

# design

scientific magazine on graphic  
design and new media



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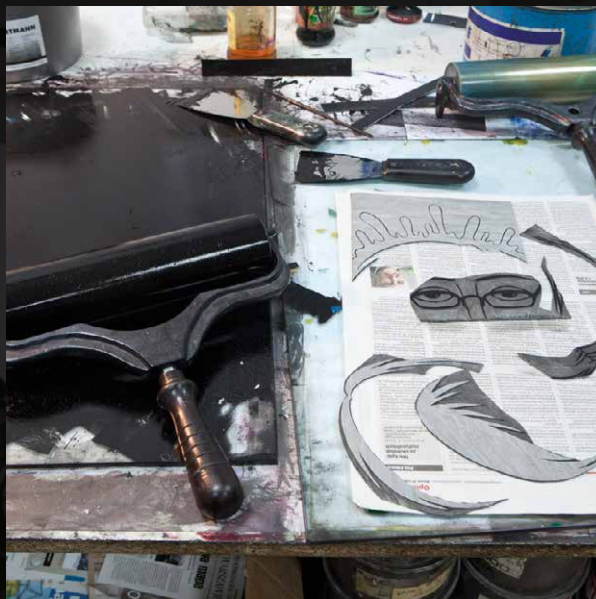


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- Multimedia techniques

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- Computer graphics



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We are delighted to present the fourth issue of our magazine, which bridges science, graphic design, and multimedia technologies. It provides a space for exchanging ideas and exploring new creative directions. Design, as a dynamic and interdisciplinary area, evolves through a constant dialogue with technological advancements, shaping our environment and ways of thinking.

In this edition, we once again turn our attention to artificial intelligence, which is making increasingly bold inroads into the world of creativity. AI is transforming not only the designers' tools but also their approach to the creative process. Can machines become partners in art, and if so, to what extent? What challenges and opportunities arise from integrating algorithms into design? In this issue, the authors showcase practical applications of technologies such as MidJourney, Cinema 4D, and ChatGPT in creating graphics, art installations, 3D models, and photography.

We also present projects of graduates of the WIT Academy in Warsaw, featured as part of the „Upgrowth” exhibition. These projects span diverse areas of graphic design, including applied graphics, interface design for websites and applications, and modern multimedia forms. The

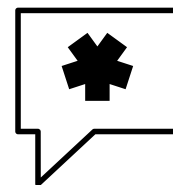
exhibition not only summarizes the educational journey of these young artists but also highlights their potential and impact on the future of the creative industry.

Additionally, we include an article on the significance of the language of art, exploring how artistic works can serve as a bridge between the creator and the audience, uncovering various contexts and modes of interpretation. Rounding out the issue is an interview with the author of a globally acclaimed book on typography. The interview touches on the future of digital and print publications, the diversity of typography, and innovations in graphic design.

We hope this issue will serve as a source of inspiration and a catalyst for further exploration.

May this issue spark  
your creativity!

**Magdalena Mirkowicz**, PhD  
Editor-in-Chief of **dsignn**



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## UPGROWTH the Best Diplomas of WIT Academy

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**Małgorzata  
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WIT Academy

# UPGROWTH

## the Best Diplomas of WIT Academy

The decision to set up the Graphics course at the IT Faculty seemed risky and difficult. A technical university operating under the auspices of Polish Academy of Sciences wanting to create an art-and-design degree course. However, the theoretically opposing fields were successfully married together.

From the very beginning we had to compete with other private and public universities. After several years of the course being offered, it turned out that, despite the fact that we did not require any exams or submission of portfolios, the diploma work created at our university had been of a very high – both artistic and technical – standard. We wanted to show this off and to promote the best designs by our students. This is how the idea of Upgrowth came about – an annual exhibition of the best WIT diplomas.

As Professor Rafał Strent, an eminent Polish graphic artist and a lecturer at our university, wrote in the introduction to the first Upgrowth catalogue: “The graphics curriculum is based here on the principle of unity of art and design known from Bauhaus...”. On the one hand, we devote a lot of time to traditional arts – painting, drawing or workshop graphics, on the other hand, the well-equipped computer laboratories and excellent teachers make it possible to teach, and extract from students, functional graphics or multimedia creativity that is not limited by technical constraints. ►►



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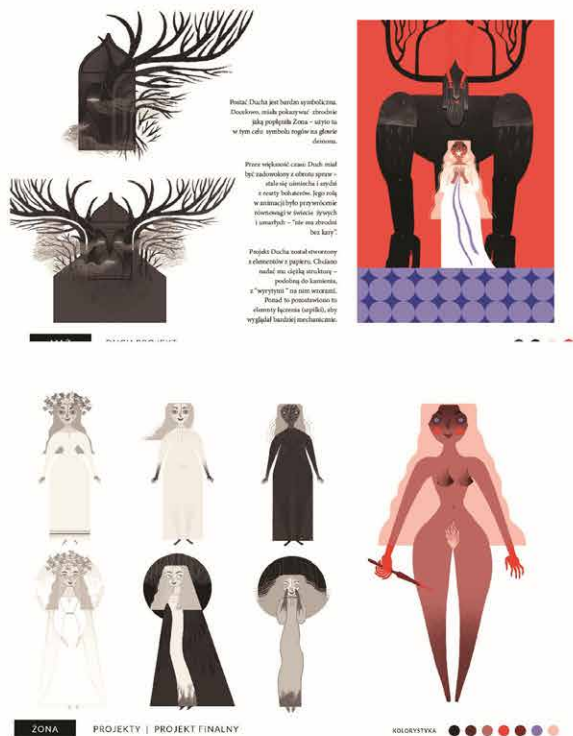
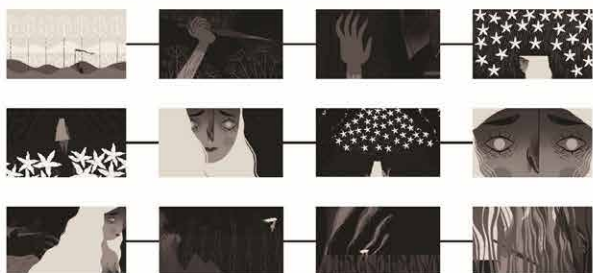
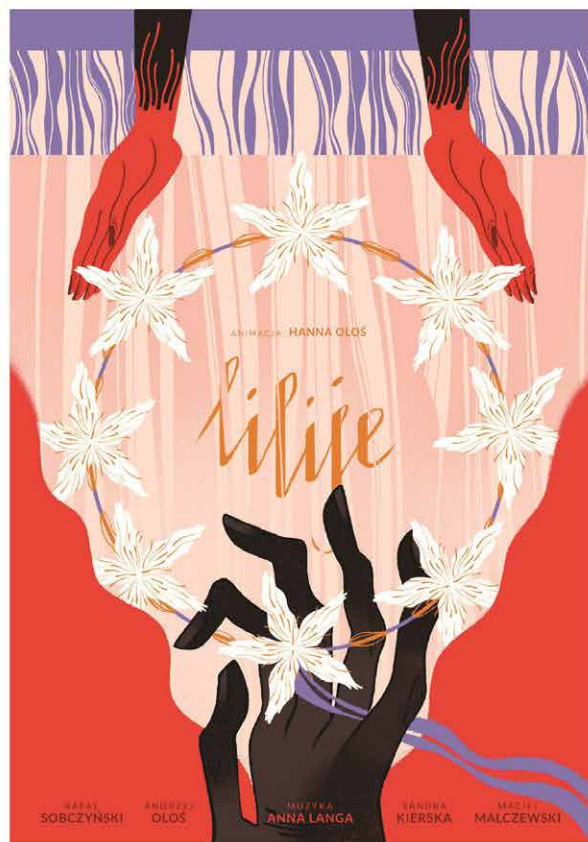


THE  
BEST



WIT'S DIPLOMAS  
ANNUAL EXHIBITION





**Fig. 1** Hanna Ołós  
A short 2D animation inspired by Adam Mickiewicz's ballad „Lilije”  
Supervisor: Grzegorz Rogala, PhD  
Advisor: Zenon Balcer, PhD

„A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away

Antoine de Saint-Exupéry

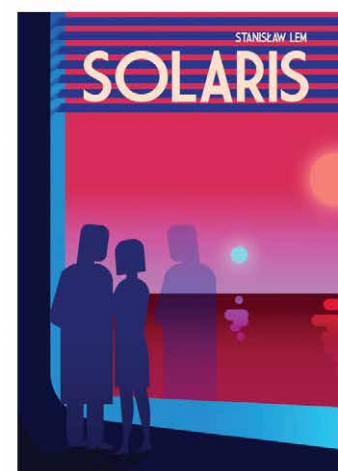
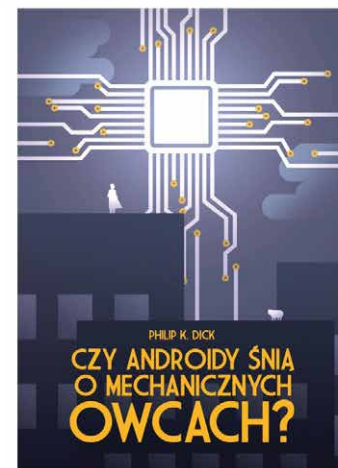
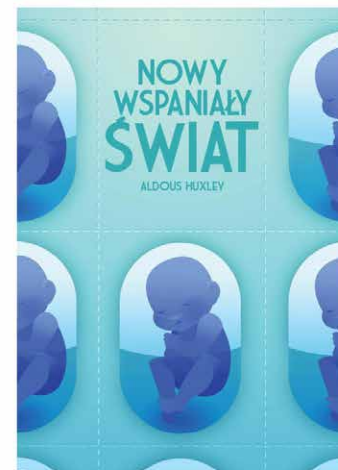
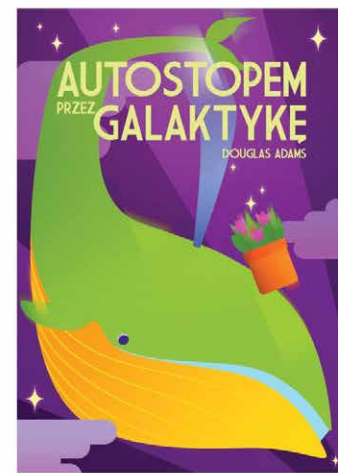
The first Upgrowth exhibition was opened on 16 March 2016 and presented sixty-three best diploma works created in 2015. Each year there were more diplomas that received recognition. From the first edition, we have presented nearly 700 designs. The exhibition of works created in 2023 comprised as many as 120. They could be viewed at a vernissage held in Galeria WIT on 25 October 2024. We have also created a website dedicated to these designs: [dyplomy.wit.edu.pl](http://dyplomy.wit.edu.pl) – it showcases both the designs as well as video or photo reports from vernissages.

Nine years after the first Upgrowth exhibition was launched, we know that opening of the Graphics course was a good idea. We have a feeling that what we are doing as a university has a positive impact on our students.

The level of works that have received recognition is very high. Our students can show off their designs with pride, knowing that they have received solid practical and artistic foundations to find fulfilment in the profession of a graphic designer, regardless of specialty.

While viewing the exhibition Upgrowth – The Best WIT Diplomas one can ask oneself some questions.

How important is the relationship between the student and the dissertation supervisor? How independent should a graduation work be? How big is the impact of the supervisor's suggestions on the diploma design? Should the supervisor influence the artistic aspect or just technical details?

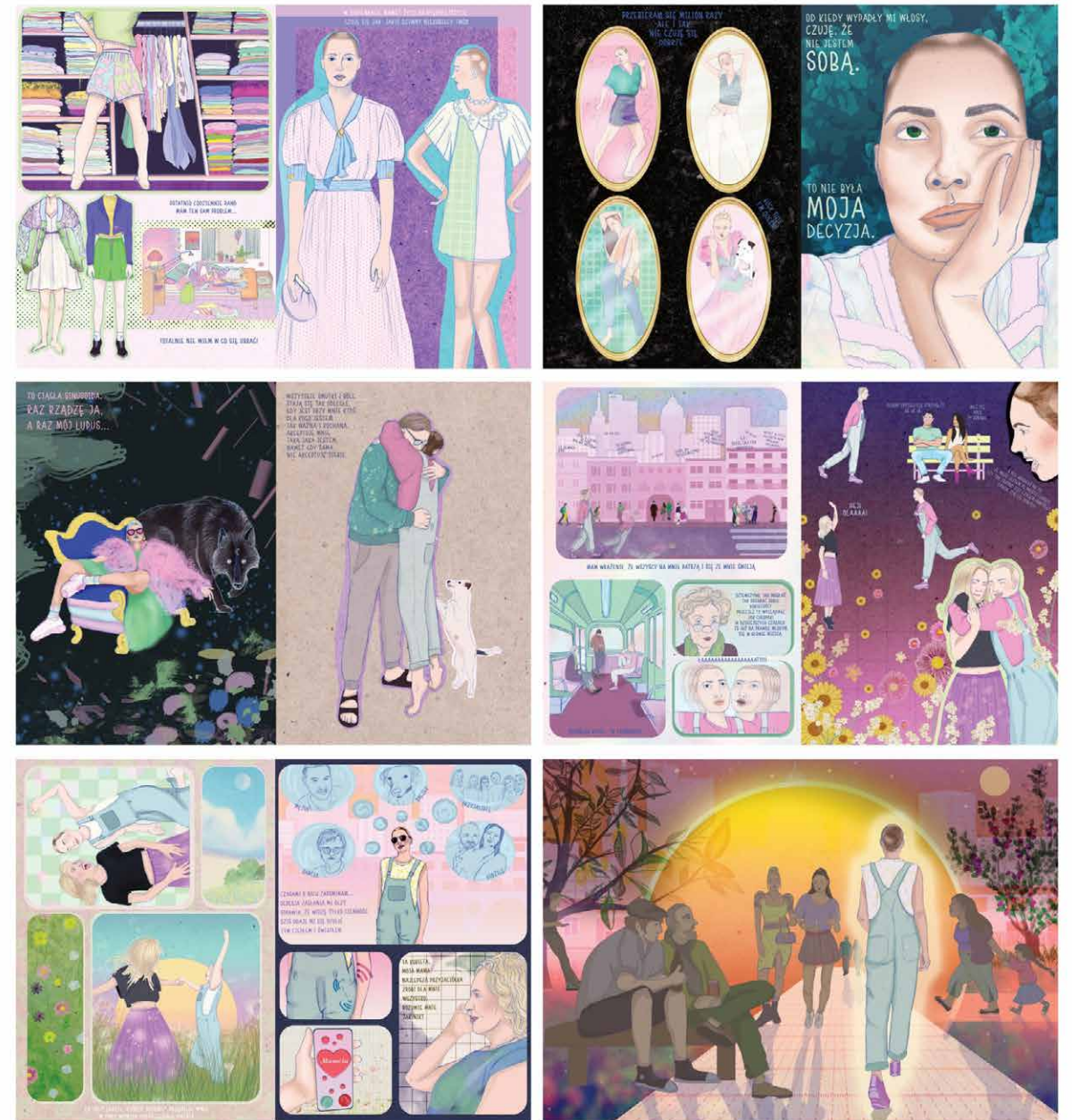


**Fig. 2** Aleksandra Pieprzowska  
Posters for science fiction-themed books  
Advisor: Anna Kłós, PhD



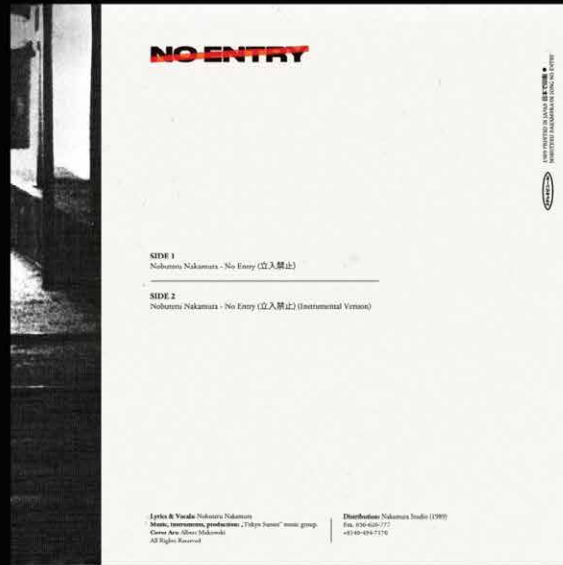
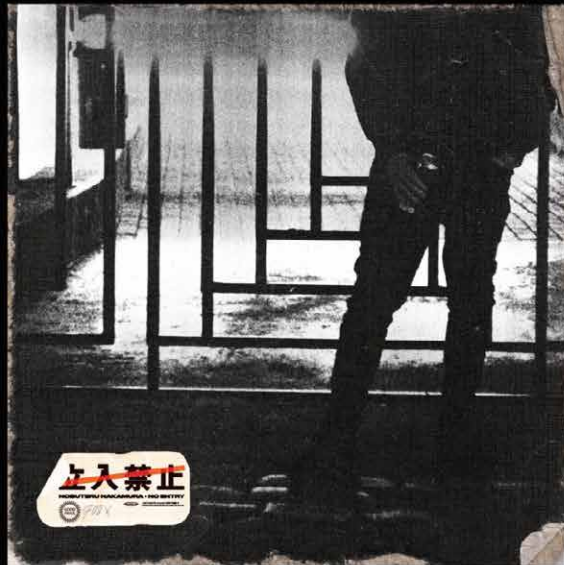


**Fig. 3** Barbara Pietrzykowska  
A 3D visualization of Rembrandt's self-portrait (fragment)  
Advisor: Krzysztof Franaszek, PhD



**Fig. 4** Aleksandra Manikowska  
Graphic novel titled „Ciałem opowiedzieć” („Telling Through the Body”)  
Advisor: Mateusz Dąbrowski, PhD





How much time should the supervisor devote to consultations with one diploma student?

