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NOVEL DESIGN OF LOW COST FLEX SENSOR FOR AUTOMATIC CONTROLLING OF ROBOTIC CAR

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Abstract- This paper is aimed to propose a very low cost flex Sensor, designed with daily used materials. The proposed flex sensor works due to movement of the body that changes the resistance of the sensor according to the bending position of the body. The proposed flex sensor produces different resistance values correlated to the bending radius. The proposed flex sensor can be controlled by using graphite powder with great degree of accuracy.

Index term- Graphite, Flex sensor, Robotic car

INTRODUCTION

Due to rapid growth of modern communication system, the demand of consumer changes day by day. New technical innovation is required to overcome the challenged faced by the designer and scientists to meet the requirement of consumer [1]. The merging of technology and medical science has made the task like complicated surgery by robotic arm simpler; to capture the motion of human limbs sensors can be used. Among sensors, flex sensor is very attractive for automatic control of different application (robotic arm, robotic car etc) [2-3]. Robotic application demand sensor with high degree of repeatability and reliability. Flex sensor is such a device which accomplishes their task with great degree of great accuracy [4]. In this paper a novel design of low cost flex sensor with daily used materials such as, aluminium foil, cleaning pad, banded tape, graphite powder etc is represented for automatic controlling of robotic car. This sensor consist of two conductive layer of thin copper plates or aluminium foil and abrasive cleaning pad(by 3M) with some graphite powder(work as a variable resistor) and a acetate sheet for flexibility. The proposed flex sensor is novel in comparison to [1,4] because it uses low cost daily used materials. The proposed flex sensor is also precised and accurate. The proposed flex sensor is simple and it can be easily used for automation controlling of different aurduino based robotic appliance.

MECHANISM:

The mechanism of the designed flex sensor is shown in Figure 1. The flex sensor consists of two conductive layer of copper plate or Aluminium (Al) foil (food wraping film) soldered with 10cm long wire at either end of each plate and in middle of this abrasive cleaning pad (3M scotch brite) is used as resistive material. Graphite powder (collecting from useless AA battery) is attached in the middle of the aluminium foil and medical tape is used to attach both the upper & lower Cu/Al plate and it is covered with acytile sheet or channel file sheet that can help for flexibility. The structural block diagram of the designed flex sensor is shown in Figure 2.

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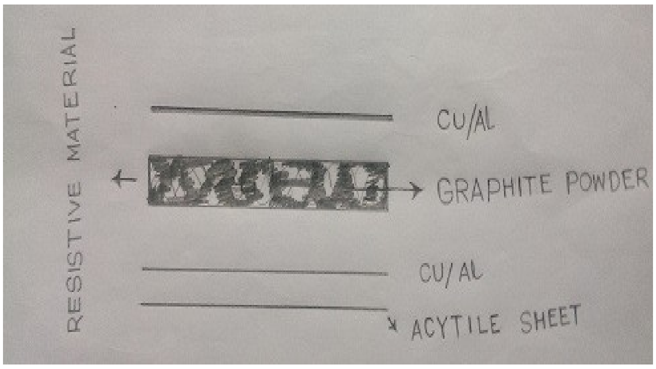

Figure: 1 Mechanism of the designed flex sensor

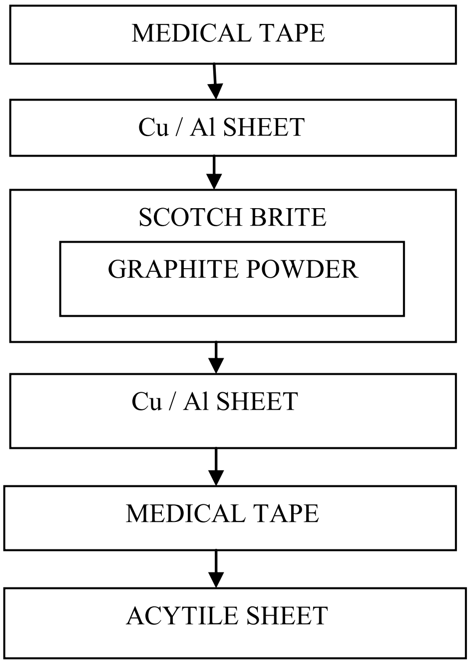

Figure: 2 Structural layout of the designed flex sensor

WORKING PRINCIPLE:

The working principle of proposed flex sensor depends upon bending phenomenon. When it is in normal condition i.e. 180°, resistance offered by it is maximum. When the sensor is bent to 90°, its resistance decreases. The resistance value decreases with further decrease in bend position. This phenomenon is validated with some numerical values. Figure 3 indicates the graphical plot of bent position versus resistance value. It is clearly seen from Figure 3 that as the bending position decreases the corresponding resistance also decreases hence conductivity increases. Finally, experimental set up of the manufactured flex sensor in application with robotic car is shown in Figure 4.

