

The Use Of Metaphors In Graphical User Interface: Carry On With The Metaphor Or Time For A Paradigm Shift?

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Abstract

The contemporary theory of metaphor defines the metaphor as a major and indispensable part of our ordinary, conventional way of conceptualizing the world and it asserts that the metaphors are used to define our relationship with the physical environment and to create a context of communication. The metaphors are the core idioms of the contemporary graphical user interface (GUI) and have an important role in helping users interact with computer systems. The desktop metaphor began with the first GUI Xerox Star and was popularized by the Lisa of Apple Macintosh. Realizing the physical-office metaphor and reflecting the familiar world of the potential users by using icons of file, folder and trashcan, the metaphor-based GUIs made it relatively easy for all to use the computer productively. Nowadays almost all of the software industry is based on the desktop metaphor paradigm. However, besides the researchers that favor the use of metaphors in the development of the system image by accentuating their assistance to learning, there are also other researchers, who reject the metaphor-based design approach in GUIs by referring to their limitations. Considering these discussions and various approaches, this study aims to make an outline of the historical development of metaphor-based GUIs; to determine the current state of metaphor within GUI design by brief examples and finally to identify future prospects and research themes. The study claims that metaphor

still remains to be an inevitable part of the GUI to communicate it with the users and despite its potential limitations -rather than rejecting the metaphor totally- it seems better to try compatible and supplementary solutions like visual formalism.

Keywords: metaphor, graphical user interface, design, human computer interaction

Özet

Çağdaş metafor teorisi metaforu, dünyayı kavramsallaştırma sürecimizin temel bir bölümü olarak tanımlar ve metaforun fiziksel çevre ile kurduğumuz ilişkiyi tanımlamak ve bir iletişim bağlamı yaratmak için kullanıldığını ileri sürer. Metaforlar çağdaş grafik kullanıcı arayüzünün (GKA) temel yapıtaşları olup, kullanıcıların bilgisayar sistemleri ile iletişim kurmasına yardım etmeleri anlamında önemli bir role sahiptirler. Masaüstü metaforu, ilk GKA olarak tasarlanmış olan Xerox Star ile başlamış olup, Apple Macintosh'un Lisa'sı ile popülerleşmiştir. Metafor temelli GKA'lar, ofis metaforunu bilgisayar ortamına taşımak ve dosya, klasör ve çöp tenekesi gibi kullanıcıların tanıdık dünyasını yansıtan unsurların ikonlarını kullanmak suretiyle bilgisayarı herkesin etkin kullanılabileceği hale getirmiştir. Günümüzde neredeyse tüm yazılım endüstrisi masaüstü metaforu paradigması üzerine kurulmuştur. Bununla birlikte, özellikle eğitime verdiği katkıya vurgu yaparak metaforu sistem imajını geliştirme sürecinde öne çıkartan araştırmacıların yanında, beraberinde getirdiği sınırlılıklara gönderme yaparak metafor temelli tasarım yaklaşımını reddeden araştırmacılar da sözkonusudur. Bu tartışmaları ve farklı yaklaşımları gözetmek suretiyle bu çalışmada, metafor temelli GKA'ların tarihsel gelişiminin ortaya koymak, GKA tasarımı içinde metaforun bugünkü mevcut yerini örneklerle saptamak ve gelecek öngörülerini ile potansiyel araştırma temalarını belirlemek hedeflenmiştir. Bu çalışmanın temel önermesi metaforun kullanıcıyla iletişimi kolaylaştıran boyutuyla halen GKA'ların vazgeçilmez bir parçası olduğudur. Getirdiği sınırlılıklarına rağmen, (metaforu tamamen reddetmek yerine) uyumlu ve destekleyici "görsel biçimcilik" gibi bütünleşik yaklaşımlar alternatif çözümler olarak değerlendirilebilir.

anahtar kelimeler: metafor, grafik kullanıcı arayüzü, tasarım, insan-bilgisayar etkileşimi.