Is this the university's prestige that influences a graphic designer's future career or is the level of designs that they produce?

The lecturers at private universities are often designers with significant commercial professional experience which enables them to prepare the student in practice for the graphic designer's profession. From my own experience I know that a student who is working on their graduation design after three years of studies has sufficient knowledge and skills acquired during the studies to mostly independently manage their design. The supervisor's role is to point out errors and ways of resolving them.

Work on each design starts with a concept, idea, creation. The beginnings are not always successful. Students often come to me with ideas that are not suitable as a diploma work – not every idea can be developed into a design. This is the first time that the supervisor enters the stage. How they guide their student, what advice they give him or her has an impact on the final outcome that we can see at the exhibition.

The development of an idea is a process in which both the student and the dissertation supervisor are involved. The more difficult the topic, the greater the role of the supervisor. They must devote more time to the student.

Topics undertaken in graduation works are very diverse. Visual identities, packaging, web pages and applications, 3D designs or animations. Students are also more often reaching for difficult social or health-related topics thanks to which they can solve complex design problems and create socially involved designs. They are aware of challenges and difficulties they might encounter. They

also know that they have the full support of their supervisor who, however, will not be the one to solve the problems in their place. The supervisor may simply point out the path to follow in order to find the solution.

The supporting role of the supervisor is key for the designer to become independent. Making decisions and taking the responsibility for those decisions constitutes the foundation of the design work. As their design develops, diploma students become bolder in independent selection of means to carry out their design tasks without being afraid to make a mistake. Failure constitutes an element of adulthood that we learn to accept. Accepting an error enables us to draw conclusions and continue creating.

Another aspect of design that is just as important as creation is the ability to give up ideas that have a negative impact on the design. At this stage of creation, the supervisor's role is significant. It is the supervisor that must convince the student to make a difficult decision. This is because a creator finds it difficult to abandon an element that they have created and which they believe to be attractive.

As Antoine de Saint-Exupéry said:

"A designer knows he has achieved perfection not when there is nothing left to add, but when there is nothing left to take away"

Designs presented at the Upgrowth exhibitions show emphatically that a creator's talent supported by the supervisor's experience leads to the emergence of exceptional designs. ■

**Małgorzata Sobocińska-Kiss, PhD**  
Lecturer of 2D graphics,  
curator of the UPGROWTH exhibitions,  
WIT Academy, Warsaw



**Fig. 5** Albert Makowski  
Album covers inspired by the aesthetics of the 1980s and 1990s  
Advisor: Anna Kłos, PhD



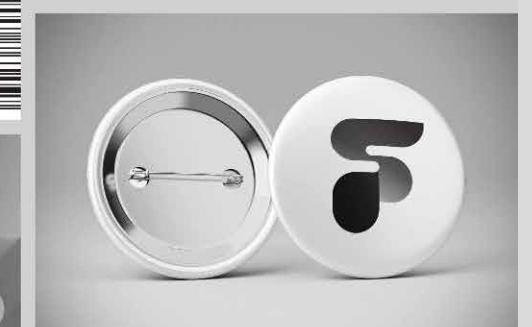
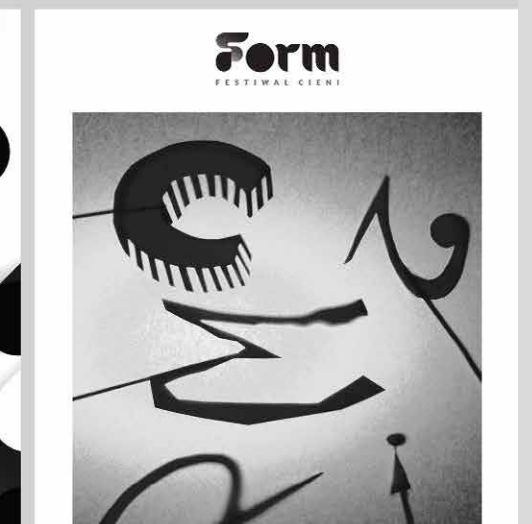
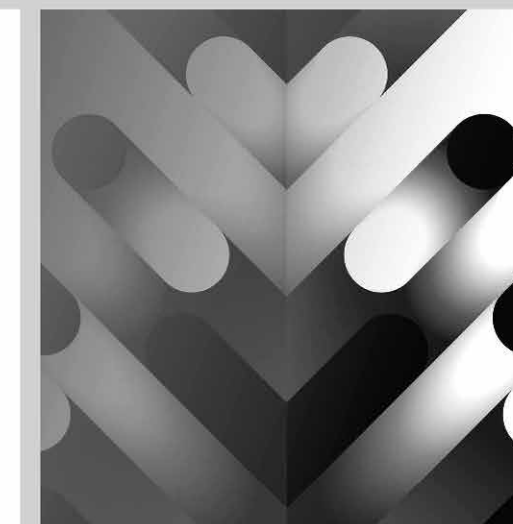


Fig. 6 Antonina Długosińska  
A series of animated illustrations for the Japanese folktale „Star Lovers”  
Advisor: Krzysztof Franaszek, PhD



Fig. 7 Szymon Grochowski  
Website design project titled „Structures”  
Advisor: Grzegorz Grodnier, PhD





← **Fig. 8** Mateusz Ferenc  
A series of concept illustrations for  
an original computer game  
Supervisor: Mateusz Dąbrowski, PhD  
Advisor: Marek Madej

↑ **Fig. 9** Katarzyna Gazarkiewicz  
Visual identity project for „The Festival of Shadows”  
Supervisor: Krzysztof Franaszek, PhD  
Advisor: Małgorzata Sobocińska-Kiss, PhD





**Fig. 10** Photos from the UPGROWTH exhibition openings from 2016 to 2023.  
Source: WIT Academy archives.

# DISCOVER UPGROWTH

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**THE BEST  
DIPLOMAS**





# Practical application of AI in the process of creating art installations



**Piotr Cieslik**  
WIT Academy

For each creator, especially a visual one, one of the most important factors is the ability to create freely and independently. This concerns nearly every stage of the project. Currently, AI-based tools may be used not just in the preparatory process, such as creation of inspirational sketches, but may lead through more complex areas, previously reserved for specialists in programming, additive technologies (e.g. 3D printing), or broadly understood programmable electronics. This article will present the process of creation of an artistic installation. The contents will focus on elements which constitute the greatest problem for artists, i.e. mainly the implementation of typically technical elements, such as electronics or 3D printing. AI tools which will be presented are ones that are generally accessible, including ChatGPT-3 and ChatGPT-4, Midjourney, Adobe Firefly. It is worth mentioning here that the process described is an experiment to defend or invalidate the thesis that artificial intelligence may support artists in the process of creation of typically physical objects. Inspirations are drawn from the experiences of an artist who has been operating at the junction of two worlds – art and technology – for over a decade.

#3DPRINT #AI #ART #CONCEPTION #INSTALLATION ART  
#WORKFLOW #OPENAI #CHATGPT



**Fig. 1** 2D sketches prepared using AI.  
Source: Own work.



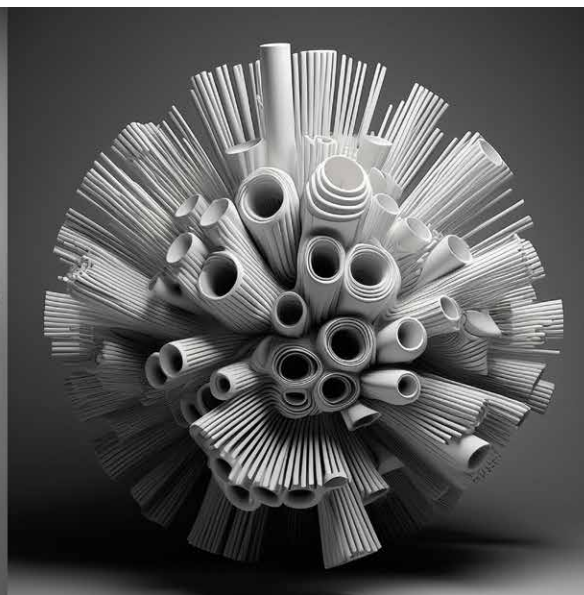
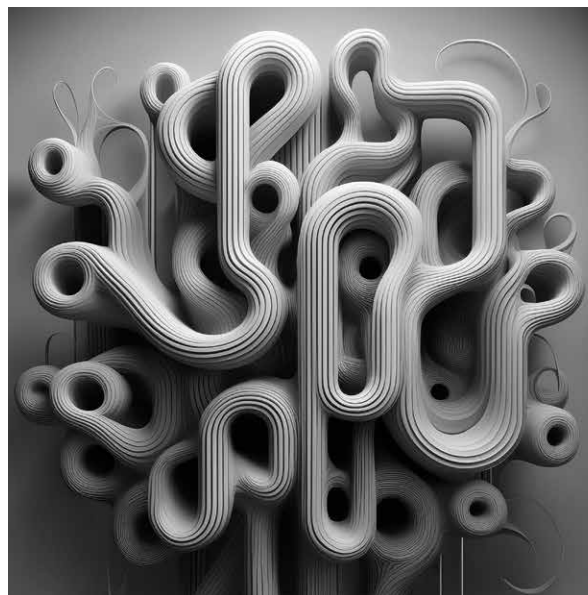
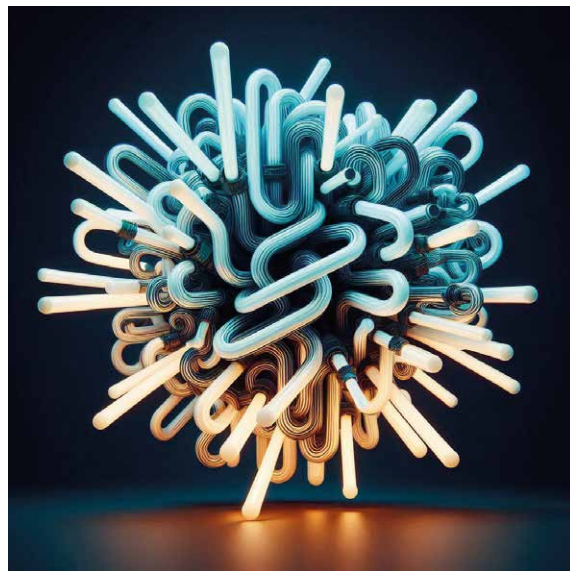


Fig. 2 i 3 2D sketches prepared using AI. Source: own work.

### Simplification of the creative process

From the beginning of work with visual artists, especially those who use technology, a question has arisen whether it is possible to simplify and shorten the creative process. This refers both to the conceptual but also the production part. As new digital technologies developed, people who supported artists could propose solutions which shortened the building of installation prototypes (CAD/CAM/3D programs). However, some 1:1 work had to still be done and time devoted to obtain a sketch. And, usually, each design has at least several pre-prototype versions.

The true revolution, especially when it comes to preparing sketches, came when artificial intel-

ligence (AI) appeared, allowing the shortening of the most important stage: building of the visual concept. Now, using key words and full sentences, we can build any images, and on the basis of results – simplified solids. In this experiment, attention will focus on the shortening of the creative process through the use of AI prompts.

### Example of an artist and a place using/presenting AI-based art

Refik Anadol defines his approach as “data painting” and “data sculpture”. The artist uses artificial intelligence algorithms, such as machine learning and neuronal networks, in order to transform huge data sets into dynamic and abstract visual forms.

His works often explore the boundaries between the physical and the digital world, breaking the dividing line between reality and virtuality. One of his interesting installations is “Melting Memories” (2018). In this installation, Anadol examines human memory by using EEG data collected from human brains, recorded during the memorisation process. Such data are transformed by AI which converts the data into fluid, moving images that look like melting canvasses [1].

The interesting place is teamLab, and the Borderless project is one of the best known and influential exhibitions of the Japanese artistic collective – teamLab.

The teamLab Borderless project is a fully immersive digital art space which is not limited to traditional walls and frames. Instead, the exhibition presents fluid, interactive images which permeate through spaces, are interactive and sensitive to the movement of audiences. The images presented change in real time.

Each element of the exhibition affects other elements, creating an interactive and unique experience which, thanks to AI, is not repeated. The advanced use of technology in art, like in the case of teamLab Borderless, draws the viewer into an interaction with the art being presented [2].

### Exploration of ideas on the basis of the Bing AI, Midjourney and Adobe Firefly tools

Each visual design should commence with the acquisition of certain reference materials. However, with the initial sketch of the idea, it is possible to change it into a visual prototype previously created mentally. Knowing that you want to create an object, an installation which will be built using lamps, lightbulbs, fluorescent tubes and will have an abstract, organic form, you can prepare data for artificial intelligence.

In the design presented, popular and accessible tools, such as: Bing AI, Midjourney and Adobe Firefly were used. Key words describing specific graphic, technical or artistic areas were prepared (avoiding exact prompts used to create the graphic designs). The main keywords include: organic, abstract, monochromatic, fluorescent bulb, lamp, morphic, polygonal.

The images received were divided into three sections (fig. 1, 2 and 3) because each of the groups has its own characteristic elements: entanglements of forms, presentations of organicity, colour, etc. What emerges from those renders are geometry details and liquidity of form. From the technical point of view, some images obtained, and which follows – ideas, cannot be reproduced

in the real world. This is a frequent problem of generative content which is sometimes contrary to basic assumptions of the world of physics. However, at the same time this is not a problem because designers, visual artists often are searching for such abstract forms. This is also the case where the images obtained constitute a very important element of the entire process – they steer you towards the final shape of the whole installation.

### Commencement of the process of creating the installation and presentation of needs

As in any creative process, basic material and non-material needs should be specified. Drawings and images executed using AI carry a lot of information about their components (they have been created using very suggestive keywords). Physical elements, such as LED tubes, constitute the first very important and dominant element of the installation. Nevertheless, they are the least relevant element from the point of view of the solid, they are repeatable and have the same scale. This is why it is necessary to create the part that will make the form more organic, morphic and analogue. This is why tools that allow the execution of a solid that will present the final analogue form will be needed. The final shape of the installation will be described in the further part of the article.

A contemporary installation, besides typically aesthetic qualities, should include elements of interaction, dynamics, and responses. The use of a human being as a medium co-creating the work is of key importance here.

In the experiment described, we intend to use the observer's hand movement to activate specific LED tubes. Zones will be created which will be

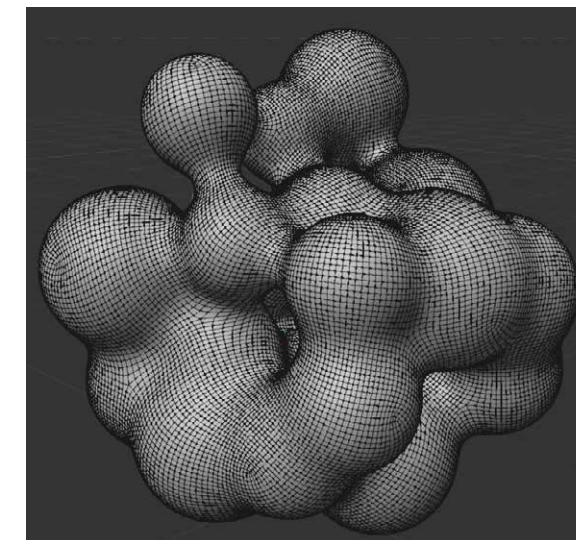


Fig. 4 Result of the solid creation using Volume objects. Source: Own work.



activated or deactivated by the observer moving towards/away from them. This is the entire information which we and AI need to support the creation of the interactive installation. The summary of main assumptions is presented below.

### Creation of the solid

A 3D model is needed to allow the development of a physical object which will be then rendered using any method, e.g. additive technology. In the case described, a decision was made to use the Maxon Cinema 4D software. However, modelling methods other than classic ones were to be applied in order to avoid the hard surface modelling. In order to learn about the new tools, a prompt was made to ChatGPT-4 on how to best develop a 3D model which would have the features of an organic form. A fragment of the answer is presented below:

Volume Builder is one of the tools available in 4D Cinema 4D which allows the creation of complex organic forms using operations on volumetrics. This tool operates on the basis of voxel fields which make it possible to manipulate objects at the level of their internal structure, a perfect tool for generating soft, fluid shapes and point cloud effects.

On the basis of information received, knowledge was gained on the operation of the tool which would allow the creation of a model based on voxels. The development of the test model started, and this could provide information about all options of solid generation and visual modification (fig. 4)

Having the grasp of how volumetric tools operate, you can start the solid creation process. This was commenced with the basic tube shape which was then repeated. Thus, a 3x3 matrix of a solid was obtained. At this moment, objects are joined only through the intersection of their geometry, however they do not constitute a single combined mesh (fig. 5).

The next stage is the random distribution of solids and increasing the number of copies in the matrix. Besides the dispersion itself – displacement of models, it will also be necessary to produce random transformation through rotation (fig. 7). At this stage it is still possible to consider the optimisation of angles of elements so that in the future, when the object is 3D printed, it is possible to obtain spaces that do not need many supports.

