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Automatic Underground Water Leak Detection System using Noise Logger for Main City Feeder Pipeline

Binnaser Aziz Abdullah (Author)
Head & Assistant Professor (Computer) Sir Sayyed College Roshan Gate Aurangabad,
Pin: - 431001, Maharashtra, India *E-mail: azizbinnaser@gmail.com*

***Abstract*—** Water systems all over the world experience water losses. Leakage is the most common reason of water loss. Problems associated with water main leaks are a growing concern around the globe. These problems include water and energy loss. Management of water leaks can be improved if leaks can be detected effectively then rectified efficiently. This paper presents a study conducted for detection of water leaks, and identification of their respective locations in underground pipelines using noise loggers. There are many technology used for water leakage detection. The technology explains here is GUTERMANN Cloud System which uses noise loggers for detecting the leakage. The ZONESCAN is used for Public Water distribution in which the noise logger is placed on the Pipeline which can detect the leak in pipeline up to 100 meters. The HiSCAN is used for professional leak detection in trunk main pipeline, the noise logger are inserted in to main pipeline which can detect the leak up to 1KM. Whenever there is a leak in pipeline the noise logger will detect the leak and measured it. The data measured by the logger is collected by the repeaters, which are mounted above ground. The repeaters then transmit the data via radio signal to the alphas. The collected data is then transmitted by means of GPRS (General Packet Radio Service) via the alpha to ZONESCAN cloud service. As the system uses the Google Map the system can be access from any location and can also predict the leak in the pipeline.

Keywords*: GUTERMANN, ZONSCAN, HiSCAN, Noise Logger, Alpha*

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I. INTRODUCTION

Conservation of water is one of the major objectives for any country around the world. Water management plays a very important role in a society, as it is one of the basic needs for the mankind. Water supplied for human consumption must be highly efficient with minimum wastage. In a developing country like India, loss of water in domestic sector on account of leakage is approximately 30 to 40% of the total flow in the distribution. This leads to high risks in public health, money invested and on the valuable natural resource.

Water systems all over the world experience water losses. Leakage is the most common reason of water loss. Problems associated with water main leaks are a growing concern around the globe. These problems include water and energy loss, in addition to considerable properties damage. In current practice, not all water leaks can be detected due to intensive time and expensive cost associated with the leak detection process; consequently, some leaks are still occurring and lead to problems mentioned above. Management of water leaks can be improved if leaks can be detected effectively then rectified efficiently. This paper presents a study conducted for detection of water leaks, and identification of their respective locations in main underground pipelines using noise loggers by GUTERMANN Technology

II. LEAK DETECTION TECHNOLOGIES

The science of leak detection has evolved into two general methods: active and passive. Active acoustic leak detection requires a person/s using sonic ground listening devices, correlates, and probes to carry out the listening phase of the program. This is performed by walking along main pipelines and listening at valves, fire hydrants and key junctures. This method can be time and labor-intensive, and requires highly trained staff, or contractors. Passive leak detection programs utilize permanent and semi-permanent acoustic leak detection devices or 'Noise loggers' to do the listening. The loggers are small-scale, self-contained devices that magnetically attach to distribution valves, fire hydrants, and key junctures. At night or during low ambient noise (often low use) periods they activate and listen for unusual vibrations that could represent a leak in the pipe. They transmit the data via radio telemetry to a receiver, located in a maintenance or meter reader truck, which can access the data via a drive-by mode when the logger and receiver are in close proximity. If a logger detects an abnormal noise vibration during the listening period, the logger will send an alert to the receiver. These alerts are then investigated by utilities to substantiate or dismiss a possible leak.

III. GUTERMANN TECHNOLOGY

GUTERMANN is a global technology leader and innovator in intelligent water loss technologies and Passive leak detection technology. GUTERMANN has been specializing in the design, manufacturing and distribution of all conventional acoustic leak detection equipment. It is a synonym for precision, quality and reliability in leak detection technology worldwide. GUTERMANN Technology had developed the noise logger for underground water pipe line leakage detection, which can detect the water leakage location in pipeline; the accuracy found is in between 2 m to 5 m.

