SMART WATER GRID

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ABSTRACT:

The important resources needed for mankind are water, air and fuel. In this project, one such water resource is monitored. With sensors and analytic tools deployed to provide a real-time monitoring and decision support system, the Smart Water Grid system enables to manage the water supply network efficiently, ensuring that all people will continue to enjoy a reliable and sustainable water supply for generations to come. This project covers the four key aspects of the Smart Water Grid system, in relation to both the key operational aspects of a water distribution system (asset management, water quality monitoring) and the customer's end (automated meter reading and water conservation). Real-time water consumption information helps the customers to keep tabs about their water usage and conserve water. On the customer's end, this system hopes to use technologies like automated meter readings and smart water gadgets provide real-time feedback on water usage to customers. This enables the customers to make informed choices towards water conservation within their homes and company premises. In addition to that, the usage data from automated meter readings will give us more accurate demand prediction for optimizing pumping schedules.

Keywords: Raspberry pi,NodeMCU, Flow meter, Hall Effect sensor, Electro solenoid valve.

1. INTRODUCTION

Water is the most important resource in this world. Water is essential for all humans in the planet. Earth has less than 1% of freshwater to fulfil the human's day-to-day needs. We are using this lesser amount of water for drinking, domestic, industry and many other purposes[1]. Usage of water is very important to save the resource for present and future generation. Water supply is the essential requirement for all people. Providing enough water to meet everybody's needs is difficult. This system aims at calculatingthe amount for the consumed water.[11]It also aims to supply water according to the user's request and the taxes are calculated for consumed water. If the user is in need of excess water, user can request the amount of water only once per day. User can request only at emergency situations. The amount will be calculated for excess consumption of water. The user can view the entire details in a web page in their respective accounts. This system has Raspberry-pi which act as the server, node MCU, flow meter for monitoring the flow rate of water from the pipe and solenoid valve for ON and OFF of the water supply.

2. EXISTING SYSTEM

Availability of water is very less. We are in the situation to consume less amount of

water, to conserve water resources[2].The consumers in new apartment complexes fitted with metered connections are complaining that they are being charged more than what they should pay. According to them, the problem lay in splitting the amount between the households as a meter is installed and a bill for the cumulative consumption in the complex is issued. In the absence of smart meter setup, the residents' association in such complexes resort to dividing the bill amount equally among the households. This is objected to by many households. The families that use less water have to bear exorbitant charges on account of those who consume more which are one of the major problems that people tend to face[3].Also the existing system only takes account of the tanks in the houses and doesn't take into account the individual pipes in the houses[12]. In India, the design of water supply systems has been done using certain standards. The survey is listed in Table 1[5] to know how much water is supplied to the municipality, town panchayats and corporation. The mere amount of water is supplied to all the districts in Tamil Nadu[6]. Currently the standard being used is BIS 1172: 1993, reaffirmed in 1998. For communities with a population of 20,000 to 100,000 we need 100 to 150 litres per head per day. For communities with a population of over 100,000 we need 150 to 200 litres per head per day. In its previous avatar there was also an attempt made in IS 1172 to understand the break-up of this demand which was then put as 135 litres per person per day[4]. A person uses 135 litres in following aspects, Bathing: 55 litres, Toilet flushing: 30 litres, Washing of clothes: 20 litres, Washing the house: 10 litres, Washing utensils: 10 litres, Cooking: 5 litres, Drinking: 5 litres. To overcome above said problems our system is designed. Every individual home and apartment, if smart meter is installed, it can measure the waterconsumption and allows the person to request the need of water per day and if level reaches it automatically shut off the supply. Amount

TABLE 1:Water Distribution in South Zone(Tamil Nadu)

S.NO	DISTRICT	TALUK	WATER SUPPLY
1	KARUR	THANTHONI	90 L(MUNICIPALITY)
2	MADURAI	ANAIYUR	90 L(MUNICIPALITY)
3	THENI	PERIYAKULAM	90 L(MUNICIPALITY)
4	DINDUGAL	KODAIKKANAL	90 L(MUNICIPALITY)
5	NAMAKKAL	MOHANUR	70 L(TOWN PANCHAYAT)
6	TRICHY	KALLAKUDI	70 L(TOWN PANCHAYAT)
7	KANCHEEPURAM	THIRUKAZHUNKUNDRAM	70 L(TOWN PANCHAYAT)
8	ERODE	WSIS TO ERODE	110 L(CORPORATION)
9	TIRUPPUR	WSIS TO TIRUPPUR	110 L(CORPORATION)
10	VELLORE	WSIS TO AMBUR	110 L(CORPORATION)