This way, the final distribution of solids was obtained. Next, a tool to combine the geometries

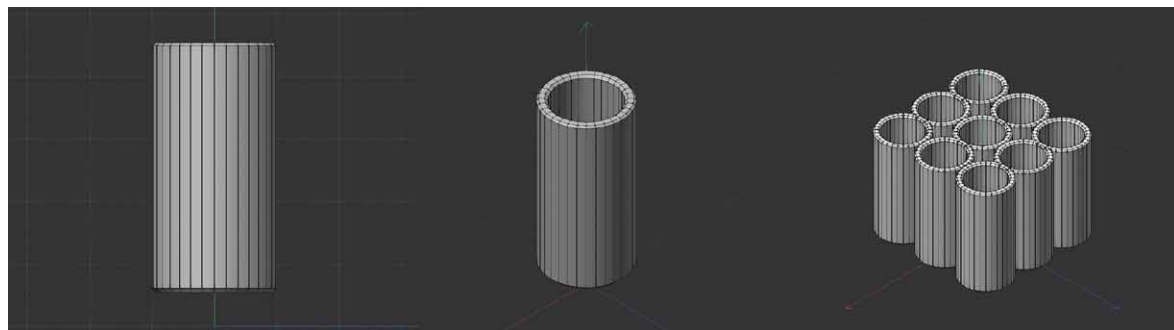


Fig. 5 Stages of the solid creation process. Source: Own work.

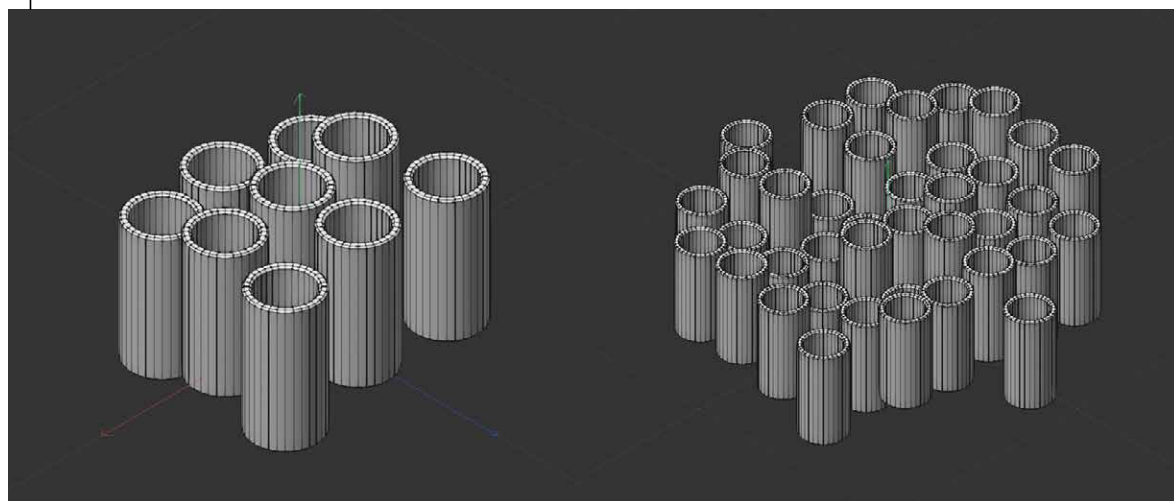


Fig. 6 Stage of random distribution and increasing the number of copies in the matrix. Source: Own work.

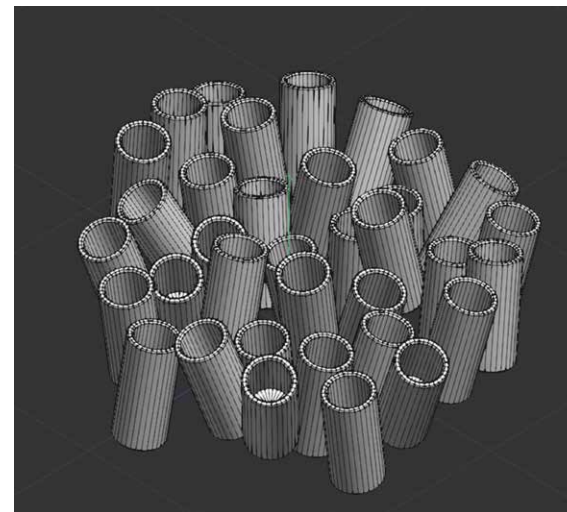


Fig. 7 Comparison of models before and after they are linked using the Volume tools. Source: Own work.

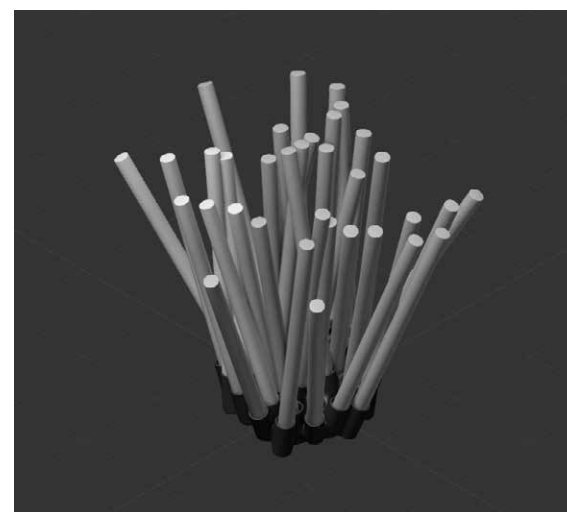


Fig. 8 Stage of combination of the organic form with lights. Source: Own work.

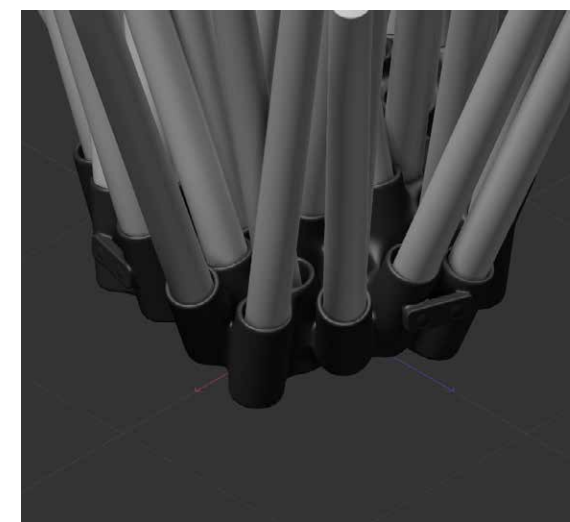
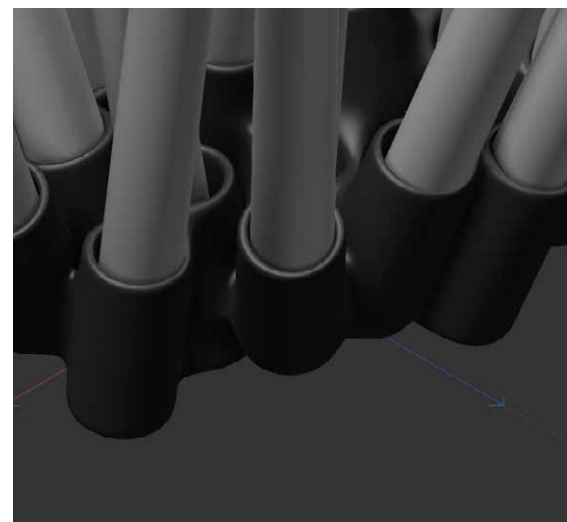


Fig. 9 Morphic transitions of shapes. Source: Own work.



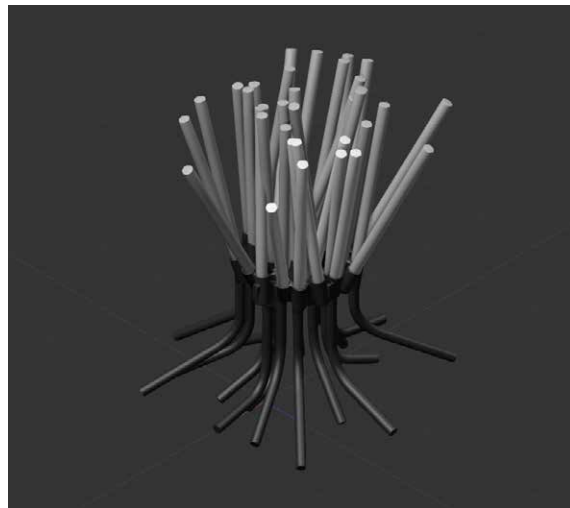


Fig. 10 Final installation - first version. Source: Own work.

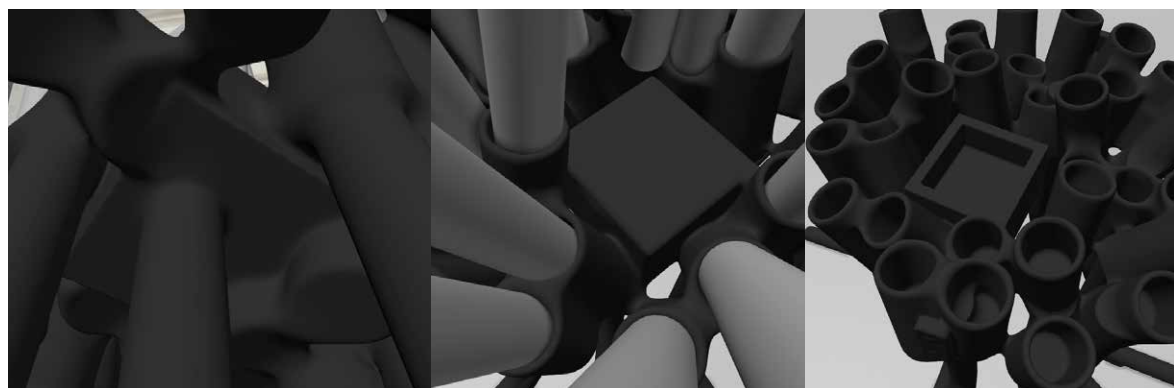


Fig. 11. Technical details. Source: Own work.

and create the volumetric object needs to be used – the Volume Builder. The outcome is a model created from voxels which will then be connected thanks to the Volume Mesher tool in order to finally obtain a monolithic solid. The level of fluidity of shapes and the level of smoothness of finish may also be defined through parameters inside the Volume Builder. Fig. 7 presents two stages: before and after the shapes are linked.

The organic form which will constitute the main stylistic element has been developed. At the next stage of design, technical elements, such as: type and size of lamp, fittings and service openings must be taken into account. After a prompt to ChatGPT-4, the following feedback was received, among other things:

The appropriate LED tube is T5. T5 tubes have standard lengths and diameter. These are the details:

#### 1. Length:

- The most frequently encountered lengths of T5 tubes are 15 cm (6 inches), 30 cm (12 inches), 45 cm (18

inches), 60 cm (24 inches), 90 cm (36 inches) and 120 cm (48 inches).

#### 2. Diameter:

- The diameter of T5 tubes is 16 mm.

Other information concerning the technical elements was disregarded as it is not relevant for the experiment. One should remember, however, that the necessary information about the sizes of fittings, the required electricity supply, etc. was acquired.

The information collected allows the modeling of a solid which will be compatible with physical LED tubes in the future (fig. 8 and 9).

With the completion of the construction of the installation in mind, you need to carry out the last stage, which is the final visual form. In this case it will be both the impression (artistic) part, and the construction part. Not all technical issues are described here, such as the preparation of the space for electronic modules, power supply, etc. (fig. 10 and 11).

### Visualisation of the design

The visualisation of an installation is an important element as it will produce a sensual model which, besides the presentation of artistic qualities of the installation, will demonstrate its most important side, including: intensity of illumination from the LED tubes designed and presentation of interactions. However, in order to obtain an image that perfectly “pretends” to be reality, a rendering engine should be used. In the case of a design developed in Cinema 4D, it will be Redshift 3.5. At this stage, AI (ChatGPT-4) was used once more to obtain information about the creation of an optimum and fast mechanism of lighting the planned scene. Finding out the parameter of the final render is also important (these parameters determine the level of detail and realism of the final image). Fragments of the answer received:

In order to efficiently light the scene in Cinema 4D with the Redshift rendering engine, it is worth using several tested methods and techniques.

Dome Light in Redshift is an excellent solution for lighting a scene using HDRI maps. HDRI maps allow the realistic reproduction of the light from the environment, which may significantly increase the realism of renders.

Enter Dome Light, assign the HDRI texture to it and adjust the intensity of light and exposure. You can also control the HDRI rotation in order to obtain appropriate lighting angles.

#### Area Lights:

Area Lights is the most universal type of light in Redshift. They may imitate light originating from windows, lamps, or other light sources. It is worth placing Area Light in key places to emphasise elements of the scene. Adjust the size of light, its intensity and colour temperature to obtain the appropriate ambience.

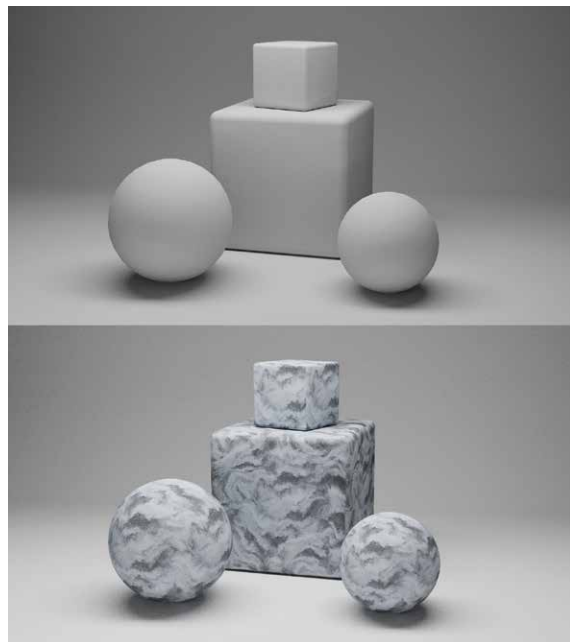


Fig. 12 Render 1 of the installation prototype. Source: Own work.

Fig. 13 Render 2 of the installation prototype. Source: Own work.

Fig. 14 Render 3 of the installation prototype. Source: Own work.





← **Fig. 15** Before/After outcome of the operation of an AI-based rendering engine (imposition of texture on a 3D model). Source: Own work.

The optimisation of settings for Cinema 4D with Redshift, with the resolution of 2048x2048 pixels, depends on several factors, such as the level of scene details, the complexity of lighting, and available hardware resources. Below, the recommended settings are indicated, which can help in achieving a good balance between the quality of render and the rendering time:

#### 1. Render Settings:

Resolution: 2048x2048 px (of course, adjusted in the „Output“ tab).

Sampling: In Redshift you control the quality of image mainly through Primary Rays (Unified Sampling). The recommended values are as follows:

Min Samples: 16

Max Samples: 128-256 (increase depending on the quality requirements)

Adaptive Error Threshold: 0.01-0.03 (a lower value means better quality but longer rendering time)

Bucket Size: 256x256 (for high resolution it is better using bigger buckets in order to optimise the rendering time).

#### 2. Global Illumination (GI):

Primary GI Engine: Brute Force

Secondary GI Engine: Irradiance Cache or Light Cache (adjusted depending on the scene)

GI Samples: 128-256 (depending on the amount of reflected light, may be increased in the case of complex scenes).

#### 3. Lights and Shadows:

Light Samples: Values between 128-256, but you can increase them if you notice grain in shadows.

Shadows: Set Shadow Samples at 64-128 in order to achieve soft shadows without excessive graininess.

#### 4. Denoising (Optionally):

OOptiX Denoiser: You can use it to quickly remove noise. If you want quality, Altus Denoiser in Redshift may provide better results but with a longer processing time.

#### 5. Reflections & Refractions:

Reflection Samples: 128-256 (depending on the complexity of the material).

Refraction Samples: 128-256 (for glass and other transparent materials).

#### 6. Textures & Displacement:

Texture Filtering: Turn on the filtration of textures (Anisotropic 16x) for better quality of textures at high resolution.

Displacement Subdivision: Displacement settings depending on model details, but try to maintain lower subdivision values at 2-4 for faster rendering.

#### 7. Subdivision Surfaces:

If Subdivision Surfaces are used, adjust the Subdivision Level to scene details. It is recommended to use values between 2 and 3 for more detailed models, which allows the minimisation of the rendering time.

#### 8. AOVs (Arbitrary Output Variables):

If you intend to work on postproduction, add appropriate AOVs, such as Diffuse, Reflection, Shadows etc. The optimum use of AOVs will allow better control over the final image without the need to re-render the entire scene.

#### 9. Redshift Render Settings (Performance):

Ray Depth: Reflections – 4-6, Refractions – 4-6 (these settings control the maximum number of light reflections by surfaces, which affects productivity and quality).

Texture Cache: Optimise the use of memory by Redshift by setting the Texture Cache Size depending on the VRAM memory available (e.g. 2-4 GB for scenes with a large number of textures).

After instructions concerning lighting settings and rendering engine parameters have been received, the process of creation of the final image started. Final renders and their variations are presented in figures 12, 13 and 14.

#### Rendering engine using AI

Besides the classic image rendering method described, you can more and more often encounter solutions based on artificial intelligence – using the stable diffusion method to create images.

