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CHAPTER 14.
THE ROLE OF COMPUTER VISUALIZATION IN THE FORMATION OF MEDIA LITERACY: HOW DIGITAL IMAGES INFLUENCE OUR PERCEPTION OF INFORMATION

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Abstract. The article discusses the role of computer visualization as a key tool for influencing the modern information space. Visual content has become an integral part of communication in the digital age, which necessitates a critical approach to its analysis and interpretation. The author explores how computer visualization contributes to the effective transfer of knowledge, as well as how it can be used to manipulate the minds of the audience.

Particular attention is paid to the phenomenon of deepfakes and the use of artificial intelligence to create realistic but completely falsified images and videos. Such technologies have a wide range of applications – from educational and scientific to potentially dangerous, in particular in political manipulation and the spread of disinformation. In this regard, the importance of developing media literacy, including the ability to analyze and verify visual information, is emphasized.

It also discusses the positive aspects of using computer visualization, in particular in education, journalism, science, and mass communications. Visual tools such as infographics, 3D-models, animations, and interactive graphs help to improve the understanding of complex concepts and contribute to the quality of information perception.

Given the rapid development of digital technologies and their impact on society, the author emphasizes the need to develop critical thinking and skills of conscious consumption of content.

Keywords: Computer visualization, visualization, digital signage, media literacy, visual content.

Introduction. In today's information society, where visual content has become the main means of transmitting information, computer visualization plays an important role in shaping the perception of reality and critical thinking. Thanks to the development of digital technologies, people interact with a huge number of images every day: from photos and videos to complex infographics, animated presentations, and 3D-visualizations. Visual information penetrates all spheres of life – from education and science to mass media, advertising, and social networks. That's why the ability to critically analyze digital images and understand their impact on the perception of information is one of the key skills of media literacy *(Petko, 2024).*

Media literacy is defined as a set of knowledge and skills that allow a person to consciously perceive, analyze, verify and interpret information coming from various media resources. In the digital era, this is especially true, as computer visualization can both

contribute to the effective transfer of knowledge and be used to manipulate public opinion. The use of images in the media affects the emotional state of the audience, creates certain narratives, and sometimes can even distort reality *(Medvedieva, 2020).*

One of the main challenges of the modern information space is the spread of fake news, disinformation and manipulative content. The advent of artificial intelligence technologies, generative algorithms, and deep neural networks has made it possible to create realistic but completely fictional images and videos (the so-called deepfake). Such technologies can be used both for positive purposes (e.g., to recreate historical events or training simulations) and for destructive influence on the public (e.g., political manipulation, fabrication of compromising material, creation of false stories).

At the same time, computer visualization is a powerful tool for developing critical thinking and media analysis. Visual tools such as infographics, 3D-models, interactive graphs, and animations help people better understand complex information, facilitate the educational process, and improve the quality of data perception *(Melnychuk, 2023).* Educational and scientific institutions are actively using computer visualization to create educational materials, and journalists are using it to explain complex social, economic, or environmental phenomena.

Thus, the study of the role of computer visualization in the formation of media literacy is important not only for understanding the modern information environment, but also for ensuring the resilience of society to information threats. It is important not only to recognize visual manipulations, but also to understand the principles of image creation, learn to critically analyze content, and develop the skills of conscious information consumption.

1. Definition and essence of computer visualization

The current stage of education development is characterized by the rapid introduction of information technology, which opens up new opportunities for optimizing the educational process, as well as for creating more efficient and accessible conditions for learning. One of the key tools actively used in educational practice is computer visualization, which provides an interactive presentation of material, allows for a better understanding of abstract concepts, and promotes a better understanding of complex topics. It helps to transform complex theoretical knowledge into visual, understandable images, which significantly increases learning efficiency, reduces cognitive load, and activates students' cognitive activity *(Tkachuk, Bondarenko, 2024).*

Computer visualization has a special role in disciplines such as computer science, where many concepts are abstract and difficult to understand without visual representation. This applies to such important topics as algorithms, data structures, programming, computer graphics, and others (Fig. 1). The use of computer visualizations allows not only to understand the principles of complex systems, but also to carry out their experimental visualization, which allows students to visually observe processes that are difficult to imagine without special tools.

Thanks to computer visualization, students are able to better navigate complex theoretical issues, as visual tools allow them to turn abstract concepts into concrete, understandable illustrations. They can observe the dynamics of changes in real time, track the execution of algorithms, or examine data structures that would be difficult to comprehend without visual tools. For example, when studying sorting or search algorithms,

computer visualization allows you to see each step of the algorithm, which makes it much easier to understand *(Shtaier, Nazarov, Kravets, 2023).*

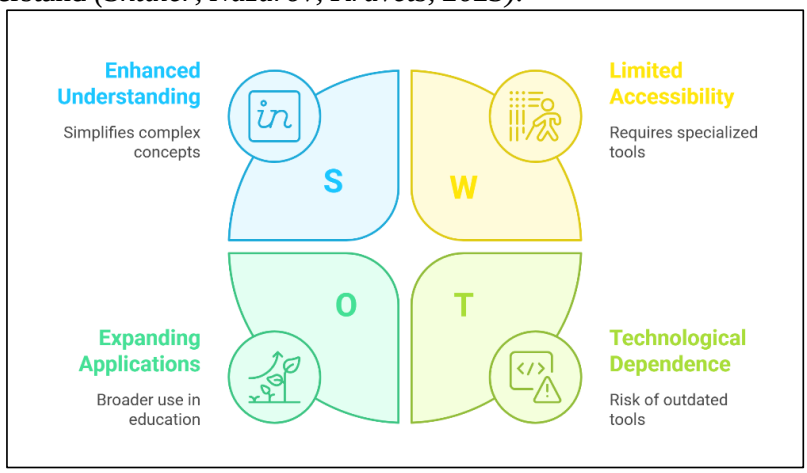


Fig. 1. Computer visualization in education

Computer visualization is also becoming a powerful tool for interactive learning. With the help of tools such as simulations, interactive graphs, or animations, students can not only observe processes but also actively interact with them by changing parameters or testing hypotheses (Fig. 2). This contributes to the development of critical thinking, in-depth understanding of the material, and the ability to apply the knowledge gained in practice. For example, a student can change the input data in an algorithm or vary the parameters of a data model, observing how this affects the result. This approach not only strengthens the understanding of theoretical aspects, but also allows you to develop skills in solving real-world problems.



Fig. 2. Interactive learning cycle

Already at the early stages of learning with the use of computer visualization, one can see a significant reduction in the level of stress among students, as complex theoretical tasks cease to be abstract and difficult to understand. Visual tools provide access to information

in a form that is intuitive, allowing students to navigate new material faster. As a result, students become more engaged in learning, more motivated, and more interested in actively using technology in their educational process *(Titova, 2024)*.

Computer visualization is a process that uses computer technology to create, process, and display graphical objects that help simplify the perception and understanding of information. It includes various forms of data representation, such as graphs, charts, 3D-models, and other visual elements.

This process starts with converting data into a graphical form. Using software allows you to create and manipulate these graphical objects. For example, statistical data can be transformed into graphs that demonstrate trends and correlations that may be less obvious in text form. To create such visualizations, a variety of algorithms are used to generate both static images and dynamic elements such as animations and interactive models.

One of the main functions of computer visualization is to simplify the perception of complex information. Instead of looking at large volumes of numbers or textual descriptions, users can understand data more quickly through visual elements such as graphs and charts. This is especially important for analyzing large data sets, where visualizations can quickly demonstrate key patterns and trends *(Kryvoruchko, Allakulyiev, 2023)*.

Computer visualization also contributes to a better understanding of complex concepts. It allows you to represent abstract or complex ideas in an understandable way. For example, three-dimensional models can represent physical objects and their properties, which can be useful for learning in fields such as science, architecture, and engineering.

In the field of education, computer visualization is of great importance. It can improve the quality of the learning process by helping students to better absorb material through visual representations of complex topics (Fig. 3). Teachers can use visualizations to demonstrate theoretical concepts, conduct interactive lessons, and create dynamic learning environments that stimulate active learning and student engagement *(Kryvoruchko, 2022)*.

