Leakage and Blockage Detection for Water Pipelines

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Abstract

Leakage is usually the major cause of water loss in water-distribution systems. To minimize public health risk and economic loss and to conserve water, utilities regularly audit their distribution systems and conduct leak-detection surveys. When pressurized water leaks out from the cracks in the pipe, there will be loss of energy in the water. Some of this energy is transformed to noise, which spreads in all directions through soil and some of this noise reaches the surface. Some noise spreads longitudinally through the pipe and through water in the pipe. These leakages and blockages are detected by digging and checking for cracks on the entire length of the pipe which wastes a lot of time and resource. This problem can be solved by using a detector comprising of different sensors attached to a cable that will detect the leakage and the blockage in water pipelines.
Keywords: leakages and blockages, detector, sensors

I. INTRODUCTION

The water pipeline is always laid underground at the depth varying from 30cm to 90cm in India. Whenever the cracks in the pipe occur, the water travels to the surface indicating the leakage in the pipeline. As the water takes any favorable path to the surface, we cannot locate the exact location of crack in the pipe which is sometimes far from the water on the surface. Sometimes high amount of dirt and unwanted objects like roots of the trees that penetrate through these pipes tend to block the water supply.In order to locate this crack and the blockage, Public Works Department has to dig and check for cracks on the entire length of the pipe.

Presently the leakage detection is done by using the Japanese technology called JICA leakage detection which is not favorable in India. JICA technology is based on detection of cracks in pipelines from above the surface of the ground/road. In Japan, the pipelines are laid closer to the surface hence making it easier for the use of JICA. But in India, the depth of the laid pipeline varies from place to place and hence JICA cannot be used in India.

To overcome this problem, SAHARA came up with a setup which successfully detected the location of cracks and blockages in pipelines but at a cost of around 12crores which made it difficult for Indian government to use it nationwide. It even has a disadvantage of its huge size.

A more economical solution could be making a detector that includes different sensors like hydrophone and camera attached to a cable. When this device is inserted it will travel along the length to and fro of the pipe and will be able to detect the cracks, leaks and blockages and display the exact location of the crack and the cause of blockage on the display screen.

