IOT BASED DIGITAL WATER SUPPLY SYSTEM

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Abstract: Water theft is illegal tapping of water supply systems. Together with losses from water leaks in piping, water theft is one of the major factors contributing to non-revenue water in urban areas. In this paper, a method is proposed for remote water monitoring and preventing water theft by ensuring the flow rate is normal. The consumer/user is provided with a web application with options to check the water level, request for more water, and post-paid bill payment based on the consumption of water. The flow rate is recorded using a water flow sensor and the data is transmitted to a remote monitoring station. A solenoid valve is used to turn on/off by the central processing unit Raspberry Pi to stop the water supply when it exceeds a pre-defined limit. The admin monitors the water level at the user end, send notifications to the users, and detect the leakage of water using a moisture sensor. The method employs Internet of Things for wireless communication.

Index Terms **– Water Theft, Solenoid Valve, Raspberry Pi, Internet of Things**

I. INTRODUCTION

Water is one of the most vital resources for all life on Earth. It is used in household, agriculture, industry and recreational purposes. Economic growth has led to an increase in water demand by enterprises. Excessive water drawing by connecting motor-pump sets to water lines is described as water theft. This is one of the major reasons contributing to non-revenue water in urban areas. The safe monitoring of water in the enterprises can prevent water theft and water leakage. In recent years, many systems have been proposed for the prevention of water theft and water leakage.

In this methodology, it is proposed to develop a remote water monitoring and water theft prevention system by recording the water flow rate at the user/consumer end. The user is provided with a web application where the user can login to his/her account using the required username and password credentials. Upon logging in to the web application, the consumer can check the water level in the tank using an Ultrasonic Sensor placed inside the tank. The user can also request for more water. The requested quantity of water will flow into the user's tank if it is not already full. A solenoid valve is used to turn on/off by the central processing unit Raspberry Pi to stop the water supply when it exceeds a pre-defined limit. A bill will be generated based on the amount of water consumed by the user. The admin can also login to the web application using the required username and password credentials. The admin monitors the water level at the user end, send notifications to the users, and detect the leakage of water using a moisture sensor. The data from the sensors are communicated wirelessly to a remote monitoring station. The method employs Internet of Things for wireless communication.

II. LITERATURE SURVEY

The recently developed solutions for the prevention of water theft and/or water leakage include Anti-theft control system, embedded based remote water monitoring and theft detection and prevention system, water environment monitoring system based on wireless networks.

[1] Anti-theft control system for drinking water supply. It makes use of an embedded based remote water monitoring system by recording the flow rates at the consumer/user end. Its main objective is to control drinking water theft in domestic areas.

[2] Embedded based remote water monitoring and theft detection and prevention system. The objective of this system is to deliver wholesome water to the consumer at a particular area and in adequate quantity and to achieve continuity and maximum coverage at an affordable cost.

[3] Water environment monitoring system based on wireless networks. It proposes a system which is suitable for complex and large scale environment monitoring, such as for lakes, swamps, rivers, and shallow or deep ground waters.

