



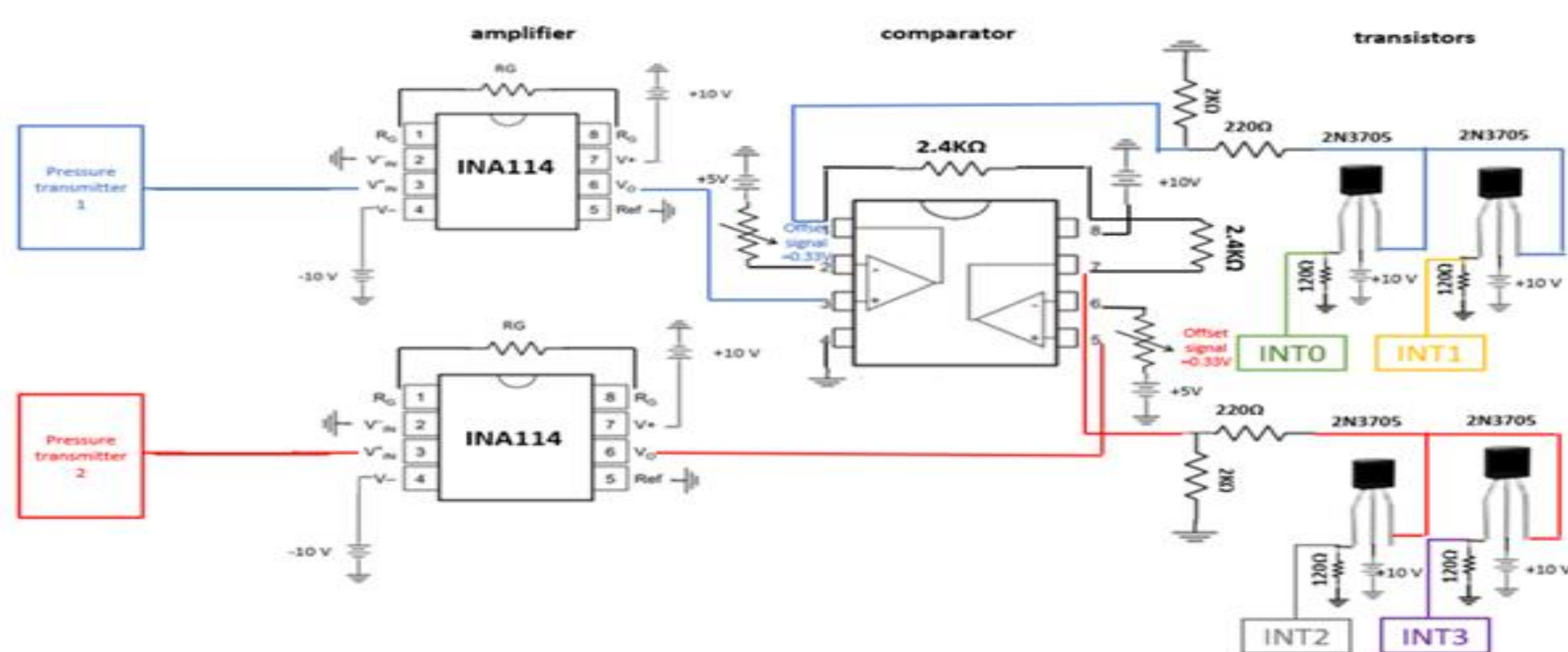
Design of an Online System to Detect Water Leak Underground Using Zero-Crossing Correlation with the Aid of Pressure Transmitters

Abstract

This project focuses on designing an online system that aims to detect and locate desalinated water leakage in the underground piping networks using pressure transmitters and applying zero-crossing correlation to their signals, which is a more efficient algorithm that requires less processing power and storage from the processor. The project has two stages: designing a circuit to interface the system to the microcontroller and programming the microcontroller to apply the zero crossing-correlation.

Design and Implementation

In this project the leakage signal picked up by the pressure sensor is further sent to a designed signal conditioning circuitry that involves three stages amplifying, converting to a square wave, to lastly interfacing it with the microcontroller.



Zero cross-correlation code is written in PIC 32 microcontroller by employing interrupts for detecting the change of state in the signal to save the timer readings on the rising and falling edges of the signal which is used in the coded operation of the zero cross-correlation to find the delay between the signals in order to locate the leakage.

Conclusion

The method of applying zero cross-correlation on the leakage pressure signals proved to be a reliable technique for detecting and locating the leakage in pipping networks.

An interface between the pressure signal and the microcontroller was done successfully by building the designed circuit and accurate results were obtained when performing the zero cross-correlation algorithm on the signals.