For the Cinema 4D software, this is for example Airen 4D – a rendering engine which uses artificial intelligence, and more accurately stable diffusion models, to transform simple geometries into photorealistic images. The purpose of this tool is to speed up the rendering process, making it possible to generate detailed materials and li-

ghting in a very short time. Thanks to AI, visual artists and designers can quickly create visualisations and iterate various ideas without the need to wait for a long time for the final classic render. Airen 4D also provides the possibility of generating materials and textures using AI.

#### Design and programming of electronic elements

At the concept-forming stage, it was decided that the installation would have elements of interaction. Thus, the focus should be on the use of programmable electronic elements that will execute LED tube group switching on operations based on distance-measuring sensors: installation – trigger (in this case it will be a human hand). To simplify: the closer the hand is, the brighter the LED tube groups will be lit up.

At this stage, no specific distances will be defined. They will be determined at the time of operations on a finished, assembled prototype of the installation. With such precise plans and knowing that we want to use the Arduino MEGA module, we send a query to ChatGPT-4 and we define the needs describing them with the language that is more poetic than technical. In the previous parts of the article, no prompts sent to the AI were presented, just the answers, however in this part their presentation will demonstrate how the AI (in our case – ChatGPT-4) is useful for a visual artist who does not have to base their ideas on technical terms.

I want to make an artistic installation based on Arduino, an ultrasound sensor, light generated by LED tubes. A hand movement will activate the lights. There will be 12 LED lamps, the closer the hand to the sensor, the brighter the LED will lit up. Please, create an schematic diagram and write code. And describe what else I will need (power pack, etc.).

#### Schematic diagram

##### Elements:

- Arduino MEGA (or another Arduino board)
- HC-SR04 ultrasound sensor
- 12 LED diodes (in different colours or white)
- 12 resistors (330Ω for each LED diode)
- 5V power pack (or 5V battery if the design is to be portable)
- Connection cables
- Contact plate (optionally, for easier assembly)

##### Diagram:

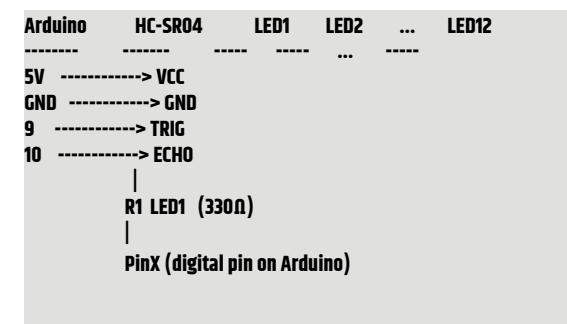
HC-SR04 ultrasound sensor:

VCC → 5V (Arduino)

GND → GND (Arduino)

TRIG → Digital pin 9 (Arduino)

ECHO → Digital pin 10 (Arduino)



#### LED diodes:

Each LED diode has its own resistor (330Ω) connected to the cathode (shorter leg of the diode).

The anode (longer leg of the diode) connected to the digital output on Arduino MEGA (e.g. pin 2-13).

Resistor connected to GND.

5V power pack connected to 5V pins and GND on Arduino.

#### Description of Blocks:

1. Power source (5V): Powers both Arduino and LED diodes. It may be a USB power pack or a battery with an appropriate voltage regulator.

2. Arduino: Controls the entire system, receives signals from the ultrasound sensor and controls LED diodes. Responsible for processing distance and regulating the brightness of LEDs.

3. HC-SR04 Ultrasound Sensor: Measures the distance from the hand and sends the data to Arduino. Composed of two pins: TRIG for sending impulses and ECHO for receiving the echo.

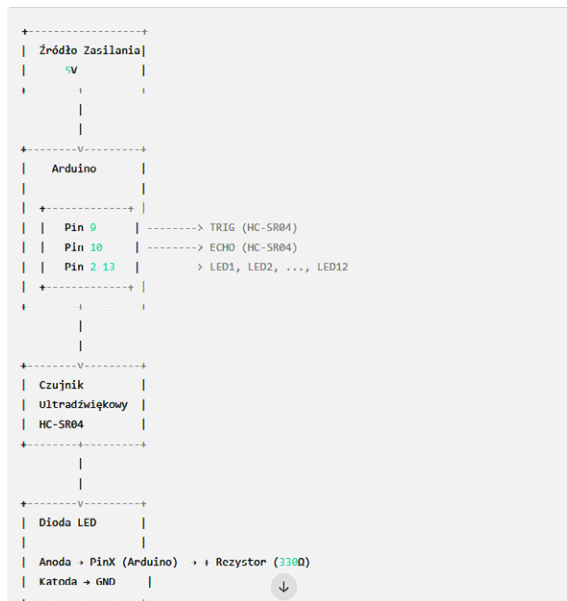
4. LED diode: Lits up brighter as the hand moves nearer to the sensor. Each diode is connected to a separate pin on Arduino and is controlled using a resistor.

#### How it works:

- Measurement of Distance: Ultrasound sensor sends an impulse and measures time required for it to be reflected from the hand.
- Processing: Arduino processes the echo time to distance.
- LED Brightness Regulation: Arduino uses the distance to control the brightness of LED diodes. The closer the hand to the sensor, the more LEDs become brighter.

The resultant block schematic diagram, the discrete elements used, and ultrasound sensor modules or the code are more than useful; obviously they require some changes and verification of correctness, but they constitute a base for further development. Thanks to this, the part of the design that describes the interaction and physical connections is practically ready. Here, more obvious components, such as e.g. physical connections on the section between the connector on the LED tube and the controller, are omitted because this





**Fig. 16** Block diagram.  
Source: Own work based on ChatGPT-4 data.

does not constitute a high complexity level. One should remember that only a certain fragment of the experiment is described and not the complete instruction on how to create the installation.

### FDM (Fused Deposition Modelling) 3D printing

Additive technologies, and 3D printing is one of them, enable visual and digital artists to develop a prototype quickly and relatively cost-effectively. In the case described, a 3D model is needed that will be optimised and prepared for printing. The optimisation and setting process will be described during following stages. However, the information to be obtained is what kind of material should be used for printing and how to deal with supports in the case of such a complex shape. Popular 3D printers that have one nozzle and extruder use the same material to create supports. In the case of large printouts and more complicated geometry, supports may be difficult to remove, and which is more important – may create deformities at the

junction between the support and the base model. This refers to e.g. printing with nozzles of a larger diameter. For this reason, ChatGPT-4 was used in order to find out whether there is a more suitable material. In the case described, the printer has a dual printer head, which will allow printing with two materials simultaneously.

#### 1. PVA (polyvinyl alcohol)

- Use: For printing with PLA, PET-G, TPU.
- Advantages: PVA is water-soluble, which makes it easy to remove supports by immersing the model in water. This is a perfect solution for complex geometries.
- Disadvantages: PVA is moisture-sensitive, which may make it difficult to store. It is also more expensive than other materials.

#### 2. HIPS (High Impact Polystyrene)

- Use: For printing with ABS.
- Advantages: HIPS is limonene-soluble, which makes it easy to remove supports from models printed with ABS. It also has similar thermal properties as ABS, which ensures good adhesion.
- Disadvantages: The removal of supports requires the use of limonene which is a chemical and may be more difficult to use under home conditions.

Having such feedback, one can move to printing. A decision was made to use the first of the options mentioned above, in which PET-G will be used as the main material and PVA as the support material. Such combination of materials was selected due to the very simplified procedure of removing supports – the solvent used is water. One of the drawbacks is the high cost of the material

itself, however one should remember that this means huge time savings – mechanical removal of the material can take many hours.

### Optimisation of the 3D model in Cinema 4D

The 3D model mesh optimisation process for the purposes of 3D printing is an important process from the technological point of view. Using the example of the solid in the design described, it may be noticed that the resulting mesh is very dense (fig. 18). It is a normative situation when we use tools aimed at smoothing the surface structure. The high density of the mesh obviously has an impact on how detailed the solid is, however it also leads to a large size of the resultant file. If we adopt an assumption that the model is to be printed, it immediately begs the question: what is the resolution (in the case of 3D printers, this is about the height of layers) of the printout?

In this design, the 0.05 – 0.28 mm range was available. This is why the mesh could be limited, however remembering the shape which in this case resembles a more organic form. One should also remember about all smoothing materials, such as phong, because 3D model-cutting programs (the model cutting process will be described in the further part of the article) do not include them – the operation is exclusively on the 3D model mesh itself.

It is now time to learn about the tools available in the Cinema 4D program which will allow the optimisation of the model for 3D printing. For this purpose, a query was submitted to ChatGPT-4 with regard to the processing of the 3D model mesh. The answer received is provided below:



**Fig. 17** Code fragment.  
Source: Own work based on ChatGPT-3 data.

```
// Definiowanie pinów
const int trigPin = 9;
const int echoPin = 10;
const int ledPins[] = {2, 3, 4, 5, 6, 7, 8, 11, 12, 13}; // Piny LED
const int numLeds = 10; // Liczba LED-ów

void setup() {
  // Inicjalizacja pinów
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  for (int i = 0; i < numLeds; i++) {
    pinMode(ledPins[i], OUTPUT);
  }
  Serial.begin(9600);
}

void loop() {
  // Wysłanie impulsu
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  // Odbieranie impulsu
  long duration = pulseIn(echoPin, HIGH);
  int distance = duration * 0.0344 / 2; // Przemiana na centymetry

  // Ograniczenie odległości do zakresu 0-100 cm
  int constrainedDistance = constrain(distance, 0, 100);

  // Wyświetlenie odległości w monitorze szeregowym
  Serial.print("Distance: ");
  Serial.print(constrainedDistance);
  Serial.println(" cm");

  // Mapowanie odległości do liczby LED-ów
  int ledIndex = map(constrainedDistance, 0, 100, 0, numLeds);

  // Włączanie LED-ów zgodnie z odległością
  for (int i = 0; i < numLeds; i++) {
    if (i < ledIndex) {
      digitalWrite(ledPins[i], HIGH); // Włącz LED-a
    } else {
      digitalWrite(ledPins[i], LOW); // Wyłącz LED-a
    }
  }

  delay(100);
}
```



**Fig. 18** 3D model with mesh density preview.  
Source: Own work.





3D mesh optimisation for 3D printing in Cinema 4D is the key step to ensure that the model will be printed correctly, retaining its quality and without technical issues. These are steps which will allow the optimisation of the model:

#### 1. Correctness of Topology:

- **Quad-based Geometry:** Try to use a mesh composed of quads instead of triangles. Quads work better with modelling and rendering tools, and they make the model subdivision easier during the preparation for printing.
- **Avoid N-gons:** N-gons (polygons with more than four vertices) may cause problems during printing, this is why it is worth converting them into quads or triangles.

#### 2. Watertight Mesh:

- **Absence of holes:** Make sure that the mesh is watertight, i.e. there are no holes or gaps. Models for 3D printing must be "watertight", which means that each polygon must be correctly connected.
- **Check Mesh Integrity:** Use tools for checking mesh integrity in Cinema 4D or in the 3D printing software in order to detect any errors such as double vertices, reversed normal or incorrect edges.

#### 3. Scaling and units:

- **Measure units:** Make sure that the model is on a scale suitable for printing. Check whether the units in Cinema 4D (mm, cm, etc.) are consistent with the ones accepted by the 3D printer. Models often must be rescaled to appropriate sizes.

#### 4. Thickness of walls:

- **Minimum thickness:** Check specifications of the 3D printer to find out the minimum thickness of walls that the printer can print. Make sure that no parts of the model are thinner than this value. In Cinema 4D you can use the Measure & Construction tool to check the thickness of elements.

#### 5. Redukcja Poligonów:

- **Optimize Command:** Wykorzystaj narzędzie Optimize w Cinema 4D, aby usunąć niepotrzebne wierzchołki i krawędzie, co uprości siatkę i zmniejszy liczbę poligonów.
- **Polygon Reduction:** Użyj Polygon Reduction (np. poprzez narzędzie „Reduction Deformer”), aby zmniejszyć złożoność siatki. Pamiętaj jednak, aby nie utracić kluczowych detali modelu.

#### 6. Mesh error repair:

- **Mesh Checking Tools:** Cinema 4D has tools for checking and repairing mesh errors, such as Mesh Checker. This tool will help detect problems, such as double edges, bad connection of vertices and other structural errors which may affect the print quality.

#### 7. Normals Alignment:

- **Normals Alignment:** Make sure that all normal are pointed in the correct direction (to the outside of

the model). Reversed normal may result in problems during printing, such as missing parts of the model.

With the knowledge about the mesh optimisation, a test of the mesh density level and its impact on the final 3D model printed may be carried out.

Figure No. 19 presents the result of the model mesh optimisation in two variants. The first one contains around 1 million polygons, the second one – around 0.2 million. Default settings in the printer profile were used, the detailed description of the configuration will be presented in the further part of the article. Additionally, details are presented, as is the level of their changes and how they affect the final (simulated) shape of the model.

To sum up, for the design created the mesh at the level of around 1 million polygons is an optimum one. The size of the file is around 25 MB, and the level of detail is close to the original form of the model which before the processing had around 2.5 million polygons.

#### Correct settings of 3D printing parameters in the Prusa Slicer program

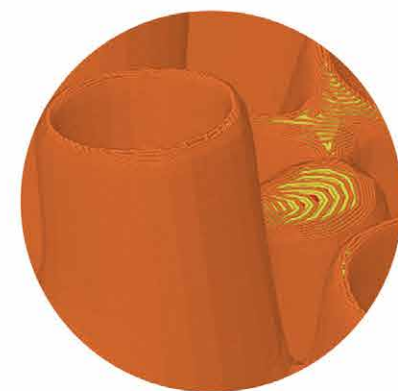
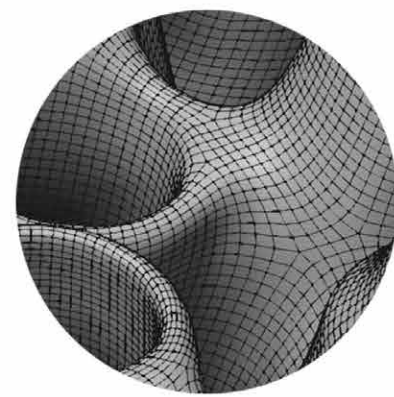
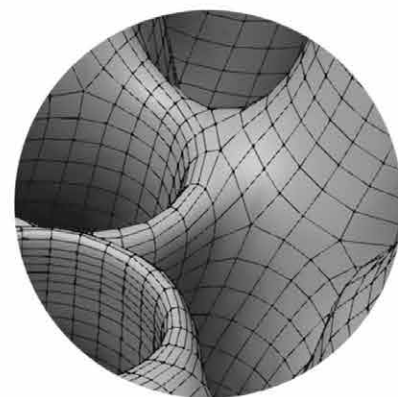
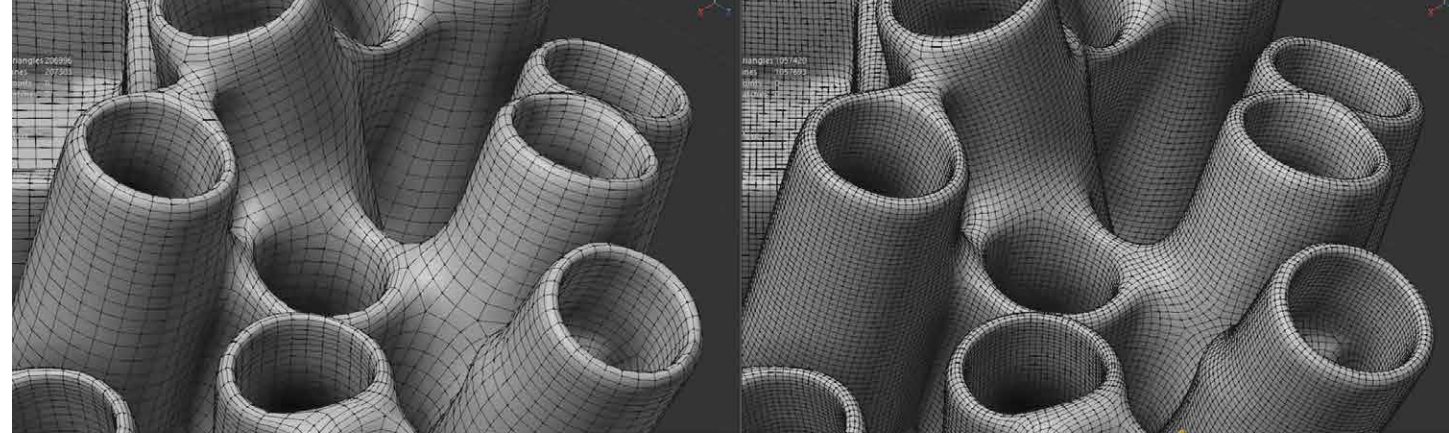
With an optimised 3D model, the next step was to import it into the Prusa Slicer program which carries out the model cutting process. It consists in disassembling the model geometry into machine language for the printer – gcode. The second important operation is applying optimum parameters in order to achieve the best technical quality. The earlier stages already revealed which material would be used. A decision was also made on which printer to use. It is important because the program has information about the printer output (speed, size of the work area, etc.). On the basis of this information, a prompt for ChatGPT-4 was created. The PET-G material which will be used to produce the physical model was selected for the execution.

