



# Analysis on Dimensional Design and Its Application

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**Abstract.** Modern design methods include computer-aided design, optimization design, reliability design, etc., and are with solid theory foundation. Modern design methods can be applied to solve some practical problems encountered in projects, and can improve product design and quality, thus promoting design development.

With the rapid development of Internet technology, the whole process of design activities are added with new features in terms of expression, communication and spreading means, embodying the concept of modernism, while existing design system has been unable to meet the demands of the new era. The main purpose of this paper is to build a new design system to serve the world view of the Internet era by putting forward the concept of the Dimensional -Design, and analysing real cases.

**Keywords:** Dimensions · Dimensionality · Interaction · Carrier  
Technology · Dimensional design

## 1 Definition of Dimensions

### 1.1 Broad Definition of Dimensions

Dimensions refers to the multiple index of unknowns, commonly used to refer to dimensionality or independent spaces. Multiple exponents of unknowns is called dimensions, such as in mathematics the  $n$ -th power of a number can be called the  $n$ -th dimension of the number; or in physics, the meta-spaces can be called the meta-dimensions. So the dimensions refer not just to the number of squares in mathematics.

### 1.2 Dimensions Culture

ACGN originated in the mid-to-late 1990s and is an acronym for Animation, Comic, Game and Novel. Later the concept of Dimensions was introduced into ACGN works to refer to the fantasy world and the collection of other fantastic elements. For example, the world where magic or bullets exist is often referred to as “warp dimension world”, or simply “warp dimension.”

Cospa refers to the two-dimensional plane in ACGN culture. It is a term for imaginary worlds in Animation, Comic, Game and Novel (Fig. 1).

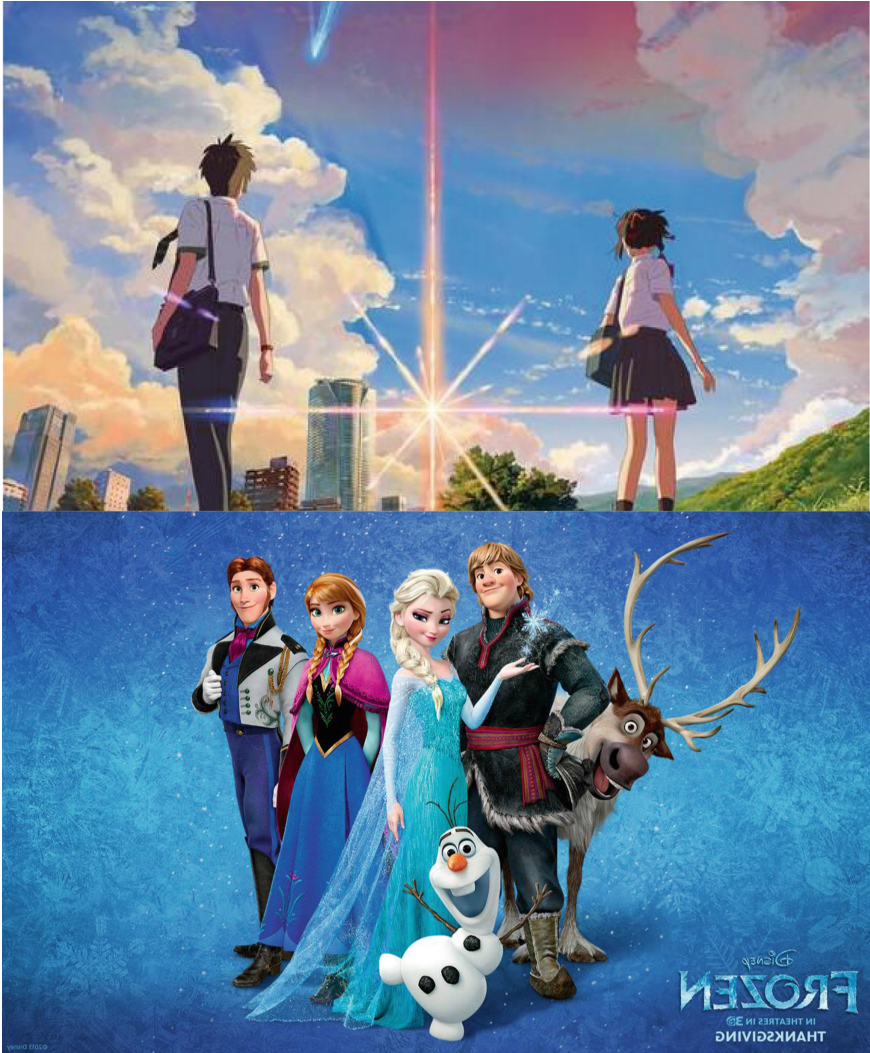


Fig. 1. Cospa comics works

The Three Dimensions is the dimensions where we exist, that is, the real world, including image or video works made from real-world people and things, such as live-action movies, TV dramas, and live-action photographs.