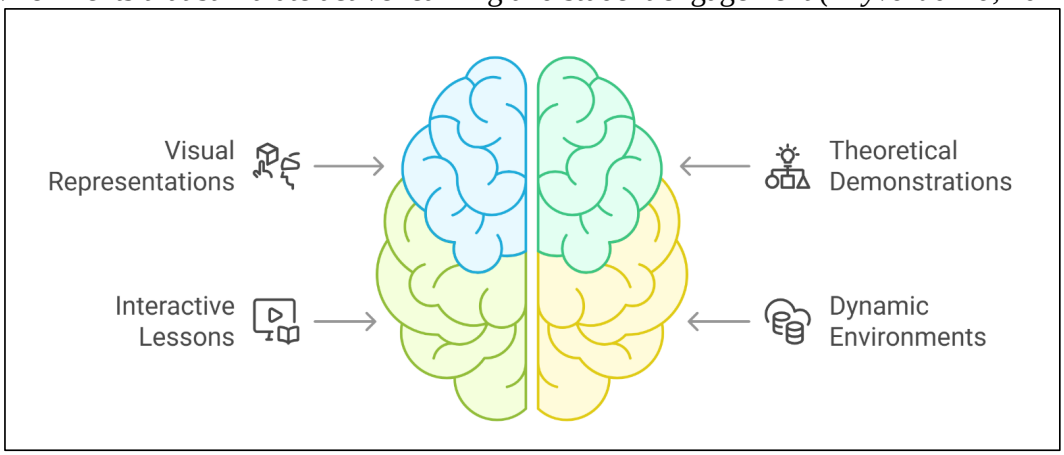


Fig. 3. Computer Visualization in Education

Computer visualization is also widely used in business and industry. For example, in marketing, visualizations are used to analyze consumer data, evaluate the effectiveness of advertising campaigns, and predict market trends. In manufacturing, three-dimensional models allow you to create product prototypes, optimize production processes, and conduct virtual tests before actual production begins.

In the medical field, computerized imaging provides revolutionary opportunities for diagnosis and treatment. Modern methods, such as visualization of internal organs using CT (computed tomography) and MRI (magnetic resonance imaging), allow doctors to obtain detailed three-dimensional images of the patient's body. This helps to diagnose diseases more accurately and plan surgical operations *(Usatiuk, Zhmud, 2018)*.

In addition, computer visualization plays a key role in scientific research. It helps scientists model complex natural phenomena such as climate change, the spread of epidemics, or the dynamics of planetary systems. This allows them to gain new knowledge and create innovative solutions to global challenges.

In today's world, the development of artificial intelligence (AI) technologies further expands the capabilities of computer visualization. AI allows automating the analysis of large volumes of images, improving their quality, and creating realistic virtual worlds. As a result, computer visualization is becoming even more effective in various industries, from entertainment to high-tech innovation.

Computer visualization has prospects for rapid development, in particular through the introduction of augmented reality (AR) and virtual reality (VR) technologies. In these environments, users can interact with digital objects in real time, which creates new opportunities for training, education, gaming, design, and even psychological therapy (Fig. 4). For example, architects and engineers can use VR to inspect projects at scale before construction begins, allowing them to identify potential errors at an early stage.

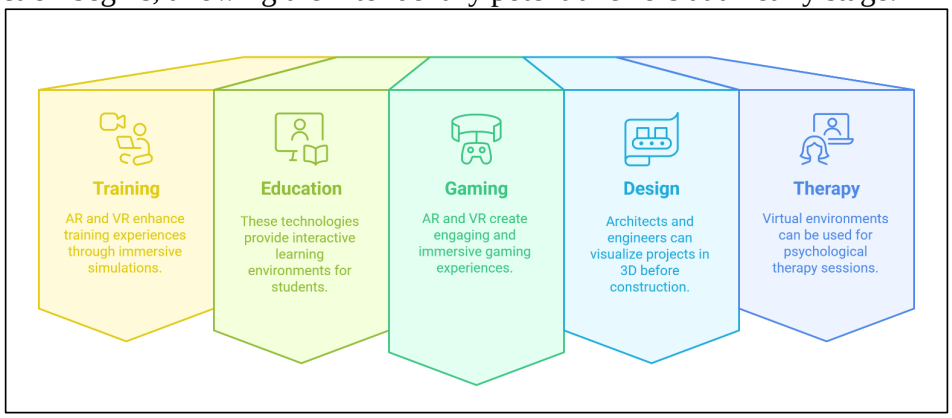


Fig. 4. Application of computer visualization

In cybersecurity and digital forensics, computer visualization helps analyze complex network structures, track threats, and detect anomalies in real time. Visual representation of data flows allows experts to respond faster to cyber threats, optimize system security, and analyze digital traces for investigations *(Kovtaniuk, 2022)*.

Another area where visualization is becoming critical is the development of “digital twins.” These are virtual copies of physical objects such as machines, buildings, or even entire cities. They allow you to run simulations, test changes, and analyze the results without risking the real world. Digital twins are actively used in industry, logistics, and urbanism to optimize processes and predict possible problems.

In art and entertainment, visualization opens up unlimited scope for creativity. By combining computer graphics with neural networks, artists create breathtaking digital paintings, animations, and interactive installations. In cinema and video games,

visualization allows viewers to be transported to fantasy worlds with an unprecedented level of detail and realism.

In particular, in the field of social research, computer visualization is becoming a tool for analyzing and predicting the behavior of large groups of people. This is important for modeling urban processes, assessing the impact of political decisions, and even developing strategies for responding to crisis situations such as natural disasters or pandemics *(Karakoz, 2023)*.

Computer visualization continues to integrate into our daily lives through mobile applications, online services, and devices with advanced functionality. For example, visualization technologies are used in personalized medical applications that help users track their health or learn the anatomy of their bodies (Fig. 5).

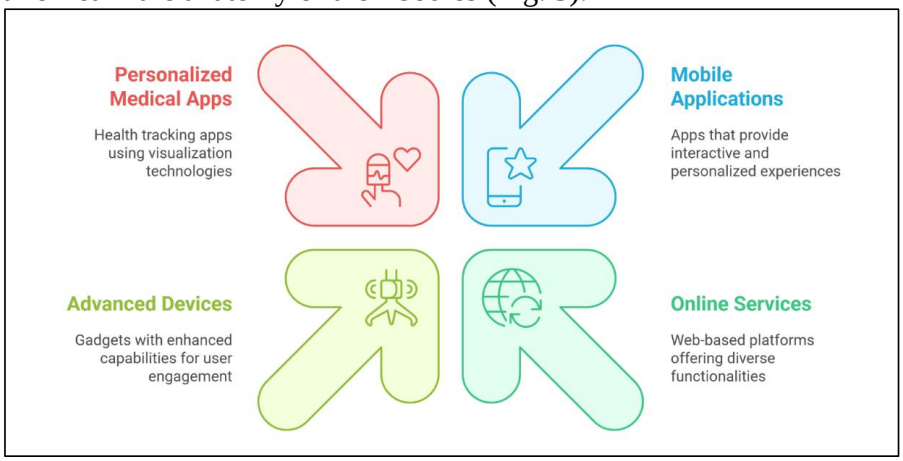


Fig. 5. Integration of computer visualization into everyday life

Computer visualization not only transforms existing industries but also creates new ones, for example, in the field of data and artificial intelligence. Interactive visualizations of big data allow researchers and analysts to interact with information in a convenient format, discover hidden connections, trends, and patterns. This is especially important for making strategic decisions in business, finance, logistics, and risk management.

In the era of smart cities, computer visualization has become a key tool for infrastructure management. For example, digital dashboards allow real-time monitoring of traffic, utilities, air pollution, and much more. This contributes to more efficient use of resources and improves the quality of life for residents *(Holub, Kriukova, Kovalenko, 2021)*.

In the military, visualization provides new opportunities for training and simulation of combat situations. Using virtual and augmented reality simulators, the military can train in a safe environment, practicing strategies and decision-making (Fig. 6). In addition, three-dimensional terrain maps with centimeter-level detail allow for much more accurate planning of operations.

The integration of computer visualization with bioengineering is particularly promising. Real-time visualization of cells, genes, and biological processes opens the door to a more accurate understanding of the nature of life. This can lead to the creation of new medicines, treatment of genetic diseases, and even the cultivation of organs for transplantation.

