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STUDY ON RECENT DEVELOPMENT ON MEMS PRESSURE SENSORS IN BIOMEDICAL APPLICATIONS

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ABSTRACT

This work presents a new development approach of few different types of MEMS pressure sensors in the field of biomedical applications. As found in literature, micro pressure sensors are broadly categorized as piezoresistive and capacitive type. The fabrication of piezoresistive type is much easier as one can produce it by doping boron ion on silicon effortlessly. In most of bio applications, two factors like heat dissipation and smaller pressure range (500mm Hg) are becoming vital. It has been observed that MEMS capacitive based microphones allow detection of small pressure gradients. Thus, the MEMS based capacitive pressure sensors meet the design specifications for bio-related pressure measuring devices.

In our fabricated MEMS piezoresistive pressure sensor, the effect of with/without heat compensation have been studied and analyzed for biomedical applications. At first a comparative study has been made on simulated diaphragm based pressure sensors of square and circular shape on which the piezoresistive material is deposited in the form of a wire. With increase in pressure, the diaphragm is deformed due to corresponding change in the resistance of the wire. Results from the simulations and experiments clearly demonstrate a comprehensive system optimization for biomedical pressure detection applications.

ABSTRACT

The developed piezoresistive sensor compared to capacitive sensors are easy to fabricate, but are dependent of temperature variation. Hence, a MEMS based capacitive nasal sensor system for measuring Respiration Rate (RR) of human being is developed. This capacitive nasal pressure sensor has two identical diaphragms that are designed and virtually fabricated for performance evaluation. In order to measure the respiration rate the sensors are mounted below Right Nostril (RN) and Left Nostril (LN), in such a way that the nasal airflow during inspiration and expiration impinge on the sensor diaphragms. Due to nasal airflow, the designed square diaphragm of the sensor is being deflected and thus induces a corresponding change in the original capacitance. Similarly, applying the same concept a MEMS based capacitive sensor for measuring Heart Rate (HR) in human beings has been build up. In order to measure the heart rate an array of capacitive sensors are mounted on wrist in such a way that the radial artery blood flow during contraction and expansion of the heart impinge on the sensor diaphragms. Due to blood flow in the wrist artery, the designed diaphragm of the sensor is being deflected and thus induces a corresponding change in the capacitance value. Further for in-vitro analysis of human tissue MEMS based acoustic wave sensor are current being developed. The dynamic characteristics of the designed sensors show a direct correlation with real time experimental results.

Keywords:*MEMS; Diaphragm type sensor, Piezoresistive pressure sensor; Heart rate measurement; Capacitive nasal sensor; Micro fabrication; Respiration rate (RR); Heat compensation.*