III. PROPOSED SYSTEM

3.1 BLOCK DIAGRAM OF PROPOSED METHOD

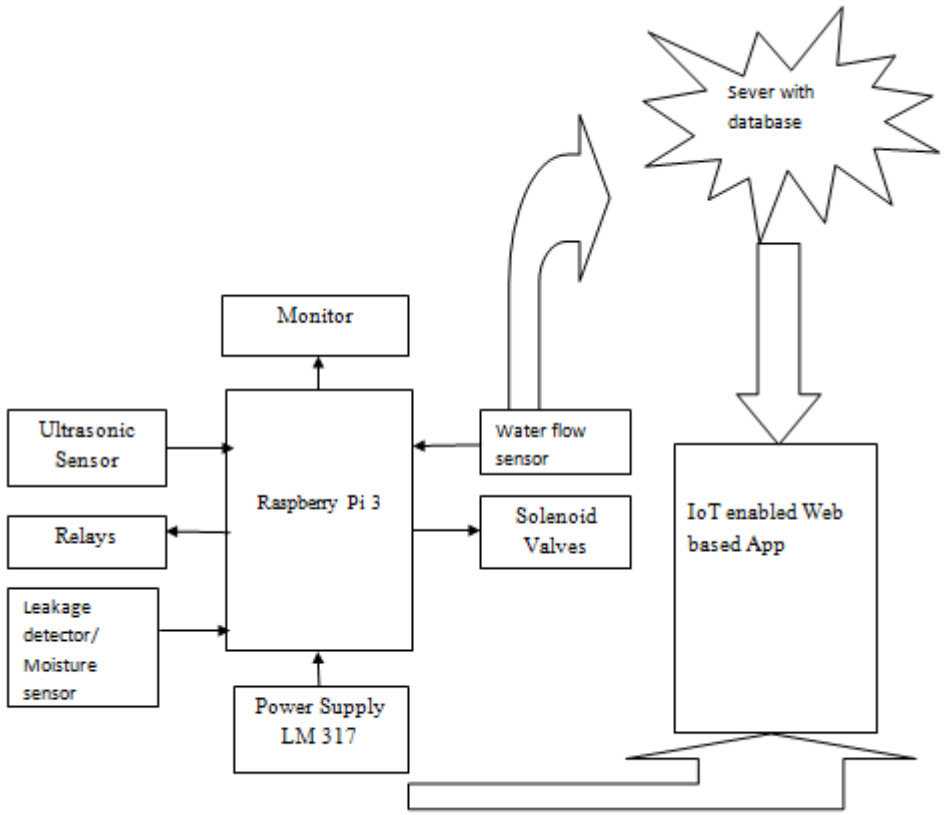

Fig 3.1: Block diagram of proposed method

As shown in the figure the system is designed around the Raspberry Pi. It consists of an Ultrasonic Sensor to measure the level of water in the tank. A moisture sensor is used to detect any leakage of water. The water flow sensor is used to measure the rate at which water flows from the main tank to the user tank. Solenoid valves turn on/off by the central processing unit Raspberry Pi to supply water for the required time period. Power Supply LM317 is an adjustable three terminal positive voltage regulator. A web application is used which provides an interface for the user and the admin.

3.2 WORKING PRINCIPLE

The proposed methodology is used for steady water flow from the main tank to the user end tank and to detect any leakage of water. The system uses a web application where the user can login to his/her account using the required username and password credentials. Upon login, the user can monitor the water level of the tank assigned to the user. This can be done using an Ultrasonic Sensor placed inside the user tank. The data from the ultrasonic sensor is communicated to a remote monitoring station. The user can also request for more water from the main tank. A Solenoid Valve is used for the supply of water from the main tank to the user tank. The valve turns on/off by the central processing unit Raspberry Pi to supply water for the required time period. A water flow sensor is used to measure the rate at which water flows from the main tank to the user end tank. This prevents the major concern of water theft as the water flow can be monitored at each stage.
The admin can also login to the web application using the required username and password credentials. The admin can monitor the water level of the main tank and the user end tanks. The admin can also communicate with the user regarding any problems such as water leakage and bill payment by sending notifications to the user. Leakage of water can be detected using a moisture sensor which detects and alarms the admin that a leakage has been found. The admin can then take necessary action and fix the problem. The sensor data is communicated to a remote monitoring system where the data can be monitored at every stage.

3.3 IMPLEMENTATION-HARDWARE

All the modules can be implemented using Raspberry Pi. The hardware components of the system are – Ultrasonic Sensor, Water Flow Sensor, Solenoid Valve, Relay, and Moisture Sensor.

3.3.1 Ultrasonic Sensor: An ultrasonic sensor is placed on top of the user tanks to measure the level of water. A pulse is transmitted down the tank. This pulse which travels at the speed of sound is transmitted back from the surface of the water. It is a simple and easily configurable device which has on board programming capacity.