Introduction

Metaphor has a major role in human communication, interaction, learning, teaching and cognition. In the first part of this paper, the vast theoretical background of the metaphor is investigated. Almost the entire graphical user interfaces are based on the desktop metaphor, which includes the icons of the concrete and familiar items from the real, analog world. In the second part, the use of metaphors in computing is examined by brief examples. The third part is based on the historical development of the graphical user interface. In this section, the route of the development of the GUIs-from the Memex of Bush and Engelbart to MacOS and Windows- is defined. In the fourth part, the discussions on the limitations of (the use of) the metaphor are examined in details and the need for a paradigm shift in GUIs is investigated. In the fifth part, visual formalism, which is an approach alternative to metaphors, is evaluated reciprocally and in conclusion, prospects and potential future themes of the metaphor-based design are proposed.

Metaphor / Theoretical background

There are different definitions of the metaphor. Originally the word "metaphor" comes from the Greek "metaphora" which literally means to "transfer" or "convey". In "Poetics", Aristotle defines the metaphor as giving the thing a name that belongs to something else. (Johnson S. 1997: 58). In literature metaphor is described as an "an implied comparison between two things of unlike nature that yet have something in common" (Corbett 1990: 122)

Langer describes a metaphor as an idea expressed through language, which functions as an expressive symbol (Langer 1953: 189). Rather than clarifying, the metaphor provokes imagination and opens the possibility of linking a complex idea with a new perspective. Metaphor can highlight "semantic creativity, the capacity of language users to create and understand novel linguistic combinations that may be literal nonsense."(Paivio 1979: 150)

The term 'metaphor' is traditionally associated with linguistics. Metaphors are used to express an abstract concept in a familiar way. In 1979 Lakoff and Johnson defined an embodied view of metaphor, which was indeed a breakdown concerning the traditional, objectivist and philosophical paradigms that marginalized metaphor. They stated that metaphoric thinking is both physically and culturally constrained and basic to human cognition. "Most people think they can get along perfectly well without metaphor. We have found, on the contrary, that metaphor is pervasive in everyday life, not just in language but also in thought and action. Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature". (Lakoff and Johnson 1980: 3).

Today, researchers and theorists from different disciplines acknowledge the fundamental role of metaphor in communication, interaction, learning, teaching and cognition (Cameron and Low, 1999; Carroll and Mack, 1999; Duranti, 1997; Egan, 1997; Gentner and Markman, 1997; Hummel and Holyoak, 1997; Lakoff and Johnson, 1999; Ortony, 1993; Salvucci and Anderson, 1998; Winner and Gardner, 1993). There are different theoretical perspectives and analytic approaches among these researchers towards the conception of the metaphor. Considering the contemporary theory of Lakoff and Johnson as a basis, we can state that "metaphor is pervasive in the conceptual system" (Lakoff and Johnson, 1980), "metaphor is one of the most basic mechanisms people have for 'understanding their experience" (Lakoff and Johnson, 1980: 210-211) and "metaphor is a major and indispensable part of our ordinary, conventional way of conceptualizing the world" (Lakoff, 1993: 204).

We may assert that the metaphors are used as tools to help to define our relationship with the physical environment and to communicate with others about it. Many of these metaphors suggest a structural and hierarchical relationship with the world that is evident in our spatial, cognitive and linguistic realms (Correa, 1992: 33).

Furthermore, the metaphors also have an important role in the development of new concepts in science (Condon, 1999: 36). Eileen Cornell Way gives some examples on the use of metaphors in science "The use of metaphor to extend our concepts in science is legendary: the Bohr model of the atom uses the structure of the solar system, Maxwell's represents an electrical field in terms of the properties of a fluid, atoms as billiard balls, etc. Thus, even science is not the paradigm of literal language it was once considered to be; rather metaphor is vital to the modeling processes that result in advances in science" (Cornell, 1991: 8).

We can say that creating new metaphors for new machines has a long history. In every period, the latest technology brings out new terms that stem from the imagery of older and more familiar things. Mainly based on the analogies between machines and organisms, Dickens saw the Manchester factories as mechanical jungles populated by "serpents and smoke" and a steam engine with a "head like elephant", Thoreau named the railway as "the devilish iron horse" and Thackeray named it as "arteries coursing through the body politics" (Johnson, S. 1997: 16).

