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PhD Project Plan

Physics of Laser in Contemporary Visual Arts: the research protocol

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Abstract

This protocol articulates an ongoing PhD thesis in Laser Art as an independent artistic trend including its history, classification criteria, philosophical and aesthetical aspects. Via several analytical studies theoretically and practically, the thesis is going to prove that laser art actively contributes, as an independent artistic trend, to change the conceptual definition of the artistic material. On the other hand, it bridges the gap between the artistic context and the technical issues, in which the conceptual values became fully integrated into the physical properties of the medium (laser beam), therefore it became impossible to separate the idea and the material of the artwork from each other. Besides, the thesis reveals the potential hidden conceptual and philosophical dimensions of the holographic art as one of the most important branches of laser art. In advanced step, the research suggestes a new model of interactive holographic art based on neural controlling system, and how this advanced approach can lead us towards a new kind of the aesthetic values, in which participants effectively contribute neurologically to constituting the artwork.

Keywords

Laser Art; New-Media arts; sciences of visual arts, holographic art; neural holography; new aesthetics

Problem staement, objectives, importance

Research questions:

According to the state of the previous research, it became obvious that there are knowledge gaps in Laser art because it is still outside the theorizing circle (Analysis, Classification, Documentation). This problem hamper progress in the artistic practical procedures as a result of the missing the conceptual approaches. Accordingly, this research tries to answer four questions:

1. How can the scientific procedures in Laser Art contribute to reformulate a new key to 21st century aesthetics in contemporary visual arts?
2. To what extent physics of laser beam has a significant role to change the nature of light art through contemporary visual arts?
3. How far some of theoretical theories can reinterpret the laser artworks as an independent visual artistic trend?
4. Can some kind of advanced interactive technologies represent new approaches towards re-defining laser beam as an artistic element and material in the light art?

Hypothesis:

1. The physics of the Laser beam has significantly contributed to change the nature of light into a Hyper-Material in the contemporary visual arts technically and conceptually.
2. The scientific processes and technological techniques have significant effects on the nature of the aesthetical values in laser artworks.
3. The theory of information and the theory of communication can reinterpret laser artworks quantitatively and qualitatively" as an independent contemporary artistic trend.
4. Holographic Neural Game can represent a revolutionary assumption in laser art by using neural inputs to build an interactive artwork through a holographic environment.

Objectives:

1. Investigate and compare the history of visible light usage in artworks before and after the availability of laser light through the historical relationship among art, science, and technology technically and conceptually.
2. Evaluate the role of contemporary theories to explain, classify, and document laser artworks conceptually and technically.
3. Analyze the new artistic and aesthetical values, which are emerged as a result, from the use of laser light in artworks as an extraordinary element and material.
4. Examine some of interactive approaches technically to design an interactive virtual environment as an advanced level of interactive holography.

Importance:

1. Confirming solid principles of laser arts as an independent and advanced level in contemporary visual art trends.
2. Enrich laser art technically and conceptually as a one of the important branches in sciences of visual arts.
3. Support new advanced scientific methodologies in sciences of visual arts by laser artworks that can melt artistic, scientific, and technological concepts in one artwork.
4. Improve some of technical approaches in sciences of visual arts as a significant guide to analyze laser artworks.
5. Emphasize the deep philosophical and technical knowledge of sciences of visual arts generally.
6. Reinterpret the relationship among art, science, and technology by new understanding of contemporary visual arts.

