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IoT Based Smart Water Leak Detection System for a Sustainable Future

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***Abstract*—Water may be a precious resource that ought to be managed fastidiously. But because of leak in water distributed networks an outsized quantity of water is lost annually. The innovative plan is automatism of the water leak detection in water distributed network system. The amount of water distributed is detected using water flow device. The situation of autonomous water leak detection in an exceedingly immense space are often tracked and monitored. The paradigm has been designed for water leak detection. The system is controlled by ATMEGA328 microcontroller. The direction of water is monitored by resistance detector. Correct location and leak are the areas of concern that have been concentrated in the system.**

***Index Terms*—Leakage detection, Resistance detector, Water flow sensor.**

I. Introduction

Many countries are known to face issues of scarce water resources, and corrective measures area unit taken to develop higher water management system. Water leakage and loss from the most distribution system has been one of the most problems faced not solely by the developing country and conjointly by the developed country round the world. Pipeline networks area unit are the main components for transporting water from one destination to a different place, especially to rural areas. Somehow, leaks could incur due pipeline ageing, corrosion and intensive pressure ensuing from operational error and also due to the fast closing or opening of valves. To forestall future water losses, several techniques are planned with completely different applications to sight leaks within the pipeline system or network.

The manual meter reading could be a tedious, overpriced and extremely labor-intensive job. The innovation in technology has given ways to measure water leak with a rising accuracy. The amount of water flow is unceasingly monitored. Leak within the pipeline is detected using the resistance detector. The solenoid valve mechanically turns off once water leaks. The location, resistance, distance, rate of water flow is monitored and viewed via mobile application.

II. Related Works

Passive and active systems are the current leak detection technologies. The oldest and maybe unsystematic passive leak detection is to observe any indication of ponding at ground surface [1]. As technology advances, a lot of accurate leak detection is carried by using manual sticks or portable measuring devices. These devices will detect sound or vibration made by water leak from pressurised pipes [2]. In paper [3] the authors discuss on the need for finding the location of the vehicle using GPS where ATMEGA328 is being employed. In [4], the authors have developed a system in which ARM – M4 processor has been used to process the sound information and to alarm the water leakage. Afterwards, with the provision of remote-controlled robots, detection of pipe leak is administered using Closed Circuit loop Television (CCTV) was designed in [5]. Software-based ways use various computer applications to analyse and find out the leaks in pipeline systems. This methodology is employed to measure internal pipeline parameters, together with pressure, rate of flow and temperature [6]. Introducing challenges of designing citizen's campaign for collecting data on environmental water, a set of developed internet and web applications is then introduced, integrated inside a particular platform, because it was utilized in the execution of citizen campaign for data required in flood analysis and management [7]. In [8,9] and [10] the authors describe the technologies that are involved in IoT towards sustainable development of urban areas and cities.

III. Proposed Model

The proposed system consists of water flow detector that is employed to take a note of what quantity of water has been transferred from one place to the other. If there's leak in pipeline the water detector senses the water flow and sends signal to the controller. The controller sends the signal to the relay then the solenoid valve activates mechanically. Quantity of water flow and resistance value is monitored. Resistance value has been set different for different locations. The location can be known using the resistance value viewed within the mobile app. The water turbine rotates once there's water flow and power is generated.

A. Water Flow Sensor

The rate of flow of water or the amount of water being provided is measured using the water flow detector. Rate of flow of water is measured in litres per hour. If there's leak

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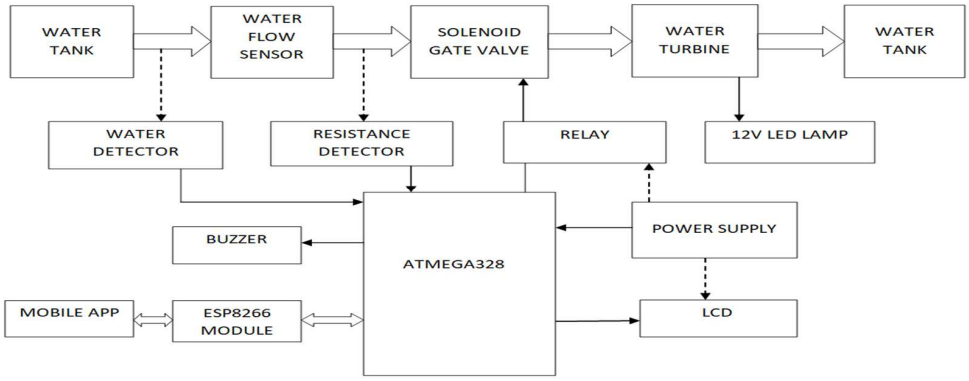

Fig. 1. Block diagram.

