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Research on Potentialities of Audio Information Recovery from Video Without Audio Track

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Abstract—The article analyzed the possibility of the appearance of an acoustic information leakage channel that is formed by analyzing the video stream on the video record. The authors investigated the possibilities of speech recovery from a low quality recording, determined by the signal-to-noise ratio (SNR), sampling frequency, number of quantization levels, and clipping level, taking into account the features of the leakage channel under study. As a result, the required frame rate of the video image, the minimum SNR, the number of quantization levels, and a sufficient dynamic displacement range of the oscillating object are determined. The authors also investigated the requirements for the leakage channel parameters and possible ways for an attacker to improve its quality. The requirements for the displacement of an object oscillating under the action of acoustic waves in a video were calculated. The article justified the potential of reducing the requirements for the displacement of an object by applying averaging of a large number of different points on the object. The authors performed an assessment of the existing noise reduction software for sound recordings, which is used to increase the intelligibility of the message that is intercepted by the attacker in the considered information leakage channel. Obtained results revealed that there are potential causes for the leakage of acoustic information by analyzing the video stream on the video. The conditions for the emergence of such a channel are not excessive. Therefore, the possibility of its appearance is a security risk and it is necessary to provide the means to protect the object of information activity from it.

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1. INTRODUCTION

The method of recovering audio signals from a video without an audio track is detecting small vibrations in the object (pixel displacements) and converting them into an audio signal. Various items (candy wrapper, glass of water, curtains, etc.) are potential membranes of microphones. To restore sound from an object, you need to record this object using a high-speed video camera, and then extract information about local movements. Information on local movements is aligned and averaged into one signal that describes the global movement of an object over time. The next step is to remove noise from these signals to transform them into quite legible speech.

Compared with the laser system of acoustic intelligence, this method of voice information recovery provides several advantages: it does not require active lighting, and does not use special technical means. It uses a camera, the presence of which on the territory of the object is optional (no-break method of reconnaissance). An attacker can make a video outside the designated room by using publicly available optical devices (telescopes, binoculars). This is a great threat to information security.

Currently, protection of information from leakage through this channel is neglected, since it is quite new, and there is almost no information about it in open publications. Therefore, the article investigates the features of intercepting acoustic information using a visual microphone (through a video camera).

Highly sensitive microphones with a very narrow directivity pattern are often used in acoustic leakage channels. These microphones perceive and amplify sounds coming from one direction, and attenuate interference and noise in other directions. Such microphones can be in the form of a long tube (or several tubes) or a parabolic plate with a concentrator in the form of the cone [1]. The disadvantages of such microphones are low efficiency when intercepting acoustic information through closed doors/windows.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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