Analysis of Distinctive Features and Database Conception for Hardware Interface of It Devices in the Process of Their Identification Based on Radiated Emission

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Abstract— In the article distinctive feature for modern IT equipment present on the European Union market have been presented. The collected measurement results of radiated emission generated by particular components of IT devices allowed it to build data base which could be used for identification of components characterized by too high level of radiated emission.

This paper describes the concept of building a database for IT devices in the process of identification based on radiated emissions. In addition, the article presents a similarity measure radiated emissions for each hardware interfaces of PC computer.

1. INTRODUCTION

Generally, energy emitted by any source can depend on frequency (f), time (t) and direction (Φ). Quantity ε can be found as operator describing conversion of energy released in source (which depends only on frequency and time) into space-time-frequency distribution of energy in medium surrounding source. If direction, frequency and time features of source are independent of each other, then its emissivity ε can be presented in the form of product of three functions representing separate characteristics describing frequency, direction and time selectivity of source. With large amount of emission sources working simultaneously the resultant process contains prevailing discrete components with particularly large intensity and electromagnetic background close to noise. Basically intensity of intentional emission can be estimated on the basis of space-time-frequency distribution of sources, radiated power and other nominal parameters of related devices. Whereas unintentional emission is much more difficult for quantity assessment. Such an example is collocated system in which there are a few sources of electromagnetic emission at the same time.

Based on there search and obtained measuring results it can be concluded that it is possible to identify the hardware interfaces of information device giving rise an increase in emission. Distinctive feature of the work of the individual interfaces is therefore the working frequency and the level of emission allowing the identification of the hardware interface. Given the above,it is possible to build a database that will help an easy way identify individual interfaces of computer devices.

2. IDENTIFICATION PROCESS OF HARDWARE INTERFACES IN IT DEVICES

In general,the process of identifying the hardware interfaces in IT device can be divided into two stages. The first step it is the measurement process, used for the assembly of distinctive features the work of individual hardware interfaces, which can include working frequency and the level of emission. The second stage is the main process of identifying the hardware interface in IT device based on a database created and defined similarity measures radiated emissions coming from the IT device.

2.1. The Measurement Process

The measurement process consists in making very large amount measurements of radiated emission derived from different information devices in order to obtain empirical data used to build a database containing the distinctive features of individual hardware interfaces. The first step in the measurement process is to measure the radiated emission of the device when,the work of all hardware interfaces is turned off.Thenweextortionworkone of the hardware interfaces (e.g., USB, Parallel, RS-232, DVI, VGA, LAN, etc.) and make measurement of radiated emission of information device for this configuration. After completion of the measurement we were writing the measurement results and check to see if we have to run another hardware interface into IT device. If yes then we go back to start point of the next hardware interface (remember to work individually hardware interfaces) and make measurements of radiated emission. After completing all measurements the measurement process for a single device coming to an end. It should be noted that in order to build a database of measurements must be taken for a specified number of samples (several dozen) and perform averaging the results [3, 6–10]. Algorithm of the measurement process is shown in Figure 1.

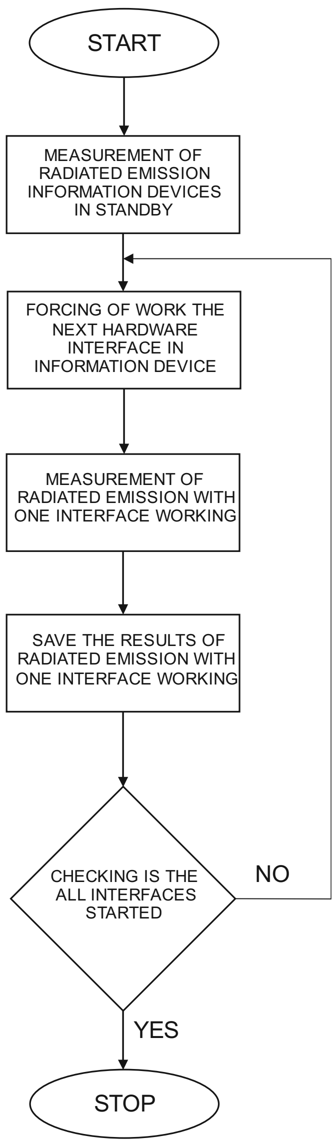

Figure 1: Algorithm of the measurement process for one IT device.