TABLE I
RESISTANCE VALUE FOR DIFFERENT LOCATION.

S. No.	*Location*	*Resistance (ohms)*
1	Erode	0.14
2	Thindal	1.17
3	Perundurai	2.25
4	Avinashi	3.33
5	Coimbatore	20

within the pipeline, it's detected by the water detector and the detector sends signal to the microcontroller. Once the leak is detected the solenoid valve turns OFF.

B. Resistance Detector

Resistance detector measures the resistance of the copper wire connected to the pipe. Once water leaks tangency happens. Tangency is often determined by measuring resistance between two cables at one end. The value of resistance tells us the precise location of the tangency. Each location contains a bound resistance value using which we can easily locate the area of leak. Table I shows the resistance value for certain locations in Tamil Nadu

C. Function of Microcontroller

The leak in pipeline is detected by the water detector that successively sends the signal to the controller. The controller sends the signal to the relay that turns off the solenoid's valve. Once the solenoid valve is off there is no water flow within the pipeline. Once there is water flow within the pipeline the water rotary engine rotates and power is generated. An alphanumeric display is connected to the controller that displays the quantity of water flow within the pipe and also the resistance value. The controller is connected to the ESP module that transfers the information to the mobile application where we are able to view the location of water leak within the pipeline. Fig. 2 depicts the internal wiring connections involved in connecting the controller with water detector, water flow sensor, solenoid valve and IoT module.

D. ESP8266 Module

ESP8266 module is a standalone low cost wireless transceiver used to communicate with the WiFi module.

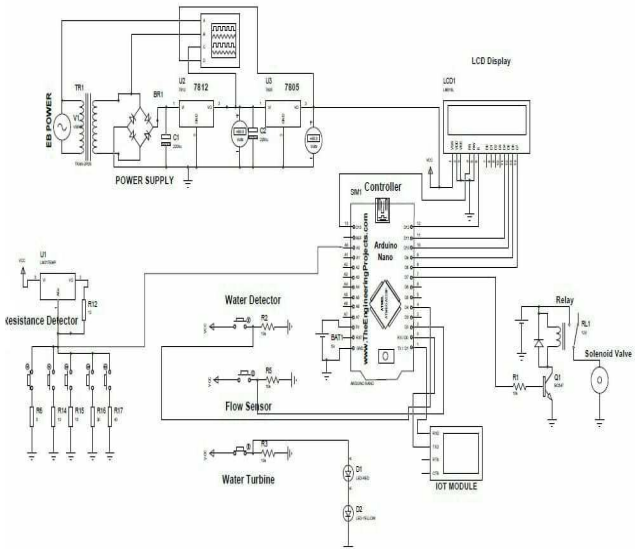

Fig. 2. Schematic Diagram.

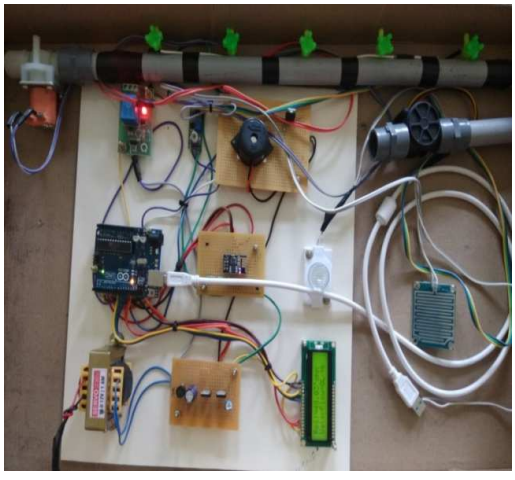

Fig. 3. Prototype of the system.