#### Settings for PET-G in PrusaSlicer for a 3D Printer:

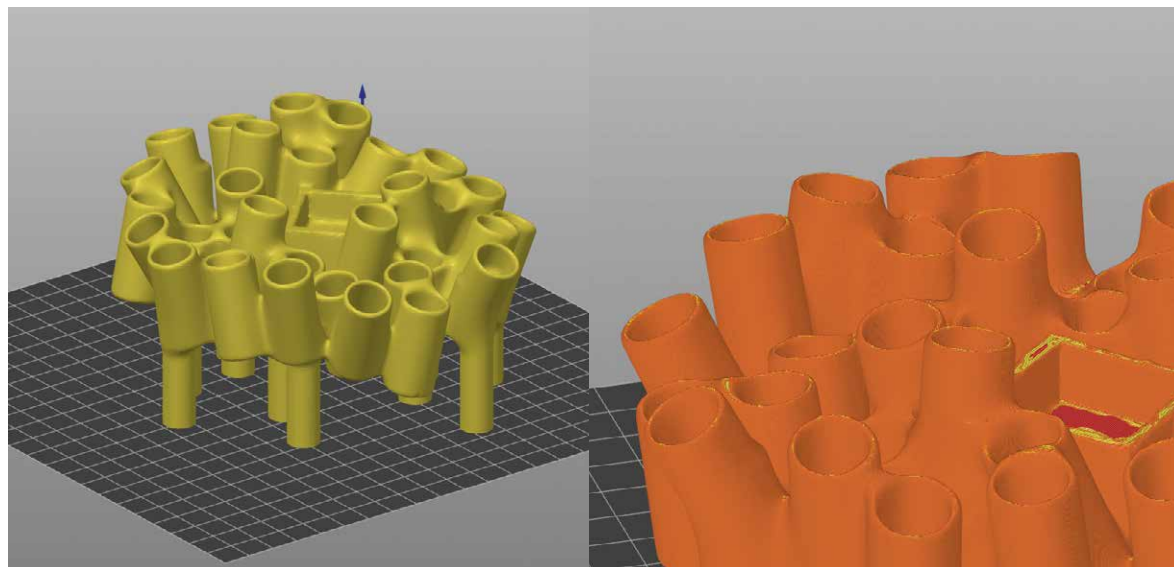
##### Extruder and Table Temperature:

- **Nozzle temperature:** 230°C - 250°C (best to start from 240°C and adjust depending on the filament).
- **Table temperature:** 70°C - 80°C (70°C is sufficient for most cases but it is worth adjusting to the specific filament).

**Fig. 19** 3D model with the mesh optimisation applied on two levels. On the left-hand side, around 0.2 million polygons, on the right-hand side – around 1 million. At the bottom, presentation of the level of detail in the final (simulated) form. Source: Own work.







**Fig. 20** Part of the model prepared for printing and the cut model. Source: Own work.

## 2. Printing Speed:

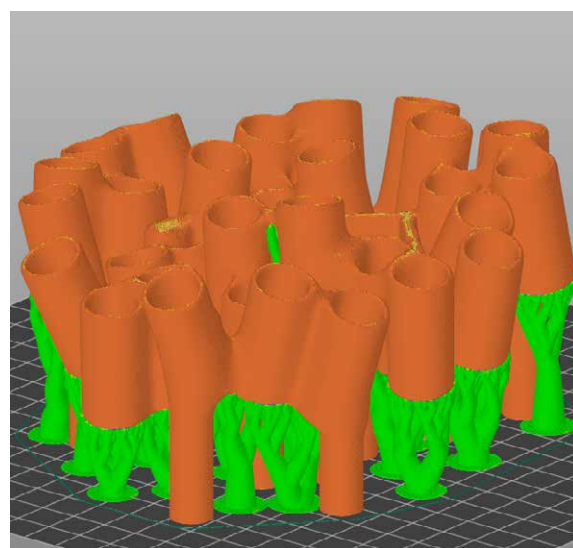
- Printing speed: 30-50 mm/s (for larger details it is best to start with a lower value, e.g. 30 mm/s, in order to ensure better reproduction of shapes).
- First layer: 15-20 mm/s (slow printing of the first layer ensures better adhesion).

## 3. Layer Height:

- Layer: 0.1 mm – 0.2 mm (for details, select a lower value, e.g. 0.12 mm, so that smooth surface is obtained).
- First layer: 0.2 mm (slightly higher first layer may improve adhesion).

## 4. Extrusion and Retraction:

- Retraction: 4-6 mm at the speed of 25-40 mm/s (for Bowden-style extruder, as in Ender 5, PET-G is viscous, so lower values of retraction prevent problems with stringing).



**Fig. 21** Cut model mor printing with visible supports. Source: Own work.

- Flow rate: Usually set at 100%, but it is worth adjusting by several percent depending on the line thickness.

## 5. Cooling:

- Cooling: 30-50% after the first layer (PET-G does not like full cooling because it may lead to problems with adhesion and delamination between layers).

## 6. Supports:

- Type of supports: For PET-G, the best are supports trees, set at 15% of infill. You may also select „Support enforcers only” in order to add supports only where they are absolutely necessary.
- Distance between supports and the model: Z-distance at 0.2 mm for easier removal (PET-G may be difficult to detach, so maintain an appropriate distance).
- Support interface layers: Set 2 support interface layers, which will make it easier to remove them without any damage to the model.

## 7. Infill:

- Wypełnienie: 15-25% dla detali, w zależności od potrzeb wytrzymałościowych.
- Rodzaj wypełnienia: Grid lub Triangle (Triangle jest dobrą opcją, ponieważ zapewnia stabilność i elastyczność struktury przy mniejszej ilości materiału).

## 8. Table adhesion:

- Brim: It is recommended to add a 5-10 mm wide brim to improve table adhesion and prevent rolling up of edges.
- Adhesion (glue): Use glue or another adhesion medium on the table to ensure good adhesion for PET-G.

## Additional Notes:

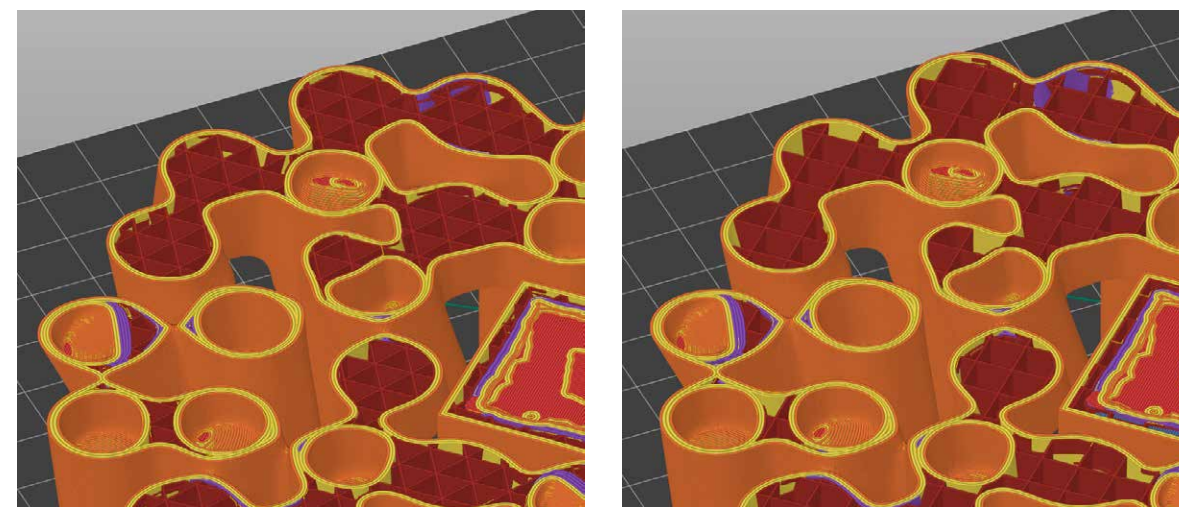
- Cleanliness of nozzles and table: PET-G is material which easily attracts impurities, this is why you need to make sure that the nozzle and the table are clean before you start printing.

- Stringing control: PET-G has a tendency to stringing, therefore it is worth testing various settings of retraction – and temperature.

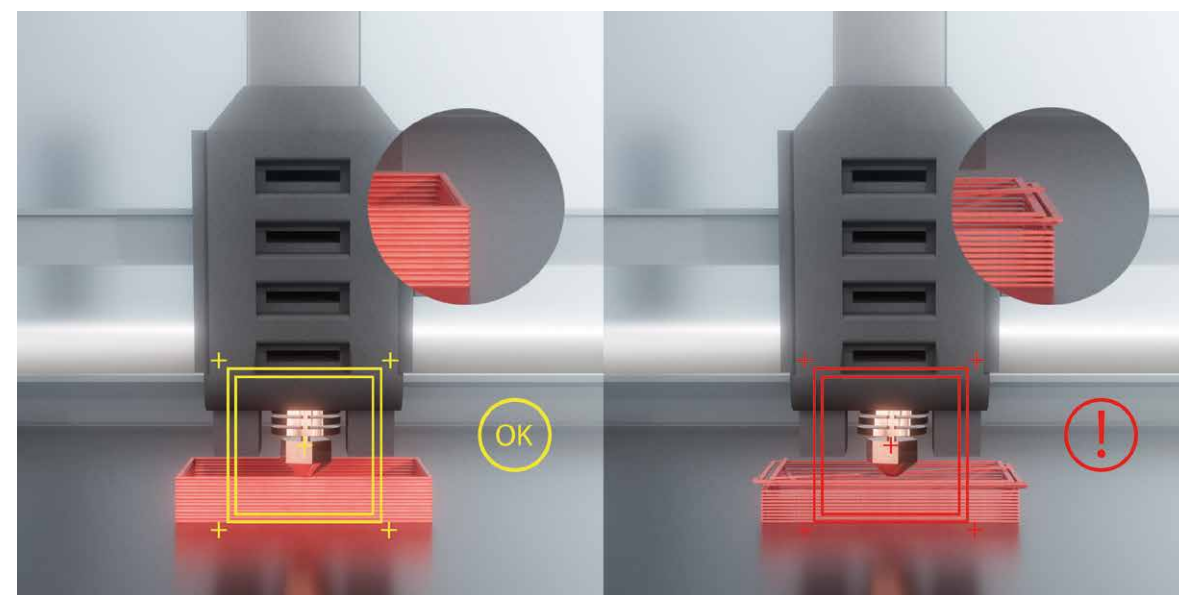
The parameters received were applied and the actual (simulated) resultant model has many details, there are also no distortions or thin edges visible. The model retains the originally designed shapes. It is interesting that ChatGPT-4 provided additional instructions concerning e.g. adhesion and general information affecting the quality and stability of the print (fig. 20, 21, 22).

## AI and detection of errors during printing

PrintWatch is an AI-based tool which automates processes connected with 3D printing. It functions as an extension for the 3D printer management system – OctoPrint. Thanks to the use of a camera which monitors the 3D printer working area, PrintWatch detects in real time all defects in printing (fig. 23). The system is capable of stopping the printing when a problem is detected, e.g. detachment of part of the model from the table, tangling of the material, etc. It is an extremely useful functions, especially during the creation of large models. It is worth adding that it is possible to use PrintWatch in printers which enable integration with OctoPrint.



**Fig. 22** Different types of the 3D print infill types. Source: Own work.



**Fig. 23** Example of 3D printing error detection. Source: Own work.



**Further stages and design summary**

It is worth pointing out at the beginning that although artificial intelligence, including ChatGPT, can be sometimes very helpful, it has its limitations and may present erroneous suggestions. This refers in particular to technical matters, such as the settings of 3D printing, logical elements in the source code, or construction of diagrams. For this reason, all suggestions received from the AI should be tested and verified to ensure their correctness.

Assuming that the printing process has been completed successfully and we have the finished model, we can move to the stage of assembly of all components, such as electronics, LED tubes and the base. This way we will obtain the first prototype of the installation which should theoretically be functional. However, prototypes follow their own rules, therefore empirical actions will be required to verify whether the installation works.

Let us now sum up the entire process and try to answer the question whether artificial intelligence and tools that use it are actually helpful. At the beginning of the project, certain assumptions concerning the installation creator's description were formulated. Such person may be described as a deliberate creator who moves freely in the world of new technologies and understands it. Without this knowledge, the entire process would be different. Firstly, the queries we submitted to AI would be less precise, and only on the basis of the answers we could specify our needs in more detail, which would definitely extend the preparatory process.

Based on experiences, it could be stated that a contemporary visual artist may have partial technological knowledge but lack the ability to combine art and technology. Support in this case may be offered by AI which operates as an assistant. One must remember, however, that artificial intelligence may be low on detail and sometimes does not provide completely true solutions. Despite these imperfections, most creators who want to gain more independence may fully employ AI – continuing to remember about its limitations. Another thing that should be noted is that the information obtained through artificial intelligence may be used as sketches for the artist who later, in a more deliberate way, may confront them with the person responsible for the technical aspects of the design. Thanks to this, we can shorten the entire creative process.

The topic of the moral aspects of using AI and the issue of copyright have not been discussed in the paper. The assumption was the use of artificial intelligence as an assistant and helper (who does not always provide correct prompts), and not as a tool to independently shape the design. When creating designs, it is worth relying on one's own and not completely artificial intelligence. ■

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WIT Academy Warsaw**Bibliography**

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# Mobile photography – new technical possibilities

**Mobile photography, as the consequence of the extremely dynamic development of digital technology, and in particular computational photography, not only revolutionised but simply redefined the way images are created and received. As technology is moving forward, boundaries between traditional methods of recording images and modern computational techniques are becoming more and more blurred. Thus, new artistic and technical possibilities arise – ones that just over a decade ago were exclusively notional.**

In traditional photography, image has been recorded at the moment of shutter release, and the quality of the photograph has been directly related to the parameters of the equipment used – lens, matrix or lighting. Computational photography changes this paradigm by introducing advanced algorithms which analyse and modify data originating from the matrix in order to obtain an optimum final effect. This process of image processing makes it possible to achieve visual effects which previously would have been impossible to attain using the same optics [1].

**Digitisation of image as the first step  
towards computational photography**

The first stage of evolution of computational photography was digitisation of the image, which initiated the transition from analogue, optical-and-chemical processes of recording light on photo-sensitive emulsion to complex digital structures on matrixes, such as the Charge-Coupled Device

(CCD) and Complementary Metal-Oxide-Semiconductor (CMOS). This transformation allowed the conversion of visual information to the form of digital data which can be subjected to complex analysis algorithms, multi-stage treatment and advanced processing.

The breakthrough came in 1975 when Steve Sasson, a Kodak corporation engineer [2], developed a prototype device, which enabled the recording of an image in the binary form [Fig. 1]. The reactions of his contemporary colleagues and the management focused not on issues connected with the mechanism of this technological breakthrough but on the question: “why would anyone want to take photos this way when there is nothing wrong with traditional photography?” Paradoxically, it was Sasson's invention that opened the route for the development of advanced technologies, such as High Dynamic Range (HDR), which made it possible to obtain images with an extended tonal range, or Super-Resolution in the case of which reconstruction







**Fig. 1** First digital photograph. Source: Mistry P., How Steve Sasson Invented the Digital Camera, Source: <https://petapixel.com/how-steve-sasson-invented-the-digital-camera/> [access: 23.09.2024].

algorithms allow the increasing of the image resolution through integration of information originating from multiple shots [3]. Digital photography, although historically rooted in traditional optical methods, as a result of the continual technological progress and growing computational capacity, evolved towards a new form that is computational photography, thus rejecting the earlier restrictions of the photographic medium.

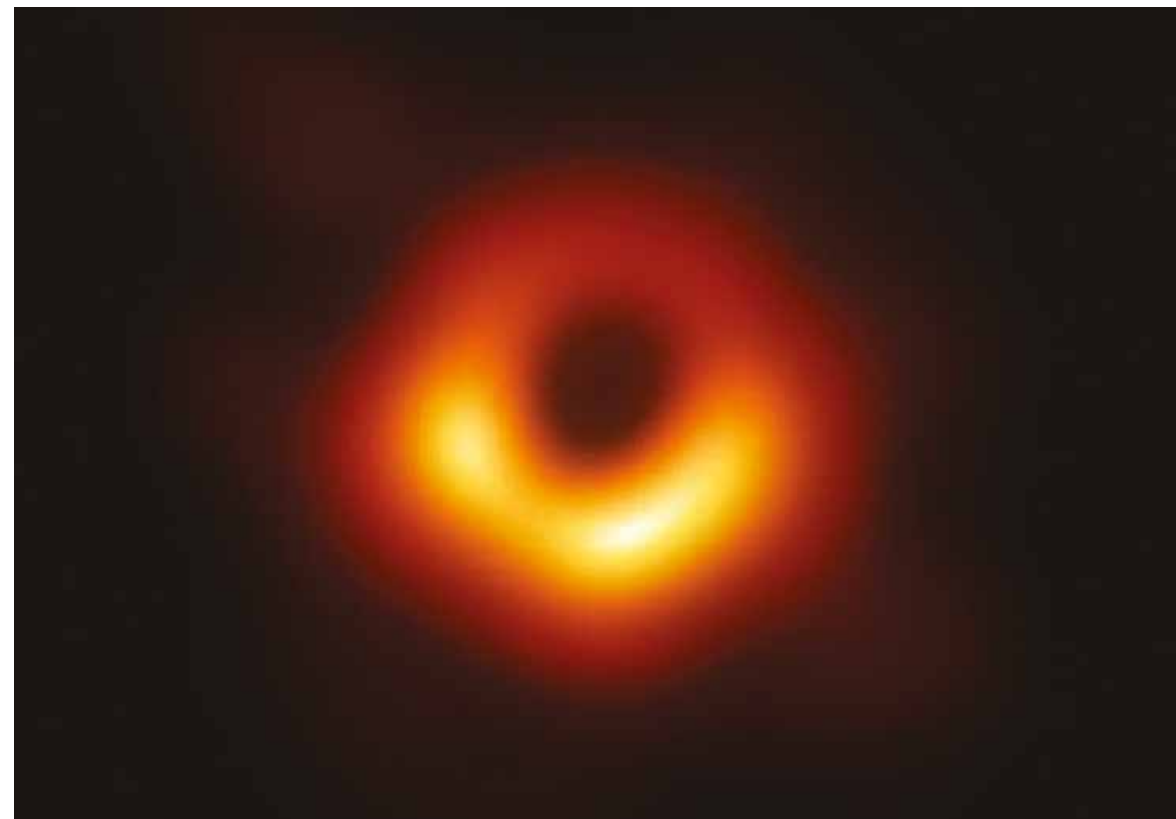
Computational photography is an interdisciplinary field which integrates traditional photography techniques with advanced digital image processing methods based on complex computational algorithms. Contrary to conventional photography which is based mainly on physical properties of optics, such as the focal length of lenses or sensitivity of photosensitive matrixes, computational photography uses the high computational power of modern processes and artificial intelligence algorithms in order to significantly improve the quality of images, create advanced visual effects, and even produce (“generate”) images that are impossible to obtain using exclusively traditional optical tools [4]. Contemporary lenses transform into multi-task sensors, collecting various data on light, colour and depth, which are

then processed by computational systems into images with a high degree of detail and realism. Details concerning this complex topic have been discussed in the publication entitled “Bridging Machine Learning and Computational Photography to Bring Professional Quality into Casual Photos and Videos” [5].