Metaphors in computing

The metaphors are one of the core idioms of the contemporary graphical interface. Most of the computer interfaces are metaphoric (Lovgren, 1994: 87). All the features on the screen represent different functions and are all based on

familiar terms. Metaphors are used to help users interact with computer systems. Metaphorical reasoning involves prior knowledge and facilitates to understand new situations. This reasoning is widely applied to interface design (Preece, 1994). Briefly, we use our knowledge of the real world to help us out in understanding the interface. For example 'cutting' and 'pasting' are familiar actions used for making artwork or documents. These words are metaphorically used in word processing to represent the actions of taking part of a document away and inserting it somewhere else. Linking a model of a known system and its functions to an unknown program via metaphor allows the user to apply what they know about the one system to the new one. This link applies the user mental model of the known system to that of the unknown system (Mohnkern, 1997: 2). The use of metaphors in computing varies from the superficial, such as wastebasket and desktop, to those at a deeper level like interactive media

There are different classifications of metaphors in human-computer interaction literature. For example according to Preece metaphors can be subdivided into three groups (Preece, 1994):

- 1) Verbal metaphors: A new technology is described in terms of a familiar concept. For example a word processor is described in terms of the notion of a typewriter.
- 2) Virtual interface metaphors: At a deeper level, the interface metaphor is used to create the illusion of a familiar work environment for the user such as a desktop or a book. The actual system is hidden by the new illusion introduced.
- 3) Composite metaphors: New metaphors were created to carry out the functions of new computer actions. The previously introduced metaphor is combined with new elements that were based on different metaphors to express these new computer based actions. Scroll bars and windows can be given as examples, because these elements normally aren't associated with the desktop system, but are proposed to be the significant parts of the system.



Figure 1: Three aspects of mental models (Norman 1988: 190)

Besides the expectations that composite metaphors would cause difficulties for users, Preece states that users can assimilate these different concepts and develop multiple mental models (Preece, 1994). The user's mental model is what the user develops to explain the operation. In the design process of a new system, designers develop a "design model" which is the conceptual model of the system. The design model includes the tasks, the features and the structure of the system and the development of this model is based on a particular set of users and a particular context of use. The main goal of the designer is to create a communication between the design model and the user model and the system image is the only way of communication between the designer and the user. At this point metaphors of the familiar, real world concepts such as a typewriter, files and folders are used for helping the user to understand and use the functionality of the virtual world in terms of features like keyboard, icons, etc. A system can be promoted as a successful one if the user model is equivalent to the design model (Norman, 1988: 190).

Once computer scientists and designers had conceived and developed the graphical computer interface, human-computer interaction expanded to afford virtual push-pull and other sensory transactions that could be designed to model the familiar actions and procedures humans normally conduct with the concrete world (Reese, 2003: 40). The computer interface, then, became a virtual world that could be designed according to specifications to highlight specific virtual objects, project and highlight specific relations between virtual objects and enable the user to conduct transactions with virtual objects (Lakoff and Johnson, 1980: 10-13). Briefly in this context, it can be stated that the computer interface could be designed to help people to learn (Carroll and Mack, 1999: 400). This statement leads us to another fundamental advantage of the use of metaphors in the graphical interfaces: its assistance to learning. The computer-mediated learning environments designed from the vantage of metaphor and analogy could enhance human learning through mechanisms indigenous to human cognition (Carroll, 1997; Carroll and Mack, 1999: 393).

Considering these advantages of the use of metaphors, many different types of interfaces were developed since the rise of direct manipulation in the early 60s and today almost all of the operation systems are based on the desktop metaphor paradigm. At this point, we will make an overview on the historical development of the graphical user interfaces (GUI).

Graphical User Interfaces / A Historical Overview

The quest for GUI started with Vannevar Bush, a scientist who worked at MIT during World War II. In 1945 he published the article "As We May Think" (Bush 1945: 101-108) in which he describes the Memex, a new information-administration tool. The Memex was a hypermedia system in which data could be stored on microfilm and be made accessible and linkable. Johnson names

Bush's proposed solution as the birth of hypertext, at least in its modern incarnation. "Only he chose to imagine the "links of association" connecting all that data as "trails" not links" (Johnson S., 1997: 118). Bush's research had affected many of the scientists in his period, one of which was Douglas Engelbart. As being a researcher in the domain of human-computer interaction at Stanford University, - heavily inspired by the theories of Vannevar Bush- Engelbart considered the computer as an "augmenting" tool. He used "augmentation" instead of the conception of "automatation" and aimed to empower the user instead of replacing human work by computers. He proposed the ideas of "bitmapping and direct manipulation" which liberated the users from the old command-line systems based on the strings of 0s and 1s. On the basis of "direct manipulation", the contemporary concepts and devices such as keyboard, mouse, video screen and word processing software were developed.

