UDC 343.982.4
DOI: 10.33270/0122271.40

Forensic Examination of Documents Made Using Computer equipment

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■ **Abstract**. The relevance of the study is conditioned by the presence of problems of forensic analysis of documents and the great importance of practical application of computer technology for the production of such documents. The purpose of the study is to investigate the prospects of using modern computer technology in the production of special documents and to assess the prospects for studying such documents using modern forensic methods. The basis of the methodological approach is a qualitative combination of methods of system analysis of modern criminalistics in the field of document research with an analytical investigation of the prospects for the use of computer equipment for the production of documents for their further criminal use. The results obtained should be considered the definition of the main types of forgery of documents and criteria for the use of modern computer equipment for the production of documents for the purpose of their further use in criminal intentions; the formulation of the main goals and objectives of performing methods of forensic analysis of documents made using computer equipment. The findings and the conclusions formulated on their basis are of significant importance for employees of modern forensic institutions, whose duties include performing a forensic analysis of documents produced using computer equipment, which is essential for solving crimes committed using modern computer and electronic equipment and preventing computer and electronic terrorism in everyday life

■ **Keywords**: handwriting and signature forgery; criminalistics; electronic equipment; forensic science; scientific research in criminalistics; crime detection

■ Introduction

The development of theoretical foundations for forensic analysis of documents produced using modern computer technology is essential from the standpoint of solving crimes committed using modern computer equipment. In addition, in this context, it is important to define the subject area of research from the standpoint of assessing its limitation to the analysis of documents using special forensic knowledge, or to include topical issues related to the analysis of documents in a broad sense, for example, including the features of document review by investigative units [1].

When searching for ways to effectively solve this problem, it is necessary to consider general approaches to defining the concept of a document and the main provisions in the field of forensic research of letters and documents. The introduction of such restrictions would help to determine the key types of research work reasonably, including the range of special knowledge necessary for the gradual establishment of a general characteristic of the research process [2]. At the same time, without considering the fact of insufficiency of some theoretical provisions of forensic analysis of documents, until now, a very serious problem was that a significant part of research activity in the field of modern forensic science was aimed exclusively at the investigation of theoretical provisions without practice, despite the fact that in this way the issues of general provisions of criminalistics are mainly raised, in particular, towards clarifying the subject, goals, and key tasks of modern criminalistics [3]. In this context,

■ **Suggested Citation:**
Sezonova, O.M., & Sezonov, V.S. (2022). Forensic examination of documents made using computer equipment. *Scientific Journal of the National Academy of Internal Affairs,* 27(1), 40-47.

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■ Received: 10.12.2021; Revised: 11.01.2022; Accepted: 10.02.2022

a wide range of issues related to the forensic analysis of documents that were produced using modern computer technology is essential from the standpoint of the need to continue research on the use of modern computer tools to commit various crimes aimed at document forgery [4].

Despite the need to continue research in this line, it is worth noting that modern criminalistics should qualitatively contribute to solving a wide range of existing issues that occur in the activities of law enforcement agencies, and create conditions for the progress of forensic science, toward conducting research aimed at improving the cooperation between law enforcement officials and representatives of modern forensic institutions.

Nowadays, there are certain difficulties in making distinctions in the areas of responsibility of modern experts, who conduct research in the field of forensic analysis of documents made using computer equipment, and employees of investigative units who are obliged to use the information obtained efficiently to solve crimes committed. However, the gradual creation of a qualitative basis for conducting qualified research on the use of modern computer technology to create various documents contributes to obtaining the results necessary for assessing the existing prospects for using modern computer tools to commit crimes aimed at forgery of documents with their subsequent criminal use [5]. It is also important to investigate the prospects of using computer technology to create man-made signatures, especially if these documents were created by electrophotographic method.

