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Developing interactive printing techniques using ghostly printing(*)

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Abstract

This study aims to develop interactive printing techniques by employing the concept of "ghostly printing," where the viewer's shadow becomes part of the artwork. The objective is to explore how shadow-based interaction can enhance the communicative function of art through physical and emotional engagement between the artwork and the audience.

The methodology combines theoretical and experimental approaches. The theoretical axis reviews concepts from interactive and conceptual art, while the practical axis involves laboratory-based experimentation using phosphorescent materials and controlled lighting environments. The researcher prepared the exhibition space with light-absorbing surfaces coated in phosphoric acrylic paint. When exposed to white fluorescent light and later to blue tungsten light, these surfaces retained the viewer's shadow for a limited time, producing an ephemeral visual imprint. Various exposure durations were tested to determine the relationship between light duration and the persistence of the ghostly print.

The study concluded that ghostly printing offers a safe and environmentally friendly method to engage audiences in the creative process using accessible materials. A direct correlation was found between the exposure time to blue light and the duration of the resulting print. This interactive method reflects the temporality of human presence and introduces a modern, participatory form of printmaking that aligns with contemporary cultural practices.

Key words: Artistic printmaking, Interactive printing, Ghostly printing.

Introduction:

The concept of printing, which refers to the unique mark on surfaces to signify one's presence, has fascinated man throughout history, whether that surface is the wall of the cave where the first man lived or the pages that chronicle and recount his life's events for future generations, as was the case in ancient civilizations.

Thus, there were numerous attempts to create printing; as a result, stone seals for printing on clay surfaces first appeared in the ancient Babylonian and Assyrian civilizations, followed by wooden printing templates in the ancient Chinese civilization centuries later.

Since printing's inception in its organized and literal form in China with the innovation of the paper industry by Cai Lun (62-121 AD), who was credited with inventing paper and modern paper-making techniques around (105) AD.

The methods and techniques of printing have multiplied through research and experimentation with artists around the world. The printing arts became how the artist produces multiple copies of his artwork.

The techniques for creating and disseminating images have advanced in the modern era of the visual arts, particularly since the last quarter of the 20th century, as communication tools have integrated into daily life.

The printing process has been reduced for artists who use the printing arts as the foundation for their artwork as a result of the publication of images becoming widely and extensively available through electronic communication methods.

This is because the visual arts have become more concerned with incorporating new techniques into the artistic process to make it a visually distinct process and belong to an innovative idea that makes it unique. In the field of visual arts and in light of the image's accessibility and its widespread and dense transmission, what is now referred to as interactive art is one of the emerging techniques in dealing with visual art.

By creating a crucial connection between the recipient and the artwork that he directs to, watches, and participates in, interactive art has been multiplied and varied by artists around the world.

The main purpose of interactive art has been the participation of the recipient of the artistic process in achieving a part of that process. The transformations of the image or the three-dimensional block from one situation to another in front of the recipient is the main component of this relationship.

In light of this, the researcher presented an experiment for one of the interactive printing techniques, known as "ghost printing", in which the recipient (the visitor to the exhibition) takes part in the creative process. Several three-dimensional elements, flat objects, or various shapes are placed in the display arena as part of the experiment's preparation stages.

Those elements are painted in phosphoric acrylic white and then exposed to fluorescent white light for a while, absorbing the light for a limited time.

The display area is then completely darkened before being lit up again in strong bright blue light.

When the viewer moves in front of the fixed elements in the display arena so that the blue light is focused on him, while he stands as a barrier between the light and the element, his shadow appears as a dark space on the element's surface. When the viewer moves to another location, the shadow stays in place briefly. The length of time the visitor stands in front of the object is directly proportional to the period of standing. As a result, we obtain the ghostly print of the viewer's body, which persists briefly before dissipating. Thus, the phosphorescent components continue to be recharged with light, and the process continues.