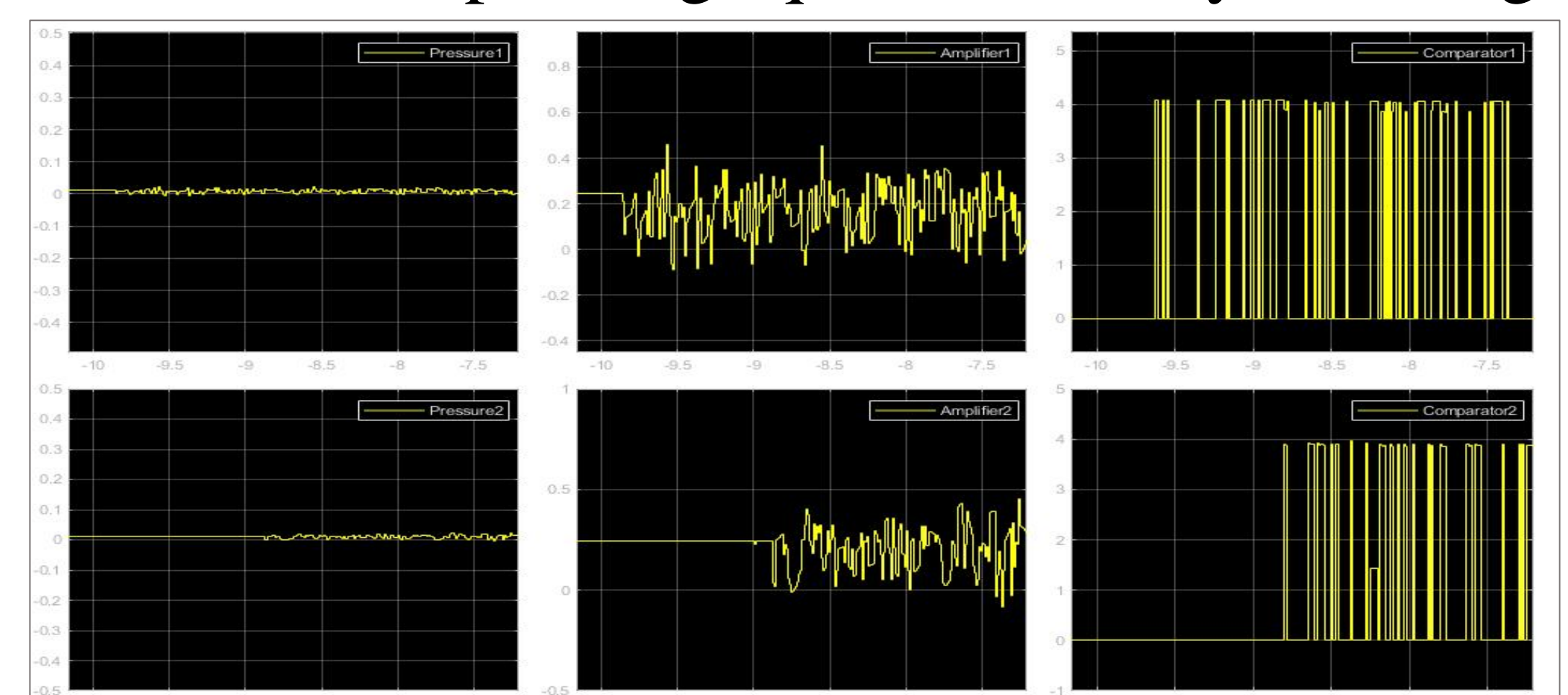
Objective and Motivation

Water loss can come from a variety of causes, but one of the most significant is leakage, it has been reported to reach 30% of total water supplied in some countries. Ordinary cross correlation-based water leakage detection systems require huge amount of storage alongside advanced processing power to perform their work. This is motivating us to design an optimized online system to detect water leak points underground with the aid of pressure transmitters to attenuate the effects of this problem economically as well as environmentally.

The main purpose of this project is to find a solution for detecting and localizing leakages that occur in underground desalinated water piping networks by modifying the leakage pressure signal properties and sending it to the microcontroller where zero cross-correlation function is applied to it to calculate the leakage point location effectively.

Results

The leakage pressure signals from the pressure transmitters are converted to the corresponding square waves by the designed circuit.



The table below shows the results from applying the zero crossing-correlation on the four leak signals.

	Actual distance (m)	Measured distance (m)	Percentage of error	Actual error (m)
Leakage 1	5.16	5.58	8.14%	0.42
Leakage 2	8	7.33	8.37%	0.67
Leakage 3	12.66	12.79	1.03%	0.13
Leakage 4	15.5	15.52	0.13%	0.02

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