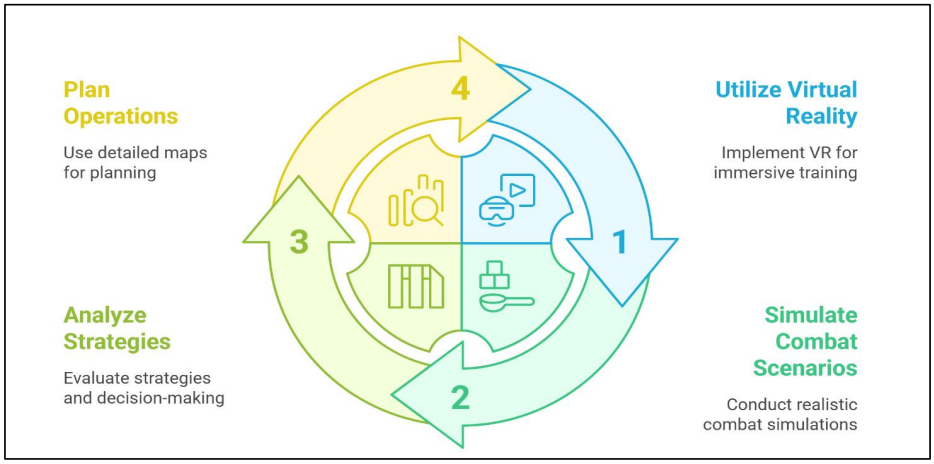


Fig. 6. Military Training Enhancement Cycle

In agriculture, computer visualization allows for optimized crop management. Using drones, satellite imagery, and software, farmers can visually assess soil conditions, plant health, and predict yields. This helps to reduce costs and increase production efficiency *(Bondarenko, 2020)*.

Another area where visualization plays a key role is in ecology and environmental protection. Computer models help reproduce natural systems, analyze the impact of human activity, and predict climate change. Such models enable governments and organizations to develop environmentally sustainable development strategies.

The prospects for computer visualization are also closely linked to the development of quantum computing. The ability to process huge amounts of data and create visualizations of highly complex processes, such as modeling the behavior of elementary particles, can be a real breakthrough in physics, chemistry, and other natural sciences.

Thus, computer visualization is not only a tool for analyzing and presenting information, but also a powerful driver of innovation in many industries. Its future lies in the integration of the latest technologies that will make visualization even more natural, interactive, and accessible *(Avramenko, Usatiuk, 2019).*

2. Deepfakes and mind manipulation: challenges of computer visualization

The development of computer visualization has significantly expanded the possibilities for creating realistic images and videos. Thanks to deep learning and artificial intelligence algorithms, visual processing technologies have reached a level where digital images are almost indistinguishable from real ones.

One of the most common manifestations of computer visualization is the use of digital facial recognition, a technology that allows you to replace people's faces in a video, change their facial expressions and voice with impressive accuracy.

The development of the technology has both positive and negative aspects. On the positive side, they are used in the film industry, to create special effects and recreate historical events, as well as in education and artificial intelligence training *(Kovtaniuk, Titova, 2024)*.

If we look at the negative side of the equation, they are particularly dangerous in the context of information warfare. After Russia's full-scale invasion of Ukraine, the enemy has

been actively using this technology to spread disinformation and manipulate public opinion. Propaganda materials created with the help of dipfakes often contain shocking content that evokes strong emotions in people, such as panic, fear or anger, which makes it difficult to critically analyze information. In addition, the enemy modifies old photos and videos from the territory of Ukraine to create the impression that they are up-to-date, thus misleading Ukrainian society.

Today, there are many online tools and programs that allow you to create a digital signage even without special knowledge of artificial intelligence. Some of them are based on neural networks, while others use face replacement or voice synthesis algorithms. We will review the most popular services, their capabilities, advantages, and limitations.

StyleGAN or ChatGPT generative models combined with the DALL-E neural network (Fig. 7) allow you to create images that have never existed but look absolutely realistic *(Yamkovenko, Kovtaniuk, Kovtaniuk, 2024).* Such technologies can be used for both creative and manipulative purposes. In addition, ordinary photo editing with Photoshop or other graphic editors allows you to change the content of images by removing or adding elements that can change the essence of the information conveyed.



Fig. 7. Image generated by the DALL-E neural network with the query "Ukraine's victory in the war against the invader"

Remini is a popular service that uses artificial intelligence technology to enhance (Fig. 8) and create images. It was originally developed as a tool for restoring old or blurry photos, but over time, it has expanded its functionality to include the ability to generate new images *(Medvedieva, Titova, 2022).*

One of the key features of the service is improving image quality. Remini is able to increase the resolution of photos, eliminate noise and blurring, and add detail. This is especially useful for restoring old or damaged photos, as well as for improving the quality of portraits taken with low-end cameras.

In addition to image enhancement, the service offers the function of generating avatars based on uploaded photos. Users can get images in different artistic styles, such as animated portraits, painting, or digital illustration. This allows you to create unique images that can be used for profiles on social networks or other digital platforms *(Tkachuk, Bondarenko, 2024).*

Another interesting feature is the AI Photo Generator function, which allows you to create images based on a text description or an uploaded photo. Thanks to deep learning algorithms, Remini is able to change facial features, apply stylization to images, and simulate the process of rejuvenation or aging of a person in a photo.

The service is available as a mobile application for iOS and Android. The free version has certain limitations, such as a limited number of treatments per day, watermarks, or ads. To access all the features, you can sign up for a premium subscription, which opens up the possibility of unlimited image generation and enhancement.



Fig. 8. An example of an enhanced photo in the Remini app

Remini remains one of the most popular image manipulation tools thanks to its combination of ease of use and powerful AI algorithms. It is suitable for both ordinary users who want to improve their photos and content creators looking for styling and image generation tools.

Ai Faceswap is a free online service that allows you to quickly and easily replace faces in photos using artificial intelligence. Its main advantage is its ease of use, as it doesn't require registration, software downloads, or complicated settings. All you need to do is upload an image, select a new face, and the neural network will automatically substitute it for the old one (Fig. 9). The process takes a minimum of time, and in a few seconds, you can get the finished result *(Titova, 2024).*

One of the features of the service is the absence of censorship, which means that the user can replace the faces of any people, including famous personalities. This distinguishes it from many similar platforms that have restrictions on the use of celebrity images.

The result of the service is saved in JPEG format with a size of about 232 KB. This means that the photo will have a rather low quality compared to the original (Fig. 10), which can be a disadvantage for those who want to get a high-precision image. However, for entertainment use or quick demonstration of the result, this format is quite suitable.

Ai Faceswap is suitable for those who want to quickly change the face in a photo without too much effort (Fig. 9). It is simple, fast, and requires no special knowledge. At

the same time, the low quality of the output file can be a disadvantage for those who need a more professional result. Nevertheless, the service remains a good tool for fun and experimentation with images *(Lytvynova, Kuzminska, Medvedieva, 2022).*

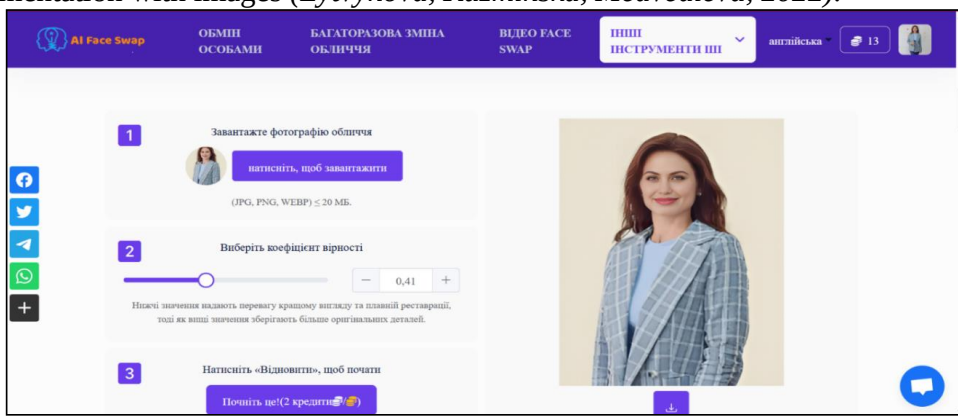


Fig. 9. Face replacement using the online service Ai Faceswap



Fig. 10. The result of the Ai Faceswap service

Vidnoz Face-Swap is an online service for replacing faces in photos and videos using the technology of deepfacing. It allows processing not only static images but also video files, which makes it convenient for creating realistic face replacements in dynamic content. One of the features of the service is its support for multiple deepfakes, which allows you to replace the faces of several people in one frame while maintaining naturalness and high detail.

