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YANGI DAVR ILM-FANI: INSON UCHUN INNOVATSION G‘OYA VA YECHIMLAR

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Yangi davr ilm-fani: inson uchun innovatsion g‘oya va yechimlar. I Respublika ilmiy-amaliy konferensiyasi materiallari to‘plami. 2-jild, 1-son (yanvar, 2026-yil). – 80 bet.

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Konferensiya tashkilotchisi: “Scienceproblems Team” MChJ

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Annotatsiya
Mazkur to‘plamda “Yangi davr ilm-fani: inson uchun innovatsion g‘oya va yechimlar” mavzusidagi I Respublika ilmiy-amaliy konferensiyasi materiallari jamlangan. Nashrda respublikaning turli oliy ta’lim muassasalari, ilmiy markazlari va amaliyotchi mutaxassislari tomonidan tayyorlangan maqolalar o‘rin olgan bo‘lib, ular ijtimoiy-gumanitar, tabiiy, texnik va yuridik fanlarning dolzarb muammolari va ularning innovatsion yechimlariga bag‘ishlangan.
Ushbu nashr ilmiy izlanuvchilar, oliy ta’lim o‘qituvchilari, doktorantlar va soha mutaxassislari uchun foydali qo‘llanma bo‘lib xizmat qiladi.

Kalit so‘zlar: ilmiy-amaliy konferensiya, innovatsion yondashuv, zamonaviy fan, fanlararo integratsiya, ilmiy-tadqiqot, nazariya va amaliyot, ilmiy hamkorlik.

MUNDARIJA

TIBBIYOT FANLARI

PSIXOLOGIYA FANLARI

TEXNIKA FANLARI

KEY STAGES OF RECOVERY OF VISUAL INFORMATION FROM SIDE ELECTROMAGNETIC RADIATION VIDEO PATHS OF COMPUTING SYSTEMS

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Annotation. In the article examines the problem of visual information leakage through channels of side electromagnetic radiation of video paths of computing systems. It is shown that the effectiveness of developing information security methods is directly related to an understanding of the mechanisms for intercepting and recovering visual data from SER. It is noted that the information recovery procedure is a multi-stage process, including SER reception, clock and synchronization signal recovery, signal filtering and threshold processing, data bit recovery, and image reconstruction with an increased signal-to-noise ratio. Based on an analysis of the recovery sequence, it is established that the key stage of the process is the recovery of the video path clock signal, since other synchronization signals are formed on its basis. It is concluded that this stage must be taken into account when developing new methods and tools for protecting information from leakage through SER channels.

Key words: SER, video path of computing systems, information leakage, image restoration, clock signal, video signal synchronization, information security.

HISOBLASH TIZIMLARI VIDEO TRAKTINING YON ELEKTROMAGNIT NURLANISHI ORQALI VIZUAL MA'LUMOTLARNI TIKLASHNING ASOSIY BOSQICHLARI

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“Elektronika va radiotexnika” kafedrasi katta o‘qituvchi

Annotatsiya. Ushbu maqolada hisoblash tizimlarining videotraktlaridan kelib chiqadigan yon elektromagnit nurlanish (YEN) kanallari orqali vizual axborotning sizib chiqishi muammosini ko‘rib chiqadi. Axborot xavfsizligini ta’minlash usullarini ishlab chiqish samaradorligi YEN orqali vizual ma’lumotlarni tutib olish va tiklash mexanizmlarini tushunish bilan bevosita bog‘liqligi ko‘rsatib berilgan. Axborotni tiklash jarayoni ko‘p bosqichli ekanligi qayd etilib, u YENni qabul qilish, takt va sinxronizatsiya signallarini tiklash, signalni filtrlash va chegaraviy qayta ishlash, ma’lumot bitlarini tiklash hamda signal/shovqin nisbatini oshirgan holda tasvirni qayta tiklash bosqichlarini o‘z ichiga oladi. Tiklash ketma-ketligini tahlil qilish asosida jarayonning asosiy bosqichi videotraktning takt signalini tiklash ekanligi aniqlangan, chunki boshqa barcha sinxronizatsiya signallari aynan shu signal asosida shakllantiriladi. YEN kanallari orqali axborot sizib chiqishidan himoya qilishning yangi usullari va vositalarini ishlab chiqishda ushbu bosqichni albatta hisobga olish zarurligi xulosa qilinadi.

Kalit so`zlar: YEN, hisoblash tizimlarining videotrakti, axborot sizib chiqishi, tasvirni tiklash, takt signali, video signal sinxronizatsiyasi, axborot xavfsizligi.

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With the widespread use of computing systems (CS), the threat of confidential data leakage via side electromagnetic radiation (SER) channels is increasing[1]. The most vulnerable element of computing systems are video channels, since the visual information transmitted through them is generated and processed in clear text and is accompanied by informative electromagnetic radiation [2-5].