#### Computational photography – the next stage of development towards mobile photography

Mobile photography would not exist without computational photography because it directly originates from it. It is the advanced computational technologies that enable smartphones, which have limited optical and hardware capabilities, to create high-quality photographs. Thanks to image processing algorithms and the computational power of mobile devices it is possible to acquire effects in the form of photographic images. Computational photography has become another stage of evolution of photography, opening the path to everyday photos taken using a smartphone as well as undertakings of global importance.

The most spectacular example of application of computational photography that is at the same time a breakthrough event in the history of scien-



**Fig. 2** Computational photography made it possible to photograph a black hole, M87 from the middle of the Milky Way. Source: <https://science.nasa.gov/resource/first-image-of-a-black-hole/> [access: 23.09.2024].

ce and technology is the capture of the image of a black hole. Thanks to the international project Event Horizon Telescope (EHT), in April 2019 the world saw for the first time the visualisation of the supermassive black hole in the centre of the M87 galaxy. It is worth emphasising, however, that what was presented is not traditional photography but the result of advanced data processing, in this case the observation of radio waves [6] based on simulations of computational algorithms [7] [Fig. 2].

A question arises therefore: to what degree does this image reflect reality? Having observed how accurately computational photography recreates reality in everyday uses, such as photographs taken using smartphones, one might assume that much more advanced technologies and supercomputers used in the EHT project provide just as precise or even more faithful reproductions of astrophysical phenomena. It is worth noting that, unlike small sensors and software that is suited to mobile photography, EHT has an Earth-sized “lens” – these are research stations situated in several locations (Hawaii, Chile, Mexico, Spain, Greenland [8]), operating on advanced scripts [9].

In computational photography, optical information is not necessary to create an image. An excel-

lent example is the mission of the Perseverance rover which landed on Mars in 2021 and mapped the surface of the planet using an instrument called RIMFAX, Radar Imager for Mars’ Subsurface Experiment [10]. This radar, penetrating the surface of Mars, makes it possible to create the so-called “radargrams” which reach to a depth of even 15 metres from the surface. After the raw radar data have been processed, results are visualised in the form of three-dimensional models, which makes it possible to study in detail the geological structure of Mars in a manner which is unavailable to traditional photographic techniques. Thanks to the advanced computational photography technologies, these data are transformed into imaging forms which can then be analysed by scientists as if taken using a conventional camera despite the fact that in reality the image originates from deep layers of the ground [11].

It is a no less fascinating fact that scientists are working on creating “photographs” of people based on just their DNA data [12]. Already in 2013, Heather Dewey-Hagborg presented her research on facial reconstruction based on the analysis of DNA traces [13]. In her project entitled “Stranger Visions”, she creates three-dimensional portraits of people on the basis of DNA collected from ►►







**Fig. 3** Printed faces generated on the basis of remaining DNA. The box under the portrait contains a genetic trace, e.g.: chewing gum, hair, cigarette.  
Source: <https://deweyhagborg.com/projects/stranger-visions> [access: 23.09.2024].

random biological samples, such as hair, cigarette ends or chewing gum. This process consists in analysing specific regions of the genome that are linked to physical traits such as sex, eye colour, skin colour, or facial features. After the DNA has been analysed, the artist creates digital models of faces, which are then printed using the 3D printing technology, and presents them in the form of sculptures [Fig. 3]. Although her work is not perfect in terms of accuracy, because genomic connections with facial features are still not fully understood, her research shows the potential of computational photography to reproduce physical appearance based on genetic information. As a confirmation of this, Parabon NanoLabs launched a “DNA snapshot” service offered to the police throughout the United States [14].

Contemporary imaging methods, such as confocal microscopy and super-resolved microscopy (STED), additionally make it possible to obtain images of intracellular structures at the molecular level, giving researchers an unprecedented insight into biological processes [15].

It is also worth mentioning advanced mapping applications, such as Google Earth and 3D Maps, which use millions of satellite and aerial photographs to create gigantic mosaics and detailed three-dimensional reconstructions [16].

All these examples are aimed at emphasising the key feature of the final image – it is the visualisation of data and not photography within the traditional meaning of the word. The image is created not thanks to direct recording of light but as a result of the processing of information using advanced algorithms. Which is more, this technology is not reserved for specialists or scientists alone but is increasingly accessible to ordinary users and people not acquainted with advanced photography. In the recent years, computational

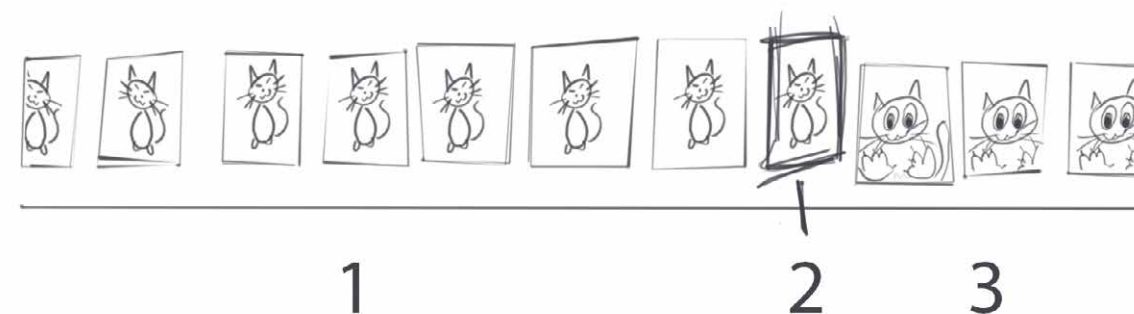
photography has become a standard in mobile devices such as iPhone, Samsung Galaxy or Huawei series P, enabling users to take daily photos with the quality that was previously possible only thanks to professional cameras.

### Mobile photography

What is mobile photography then, based on the above examples of computational photography? It is a type of photography that uses mobile devices, such as smartphones or tablets. When describing mobile photography, one should clearly distinguish between two key elements – hardware and software which play different although complementary roles and which are successively replacing traditional photographic technologies [17]. In computational photography, both these components work together in a complementary fashion, creating an advanced image processing system, although their functions differ.

Hardware, comprising light-sensitive matrixes and lenses, is responsible for the physical recording of raw visual data. Matrixes such as CMOS or Dual-Pixel play the key role, gathering information about light, colour and depth. These are unprocessed data which in themselves do not form a finished image. Thus, hardware provides basic visual information but without the support of software the raw data remain unused.

Software, on the other hand, fulfils the data processing and interpreting function. Advanced algorithms analyse information provided by matrixes and lenses, correcting the image, optimising the quality, and even creating visual effects which would not be possible if only optical equipment had been used. Thus, software transforms data into an optimised, final image ready for use. The difference between hardware and software consists in the hardware dealing with the physi-



**Fig. 4** Photograph evolution diagram. Source: own work.

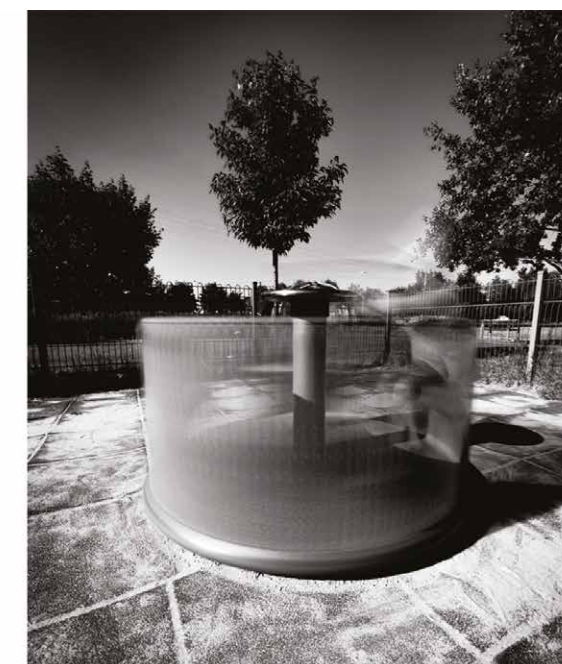
cal recording of the image, whereas software is responsible for its interpretation and final quality.

Thanks to the cooperation of both these elements, it is possible to obtain professional quality images with limited computational resources offered by smartphones. Software is optimised for effective operation with a lower computational power, which eliminates the need for larger, more energy-intensive components. Computational photography in mobile devices thus reaches impressive effectiveness by combining advanced optics with smart image processing algorithms.

Computational photography in smartphones allows the creation of high-quality photos despite relatively small and optically restricted sensors [18]. The key element of this technology are

advanced image processing algorithms which analyse and improve quality of photos in real time. At the time of taking the photo, the image visible on the screen is already processed by algorithms and stored in the phone memory buffer before it is saved as a final file.

One of the most obvious examples of this technology is the Live mode known as “Live Photos” (on iPhones) or “Motion Photos” (on Android system phones). When the camera application is launched in the phone, it immediately starts recording images (thanks to this we can see the image on the screen). During this time, images are in the buffer and are stored there. In the Live mode, smartphone records the image for a short period of time – usually 1.5 seconds – before and after ►►



**Fig. 5** Time stacking allows the simulation of a photograph in a long-exposure mode. The strobe effect in the photo is due to the small number of frames. Source: own work.





**Fig. 6** Mapping of space. (background lens #1, foreground lens #2). Source: own work.

the shutter release [Fig. 4]. Thanks to this, the user receives a moving image which captures not just the moment when the shutter button is pressed but also a brief period before and after, as a result creating a more dynamic and fuller capture of the moment. The end file is composed of one standard photo and a short video recorded in the background which may be played after the screen is touched.

Additionally, this technology offers functions such as the selection of the best frame from the Live mode, which can then be set as the main photo. For example, on the iPhone devices, users may review individual frames from the recording and set the one which best represents the selected moment. This mode also allows the combination of all photos stored in the buffer into a single frame (this is a technique referred to as time stacking). It consists in taking photographs of the same scene for a certain period, depending on the expected effect. It may last anything from several seconds (e.g.: light traces in road traffic), to minutes (cloud blurring), up to even several hours (light arcs traced by stars in a night sky). This simulates long-exposure photography [Fig. 5].

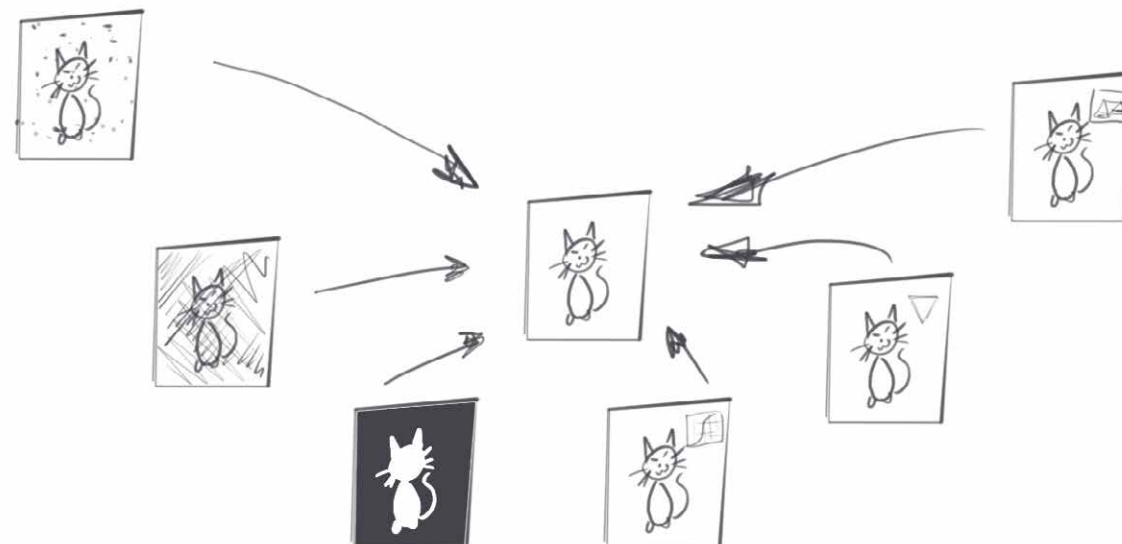
Another example of computational photography application in smartphones is the portrait mode which allows photos to be taken with the effect of blurring of the background (bokeh), making the object in the foreground more distinctive. In traditional cameras, this effect is achieved by using lenses with a wide aperture, as a result of which the depth of focus achieved is low. However, in smartphones which, due to their physical limitations, cannot use such optics, the blurring effect is achieved through

advanced computational algorithms and artificial intelligence. In other words, the depth of field is an artificial effect [Fig. 6].

At the beginning, artificial intelligence utilised in the portrait mode identifies the main object in the frame, usually the face or silhouette of a person. When analysing the image, it precisely separates the foreground (portrait) from the background [19]. In modern smartphones such as iPhone or flagship models with the Android system this effect is additionally supported by multi-lens systems, e.g. dual or triple cameras. One of the lenses records the image, whereas another one measures the depth of the scene, which allows for more accurate and more precise separation of the object from the background [20].

The main camera usually offers a wide angle of viewing, whereas the telephoto lens ensures the possibility of bringing the scene closer without the loss of picture quality. Because each lens records the image from a slightly different perspective, manufacturers must achieve synchronisation between the lenses in order to avoid problems such as ghosting [21] or other artefacts in photos. After the object has been identified and separated from the background, advanced algorithms simulate the effect of blurring which in traditional optical photography is achieved through shutter regulation. In consequence, the object in the foreground becomes clear and its background is subtly blurred, which creates the impression of low depth of field, characteristic of professional portrait photography.

Which is more, users of many smartphones may adjust the intensity of background blurring



**Fig. 7** Data analysis by algorithms in order to create the best image. Source: own work.

already after the photo has been taken, and additional functions, such as the simulated studio lighting, make it possible to modify the type and direction of the light on faces. These advanced technologies allow the creation of photographs which look like professional portraits despite the fact that they are taken using mobile devices.

None of the photographs taken in the Live or Portrait mode would achieve high quality without the support of advanced algorithms such as Deep Fusion and Smart HDR (Apple), Night Sight (Google) or AI Scene Detection (Huawei, Samsung, Apple). These algorithms automatically adjust the white balance, colours and contrast, eliminating artefacts and improving the general quality of the photo depending on the scene. Although for human visual perception these elements seem obvious, you should remember that machines see the surroundings completely differently, this is why it is necessary to process images in a manner adapted to the conditions of the given scene [Fig. 7].

Algorithms analyse the source of light in the scene and automatically adjust the colour temperature of the image so that the colours are as natural as possible. Without the appropriate white balance photographs could be too warm (with a yellowish tinge) or too cold (with a bluish tinge). The precise matching of the colour temperature is particularly important in the changing lighting conditions where algorithms correct the colour so that to ensure the best representation of reality. The change of colour temperature also affects the intensity and accuracy of colours, depending on the type of scene. Artificial intelligence can identify the context – e.g. landscape, faces or food –

and automatically adjust the colour palette in order to achieve a more realistic effect.

The Deep Fusion technology used in iPhones is an example of an algorithm which combines many shots into one photograph, enriching colours and sharpening details. The adjustment of contrast on the other hand, particularly in light and dark parts of the photo, is just as important in order to retain all of the details of the image. This process is often supported by the HDR (High Dynamic Range) technology which combines several exposures into a single photo to obtain a wider tonal range. Thanks to this, scenes with extensive contrasts between light and shadows are reproduced with greater precision, and photographs become more dynamic and detailed [22].