The researcher was inspired by the experience of the Dutch visual artist Daan Roosegaarde, who created an artistic process that allows the recipient to participate and become a part of the artwork. Through a modernist lens, the artist considers it a form of interactive printed artwork. Daan Roosegaarde presented his interactive exhibition in (2019) at Groninger Museum- Netherlands, entitled *Presence*.



Figure 1- Daan Roosegaarde exhibition in 2019 at Groninger Museum –Netherlands

<https://www.stirworld.com/see-features-daan-roosegaarde-invites-your-presence-at-the-groninger-museum-in-the-netherlands>

Figure (1)



Figure 2- Daan Roosegaarde exhibition in 2019 at Groninger Museum –Netherlands

<https://www.stirworld.com/see-features-daan-roosegaarde-invites-your-presence-at-the-groninger-museum-in-the-netherlands>

Figure (2)

Research Methodology: Experimental method.

Research Problem:

- How to develop materials used in interactive arts through the process of ghostly printing.
- How to achieve the best results in the artistic interactive process using ghostly printing.
- Simplify the interactive art creation process so that it can be widely distributed using ghostly printing.

Research Hypotheses:

- 1- Reactive printing with shadows can create artwork with simple capabilities and supplies.
- 2- The chemical constituents of the materials used in the interactive ghostly printing of some contemporary artists may be harmful to both humans and the environment.
- 3- Interactive printing is a technique used in contemporary art that advances its development.

Significance of the Study:

- 1- The research is regarded as one of the serious contributions to publishing printing art in various forms.
- 2- Updating references to technical procedures connected to interactive printing arts.
- 3- Overcoming challenges and complexities presented to employees in the field of interactive printing arts, whether in terms of tools or working methods.

Objectives of the Study:

- 1- Contribute to expanding the scope of interactive art practices through the use of printing techniques applied to accessible and affordable materials.
- 2- Promote environmental sustainability by utilizing organic, eco-friendly materials in artistic formulations instead of chemically complex substances that may pose risks to human health or the environment.
- 3- Foster the global applicability of interactive arts by developing approaches that are culturally inclusive and adaptable across diverse communities.
- 4- Establish new scientific standards and methodological criteria for the field of interactive printmaking, thereby supporting its long-term development and innovation.

Spatial Limits of Research: Saudi Arabia.

Limitation of the Study: Interactive Printing-Ghostly Printing.

Terms of the Study:

Artistic printmaking:

The phrase's linguistic definition:

leaving a trace of an effect on any of the surfaces or the various elements.

Terminological definition in the field of arts:

It is the process of reproducing works of art by printing through various techniques.

The term's procedural definition:

The transfer of drawings or shapes from one surface or medium to another surface or medium.

Interactive art:

The term's linguistic definition: the mutual influence that the artist uses to interact between the recipient and the artwork's components.

Terminological definition in the field of arts: One of the goals of contemporary art is to remove barriers and borders between the recipient and the artwork so that they interact with each other through emotional or motor reactions (standing, passing, or moving one or more parts of the artwork by the recipient). This is consistent with the procedural definition of the study.

Ghostly printing:

Definition based on research experience: It is the use of light to create shadows of the recipients of the artwork within the exhibition space and cast them on a fixed element covered in radioactive material, and the survival of that shadow imprinted on that element for a while directly proportional to the time the recipient's body was exposed to light.

Previous Studies:

- 1- The Interactive Printmaking and Communication role. This research examined interactive printing's function as a communication tool, as well as the idea and history of interactive art, as well as the types, properties, and concepts of interactive printing. The research then focused on an analytical study of interactive art printing techniques by examining models of some artists' works and utilizing them in contemporary artworks distinguished by expressive visions. Different formats enhance the print's interactive aspect, express various meanings and contents that are challenging to express in traditional ways and add aesthetic dimensions to printmaking that draw the recipient and appeal to his senses. (Noureddine K. & Al-Sarwi H).
- 2- Interactive Printing Works as a Driving Force for the Viewer. This research examines interactive art, its traits, its connection to communication theory, and its relationship to the viewer's movement by presenting two models for each type of interaction. Its objectives are to reveal the plastic potential of interactive printing works, to identify aesthetic and technical principles associated with the scenes, and to enhance the print work by using the variables of interactive art as a motivating factor for the viewer. (Rizk W. & et al).