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Diagram

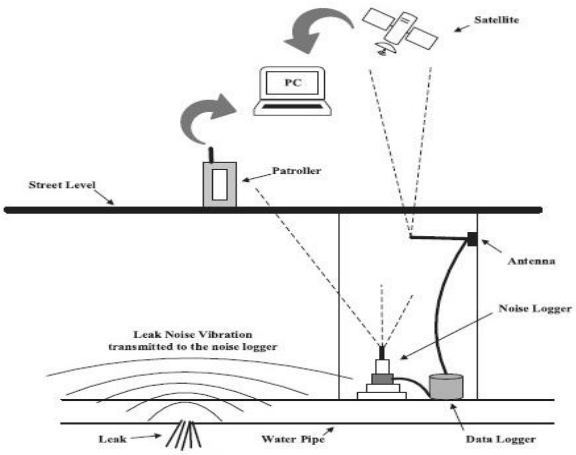

Figure 1 GUTERMANN Technology System

Gutermann Technology has developed many cloud services for water leakage detection System like ZONESCAN (Fixed Distribution Network Monitoring) and HiSCAN (Fixed Pipeline Monitoring)

IV . ZONESCAN (FIXED DISTRIBUTION NETWORK MONITORING)

Gutermann Technology has developed the ZONESCAN System (Permanent Leakage monitoring system) for professional leak detection in public drinking water pipelines which can detect the water leakage up to 100 meters only. This unmanned, acoustic leak monitoring system with noise level and correlation measurements ensures that leak detection specialists are deployed only at the actual leak locations

Distributed over the entire water network, ZONESCAN Loggers continuously monitor and analyze the noise characteristics and can thereby detect the presence and location of leaks. Each data Logger stores the leak analysis results, including the detailed noise level distributions which are transferred to the ZONESCAN NET via the Repeater and Alpha array. This measurement data is automatically stored in the powerful ZONESCAN NET database. This is used to produce detailed logs for the maintenance personnel and, ultimately, a systematic analysis of historical data for optimizing future water network planning. The ZONESCAN Net System offers the possibility to integrate GPS for automatically importing noise level and correlation data

System Overview

The ZONESCAN Correlating Radio Noise Data Loggers are mounted directly in the water network to record and to save the existing noise level and the ambient temperature. The statistical analysis of the stored values indicates whether or not a leak is present. A number of strategically mounted ZONESCAN Correlating Radio Noise Data Loggers allow all segments with water losses to be identified. The data measured by the logger is collected by the repeaters, which are mounted above ground. The repeaters then transmit the data via radio signal to the alphas. The collected data is then transmitted by means of GPRS (General Packet Radio Service) via the alpha to your ZONESCAN NET Program for further processing.

he software automatically evaluates the collected data daily. The more exact the pipe data entered by the user, the better the results. The results calculated in ZONESCAN NET are numerically and graphically presented in the form of histograms and frequency distributions, interpretation of the statistical evaluation facilitating the identification of the leak locations. A numerical leak indicator simplifies the interpretation of the statistical evaluation.

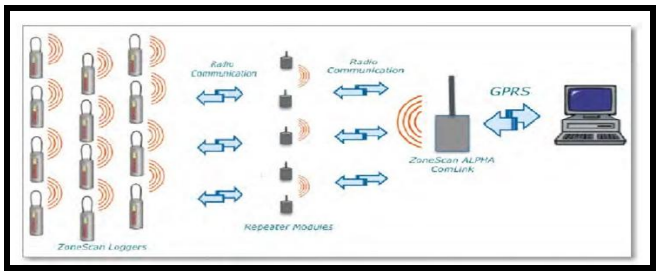

Figure 2 Functionality of Logger, Repeater and Alpha

V. HiSCAN System (Fixed Pipeline Monitoring)

HiSCAN System is used for professional leak detection in Trunk Mains. This unmanned, acoustic leak monitoring system with noise level and correlation measurements ensures that leak detection specialists are deployed only at the actual leak locations. It has smart algorithms for synchronization and noise filtering and is a true fixed installation with automatic leakage alarms. The distance between the measurement point in HiSCAN system is up to 1KM.