In the middle of 70ies, The Xerox Palo Alto Research Center (PARC) researchers started a revolutionary research on new computer input and output devices based on the basis of Engelbart's propositions. Finally Bob Taylor and Alan Kay developed the first prototype of a personal computer: the Xerox Alto. It represented most of Douglas Engelbart's ideas about direct manipulation and was equipped with a mouse as pointing device, a keyboard for data input and a video-screen as an output device. Furthermore, it carried the first graphical user interface within: Xerox Star as a part of an experimental operating system called Small Talk. "The desktop metaphor began with the Xerox Alto and was refined on the Xerox Star. The designers chose what they referred to as the "physical-office metaphor" because the Star was intended as an office information system, so reflecting the familiar world of the potential users" (Smith, 1982: 246). "The designers saw their metaphor as providing a 'physical' environment rather than a language of interaction: The Desktop is the principle Star technique for realizing the physical-office metaphor. The icons on it are visible, concrete embodiments of the corresponding physical objects. Star users are encouraged to think of the objects on the desktop in physical terms" (Smith, 1982: 247).



Figure 2-3: Xerox Alto and Xerox Star (Lineback 1999: 190)

Steve Jobs from the "Apple Company" -heavily inspired by the PARC innovations- adopted the idea of easy-to-use home computers. Supplied by the technological know-how of Xerox on GUIs, the first Apple Personal Computer transformed the ideas around Xerox Star into a marketable product: the Apple Macintosh in 1984. The desktop metaphor, drop-down menus, folders, the wastebasket and overlapping windows were the core innovations of the Apple-GUI which make it relatively easy for novices to use productively. The commercial success of the Macintosh GUI led to a new age of graphics-based applications and operating systems like Windows of Microsoft.

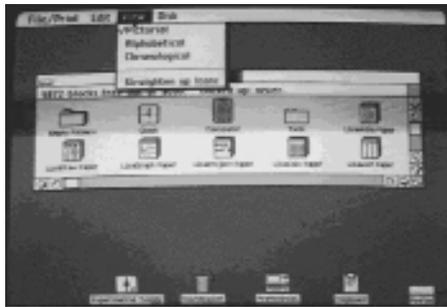


Figure 4: "Apple-Lisa" (Lineback 1999: 190)

"The widespread adoption of the GUI has dramatically changed the way in which humans and computers interact and has greatly expanded computer literacy among people once alienated by the arcane syntax of the old "command line" interfaces." (Johnson S.1997: 16). It was obvious that especially the window metaphor was really liberation for most users, because the transparent mode switches of a windows-driven interface allowed the users to multitasking more easily. This innovation was called as a paradigm shift by researchers and writers from different disciplines. Steven Johnson makes an interesting statement by evaluating this shift in a philosophical context: "The passage from the fixed system of the command-line to the more anarchic possibilities of the windows follows the same route traveled by western philosophy: From the stable, unified truth of Kant and Descartes to the relativism and ambiguity of Nietzsche and Deleuze" (Johnson S., 1997: 83).

The software industry has developed rapidly on the paradigm of metaphor and new types of software were developed considering the needs of different markets. For example various multimedia programs use other metaphors referring to the existing media industry, such as films (video editing programs) and newspapers / magazines (page layout programs). The Internet has also led to different metaphors, such as the World Wide Web or the Information Highway.

The high frequency of the technological innovations in this digital era comes with new metaphors. For the future, many of the interfaces systems seem to be based on virtual reality and various metaphors have been suggested for creating these virtual spaces. Many are based on extended spaces and landscapes or on various types of community. The domain of video games can be given as an example, since it has successfully expanded the original desktop metaphor into three dimensions.

The breaking from the metaphor-based design: Time for a Paradigm Shift?