2.5-Dimensions refers to the collection of things “between cospa and three dimensions”. It is abstract and covers various elements which can mainly be categorized into two types: three dimensions elements shown by using cospa elements, such as games and animations; and cospa elements shown by using three dimensions elements, such as Garage Kits, Voice Actor, Cosplay, Doll Outfit, etc. (Figs. 2 and 3).



Fig. 2. Garage Kits

In summary, dimensions culture can be understood from the aspect of dimensionality: 1-dimension means straight line or linear space; cospa means planes; 3-dimensions menas real and three-dimensional spaces; and also some concepts such as 2.5-dimensions are extended from the above foundations.





Fig. 3. Cosplay

### 1.3 Application of Dimensional Design

Although there are other words to substitute “dimensions” in language, the word “dimensions” popularized since it’s widely used by certain groups. Dimensional concept in design area is referred to as Dimensional Design, which is a dimensionality concept but differs from that in dimensions culture or in the broad sense of dimensions.

We shall firstly come to a systematic understanding of the concept of “dimensionality”:

Dimensionality is the number of the abstract concepts of “connection” of things, so the premise of this concept is that everything is relative. The connections one thing has to others constitutes its changing dimensions. In mathematics, dimensions is the number of parameters needed to describe a mathematical object under certain conditions (Fig. 4).

a[0]
a[1]
a[2]
a[3]
a[4]

一维数组

a[0][0]	a[0][1]	a[0][2]	a[0][3]	a[0][4]
a[1][0]	a[1][1]	a[1][2]	a[1][3]	a[1][4]
a[2][0]	a[2][1]	a[2][2]	a[2][3]	a[2][4]
a[3][0]	a[3][1]	a[3][2]	a[3][3]	a[3][4]
a[4][0]	a[4][1]	a[4][2]	a[4][3]	a[4][4]

二维数组

Fig. 4.

The physical dimensionality is extended from the space concept: 0 dimension is a point with no length; 1 dimension is a line with only length; 2-dimensions is a plane with area formed by the length and width (or curve); 3-dimensions adds height to 2-dimensions and has volume. The dimensions in dimensions culture is closer to the physical dimensions in meaning (Fig. 5).

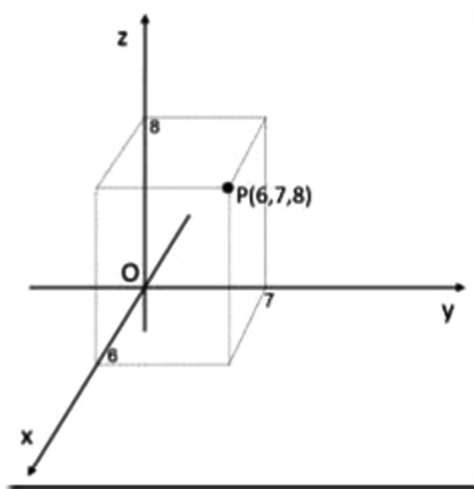


Fig. 5.

From a philosophical point of view, the way people observe, think, and describe things are known as the philosophical dimensions; for example, people may observe and think about the “design” thing from dimensions of “content, domain and method”, or from the “carrier, form and space” of design.

When we come back to the concept of dimensional design, from the philosophical point of view and by combining with the current situation and development of today's design industry, we can divide its dimensions into content, interaction, carrier and technical means. The "thinking point of view" that divide design by using current elements is dimensional design.

## 2 Concepts in Dimensional Design

### 2.1 Dimensionality of Dimensional Design

The dimensionality of dimensional design is the "thinking point of view" from which the design elements are divided. In the following I shall explain the dimensionality of dimensional design through the development process of the design industry.