Samples of interactive artworks:

1- Moodwall (Figure 3):

The Moodwall is situated in a pedestrian tunnel and interacts with people passing by, improving the atmosphere in the tunnel and making people happy and feel less unsafe.

Figure 3 - Moodwall

The interactive urban wallpaper is built out of about

Image by: Studio Klink and
Urban Alliance 19/2/2009

ribbed semi-transparent wall. The curves in the wall make graffiti and improve the visibility of the content for the side. The resolution is horizontally stretched so the images of the screen are better for the side so people are stimulated to watch the screen from outside the tunnel. This prevents the tunnel to become a hang-out spot.

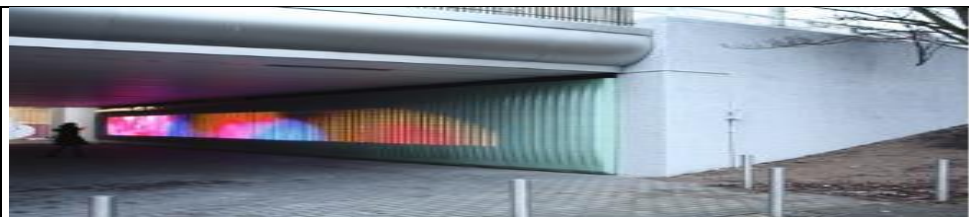


Figure 4 - Deep Walls - January 2003 - San Francisco, Museum of Modern Art, Reactive Art - <https://www.snibbe.com/art/deepwalls>

Moodwall Figure (3)

2- Deep Walls (Figure 4):

Deep Walls is a projected cabinet of cinematic memories. When a person walks into its projection beam, the interactive wall starts recording their shadow, and the shadows of those who follow. When the last person leaves the frame, the shadows replay within one of sixteen small rectangular cupboards, looping indefinitely. Like [structural films](#), the collection of repetitive videos becomes an object unto itself, rather than strictly representational “movie”.



Deep Walls Figure (4)

Theoretical axis:

We live in a reality that is charged with images, making the visual language the most widely used in the general culture of human societies. This is where the theoretical axis of the research experiment derives from the idea of interactive art, as one of the contemporary trends in the formulation of visual arts. Given that the science of media communication and its technological advancements, beginning with the development of the photography, have made the image language, the foundation for cultural exchange and awareness among human societies at present, as the French thinker and writer Régis Debray mentioned in his lectures, which he included in his book ([Mediological manifestos](#)), To the extent that Régis Debray asserted that the rapidity of image exchange and their lack of stability in consciousness had led to what he termed "visual blindness," or the mind's inability to take in the complex information that images deal with. which made the process of identifying what we refer to as visual art increasingly complicated. ([Debray, R. 1997](#)).

This is made abundantly clear in the book (Ways of Seeing) by the English writer, and TV presenter, John Burger, where he makes the argument that the availability of reproductions of artworks through contemporary methods of image circulation has caused them to lose the significance for which they were intended and the context in which they were produced. This idea caused us to reconsider the contemporary model for visual artwork as a distinct form of art. In the age of image distribution. (Burger, J. 2018)

We must mention conceptualism here as a context for the formulation of visual art, which was theorized by the American artist, Joseph Kosuth in his famous article (Art after Philosophy), which was mentioned in the book, and conceptualism is the framework that brought visual art out of its museum context to transform art onto a conceptual basis that can make the visual subject based on an intended and specific point of view, with which the artist communicates with the recipient, to make him, on the one hand, coexist, think, and share with the visual subject presented by the artist.

And this is where Joseph Kosuth is headed so that we can say about the concept of work that it entered the framework of its definition as an art that is deeper than the formalism aspired to by modernist artists, to create a new

era for the visual arts, and was characterized by what is postmodern in art. According to that theory, a variety of artistic mediums, such as land arts, environmental arts, and three-dimensional stereoscopic formations, emerged that successfully achieved the conceptual formula of visual work. Reputable artists like “Joseph Beuys” * and “Anselm Kiefer” * conducted numerous experiments to support this theory.

