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High Accuracy (by Direct Sequence Spread Spectrum Technique) Level Measurement using Non-Contact Capacitance type Level Transducer for Conducting Liquid

Karunamoy Chatterjee [1], Subhashis Das [2]

Abstract- In this paper, an attempt has been made to design a high accuracy level measurement system for conducting liquid using direct sequence spread spectrum technique with the help of non-contact capacitance type level transducers. Here the sensor is in the form of uniform circular cylinder made of insulating material like glass, ceramic, plastic etc. The sensor is connected with the metallic or non-metallic type liquid storage tank, in which the conducting liquid column is taken as one electrode and a non-conductivity wound short-circuited outside coil is taken as other electrode of a variable capacitor, the change in capacitance due to the change in liquid level is measured. But the accuracy of the level measurement is the vital part of the measuring instrument. The technique of Direct Sequence Spread Spectrum (DSSS) claims its novelty over other to get high accuracy. In this technique the signal coming out of the level sensor (Non-contact capacitance-type) is put down below the white noise level and then amplified and is finally converted into digital form. Subsequently, the digital signal is input to the micro controller thus the data is transmitted accurately.

Index Terms- level measurement for conducting liquid, direct sequence spread spectrum technique, accuracy, non-contact, level transducers

I. INTRODUCTION

To accurately indicate the level of a process without extensive operator involvement, a level indicator system relies upon a transducer, which accepts a level, such as a capacitive (Contact or Non-contact-type) as input. When the level sensor detects the external level of a liquid, it produces a weak current. The weak current is passed through AD7730 that has the PGA (Programmable Gain Amplifier), A/D converter and the two stage digital filter into digital signal**.** The micro-controller (8031) transfers the detected digital signal to the communication unit and the display unit according to the procedure set on the memory. In the practice, the micro-controllers using general algorithms cannot meet higher accuracy. This paper, we present the comparison between the proposed digital filters in PC and the other filters which can achieve the main features the level measuring system needs.

II. REVIEWS AND OVERVIEW

The main constraint in achieving higher accuracy is a superimposed noise on a useful signal from the temperature control system**.** The common sources are: (1) constant values (2) the noises: electromagnetic pick-up, power harmonic, thermally unstable circuits and the gain programmable by software (through PW's output of the micro controller) (3) Level sensor (i.e., Capacitive level sensor**).** The common sources are amplified before transferred into the *A/D* converter, and therefore the noise is amplified and an error is introduced in the system. A signal processing module (SPM) acquires the electrical signal from the level sensing device and estimates a value of level .The two main aims for improvement are increasing the Speed of sensing the level variation and achieving good measurement accuracy. Improvement in SPM that provides any one or both aims brings significant benefit to the overall level monitoring system.

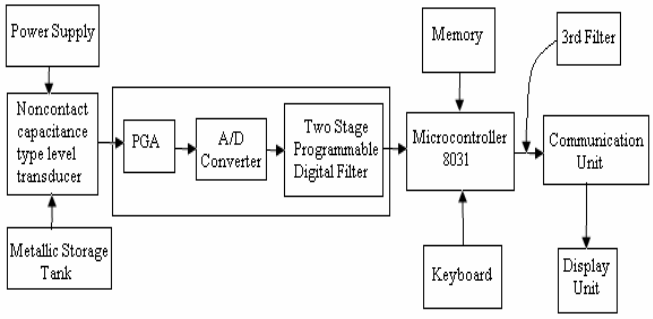

Fig.1 Signal processing module and Level measurement

III. PRINCIPLE OF THE SENSOR

The level-sensing probe consists of a uniform hollow cylinder made of insulating material like glass, ceramic, PVC, Teflon, etc. The cylinder is connected with a metallic storage tank as shown in Fig 2. The insulating material of the sensing cylinder is taken as the dielectric of the cylinder capacitor, whereas the conducting liquid column inside the cylinder is taken as the grounded electrode of the capacitor because the liquid is generally stored in a metallic grounded vessel. Thus the vessel itself may be taken as one electrode of the capacitor, whereas an outer double-layer non-inductively wound short-circuited coil may be taken as the other electrode of the capacitor. In as much as the coil is short-

circuited, all the turns will be as the same potential, and the inter winding capacitance and the inter layer capacitance of the coil may be assumed to be negligible. Moreover, the short-circuited outer layer coil and the short-circuited inner layer coil have the same conducting material, and hence the effect of the inner layer coil on the capacitance of the whole two-layer coil with respect to the liquid column may be ignored. Thus, the capacitance between the liquid column and the short-circuited non-conductively wound two layer coil may be assumed to be equivalent to the capacitance between the liquid column and only the outer layer of the column.