The service is based on a credit system. Each user receives one free credit, which is enough for one face replacement. In order to download the resulting image or video, you need to be authorized. The free version offers a PNG image of approximately 1 MB in size, which is of high quality but contains a watermark. If the user wants to get a file without a watermark, he or she will have to use additional credits or subscribe *(Kruhlyk, Tryhub, Mamonov, 2022).*

The service stands out among its peers for its ability to work with video and support for simultaneous processing of several people in a frame, which makes it useful for content creation (Fig. 11), editing materials, or entertainment purposes.

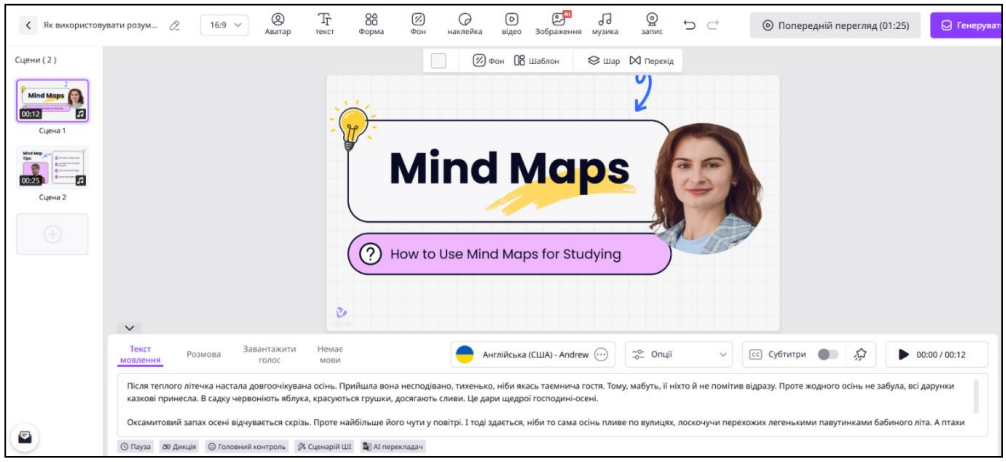


Fig. 11. Creating a video lecture in the Vidnoz Face-Swap service

Face Swap Online Free is a web service that allows you to change faces in photos for free, using artificial intelligence to create realistic and accurate results. The platform works online without the need to install additional software, making it accessible to any user regardless of device.

The main advantage of the service is its simplicity and speed of use. It is enough to upload a photo, select the area to replace the face and add a new image, after which the algorithm will automatically adjust colors, shadows and textures to make the final result look as natural as possible. Thanks to the high-precision technology for recognizing and selecting details, the images are of high quality and realistic (Fig. 12), even without manual adjustment.

The platform is suitable not only for entertainment, but also for professional image editing, as it allows you to fine-tune the face replacement parameters. In some versions of the service, you may be able to edit several faces in one photo, as well as process images with different angles and lighting *(Kryvoruchko, 2024)*.

Among the limitations, it is worth noting that free access may include a watermark on the final image or reduced file quality for saving. Overall, however, Face Swap Online Free is a convenient and affordable tool for quickly swapping faces, suitable for both entertainment and content creation.

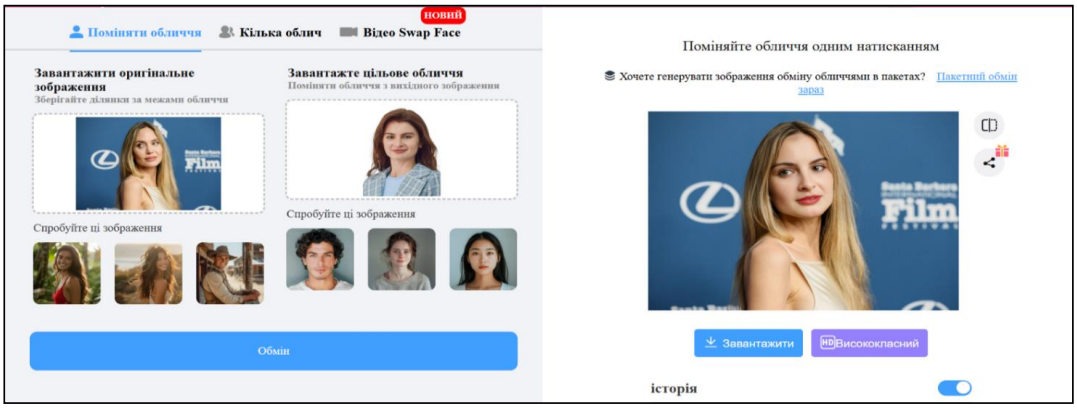


Fig. 12. The result of face replacement in the Face Swap Online Free web service

Faceswapper is a modern platform that uses artificial intelligence to edit images, offering a wide range of tools for manipulating visual content. The main function of the service is to replace faces in photos (Fig. 13) and GIF animations, which allows you to create realistic and dynamic effects without the need for special skills in graphic design.

In addition to the standard face substitution, Faceswapper provides a unique opportunity to change the clothes on a photo, which opens up new horizons for personalizing images. This allows users not only to change faces but also to experiment with style, creating holistic and harmonious images.

The platform is powered by powerful neural network algorithms that ensure high quality processing, natural replacements, and smooth GIF animations. The intuitive interface allows you to quickly upload images, select the necessary effects, and get the finished result without any extra effort. The combination of functionality and ease of use makes Faceswapper the perfect tool for creativity, entertainment, and visual experimentation *(Kryvoruchko, Kovtaniuk, 2022).*

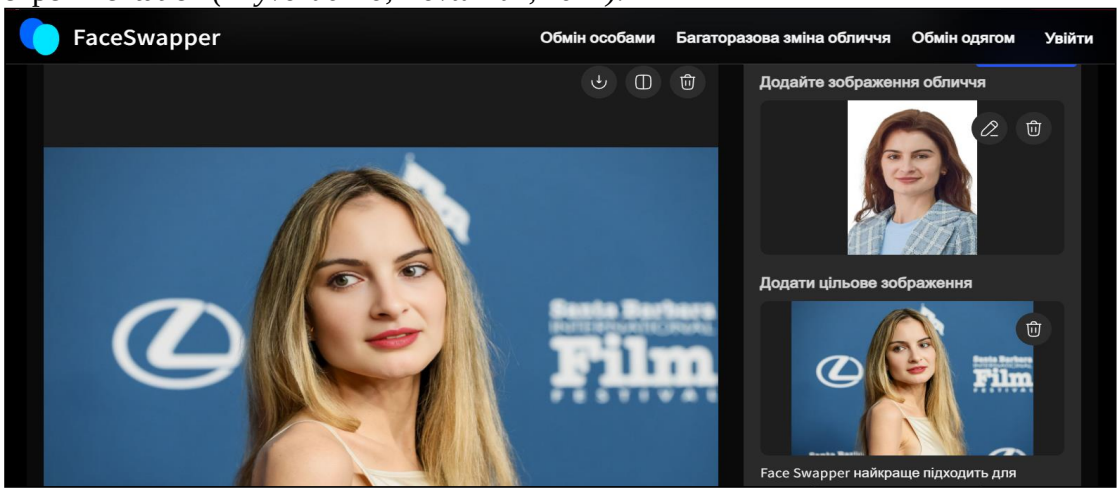


Fig. 13. The result of face replacement in the Faceswapper service

Elai.io is an innovative platform that allows you to create training videos using artificial intelligence, completely eliminating the need for cameras, studios, or green screen. This technology allows you to generate professional videos with virtual presenters in just a few minutes, making the content creation process fast, affordable, and efficient.

The service offers a wide range of avatars – digital presenters who voice text in a realistic and natural way. The user only needs to upload or enter text, and then the neural network will automatically create a video, synchronizing the speech and movements of the virtual presenter (Fig. 14). With support for multiple languages and different voice models, Elai.io is suitable for creating content for a global audience *(Baranetska, 2019).*

The platform's interface is intuitive and does not require special skills in video editing or working with graphic editors. Users can add their own backgrounds, insert images, slides, or text blocks, allowing them to create personalized videos for specific needs – from corporate training to marketing presentations and educational courses.

However, the development of such technologies also raises the issue of deepfakes – videos created with the help of artificial intelligence that can imitate real people. Deepfakes offer great opportunities for creativity and content automation, but also raise concerns about

their potential use in manipulation and disinformation. Elai.io applies ethical approaches to content creation, providing users with legal and transparent tools for video generation. It is important to note that this platform is not intended to create misleading or fraudulent digital avatars. All digital avatars are officially created models, and users cannot replace the faces of real people without their consent.