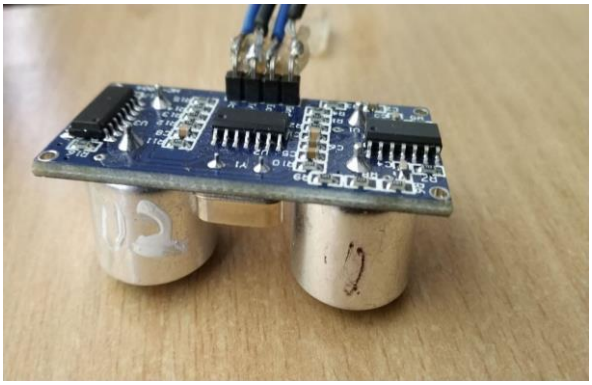

Fig 3.2: Ultrasonic Sensor

3.3.2 Water Flow Sensor: The water flow sensor comes with three wires: red (5-24VDC power), black (ground), yellow (hall effect pulse output). We can calculate water flow by counting the pulses from the output of the sensor. It needs to be carefully measured if better than 10% precision is needed. The pulse signal is simple square wave.

Fig 3.3: Water Flow Sensor

3.3.3 Raspberry Pi: It is a credit card sized computer that plugs into a television and a keyboard. It is a small computer which is used in electronic projects and for many other applications like spread sheets, word processing, and browsing the Internet. The Raspberry Pi 3 Model B+ uses a Broadcom BCM 2837, containing a quad core ARM cortext-A53 running at 1.2GHz.

Fig 3.4: Raspberry Pi 3 Model B+

3.3.4 Solenoid Valve: The valve used in this system is a 2/2 way usually open valve. It enables water flow from one end to another end. It has two ports and one orifice seat. A short electrical pulse enables the valve to open and close. The residual effect of permanent magnet is enough for keeping the valve in a particular working position without any electrical energy consumption.

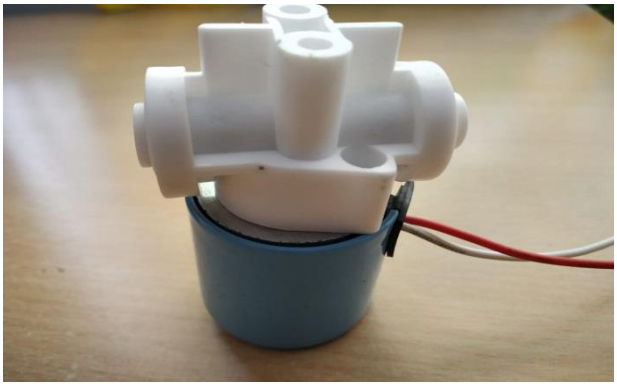

Fig 3.5: Solenoid Valve

3.3.5 Relay: Relays are used as a switch for the Raspberry pi controller.

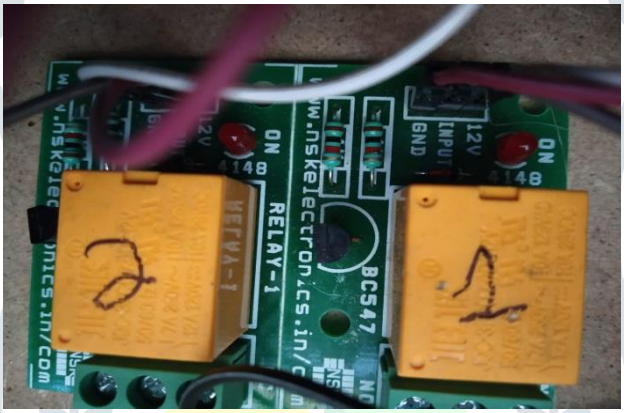

Fig 3.6: Relay

3.3.6 Moisture Sensor: These sensors are used to detect any leakage of water and notify the server about the leakage.

Fig 3.7: Moisture Sensor

IV. TESTING AND RESULTS

4.1 LOGIN PAGE

- The user and admin can login using the required username and password credentials.

