CONTROL OF FIRING ANGLE OF CONVERTER USING CAPACITIVE HUMIDITY SENSOR

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ABSTRACT

The theme of the paper is to design and implement a low cost simple humidity controlled firing circuit for single phase line converter.The necessity of getting synchronized firing pulses for the gate of the thyristor is discussed.In this paper,we fabricate one thin film parallel plate capacitive humidity sensor by using chemical route like sol-gel and one hardware phase detection electronics circuit interfaces the humidity sensor with an aim to control and monitor the humidity.The triac controlled out put power is applied to the hair drier.The experiment show the variation of the load available to the lamp load with humidity.

Keywords: *Humidity sensor, sol-gel method, triac, load power control.*

INTRODUCTION

Silicon controlled rectifiers (SCRs) are widely used as switching device for controlling different type of electrical loads ranging from watts to several kilowatts. Although other devices like MOSFETs and insulated gate bipolar transistor (IGBT) have faster switching operation but the lower cost and higher operating voltage of thyristor make SCR a better choice even today particularly for line commutated converter application[1]. In the recent times, dehumidification is being increasingly used for treating fresh air for indoor air quality (IAQ) needs. Thermal decision provided for the data centre is based on the assumption that the thermal environment is comfortable for the personnel would also be the preferred environment for computer equipment, but when the entire facility is predominating for house electronics then a different temperature is more appropriate. One of the challenges for refrigerated computing is the moisture content of air that leads to condensation of water and malfunctioning of the electronics [2]. Using desiccant system that is already on the market, it is possible to suppress the dew point at -40°C so that moisture condensation is not an issue but it requires troublesome maintenance of drying agent used in dessicant. Dehumidification is also essential for preservation of food in cold storage. To make the dehumidification automatic at desired humidity range, the operation of dehumidifier can be suitably controlled by controlling the firing angle of converter through humidity sensor. In this paper we have designed a low cost simple humidity controlled firing circuit for single phase line converter. One thin film interdigital capacitive humidity sensor has been fabricated by

following a simple low temperature chemical route like sol-gel method. The pore morphology of the γ-Al_2O_3 sensing film was properly made to have desired response characteristics of the sensor. A signal conditioning circuit based on phase detection principle was then developed to interface the capacitive humidity sensor with an aim to monitor and control the humidity. The sensor has been used to measure humidity in the range of 10 to 98% RH. Ultimately the sensor is used to control the power of electrical load which can be useful for dehumidification process.

FIRING ANGLE CONTROL OF LINE CONVERTER USING RH SENSOR

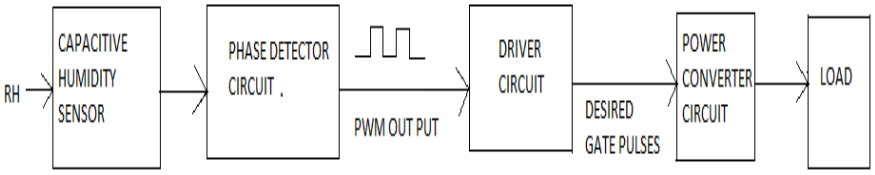

FIGURE 1. Schematic block diagram of the scheme.

The object of this scheme is to control the power input of an electric load through humidity sensor. Fig. 1 shows the block diagram of the scheme. When the humidity sensor is exposed to the humidity, the capacitance value of the sensor changes, the change in capacitance causes the change in pulse width of the pulse wave modulated output of the phase detection circuit. The output of the electronic circuit is given to power driver circuit and then applied to the gate of the line converter through pulse transformer. Thus the firing angle of the converter changes according to the humidity of the ambient. Since the output power available to the load depends on the firing angle, the power input to the load will vary according to the humidity

EXPERIMENTAL RESULTS

The capacitive humidity sensor has been fabricated by coating a thin film of aluminium oxide on interdigital parallel electrode. The coating solution has been fabricated by sol-gel method [3-4]. Fig. 2 shows the photograph of the sensor. The phase detection signal conditioning circuit has been implemented on breadboard. The senor was placed in humidity controlled environment where humidity is varied by saturated salt solutions. Fig. 3 shows the voltage response of the sensor in presence of different level of percentage relative humidity. It shows that as the humidity increases voltage level of the sensor increases. The output change is nonlinear, which is the common nature for the sensor which works on adsorption and desorption principle [3-4]. The traic controlled output power is applied to a hair dryer. Fig. 4 shows the variation of the load available to the lamp load with humidity. It shows in the Fig. 4 that as humidity level increases the power available of the load decreases significantly.