Besides the researchers that favor the use of metaphors in the development of the system image by accentuating their assistance to learning, there are also other researchers, who reject the metaphor-based design approach in GUIs by referring to their limitations (Halasz and Moran 1982: 383-386). The argument is mainly based on the paradox between the "literal" and "magical" features of the computer system, which are presented to us by the metaphors. The metaphor has literal features, which facilitate and enhance the learning whereas they can also imprison the real, but skilled, "magical" capacity of the system in its boundaries. Besides this literal aspect of the metaphor, also the "over-literal approaches" towards using the metaphors in the interfaces cause some problems. Finally the cross-cultural nature of the metaphors should be considered as an important and critical factor in developing a metaphor-based design. Culturally inappropriate interfaces can cause frustration of the users. At this point, the three dimensions mentioned above will be examined by brief examples.

The use of the desktop metaphor has as some conceptual blind spots as its command-line predecessors. These restrictions mainly stem not from the metaphor itself but rather from being too faithful to the original metaphor, especially in the examples that carry the original desktop into much more realistic 3D spaces such as office buildings and living rooms. It can be stated that taking the metaphor too literally causes today's misconceptions. What makes a metaphor powerful is the gap between the two poles of the equation. Metaphors create relationships between things that are not directly equivalent. There's a necessary distance between the real and virtual trashcan that makes the analogy useful to us and metaphors based on complete identity are not metaphors at all. Alan Kay points out this potential misconception in "User Interface: A Personal View" in 1990: "My main complaint about modern interfaces is that metaphor is a poor metaphor for what needs to be done. At PARC we coined the phrase "user illusion" to describe what we were about when designing user interfaces... Should we transfer the paper metaphor so perfectly that the screen is as hard as paper to erase and change? Clearly not..." (Brenda, 1990: 189).

Microsoft's operation system - dating back to 1995 - "Bob's Living Room", can be considered as a corresponding example. In this GUI, an extended metaphor of a living room was introduced and it could be personalized (redecorated) according to the user's demands. But an over-literal interface environment like Bob wasn't indeed a metaphor but rather a simulation. Johnson makes a distinctive evaluation on the case of "Bob's Living Room": "Bob represents the domestication of the personal computer, in the pejorative sense of the world, turning the miraculous shape-shifting capacities of these machines into a dulled repetition of everyday, household reality. The real magic of graphic computers derives from the fact that they are not tied to the old, analog world of objects" (Johnson S.,1990: 61).



Figure 5: "Bob's Living Room" (Lineback 1999: 190)

Metaphors bring the knowledge of the real world to the computer and a real-world metaphor supplies us with only a "real world" user model. But it may also tend to limit the functionality of the software to that of the physical analog; the implementation can never be completely faithful to the metaphor and so will sometimes behave in unexpected ways; and whereas the interface is easy to learn, it is not optimal for many tasks and impedes maximum utilization of the capabilities of the computer system (Gentner and Nielsen, 1996: 70-82, Halasz and Moran, 1982: 383-386, Johnson, 1985: 548-549).

Briefly metaphor can hide certain existing features of the system. Lakoff and Johnson write that metaphor not only emphasizes similarities between two things, but also hides non-similarities (Lakoff and Johnson, 1980). Computer-based systems are very different from physical systems. The computer frees us to do tasks that impossible and "magical" in the physical world. So modeling one after a physical analog is bound to bring up inconsistencies and inadequacies.

Metaphor involves all the natural dimensions of our experience, including

aspects of our sensory experience: color, shape, texture and sound (Lakoff and Johnson, 1980: 234). This connection to sensory experience is important in the realm of graphical user interfaces in which the perceptual, functional and purposive properties of our interactions with technology are established, but on the other hand we may have expectations that are shaped by our understanding of gravity, velocity, inertia and elevation; properties of the natural world that do not necessarily correspond to multimedia environments.

We may be likely to want to use the habits we've developed to work with the metaphoric system while working on the new system. For example insisting on hitting the delete key to move back to previous sentences in a word processor rather than setting the cursor by using the mouse or selecting a range of text for deletion with the mouse. This is simply a habitude of using the keyboard like a typewriter. By working with a system that looks like something we're so familiar with, we apply our old habits to the new system. Similarly, if a user is ejecting a floppy disk for the first time in a Mac OS system, it isn't so easy to drag the disk to the trashcan without hesitation, since in the physical, reel world things in the trash can is the way that we get rid of them.

Another example could be given for the cases of breakdowns in the system. When the system fails in some way not foreseen by the designers, users may be unable to fix it since they lack a real knowledge of its inner workings. This problem is becoming increasingly common as the complexity of systems increases, causing conflicts or unanticipated interactions between different system components.