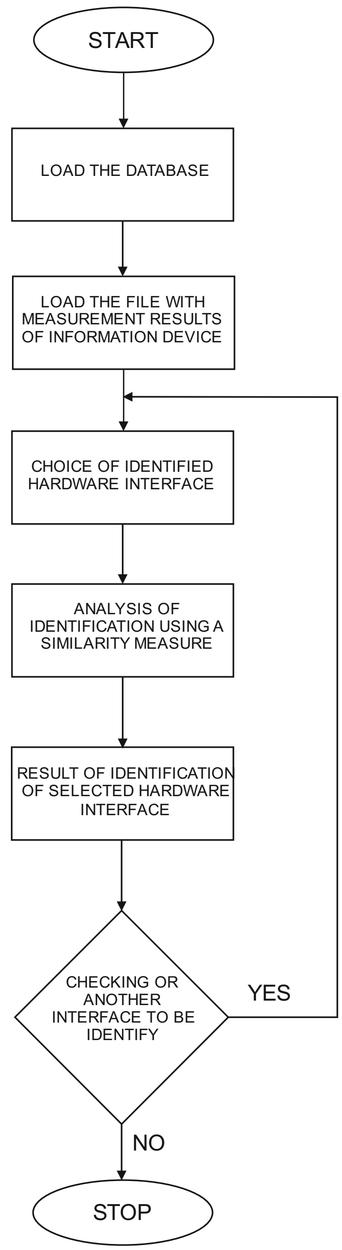

Figure 2: Algorithm of the main hardware interface identification process in IT device.

2.2. The Main Hardware Interface Identification Process

The basic hardware interface identification process is based on identifying work of the individual hardware interfaces during normal operation of IT device. The first step in the identification process is to load the database containing the distinctive features of each hardware interfaces into computer. Then we load the measurement results of the radiated emission for tested IT device. We choose one of the hardware interfaces (e.g., USB, Parallel, RS-232, DVI, VGA, LAN, etc.) which we want to identify and make identification analysis using measure probability of radiated emissions. After identification, we have information on whether it is specified interface, and then check to see if we have to identify another interface hardware in the device. If yes then we go back to point of select the next hardware interface and make an analysis of radiated emissions again. After all the tests of identification hardware interfaces for device identification process comes to an end. Algorithm for the main hardware interface identification process is shown in Figure 2.

3. THE LEVELS OF RADIATED EMISSION

On the basis of there search and obtained measurement results one can state that there is a possibility to identify hardware interfaces of IT device which cause the increase of emission level. So, a distinctive feature of operation of specific interfaces is its work frequency and emission level allowing to identify a given hardware interface [4, 5]. The results of hardware interface identification have been collected in Table 1.

Table 1: Levels of EM field from hardware interfaces into PC unit.

Device/kind of interface	**f [MHz]**	**Emission level within the distance 3 m from PC [dBμV/m]**		**Device/kind of interface**	**f [MHz] Przy pracy Interfejsu**	**Emission level within the distance 3 m from PC [dBμV/m]**	
		With work of Interface	**Without work of interface**			**With work of Interface**	**Without work of interface**
LAN	30–34	33,91	27,30	USB	240,00	40,71	32,47
USB	62,00	31,11	25,72	USB	247,00	44,68	35,60
USB	62–70	33,67	24,50	LAN	250,00	40,63	35,33
USB	92,00	31,30	26,68	USB	260–290	31,05	24,30
RS-232	92,20	31,43	26,72	RS-232	287,90	41,98	33,84
USB	119,00	35,45	31,06	VGA	288,00	41,98	34,55
USB	120,00	35,50	32,18	USB	305,00	44,14	33,20
USB	124,00	35,69	28,82	USB	330–350	33,01	24,70
USB	140–160	33,18	28,79	USB	336,00	44,66	41,44
LPT	144,00	39,73	34,14	RS-232	370,30	33,20	28,50
VGA	153,00	37,22	28,92	HDD	374,00	31,56	28,01
LPT	203,00	36,11	34,40	VGA	382,00	43,46	35,10
RS-232	403,60	34,67	28,17	LAN	600,00	46,55	38,94
RS-232	415,70	32,40	29,02	LAN	618,00	37,40	32,90
VGA	417–421	43,08	28,67	LAN	619,00	37,38	32,91
USB	450,00	36,48	32,72	VGA	650,00	40,58	34,74
HDD	450,00	37,31	32,37	CPU, RAM	663–666	36,89	33,04
USB	480,00	54,44	35,79	USB	743,00	37,87	34,94
VGA	511–514	38,42	32,61	USB	749,00	39,87	34,37
USB	587,00	40,57	35,26	HDD	801,80	46,92	44,70
HDD	600,00	46,91	40,02	RS-232	820,00	50,25	39,04
VGA	600,00	48,65	37,34	VGA	820,00	46,71	38,84
HDD	868,90	46,50	42,09	USB	975,00	53,94	48,87
USB	960,00	54,87	45,92	USB	983,00	48,14	43,96