The main problem of earlier studies was the almost complete absence of factual material regarding the existing means of forensic analysis of documents produced using modern computer tools. *The purpose* of this study is the definition of modern means and existing prospects for forensic analysis of documents made using computer technology, which is important in the context of the development of modern forensic science and the qualitative understanding of the capabilities of modern computer technology in matters of forgery of documents and their further criminal use.

■ Materials and Methods

The methodological approach consists of a qualitative combination of methods of system analysis of modern criminalistics in the field of document research with an analytical investigation of the prospects for the use of computer equipment for the production of documents for their further use. This study involves the search for effective ways to use computer technology to forge handwriting and signatures, which are important aspects in creating high-quality copies of documents. The research was conducted on the basis of a pre-compiled theoretical framework, which acts as a qualitative foundation for conducting all further studies.

The theoretical basis consists of the findings of a number of Ukrainian and, mainly, foreign researchers who investigated problematic issues related to the forensic analysis of documents produced using modern computer technology. All materials presented in this research paper have been translated into English to facilitate the understanding and maximise the comprehension of the information presented therein.

The study included three main stages.

At the first stage, the theoretical basis was prepared, which is later used as the main foundation for further research. A systematic analysis of the methods of modern criminalistics used in the field of document analysis is performed. The main issues that can be effectively and efficiently solved through the practical use of modern methods of preparing expert assessments in the field of analysis of documents produced using modern computer technology are outlined.

At the second stage, an analytical investigation of the prospects for using computer equipment for the production of documents and their further practical use was performed. In addition, an analytical comparison of the results obtained with the findings and conclusions of other researchers was performed. This contributes to clarifying the results obtained, expanding the prospects for further analysis of the capabilities of computer technology in the production of documents and conducting forensic analysis of similar documents produced using modern computer technologies.

At the final stage, the final conclusions were formulated based on the findings, which determine the main trends in forensic analysis of documents produced using modern computer technology.

■ Results

The study of the prospects for conducting a forensic analysis of documents made using computer equipment has yielded the following results. Numerous issues related to the use of modern computer technology for the production of documents require a thorough investigation to determine the main areas of using computer technology for the production of documents and the possibilities of effectively stopping this phenomenon. An important aspect in this issue is the identification of the main methods of computer forgery of handwriting and signatures, which are essential from the standpoint of conducting further forensic research of these documents [6].

In general, forgery of handwriting and signatures using computer equipment involves:

1. Use of printers and other technical copying tools. They are necessary for scanning the document, which allows editing its main text if necessary. At the next stage, it is printed out while preserving the required content. In this case, it is necessary to establish an electrographic method of image reproduction. This is done with the typical gloss of the toner, typical dots, and

using surface application of strokes, without penetration into the paper fibres, in the complete absence of any traces of pressure.

2. Use of pantographs – devices that were originally created to reproduce and scale copies of drawings, maps, etc. When using a pantograph, it is possible to find the same, typical pressure that is not inherent in the manuscript. In addition, there will be no variability, because signs of the same type will not have any differences between them.

3. Use of plotters or graph builders, which are advanced versions of the pantograph that are controlled by a computer. A module with any printing device is used to create a high-quality image.

4. Use of a robotic arm. This technology was created specifically for the highest quality reproduction of handwriting. This device also reproduces differentiated pressure. However, in the case of handwriting imitation, the lack of variability can still be detected. In addition, in the case of signature forgery, the situation has significant complications. A monotonous pressure can be detected, including the absence of random strokes, blots caused directly by the device itself, and slowing down of movement. In the presence of a large number of samples, other deviations can also be found.

A forensic examination may be appointed to detect computer forgeries of handwriting and signature. Such an examination helps to solve many issues, including:

– types of equipment that was used to perform the records under study;

– printing devices that were used to create a record subject to forensic examination;

– sequence of drawing intersecting strokes in the studied records;

– was there any preliminary technical training when performing the test recording;

– were additional drawing, erasure, or etching used when applying the records;

– were there any changes to stamps, seals, or strokes in the documents under study, and if so, in what technical way were they made;

– what typographic font was used to create the text under study, if the font is present in the text.