Microcontroller communicates with ESP8266 module using UART.

The prototype that is designed is shown in Fig. 3. The prototype is designed for detecting water leak for pipeline system from Erode to Coimbatore.

IV. Results

Different location has different resistance values. The location can be viewed and if there is no leak it shows no fault. Resistance value, water flow rate and the distance can be viewed. An alert button has been included in the application. When we click on the button the buzzer beeps which intimates water leak. Fig. 4 shows the result viewed via the mobile application.

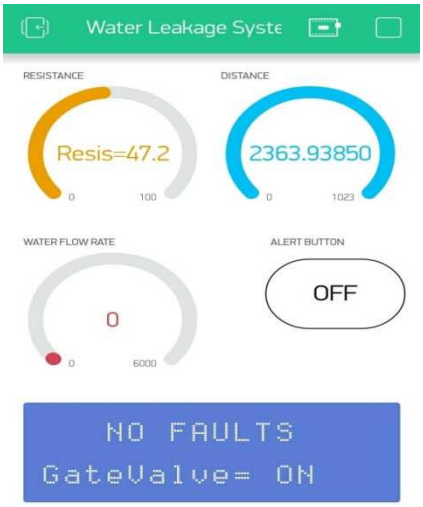

Fig. 4. Result obtained when no water leak is detected.

Case 1: Water leak detection at Erode

It is observed as per the design, if there is any leakage of water in Erode district, the resistance value that is being measured becomes 0.14 ohms and the distance where the leak has occurred from the point of the system prototype is also observed as 7.0425 kms.

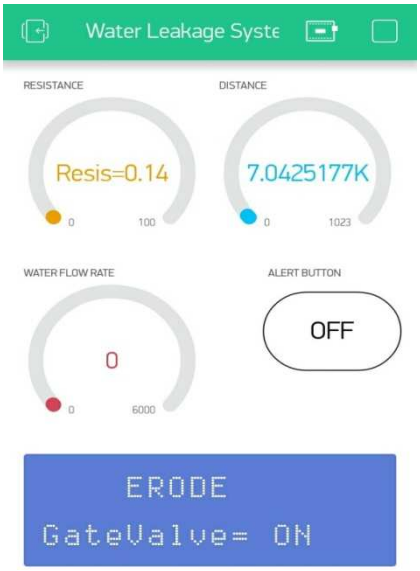

Fig. 5. Result obtained when water leaks in Erode.

Case 2: Water leak detection at Thindal

In case there is any leakage of water in Thindal district, the resistance value that is being measured becomes 1.17 ohms and the distance where the leak has occurred from the point of the system prototype is also observed as 58.6876 kms.

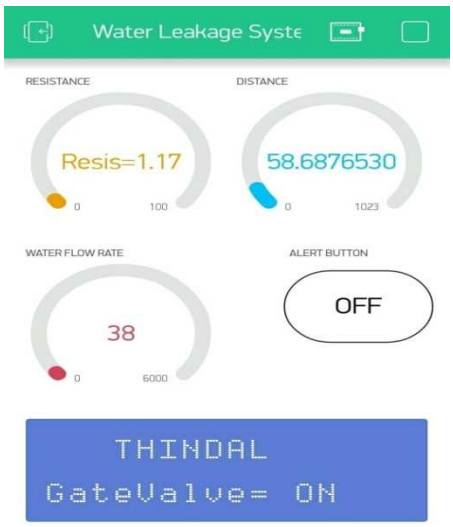

Fig. 6. Result obtained when water leak is detected in Thindal.

Case 3: Water leak detection at Perundurai

If there is leakage of water in Perundurai district, the resistance value that is being measured becomes 2.25 ohms and the distance where the leak has occurred from the point of the system prototype is also observed as 112.6803 kms.