From this vantage point, the researcher observed that interactive art through printed work (ghostly printing process) is one of the modernist formulas that makes visual work interactive with the viewer through the logic of modernity and the creation of the art of the moment, so that the visual creative process presents through that a pattern consisting of:

1- The interactive creative context of the artwork and the contribution of the scientific experiment in achieving interactive art's goal.

The deep impact that the artist intends to have on the recipient's psyche is achieved through laboratory chemical analysis of the artistic materials and by adhering to methodical scientific procedures. In this way, the artistic process in this context functions as a crucial knowledge exchange between the creative process and the life we live with our bodies, where the creative process touches and influences us physically with this logic. The collaboration between the artist, the recipient, and the artwork results in the creation of the prints in this instance.

2- The philosophical implications of the ghostly printing process from the researcher's perspective.

This is in terms of the fact that the process of ghostly printing belongs to leaving the impact of the human presence for a temporary and very short period on the elements scattered in the exhibition hall, which means that we emphasize the idea of demise and its relationship to time, considering that the process of printing throughout human civilizations was a process of recording and documentation, in order to survive and continue, and hence eternity.

***Joseph Beuys**, German artist (1921-1986) was a Vlasov network artist, performance artist, sculptor, graphical, art theorist, and art educator.

***Anselm Kiefer** (b. 1945) is a German painter, sculptor, and graphic designer. His works include materials such as straw, ash, clay, lead and lacquer.

The research leans in the opposite direction because the effect depicted here does not confer immortality. It is merely a shadow of man. The ghostly impression left by that passing individual only lasts for a brief period of time before his shadow vanishes, indicating his transient presence.

Through this interactive artistic process, a new vision that is in tune with our time and culture is presented. the practice of having things and having them disappear quickly in a culture where consumption is the norm. Everything in the specifics of our current way of life is consumed in a utilitarian manner, so that the thing disappears along with the loss of its utility to us, and this loss happens so quickly that we do not have enough time to allow the matter to settle in our conscience. This causes a person to consume himself within that lifestyle so that he does not realize his consumed self except at the moment of his departure from the world. For this reason, we invite the person to meditate on what is happening to him and around him in order to realize the value of time and turn it into productive work that has value for both himself and those around him among humans.

The ghostly print is created on the fixed elements in the exhibition hall by painting these different elements, ranging from flat surfaces to three-dimensional figures, with phosphorescent acrylic white paint and exposing them to fluorescent white light for a period of time that extends to about ten minutes, as the phosphorescent paint absorbs and retains fluorescent white light. The exhibition space is then darkened, allowing only strong blue light to be lit through tungsten lamps coated with transparent blue paint, and the viewer passes between the fixed shapes in the exhibition to create a barrier between them and the blue light, which shows his shadow on those shapes. When the viewer starts to leave, his shadow is still visible for some time, directly proportional to how long he or she has been standing in front of the object or surface where the shadow is visible. which could last between a few seconds and ten minutes.

The ghostly printing process here is inspired and extended by the Dutch artist Daan Roosegard's work, who created this process and presented it in his interactive exhibition in (2019) in the Groninger Museum hall. That exhibition was titled.

"Presence". The artist used a fluorescence dye to coat the exhibition walls and the masses of big and small balls, which he symbolizes as grains of sand, to create a virtual relationship between the earth and the universe, and environmental purity.

The relationship between people, technology, and space is a topic that Daan Roosegaarde explores as a creative thinker and designer-maker. Cleanliness represents new values for him and his team, who are committed to preserving clean air, water, energy, and space.

Roosegaarde's famous designs, like:

- "Waterlicht" is a virtual flood that shows the power of water.
- "The Smog Free Project" is the largest outdoor air purifier project in the world that is said to be able to make jewelry out of smog.
- "The Space Waste" Lab Project visualizes and recycles space waste and the modern "Urban Sun" that cleans up the coronavirus in public spaces.