Project Overview

Since the middle of the 20th century, the scientific and artistic communities have both attempted to understand the beginning of the universe, the origin of the human being, consciousness, and human brain in order to decode our potential future, our identities, our cultures and civilizations based on the latest scientific mutations and discoveries. Accordingly, the 'visual arts', as an important branch of humanities, is no longer an isolated domain, but it developed a strong relationship with other scientific disciplines (Wilson 2003) This could be considered as one of the most important characteristics in some contemporary visual arts trends, which are reflected in a renewed and strong sense of affinity between art, science and technology (Canaria 2009) After all, the relationship among art, science, and technology (AST) has extended roots through the history of art (Hughes 2006). The difference in our contemporary era is represented in several paradigm shifts that have broken the dividing line among scientific and artistic specializations by conducting cutting-edge research cross a wide range of disciplines. Consequently, in some cases it became difficult to redefine sharp boundaries among some of the artistic and scientific fields (Shanken 2002). So, 'interdisciplinarity' as a term reflects a new method that has already dominated scientific and artistic activities. Due to those paradigm shifts that happened in the scientific methodological practices through many artistic and scientific domains, in his book entitled "Art and science now", Stephen Wilson describes accurately the current phase of the unity among art, science, and technology and its effects on the nature of the artistic creation processes in some contemporary experimental artistic trends:

> "In the 21st century, some of the most dynamic works of art are being produced not in the studio but in the laboratory, where artists probe cultural, philosophical and social questions connected with cutting-edge scientific and technological research. Their work ranges across disciplines – microbiology, the physical sciences, information technologies, human biology and living system, kinetics and robotics- taking in

everything from eugenics and climate change to virtual reality and artificial intelligence" (Wright 2010).

In fact, Wilson's description of the contemporary visual arts trends is confirmed by what Roy Ascott said about the contemporary visual arts when he emphasized the relationship between art science and technology in visual arts has been divided into three phases: The first and the second have shared properties; most important of them are reliance on the use of technology either directly or indirectly in the artworks, and several sciences applications had been expanded to be used in many visual arts trends (Popper 1993).

Nevertheless, the contemporary documented roots of the third phase of the relationship between art, sciences and technology may be detected in the C. P. Snow's famous annual Rede lectures at Cambridge on May 7th, 1959. These lectures were combined in a book entitled "*The Two Cultures and the Scientific Revolution*" (Shanken 2002). In the second edition of This book, in 1963, Snow added a new essay entitled: "*The Two Cultures: A Second Look*". In that essay he suggested a 'Third Culture' as a new term that would emerge and close the gap between artistes and scientists, where the sciences were not used in an unlimited way, rather, the art and sciences became two sides of one coin. Consequently, The artworks are achieved in laboratories, and artists and scientists moved along a common path, to the extent that some of the artistic trends were classified by some kinds of scientific techniques that are used to achieve them, for instance: (Laser Art – physics applications in visual arts), (Bio Art – Biological sciences in visual arts) and (Mechatronic Art – Engineering applications in visual arts). (Molnar 1997). All of those three visual artistic trends belong to the 'Processes art' historically, in which the conceptual core of the artwork is constituted in the processes performed beyond the visual form or even the physical form of the artwork itself (NAGAI 2000).

'laser light' as an artwork may have the biggest chance for expansion, more than the other kinds of these trends, because it represents a unique Hyper-Material due to its 'spatial' and 'temporal' 'coherence' leading to 'speckle' and allowing signal processing, 'interference patterns', very 'narrow beam width' and very 'narrow line width' which leads to strong and pure colors (the scientific properties became artistic advantages; (Oliveira and Richardson 2013).

On the other hand, the use of laser demands high skills and expensive equipment which forces the artist to perform their artworks in cooperation with scientists inside their labs. Besides, artistically it has extraordinary ability to interact with different environments and audiences (Szanto 2015).

In terms of theoretical documentation in 'laser art', we can see most of references explain and analyze laser artworks in the same way that is usually used to analyze other visual arts trends and the same criteria without taking into account the special case of laser artworks. Few studies highlighted laser art in a more suitable position, the common characteristic in all of these studies that they were written under the same title (art and science), and the laser artworks were a part of them (Bjelkhagen 2013).

Conceptually, the current research focuses on the laser light itself as an artwork, the research wants to elucidate the historical roots of laser artworks conceptually and technically. the current work will focus on the full period from the invention of the laser in 1960 up to the present (Soskind et al. 2015).