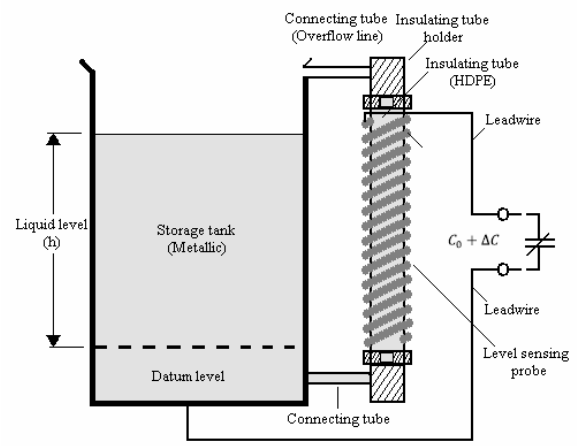

Fig. 2 Non-contact capacitance-type level sensor in a metallic storage tank

IV. DESIGN METHOD

In Fig.3**,** the amplitude spectra reveal the significant noise components of the Level measurement system. The first peak is centred at approximately 2.2Hz**,** and the second and third peaks appear to be integer multiples of this noise. Hence we can assume that there are no significant harmonic components beyond 40Hz**.** Therefore any sampling rate selected must be greater than 80Hz. In order to reject the high-frequency random oscillatory component in the circuit, there **is** always a RC low pass filter in the output of the circuit. This kind of filters can restrain high frequency noise, but its effect on low frequency noise is few. Digital filters are ideal for the treatment of low frequency noise. They can be implemented in real time or as post-processed applications. Then, we present [1] Moving average filter algorithm [2], LMS adaptive filter algorithm [3], conventional FIR filter algorithm discusses the development of a micro-controller based measurement system. A low cost non-contact type capacitive transducer can give accurate level.[4], In particular, the focus is on using digital filtering techniques to remove measurement noises from the extremely low frequency noise of the temperature control System.

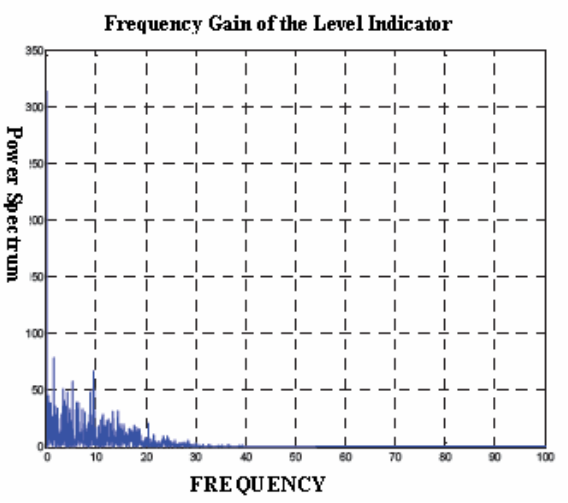

Fig.3. Noise spectra of Level Indicator system

Hence DSSS in the measuring system is proposed. The main difference is that we use a very important PN code to shift the noise to high frequency and we use different procedures to apply new DSSS**,** as shown in the of Fig.**4.** After shifting the noise to high frequency, we can use the filter with 9 taps to filter the noise.

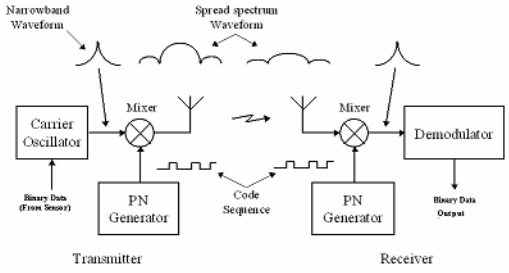

Fig.4 DSSS Block Diagram

With this novel method, the proposed DSSS filter algorithm used in level control system can meet the requirements of speed, stability, and precision.

V. CONCLUSION

In the Level measurement systems conventional filtering method employed have limitation in improving the accuracy and in throughput rate. In this case, an alternative technique has been explored to find a solution. It will enable measurement accuracy to be 1/172000. The result shows that new DS/SS filter can be employed in a practical system. The basic material for making level sensor is simple glass tube and enamelled copper wire and the filtering circuit involved semiconductor devices. From the experimental study, the repeatability, linearity, and resolution are satisfactory within the tolerable limit of industrial level measurement.

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[1] **First Author** – Karunamoy Chatterjee, Dept of Electronics & Communication Engineering, Bankura Unnayani Institute of Engineering,Pohabagan, Bankura, India, Pin-722146, karuna_ds@rediffmail.com

[2] **Second Author** – Subhashis Das, Dept of Electronics & Communication Engineering, Bankura Unnayani Institute of Engineering,Pohabagan, Bankura, India, Pin-722146, subhashis_32@yahoo.co.in