These are only the main questions that are essential when performing a forensic examination, in general, the list of questions to a forensic expert who deals with the issue of conducting a forensic examination of a document made using computer technology is much wider [7].

In general, the tasks of forensic expertise are the following:

– determine the means of forgery of a document or its individual parts;

– determine the computer equipment used to create a forged document;

– establish the primary content of a document, in cases where it has lost readability for any reason;

– determine the deadline for developing a document as a whole or its individual parts.

Forensic examination of documents made using computer technology implies the mandatory participation in this procedure of not only a forensic expert, but also an investigator, who can act independently or with the involvement of a specialist. In general, the purpose of forensic research in documents made using a computer requires the necessary basis [8]. Such a study is a type of forensic examination performed to obtain certain evidence and other objects on behalf of pre-trial investigation bodies and judicial instances to resolve issues put to the expert.

Forensic examination of documents made using computer technology is necessary to determine the facts of forgery of documents, if there is a suspicion of such. In modern criminalistics, there is a conditional division of all detected forgeries into two main types: material and intellectual. Material forgeries involve making false information and illegal changes to a previously created document. Imitation of the original document by a fake is performed in whole or in part. Intellectual forgery involves purposefully drawing up a document in accordance with all the requirements for similar documents, but at the same time, it contains false information. Figure 1 shows schematically the main types of existing material forgeries of documents.

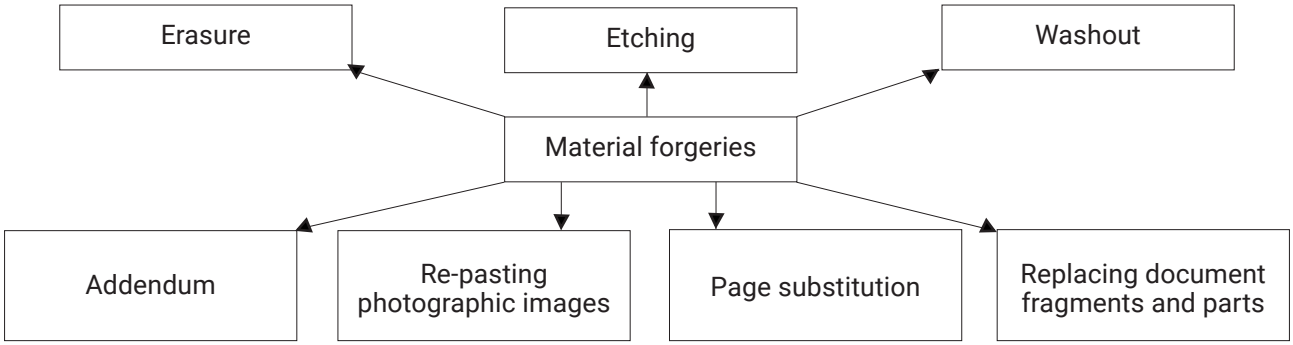

Figure 1. Main types of material forgery of documents

All types of material forgery of documents do not require the use of computer equipment, unlike intellectual forgery. Figure 2 shows the main types of intellectual forgeries, which in some cases are performed using modern computer equipment.