Practical Axes:

From this foundation, which builds on the ideas of the artist Roosegaarde, the researcher's work develops this printing process (ghostly printing) by adding variables to the display materials and environment, making the process safe with regard to the lighting and paint materials used in the work. Through research and chemical analysis, the researcher was able to use safe and environmentally friendly materials to achieve the same result, and obtaining a result similar to what the artist Roosegaarde achieved, which was to maintain the ghostly shadows of the exhibition visitors and those interacting with the techniques made available by the artwork for a period of time.

Table (1) Comparison Between the Two Technologies

The subject	The Researcher's Experiment	Artist Daan Roosegaarde's Experiment
The lighting used	The natural sunlight or fluorescent lights	UV rays
The type of paint	Radiant-based colors	Non-radiant-based colors
The component of the paints	A phosphorescent paint that is chemically composed of organic compounds (contains minerals), such as strontium oxide, which gives the strong and radiant color.	Fluorescent paint is chemically composed of inorganic compounds (it contains carbon, hydrogen, or nitrogen, as it does not contain metal), such as rhodamine.
The technique	The painting material absorbs white light while retaining it and then reflects it after exposure to blue light.	The painting material absorbs UV light and then reflects it directly.

This comparison clearly shows:

- 1- The artist Daan Roosegaarde uses UV rays, which are rays with a variety of side effects that can vary from one person to another.
- 2- The paints used by the artist Daan Roosegaarde are inorganic and lack environmentally friendly components in their chemical composition.
- 3- The UV rays quickly respond to display the ghostly print's outcome.
- 4- The phosphorescent acrylic colors that the researcher used are environmentally friendly materials because they are unlikely to have any negative effects on the recipient who is visiting the exhibition.
- 5- Instead of using UV lighting in her experiment to display the ghostly print, the researcher used white fluorescent light, which is one of the types of light that is unlikely to have any negative effects on the recipient who is visiting the exhibition.

Procedure for the experiment:

The experiment was based on the following elements:

- 1- Acrylic paints that glow in the dark (phosphorescent paint). (Figure 7).
- 2- A cork figurine in the shape of a human head was approved in all experiments. (Figure 5, Figure 6).

3- Two types of lighting:

a- White light (neon).

B- The blue light comes from ordinary (tungsten) lamps, which are painted in a transparent blue color.

4- The object to be printed, whether it is a hand or the entire body of a human being, or any other element.

		
Figure 5 - Ghostly printing of the experiment, with the Cork head	Figure 6 - Ghostly printing of the experiment, with the Cork head Photo by the researcher	Figure 7 - Radiant acrylic paint, which was used in the experiment Photo by the researcher
Figure (5)		

The following steps represent the ghostly printing techniques devised by the researcher during the experimental phase:

- 1- Painting the elements to be printed in phosphorus white (a tincture of phosphorus that contains some minerals and other organic compounds).
- 2- after the element has been painted with phosphoric acrylic paint, exposing its surface to neon light or the sun's natural light. That is done to get it ready for the ghostly print to be picked up by the surface of the element.
- 3- Turn off the lighting in the area. The surface of the receiving element of the edition becomes radiant, and contacts the shape or organ, whether it be a hand or the entire body, to the surface of the phosphorescent element.
- 4- Strong blue lighting is shone on the body part that is in contact with the stereoscopic element's surface for a period of time proportional to the amount of time required for the ghostly print to endure. as it was found through numerous experiments that there is a direct correlation between the duration of the blue highlight and the duration of the ghostly print that can be seen on the surface.

5- After turning off the blue light, the showroom is dimmed as a whole. An important finding is that "the blue light interacts with the radiant color surface, as the part that is obscured by the organ or the body remains outside of that interaction." We discover that the surface of the receiving element of the ghostly print glows in the dark, with the exception of the part that was covered by the organ, which left a shadowy effect on it. to display the ghostly print as the investigation's conclusion.