The platform is an ideal solution for companies, educational institutions, and content makers who want to create high-quality learning materials quickly and efficiently without high production costs. Elai.io greatly simplifies the process of producing video content, making it accessible to anyone who wants to convey information to their audience in a modern format *(Medvedieva, Titova, 2022).*

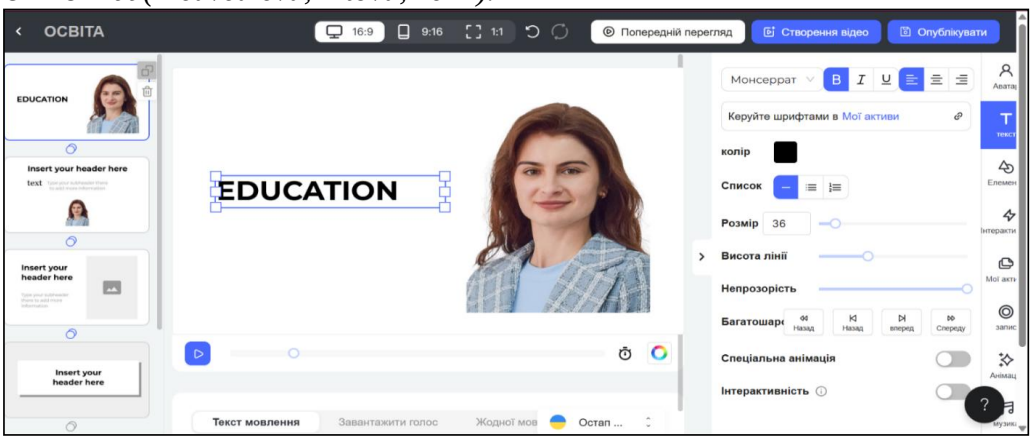


Fig. 14. A digital presenter who reads the text

Consider Canva, one of the most popular online graphic design editors that also has features for creating manipulative images, including digitized images. Although Canva is not a specialized service for creating complex neural network-based dipshots, its capabilities allow users to change faces, edit photos, and create realistic fakes using built-in artificial intelligence tools (Fig. 15).

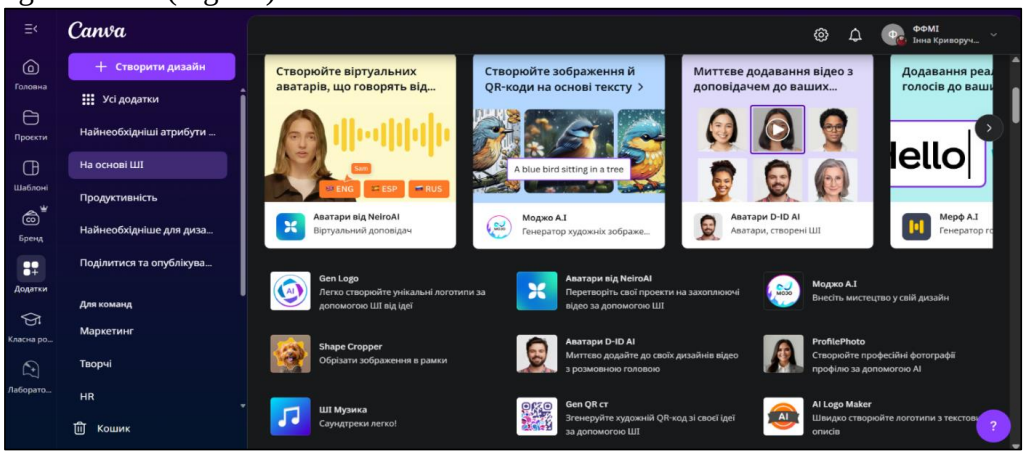


Fig. 15. Applications in the Canva online service based on artificial intelligence

Magic Media in Canva is a powerful AI-powered tool that allows users to create and edit media files, including images and videos. This tool opens up new possibilities for

designers, marketers, and anyone working with visual content by providing simple and intuitive ways to automate creative processes.

One of the main functions of Magic Media is to generate images based on text queries. The user can describe the desired result in a few words or sentences, and artificial intelligence will instantly create the appropriate graphic (Fig. 16). This allows you to quickly get unique illustrations without wasting time searching through photo stocks or drawing them manually. The image generator supports various styles (Fig. 17) and formats, so users can customize the visual design to suit their needs *(Kryvoruchko, Titova, 2024)*.

In addition to creating static images, Magic Media also works with videos. It can edit videos, change their backgrounds, add effects, or even generate new animated scenes based on a text description. This greatly simplifies the process of creating advertising materials, social posts, and presentations.

Another important feature of Magic Media is automatic image quality enhancement. Artificial intelligence algorithms are able to recognize problem areas in photos, eliminate blur, improve colors, and adjust lighting. This is especially useful for those who work with low-quality photos or want to quickly edit images before using them in a project *(Kruhlyk, Tryhub, Mamonov, 2022)*.

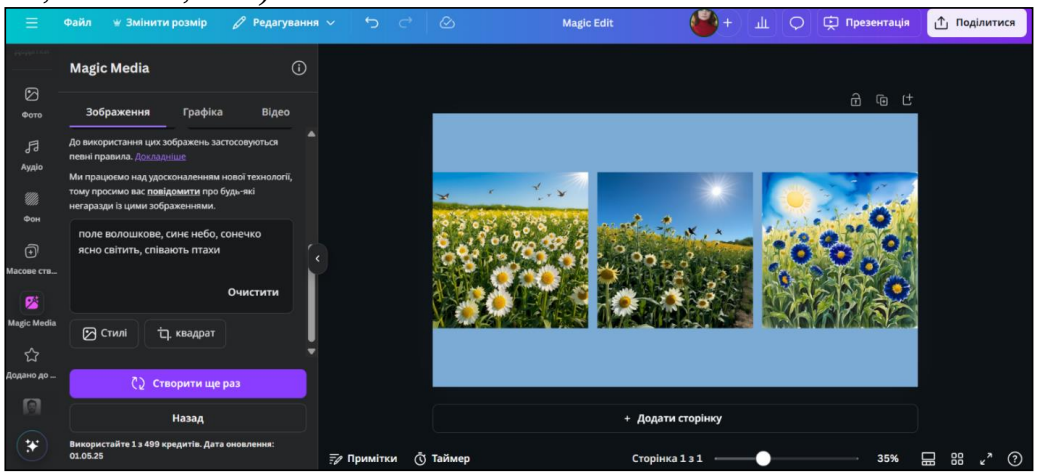


Fig. 16. Generated images for a specific request

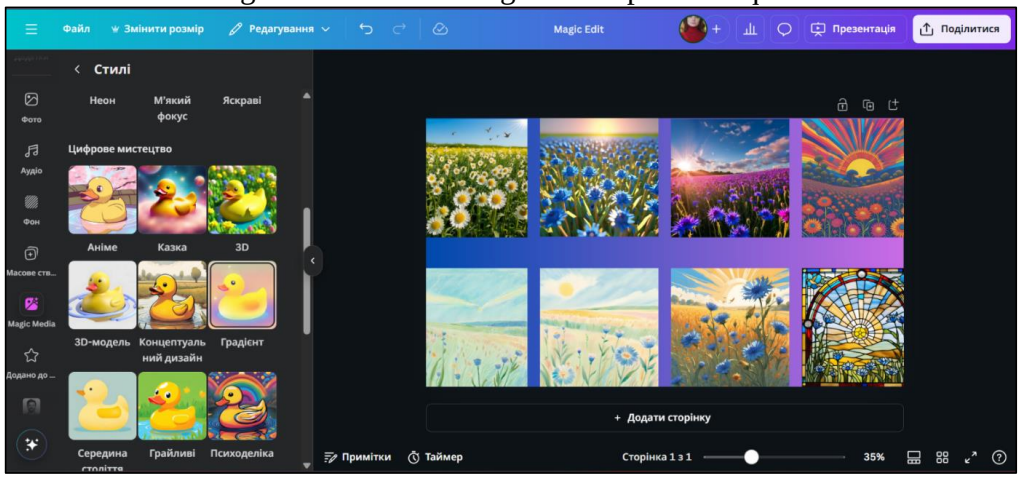


Fig. 17. Different styles of generated image on request

Magic Media can also help with editing faces and objects in images. The user can easily change facial expressions, remove unwanted elements, or adapt the background to a new style. All this happens automatically, without the need for deep knowledge of graphic design.

