records the rate of water flow from the flow sensors located near distribution area. If there is difference in flow rates, it is recorded as leakage or theft then PLC automatically closes the valves to avoid unnecessary flow of water. This information is passed to GSM modem. The working of entire system can be viewed on SCADA screen and home street pipeline.

Thus, it ensures to avoid wastage of water and reduces time. Due to PLC and SCADA it is possible to monitor and control whole system from head quarters. The entire system can be operated by person who apparently has no knowledge over PLC and SCADA. By using water theft identification method in real time it is possible to reduce 3/4th or 75% of water loss that is occurring due to leakage or theft in pipelines.

A. Existing System

In the existing system, billing is done based on the monthly consumption of water. The users get to know the monthly usage amount. The systems lack in providing daily usage statistics and a way of storing the past usage statistics. One of the very concerned issues is to incorporate an automated way of storing water, which the existing systems lack. The current systems do not provide a method of alarming the user whenever there is water supply.

III. PROPOSED SYSTEM

The proposed system provides an automated method for collecting the water and also provides a way of storing water usage statistics. When the water arrives at the tap, Piezo buzzer is activated to alarm user about arrival of water and the the level of the water in the container is checked with help of the ultrasonic range sensor. If the level of the water is above certain threshold then water solenoid valve is closed to prevent any wastage of water. In this process, the amount of water consumed is calculated with help of water flow sensor and sent to the centralised database. In the database, the statistics of water usage along with the day of usage is stored for each house and can be used for further data analysis such as to calculate the total water consumption in a locality or a city or across the different seasons and also be used to generate bills for each household. These data are also displayed in mobile app by retrieving the stored data from the cloud.

IV. NOVELTY OF THE PRODUCT

The introduction of automation in the water flow management system can provide a solution to the problems in the existing system such as wastage of water due to human errors and also a lack of proper management in the supply of water. The proposed system is unique since it facilitates the storage of water flow consumption data to which the user has an easy access. The collaboration of various sensors and android proves to be yet another unique feature of the proposed system.

V. COMPONENTS AND BLOCK DIAGRAM

Components used:

- Arduino Uno
- Water solenoid valve- 12V 1/2" 
- Nominal Water flow sensor YF-S201
- Ultrasonic sensor HC SR04 Raspberry Pi b+
- Piezo Buzzer
- Jumper wires ,9V Batteries
- Android mobile phone
Fig. 1. Block Diagram of the system
VI. DESIGN AND WORKING

The overall project works in different phases. The initial state of valve is on. Whenever water arrives at the pipeline, it is detected and the buzzer is set on for a short duration. The ultrasonic depth sensor is used to measure the level of water in the container and whenever the water level crosses a set limit, valve is closed. The water flow sensor, ultrasonic depth sensor, buzzer and the solenoid valve are controlled by the arduino from which the data are sent serially to the raspberry pi. Raspberry pi sends this data to Google database. This data can be retrieved from Google database through android app. The data can be retrieved date-wise or month-wise. The readings are calibrated into a gauge for the ease of representation of data.

Algorithm 1 Algorithm for sensor
1: Initialisation : valve=on, buzzer=off
2: Function loop()
3: if (waterflow) then
4:   buzzer = on
5: end if
6: if (level > threshold value) then
7:   valve = off
8: send the dispensed water data to raspberry pi with meter ID
9:   flowRate = ((1000.0 / (millis() - oldTime)) * pulseCount) / calibrationFactor
10:  flowliters = (flowRate = 60)
11: end if

Initially, the valve is kept on. When water arrives at the pipeline, the user is alarmed by turning the buzzer on for a short duration. The level of water in the container is measured using ultrasonic depth sensor. If the level of water in the container exceeds a certain threshold, the valve should be turned off. Else, the valve is kept open until the level of water reaches the threshold. The water flow through the pipeline is calculated with the formula

Algorithm 2 Algorithm for Raspberry Pi
1: Initialisation
2: Function loop()
   Receive the data
   Send data to Google database

VII. SOCIETAL BENEFITS

As soon as water arrives at the pipeline or tap, user gets an alarm. This helps the user collect water in case of untimely supply of water.

Algorithm 3 Algorithm for Android
1: Initialisation
2: User registration
3: if (MeterID = getMeterIdfromDB) then
4:   Go to step 2
5: else
6:   send registration data to Google database
7:   Go to step 9
8: end if
9: Open up the calibration page
10: if (user input = day) then
11:   Retrieve data from DB with the date
12:   Calibrate into gauge
13: else
14:   if (user input = month) then
15:     retrieve data from DB with that month
16:     Calibrate into gauge
17:   end if
18: end if

The amount of water consumed for a particular house is calculated. This statistics helps user to know about the daily as well as monthly consumption of water.

The system calibrates the readings into meter thus easing the reading of statistics.

The usage statistics are stored in cloud database to which the user has full access. Thus the past and the present usage statistics are stored. The system is up-to-date.

Since the readings can be retrieved anytime, the system is available.

As a whole, the automated water flow control system helps automating the processes of detection of water arrival, storage and calculation of water usage. This will help the society to use water judicially along with the ease of water management.

Most of the human errors in the water management system are eliminated.

VIII. CONCLUSION

This project represents a solution for the easy and automated management of water in households which helps in preventing wastage of water. It is also supposed to help people to tackle the untimely supply of water by authorities. The following are the key highlights of the completed project:

The water flow sensor is working as per the design expectations. The process of water flow detection has been automated successfully. Further, the working of buzzer on the detection of water has also been found to be working correctly.
The amount of water flown through the pipeline has been found to be calculated with satisfying accuracy. Serial connection between Arduino and Raspberry pi has been successfully established and found to be working as per the design expectations.
The connectivity to the internet has been established successfully. Google cloud successfully stores the data sent from Raspberry pi.

The Android application to provide remote access to the cloud database has been successfully developed and implemented. Its functioning has been thoroughly tested to ensure that it provides seamless access to the data regardless of physical location.

As a result, the designed "Automated Water Flow Control System” can be deemed as functional without any compromise on its most important characteristic, which is its fidelity and compatibility with the Internet of Things (IoT) concept.

IX. FUTURE ENHANCEMENTS:

The future scope of the project can be implementing in practical environment and reducing the cost associated and make the whole system to be user friendly and implementable in every household. It can be extended so that the system can be implemented in a particular area rather than a house. The statistics regarding the water consumption for that particular area can be stored in a centralized database which is maintained by concerned authority so that a centralized management is done. The information stored in the database can be used to generate bills thus reducing the manual work considerably. The authority can also decide on the amount of water supply to each house based on statistics and generate bills accordingly. This accounts for the fair usage of water.

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APPENDIX A

SNAPSHOTS OF ANDROID APPLICATION

REFERENCES


Fig. 3. Registration form