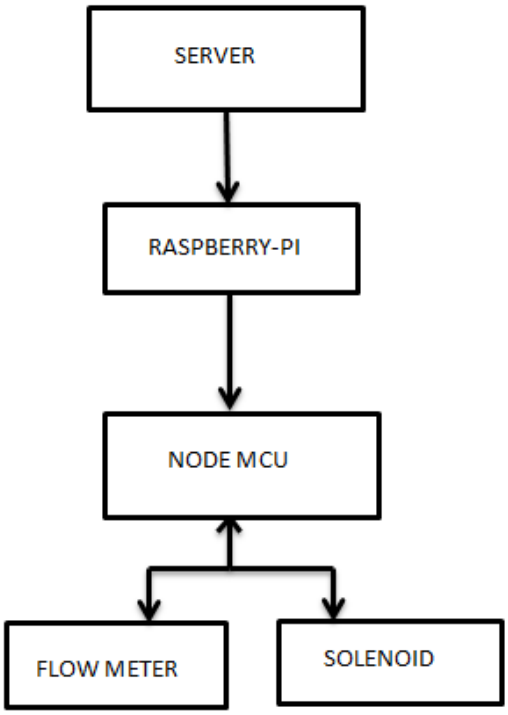
billed for usage can be sent to the user according to the water usage.

3. PROPOSED SYSTEM

The proposed system to monitor the daily usage of water in particular houses and to view their amount for the usage of water, consists of flow meter, solenoid valve, nodeMCU, Raspberry-piand server. The block diagram is shown in the fig 1.

Fig 1: Proposed Model

To measure the flow rate of the water the flow meter is used. Raspberry-pi acts as a



server. NodeMCU will act as the node which senses the data. The solenoid is connected to the flow meter, which is used to control the open and close of the water supplyvalve[8]. The flow meter generates the pulses. The nodeMCU is connected to the flow meter. It senses the pulses from the flow meter and transmits the processed value to the Raspberry-pi. Raspberry-pi, which act as intermediate to control the solenoid for open and close mechanism of the supply[10]. The nodeMCU is used to collect the data from the flow meter which is transmitted to the Raspberry-pi. When the value reaches the user requested amount, the signal is sent to the [10]solenoid valve to close the water supply[9]. Raspberry-pi uploads all the data from the nodeMCU and displays it for user's view.

A. RASPBERRY-PI

Raspberry-pi is a single board computer, can do entire work that a normal computer does. In this system Raspberry-pi 3 is used[8]. The specifications are Quad Core 1.2GHz Broadcom BCM2837 64bit CPU,Upgraded switched Micro USB power source up to 2.5A, General purpose I/O pins, runs on 5v. Raspberry-pi 3 is shown in the fig 2.

Fig 2:Raspberry-pi 3

Raspberry-pi is interfaced with nodeMCU which passes the data from the flow meter and solenoid. Raspberry-pi which acts as the server gets the data from the nodeMCU and stores it in database.

B. NODE MCU

NodeMCU is the single board microcontroller. It has Wi-Fi module named ESP8266.It is an open source IoT platform. It runs on 3-5v by USB. It has memory capacity of 128k bytes and storage of 4 bytes. This device has core processor ESP8266EX and Tensilica L106 32-bit micro controller unit.NodeMCU is shown in the fig3.

Fig 3: Node MCU

Flow meter and solenoid valve are connected to nodeMCU. The reading from the flow meter and solenoid valve is sent to the nodeMCU. This system is used because power consumption is low and low cost.

C. FLOW METER

Flow meter is the sensor which is used to sense the rate of water flow through it. It consists of pinwheel sensor which is used to measure the water flowing through it. It also consists of integrated Hall-Effect sensor which produce magnetic field due to the rotation[7]. The flow meter is shown in the fig 4.

Fig 4: Flow Meter

The output of this will be analogue signal/pulses for every rotation. For each revolution it produces 4.5 pulses. The flow meter is connected to nodeMCU which will collect all the data's regarding the rate of water flowed through it. The calculations are made to determine the rate of the water flow. In this system the daily usage of water is determined using flow meter.

D. SOLENOID VALVE

This sensor senses the process towards the outlet side of the solenoid valve. When it senses that certain quantity of the flow of the fluid is required, it allows the current to pass through the solenoid valve. Due to this the valve gets energized and the magnetic field is generated which triggers the movement of the plunger against the action of the spring. The solenoid valve is shown in the fig 5.

Fig 5: Solenoid valve

Due to this the plunger moves in upwards direction, which allows the opening of the

orifice. At this instant the flow of the fluid is allowed from the inlet port to the outlet port. If the required flow of fluid is less, the sensor allows passage of the lesser current to the solenoid valve.When the sensor senses that the fluid is no more required in the process, it stops the flow of the current to the solenoid valve completely. Due to this the solenoid valve gets de-energized and the plunger reaches the bottom most position and closes the orifice completely thus stopping the flow of fluid from the inlet port to the outlet port.This solenoid valve is connected to the nodeMCU it also senses the data from the valve and passed to the Raspberry-pi where it is programmed to control open and close of the valve to limit the water supply.

