DEVELOPMENT OF DATA ACQUISITION FOR UNDERGROUND WATER AND GAS PIPELINE LEAKAGE MONITORING USING IOT

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Introduction:

Water is considered to be one of the vital resources used around the world. And most of the countries highly depend on the standard of water management. Wastage of water due to pipeline leakages is one of the most serious and largest challenges faced across the globe. From an engineer's perspective, distribution of water can be improved mainly by limiting the water waste that occurs along the path, between the source and the end-users. But leakages are unavoidable due to some circumstances, such as corrosions, manufacturing defects and aging of pipes.

When leak occurs in pipelines, large volume of water is lost, causing adverse impact on the production industries and common people's routine. Since the pipes are invisible and unreachable, indication of cracks is not noticed. Hence finding the leakages and replacing the defective pipe is very crucial during water or gas distribution.

Existing leak detection systems such as measurement of acoustic waves, ground penetrating radar (GPR) systems, pressure measurements, fiber optic monitoring and vision based systems needed lots of labor efforts and erroneous measurements of leaks would lead to expensive repairing of the pipeline.

Therefore a possible system is to be built, that can effectively detect the leaks in the pipeline to minimize human intervention by using reliable networks with stable communication such as Zigbee and WSN is needed to invigilate cracks and identify leakage position, which composes small Printed Circuit Boards (PCB), data from different sensors such as Moisture and Water flow sensors, which are collected and monitored on a PC or smart phones through IOT. IOT is mainly used for the connectivity of devices. The PCBs are powered by voltage through battery. When a leak is noticed, remedial measures are taken to reduce water losses in the water supply system. Exact leakage position and replacement of underground water pipelines in a distribution system highly reduces the loss of water. So the expected system will be used to conserve water and minimize the repairing cost.

Objectives:

- To implement a wireless sensor based monitoring and controlling system that can be accessed in close proximity along with remote access.
- To ensure the availability of the monitoring system in case of underground water distribution where there is a constant need to detect possible underground water leakage for residential water pipes that are monitored from a PC.
- To ensure this proposed system can be employed globally and to provide a very user friendly environment for people to use the application and the hardware without need for extensive training.

- To Publish connectivity to unreachable and dangerous areas
- To notify the water leakage without human intervention under the ground.

Methodology:

Hardware Requirements

Raspberry Pi
Relays
Water flow sensors
Monitor
ARM 7 LPC2148
Moisture sensors
Power supply

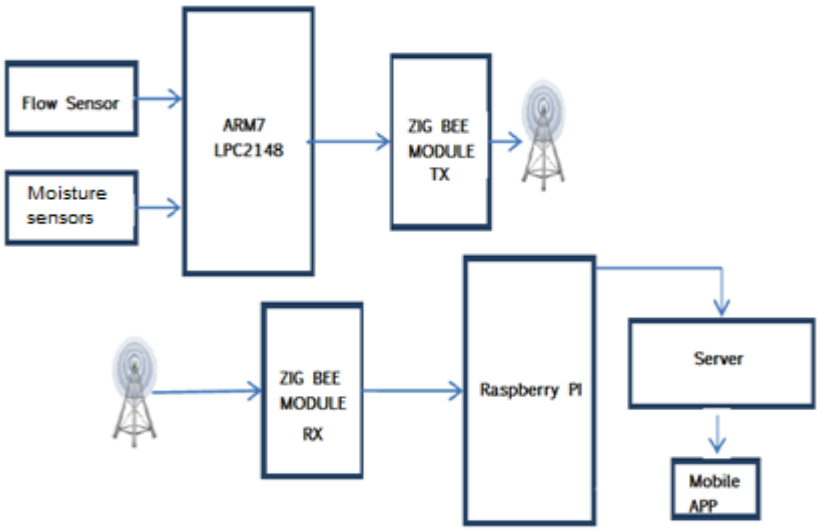
Software Requirements

Programming language Python
Linux
IOT
Embedded C
Keil uv5

The implementation methodology comprises of the following components.

- Flow sensor is an analog sensor used to measure the rate of flow of water.
- Moisture sensors measure the volumetric water content in soil.
- ARM7 LPC2148 is a microcontroller used to acquire the data regarding the leakage from the Moisture sensors.
- Zigbee is used to transmit the data received by ARM7 to the receiver Zigbee.
- Raspberry Pi is used to collect the data and transmits the information to the server.
- Mobile App is used as user interface to display the information's to the end users.

Water leakage detection system using Moisture and flow sensor is discussed here.



Block diagram

Fig illustrates the System block diagram of the proposed system. Flow sensor measure the flow rate of the water between two ends, if a leak happens anywhere between the two sensors the water flow rate of the second sensor drops and the analog signal is converted to digital signal. The respective Moisture sensor is responsible to detect leakages in the particular pipe which senses the leakages of water and gives analog or digital values in the form of 1 or 0 and transfers the values to the microcontroller. Thus the microcontroller buried underground detects the drop in the flow rate, if there is any change in the value it intimate about the leak at the receiver end. Here the transmitter is ARM7 LPC2148 (microcontroller) and receiver will be Raspberry Pi.

ZIGBEE wireless communication is needed to communicate between the two modules. Zigbee is a type of serial communication which can transmit and receive 1 bit at a time. The transmitter has the flow and moisture sensors which monitors the flow rate and indicate about the leaks. By a time interval of 1 second the flow rate is transmitted. The flow rate values are compared at the receiver side, if there is a change in the flow rate value. Then it sends an alarm signal. After Raspberry Pi receiving the signal through zigbee activates the internet port and sends the information to server. The server will send the information to Mobile App where data will be stored and hardware can be controlled from App.

Results and Conclusion:

Thus the proposed system makes use of modern technology and equipment that help in reducing and controlling the major problem of water loss. Large volumes of water are being wasted from main transmission lines and are traditionally difficult to detect. Some of the technologies used for detecting are relatively new and resulting in rapid development of instrumentation, interpretation and communication.

This has enabled the service engineers to adopt a 'multi-sensor' and ‘cloud’ approach to utilize the whole range of internet of things (IOT) technology and selecting an appropriate mix of equipment for specific network characteristics, site locations and type of leak and as well as user interface to detect and control leak .

New systems and instruments are continuously being developed. Some of the technologies are in the experimental stage, others are still being trailed, but many of them are already being used or nearing production, this proposed system adds a new range of tools to the multi-sensor concept and also makes use of relatively new cloud concept. Detection system (PLDS) experimental testing technique for future applications was established using PVC pipe and is intended to accommodate dissimilar types of pipe and is designed to accommodate different types of pipe and leak configurations. Leak detection experiments could be used by local service providers to implement the technology necessary to spot leaks in the water distribution system and reduce water loss.

Scope for future work:

This proposed system can be used by water supply industries such as Bangalore Water Supply and Sewerage Board (BWSSB), Karnataka Urban Water Supply and Drainage Board (KUWSDB) etc, so that water pipelines, drainage pipelines and in gas pipelines involved in the industries can be monitored. It is ranged between districts and can be employed or monitored by a single district water supply manager to supervise continuous evaluation of pipe leakages on the app deployed by the proposed system. Once the leakage is detected, the required measures to rectify the defective pipeline can be taken.

The user interface used in the application is easier to learn and understand with minimal guidance and training thereby less training cost and in future it can be further extended to personnel monitoring of pipelines on an individual level such that the pipelines of residential place or company can be monitored by themselves. Eventually it could be used to detect the illegal tapping.