Hybrid Media Platform
Patterns of Interaction and Integration of Analog and Digital Media in the Architectural Design Process

Seyed Amir Hosseini [1], Vahid Majidi* [2], MohammadMehdi Danesh [3],

1- Tarbiat Modarresh University, Tehran, Iran

2- Iran University of Science & Technology, Tehran, Iran

3- Keene State College, New Hampshire, USA

*Corresponding Author: V.majidi2010@gmail.com

Abstract

Designers use a variety of media to record and represent the information generated during the design process. Potentials, constraints, and programmed structures in each of the media contribute to form and represent a particular type of idea and the architectural designer develops different aspects of the design by representing the ideas through different media. Considering the design process as continuous representations of ideas through various media provides the necessary grounds for understanding the role of media in the design process. The present study specifically considers the patterns of using and integrating two important types of media, namely digital and analog media. Based on the theoretical studies, a conceptual model was developed aiming to examine, analyze, and classify the types of applications and the integration of digital and analog media. The hybrid media platform that results from the interaction of different types of media makes it possible to represent ideas through various media (according to the nature of the idea and the structure and potentials of the media) as well as the development of ideas (based on the strategies for developing and editing the ideas in the media). Additionally, the interaction of media helps the representation of ideas to be changed and interpreted by the designer on the one hand and to be pursued in another media context on the other hand. This places the designer's decisions beyond the specific constraints of a medium, in a position between subjectivity and intersubjectivity. The interactive use of digital and analog media leads to the juxtaposition or even the combination of deductive and computational strategies when representing ideas. Thus, human-machine thinking can be realized.

Keywords: Analog, Computational, Design process, Media

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March 2022

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Introduction

Today, computer technologies are increasingly used in various disciplines. Architectural design and education have also evolved under the influence of the application of computers and software. As a result of the developments, computer technologies are widely used by students in architecture schools and by professional designers in architectural offices. However, despite accepting the use of computers in architectural design and education, schools and colleges of architecture have not yet reached logical and acceptable results to explain their presence in the design process. The introduction of computers into the world of architectural design began with the concept of computer-aided design (CAD), and then gradually their presence have become more prominent and closer to the design process.

Along with the emergence and development of computational technologies, the introduction of computers into architecture led to the formation of a continuum ranging from the beginning of design to the end of construction. While combining materials and technology, this event caused the relationship between architecture and computers to be strengthened (Oxman & Oxman, 2014). As predicted, computers will soon enable full conceptualization (generating thoughts, enhancing the power of visualization, better understanding of design, inspiring the designers, and giving the designers a sense of confidence when searching for all options and experiencing different and complex geometries, etc.) (Muzaffar & Khakzand, 2008). The connection between the architecture and computers results from the similarity between the way of thinking involved in the architectural design and the design in computer science so that both of them can be considered as a problem-solving process to achieve an appropriate solution in the context of the design problem (Chan, 1990; Gallopoulos et al., 1994). Taking a closer look at the presence of computers in the world of architecture, Terzidis (2005) divided the relationship between the design and computers into three periods as follows.

In the 1960s, computers were trying to replicate human endeavors and to take the place of designers. In the 1970s, the attempts aimed to create systems that would be intelligent assistants to designers. Today, computers are increasingly involved in the design process. Their roles vary from drafting and modeling to intelligent knowledge-based processing of architectural information. Terzidis (2005) then continued to introduce three scenarios for the role of computers in the design process:

A. Computers can complement the human thinker
B. Computers can extend the process of thinking
C. Computers can replace the human thinker

Figure 1: A) first scenario, the computers for complementing the human thinker; B) second scenario, the computers for extending the process of thinking; and C) third scenario, the computers for replacing the human thinker (Reference: Terzidis, 2005)

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Proportional to the three human-machine scenarios, one can talk about the three designer-media scenarios. The use of digital and analog media in the design process can also be explained in relation to these three scenarios.

Although science laboratories were created in architecture schools to demonstrate physical concepts such as acoustics, lighting, and statics in architectural applications and to study scientifically the computer-aided design process (Celani, 2012), a misunderstanding of the new tools used for the architectural design and education can have adverse consequences such the minimal use of computers to represent architectural designs or the unilateral imposition of computer ideas and structures on human. While creating a tool-dependence trap, this causes the designers' ideas to be affected by the capabilities of the software. Experiences have also shown that mere knowledge of computer-related skills does not necessarily result in the representation of an architectural work based on computer design techniques (Menges & Ahlquist, 2011; Oxman & Oxman, 2014). Understanding traditional tools and new technologies under the integrated concept of media and defining the design process based on the designer's mental actions in the media context can pave the way for the integration and interaction of traditional and new methods that lead to improved quality of the design process. The present study seeks to explain the position of the design process while investigating the interaction between such dualities as human thinking and computational thinking, traditional design methods and new computational methods, and analog and digital media.