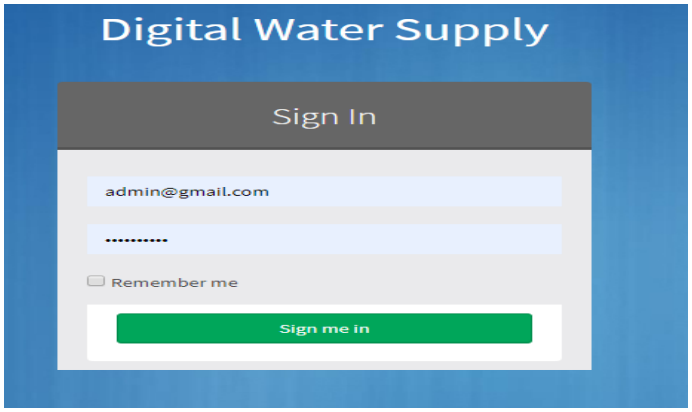

Fig 4.1: Login Page

4.2 ADMIN

- A web page is displayed after the admin is logged into his/her account.
- The admin can monitor the water level of the main tank as well as the user tanks. The tanks will be automatically updated if water flows from the main tank to the user tank.
- The admin can also send notifications to the user regarding bill payment or any other problems.

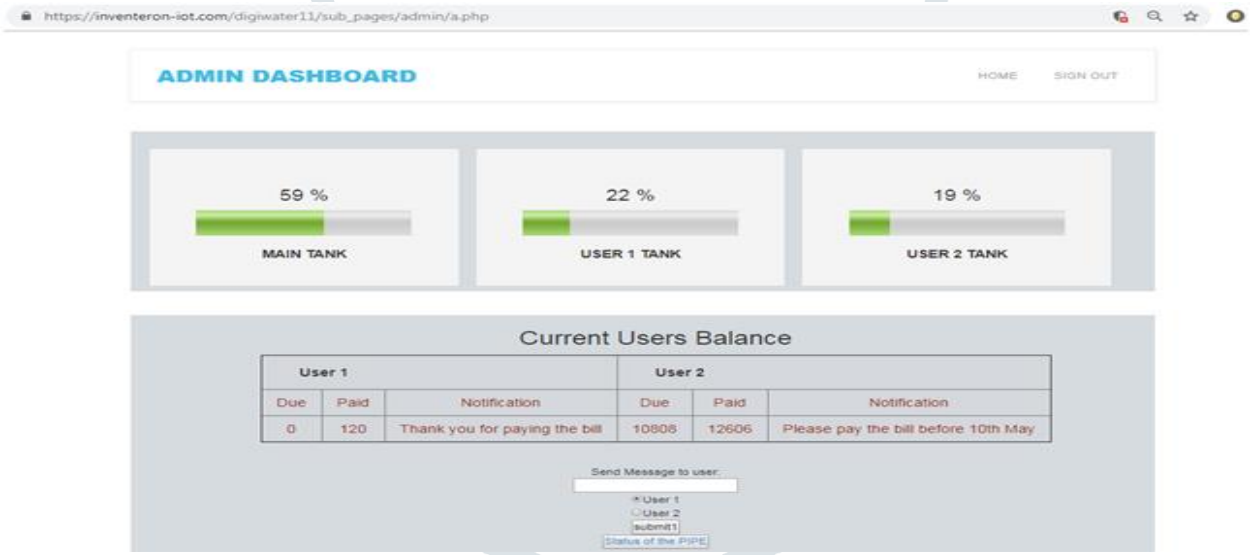

Fig 4.2: Admin Page

- The admin can also check the status of the pipe so as to detect if there is any leakage of water.