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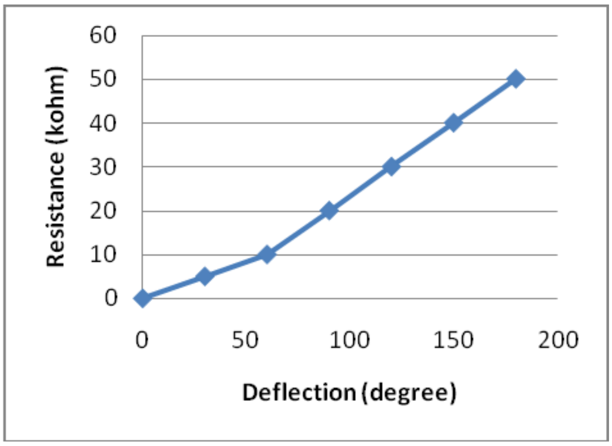

Figure: 3 Plot of resistance Vs bend position of flex sensor

Figure: 4 Experimental setup of flex sensor

MATHEMATICAL FORMULATION:

The most important things required for flex sensor is voltage divider circuit.

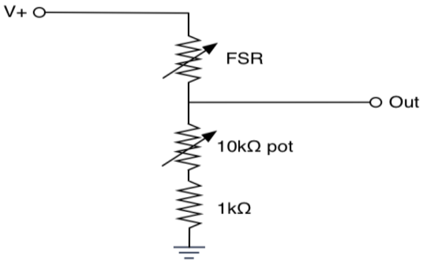

Figure: 5 Voltage divider circuit

$$V_{out} = \frac{V_{in} R_2}{R_1 + R_2}$$

V (out) =output voltage
V (in) =input voltage
R2=Resistance value
R1=Resistance of flex sensor (FSR)

The above figure 5 helps for supplying voltage according to the bending position of the flex sensor.

RESULTS & DISCUSSION:

The graphical plot of voltage measured across voltage divider circuit with corresponding bending position is given in Figure 6.

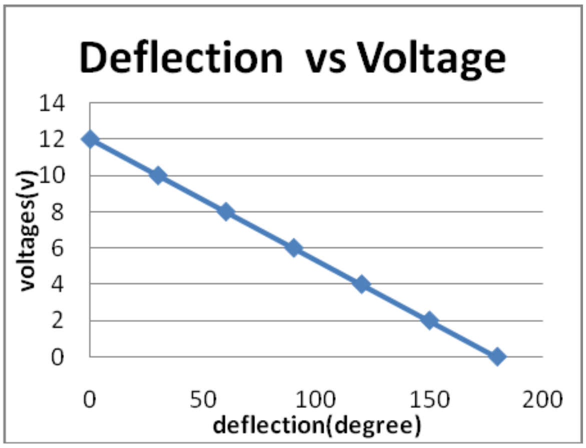

Figure: 6 Plot of bend position Vs voltage of the flex sensor

It can be seen from Figure 6 that the voltage level is minimum (approx. 0 volt) when the bending position is 180°. When the bending position is decreased to 90° its corresponding voltage increases to 6 volt. Maximum voltage of about 12 volt is recorded when the bending position is further decrease to 0° position. The graphical Plot of resistance that measured from flex sensor Vs corresponding voltage by voltage divider circuit is shown:

The variation of sensor resistance versus voltage is shown in Figure 7. As seen from Figure 7 the variation of sensor resistance and voltage is inversely proportional. That means higher the value of resistance lower is the voltage and vice versa. The maximum resistance of 40k ohm is noticed when the voltage across the voltage divider circuit connected with flex sensor is 0 volt.

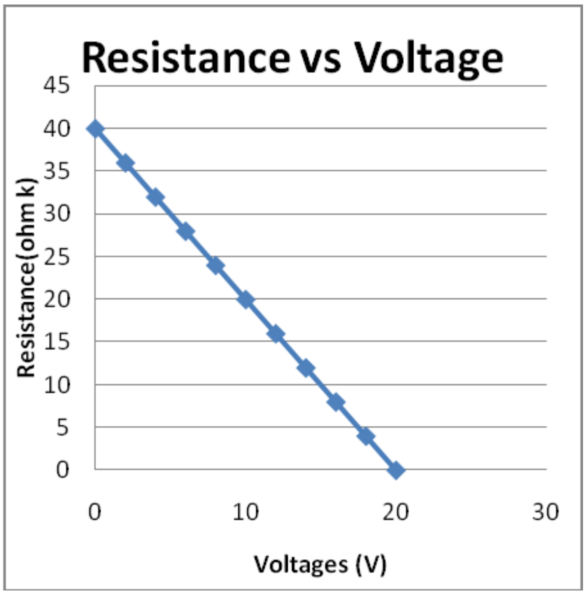

Figure: 7 Plotting of resistance Vs voltage

CONCLUSION:

The paper discussed a novel technique to design a flex sensor using daily used materials for controlling of robotic car. The proposed sensor can also be used in industrial purpose, gaming device and measuring device. The proposed sensor is much more cost effective and less complex in structure. This sensor is greatly advantageous due to its bidirectional motion control capability. so, using the proposed technology , we can

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enhance the use of conventional robots by adding human intelligence as decision are taken by operator and working capability of robots.

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