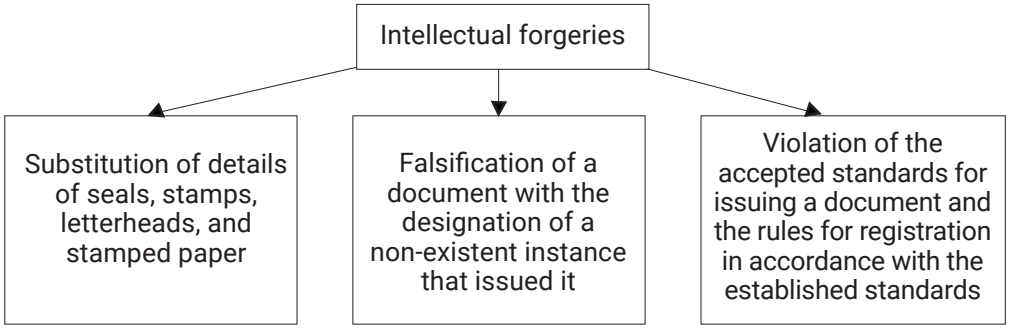

Figure 2. Main types of intellectual forgery of documents

Conducting a forensic analysis of documents made using computer technology allows identifying the main inconsistencies of the document under study in relation to the established sample, which is a sufficient basis for forming a conclusion about the fact of document forgery. Thus, with the help of forensic research, the evidence base necessary for conducting investigative actions and establishing the fact of forgery of documents is collected and systematised. At the same time, the most important aspect in this process is the preliminary receipt of good-quality original samples of documents, which are used during the examination for comparison with samples subject to forensic analysis. This is necessary to identify specific facts of forgery of documents in which there are actual differences between the studied samples and the original ones.

High-quality and professional performance of forensic analysis of documents made using computer equipment requires both the presence of a certain qualification of technical personnel and professional training of the investigator responsible for the correct interpretation of the results obtained and their attachment to the materials of criminal proceedings as recognition as material evidence. In general, research of this kind is one of the new directions of modern criminalistics, which has significant prospects for development in the context of existing and most relevant trends in scientific and technological progress in modern society.

Discussion

Forensic analysis of documents, as a separate and independent branch of modern criminalistics, has existed and developed for quite a long time. However, its individual provisions have not been rather underinvestigated. Forensic analysis of documents has several parallel existing interpretations, which were gradually introduced into circulation and contribute to a more complete perception of the goals and objectives of forensic science, in particular in the context of research on various aspects of document flow [9; 10].

In the 21st century, one of the most promising areas for improving the quality and efficiency of law enforcement agencies in the context of crime investigation and detection is the gradual introduction of new information technologies into forensic science. There is an active transformation of modern criminalistics into a science that uses new knowledge and more effective technologies that contribute to the effective development of criminalistics in general. This knowledge and technologies related to the collection, research, and establishment of a qualitative assessment of physical evidence obtained in the framework of crime investigation activities actively contribute to the creation of appropriate conditions for the development of criminalistics and effective detection of crimes commenced using computer technologies [1].

It often happens that the positive aspects of modern scientific developments in the field of criminalistics begin to be used for criminal purposes. Modern criminals quite actively use the information space and the means of television communications to commit a pre-planned crimes, coordinate their activities, and maintain communication in the criminal group. At the same time, various technical innovations are used directly in the process of committing crimes, thereby leaving electronic traces of their activities. With the help of modern computer technology and information and telecommunications systems today, a huge number of crimes are committed, the mechanism of which is often very difficult to establish [11]. Therefore, the extraordinary activity of introducing modern information and computer technologies into forensic activities and their development by individual criminals has significantly changed modern approaches to the development of criminalistics.

Modern forensic science is increasingly raising questions about the place and role of virtual traces, electronic evidence in science, and even significant trends in the development of modern digital criminalistics. Modern digital technologies in their development

significantly affect the qualitative and quantitative indicators of crime, which marks the emergence of a new criminal environment – virtual digital space.

Nowadays, humanity is very actively entering a completely new stage of its development. Therefore, the impact of modern digital information and telecommunications technologies on everyday reality has become a global phenomenon in the modern world. Every year in many countries, the overall level of digitalisation of the economy and society significantly increases, which opens up new, unprecedented prospects for socio-political development [12]. Among them, this also applies to the legal systems of modern states, in the operation of which modern information technology advances are actively used today.

Discussing the possibilities of the practical application of information obtained during forensic examination of documents, it should be noted that it can be used not only in criminal proceedings. In general, it has much more extensive capabilities.

