

Remote and Self-Teaching Material for Sensorics: SenseEdu

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Summary:

Conventional teaching of sensors, based on lectures, static written materials, laboratories, etc., has become rather difficult at all levels of education, recently – especially during the period of pandemic. The main objective of the described material is multimedia-supported education material that teaches the theoretical physical-chemical-biological bases, operation principles and various application possibilities of classical and smart sensor devices for the next generation of intelligent systems. The new approach to teaching sensorics tries to exploit all the advantages of multimedia computer-aided teaching and remote internet availability. The course material is practically available for the technical community, for university professors for teaching and company courses on the internet and other informatics media, and has continuously been developed for many years. The lecture will highlight the structure of the course material and demonstrate the animated sensor examples.

Keywords: theory, teaching, education, internet-based learning, applications

Background, Motivation

Several e-based teaching materials were developed recently during the pandemic, that are following some formats available on the web [1,2]:

- The teacher is available in a small picture or given periods on the web
- Explanations are made with static text and figure
- A step-by-step view of the slides is needed (like with PowerPoint materials)
- Flexibility is available only with a table of content
- Tests for self-control can be added
- -> Absolute passive
- -> Nothing extra over reading a book with figures or listening to the teacher

The main specific reasons handle sensorics differently are as follows:

- Both sensor technologies and sensors' operation include dynamic processes that are difficult to illustrate and need many explanations.
- The number of sensing principles for various parameters became so large that they hardly can be included within one course

Description of the New Teaching Material

The planned new approach of teaching sensorics tries to exploit all the advantages of multimedia computer-aided teaching not only for keeping the competitiveness but also to overcome the above specific difficulties of the particular area:

- Dynamic processes and sensing effects will be illustrated by animation.
- A large amount of information could be available even though not all areas are used by everyone.
- Course users could teach themselves by selecting the particular route of their interest: the explanations from the basic sciences are connected to the material by hyperlinks.
- The course material is available for the technical community, and for university professors for teaching, and will continuously be developed on the internet and e-media.

Results

The SenseEdu material has a menu with the following headlines [3,4]:

- Introduction: basic definitions and development trends.
- Technologies: manufacturing processes (like semiconductors, thin- and thick-film technologies, ceramics, etc.)

- Structures: devices for sensors (like resistors, transistors, diodes, etc.)
- Effects: physical-chemical and biological bases of sensors operation (like piezoelectricity, Hall-effect, etc.)
- Measuring parameters (like pressure, acceleration, pH, etc.)
- Applications (including industrial, household, automotive, etc.)

The Figures. below are some examples.

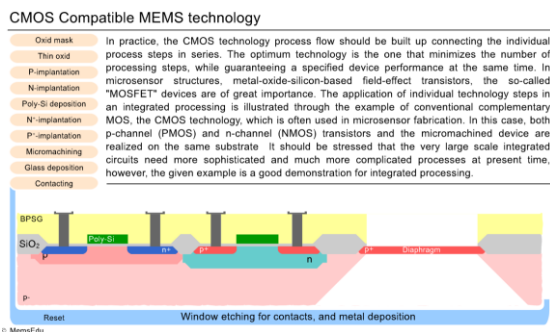


Fig. 1. Technology approach of a MEMS-compatible CMOS processing: the steps can be activated individually by pressing the buttons on the left side.

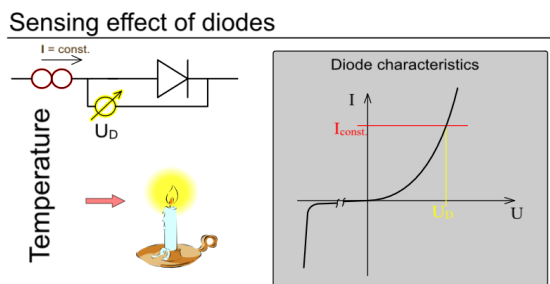


Fig. 2. General operation principle of a temperature-sensitive diode.

