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EDUCATIONAL PROGRAMS FOR CALCULATING THE PARAMETERS OF MEMS USING CLOUD COMPUTING

НАВЧАЛЬНІ ПРОГРАМИ РОЗРАХУНКУ ПАРАМЕТРІВ МЕМС З ВИКОРИСТАННЯМ ХМАРНИХ ОБЧИСЛЕНЬ

The paper proposes a structure for implementing of the system for calculating the parameters of microelectromechanical systems using cloud technologies. Considered the advantages of this system over existing models.

Key words: microelectromechanical systems, educational systems, cloud computing.

Запропоновано структуру для реалізації системи для обчислення параметрів мікроелектромеханічних систем із використанням хмарних технологій. Розглянуто переваги даної системи над існуючими зразками.

Ключові слова: мікроелектромеханічні системи, навчальні системи, хмарні обчислення.

Introduction

In recent decades, thanks to the rapid development of electronics and the growth of the population, is attracting an increasing number of MEMS (sensors, actuators, etc.) to be used everywhere, from cars and ending with toys, so it is important to accurately calculate parameters such sensors for further use. One of these parameters, for example, is the capacity of MEMS capacitive sensor with a circular membrane. The sensor may be imposed electrostatic pressure, and in these cases membrane will shift. During this shift capacity between the membrane and the back wall of our sensor will change, and it is important to know how much change capacity at imposing pressure on it. It is therefore very important to first determine as accurately as possible displacement of the membrane compared to the initial state, and then the capacitance between it and the back wall of the sensor. Similar problems arise in the calculation of other MEMS elements. So, in fact, the calculation of the parameters of MEMS is very important and topical area of research today [1]. Is also an urgent need to create corresponding educational programs for calculating of the MEMS parameters using the latest design technologies (cloud computing, etc.) for educational use in the preparation of specialists (masters and PhD students) in the design and research of MEMS.

Cloud computing

Modern design methods often use a number of intensive computations, which is associated with frequent use of numerical methods, which entails time-consuming. Although the time spent in the performance of these calculations can be reduced by scaling of computer technology, involving power increasing of computing components using vertical scaling, or increase of the number of computing nodes in the horizontal scaling. However, the process of scaling is quite costly in material terms is not always fast during the examination without the involvement of experts in the field, so to solve this problem is to use cloud services, which are based on the model of cloud computing. This model provides centralized hardware and software that is adapted for scaling and is available in local or global networks and may be available for use for a period of time. These features of the model allow abandoning from maintenance of hardware and software by user and reducing the cost of scaling. That was accounted during development of proposes structure of educational system for calculation MEMS parameters [3].

System structure

Fig. 1 shows the structure of system for implementation of training programs complex for calculating the parameters of MEMS using clouds. As shown on the figure, the client application gets the input parameters which after preprocessing are sent to the server where calculations are held. After completing the calculations results are saved in the DB (database) and sent to the client application, where they get to the user.

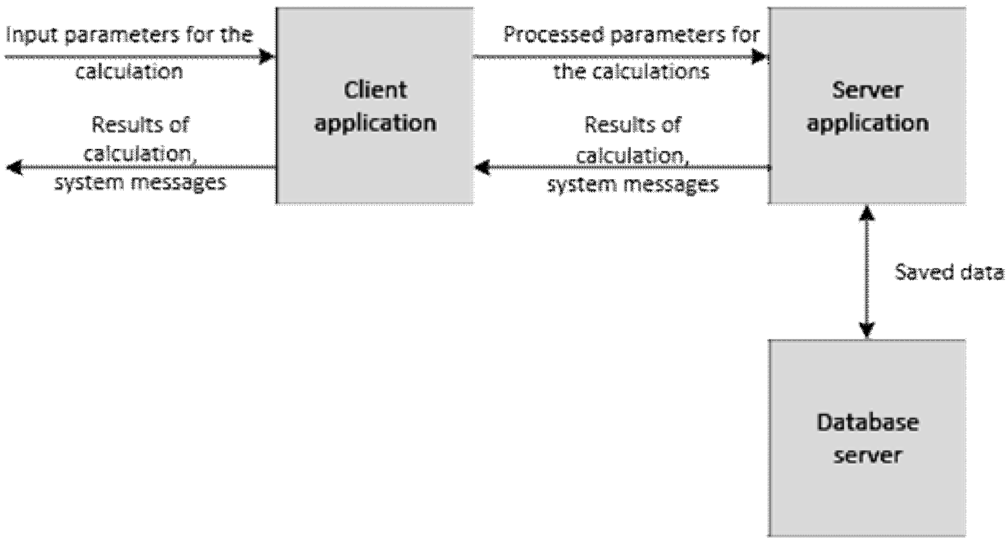

Fig. 1. Structure of complex of training programs for calculating the parameters of MEMS using cloud