Modern design can be broadly divided into visual design, art design and product design. Design of the poster, 3D model animation, product, etc. in the early stage concentrates on the physical content of the object itself, which is the physical dimension of design, or can be defined as one-dimensional design.

With the development of science and technology, the dimensionality of dimensional design continues to expand, and enters the multi-design era, no longer confined to physical contents. Taking game design as an example, the designers need to design interactive patterns in addition to physical contents such as scenes and characters in the game. Interactive patterns may be the type of games, such as fighting games or shooting games; or interactive means such as interacting through a handle or a touch screen. These are the man-machine interaction dimensions of dimensional design, which requires the common realization of the two dimensions of vision and interaction, and thus can also be called *cospa* design.

Game design also includes carrier design. For example, game machine used to be the carrier of electronic games, which was then substituted by computers and mobile terminals as the hardware technology developed. This is the carrier dimension of dimensional design.

In face of fierce competition, the game design process also applied a variety of technical means: from the early stand-alone games to Internet games; augmented reality games and virtual real-world games emerged as graphics technologies developed; big data is being used in increasingly more large games with the development of computing and storage technologies. This is the technical dimension of dimensional design.

### 2.2 Concepts of Dimensional Design

3D animation technology is the emerging technology with the development of computer hardware and software technologies. It is the use of 3D model animation software to create a virtual world. It is mainly used in the dimension of physical content design, with main applications of video animation, advertising effects, virtual simulation, etc. It's called one-dimensional design from the perspective of dimensional design (Fig. 6).



**Fig. 6.** 3D animation

Mobile internet is an emerging technology after the Internet and mobile communication technologies are developed independently and then merged together. Nowadays, the mobile Internet is stronger than the Internet of mobile products. The mobile Internet is mainly applied in the man-machine interaction or technology dimensions, with main applications of mobile APP, mobile payment, WAP, two-dimensional code, navigation, location services, etc.

The design of mobile Internet generally involves two cross modules of functional design and information design. Functional design is broken into user interface (UI), content design and interaction design. Information design covers databases, artificial intelligence and big data. Overall, however, the mobile Internet-based products are designed based on two dimensions of functionality and information, which is thus called *cospa* design (Fig. 7).



Fig. 7. VR equipment

Virtual Reality (VR) uses modern advanced technology with computer technology as its core to create a verisimilar virtual environment that integrates vision, sound and tactile sense. Users can interact with virtual objects through the necessary input and output devices, and get immersive experience. This kind of computer-generated virtual environment can be a representation of a particular objective world, or can be a purely fictional world (Fig. 8).

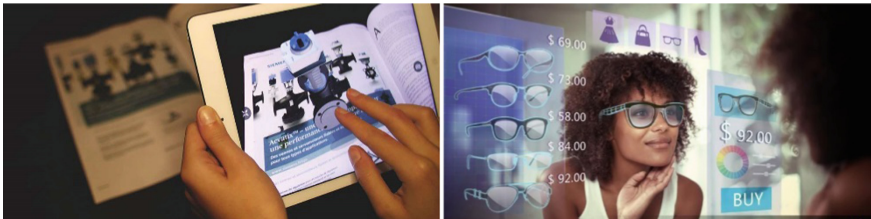


Fig. 8. AR application

Augmented Reality (AR) is also known as mixed reality. It uses computer technology to apply virtual information to the real world, where the real environment and virtual objects are superimposed and exist in real time on the same screen or in space. It is a real-time technology that not only shows the real world information, but also displays virtual information simultaneously. The two kinds of information complement each other. The goal of this technology is to set up a virtual world in the real world on the screen. AR is mainly used in the dimensions of man-machine interaction and technology, with main application areas of education, games, medical treatment, restoration of historic sites, cultural relics protection, advertising and so on.



VR and AR are mainly used in the dimensions of man-machine interaction and technology in dimensional design. VR content includes animation, video, artificial intelligence, databases and the Internet, and thus is called three-dimensional design (Fig. 9).



Fig. 9.

“Big Data” is a kind of information asset that needs new processing models to provide decision-making power, insight and process optimization capabilities to adapt to massive, high growth and diversified business. The key of big data technology is not to master the huge data information, but to process these data to make them meaningful. In other words, if big data is likened to an industry, then the key to making such an industry profitable is to increase the “processing power” of the data and “add value” to the data through “processing.” Big data is mainly used in the dimension of technology, with application areas of education, healthcare, military, e-commerce, etc. (Fig. 10).