4. SIMILARITY MEASURE OF RADIATED EMISSIONS

Measurement radiated emissions methodology of internal components in IT device refers to measuring the strength of electromagnetic field level emitted by such devices for certain frequencies [11, 12]. In order to determine the similarity between the measured radiated emission with a specific reference spectrum of radiated emissions for each hardware interfaces, you can use the following similarity measure of radiated emissions on different frequencies:

- the average value,
- the correlation function,
- the relative value of the error signal level,
- the maximum value of the relative error signal level,

- the indicator z,
- the numer En.

The above-mentioned similarity measure of radiated emissions were considered by the author and are discussed in detail in the publications [1, 2, 8, 9].

5. THE CONCEPT OF DATABASE FOR HARDWARE INTERFACE OF INFORMATION DEVICES

The database is one of the basic cells of the effective functioning identify system of hardware interfaces into the IT device. It is an essential part of supporting the process of recognizing the individual hardware interfaces based on of radiated emissions, which the aim is to increase the probability of correct identification. The concept of a database must include the largest possible number of factors affecting the foreseeable possibilities for its use, and should include distinctive features for each hardware interfaces of IT device empirically determined. Figure 3 shows the appearance of the concept of a database created for identification of hardware interfaces.

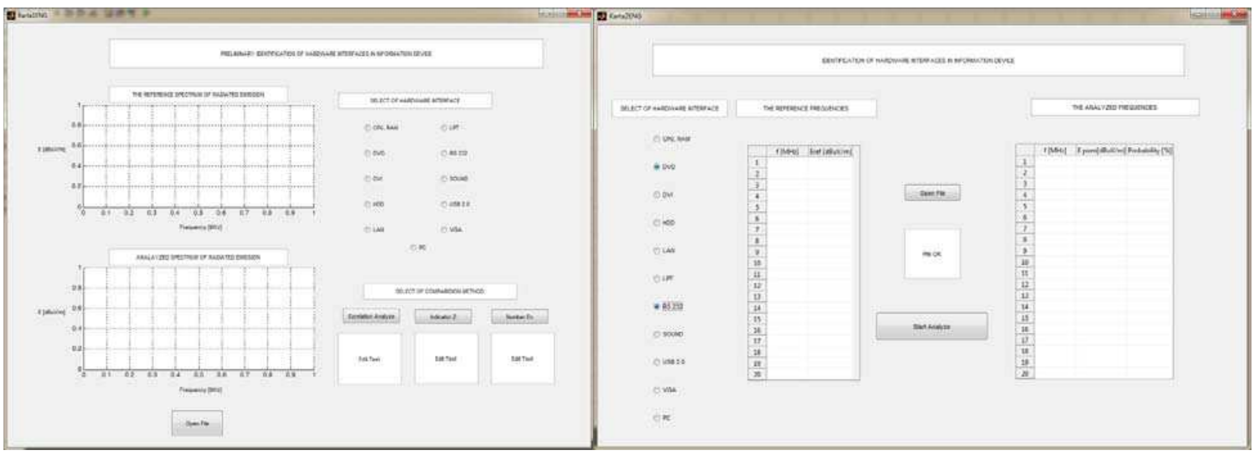

Figure 3: The appearance of database concepts created for the identification of hardware interfaces.

Presented in this chapter, the concept of database provides an accuracy and uniformity of the designated of distinctive features for individual hardware interfaces in information device. The database is stored sets of parameters and analysis functions allowing identification of the hardware interface. The proposed structure of the database contains two tabs for initial identification the hardware interface and the precise identification of the interface on different frequencies during information device normal working.

6. CONCLUSION

Collected as part of research conducted by the author test results of radiated emissions generated by different hardware interfaces of information devices allowed it to build a database, which can then be used to identify the components which are characterized by very high levels of radiated emissions. Identification is based on measures of the probability of radiated emissions of modern information devices. The designated distinctive features of hardware interfaces can be the basis in the early stages during design process of electromagnetic security of modern information device aiming to provide compliance with relevant standards in force in the European Union. In addition by identifying the hardware interfaces of information device resulting in increased emissions, there is an opportunity to significantly speed up the process of preparing device to sale where the emission level is incompatible with the standard.

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