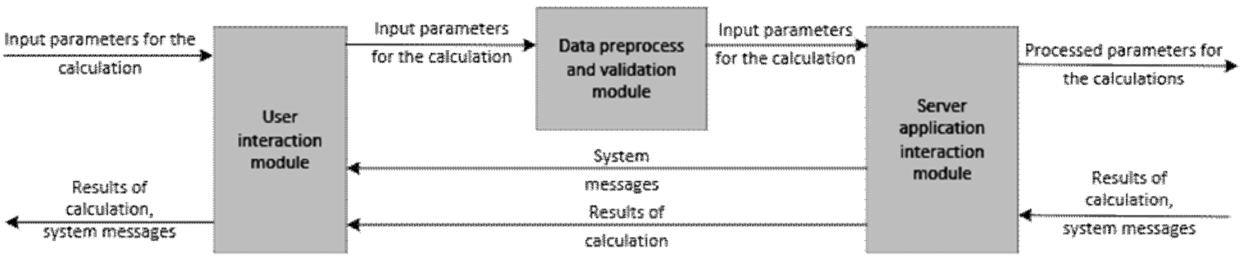

Fig. 2. Decomposition of the client system

Fig. 2 shows the decomposition of the client system. The input parameters for the calculation are sent to the module of interaction with the user, and then they go to the data preprocess module. If the data is incorrect, data preprocessing module sends a system message to the user interaction module. Otherwise, go to the server application interaction module. The calculation results are sent directly from the server application interaction module to the user interaction module.

Fig. 3 shows the decomposition of the server system. Access control module gets processed data for parameters calculation, which is determined in accordance with the priority calculation and this request is queued. Then the parameters are sent to the validation module, where they go to the computing module. After computing the data entered in the database and sent to the server application interaction module, where they are sent to the client application.

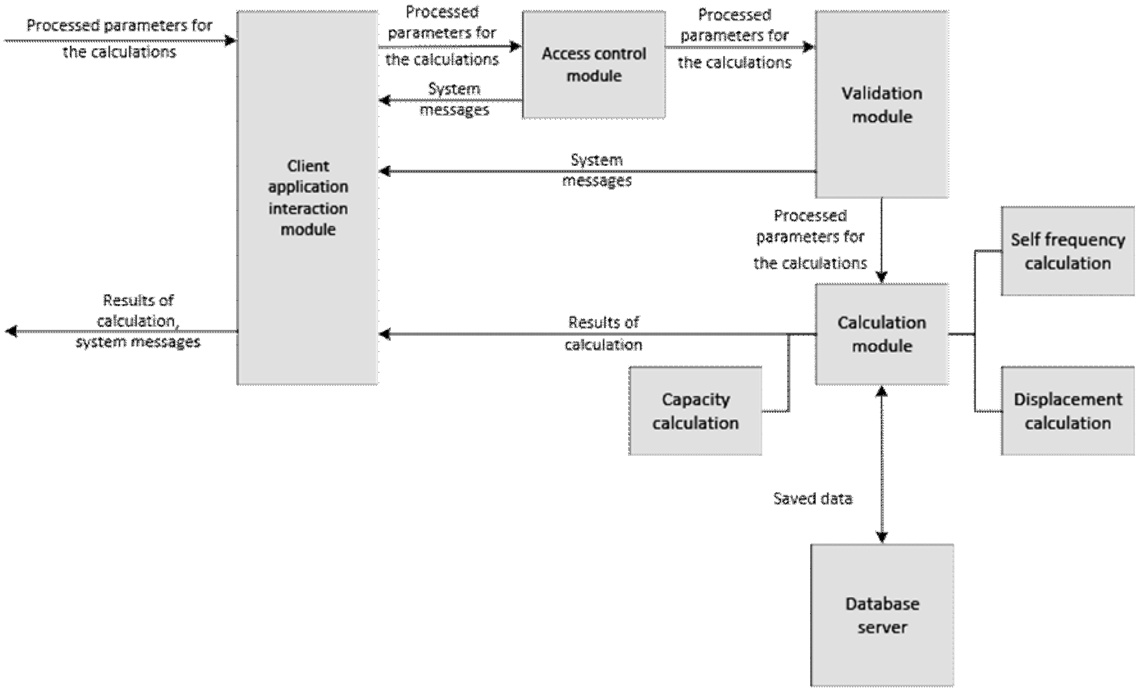

Fig. 3. Decomposition of the server system

Practical part

Deflection of the membrane after applying uniform pressure on it is an important parameter, since it depends on the capacitance of the sensor and work ability in general. The shift in the center of the membrane is computed by calculating a cubic equation in which only one root is real and the rest is imaginary, namely [2]:

$$\frac{128\alpha D}{h^2a^4}w_0^3+\left[\frac{2k^2D/a^4}{\frac{I_0(0)-I_0(k)}{kI_1(k)}+\frac{1}{2}}-\frac{\varepsilon_0V^2}{d_0^3}\right]W_0-\left[P_m+\frac{\varepsilon_0V^2}{2d_0^2}\right]=0 \qquad (1)$$

Here: h – membrane thickness; I_0, I_1 – Modified Bessel functions of first kind of order zero and one; d_0 – the distance from diaphragm to the back plate of the sensor; V – bias voltage; P_m – uniform pressure; e_0 – permittivity of free space; a – Poisson ratio dependent variable:

$$a=\frac{7505+4250v+2791v^2}{35280} \qquad (2)$$

Where v, respectively, is the Poisson's ratio.

D – Flexural rigidity, which is calculated by:

$$D=\frac{\tilde{E}h^3}{12(1-v^2)} \qquad (3)$$

Where $\tilde{\mathrm{E}}$ – effective Young’s modulus of the membrane material, namely:

$$\tilde{\mathrm{E}}=\frac{E}{(1-v^2)} \qquad (4)$$

The term k from (1) is given by:

$$k=\sqrt{\frac{s_0+\mathrm{a}^2+h}{D}} \qquad (5)$$

After the central deflection was found, we can calculate the deflection in the other points of membrane [2]:

$$w(r) = \left[w_0 + w_1 \left(\frac{r^2}{a^2} \right) + w_2 \left(\frac{r^4}{a^4} \right) \right] \left(1 - \frac{r^2}{a^2} \right)^2 \qquad (6)$$

where r – radial distance from diaphragm center.
The coefficients w_1 and w_2 is given by:

$$\left. \begin{aligned} w_1 &= \frac{0.0009}{\sqrt{h}} w_0 \\ w_1 &= \frac{0.001}{\sqrt{h}} w_0 \end{aligned} \right\} \qquad (7)$$