For this purpose, a conceptual model has been presented based on theoretical studies to examine, analyze, and categorize various applications and integration of digital and analog media. Finally, in addition to explaining the hybrid media platform as a result of the interaction of various media, some recommendations have been presented.

1- Definition of Media

According to the Oxford dictionary, the word "media" comes from the Latin plural of medium and literally means the main ways of transmitting something. It has many applications and examples so that the senses and organs of the body are also called media because they are the means of transmitting data from the environment to humans.

Today, any means of transmitting thoughts and ideas is also called media. From the communication sciences' point of view, media means individuals, tools, or situations through which a message is communicated. The first known use of media was in 1841, as indicated in Merriam-Webster. In art, the materials and forms that the artist uses to express his ideas are called media. McCullough (1996) defined media as a set of tools and raw materials. For example, he considered metalworking as a medium.

Among various meanings of the term media, two general meanings can be considered. The first one refers to the media as a mediator between us and phenomena (for example, five senses as the media). The second meaning of the media can also be derived from the first one. It refers to the media as a means of communication (for example, the press, television, and other means of communication as the media). The term media used in the present study refers to various tools used by architects during the design process. It includes drawings (sketches, diagrams, etc.), documents and representation methods (sections, plans, perspectives, etc.), materials (cardboard, paste, etc. for

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making scale models), and digital tools and technologies (architectural design software, digital design and construction technology, etc.) used to facilitate dialogue between the designer and the design (the designer whispers with his ideas) and the communication between the designer and others. Thus, the media play a mediating role between us and external realities (in cognition) and cause the internal realities to appear (when designing and creating phenomena), each of which functions in proportion to the subject of the project (Davidova, 2017). According to Bacon (1997), we expect the media in the process of cognition to help us to design, create, and ultimately represent phenomena. Two basic functions can be considered for the media:

- We need media to mediate the work of our hands, eyes, and tools. Our knowledge and skills must always have a context for action (McCullough, 1996). Thus, one of the fundamental functions of the media is to provide a context in which a person's intentions, ideas, and actions can be manifested. In this process, ideas emerge and are formed while expressing themselves.
- The media are also a mediator between the author (designer) and the audience (users, other members of the design team, or even the designer himself in the dialogue between him and his design).

As McCullough (1996) argues, mediation does not only mean giving form but also means communicating. Thus, the media devise the author's path and purpose. It provides a place for expression and becomes a subject for interpretation, by which the media create a communication between the author and the audience of the work. Rich media call for interpretation. Just as the media must provide a context for skilled action, it must provide a context for developed interpretations. [In this function], the word "media" is used to mean the carrier and mediator.

2- Properties, Constraints, and Narrative Structure of Media

Media have certain properties, potentials, constraints, and structures. When working with the media, the technical and conceptual aspects of the media, as well as the perception of the end product, engage our minds. Each medium has special technical and conceptual properties that determine the amount and type of our engagement with the medium while working. Each medium offers us a range of possibilities, opportunities, and constraints. Thus, it can be said that every medium has a structure by which not everything can be represented so that it only fits certain ideas (McCullough, 1996).

Thus, a skilled craftsman does not only ask what do I want to do with this medium? He also asks what can this medium do? An experienced craftsman knows how to choose the right medium and how to use the medium in a way that fits it (McCullough, 1996).

3- Considering the Design Process as an Iterative Representation

Considering the design process as an iterative representation of ideas in different media contexts (Bermudez & King, 2000) makes it possible to examine how and to what extent the choice of specific media influences the representation of initial ideas. With each representation, ideas are formed in the

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new media context. During representation, the idea changes and is redefined according to the new media structure.