II. BLOCK DIAGRAM

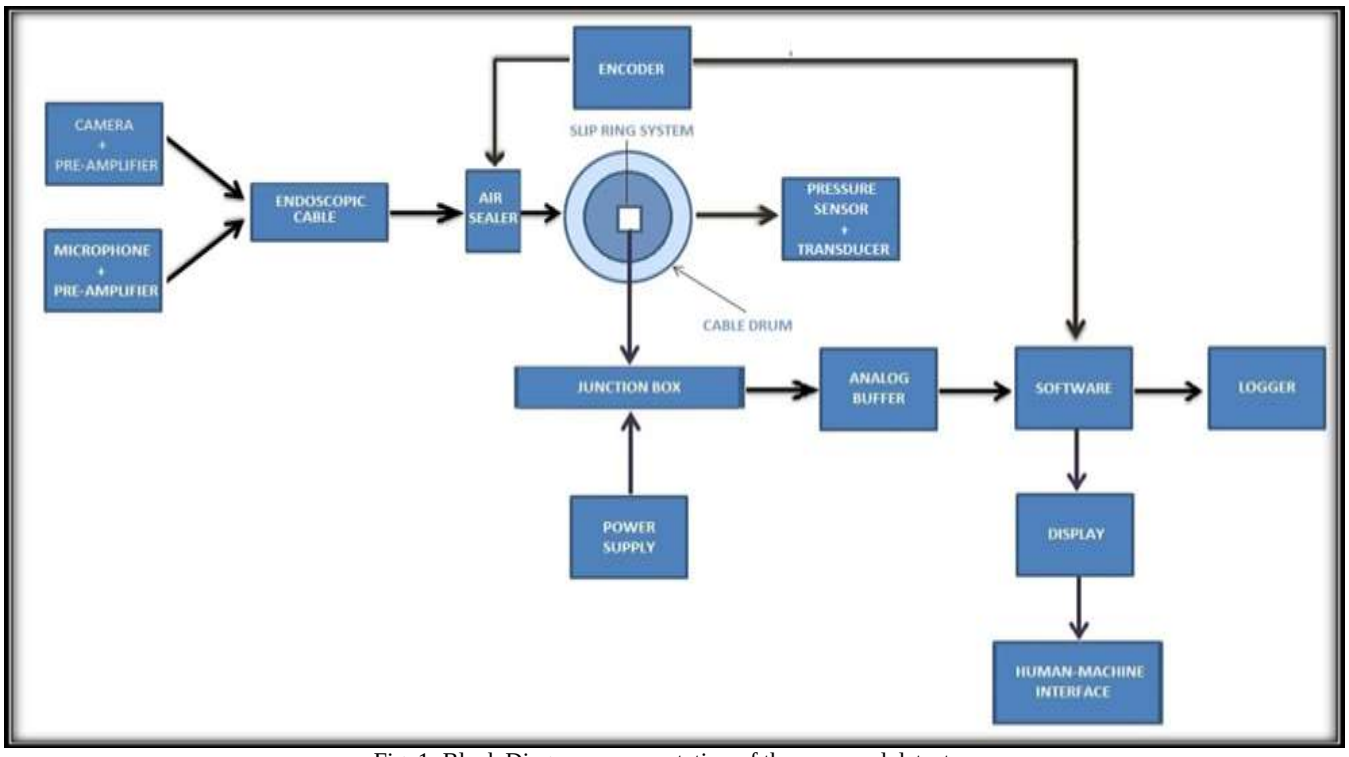

Fig. 1: Block Diagram representation of the proposed detector.

The block diagram in Fig.1. shows the input side consists of a noise sensing hydrophone and visual sensor camera. The endoscopic cable will be consisting of transmission cable of camera and hydrophone. The cable length will be wound over the cable drum. The slip ring will help us to unwind the cable.

The power input will be given by the power supply generator (Inverter+ battery, 230 V, 1000W). The power signals will be separated from other signals using a junction box. The USB driven output will be taken on the laptop where it will be processed and displayed on the screen. Logger is a retractable drive which will store the history.

When we will insert the device in the pipe for crack detection, the encoder present near the air seal will measure the length of the cable inserted inside the pipe. This will also indicate the location of the crack. Air seal will be used to protect water from gushing out of the manhole from where device will be inserted inside the pipe.

III. DESIGN AND DESCRIPTION

A. Hardware Design:

The input side consists of a noise sensing hydrophone and visual sensor camera. Hydrophone will capture the noise present at the crack. The camera will capture the position of the crack on the pipe's circumference. When we will insert the device in the pipe for crack detection, the encoder present near the air seal will measure the length of the cable inserted inside the pipe. This will also indicate the location of the crack.

There will be inbuilt preamplifiers in the camera and hydrophone for 5 meters of transmission cable. The endoscopic cable will be consisting of transmission cable of camera and hydrophone. The endoscopic cable will be made up of PFA material. The cable length will be wound over the cable drum. The slip ring will help to unwind the cable.

The power input will be given by the power supply generator (Inverter+ battery, 230 V, 1000W). The power signals will be separated from other signals using a junction box.

B. Software Design:

The software part involves acquiring the data from the rotary encoder via inbuilt analog to digital convertor of the Arduino UNO development board which uses Atmega328 Microcontroller and processing it to display the exact location of the leak. The rotary encoder generates pulses as the rotary wheel is rotated in any direction.

IV. IMPLEMENTATION

A. *Hardware Implementation:*

Camera and hydrophone were encapsulated in a waterproof acrylic case which was propelled inside the pipeline using pressurised water. The outputs from these sensors were displayed on laptop. The encoder was coded to measure the length of the cable inserted inside the pipeline which in turn gives the location of crack. The endoscopic probe was inserted with the help of slip ring.

B. *Software Implementation:*

The code to acquire data from the encoders is developed using the Arduino UNO which uses C++ language. Each pulse generated by the rotary encoder corresponds to a particular length of the pipe.

V. CONCLUSION

Our device will detect the leakage in water pipelines. When the device is inserted it will travel along the length to and fro of the pipe and will be able to detect the cracks or leaks and display the exact location of the crack.

It can be used to detect blockages and display the cause of blockage on the display screen. It can be also used as feedback to check if the leakage still exists after the repair.

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