However, applications in which lasers were a source of illumination, like laser shows, are not a part of the current study. The research attempts to achieve new approaches to explain and document new artistic and aesthetical values, which are a result of laser light usage in contemporary artworks conceptually and practically. The theoretical outcome of the research should lead to a new classification for types of laser artworks, therefore enriching the contemporary visual arts trends by accurate analytical studies and practical experiments in laser arts (Ahmedien 2016).

For better understanding of laser artworks, several experiments were done in the current research comprising of three parts; the first part was conducted in a holographic lab to produce an analogue holographic recorded image and analyze the result to document the scientific processes and their effect on the aesthetical values by comparing the holographic image to a normal image. The second part was lead to experimental studies in light and interactive techniques and how advanced technology can redefine the concept of light through the contemporary visual arts trends. The third part which is only a concept of a potential project: the design of an interactive system by using neural controlling techniques to create an advanced virtual environment as a neural holographic game that can interact with audience automatically or can be controlled by the audience neurologically.

Implementation

Methodology

Theoretical framework

The Theoretical Framework is consisted of two axes; the historical axis and conceptual axis as follows:

Historical Axis:

- analytical studies of the previous literatures
- Drawing analytical diagrams to summarize progress processes in light art before laser through visual arts and related domains.
- Analytical studies of the history of the theory of laser action.

Conceptual Axis:

- Analytical studies of the formation theories by laser beam in visual arts.
- Analytical studies to document the new artistic and aesthetical values, which have existed as a result of laser light usage in contemporary artworks.

- Analytical studies of some of leading contemporary theories to classify laser artworks.

Practical Framework

The Practical Frame is consisted of two axes; the experimental studies and the final project as follows:

Experimental Studies:

- Experimental studies to classify laser artworks technically and conceptually.
- Experimental studies in object building techniques (Hologram).
- analytical studies in interactive techniques.

Final Practical Project:

- designing experimental setup to recorded neural responses holographically.
- Designing an interactive system in neural based
- Designing a setup of Neural Holographic Game.

Structural Mode

the accumulation system was used to constitute the manuscript. Through seven separate Research that have been partly published internationally, this thesis summarizes the main ideas of theses research including the final findings.

Structural Pattern

This thesis follows the compromise pattern in its structure: structural Matrix **B** in the PhD guide to style, 2nd end, Houndmills, Basingstoke, Hampshire: Palgrave Macmillan (Hammersley 2003). The thesis has been written using Harvard style (Harvard - Cite Them Right 9th Edition). Accordingly, the research will be divided into 5 chapters as the thesis' flow chart shows Fig. 1.

Data balance:

Depending on the compromise pattern, the research keeps palance by dividing data into inputs, outputs and the core of the research processing as Fig. 2 shows.

Work plan

The research will follow a custom-designed, logical framework matrix (LFM model) to determine to what extent the current research questions can be answered, besides, to illustrate a set of physical indicators that can refer to a potential positive result as Figs 3, 4 illustrate.

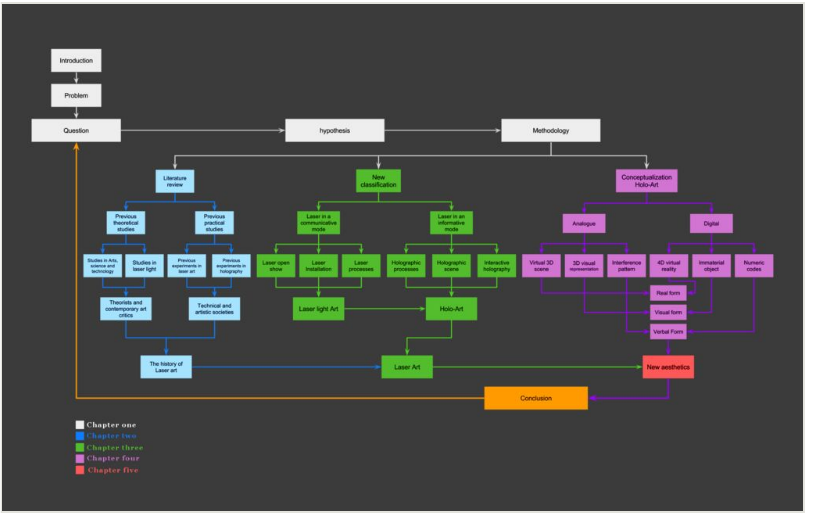

Figure 1.