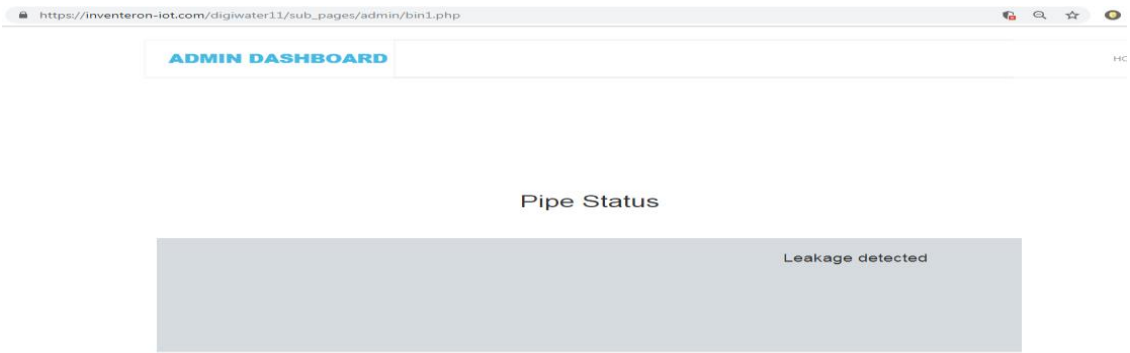

Fig 4.3: Pipe Status

4.3 USER

- A web page is displayed after the user is logged into his/her account.
- The user can check the water level by clicking on the water level option.
- The user can request for water by clicking on the request to control option.
- The user can pay the bill based on the quantity of water consumed

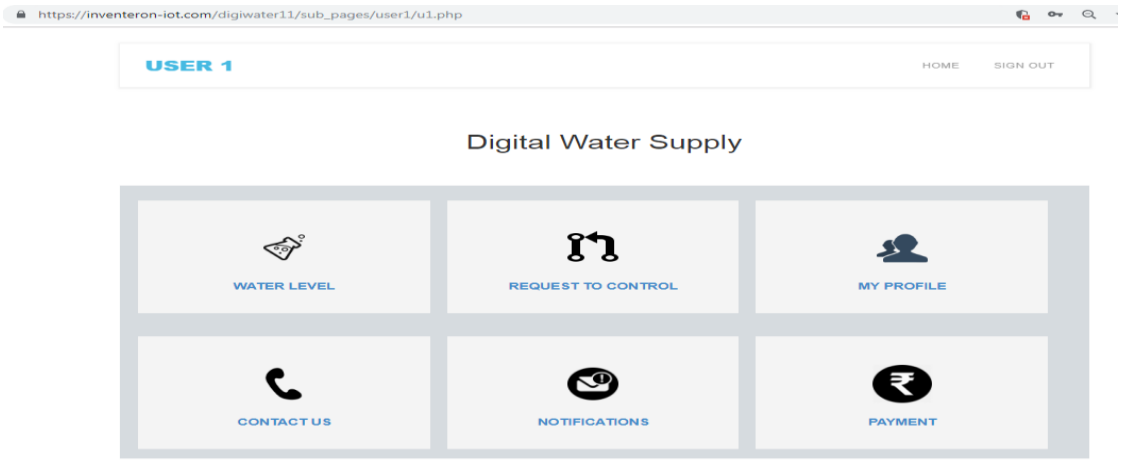

Fig 4.4: User Page

4.3.1 Water Level:

- The water level reading is shown in the figure 4.5

Fig 4.5: Water Level of User Tank

4.3.2 Request to control:

- The user can request for water from the main tank for a finite number of seconds.
- Bill will be automatically generated based on the quantity of water requested by the user from the main tank.