As mentioned above metaphors carry the knowledge of the real world to the digital media. The problem in cross-cultural interface design is that the real world changes dramatically from culture to culture (Fernandes 1994). In this context, users may easily be frustrated by a culturally inappropriate interface because it would not represent their view of the real world. This lack of familiarity would easily lead to frustration and finally, rejection of the interface. The effect and understanding of metaphors is strongly dependent on the environment they are used in. Different cultural and intellectual aspects have to be considered and these influence the effectiveness of metaphors. Ethnic stereotypes, religious symbols, gender roles, treatment of animals, jargon, humor, text and graphics formats, colors and customary languages are all concerns that can be inappropriately addressed in an interface. When encountering an improper interface feature from a American software, users from different cultures can be confused about its meaning since it does not provide any link with the users' real world. This intuitive recognition enabled by metaphors could be used to help the user to understand the interface. People from the Arabic world (where they write in a graphical script and from right to left) or the Chinese (who have a vertical pictographic script) have intuitive

behavior concerning the flow of information that is different from that of Americans. The current American software focuses on the top left hand corner of the screen, with a left to right flow. This might not be according to intuitive behavior Arabs and Chinese would have when confronted with such an interface. That's why sometimes a culture may need more functionality than the original version (such as the specific editing functions for Asian scripts) or a fundamental function in the original version might not be needed for a different culture. For example Microsoft's change case function is not necessary in Thailand, because they don't use upper or lower case in that country (Evers 1997: 2).

Potential and alternative propositions

Visual formalisms are frequently seen as an alternative approach to metaphors. "Visual Formalisms are diagrammatic displays with well-defined semantics for expressing relations. Visual Formalisms are tables, graphs, plots, panels, maps, and outlines." (Johnson J. 1997: 44). "They are based on simple visual objects such as tables, graphs, plots, panels and maps – objects that contain their own semantics and do not metaphorically recreate the semantics of some other domain." (Nardi and Zamer 1993: 5). There are two different aspects of visual formalisms: "visual, because they are to be generated, comprehended, and communicated by humans; and formal because they are to be manipulated, maintained, and analyzed by computers." (Harel 1988: 528) The advantage of visual formalisms over metaphors is often accentuated by their potential to build up a new and defined semantic. Thus, the user does not have to deal with the semantics of two different domains as in the case of metaphor. In addition, a visual formalism can be used in different domains and therefore be familiar to the user. But the distinction between visual formalisms and metaphors don't seem to be clear as it is mentioned, because like the metaphors, the advantages of visual formalisms have limits, too. First of all, both the visual formalisms and metaphors imply prior knowledge. In cases where the user lacks this knowledge, none of the concepts works without further explanation. Secondly, there also seems to be a lower boundary of data complexity and quantity for visual formalisms. Metaphors have more advantages when dealing with simple data. For example a trashcan seems to work better than any example of visual formalism. Also tables and graphs may sometimes have problems in displaying large amounts of data.

As a result, it is evident that various tasks require various methods of conceptualizing the user interface. Considering the advantages and disadvantages mutually, the choice between metaphors and visual formalisms varies due to the specific situation and even within the same interface; both methods may be chosen to create the context of communication.

Conclusion

Though the domain of human-computer interaction develops very rapidly in the current digital era; metaphor still remains to be an indispensable part of the graphical user interface to communicate it with the users. In addition, the metaphors still play an important and critical role in helping the user to conceptualize and learn easier and faster. Metaphor still remains as a basic stage of design supplying the appropriate features of the system. Although the metaphor is a useful way of providing consistency and structure, sometimes the limitations of the metaphor itself might be restrictive. In these cases, rather than rejecting the metaphor totally, it seems better to apply for alternate and compatible solutions like visual formalism.

On the other hand, if the enormous sphere of information continues to grow exponentially, the metaphors used to describe it also seem to grow both in scale and complexity. In the coming future, the metaphor-based GUIs might probably work for creating various 'social' agoras in digital medium in which the people can meet and communicate. The future research themes will probably focus on complex and huge 3D interfaces of environments designed to represent communities rather than private workspaces based on individual use. Especially the spatial metaphors of original desktop have the potential to expand into environments to communicate the individuals from different locations.

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