the flow chart of the thisis that shows thesis' chapters depending on the research methodology

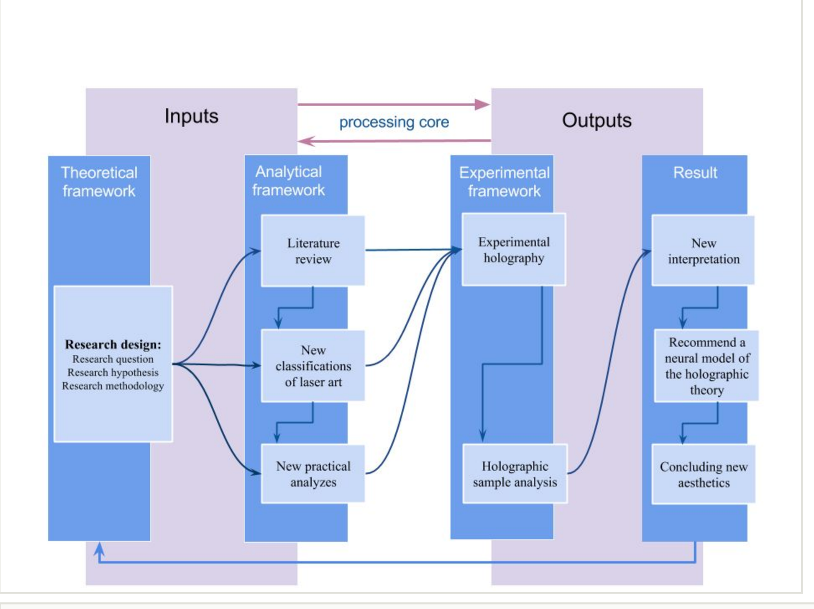

Figure 2.

the graph illustrates the Data flow through the methodology designed in order to control the circle of the data processing from the inputs into the outputs and the processes in the middle through all research processes.

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Ph.D. Research Proposal (LFM)

Final project in Practical Frame

Logical framework matrix (LFM-model)

The final Practical Project of the Ph.D. thesis entitled:
PHYSICS OF LASER IN CONTEMPORARY VISUAL ARTS.

Submitted by

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Under supervision:
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Activity description	Performance Indicators	Means of Verification	Potential Risks and Assumptions
Goal (Overall Objective): - This project aims to reveal on new nontraditional dimensions of the relationship among art, science, and technology. Via using advanced interactive techniques in laser artworks, some kind of interactive holographic virtual reality will be created.	- The high performance of interactive digital hologram.	- Publication in international journals. - Conferences presentations. - Use other labs as a reference of our result.	- financial support. - Delay in time table. - change the prices of references.

Final project in Practical Frame
| P a g e 1

Figure 3.

Logical Framework Matrix (LFM model) part 1

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Ph.D. Research Proposal (LFM)