It is the transforming power of the process of representation that accounts for the fact that our concepts and the products of our designs do not often look the same [in each representation]. These distinctions exist not only between the mental image and the building [final product of architectural design] but also between the various representational modes an architect may employ. No one medium can communicate every aspect of the work. Each mode of representation has constraints and each form in which our architecture takes shape contains different and potentially new meanings (DeLaura, 1997)

Reviewing the paradigms of design methodology, Naser Khaki and Nourian (2011) defined the design process as a purposeful activity that proceeds between the actions of the mind, media, and reality to change the present state and move towards the preferred (spiral) state. In fact, combining, adapting, and integrating what has been proposed in the recent design methodology literature, they arrived at the following model to explain the design process:
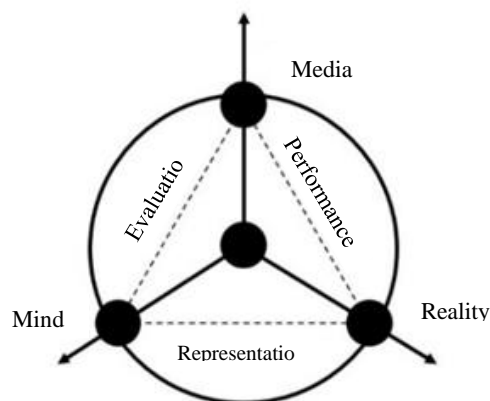

Figure 2: Comprehensive model of the three main dimensions of design and overall design workflow (Reference: Naser Khaki & Nourian, 2011)

Based on the inclusive model, the four basic interactions in the design process are as follows:
- Reality; analysis (evaluation) of the interactions between the media and the mind based on objective reality
- Mind; synthesis (performance) of the interactions between media and reality based on the human mind
- Media; interpretation (representation) of the interactions between the mind and reality in the context of intersubjective media
- Time; the driving force of design, generation over time (Naser Khaki & Nourian, 2011)

In the design process, the media are a good platform for objectifying subjectivity and subjectifying objects. In fact, by creating intersubjectivity (Naser Khaki & Nourian, 2011), the media are a suitable platform for representing the designer's interpretations and mental perceptions of reality in the stages of recording and analysis (Gharibpour, 2014) of the design process and objectifying the designer's minds and imaginations in accordance with reality.

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4- Types of Media

In more traditional classifications and architectural theory, most media are categorized based on documents such as plans, sections, perspective drawings, and pen and ink drawings. However, this classification is not very popular today. DeLaura (1997), for example, suggested that instead of emphasizing the above categories, the media should be studied by emphasizing the three stages of creating an architectural work, namely perception, intention, and conception.

Media in their modern sense have created an independent world. In the past, design media were in absolute control, a subordinate or a part of the designer and reality, including the paper media that were formed based on the discretion of the designer and the experimental construction in the real world that was itself a design medium in experimental, traditional, and rural architecture. However, current design media indicate an independent concept and include general standards (Naser Khaki & Nourian, 2011).

In general, media are divided into two categories, analog and digital. Bermudez and king (2000) refer to the interactive use of media in the general classification and definition of analog and digital media. Analog media include tracing paper, vellum, graphite and ink, clipboard, clay, balsa wood, plastic, metal, etc. Analog media are also called handmade, manual, material, or physical. Digital media include scanning, image manipulation, visualization, solid modeling, computer-aided drafting, animation, rendering, etc. Digital media are also termed electronic, computer-aided, and virtual (Bermudez & king, 2000).

This general classification is valid because there are profound differences between analog and digital media, each of which refers to a way of thinking and a way of solving a problem. However, we mean the interactive use of media in all types. Emphasizing the design process as a process combining digital and traditional techniques and design strategies, Sevaldson (2005) considered the roles of various people with different responsibilities in the design team.

McCullough (1996) referred to three fundamental differences between digital and traditional media as follows:

a. The operations and changes made in traditional media are irreversible, while all operations and changes in digital media are reversible. We may even move back and forth by completely saving and re-reading different versions of the work process in these media.

b. In digital media, the format is often determined after content. Ideas designed by these media can even be stored or represented in a variety of formats. However, in traditional media, the format of the work was first determined and then the content was designed.

c. Digital media represent design ideas through a highly accurate numerical system. This increases the density of these media and provides conditions similar to the continuous operations and changes that were previously possible only by physical and material media.