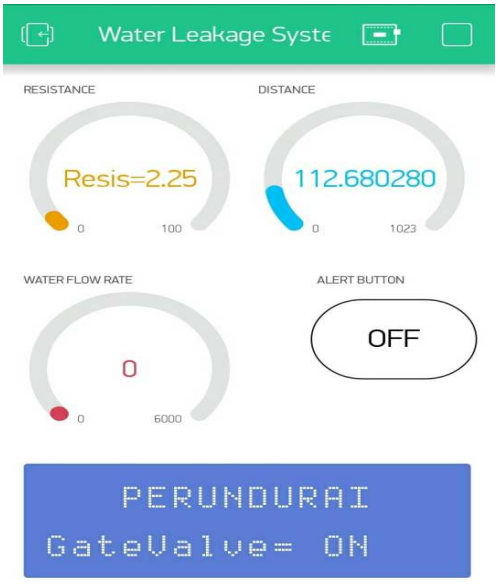

Fig. 7. Result obtained when water leak is detected in Perundurai.

Case 4: Water leak detection at Avinashi

If there is leakage of water in Avinashi district, the resistance value that is being measured becomes 3.33 ohms and the

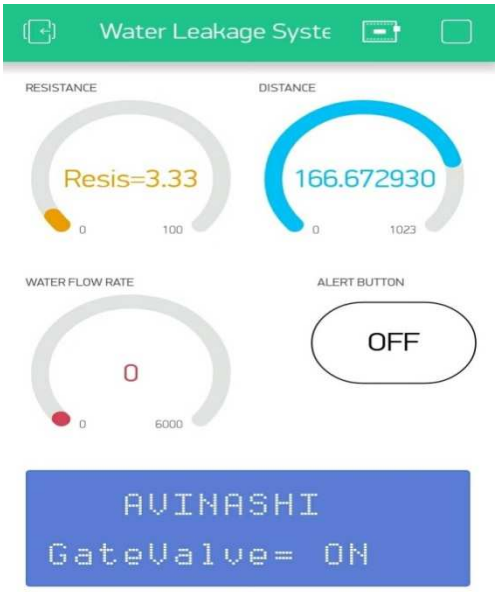

Fig. 8. Result obtained when water leak is detected in Avinashi.

distance where the leak has occurred from the point of the system prototype is also observed as 166.6729 kms.

Case 5: Water leak detection at Coimbatore

If there is leakage of water in Coimbatore district, the resistance value that is being measured becomes 20 ohms and the distance where the leak has occurred from the point of the system prototype is also observed as 1004.7325 kms.

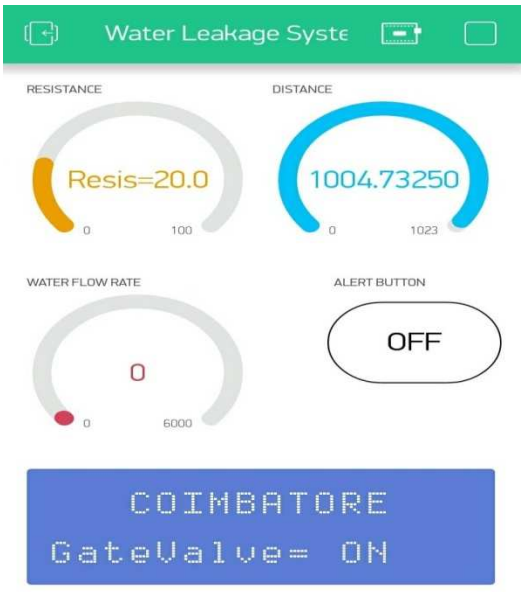

Fig. 9. Result obtained when water leak is detected in Coimbatore.

V. Conclusion

By using a better monitoring system, we can control water loss and save water for future generation. Based on microcontroller and resistance detector we achieve the main purpose of this system. Internet of Things is used here to collect the data and send it to the mobile application in which we can view the location where leak occurs in the pipeline.

VI. Future Work

WSNs will transmit the collected data to a monitoring and decision system known as Internet of Things. The investigation of real time analysis by using Fuzzy logic or artificial neural networks from online server data can be done. The online decision system will be able to alert worse conditions of the pipeline and locate the leaks in real time.

Acknowledgment

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