Thanks to Magic Media's integration into the Canva interface, this tool remains accessible and easy to use even for beginners. All changes are applied in real time, and intuitive settings allow you to quickly get the desired result. Magic Media makes content creation much easier, reducing time spent on mundane tasks and allowing you to focus on your creativity.

With the Canva for Education plan *(Kovtaniuk, 2024)*, users get access to the Background Removal feature for free. This feature is powered by artificial intelligence and allows you to cut an object out of the background very accurately and cleanly with just one click (Fig. 18).

Unlike many other services that leave jagged edges or distorted details after removing the background, Canva's deep learning algorithms carefully determine the boundaries of the object, ensuring maximum clarity and a natural look. Even if the background has complex details or gradients, Canva removes them correctly without unnecessary artifacts.

This is especially useful for creating professional presentations, training materials, or creative projects. Since the feature is available in a free plan for educators and students, it becomes an indispensable tool for those who want to work with high-quality graphics without extra costs and complex editing (*Medvedieva, Zhmurko, Kryvoruchko, Kovtaniuk. 2021).*

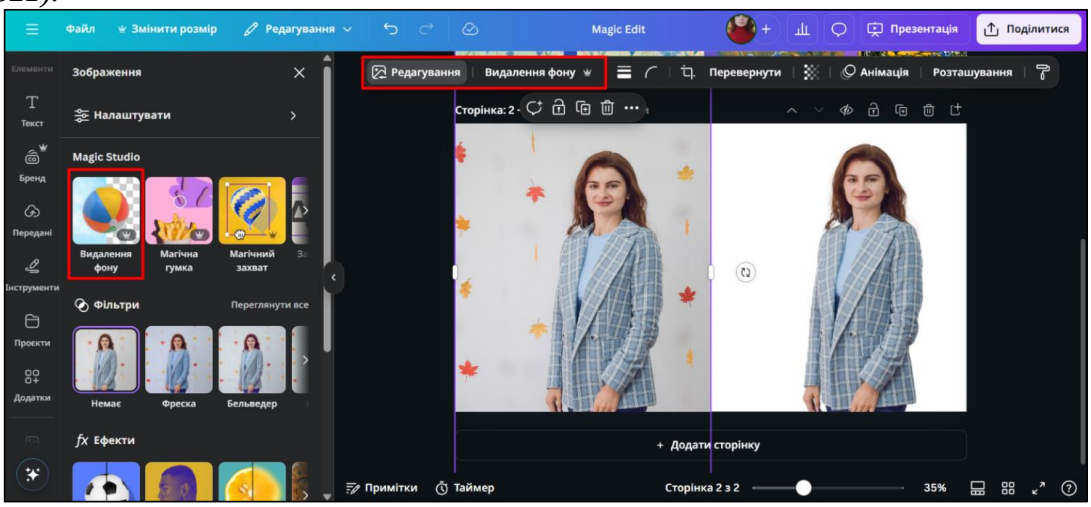


Fig. 18. Remove the background from the image

Canva also has AI image generation (Fig. 19), which allows you to create new faces or modify existing images based on text queries. This feature can be used to generate fake photos, which is potentially misleading if used for manipulative purposes.

Unlike professional services for deepfakes, Canva does not use deep neural networks to replace faces in videos, but its tools can create plausible photo fakes, which also poses a risk. Therefore, the use of such features requires a responsible approach and awareness of the ethical aspects of working with visual content.

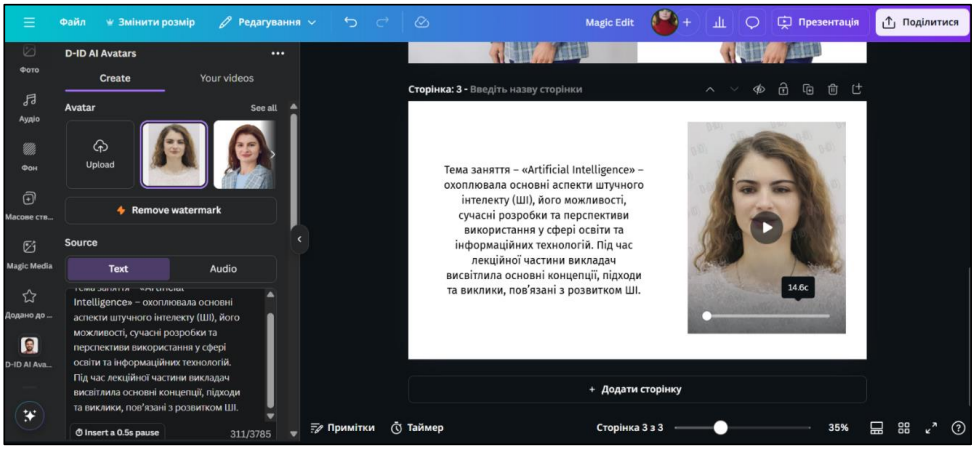


Fig. 19. A video created from a photo using the «D-ID AI Avatars tool»

As for voice diphones, there are specialized services that allow you to clone the voices of famous people or create fully synthetic voices that can imitate real ones.

Retrieval-based Voice Changer (RVC) is an advanced technology based on deep neural networks that allows you to change the voice of one speaker to another person's voice (Fig. 20). It works on the principle of training models on audio recordings, which makes it possible to achieve realistic voice imitation with a minimum amount of input data. The main advantage of this technology is the ability to create high-quality voice dipfaces using only a ten-minute sample of the target person's voice *(Tselik, 2024)*.

The RVC system is based on deep neural networks that analyze voice features, including timbre, intonation, and articulation. This allows the model to accurately reproduce the speech characteristics of a particular person and apply them to any other voice recording. The algorithm is based on methods of extracting and transforming acoustic features, which allows synthesizing voice fragments with a natural sound and a high level of authenticity.

RVC technology is used in various fields, including dubbing, voice assistants, and the entertainment industry. It makes it possible to change the voices of actors, synthesize the voices of historical figures, or even create personalized audio messages. At the same time, its use raises ethical and security issues, as it can be used to create unfair fakes. That is why the development of RVC is accompanied by the development of mechanisms for detecting fraud and regulating its use.

OpenAI's Voice Engine is a tool for realistic voice synthesis that can reproduce a human voice based on only a 15-second audio sample and a text input signal (Fig. 21). By using deep neural networks, this technology allows you to accurately reproduce the timbre, intonation, and rhythm of a particular person's speech, creating a natural and authentic sound.

The main feature of Voice Engine is its ability to quickly adapt to new voices, making it an effective solution for various tasks such as automated dubbing, voice assistants, and personalized audio services. However, due to the potential risks associated with voice fraud and possible abuse, OpenAI has limited public access to this technology *(Yamkovenko, 2023)*. Currently, it is used only in selected services, including ChatGPT for generating natural voice communication, as well as in cooperation with Spotify for automatic dubbing of podcasts in different languages.

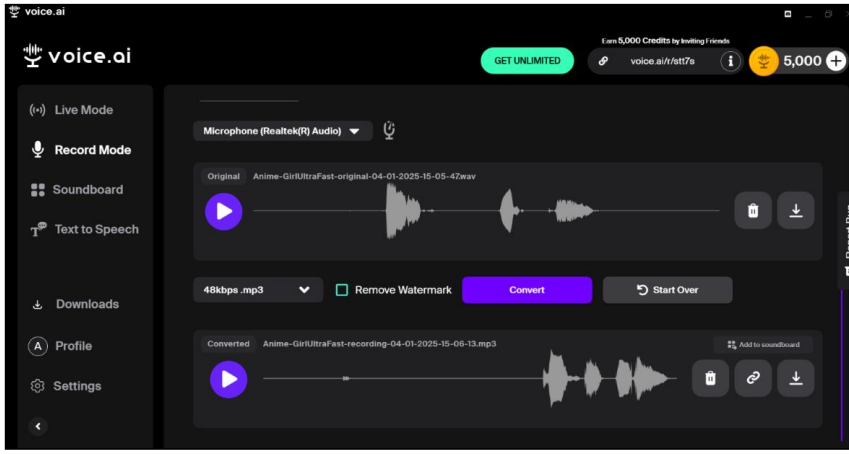


Fig. 20. Replacing the voice of one speaker with the voice of another person in Retrieval-based Voice Changer