In order to overcome the hardware limitations and obtain higher resolution and better quality of picture in difficult lighting conditions or when using a digital zoom, without the need to use larger matrixes, advanced data processing techniques characteristic of computational photography are used. Smartphones such as Google Pixel (from Pixel 3 to Pixel 6), Samsung Galaxy S21 Ultra and newer, Huawei P30 Pro and P40 Pro, Xiaomi Mi 10 Ultra and Xiaomi Mi 11 use the Super-Resolution (SR) algorithms.

The Super-Resolution algorithms are based on combining several photos taken within a very short time. Each photo can capture subtly different details due to a minimal twitch of the hand or minuscule changes of the angle at which the image is recorded. The algorithm analyses those differences and combines images by reconstructing details which would be invisible in a single





# “The boundaries between traditional photography and computational technologies become more and more blurred...”

shot taken in a lower resolution. This technology, referred to as “fusion of multiple frames”, enables the user to obtain a clearer and more detailed image.

Additionally, the Super-Resolution technology may use the pixel-shift technology – pixels are analysed to obtain more precise information about colours and details of the image. Thanks to this it is possible to acquire better quality images even with the restrictions that come with small matrixes in smartphones. These technologies significantly improve the quality of photos taken using the digital zoom and in poor lighting, which allows smartphone users to obtain more detailed and clearer photographs.

The quality of pictures which may be taken using mobile photography is evidenced by the iPhone Photography Awards (IPPAWARDS) competition launched in 2007, the same year in which the first iPhone model had its market debut. IPPA-WARDS is one of the first and most prestigious photography competition dedicated exclusively to photos taken using an iPhone. Although the first iPhone models did not offer advanced photographic functions, with time – thanks to the evolution of their hardware and software, iPhones started to be recognised as professional photographers’ tools [23], and the effects of their work are not much different from the works created using SLR or mirrorless cameras.

## Summary

Mobile photography, as the key element of computational photography, revolutionised the image recording and processing method. Thanks to the dynamic development of the digital technology and artificial intelligence, smartphones have become rightful photographic tools, capable of creating photographs the quality of which is comparable to professional equipment. Computational photography has become an intrinsic element of the contemporary mobile photography, extending its creative and technical capabilities. Thanks to the support of advanced image processing algorithms, it is becoming a powerful tool in the hands of both amateurs and professionals. The boundaries between traditional photography and computational technologies become more and more blurred, which opens up new artistic and technical possibilities. What has previously been reserved for specialist cameras is now within the reach of any smartphone user. Thus, mobile photography not only changes the way we capture reality but also redefines the art of photography in the digital era. Computational photography, in general sense, determines the new direction of development of photographic technologies, changing our perception of images and offering possibilities which even just a few years ago were unattainable. ■

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# SOME ASPECTS OF UNDERSTANDING OF THE LANGUAGE OF ART

Questions about art and artists, creation of an artwork and its message have always been the interest of a human person. Art has its own specific linguistic expression that can speak to its viewers, evoke emotions, and create for everyone a unique system of values with colours, lines and shapes. Its character changes with the development of materials and technologies influenced by historical, cultural and social events. Art's language conveys specific messages that one must learn to interpret and apply.

The environment of the 21st century exposes an individual and the society to a variety of visual manifestations, both through technologically saturated visual performances and commercials, festivals and stage performances. Visual manifestations often cause confusion and uncertainty in society. As stated by scientists R. Wilkinson and K. Pickett, the development of humanity is in a paradoxical situation: people live in an era of high material and technical achievements, but at the same time experience lots of stress and a tendency towards depression, they feel insecure as well as do not feel a sense of community with the people around them [1]. The understanding of values in society is changing. A. Mūrnieks, a researcher of cultural history, explains that if previously in human culture the dimensions of the natural or physical world, culture and spirituality have been in mutual integration, then nowadays they are often separated from each other. The author continues by saying that people nowadays get caught up in one of these three dimensions, which manifests itself as, for example, ignoring reality, accepting mysticism or misunderstanding the physically and genetically determined essence of human gender [2]. Altogether, it marks a social division, which often leads to conflicting situations.

As an important multifunctional component of culture, art can influence public thinking, build awareness of values, peace and harmony. Appreciating the importance of art in promoting creativity and innovations, and respecting the cultural diversity in the world and recognizing its important role in the exchange of knowledge and the promotion of curiosity and dialogue, the World Art Day was proclaimed on April 15, 2019 at the 40th session of UNESCO General Assembly [3]. This strengthens the connection between art and society, promotes greater understanding of the diversity of artistic expressions, and highlights the contribution of artists for sustainable development. In this regard, it is important to note that this also actualizes art education in schools. Here we can see the role of art in the journey towards inclusive and equal education. Also in Latvia, moving towards the goals of School2030 in the terms of understanding the cultural awareness and self-expression in art studies, the students' understanding of the ideas contained in the work of art, and the interaction between the era and culture, as well as getting to know different types of art and their means of expression and experiencing creative processes have been raised and implemented [4].

#ART #VISUAL LANGUAGE #MEANING OF ART #UNDERSTANDING OF ART  
#ARTIST'S SELF-EXPRESSION





In their research, the art educators and scientists D. Kalēja-Gasparoviča and I. Briška indicate that the meaning of art education in elementary school is not to raise a professional artist, but to reveal to the students the visual art as an opportunity to learn how to create a more beautiful, diverse and valuable life. These authors see the learning of the language of art as opportunity for the students to see the world truly, freshly and without stereotypes; to live fully and become aware of one's own and other people's feelings; to explore one's own individual abilities, talents and interests; to think independently and creatively; to build relationships with surrounding people; to improve the quality of daily life, to build one's own surrounding environment; to understand and engage in social and political processes; to enjoy the inexhaustible cultural heritage of humanity [5].

The artist Dž. Skulme, who has made a significant contribution to Latvian art and the development of public thought with her artwork, expresses significant insights about the importance of the language of art, based on her experience of creative activity in painting: "Painting gives me complete answers to all questions, to all problems. [...] If something does not work out, then it is a painting that brings the solution. Thinking also takes place directly when painting. No quarrels or discussions help. Painting – it's such a lively and essential activity! It's a language. If you master it, then you can talk about everything in it" [6]. The language of visual images reflects our needs, everyday achievements, our expectations, experiences and ideals, influencing both social and emotional, as well as intellectual and personal development. In turn, the process of creating visual images is not only the artist's self-expression and creativity, but also the contribution of purposeful work, often filled with doubts and reflection. The language of visual art makes us think about important values in personal life.

### Methods

This article raises a number of questions in the context of a general understanding of the language of art:

**How has art formed in the historical context of Latvia?**

**How does understanding of the art language develop?**

**How does the author implement his/her artistic reflection on the artist's inner world?**

The aim of this article is to form an image about the multifunctional nature of art in a historical context, actualizing the understanding of art in society and drawing attention to the artist's self-expression.

In the context of this aim, the following objectives are set: exploring the role of art language forms in a historical context, based on the findings of researchers of art and cultural history; characterizing the essence of art and its potential possibilities based on the findings of philosophers, psychologists and artists; identifying the self-expression of artists on the basis of the information included in monographs about artists and the findings expressed by artists themselves.

To stimulate the understanding of the language of visual art, the article includes the paintings of Latvian artists J. Feders, V. Purvītis, K. Padeģis, L. Kokle, Dž. Skulme, F. Pauļuka.

The assessment of the significance of art and its impact on the historical development of humanity will always be incomplete as research continues confirming new discoveries and raising open questions and hypotheses for discussion.

### Historical aspect of art formation in Latvia

At the end of the 19th and the beginning of the 20th century, the acquisition of professional art language was rapidly developing in Latvia, and art expression forms improved with relation to the context and conditions set by the era. In the 19th and 20th centuries, Latvians obtained art education mainly in Russia: at the Art Academy of St. Petersburg, Stieglitz Central Technical Drawing School, the Imperial Society for the Encouragement of the Arts in St. Petersburg, and at Kazan and Penza Art Schools. The first school in Riga where art education could be obtained was Riga Craft Society Evening School, founded in 1872 [7]. The first Latvian painters are considered to be the portrait artist J. S. Roze (1823-1897), who has left testimonies about the people known in the society at that time (the portrait of Philip Johann Schulz, 1861), the painter K. Hūns (1830-1877), who worked in all genres (On the eve of the Bartholomew night, 1868), the pioneer artist of landscape painting J. Feders [8]. According to the aesthetic realism principles of the era, the artist J. Feders expresses in his work love for people and nature, its sincerity and beauty. Speaking about the treasure of the Latvian National Museum of Art – his painting "Gaujas leja" (Valley of Gauja) (1891), according to A. Eglītis and A. Lapiņš, the master simply and convincingly depicts the gorgeous



**Fig. 1** Jūlijs Feders. Gauja Leja (Valley of Gauja), 1891, Oil on canvas, 111 x 173 cm. Source: Collection of LNMA [10].

down in the mist of the early morning hours. The authors note the complex choice of drawings and colours, saying that this is manifested in the compositional layout of the foliage array and the nuanced diversity of the chosen colouring in a landscape that goes deep into the perspective [9]. The work is performed clearly outlining the plans of the painting from a realistic point of view.

Today the artist's heritage allows us to view the Latvian landscape of more than a hundred years ago, which harmonizes "the colour of the painting, to which trees, shrubs, morning mist that combines separate colours and shades of objects, are subjected" [11]. Gradually, the accessibility of art to the wider public was formed, art critics had to evaluate developments in art carefully, therefore regular exhibitions were organized, art schools were established, and a Latvian painting school was formed.

At the end of the 19th century and the beginning of the 20th century, the activities of artists in Latvia were influenced by changes in art expressions and artists' views of Western Europe, as well as industrial development, and social and political events. The artists focused on the search for a versatile expression of the art language, striving both for the truest representation of reality and the abandonment of realistic and academic school. The possibilities opened up by photography led to the search for new forms of expression. Free solutions of visual art ideas were actualized, as well as romantic expression, depiction of moods, inclusion of symbolic images in works of art, creating a decorative stylized language of visual art.

At that time, the most prominent painters that had achieved the excellence in art of Latvia were J. Valters (1869-1932) and J. Rozentāls (1866-

1917) [12]. Artist V. Purvītis (1872-1945) has made a significant contribution to the recognition of Latvian professional art at the local and international level in the field of emotion-engaging landscape painting, as well as in the education of the new generation of artists. When describing V. Purvītis' work "Ziema" (Winter, circa 1910), art scientist A. Brasliņa draws the viewer's attention to the painting's elegance, spatial scope, lighting effect and its unified rhythmic and anthemic expression. As the scientist notes, the artwork reveals to the viewer a monumental image of the northern nature of a snowy landscape according to the impressions of modern art of its time [13].

The First World War [1914-1918] drastically changed the thematic range of Latvian artists: the fates of refugees, the struggles for freedom, the dramatic mood of the era – these were only a few of the themes reflected. The greatest representatives of this stage, J. Grosvalds [1891-1920] and J. Kazaks [1895-1920], with their series of ar-



**Fig. 2** Vilhelms Purvītis. Winter, c. 1910. Cardboard, oil, 69 x 99.5 cm. Source: Collection of LNMA [14].





## “ Art’s language conveys specific messages that one must learn to interpret and apply

networks, spoke to the society on such important topics as war and peace revealing the harsh, dramatic nature of the times. Public opinion and the appreciation of the importance of art developed slowly, but often the works created by individual artists under the influence of modernism seemed incomprehensible to the public. Art historian B. Vipers, describing Latvian art in the first half of the 20th century, points out that it has two ages: one is characterized by a period which is rich of external impressions, lived at a rapid pace and influenced by Eastern and Western culture; the other is characterized by the preserved power of folk traditions [15]. Thus, circles of followers were formed both for traditional art and the so-called “new art”, which required a wide range of explanatory work from the artists and art critics to the public.

Looking at the further development of art, we can get acquainted with its complex nature along with the change of the times and power. During the period of Latvia independence [1918-1940], the public received messages from the artists who had become acquainted with European art directions, influenced by them, used them, and who integrated their experience for the professional development of young artists. There was no doubt that in these two decades, in which the Latvian nation had gained independence, Latvian art was not only a taker, but also a giver [16]. These processes fostered the development of education, which contributed to the formation of the nation’s national consciousness. However, this situation was possible for a relatively short period of time. With a dramatic change of ideology, the

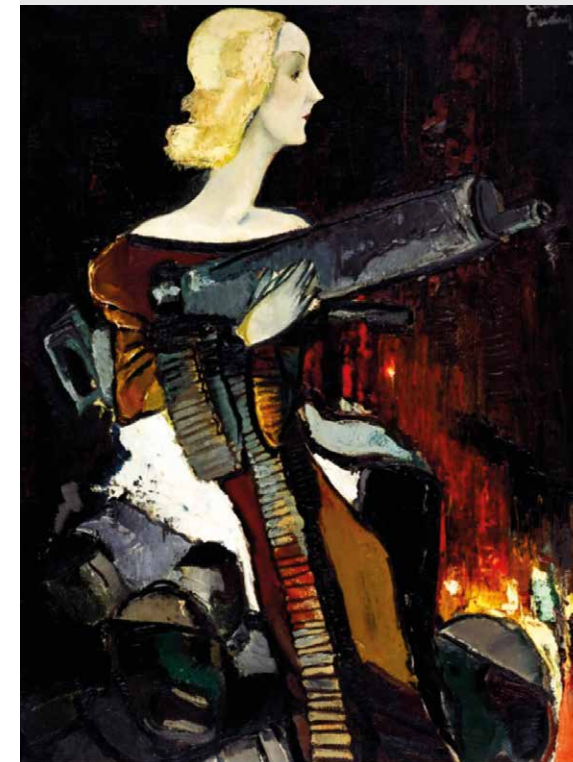
focus on European art turned into a ban. Art historian I. Konstante, accurately describing the situation, indicates that only those who complied with the ideas of Soviet art were allowed to paint and speak, while students were prepared to become the “new Soviet Latvian artists” [17]. Such situation both stopped the current development and destroyed or partially destroyed the creative trends in art and public thinking. The artists had to surrender to the tendencies of social realism, imaginatively purifying the ideals embodied by the Soviet ideology, trying to expand the range of means of artistic expression within the possibilities until the restoration of Latvia’s independence at the end of the 20th century.

### Expanding the frontiers of art

Nowadays, the expression of art experiences a peculiar state when it thematically blends together the philosophical insights of the era with aesthetic and artistic ideas. Philosopher E. Freiberga points out that art classification techniques that were significant in the past have lost their relevance [18]. Art has greatly expanded its expression and subjected itself to a variety of experiments, operating between traditional means of artistic expression and images created by the media. This opens up the new possibilities for creation of unprecedented art products such as animation, video, manipulation in digital environment, interactivity, art synthesis using sound, movement, light and images. Technologies open up various opportunities for uniting elements of the language of art in a peculiar synthesis, creating new networks within mutual

interaction. Creativity expert K. Robinson draws attention to the fact that today millions of people around the world have acquired unprecedented means for expressing creativity in the language of sound, design, science and art. According to the author, if the video camera is handled by an artist, the film that is shot can be as emotionally moving as a painting created with a brush and oil paints [19]. Now it is a time of challenges and benefits, when the integration of new technologies in terms of visual art creates both advantages and threats in the process of forming a human value system. This time of opportunities requires a serious assessment in the process of creation of the works of art. As expressed by the art scientist H. Demakova, in any era weaker and stronger works of art have been created: “... the time we call today, with its sloppiness, ‘tweeting’ and the triumph of public relations over content and knowledge, has contributed to a proportionately more significant emergence of a weak art, which for the most part cannot even be considered art” [20].

Art scientist E. Gombrich states that nowadays art is a time of bold inventions and innovations, at the same time, only a few embrace what is hap-



**Fig. 3** Kārlis Padegs, *Madonna ar ložmetēju* (Madonna with a machine gun), 1932. Canvas, oil. 100 x 134 cm. Source: Collection of LNMA [24].



**Fig. 4** K. Baltgailis, *Vientuļais jātnieks* (Lone rider), 1958. Source: J. Pujats, Kārlis Baltgailis. *Lone rider*, [Oil painting]. Rīga: Liesma, 1969, p. 35.

pening and do not even realize how much of it has come into human life, influencing the formation of taste and preferences [21].

This marks the possibility for visual art to be both rejected and accepted by society. It is possible to get closer to the artists’ message by looking at the authors’ work, focusing on the elements of the language of art, the techniques and the materials used by the artists to convey their story to the viewer. It is recognized that line, colour, shape, structure, value and space are the visual elements, which remain the same in all cultures

### Understanding the language of art

Art is one of the basic forms of understanding the existence of human life, which is based on a person’s ability to perceive and portray it in the form of an image. It is one of the forms of social consciousness that reflects people’s interests, actions, perceptions of different social groups, nations and society as a whole. Art, in the broadest sense, is all the processes and products of human craftsmanship, imagination and inventiveness, manifested as an antithesis to nature [22].

Art plays an initiator’s role in the life of society, and it embraces all the spiritual realms of humanity that other forms of social consciousness cannot. The essence of art, as a reflection of humanity’s consciousness, is closely related to the worldview of the particular time, the level of human and technology development, ethical and aesthetic presumptions, as well as a reaction to the devastating effects of wars, socio-political crises, existing ideology and events.