Generally, in the current conditions of the development of digital technologies, digital and analog media have the following characteristics in relation to the design process:

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Table 1: Comparison of the characteristics of analog and digital media, adapted from Bermudez and King (2000)

Digital media	Analog media
- Stronger for the secondary development of ideas. - A greater ability to describe geometric ideas and high complexity and details. - Allowing the easy articulation and generation of multiple viewpoints. - Narrating and storing images and models. - Making it possible to have hyper-realistic renderings of the designed environment.	- Representations are far more fluid and appropriate for the initial and fast development of ideas. - helping to stimulate the designer's imagination. - enabling free inquiry - allowing the intentional and random cross-reference of diverse sources - making it possible to manipulate and change quickly. - better visualization of scale - allowing the expression of emotional states

According to the table above, today analog media are mostly used in the initial stages of design and digital media in the final stages of design to develop it.

5- Patterns of the Use and Integration of Digital and Analog Media

According to the experiences of professional architectural offices, two general approaches can be considered when using different types of media:

- Sequential use of different media, which even happens inevitably in most designs with one media.
- Parallel and interactive use of media so that designers use multiple media to represent, develop, and document ideas or do other operations in accordance with the type of media (Bermudez & King, 2000).

If we consider the horizontal axis for time and the vertical axis for the frequency of using different types of media, we can achieve a conceptual model for the typology of the use of different types of media in the design process. The horizontal axis can also be considered for three stages of the design process, including conceptual design, design development, and construction design (Pollalis & Bakos, 1987). Figure 3 shows the sequential use of analog media (for ideation and conceptual design) and digital media (for rendering and representing documents at the end of the design process).
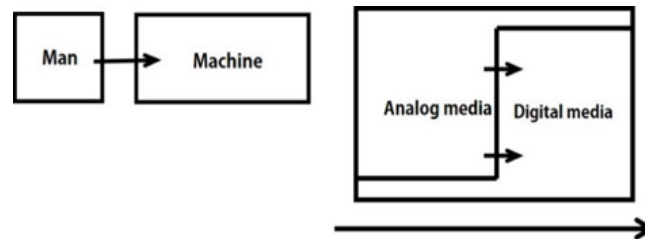
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Figure 3: Sequential use of media in the design process (Reference: Authors)

As shown in the figure, although most of the media used in the initial stages are analog, the use of some digital media such as word processing software (MS Word, pdf) is also common in these stages for collecting and analyzing information (Gharibpour, 2014). Similarly, despite the power of digital tools and media in rendering and representing the designs, part of the media used in these stages are still analog.

This sequential pattern of using analog and digital media together is a common pattern that is often used in design offices today. Wong (2010) introduces another model of using these two types of media, the realization of which depends on the development of digital technologies.
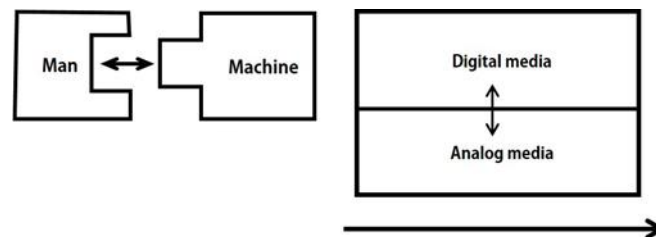

Figure 4: parallel use of media in the design process (Reference: Authors)

In this model, each medium has the same share in the design process. The second major difference is the two-way exchange of ideas and information between digital and analog media in this model compared to the one-way exchange in the previous model. To achieve this pattern, which corresponds to the pattern of human-machine interaction, digital media must be developed to be used in the initial stages of the design process. Digital media have not yet been able to adapt to the nature of thinking in the initial stages of the ideation and design process. Terzidis (1999) argued that the relationship between architecture and digital technology would never go beyond the instrumental level. According to this view, the more advanced, up-to-date, and sophisticated the technology, the more it will be considered as a tool and remain under the control of the architect (human). Today, digital media are used rarely at this stage and it is more focused on activities related to information analysis, provides a basis for creative thinking, and generally does not fit with the human mind. On the other hand, even where it has a complete presence in computational thinking, it does not mean conformity with the nature, mechanism, and structure of the human mind, but rather it indicates the domination of computational logic over the whole design thinking. Additionally, the unparalleled power of computer tools in rendering and representing design ideas at the end of the design process is another factor that has eliminated the need for analog media at this stage.