Existing approaches to protecting information from leakage via SER channels in video paths of computing systems are conventionally divided into traditional and new [1, 6–8]. Traditional methods include passive shielding and active noise suppression, which, despite reducing the level of SER, are characterized by high cost, stationarity, electromagnetic compatibility issues, and unmasking features [8]. New methods based on intelligent and technological approaches make it possible to complicate the restoration of visual information, but require more complex architecture of computing systems and significant hardware costs, which limits their practical application [1, 8].

In this regard, the development and analysis of methods for protecting the video channels of the armed forces from interception via SER channels is a pressing task.

Before developing or selecting a method for protecting information from leakage through the channels of the SER video paths of the aircraft, it is necessary to study in detail the mechanism of interception and the stages of recovery of visual information from the SER video paths of the CS.

When developing methods for protecting information from leakage via side electromagnetic radiation in CS video systems, understanding the mechanisms for intercepting and recovering visual information is crucial. The effectiveness of the developed protective measures depends largely on understanding the key stages of data recovery from SER, without which recovery of visual information is impossible. Therefore, the primary task is to analyze the sequence of operations used to recover visual information from SER.

The procedure for recovering information from side electromagnetic emissions is a multi-stage process [9-13], including receiving the side electromagnetic emissions from the video path of the CS, recovering the clock signal (pixel frequency), recovering the synchronization signals, filtering and threshold processing the signal, recovering the information bits, as well as recovering the image and increasing the signal-to-noise ratio (SNR).

Fig. 1 shows a generalized block diagram of the process of restoring visual information from the SER video paths of the CS.

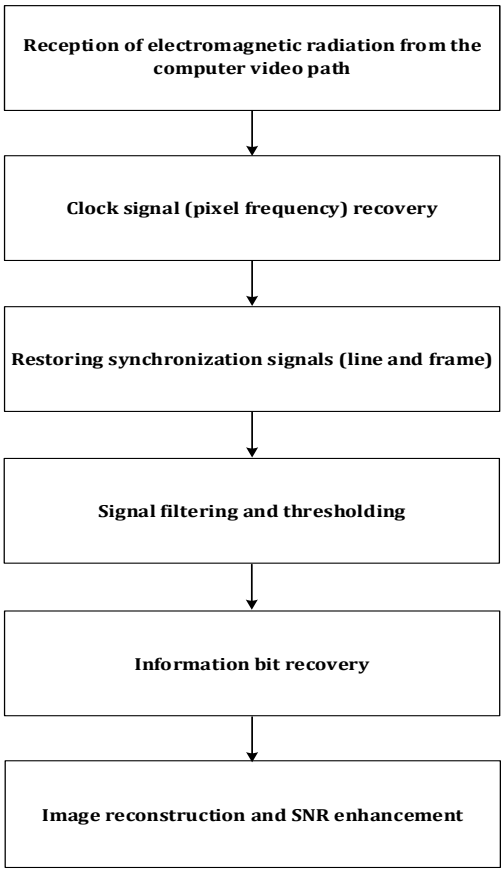

Fig. 1. Block diagram of the process of restoring a video frame from the SER of the video paths of the CS

Reception of electromagnetic radiation from the computer video path. This stage records the extraneous electromagnetic emissions generated by elements of the computer video path during information processing and visualization. Signal reception is performed using radio receivers and antennas.

Clock signal (pixel frequency) recovery. This stage determines the pixel (clock) frequency of the video path, which is a key parameter for synchronizing the image recovery process. The pixel frequency is used as the basis for forming the spatial structure of the image and determining the position of individual elements (pixels).

Restoring synchronization signals (line and frame). After determining the clock frequency, line and frame synchronization is restored, which is necessary for the correct formation of image lines and frames. This step allows for the establishment of line and frame boundaries and ensures the correct display sequence of the recovered data.

Signal filtering and thresholding. The filtering stage suppresses noise and out-of-band components of the signal to increase its information content. Thresholding involves converting the analog signal into a discrete form by setting a threshold value, which allows for separating logical levels and preparing the data for subsequent bit information recovery.

Information bit recovery. Based on the processed signal, the bit sequence corresponding to the transmitted visual information is extracted.

Image reconstruction and SNR enhancement. The final stage involves generating a two-dimensional image based on the reconstructed information bits and synchronization

parameters. To improve the reconstructed image quality and increase the SNR, temporal and spatial averaging methods are used, as well as the accumulation of multiple frames, which reduces the impact of noise and increases the visual clarity of the image.

The analysis revealed that restoring visual information from stray electromagnetic emissions from computer systems' video paths is a multi-stage process, the key element of which is clock signal recovery. Without determining the pixel (clock) frequency, restoring line and frame synchronization, as well as subsequent image reconstruction, are impossible. Therefore, when developing new methods and tools for protecting information from interception via SER channels, it is advisable to consider the specifics of generating and restoring the video path's clock signal [14], as one of the most vulnerable stages of the process.

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2026-yil, yanvar

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