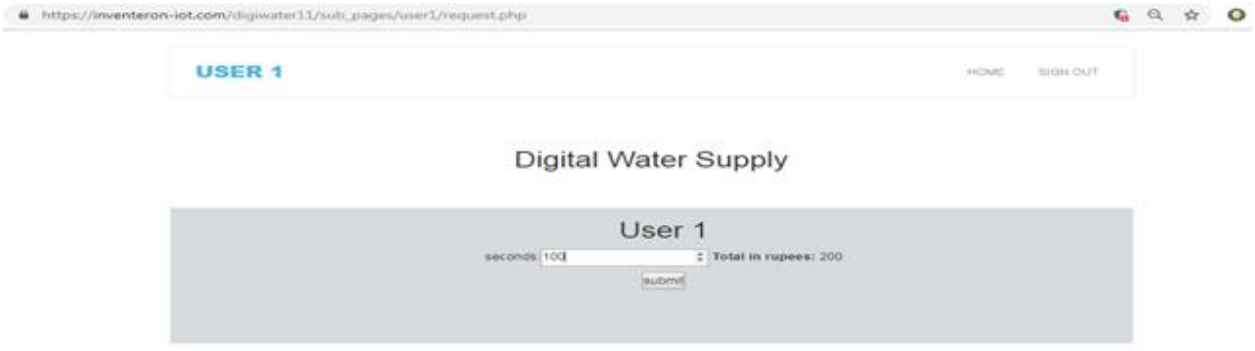

Fig 4.6: Request to control

4.3.3 Bill Payment:

- The user can pay the bill at the end of the month on a post-paid basis.

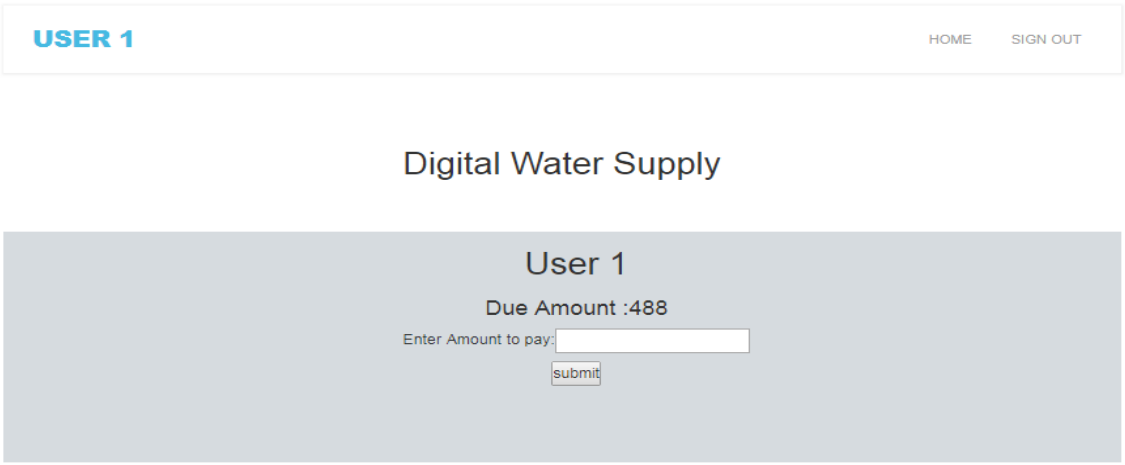

Fig 4.7: Bill Payment

4.4 Prototype Model

- Fig 4.8 shows the prototype model of the proposed system. Using a real time version of the proposed system can surely prevent water theft and water leakage.

Fig 4.8: Prototype Model

V. CONCLUSION

In the proposed methodology, we have successfully implemented a water monitoring and detection system. By implementing this methodology in real time it will surely be possible to prevent water theft and water leakage.

VI. FUTURE SCOPE and APPLICATIONS

The proposed methodology when implemented in real time, it is not possible to detect the exact location of the leakage since underground pipelining is done. In future, exact location of pipe leakage can be put into application.

Applications are:
a) It can be used in Fuel supply systems in underground tunnels.
b) The concept can be used in electricity management systems.
c) The concept can be used in home appliance control.
d) The concept can be used in health care sector.
e) The concept can be used in making of smart cities.

VII. ACKNOWLEDGEMENT

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VIII. REFERENCES

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