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Another set of tools is needed to achieve a two-way exchange of ideas between digital and analog media. Lack of development of these tools can be another important factor in the failure of the second model of using a variety of digital and analog media in an interactive way. As these tools do not belong exclusively to one of the digital and analog media, they are called intermedia tools. These tools are the basis for the entry and exit of ideas and data from the digital world to analog and vice versa. Two and three-dimensional printers and scanners are available types of these tools. As these tools develop, the exchange of ideas and data between digital and analog media becomes more bilateral and closer to an interactive pattern.
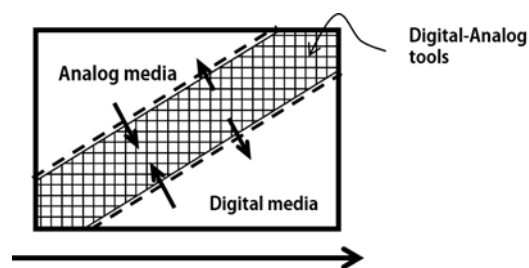

Figure 5: Digital- analog tools and media (Reference: Authors)

With the further development of these tools in the future, we may see the emergence of not only digital-analog tools but also interactive media or digital-analog media which seek human-machine interaction. In this kind of media, which may forever eliminate this analog and digital separation, we will see the juxtaposition or even the combination of the deductive and computational logic of man and machine.

The patterns introduced in the previous sections, especially the sequential pattern (Figure 1 (A)) and the parallel pattern (Figure 1 (B)) are the two poles of a continuum while the interactive use of digital and analog media in the design process can have a place between the two poles on this continuum.

The third pattern of the juxtaposition of digital and analog media that is not placed on this continuum is the result of the dominance of computational logic over the logic of human thinking. Software defines a predetermined design policy that does not rely on the designer's thinking and mental process, to some extent directs and controls the design thinking, and establishes an algorithmic and logical relationship between design factors (Gharibpour, 2014). On the other hand, computers are considered drawing tools. In this model, the computers do not have a direct relationship with the designer's mind in the drawing process. Therefore, they do not play a decisive role in the designer's intellectual flexibility in the design process (ibid.).
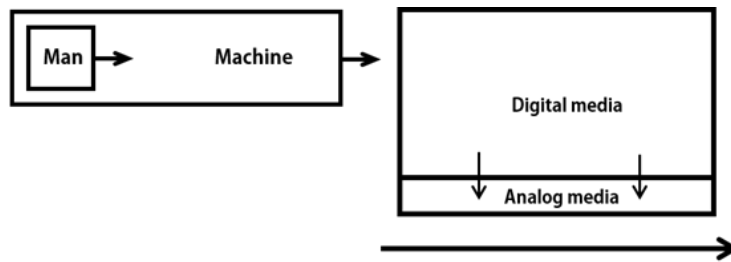
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Figure 6: The dominance of computational thinking over the third type of human-machine relationship (Reference: Authors)
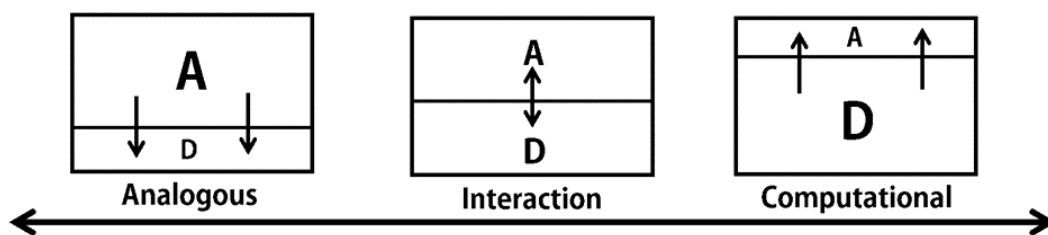

Figure 7: The change in the patterns of the juxtaposition of analog and digital media from the sequential pattern in the past to the parallel one in the future (Reference: Authors)
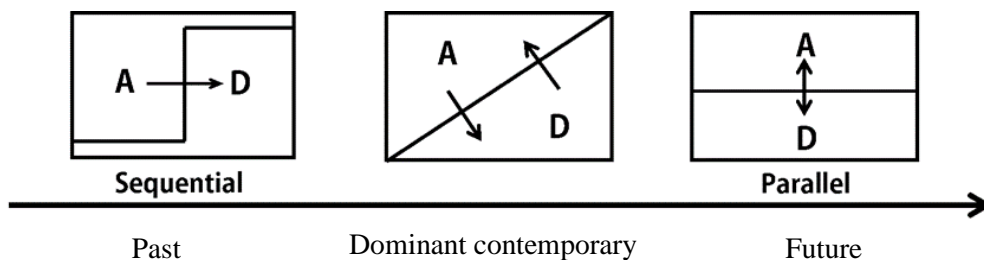

