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Недлінський Ярослав Тарасович
Київський національний університет технологій та дизайну
(м. Київ)
Науковий керівник – Ренська І. І.

SMART HEAT CONTROL OF MICROCHIPS

The purpose of research is protection against cyberattacks that can lead to the destruction of processors that used by industrial manufacturers.

Object of the research is microchips and subject of research is investigation of temperature changes of microchips under the influence of various loads.

Methods and means of research are based on identifying thermal patterns during normal operation of processors. Calculations that were carried out are stored in the main memory or can be downloaded from the hard disk. All these operations have different influence on processor, so such manipulations can produce short-term heating and cooling in different areas of the processor.

Sensitive infrared cameras are assigned to monitor such patterns and reproduced these changes in the control routine from minimum temperature changes or temporal deviations of a few milliseconds. This setup was used to demonstrate advantages of such thermal monitoring. I am convinced that in the future, sensors on the chip are planned to assume the function of the cameras.

In addition, I convinced that the scientists want to equip the chips with neural networks to identify thermal changes and to monitor the chip in real time with using of special programs.

Technological progress in the electronics sector gives opportunities to "Industry

4.0" to be implemented as quickly as possible. Thanks to technological breakthroughs such as high speeds, reduced costs and smaller sizes, which in turn lead to completely new opportunities for automation and industrial production. In particular, miniaturization advanced considerably in the last few years. Nevertheless, the physical flow of several electrons is enough to execute the software. But this progress also has disadvantages. Processors that are less than 10 nanometers in dimension are highly sensitive. That is why such microprocessors is good target for cyberattacks. As a result, they can use incorrect control commands to make a specific overloading, that lead to an artificial aging process that can destroy such the processors in a few days. But to defend such attacks on industrial facilities, researchers of KIT are now working on a smart self-monitoring system.

The new approach is based on identifying thermal patterns during normal operation of processors. Professor Jorg Henkel, who is a leader of the team at the Chair for Embedded Systems (CES) explains that "Every chip produces a specific thermal fingerprint," "Calculations are carried out; something is stored in the main memory or retrieved from the hard disk. All these operations produce short-term heating and cooling in various areas of the processor." [1] Henkel's team used sensitive infrared cameras that were assigned to monitor such patterns and reproduced these changes in the control routine from minimum temperature changes or temporal deviations of a few milliseconds. This setup was used to demonstrate advantages of such thermal monitoring. In the future, such the sensors on the chip are supposed to assume the function of the cameras. Jorg Henkel says "We already have temperature sensors on chips. They are used for overheat protection," and "We will increase the number of sensors and use them for cybersecurity purposes for the first time." [2].

The scientists wants to apply their smart heat control in industrial facilities. Because at such manufacture mostly accomplished a static control routines and it is easier to identify a deviations. Nevertheless, industry computers can be also exposed to dynamic threats. Hussam Amrouch that working in same team with Jorg Henkel explains: "As soon as the hackers will know that we monitor temperature, they will adapt," and "They will write smaller or slower programs, whose heating profiles will be more difficult to identify."[3] That is why from the beginning, it is necessary to teach neural networks to identify modified threats and warn about them.

To conclude, technological progress in the electronics sector gives opportunities to "Industry 4.0" to be implemented as quickly as possible. Thanks to technological breakthroughs such as high speeds, reduced costs and smaller sizes, which in turn lead to completely new opportunities for automation and industrial production. In particular, miniaturization advanced considerably in the last few years. Nevertheless, the physical flow of several electrons is enough to execute the software. But this progress also has disadvantages. Processors that are less than 10 nanometers in dimension are highly sensitive. To defend such attacks on industrial facilities in the future, researchers are now working on a smart self-monitoring system.

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