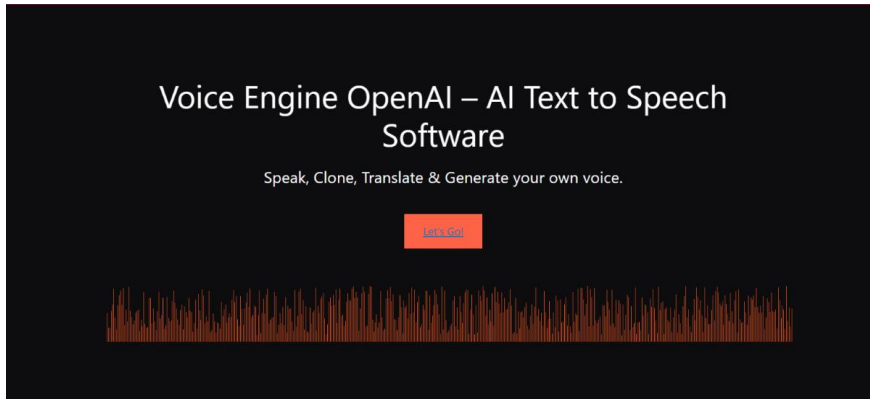


Fig. 21. A tool for realistic voice synthesis Voice Engine by OpenAI

The development of the Voice Engine takes place in the context of growing concerns about the security of voice technologies, so OpenAI focuses on implementing ethical restrictions and mechanisms for identifying synthesized voice. This should ensure responsible use of the technology and prevent its abuse in areas where voice authenticity is critical.

Microsoft's Azure AI Speech Text to Speech Avatar is an innovative feature that allows users to create realistic videos with digital avatars that can voice text scenarios (Fig. 22). This technology combines advanced deep learning algorithms responsible for speech synthesis with animation control models that synchronize facial and lip movements with the voice to provide a natural presentation of information.

To create such an avatar, the user uploads an image of a person, which the system uses to generate a digital model. Next, a text script is entered and processed using highly accurate text-to-speech (TTS) algorithms that support a wide range of languages and voice styles. The model not only generates a synthetic voice, but also analyzes speech characteristics such as tone, pauses, and accents, making speech as natural as possible. At the same time, the system reproduces the corresponding facial expressions, mouth and head movements to create a realistic visualization of speech *(Titova, 2024)*.

With the ability to personalize avatars and customize voice parameters, this technology is used in a variety of industries, including education, marketing, corporate communications, and customer service. Azure AI Speech Text to Speech Avatar allows companies to create interactive presentations, virtual assistants, and training videos without the need for real actors or speakers.

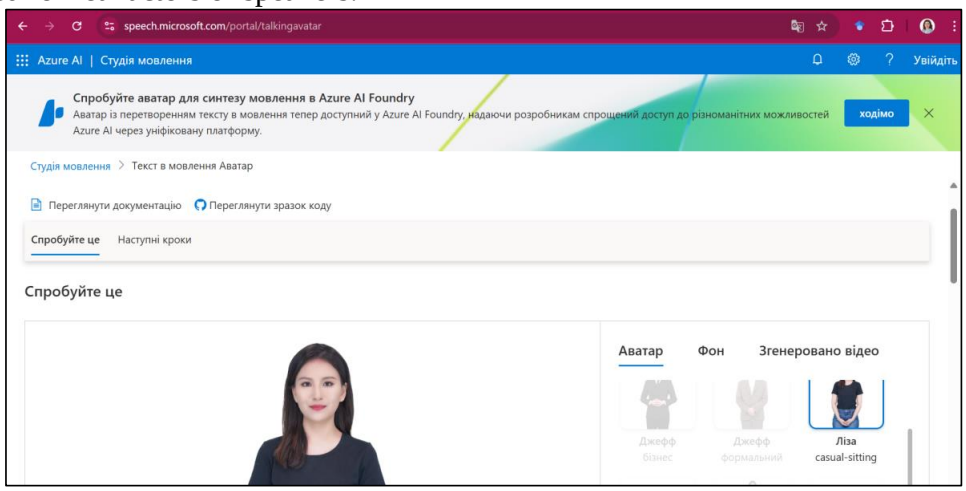


Fig. 22. Create a video with digital avatars using Azure AI Speech Text to Speech Avatar from Microsoft

Microsoft focuses on the ethical use of this technology by introducing restrictions and verification mechanisms to prevent potential misuse. This includes controlling access to avatar creation and the use of watermarks or markers to identify artificially generated content. Thus, Azure AI Speech Text to Speech Avatar combines advanced speech synthesis and animation technologies to provide users with a powerful tool for creating realistic digital representatives.

ElevenLabs is an artificial intelligence service designed to generate audio from text with extremely high quality synthesized voice (Fig. 23). Its technology is based on deep neural networks that analyze natural speech features such as intonation, timbre, pauses, and emotional nuances, which allows you to create the most realistic voice.

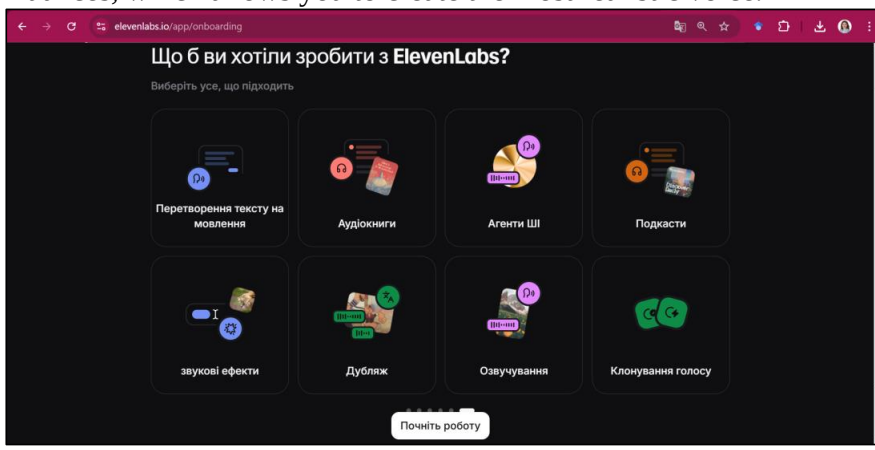


Fig. 23. Types of audio generation from text

One of the key advantages of ElevenLabs is its ability to mimic human speech patterns with great accuracy, making it ideal for audiobooks, videos, podcasts, and even interactive applications. Users can choose from a variety of synthetic voices or create personalized models based on specific speech patterns. The system also supports multilingual synthesis, which allows you to generate voice recordings in different languages with natural accents and intonation.

Thanks to its flexible customization options, ElevenLabs allows you to control the emotional tone of the voice, adjust the speed of speech, and adapt the voice to different contexts, such as formal speeches, literary reading, or interactive dialogues. This makes the service a valuable tool for content makers, journalists, educational platforms, and businesses that use voice technologies to automate communications.

The company pays considerable attention to the ethical aspects and security of its technology, implementing mechanisms to protect against abuse, such as limited access to voice cloning functions and verification systems that prevent unauthorized use of voice models. This makes ElevenLabs not only a high-tech, but also a responsible solution in the field of speech synthesis *(Kovtaniuk, 2022).*

Hume AI is an innovative voice generation tool that is distinguished by its ability to convey a wide range of emotional tones, making synthesized speech more natural and expressive (Fig. 24). Its technology is based on deep neural networks that analyze and reproduce the peculiarities of human emotional communication, providing realistic voice with variable intonation, rhythm, and timbre.

The main advantage of Hume AI is the ability to adapt the voice to the context, conveying emotions such as joy, sadness, surprise, anger, or calmness. This makes it possible to create audio content that evokes a deeper engagement and emotional response from the listener. The technology can be used to dub movies and videos, voice interactive characters, create voice assistants, and generate personalized audio messages that sound as human as possible.