Activity description	Performance Indicators	Means of Verification	Potential Risks and Assumptions
Project Objectives: - This project seeks examine some kinds of interactive techniques and their effects on the conceptual and aesthetical values on the laser arts, as an attempt to generate nontraditional practical approaches in laser art through interactive holographic virtual reality.	- Ability of system for making Interactive hologram of varied sample. - Ability of achieving interactive microscopic hologram inspired of biological cells. - Ability of designing recorded simulation to record the interactive laser art work with Google chrome experiment.	- This should enable us to check the conditions of the objects and give a statistical report of these objects under test to determine the potential pros and cons in recording processes and display techniques. - Publication in international journals. - Conferences presentations.	- Availability of necessary components and requirements of system. - Periodic maintenance & calibration of the laser systems.- Lack of time - Training prolongation
Outputs (Results): - Recorded holographic biological cells. - An interactive system to control on the microscopic holographic recording. - The final interactive holographic virtual reality. - Recorded simulation of the interactive holographic artwork (Google chrome experiment).	- The ability of reconstructing holographic cells - the ability of controlling on holographic display via software - Achievable progress in building the setup of the interactive holographic surface. - Successful submission of interactive simulation codes to "Google chrome experiment".	- Good quality of digital hologram - enable us to check the conditions of the objects and give a statistical report of these objects under tests - The ability to store and extract the Interactive holographic artwork by E-library. - easy access to the recorded simulation of the interactive holographic artwork by special interface in Google chrome experiment	- Reach the required items (components & materials) at the time. - Availability of financial support when it is needed. - Effective and serious cooperation of the company which is responsible to setup the new systems (hard or software) with the project supervising group.
Activities: - Experimental studies in analog and digital holographic recording. - Experimental studies in designing interactive systems. - Experimental studies in interactive display technologies. - Experimental studies in building holographic interactive system. - Experimental studies to record and store the interactive holographic artwork electronically	- Collect the practical references - Collect the equipment - System integration - Achievement the high quality	- Regular monitoring of ongoing activities an compatibility with the project time plane. - Regular reporting	1- Delay in equipment & materials delivery. 2- Prices will not change in the next 6 months 3- Delay in financial support. 4- Continues capacity building

Prof Dr. Norberto Gramaccini **Prof Dr. Rita Hofmann**

| P a g e 2

Figure 4.

Logical Framework Matrix (LFM model) part 2

Details for replicability and reproducibility

The research in its practical frame can be re-examined in holographic labs under the instructions of the intellectual property laws at the university of Bern.

Timeline

The thesis' time table Fig. 5 illustrates the action plan that can be followed to achieve the research within about three years.

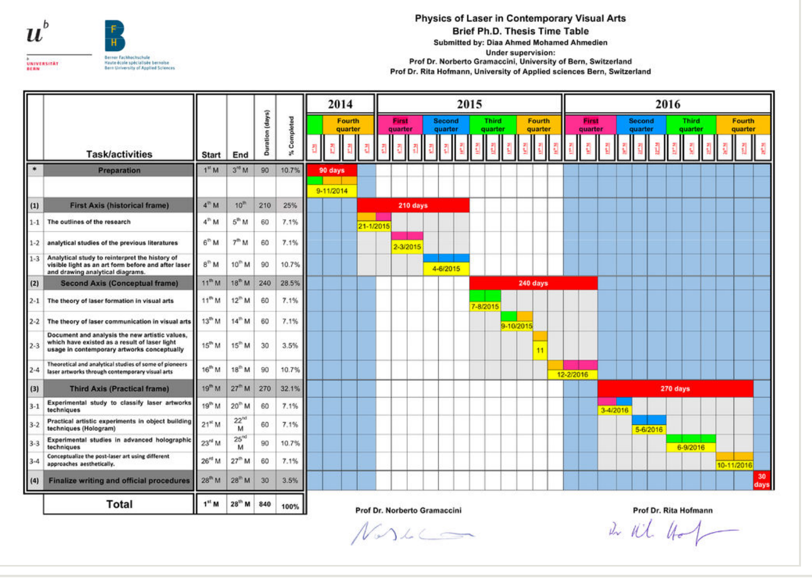

Figure 5.

Thesis' time table within 3 years

Funding program

Study full PhD programe in sciences of visual arts and new-media arts.

Grant title

Egyptian Government Excellence Scholarship.

Hosting institution

- Faculty of Humanities, Visual arts Dept., Bern University, Switzerland

- School of Arts, Universtiy of Applied sciences, Bern, Switzerland

Ethics and security

The entire project theoretically and practically undergoes to all Ethics and security laws of scientific research in the University of Bern.

Author contributions

Diaa Ahmed Mohamed Ahmedien

Conflicts of interest

The authour has no any confliect of interest

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