The results of investigating the materials of many criminal cases on fraud in the receipt of social benefits indicate that employees of social security agencies pay insufficient attention to checking information data about citizens who submit their documents for consideration. In general, this distorts the conditions for committing certain crimes. In this context, the recommendation on the practical application of methods of systematic generalisation of information obtained during the forensic analysis of documents, and to identify those issues that must be paid attention to when receiving a certain list of documents, can show its effectiveness [13].

Of particular relevance is the development and implementation of effective recommendations for conducting such verification of documents, which implies the need to provide the relevant state bodies with high-quality equipment for checking these documents. This problem can be effectively and timely solved through the use of information obtained during forensic examination of documents, and appropriate interdepartmental interaction [14]. Currently, there is a problem of both purely theoretical and practical nature, closely related to the forensic analysis of documents. The key aspects of their further solution should be the emphasis of the scientific community on existing actual theoretical problems and on the real needs of practical activities, as well as updating and developing new methodological recommendations, general principles for the application of methodological recommendations by existing competent authorities, and determining new requirements for the number of experts, their level of competence and the procedure for determining their work experience in a specific position [15].

The main subject of forensic analysis of documents should be considered not just activities to establish specific facts and circumstances of the committed illegal act related to the production, modification, use of documents, but only activities based on the application of special knowledge in this area. This can create the image that the structure of this subject area should include all information about all types of documents that have side confirmations at the level of various ideas about the structure of this division of forensic technology, which exists in the specialised literature, and is described in great detail. At the same time, it is obvious that it is not necessary to include in the subject sphere of this division of criminalistics the activities of all subjects who should temporarily participate in the detection and investigation of crimes committed through the use of modern computer technology to create certain documents [16]. Such an expansive interpretation is mostly found in specialised literature, leading some researchers to refer to the analysis of certain documents also as the practical activities of a certain range of persons conducting enquiries and investigative actions, inspection, seizure of documents or taking samples for comparative examination, which was the main reason for the appearance of the special term "investigative records management".

In modern conditions, characterised by the penetration of the main trends of IT in all spheres of life of modern society, modern information and communication tools are becoming more and more common in the commission of various crimes related to the use of information. They can equally effectively become both a means of committing a crime and its main tool. Any modern electronic devices are able to store traces of any actions in which they were somehow involved. This also applies to many issues of using electronic devices and computer equipment for the production of various documents, for the purpose of their further criminal use [12].

N. Scuddler, R. Daniel, J. Raymond, A. Sears [17] separate the modern provisions of the forensic analysis of computer information as a type of forensic research of computer information and key means of its processing and protection, which requires a thorough investigation of the existing patterns of occurrence and concealment of electronic traces and the development on this basis of technical means, techniques, and methods for their detection, fixation, seizure, and analysis to disclose, investigate, and prevent crimes in the field of using computer technology as a means of manufacturing forged documents. Forensic analysis of modern computer devices is an integral system of scientific provisions and gradually created technical means, techniques, and methods for conducting research of computer devices, information systems, and telecommunications networks as material carriers for the purpose of further investigation and prevention

of crimes in the field of information technology [17].

Forensic examination of documents made using computer equipment implies that representatives of law enforcement agencies responsible for conducting this investigation must have a certain level of competence in understanding the capabilities of modern computer equipment for the production of certain documents. In addition, their ability to build effective interaction with technical units for providing forensic analysis of documents, to obtain the necessary information about the capabilities of certain types of modern computer equipment in creating forged documents, for the purpose of their further use for criminal purposes, is also essential [18]. Thus, depending on the method of manufacturing documents and the computer devices used, it is necessary to perform the correct selection of methods for forensic analysis of documents to prevent crimes in the field of information technologies.