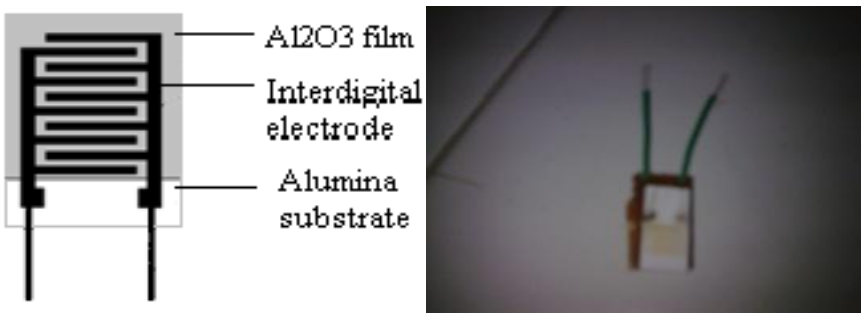

FIGURE 2. Photograph of the capacitive sensor.

CONCLUSIONS

In this work effort has been made to fabricate an interdigital capacitive humidity sensor using sol-gel method. We have also explored the automatic control of the phase angle of line converter using the sensor. This scheme is successfully applied to vary the power of electrical load through change in ambient humidity.

This scheme can be useful to control the humidity of an environment by controlling the phase angle of triac/thyristor.

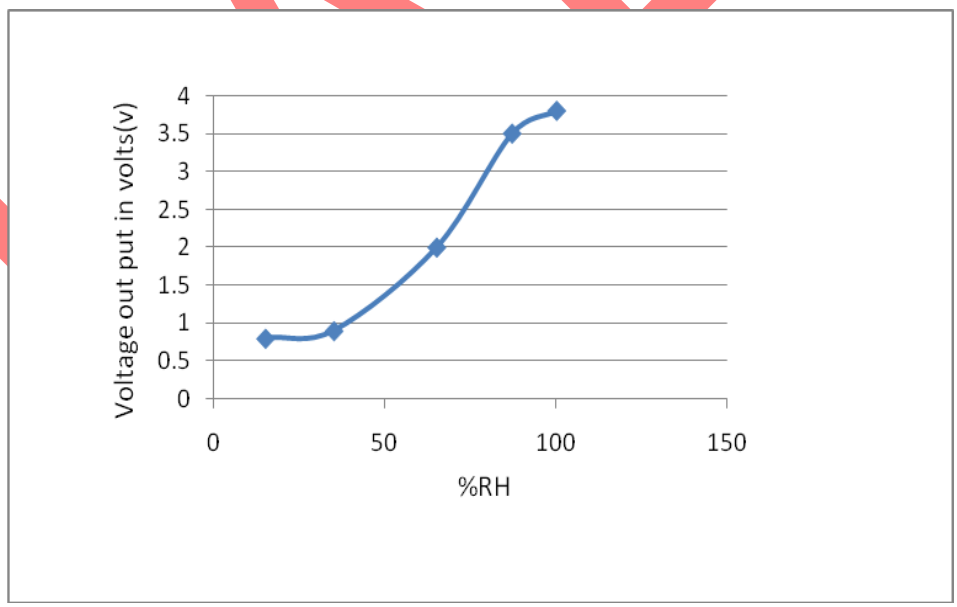

FIGURE 3. Voltage output of the sensor.

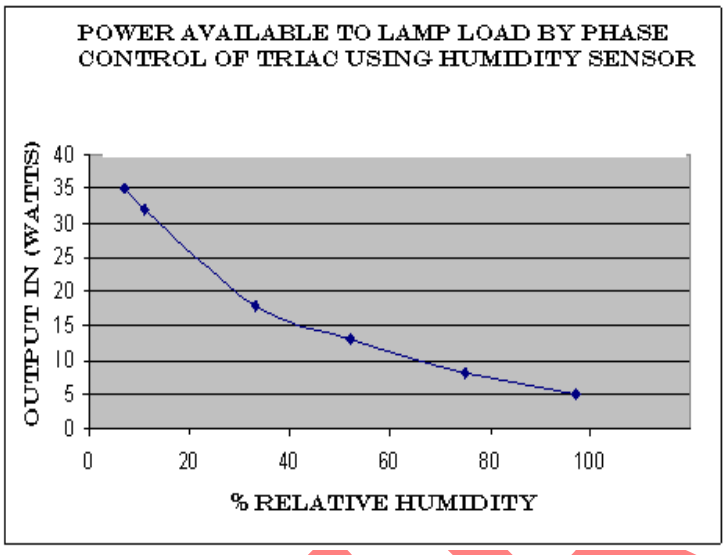

FIGURE 4. Power available to lamp load by phase control of triac using humidity sensor.

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