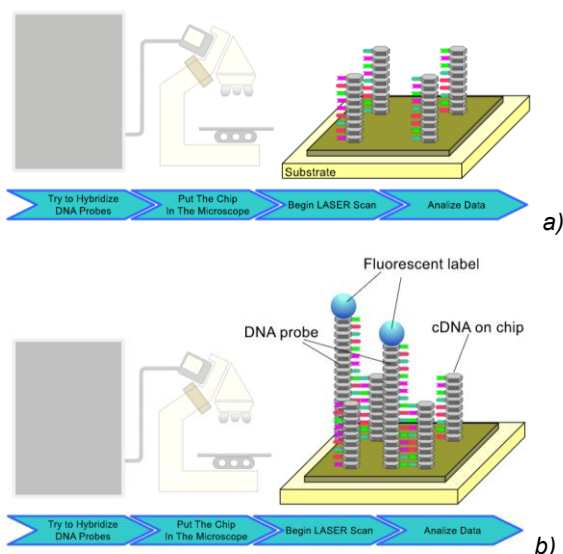


Fig. 4. Two stages of the animated illustration of the DNA chips: a) basic state, b) applying unknown DNA

sample resulting in hybridization with the matching immobilized sequences.

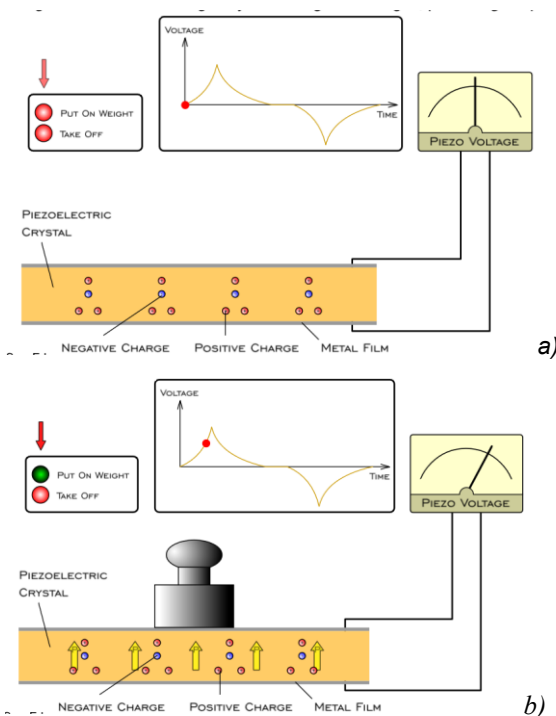


Fig. 3. Two stages of the animated illustration of the piezoelectric effect: a) basic state, b) applying force on the material, polarization and voltage impulse is generated.

References

[1] MicroElectronics Cloud Alliance, Cloud-based Teaching of Microelectronics Developed by 18 partners including Higher Education Institutes and SMEs, <http://www.ett.bme.hu/meca/EP/index.html>

[2] METIS, MicroElectronics Training, Industry and Skills, a project funded with support from the European Commission, <https://www.metis4skills.eu/>

[3] Harsanyi, G ; Lepsenyi, I ; Gordon, P ; Bojta, P ; Ballun, G ; Illyefalvi-Vitez, Z: SensEdu - An internet course for teaching sensorics, <https://harsanyi.ett.bme.hu/sensedu/>

[4] Harsanyi, G ; Lepsenyi, I ; Gordon, P ; Bojta, P ; Ballun, G ; Illyefalvi-Vitez, Z: SensEdu - An internet course for teaching sensorics, IEEE - IEEE 51st Electronic Components and Technology Conference, Orlando (FL), USA, (2001) pp. 1255-1260., doi: [10.1109/7361.987059](https://doi.org/10.1109/7361.987059)

Annotation

A preliminary paper was originally published at the conference [4] but considerable progress has been achieved since 2001.