Qualitative and quantitative indicators of crime today mostly indicate a gradual increase in the impact of the development of modern information and digital technologies on the information environment, and also reflect the emergence of a new criminal environment, which has become known as the virtual digital space. At the same time, computer criminalistics is currently insufficiently developed, despite some coverage of this topic by researchers. In addition, it is generally accepted that in the field of digital criminalistics, a thorough analysis of both purely technical and tactical methods of working with various electronic traces should be carried out [19]. At the same time, the issues of developing and implementing new, more modern and reliable means of forensic research are still debatable, often due to a lack of information on this issue. This can be explained by the fact that there is a lack of theoretical and practical experience on the use of modern information and computer technologies in the field of forensic research of various aspects of electronic terrorism and the use of computer tools to commit various criminal acts, one of which is the production of documents for the purpose of their further use for criminal purposes. Further development of modern technologies in the field of forensic analysis of documents produced using computer technology will contribute to effective counteraction to this phenomenon today and in the future.

Conclusions

The study of the prospects for conducting a forensic analysis of documents made using computer equipment has yielded the following results.

1. Forensic examination of documents made using computer equipment should determine the key aspects that are important in the context of the use of computer technology for the production of documents or their forgery. To date, the use of modern computer equipment for forgery of documents has become widespread, and sometimes it is difficult to distinguish forged documents from original ones. In this context, key importance should be given to equipping a modern forensic institution with high-quality equipment that can detect document forgery even in the most difficult cases. In addition, great importance should be given to the level of training of both employees of forensic institutions, whose official responsibility includes high-quality forensic examination of documents, and investigators, who are obliged to subsequently attach the results of research to the case as an evidence base collected during the pre-trial investigation.

2. In the process of conducting a forensic analysis of documents made using computer technology, the main types of forgery of documents are identified. The use of computer technology allows making intelligent forgery of documents in any of its existing varieties. Therefore, the task of experts and investigators responsible for conducting this forensic study and systematising its results includes determining both the types of forged documents and the types of equipment and computer equipment used to produce such documents. The results of forensic research, in general, depend on the quality of the actual performance of the task, which determines the effectiveness of collecting evidence within the framework of a specific pre-trial investigation.

In general, the issues of conducting a forensic analysis of documents made using modern computer technology require further careful study, in accordance with the current pace of development of computer technology and the possibilities of its practical application for the production of a wide variety of documents.

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Криміналістичне дослідження документів, виготовлених за допомогою засобів комп'ютерної техніки

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■ **Анотація**. Актуальність тематики наукового дослідження зумовлена наявністю проблем криміналістичного дослідження документів, а також значущістю практичного застосування комп'ютерної техніки для їх виготовлення. Метою статті є вивчення особливостей використання сучасної комп'ютерної техніки для виготовлення спеціальних документів, а також оцінка перспектив дослідження цих документів сучасними криміналістичними методами. Основу методологічного підходу становить поєднання методів сучасної криміналістики, системного аналізу у сфері дослідження документів з аналітичним дослідженням перспектив застосування засобів комп'ютерної техніки з метою виготовлення документів для їхнього подальшого використання в злочинних намірах. Головними результатами, які одержано в межах цього наукового дослідження, є визначення основних типів підробок документів і критеріїв використання сучасних засобів комп'ютерної техніки для виготовлення документів з метою їхнього подальшого використання в злочинних намірах, а також формулювання основних цілей і завдань виконання методик криміналістичного дослідження документів, виготовлених за допомогою засобів комп'ютерної техніки. Результати дослідження, а також сформульовані на підставі них висновки, мають значущість для співробітників сучасних криміналістичних установ, до безпосередніх обов'язків яких належить виконання криміналістичного дослідження документів, виготовлених за допомогою засобів комп'ютерної техніки, що має суттєве значення з точки зору поширення можливостей для розкриття злочинів, учинених за допомогою сучасного комп'ютерного й електронного обладнання, а також запобігання комп'ютерному та електронному тероризму в повсякденному житті

■ **Ключові слова**: підробка почерку та підпису; криміналістика; електронне обладнання; криміналістична наука; наукові дослідження в криміналістиці; розкриття злочинів