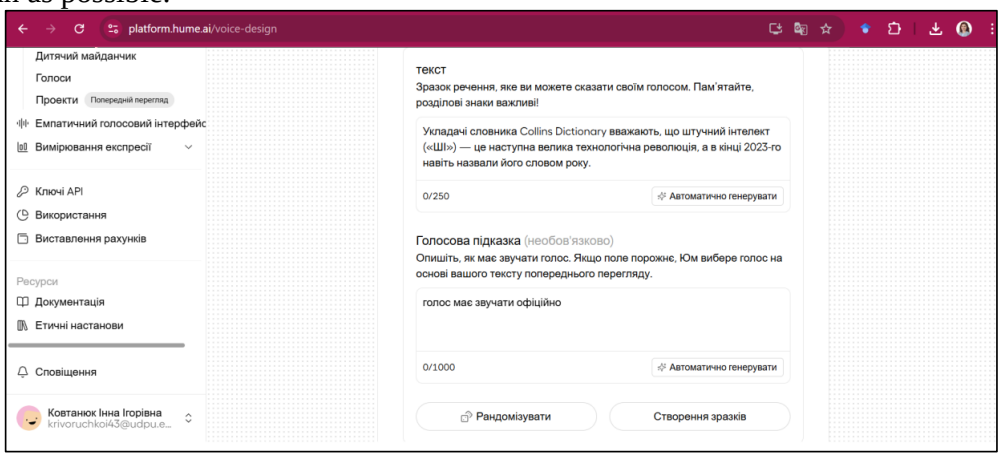


Fig. 24. Hume AI – a tool for voice generation

Hume AI allows users to customize the level of voice expression, adjust the strength of emotional expressions, and experiment with different speech styles. This allows content creators, companies, and developers to create more convincing and engaging voice interfaces. The technology is also used in the field of artificial intelligence research, where

modeling emotions in speech is key to developing more natural and responsive AI systems *(Medvedieva, 2024)*.

Hume AI pays special attention to the ethical aspects of using its technology, implementing control and verification mechanisms to prevent potential misuse. The company focuses on ensuring that synthesized voice is used responsibly and contributes to improving the quality of interaction between humans and artificial intelligence.

Despite the fact that services for creating deepfakes are gaining popularity and are constantly improving, this poses serious challenges for ensuring digital security and the veracity of information. Every year, more and more fake videos and images are being posted online, manipulating the perception of events and influencing public opinion. Thus, as technologies for creating fake videos are developing, the demand for services capable of detecting such manipulations is growing. Systems that use artificial intelligence algorithms, machine learning, and other innovative methods have become important tools in the fight against fake content. They help to detect even the most sophisticated spoofs, protecting users from misinformation and falsifications *(Yamkovenko, 2024)*.

Among the most famous developments in this area are Microsoft Video Authenticator, Deepware Scanner, and Sensity AI, which can automatically check content for signs of a deepfake.

Microsoft Video Authenticator is a tool developed by Microsoft to authenticate images, videos, and audio files. It uses artificial intelligence to analyze digital materials and determine whether they have been altered or created artificially. The program is able to detect traces of editing, analyze pixel anomalies, and assess the level of manipulation, providing the user with a percentage of the probability of fake.

This tool can work with both static images and real-time video, analyzing it frame by frame. The main goal of Video Authenticator is to identify deep fakes that are actively used to spread disinformation, create fake news, and manipulate social media. It can be used in journalism to verify the authenticity of materials, in cybersecurity to protect against fraud, in the corporate environment to prevent fraud, and even in forensic examinations to assess the authenticity of digital evidence.

However, despite the power of the technology, it does not guarantee one hundred percent accuracy. Deep fakes are constantly being improved, and some sophisticated fake methods may go undetected. In addition, processing such data requires significant computing resources, and the algorithm itself must be regularly updated to remain effective in the fight against the latest manipulation methods. Microsoft Video Authenticator is an important step in the fight against disinformation, but it should be seen as one of the verification tools, not an absolute solution.

Deepware Scanner is a mobile application developed by Deepware that is designed to detect deep fakes in videos and images. It uses machine learning algorithms to identify manipulation of media content and help users recognize potentially fake materials.

The application works by analyzing videos and images, checking them for digital anomalies that usually remain after deep learning algorithms are used to create fake content. Deepware Scanner is able to recognize the characteristic defects of deep fakes, such as unnatural eye movements, incorrect shadows, distortion of skin textures, or anomalies in lip synchronization with the voice.

The main feature of Deepware Scanner is its accessibility for users. It offers an easy way to check videos without the need for deep technical knowledge. Users can upload a video file or paste a link to an online video, and the program analyzes it and gives a result with a level of suspicion.

This tool is especially useful on social media, where deep fakes are used to spread disinformation, manipulation, and blackmail. Journalists, researchers, and ordinary users can use Deepware Scanner to check suspicious content before it is shared.

However, like most similar solutions, Deepware Scanner does not guarantee absolute accuracy. Some complex falsifications may go undetected, and the results of the analysis should be taken as an additional level of verification, not a final conclusion. In addition, the tool needs to be constantly updated to adapt to new methods of creating deepfake content.

Despite these limitations, Deepware Scanner is a useful solution for combating digital fakes and increasing media literacy *(Kryvoruchko, 2024)*.

Sensity AI is a company that specializes in detecting and analyzing deep fakes, as well as protecting against digital manipulation and cyber threats. It uses advanced artificial intelligence, machine learning, and computer vision algorithms to identify fake videos, images, and audio files. Sensity AI technology works in real time, analyzing large amounts of data and identifying potential threats.

This platform is actively used in various fields such as cybersecurity, media, finance, law enforcement, and the corporate sector. It helps to combat disinformation, digital fraud, and manipulative content that can be used for blackmail, financial fraud, or undermining trust in public institutions. Sensity AI is also capable of analyzing audio recordings and detecting fake voice messages, which is an important tool in financial institutions and legal processes.

The company offers analytical solutions that can integrate with existing security systems to help organizations quickly identify and block threats. Its technology is constantly being updated to meet the challenges posed by the latest deepfake manipulation techniques. Despite their effectiveness, even such advanced systems cannot guarantee one hundred percent protection, as deep fake technologies are evolving rapidly. Sensity AI continues to improve its algorithms to remain one of the leading solutions in the fight against digital threats.

Digital watermarks and content verification technologies are also being actively implemented. For example, Adobe, together with partners, is developing the Content Authenticity Initiative (CAI) standard, which allows embedding metadata confirming their authenticity in digital images and videos. This helps to track the history of changes in a file and detect manipulations. Similar approaches are also used in blockchain technologies, where the history of each media file is recorded, making it more difficult to fake *(Titova, Kryvoruchko, 2024)*.

An important area is to increase the level of media literacy among the population. Since even the most advanced recognition algorithms cannot guarantee 100% protection against manipulation, people must learn to critically evaluate content. Media literacy education programs teach people to check information sources, analyze the context of images, and use fact-checking tools. For example, to check photos, you can use Google Reverse Image Search, TinEye, which allow you to find the original photo and determine whether it has been altered.

Another important approach is to create legal and regulatory mechanisms to regulate deepfakes. Some countries have already introduced legislative initiatives that provide for liability for the distribution of malicious deepfakes. For example, the United States has passed laws criminalizing the use of deepfakes for disinformation in election campaigns or cybercrime. Such initiatives are aimed at limiting the use of this technology for malicious purposes.

Social platforms also play a key role in the fight against manipulation. Large companies such as Facebook, Twitter, and YouTube are implementing automatic labeling of potentially fake content and removing dangerous dipshits that can mislead users.

Thus, the fight against dipfakes requires a comprehensive approach, including the use of technological tools, the development of critical thinking among users, strengthening legislative control and the responsibility of digital platforms. Only a combination of these methods will effectively reduce the impact of manipulative content on society.

Conclusions. In today's digital world, digital technologies are rapidly evolving and becoming more accessible to the general public. This opens up great opportunities for creativity, art, advertising, cinema, and even educational projects. However, this also poses a significant threat: the use of diphones to manipulate public opinion, create fake news, fake videos and images that can influence politics, the reputation of individuals, and social processes in general.

One of the main problems with fake news is that it has become so realistic that even experienced users sometimes cannot distinguish between fake and real content. This creates the ground for disinformation, manipulation, and cybercrime. As a result, a person who lacks critical thinking skills and media literacy can easily become a victim of information attacks *(Tkachuk, Bondarenko, 2024).*

That is why it is important not only to understand the capabilities of these technologies, but also to learn how to identify their manipulative aspects. A modern media user should be able to analyze content, pay attention to its sources, check the accuracy of information, and use tools to recognize fakes.

One of the key aspects of the fight against fake news is the development of critical thinking. People should question overly emotional or sensationalized content, verify information through several independent sources, and use special services that help identify fakes. In addition, at the societal level, it is important to implement media literacy education programs to help people better navigate the digital space.

Thus, while dipshares can be a powerful tool for creative and entertainment purposes, they also pose a significant threat to society if used for manipulative purposes. Therefore, it is necessary to raise the level of media literacy, foster a culture of critical thinking, and learn to consume information responsibly in the digital age. This is the only way to minimize the negative effects of the use of deepfake technologies and effectively counteract the spread of disinformation.

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