System Overview

The HiSCAN system comprises 3 main components

i) HiSCAN Pipe monitoring Sensors with Hydrophone

ii) Zonescan Alpha Communications Module (GPRS &RF)

iii) Zonescan Alpha Software

The HiSCAN Hydrophones are mounted directly in the water network to record and to save the existing noise level and the ambient temperature. The statistical analysis of the stored values indicates whether or not a leak is present. A number of strategically mounted HiSCAN Hydrophones allow all segments with water losses to be identified.

The data measured by the logger is collected alphas. The collected data is then transmitted by means of GPRS (General Packet Radio Service) via the alpha to your ZONESCAN NET Program for further processing. The software automatically evaluates the collected data daily. The more exact the pipe data entered by the user, the better the results. The results calculated in ZONESCAN NET are numerically and

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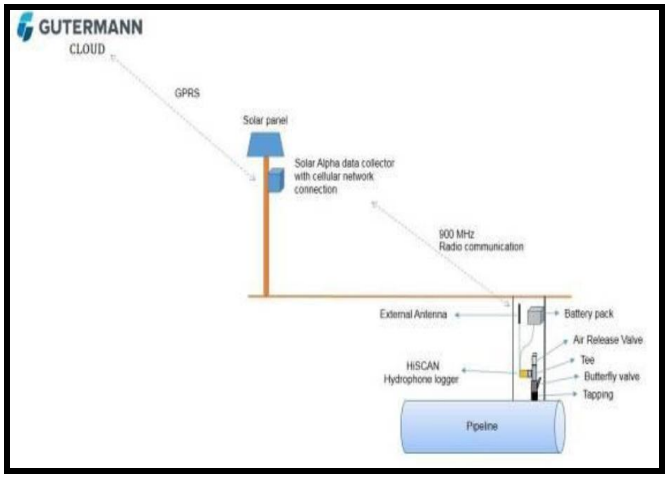

Figure 3 HiSCAN System

Interactive communication between HiSCAN and the leak detector

While conventional radio loggers are equipped with a simple radio transmitter, the HiSCAN Hydrophone logger features a transceiver (combined transmitter and receiver). This allows for interactive communication between the sensor located in the chamber and the leak detector. In addition to correlation

and remote listening, programming of the HiSCAN Hydrophone logger is also performed via radio signal directly from the vehicle (i.e., without physical contact with the logger). Thus, the factory settings can be easily adapted at any time by you to meet your specific measurement needs.

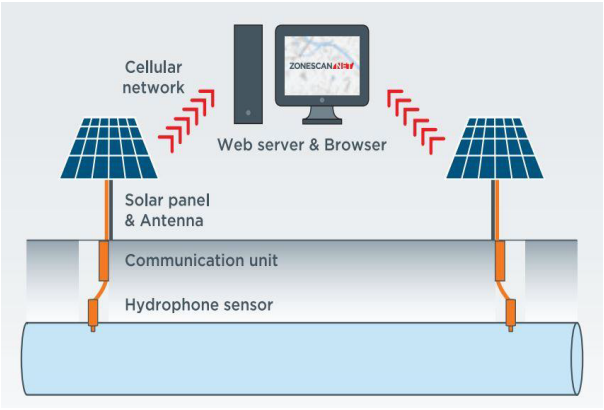

Figure 4 HiSCAN Communication

Installation of HiSCAN System:

Figure 5 HiSCAN Logger with battery pack and antenna

Figure 6 Installation of Alpha Data collector and solar panel on a pole near the chamber.

