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AN INVESTIGATION OF THE FEATURES OF DIGITAL SOUND TRACK, CREATED BY SOME DEVICES.

Results of the studying of features of the soundtracks, created by several devices, are considered.

Keywords: *authenticity of a soundtrack, multiple duration, sampling period, device, sound recording.*

Progress in technologies of electronics and computer engineering led to the creation of both a variety of digital sound-recording device, and to develop ways and means of digital montage, which, unfortunately, is sometimes used for intentional adulteration of phonograms. To detect such interference in the phonogram has the expertise and capabilities of digital recording. The identification of digital recording equipment plays a decisive role in carrying out such an examination, because the results of its study to determine identification initial digital phonograms and the presence or absence in them of signs of digital installation [1]. Because experts often put questions about making such a phonogram to present on the device. And the more signs of equipment that remain on the media record, we check during the examination, the greater the likelihood of correctly address delivered before an expert task and avoid errors.

Sometimes it happens that with any reason to get on the expert study digital recording device on which the recording was made, it is impossible. In this case no longer, you can set the originality of a phonogram, but you can try to install a specific group affiliation of the record, which was recorded on a phonogram provided expertise. And although such cases happen infrequently, solve the problems of creation of methods and means of establishing the group affiliation of the record based on the analysis of properties put on the tracks is important task for research expertise. In addition, if Group signs partly lost on the length of the phonogram you can say about the presence of signs of mounting even in the absence of appraisals of equipment

The purpose of the paper is an experimental search for sound recording devices that leave in phonograms signs with certain properties, which may be lost as a result of digital editing. One of the tasks of research expertise is the revealing fact abrasion, overwriting, installation, fragmentariness and other changes in the

phonogram after finishing recording [2]. We speculated that phonograms which were mounted (i.e. combining two or more parts of one or more previously recorded tracks by overwriting, which can make changes changes in the recorded information and may change the sequence of the fragments [3]) is almost always randomly change their duration. This assumption further will be tested experimentally.

It is clear that the most simple fact changes the duration of the phonogram you can prove if it is known its initial duration. But sometimes this can be enough to know certain individual property of some devices create backing tracks with a duration that is subject to certain laws, such as the absence of the multiplicity of its duration to several periods of sampling. Experimentally this pattern can detect algorithm for finding the greatest common divisor (GCD) for numbers that represent the duration of the phonograms. If GCD equals greater value than the sampling period, then, if you are recording a sufficient number of tracks, you can draw a conclusion about the presence in the device properties store the tracks of the law according to the duration of multiple periods of sampling. In the case where the length of the sample is a periodic shot – you need to multiply the duration value of phonograms the appropriate device on this number, which as a result of the multiplication on the duration of the period of sampling gives an integer, and then calculate the GCD of divided by the same number. This manipulation will not affect the result of finding the multiplicity of durations of phonograms, but will apply the Euclidean algorithm. This is the way and the experiments description which describes in this work.

Note that for clearness in work is analysed only setting the duration, though similarly can be seen setting the number of samples, which is much more convenient to use during calculations, because the length is derived from the number of samples. The experiment was conducted by the following algorithm. The first stage of installed equipment, in which the duration of multiple multiple periods of sampling recorded and stored in the apparatus of phonograms. The second phase compared the duration of phonograms that were exposed to the digital processing, with a duration of phonograms, that it is not exposed. It was recorded in five experimental tracks for each randomly selected device entry [4]. Found the GCD for magnitudes of duration for the first two tracks on equalize with the value obtained for the GCD of a third of a phonogram, in case the first comparison was not derived GCD, with magnitude, equal to the period of sampling. This would, in turn, would send signal about the absence of necessity of continued settlement.

From the results of the experiment, it follows that the mobile phone Samsung GT-S5610 recorded backing tracks with multiple up to 36000mks =

36ms. Compare this value with the sampling corresponding to the device. Sample rate recording mobile phone Samsung GT-S5610 is equal to 16000Gc, so the sampling period is equal to 1/16000 = 0,0000625 seconds = 62.5 μs, i.e. we can conclude about the availability features of the recording and storing of phonograms with multiple duration greater than the sampling period (36000mks > 62.5 μs). When conducting experimental research found 6 devices with similar characteristics: RM-320 (Smartphone Nokia N95 8 GB), RM-159 (Smartphone Nokia N95), RM-244 (Smartphone Nokia E51), mobile phone Samsung GT-S5610, RM-469 (Smartphone Nokia E52), Smartphone Fly IQ of 430.

Each device with a previous table worked running a standard operating system and creation of phonograms was using the standard recording applications. RM-244 (Smartphone Nokia E51) running the Symbian operating system v 9.2, has a built-in recording tool, hardware audio codec this device there are two microcontroller: v 1.12 _PA_385ZWK and AVILMA_ 1.05 c [5]. According to the results of the experiment, the algorithm, according to which the phonogram is stored with a duration, as a multiple of 100 Ms. RM-320 (Smartphone Nokia N95 8 GB) running the Symbian operating system v 9.2, has a built-in recording tool, hardware audio codec this device there are two microcontroller: v. _PA_385ZWK AVILMA_ 1.12 and 1.05. According to the results of the experiment, the algorithm, according to which the phonogram is stored with a duration, multiple up to 256 Msec.