The experiment determined the duration of the ghostly print's survival and its relationship to the length of exposure to blue light on the model's surface through observation and experimentation over several time periods (one minute, two minutes, three minutes, five minutes, and ten minutes). The following table presents the results (Table 2):

Table (2) Duration of ghostly print in relation to blue light exposure time

Ghostly print life / minute	Blue highlight duration / minutes
13.5720	1
13.4406	2
16.1975	3
17.4102	5
34.3864	10

The study concluded that there is a directly proportional between the amount of exposure time and the persistence of the ghostly print, which will last longer as the blue light shines on the holographic component, as depicted in the graph (Table 3):

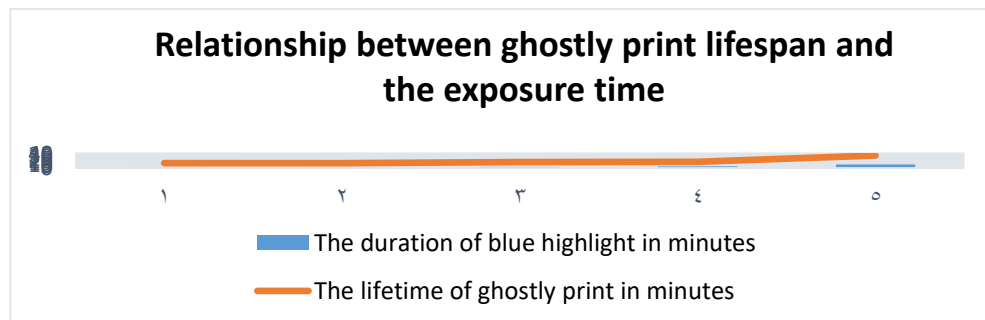


Figure (6) Relationship between ghostly print lifespan and the exposure time

Discussion of Findings:

Through interviews with artist Daan Roosegaarde and consultations with experts in chemistry, the researcher gained insight into the components and processes used in Roosegaarde's interactive printing work. Based on this understanding, a series of experiments were conducted that yielded comparable visual outcomes, albeit with notable technical differences.

One of the main distinctions lies in the materials used. While Roosegaarde's work employs fluorescent dyes composed of inorganic compounds, the present study utilized phosphorescent paints made from organic, mineral-rich components such as strontium oxide. These materials were selected for their environmental safety and sustainability.

Another key difference involves the lighting systems. Roosegaarde used ultraviolet (UV) light to activate the fluorescent dyes, which provided immediate visual effects. In contrast, the researcher employed a safer approach by using natural sunlight, white fluorescent lamps, and blue tungsten lights with transparent filters. This method required a longer exposure period for the materials to absorb and then emit light, thereby generating the ghostly print effect.

In terms of working procedures, Roosegaarde's process is faster due to the intense and immediate reaction of UV light. However, the researcher's method, though slower, offers a safer and more controlled environment suitable for educational and public engagement contexts. These differences highlight the flexibility and adaptability of ghostly printing techniques when informed by both artistic innovation and scientific experimentation.

Conclusion:

The study concluded with findings that align, in principle, with the outcomes of artist Daan Roosegaarde's work in obtaining a ghostly print. However, it introduced significant distinctions in the materials and methods used. Unlike Roosegaarde's use of fluorescent dyes and UV lighting, the researcher employed phosphorescent, environmentally friendly paints and blue tungsten lighting, with exposure durations adjusted to test variability in effect and safety.

Through this approach, the study successfully developed a new interactive printmaking technique, enriching the field of artistic printmaking

with innovative, safe, and accessible practices. It was clearly demonstrated that there is a direct correlation between the duration of blue light exposure and the persistence of the ghostly print on the receiving surface-an important scientific result derived from repeated experimentation.

Furthermore, the study proved that interactive artworks can be effectively created using ghostly printing techniques, employing low-cost materials and tools that are available and practical for use in diverse cultural and educational settings. By utilizing safe and sustainable components, the experiment emphasized environmental responsibility in the development of contemporary art practices, thus contributing to both artistic innovation and ecological awareness.

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