4. DATABASE MANAGEMENT AND USER CREDENTIALS

In this system, software module plays vital role. The creation of web page, it is an intermediate to connect the hardware module and humans usage of water resources. Web page is designed using the language of php, html, java script, SQL etc.,the user can submit their details and sign up their account to view their information on usage and cost of usage.The login page is shown in the fig 6.

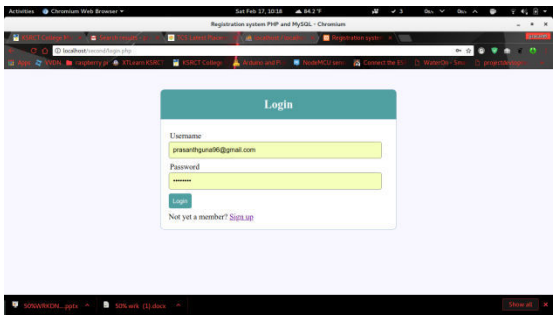


Fig 6: Login page

The additional user can also add up their account. The signup page is for adding the additional user is shown in the fig 7.

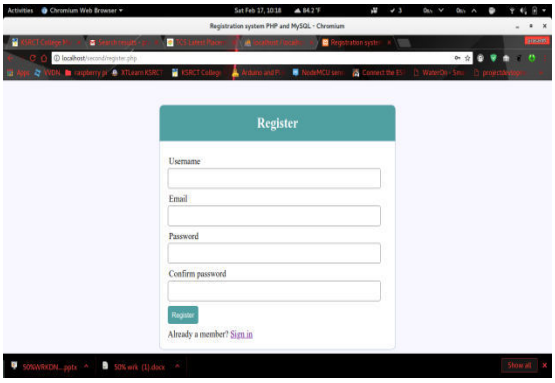


Fig 7: Sign-Up page

The already exist user can login their account by using user name and password. The data's from the sign up page is stored to the database using SQL query language is shown in the fig 8.

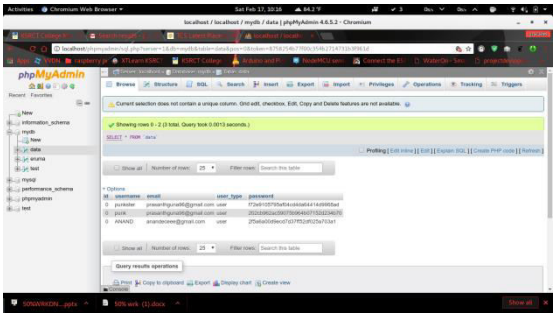


Fig 8: Updating the values in database

The data from database should be verified with the data in the login pagethat is done by php. After validation process the user is allowed to access their account. The details, after accessing is viewing the details of daily usage of water and amount for which they have used[11]. The fee is calculated on monthly basis. It will be displayed on their corresponding accounts. At first the userhas to fix their daily water consumption level, if the level is met the water supply is automatically shuts off by solenoid valve. The user is allowed to request twice a day in emergency purposes.

5. RESULT AND DISCUSSION

Asa result, the values from the flow meter are sent to the cloud, which can be viewed by the user. User has separate account to view the details of water consumption on daily basis and the amount for the water usage. Thebilling amount is calculated on monthly basis. The updation of values from the flow meter to the cloud services is shown in the fig 9.

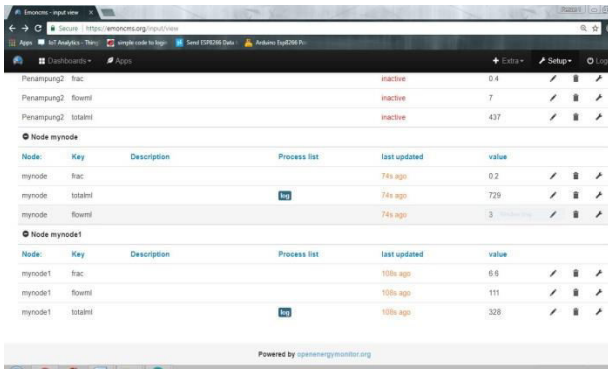


Fig 9: Updation of values in the cloud

6. CONCLUSION

This system provides water supply according to the user's request and it also monitors the daily usage of the water, so that user can self-analyse the amount of water is wasted so that the water can be saved.Thus system also provides the taxation amount to be paid by the user at the end of the month. The user can also request the water in emergency need for one time for a day. This system is essential to reduce the wastage of water and uneven taxation of consumed water.

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