Front-GCD durations in microsecond phonograms recorded Smartphone Nokia E52 were multiplied by 3, and recorded a Smartphone IQ Fly 430 for 2, in order to lead them to an integer. After the calculation is the value of GCD specified devices was divided into 3 and 2 respectively. It is not influenced the result, but allowed to apply the Euclidean algorithm. Mobile phone Samsung GT-S5610 has built-in means of recording hardware audio codec this device is a microcontroller UCP200_MAIN. According to the results of the experiment, the algorithm, according to which the phonogram is stored with a duration, as a multiple of 36 Msec. RM-469 (Nokia E52 Smartphone) running operating system Symbian_v 9.3, has a built-in recording tool, hardware audio codec this device there are two microcontroller: v 1.11 _PR_RISTA_BGA401 and GAZOO_v. 3.4. According to the results of the experiment, the algorithm, according to which the phonogram is stored with a duration, multiple to 21,333 Msec. IQ430 Fly Smartphone running the Android operating system v 4.1.1, has a built-in recording tool hardware audio codec this device is a microcontroller U101_MT6577. According to the results of the experiment, the algorithm, according to which the phonogram is stored with a duration, as a multiple of 20 msec.

We feature the above mentioned devices can be useful within the framework of research expertise by analyzing the length of submitted research Phonograms and making appropriate conclusions concerning the authenticity and preservation of the corresponding device phonogram with the appropriate duration. But revealing the fact of modifying the duration of a phonogram is probabilistic in nature because of the magnitude of the change in duration of the phonogram as a result of mounting can coincide with individual feature some devices create a phonogram with the regular duration greater than the sampling period. The probability of a detection of the fact changes the duration of the phonogram you can calculate using the formula:

$$P = 1 - \frac{1}{TF}$$

P – probability revealing the fact of modifying the duration of a phonogram

F – sample rate

T – became a time value in seconds, private for some devices that create the soundtrack of legitimate duration greater sampling period

P probability revealing the fact of modifying the duration of a phonogram F-sample rate, T – became a time value in seconds, private for some devices that create the soundtrack of legitimate duration greater sampling period. Author of experimentally using the program Cool Edit Pro "was a digital installation files" Test audio 1. Wav and wav audio Test. 2. File properties: sample rate 8000 Hz, duration of 12 500 Msec 100 MSec and 29 respectively, using RM-244 (Smartphone Nokia E51). After installing a new file was saved with a similar frequency of sampling. The probability of detecting the fact changes the duration of such phonograms according to the above formula, even with relatively small frequency is equal to 1 − 1/0.1 * 8000 = 0,99875 ≈ 0.999. But some types of mounting duration phonogram does not change in the next well seen experimentally. The application of typical methods of mounting the property of constant multiplicity of durations of phonograms to 100 MS was lost in 5 experiments of 6 (see table 2). The loss of properties of the phonogram testifies in reality signs of use of installation, if you know that the sound-recording device was RM-244 (Smartphone Nokia E51).

Table 2. Experimental installation files "Test audio 1. wav" and and "Test audio 1. wav» RM-244 (smartphone Nokia E51)

Mounting arrangement	Duration of sound records (microsecond)		Or you can make a conclusion about the presence of signs of mounting? (the duration value after installation is not a multiple of 100 000?)
	Before mounting	After mounting	
Combining of two parts of a single record	12 500 000	11 247 375	Yes
Повне зниження гучності певної частини раніше записаної фонограмі зі зміною послідовності фрагментів	12 500 000	12 500 000	No
Combining three parts of one previously recorded backing tracks with full volume decrease	12 500 000	12 396 750	Yes
Combining two parts of two previously recorded tracks	12 500 000 та 29 100 000	21 113 000	Yes
Combining two parts of two previously recorded tracks with changing sequence of fragments	12 500 000 та 29 100 000	21 113 125	Yes
Combining three parts two previously recorded tracks with a full reduction of the volume of certain parts and change the sequence of fragments	12 500 000 та 29 100 000	28 004 875	Yes

Conclusions

1. Experientally detected individual properties of the multiplicity of durations of phonograms to 100 MS for RM-244 (Smartphone Nokia E51), up to 256 MS for RM-320 (Smartphone Nokia N95 8 GB) and RM-159 (Smartphone Nokia N95), to 36 MS for the mobile phone Samsung GT-S5610, to 21,333 MC to RM-469 (Nokia E52 Smartphone), and up to 20 MS for Smartphone Fly IQ430. These values are larger than the period of sampling, therefore, can be considered a group signs recording devices monitored. 2. Experimentally it is proved, that such individual features are lost as a result of digital editing, so the use of such group featured in expert practice additionally allow detection of traces of digital processing for the duration for the relevant devices.

LIST OF USED SOURCES

1. Рыбальский О. В. Система идентификации аппаратуры записи сигналов и проверки оригинальности и подлинности сигналограмм/ О. В. Рыбальский, В. И. Соловьев, Т. В. Командина, Т. А. Татарникова // Інформаційна безпека. – 2011. – № 2 (6). – С. 7–14.

2. Россинская Е.Р. Настольная книга судьи: судебная экспертиза / Е.Р. Россинская, Е.И. Галяшина – М.: Проспект, 2010. – 303стр.

3. Каганов А.Ш. Криминалистическая экспертиза звукозаписей / А.Ш. Каганов. – М.: Издательство «Юрлитинформ», 2005. – 137с.

4. Алгебра и теория чисел: Учеб. пособие для студентов-заочников 2 курса физ.-мат. фак. пед. инст. / Н.А. Казачек, Г.Н. Перлатов, Н.Я. Виленкин, А.И. Бородин; под ред. Н.Я. Виленкина. – 2-е изд. – М.: Просвещение, 1984. – С. 8–13.

5. Cell Phone Knowledge Base : энциклопедия мобильных телефонов. CPKB [Электронный ресурс]. – Режим доступа: http://www.cpkb.org, свободный.

6. Рибальський О.В. Особливості прояву слідів цифрової обробки аналогових і цифрових фонограм та методика їх виявлення : метод. рекомендації / МВС України. КНУВС: каф. інформац. технологій. – К.: 2010. – С. 5.