VI. Leak Detection Map

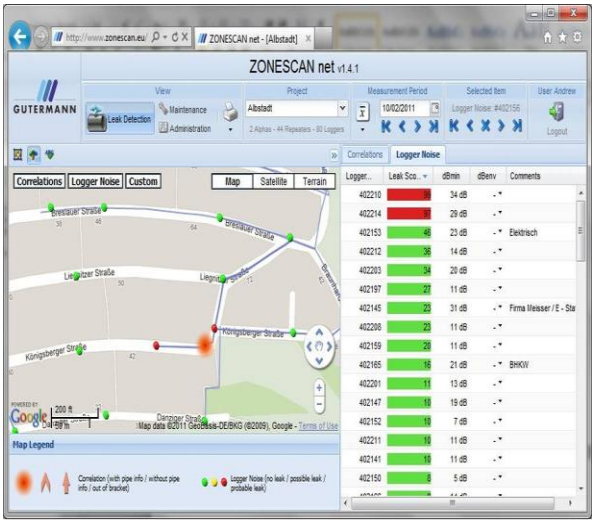

Figure 7 GUTERMANN Cloud Services

1 Map Area

The Map Area contains a map by *Google Maps* with the area of the selected project. Use the buttons located above the map

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to execute various functions which vary depending on 2 "View" - Leak Detection or Maintenance. For an explanation of the individual functions, hold the cursor over the button. The buttons in the upper part of the map can be used to display and hide individual elements of the map. Depending on 2 “View" - Leak Detection or Maintenance - the correlations, leak values and custom or alpha, repeater, logger and custom fields are displayed. Changes made here affect the view in 6 "List Area". By default, a legend is displayed in the lower part of the map.

2 View

In View, you can switch between Leak Detection, Maintenance and Administration. Use the printer drop-down menu to print the screen, the map, correlated leaks or the leak values.

3 Project

In the Project menu bar, the user can select the desired project via the drop-down menu.

4 Measurement Period

The measurement period can be changed in the drop-down menu. Select from 5 days, 30 days or an entire month. The current setting is displayed at the right.

5 Selected Period

Use the blue arrow buttons to change between the individual values in the list area. The current selection is displayed in the upper area.

6 List Area

In List area, the user finds all data relevant for the evaluation.

7 Logout Button

The user logs out with the logout button

Leak Detection Report:-

Correlations

Quality	Location	Logger 1	Logger 2	Dist. L1	Dist. L2	Center Dist.	Pipe Len.	Comments
100	Unnamed Road	4400022	4400025	614.2 m	645.0 m	-15.4 m	1,259.2 m	
100	Unnamed Road	4400022	4400023	0.0 m	1,477.6 m	-983.9 m	987.5 m	
100	Unnamed Road	4400022	4400030	873.5 m	851.4 m	11.1 m	1,724.9 m	
100	Unnamed Road	4400023	4400024	278.1 m	258.1 m	10.0 m	536.2 m	
100	Unnamed Road	4400023	4400025	134.3 m	137.5 m	-1.6 m	271.8 m	
100	Unnamed Road	4400024	4400025	392.0 m	415.3 m	-11.6 m	807.3 m	
100	Coastal Rd	4400027	4400030	0.0 m	1,339.4 m	-830.2 m	1,018.4 m	
100	Unnamed Road	4400030	4400032	387.1 m	391.4 m	-2.7 m	778.6 m	
89	Coastal Rd	4400027	4400032	33.6 m	804.3 m	-488.0 m	837.9 m	
59	Unnamed Road	4400022	4400024	766.1 m	0.0 m	536.9 m	458.4 m	

Logger Noise

Leak Score	Location	Logger	Min. Noise	Comments
25	Unnamed Road	4400032	30.5	
24	Coastal Rd	4400027	38.0	
18	Unnamed Road	4400030	33.5	
8	Unnamed Road	4400022	23.0	
4	Unnamed Road	4400025	11.5	
0	Unnamed Road	4400023	3.0	
0	Unnamed Road	4400024	0.0	

VII. CONCLUSION:

Water for domestic purposes is always very essential and it is mandatory to prevent it from getting wasted due to any pipeline leaks. Hence the designed prototype is an effective solution for monitoring the flow of water as well as detecting for leaks in the pipelines. By using this technology the following can be achieved

- Reducing the leak run-time.
- Reducing the manpower required to perform leakage surveys
- Reducing the manpower required to pinpoint leaks
- Identifying and repairing small bursts before they become large incidents
- Finding some customer side leaks improves customer relations
- Improved knowledge of the water distribution network and its problem areas.
- A fast and effective solution for reducing water loss.
- Can be monitor from access from any location.
- Leak prediction and Leak Alarming

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