Figure8: Types of the juxtaposition of analog and digital media ranging from the dominance of deductive logic (left) to a purely computational process (right) (Reference: Authors)

6- Hybrid Media Platform

Any parallel use does not necessarily mean the interactive use of digital and analog media. In fact, the interaction between these two types of media will be realized in the true sense when the following conditions are met:

- Each medium represents the ideas based on its own narrative structure and uses appropriate tools, both analog and digital, in proportion to the nature of the ideas (type and properties) to cultivate them.
- Each representation in the narrative structure of one medium should be interpreted and researched (rendering and searching for the possibility of developing an idea) in another media context.

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- The development of intermedia tools accelerates the exchange of ideas and information between analog and digital media and reduces its costs.

A successful design process will result from media interaction when the combined use of media leads to the formation of a hybrid media platform for the representation of ideas. Such a work environment should be flexible to creative thinking.

The use of both types of media and their combination creates hybrid media conditions that lower the overhead and labor-intensive use of computer-generated visualizations. The interactive use of media by creating a new hybrid media environment leads to more flexibility and creativity in accordance with the nonlinear nature of the design process, causing the increased quality of the product in the design process (Smulevich, 1997; as quoted in Bermudez & King, 2000).

Such a hybrid system of media representation creates a trans-media, or at least multimedia, a condition in which ideas are represented and researched in proportion to the narrative structure and strategies of each medium for the creation and development of ideas. Then, the ideas are reinterpreted by the designer in another media context. By representing ideas in different media, designers can use the possibilities of each medium to develop aspects of the design, causing the design process and the final product to be improved.

Such a condition allows designers to maximize the search and experience of the available options and potentials due to the use of different types of media. In addition, it allows new visualizations and representation systems to be created. Subsequent research may introduce unforeseen ways of understanding and representing architecture (Bermudez & King, 2000).
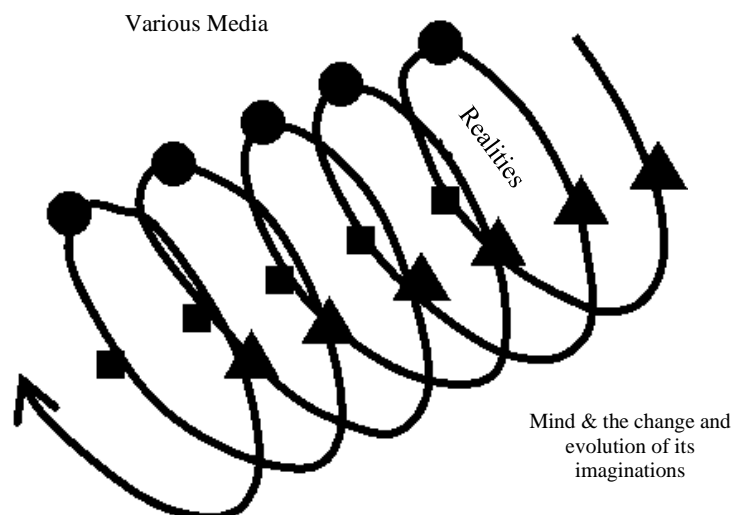
Various Media

Realities

Mind & the change and
evolution of its
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Figure 9: Representing each idea in one medium to render and research it, followed by reinterpreting it by the designer and representing it in another medium (Reference: Authors)

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Conclusion

Generally, when the designer encounters media related to the design process, three approaches can be considered.

- Ideas are formed outside a particular medium and represented in the new medium.
- Solutions are provided considering the potentials and constraints of the new medium.
- New solutions are sought based on the interaction between the potentials of the medium and the independent mental images of the designer (or ideas formed in other media).

If we want to use all the potentials of digital media alongside analog media during the design process, we must effectively interpret digital representations of ideas and pursue them in other media.

A hybrid media platform provides the grounds for the representation of ideas in different media (according to the nature of the idea and the structure and potentials of the media) and the research and development of ideas (in proportion to strategies for creating and editing ideas in the media). In addition, the interactive use of media helps the designers to interpret each representation and pursue it in another media context, a condition that places the designer's decisions beyond the specific constraints of a medium, in a position between subjectivity and intersubjectivity. The interactive use of digital and analog media leads to the juxtaposition or even the combination of deductive and computational strategies when representing ideas. Thus, human-machine thinking can be realized.

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