The theme of the damages created by war has been addressed also by the extravagant and virtuosos draughtsman, painter and graphic artist K. Padegs [1911-1940]. With a metaphorical approach, scepticism, irony and indirect attitude towards the world, the author’s painting “Madonna





↑ **Fig. 5** Leo Kokle, *Mana māte*, 1963. Oil, 81 x 73 cm.  
Source: I. Konstante, *Leo Kokle. 1924-1964 monogrāfisks albums. My Mother* [Oil painting]. Rīga: Neputns, 2005, p. 191 [29].

with a machine gun” is one of the most expressive and original paintings that is visually expressing the paradox. Art scientist, doctor J. Kalnačs writes about this work: “A peaceful, blond woman stands out with the background of an ominously glowing battlefield in the distance. She is carried by a bunch of wounded soldiers above their heads, but instead of a helpless child, she holds a massive machine gun in her hands” [23].

Thus, in a generalized format of artistic expression, challengingly and precisely, the artist draws the attention and conveys the message to the viewer about the social consequences of the war.

Art is an important means for documenting historical events in a peculiar way, so that future generations develop a fuller understanding of the values that are important in human life. One can refer to the artworks of K. Baltgailis, who depicts in silvery cool glowing colours the historical events that marked drastic and harsh turns in the fate of the Latvian land—heroism in the battlefield, pain, tragedy and the devastation caused by the First World War [25].

Art is the spiritual mastering of the human environment. In this context, spirituality is understood as not limiting oneself to pragmatic and material goals and requirements of life, but organizing one’s activities according to the ideals of human mission in life, di-

gnity and striving for perfection. The depiction of a human person is characteristic to the works of the artist L. Kokle. Describing his approach to portrait painting, the artist believed that human eyes express attitudes, thoughts and the understanding of the world, they contain the mind and feelings, joy and pain, love and hatred, strength and weakness [27]. L. Kokle himself admits that it is both interesting and difficult to show it in a work of art, believing that a human person is the most wonderful creature in nature. In the description of L. Kokle’s portrait “*Mana māte*” (My mother, 1963), the art scientist I. Konstante includes the artist’s sense of responsibility and tact, creating a true and lasting image of the depicted person and era in the unity of philosophical and artistic universality. “This light and almost transparent painting is like a memory of the mother’s selflessness of the time when the artist was small and incapable, gratitude for what she has done in her life. This portrait shows that it is not necessary to paint a wrinkled face or the attributes of hard work in order to create a convincing image” [28].

Artists, focusing on depictions of people, discover reflections on values and artistic trends determined by the era. The qualities inherent in art are often associated not only with artistically imaginative reflection of reality, but also with the socially unifying meaning. In the publication dedicated to artist Dž. Skulme, art patron J. Zuzans highlights her image of a woman in the national costume, pointing out that it has been used as a symbol of national identity, which has helped to preserve



↑ **Fig. 6** Džemma Skulme, *Dialogs*, c.a. 2000, Oil on canvas, 130 x 163 cm.  
Source: [https://artterritory.com/lv/vizuala\\_maksla/intervijas/14859-eks-presintervija\\_ar\\_laimu\\_slavu\\_par\\_gramatu\\_dzemma\\_skulme/](https://artterritory.com/lv/vizuala_maksla/intervijas/14859-eks-presintervija_ar_laimu_slavu_par_gramatu_dzemma_skulme/) (Accessed 2024-06-20) [31].

the nation’s self-confidence and has provided the opportunities for growth for the future generations [30]. Over the years, the artist Dž. Skulme’s artwork has been permeated by the image of the woman in a national costume in various techniques, but always with a new influential power.

The artist with her work unequivocally confirms that art can affect the society’s understanding of values. One can join the viewpoint of the artist P. Postažs who says that if we protect our culture and preserve it in works of art, then we will create national values that reflect the peculiarity of our nation [32]. This is important for a humanity in which the nationally peculiar is mixed with the universally humane. The prominent Russian psychologist L. Vigotsky once wrote that art is a social technique of emotions, a means for involving society in the most intimate and personal areas of our existence [33]. Art creates and organizes a person’s sensory perception of the surrounding environment. It not only cultivates the feelings morally and ethically, but develops a universal sensibility, through which a person communicates not only with other people, but also with nature. Seeing and depicting what is happening in nature is also one of the tasks of the artist’s specific mission.

### Artist’s self-expression

When creating a work of art, the artist expresses in the form of signs the world of his/her consciousness. Thus, J. Pujāts describes the artist V. Bušs’ creation by saying that he does not reconcile just with the representation of the outer shell, but rather tries to delve into the essence of the phenomenon, giving a full interpretation of it [34]. The viewer, while “reading” the text of the artwork, understands its content depending on his/her experience and understanding of the relevant art language, developing in one’s mind an appropriate image of art. Translating the phenomena of reality in the form of an artwork, the author implements the artistic reflection of his/her world – the artist’s world, expresses it in the form of a peculiar “text” using the means of expression available to the artist.

The artist E. Kalniņš admits that there are such things or moods in the nature that can be felt very deeply, which takes searching for a phrase and a form of expression until this expression is found. Thus, the artist asks a question, “How to paint silence?”, and gradually a solution is found by layering the painting yellow, then covering the blue over it without losing the yellow basis [35]. In



↑ **Fig. 7** Felicita Pauļuka, “Aktrises L. Bērziņas portrets” (Portrait of actress L. Bērziņa), 1978, Paper, pastel.  
Source: Collection of LNMA [39].

his writing, the author draws attention to the importance of the amount of work invested in achieving the goal: to paint what you cannot paint, but to succeed at the same time, replying: “Of course – this is not possible. We have to try. And then the elusive and immense beauty of the work is revealed. Perhaps this walk towards the impossible will be understandable only to me, but may be not only to me” [36]. Art has endless possibilities for exploring, imaginatively and expressively revealing the emotional attitude towards the world.

The artist F. Pauļuka [1925-2014] is one of the greatest portrait and nude painters in Latvian art. About the delicate painting of the nudes, F. Pauļuka has said “The human body expresses not only the outer, but also the deepest essence, as well as the face. The palms and feet also have their own life story. For me, therefore, the nude is an extended portrait involving the whole body and expressing the essence of the human being” [37]. In the publication about the artist, the R. Šmagre notes that every portrait created by Pauļuka is a return of the artist’s time and energy. For creative self-expression and the implementation of her intentions, the artist needed to be alone with the music – to think, breathe and work, because ►►



she believed that the artist's power is hidden in solitude. Šmagre gives a figurative picture of the portrait of the actress L. Bērziņa painted by the artist: beauty and pride of the queen, greatness and sensitivity of the personality, vulnerability and legend, uniting the creation of an understanding and loving personality in the painting [38]. The artist created a series of portraits of people related to culture.

The artist's words confirm the subtle deepening in the implementation of the intention. For each image, the artist finds her own tonal solution and approach for using the pastel. The artist's virtuoso approach to pastel painting can be compared with the pastel vibration in the artist's hands. Basically, the artist had found her technique, which was in accordance with her essence and state of emotions.

The artist V. Bušs, describing the essence of visual art, believes that real, big art in all its diversity and versatility is not meant to be for entertaining the people. It can be a great excitement that makes not only one or more people spiritually deeper and stronger, but gives strength to even a whole nation to overcome the most difficult moments of its existence [40]. Visual art is an emotional communication, a special transmission and exchange of information between contemporaries and eras. Visual images and artworks are often created in this communication, which disrupt our usual logical understanding, as expressed by the philosopher Maurice Merleau-Ponty, and mix such categories as essence and existence, imaginable and reality, visible and invisible, showing the dream world of mute meanings [41]. The philosopher's statement is explained and reinforced by artist Dž. Skulme's statement about the strokes in painting: "The strokes and the outcome succeed only if you are not guided just by what you want, but the whole body cooperates. You stroke the canvas in a way that everything dissolves and flows. In this activity, you are like a raging horse, and then some hand calms you at the right moment, restrains you, stops you" [42]. It is a language in which the artist expresses his/her feelings and experiences, as well as opinion on various phenomena of life in the form of images.

Scientist V. Velšs believes that nowadays artworks are able to change both their immediate and future conditions, and require unusual crite-

ria or the abolition of art borders [43]. The artist's self-expression is both daring and encouraging. The author's artistic self-expression is revealed in the process of creating an artwork and, when meeting a similarly feeling viewer, encourages the dialogue, which is also an invitation to dare.

### Conclusion

By its very nature, art includes both cognitive, communicative and aesthetic functions directed towards a dialogue. The artist's work reveals the spiritual mastery of the human environment, by spirituality meaning not being limited to pragmatic and material goals or requirements, but organizing one's activity according to the deeper understanding of human existence, dignity and perfection. Consequently, a person who is close to art learns the essence of life through the prism of the highest values.

The works of art created by an artist, with their inherent content and form, reveal the author's belief and idea with a new view on things, objects and phenomena, intertwining the context of the respective era with the traits of personality. The viewer, while "reading" the text of the artwork, understands its content and, depending on the person's experience and knowledge of the relevant art language, creates an appropriate image of art in his/her mind. The works created as a result of the artist's self-expression demonstrate the ability to preserve and develop cultural values, promote the affirmation of remembrance and the accumulation of memories, encourage spiritual growth, help to explain excitement, persuade to comment and critically express one's opinion.

The language of visual art opens up inexhaustible possibilities for artistic exploring, discovering and creating, giving the viewer the freedom of imagination. It has the ability to link the past and the present, orientating the message towards the future. The interaction of art and science in the era of high-tech development inspires the artists and scientists to create unprecedented messages of visual art. ■

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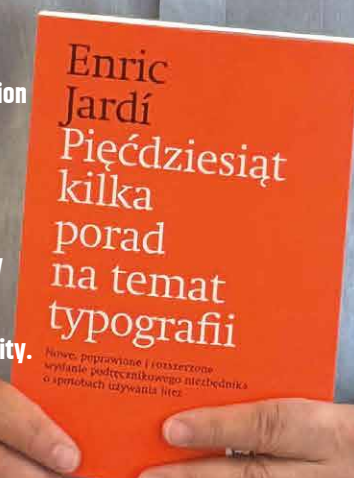
# interview

On 16 May, Enric Jordi,  
the author of  
**Fifty-Something  
“Tips on  
Typography”**

(“Cincuenta Y Tantos Consejos Sobre Tipografía”), visited the WIT Academy in Warsaw to present his work, talk to students, and hold a lecture on the work of Spanish typographers and designers. The meeting attracted a lot of interest both among students, WIT Academy lecturers, and a wide crowd of people interested in the topic of typography and typesetting.

## Enric Jordi

Developed editorial projects, such as the redesign of Chicago Reader and Boston Phoenix. President of the ADG-FAD Association of Art Directors and Graphic Designers. Graphic designer, expert in typefaces and design. Director of Typography Postgraduate Studies at the EINA University School of Design and Art of Barcelona, and also lecturer at the Ramon Llull University.



### Borys Kosmyńska:

I liked your lecture on Spanish graphic designers very much. But we are here to talk about your book. It is promoted as a world bestseller – how many languages has it been translated into?

### Enric Jordi:

The first edition came out in Spanish and in English. The second edition is in Catalan and Spanish, and now also in Polish.

### B.K.:

During our conversation you mentioned that typography is very dependent on the medium, the purpose of letters and the place they are used in. This way those who design typography create it for a specific context. So who is your book mainly addressed to?

### E.J.:

The book is addressed to graphic designers working with a paper product, because this is my specialty and this is what I know best. But in the current edition I have also devoted a lot of space to the use of typography on electronic displays because this is a very up-and-coming topic. ►►





# “ the most beautiful things are still happening on paper

**B.K.:**

**Do you believe, therefore, that in contemporary typography the need for paper versions is slowly disappearing? There has been a time when people believed that paper books would soon completely disappear from the market. What stage are we currently at in your opinion?**

**E.J.:**

Well, this is not the end of books yet. Currently, it is first and foremost newspapers that are dying out. It is a slow but systematic process. Even several years ago designing of newspapers was very popular and I had a big part in it. Today, no new paper magazines are being created because their sales are dropping drastically. Basically, today's newspaper is mainly the logo, the website and the links. Most paper editions have already moved online.

Books are different. As you can see e-books have not replaced them yet. Although electronic readers still constitute a new market, I believe that paper books are doing well and it will be difficult to replace them quickly.

**B.K.:**

**Why did you choose a book format rather than something open, like online resources or applications?**

**E.J.:**

No one would pay for a digital version of this book.

**B.K.:**

**I understand. And what are the challenges that typographers who work both on paper and on electronic displays are currently facing in your opinion?**

**E.J.:**

The main problem now is variety. A typographer may create excellent and very original designs because they have an entire gamut of modern tools to do so. Truly excellent fonts are designed, but in the end the client will still use Calibri (laughter) and other free typefaces. And all this because we have many free fonts online, very similar to the original ones for which you previously had to pay.

Let us use the example of the typeface designed by Apple that we can see on iPhone's screen. It is geometrical, neo-grotesque, with round dots. And now think how many very similar fonts there are. There are hundreds of them, they look almost the same and you can use them for free.

And this is where the contradiction arises. Because the more qualified designers who carry out their work there are, the more typefaces are available that are deceptively similar. Currently only designers pay for special typefaces.

**B.K.:**

**Where can you see innovations in typographic design, text design and book design?**

**E.J.:**

Difficult to say, because the most beautiful things are still happening on paper. There are not that many beautiful websites designed to read. That is why the place for reading is a book, a tablet or a mobile phone. Definitely not a screen.

No one reads long texts on a large screen. It is probable that the tablet and the mobile phone will soon combine into a medium that will be intended for reading books and maybe this is the direction in which we should focus our attention.

**B.K.:**

**I definitely believe that there is a lot of scope for innovations with regard to designing beautiful web pages with excellent text that will encourage people to read. It is quite difficult due to the internet technology, but I can assure you that we, designers, are working very hard on creating beautiful online fonts.**

**I am certain that you often hear this question (so do I, by the way). What is your favourite typeface?**

**E.J.:**

I don't like this question. For now we can assume it is "Swift". I use it on the cover and in the text because it fits both the display and the text.

**B.K.:**

**True, it is very flexible.**

**E.J.:**

It is also a very popular typeface which affects many other. Another very influential typeface which constitutes the basis for further designs is also Frutiger.

**B.K.:**

**Could you tell me a little about your favourite design which you have carried out in your career? What immediately comes to mind?**

**E.J.:**

At the moment I am working on a very interesting and inspiring design concerning pictures. I don't know whether it will be a book or a documentary film. It is a very complex issue that I would like to complete with the creation of the theory of an image. I am using pictures by Javier Jaén (edit. Catalan designer of editorial illustrations, book covers, and cultural communication) for my work, as well as information about how they operate. I am still gathering materials but there is so much of them that I have not decided yet what form this project will take.

**B.K.:**

**What would you like your students to achieve thanks to their work with text?**

**E.J.:**

At the end I want them to simply create a design that will encourage reading.

**B.K.:**

**I am happy you have written this book. I will definitely recommend it to the young generation of designers. Thank you for your time.** ■

The interview conducted by  
**Borys Kosmyńska**, PhD  
typographer, co-author  
of the Typoteka.pl website



# AUTHORS



**Małgorzata Sobocińska-Kiss, PhD**

A designer, illustrator, and lecturer in graphic design at the WIT Academy. One of her main professional interests is visual communication in its broadest sense. In 2020, she received the A'Design Award in the category of Graphics, Illustration, and Visual Communication Design for the Waycludi visual information system project, designed for the district hospital in Pruszków. An important aspect of her work is supporting the development of young talents. Since 2016, she has been the curator and organizer of the UPGROWTH exhibitions, showcasing the best graduation projects from the WIT Academy.



**Kamil Mirkowicz**

A lecturer in 2D graphics, mobile photography, and product photography at the WIT Academy in Warsaw. A graphic designer and photographer with a passion for Artificial Intelligence and its creative applications. A speaker at academic conferences dedicated to promoting the use of AI in graphic design. He holds a master's degree in Digital Graphics.



**Borys Kosmynka, PhD**

He earned his PhD at the Academy of Fine Arts in Łódź and a master's degree in typeface design at the University of Reading. From 2021 to 2023, he served as a board member of the Association of Graphic Designers (STGU). He has frequently co-organized the ATypI conference. He gained experience as a typeface designer while working at Brody Associates, collaborating with Ania Wieluńska and Mateusz Machalski on the projects "Brygada 1918" and "Półtawski Nowy", published on Google Fonts, as well as independently operating under the name TDBK. Currently, he lectures at the Academy of Fine Arts in Warsaw and designs typefaces in collaboration with Capitalics Warsaw Type Foundry.



**Piotr Cieślík**

A multimedia creator, working at the intersection of technology and art. He creates visual projects (animation, film, virtual reality), interactive installations, as well as video and music projects. He collaborates with visual artists and musicians from the jazz and avant-garde scenes. He has participated in nearly a hundred artistic projects and events/festivals.



**Inta Kasone, PhD**

Senior researcher in RTU „Liepāja Academy” (Latvia). Her research interests are related to the interaction between art and art education. She participates in art exhibitions, works as a teacher at Liepāja State Technical School, teaches art therapy classes at Diacony Centre.



**Enric Jordi**

Developed editorial projects, such as the redesign of Chicago Reader and Boston Phoenix. President of the ADG-FAD Association of Art Directors and Graphic Designers. Graphic designer, expert in typefaces and design. Director of Typography Postgraduate Studies at the EINA University School of Design and Art of Barcelona, and also lecturer at the Ramon Llull University.