

# A Low Cost CMOS Compatible MEMS Based Fingerprint Sensor Design

A. Ganesan<sup>1</sup>, S. Swaminathan<sup>1</sup>, N. N. Sharma<sup>2</sup>

<sup>1</sup>BITS, Pilani - Dubai, U.A.E.

<sup>2</sup>Mechanical Engineering Department, Birla Institute of Technology & Science, Pilani, Rajasthan, India

## Abstract

In this paper, a novel design of a fingerprint sensor composed of a 2D array of piezo resistive micro beams has been presented. When the user presses the sensor array with a finger, the ridges and valleys that compose the fingerprint induce corresponding deflections in the micro beams. These deflections can be detected by means of a resistivity change, which when used with appropriate signal processing circuits, convert the deflections into an equivalent voltage signal. The design also includes post processing circuits comprising of A/D converter, needed to digitalize the amplified signal. The digitalized outputs from individual micro beams represent the pixels of the final fingerprint image. A sample data resulting from a sensor array of (224 x 256) micro beams, each of dimensions 50 $\mu$ m x 50 $\mu$ m, has been successfully used to reconstruct an image of the fingerprint using MATLAB. The sensor along with the associated processing circuit can be realized as a CMOS circuit and the micro beams developed using front side bulk micromachining.

## Reference

- [1] K. Machida et al., Novel global planarization technology for interlayer dielectrics using spin on glass film transfer and hot pressing, *J. Vac. Sci. Technol. B* 16, pp. 1093-1097, 1998.
- [2] M. Tartagni and R. Gueneri, A fingerprint sensor based on the feedback capacitive sensing scheme, *IEEE J. Solid-State Circuits*, vol. 33, pp. 133.- 142, Jan. 1998.
- [3] D. Inglis et al., A robust, 1.8 V 250 pW direct contact 500 dpi fingerprint sensor, *ISSCC Dig. Tech. Papers*, pp. 284-285, Feb. 1998.
- [4] FingerChip FC15A140 Datasheet, Thomson-CSF Specific Semiconductors, 1998.
- [5] K. Machida et al., A new sensor structure and fabrication process for a single-chip fingerprint sensor and identifier LSI, *IEDM Dig. Tech. Papers*, pp. 887-890, Dec. 1999.
- [6] S. Shigematsu, H. Morimura, Y. Tanabe, T. Adachi and K. Machida, A single-chip fingerprint sensor and identifier, *IEEE J. Solid-state circuits*, vol. 34, pp. 1852-1859, Dec. 1999.
- [7] N. Sato, K. Machida, K. Kudo, M. Yano and H. Kyuragi, Advanced film transfer system for STP method in planarization technology, *Proc. Advanced Metallization Conc*, pp. 31-32, Oct. 2000.
- [8] H. Morimura, S. Shigematsu, T. Shimamura, K. Machida and H. Kyuragi, A pixel-level automatic calibration circuit scheme for sensing initialization of a capacitive fingerprint sensor LSI, *Symposium on VLSI Circuits Dig. Tech. Papers*, pp. 171 - 174, June 2001.
- [9] F. Parrain, Benoit Charlot, Nicolas Galy, and Bernard Courtois, CMOS-compatible micromachined tactile fingerprint sensor, *Proc. SPIE* 4755, 568, April 2002
- [10] Norio Sato, Hiroki Morimura, Masaki Yano, Kazuhisa Kudou, Toshikazu Kamei, and Katsuyuki Machida, Novel Surface Structure and Its Fabrication Process for MEMS Fingerprint Sensor, *IEEE transactions on Electronic Devices* vol. 52 pp. 1026-1032 , May 2005
- [11] Matthew A. Hopcroft, William D. Nix, and Thomas W. Kenny, What is the Young's Modulus of Silicon?, *Journal OF Microelectromechanical Systems*, Vol. 19, No. 2, April 2010
- [12] Hossain Saboonchi and Dr. Didem Ozevin, Optimization of Design Parameters of a Novel MEMS Strain Sensor Used for Structural Health Monitoring of Highway Bridges, 2011 COMSOL Conference in Boston.