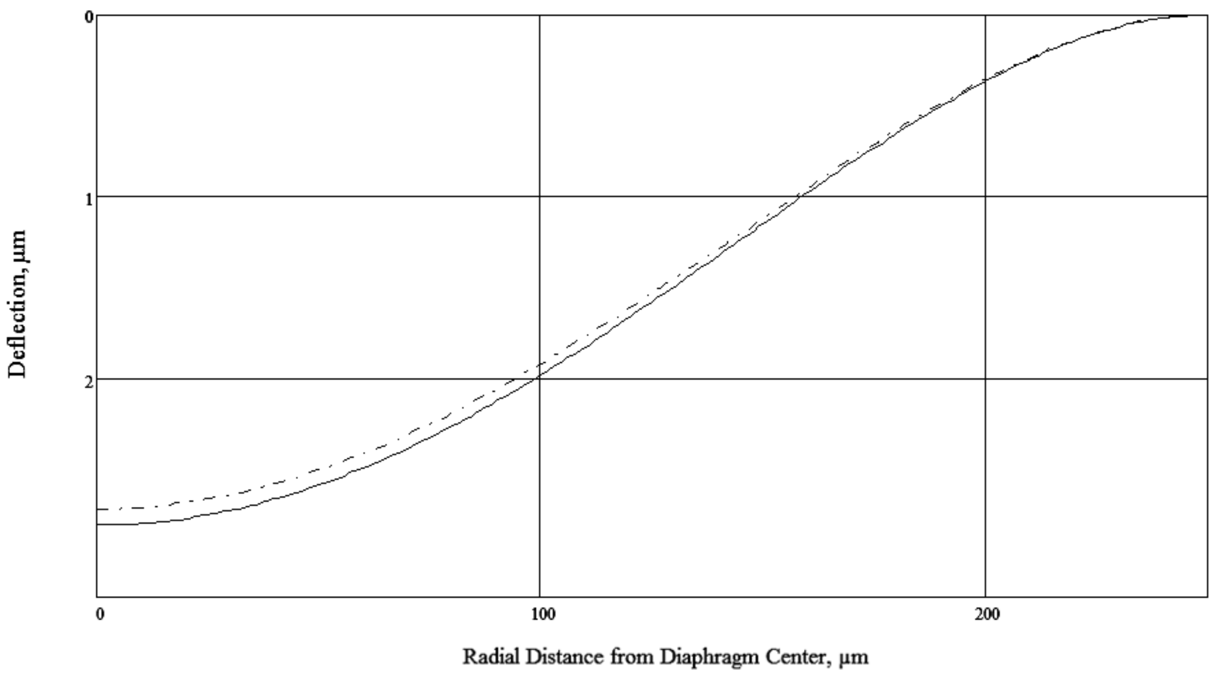

Fig. 4. The dependence of deflection from the radial distance for 1 and 3 micrometers thick membrane

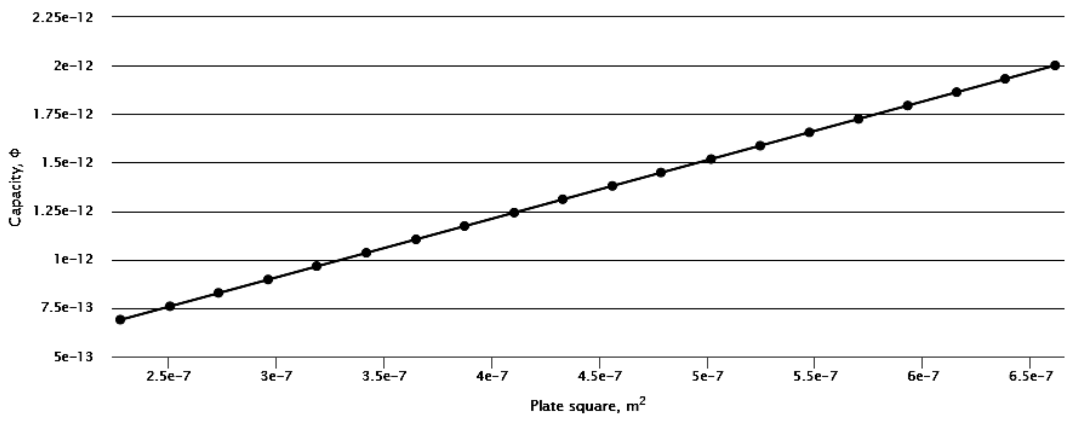

Fig. 5. The dependence of the capacitance changes depending on the height of the structure of the differential capacitive MEMS accelerometer

Results

With the help of the developed systems were calculated parameters of such microelectromechanical devices:

MEMS sensor with a circular membrane;

Differential capacitive MEMS accelerometer.

Examples of output data presented in Fig. 4, Fig. 5.

Conclusion

Today there are quite a large number of commercial systems which allow calculating the parameters of MEMS in certain situations, such as the calculation of the geometry of sensor, how thick membrane is needed in order to don't get significant deflection after applying pressure, etc. Unfortunately, these systems are expensive, demanding of computing resources and not easy to use. Organization cloud computing will greatly simplify the calculation of parameters of MEMS, making them cheaper and faster. Therefore, the calculation of parameters of MEMS using cloud computing is extremely important and urgent task.

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CREATION OF THE ANNOTATED TEXT CORPUS FOR AUTOMATIC RECOGNITION OF SEMANTIC RELATIONS WITHIN NAMED ENTITIES

СТВОРЕННЯ АНОТОВАНОГО КОРПУСУ ТЕКСТІВ ДЛЯ ЗДІЙСНЕННЯ АВТОМАТИЧНОГО РОЗПІЗНАВАННЯ СЕМАНТИЧНИХ ЗВ'ЯЗКІВ МІЖ СУТНОСТЯМИ

This article describes the general approach to creation and annotation of the medical text corpora for Ukrainian language for its future application in arelation extraction system. The annotation process was done with the help of General Architecture for Text Engineering (Gate) system.

Key words: information extraction, semantic relations extraction, annotations, annotation scheme, data corpora.

Описано загальний алгоритм створення та анотування корпусу медичних текстів українською мовою, для їх подальшого використання в системах видобування зв'язків. Анотування даних проводилося за допомогою системи Gate (Загальна архітектура обробки текстів).

Ключові слова: видобування даних, виділення семантичних зв'язків, анотація, схема розмітки, корпус даних.

Introduction

Rapid development of the information technologies causes improvement of already existing and creation of new tools and methods for natural language processing. The ability to use a variety of software innovations in linguistics allows presenting languages as formal systems with clear structural features.