

Development of Intensity Modulated Fiber Optic based Liquid Level Sensor

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Abstract - In this paper the novel design of intensity modulated fiber optic based liquid level sensor is reported. This reported sensor structure consists of two optical fibers, reflector and float. Two optical fibers were used for the transmission and reception of light. A reflector was used for the reflection of light and is placed on the float. The movement of float is directly proportional to the level of liquid. As the liquid level increases, the float moves towards the fiber probe. Therefore the distance between fiber end and reflector reduces i.e. the light on a receiving fiber area decreases. The output voltage of the photo-detector is inversely proportional to the liquid level. The sensitivity of 4.1406 volts per mm is achieved using this sensor. The measurement of liquid level up to 2mm is possible with this sensor structure.

Keywords- intensity modulation; liquid level; optical fiber

I. INTRODUCTION

The optical fiber sensor has many advantages like non-contact measurement, small size, and immunity to electromagnetic interference. Due to the advantages of fiber optic, these sensors have been used for the measurement of liquid level in harsh environments [1-3]. There are two types of fiber optic liquid sensor like intrinsic and extrinsic. In intrinsic type of fiber optic liquid level sensor, the property of total internal reflection with respect to the cladding is used. The point measurement of liquid level can be done using intrinsic type of sensor [4-9]. There are various types of sensor configuration used for the measurement of liquid level [10-14]. There are several applications of fiber optic based liquid level sensor like measurement of fuel quantity in aircraft fuel tanks [15]. The wavelength modulation based fiber optic sensors are also used for the liquid level measurement. The fiber Bragg grating based sensors are based on the wavelength modulation of light [16-18]. The fiber-optic displacement sensor is also used for the continuous monitoring of the liquid level [19].

In this paper, a novel design of intensity modulated fiber optic based liquid level sensor is reported. The sensor structure consists of two optical fibers, reflector and float. The principle of operation of this sensor depends on the intensity modulation of light. The received intensity by a receiving fiber is a function of liquid level in the beaker.

II. SENSOR STRUCTURE

The structure of intensity modulated fiber optic based liquid level sensor is as shown in figure 1. In this sensor structure, two optical fibers, reflector and float was used. Two optical fibers were used for the transmission and reception of light and a reflector was used for the reflection of light. A reflector was placed on the float. As the liquid level in the beaker changes, the position of float was also changed. The fiber optic sensor probe is fixed at some distance. The reflector changes its position vertically with respect to the liquid level.

The developed structure of intensity modulated fiber optic based liquid level sensor is as shown in figure 2. The two identical optical fibers having core diameter of 1mm and

numerical aperture of 0.5 was used. The flat mirror is used as a reflector.

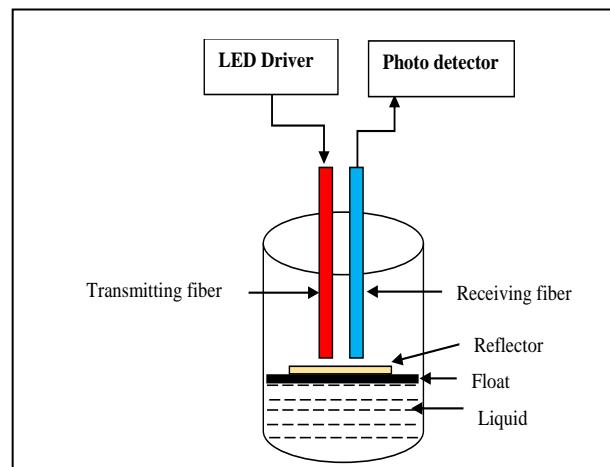


Fig. 1. Structure of intensity modulated fiber optic based liquid level sensor

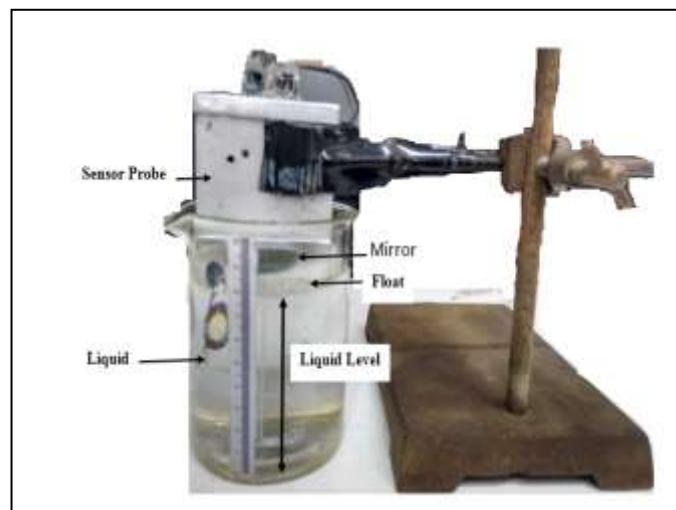


Fig. 2. Development of intensity modulated fiber optic based liquid level sensor

III. EXPERIMENTAL RESULTS AND DISCUSSION

The experimentation for intensity modulated fiber optic based liquid level sensor is performed using the developed sensor structure. For the experimentation, plastic optic fibers having core diameter 1mm and numerical aperture of 0.5 is used. The spacing between transmitting and receiving fiber is 1mm.

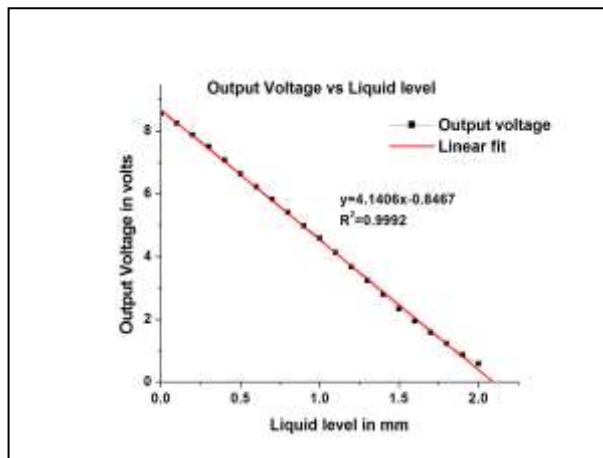


Fig. 3. Experimental results of intensity modulated fiber optic based liquid level sensor

As the liquid level changes the position of the float is also changes in vertical direction. The received intensity by receiving fiber is a function of liquid level. As liquid level in the beaker increases then the float moves towards the fiber probe i.e. the light on the receiving fiber is decreases. Therefore the output voltage of photo-detector decreases as the liquid level increases. The white color light emitting diode is used as the source and the L14G3 photo transistor is used for the detection of light. The experimental results of the intensity modulated fiber optic liquid level sensor is as shown in figure 3. The sensitivity of 4.1406 volts per mm is achieved using this sensor. The measurement of linear liquid level up to 2mm is possible with this sensor structure for $R^2=0.9992$. Due to the maximum sensitivity of sensor, this can be used for the precision measurement of the liquid level.

IV. CONCLUSION

In this paper the novel structure of intensity modulated fiber optic based liquid level sensor is reported. The linear liquid level range up to 2mm and the maximum sensitivity of 4.1406 volts per mm is achieved. This sensor structure can be used for the precision measurement of the liquid level.

ACKNOWLEDGMENT

The author SMM wish to thank University Grant Commission, New Delhi for funding the research.

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