AI (Artificial Intelligence) is a comprehensive system developed through the interpenetration of computer science, cybernetics, information theory, linguistics, neurophysiology, psychology, mathematics and philosophy; it’s a branch of science that tries to understand the underlying mechanisms of human intelligence and realize it on machines. Since ancient times, humans have had the idea of a smart machine that can assist or even surpass human beings to complete tasks that need to be done through self-thinking.

AI and big data are not only used in the dimensions of information, content and carrier design, but also in autonomous learning, data analysis, prediction and thinking, which is higher level of dimensional design.



Fig. 10.

### 2.3 Industry Application of Dimensional Design

As an important part of traditional Chinese culture, traditional Chinese medicine (TCM) is based on graphic and specimen samples, such as Compendium of Materia Medica. Chinese medicine literature and records have always relied on text, picture books graphics, physical models, herbs specimen, etc. With the development and application of digital media technologies, the forms of TCM are enriched, and multi-media forms such as video recording and sound recording have appeared. Important progress has been obtained in TCM industry design. With the continuous expansion of the dimensions of dimensional design, medical digital forms are also being enriched.

Our technical team developed a TCM digital platform during 2016–2017, which gives full play to the multidimensional design thinking in content, information, technology, big data and artificial intelligence.

In the project, we firstly designed (one-dimensional) graphics, sound and texts of Chinese medicine. Then we collected images and sorted out feature points through compilation of texts, two-dimensional scanning, picturing, camera shooting, etc. Then we selected typical herbs to build virtual digital models for them through 3D scanning, digital engraving, 3D modeling, sectional design, etc.

We also set up a TCM application software, which put user data and medicinal herb data on Internet through database, server and customer end. Thus two dimensional design of medicinal herbs introduction and physical features is completed.

We also applied AR and VR technologies on TCM to provide more intuitive and convenient interactive experience, breaking the constraints of traditional communication. In augmented reality and virtual space, multi-dimensional product experience is provided. In addition, we are trying to make machines learn to identify the characteristics of medicinal herbs through the analysis of big data, and finally being able to identify the authenticity of medicinal herbs to achieve a higher level of design and application.

Our technical team conducted comprehensive analysis after we got the topic and found out that identification of the herbs and their products was the greatest challenge for TCM application as well as for the system. With the rapid development of computer technology and three-dimensional image processing technology, people are expecting a tool that can effectively identify herbs for the purpose of both scientific research and daily life.

According to the concept of dimensional design, we need first of all design the physical contents of Chinese medicine. We collected literatures, pictures and materials of Chinese medicine and input them into the system to form a data base. Then we used 3-D model animation technology to generate virtual herbs on the computer or mobile terminal, so that customers can view the appearance and internal structure of the herbs. The growth process of the herbs can also be demonstrated through animation. All those graphics and animations are to provide data support for follow-up machine identification of Chinese herbs (Fig. 11).

With the support of data base, we need some interactive means to identify and display Chinese herbs. From the perspective of man-machine interaction in dimensional design, the traditional methods of planar and passive reading should be improved. In our system, users can view the appearance and internal structure of traditional Chinese herbs through mouse or touch screen, or learn the growing process of the herbs through animation display by clicking the hot spot area, or get more direct and convenient interactive experience through AR and VR technologies. In addition, the system's image recognition module can get images of the herbs through the mobile camera terminal to determine whether they are authentic (Fig. 12).

From the perspective of carrier of dimensional design, the system involves terminal carriers of computer, mobile terminal, AR/VR equipment, etc.; the 3-D identification system is carried on computers, which is divided into the client end (the 3-D identification and display system) and the management end (the management platform). The image recognition system is carried on mobile terminals, which owns big data and artificial intelligence as back-office support.

From the perspective of technology of dimensional design, the system involves technologies of big data, artificial intelligence and computer graphics and image technology. After the image system of herbs or herb products is established, the machine can learn by itself to improve its identification capability. The graphics system combines mobile Internet technology, big data, artificial intelligence technology, etc. to obtain ingredients and ratio of extract of each drug; which can help the system provide optimum mixture ratio according to specific physique condition of customers and drug content.



Fig. 11.

In addition, the AR and VR modules are also applied in the system. With AR technology, TCM knowledge is displayed in a stereoscopic way in augmented reality; the data base of which is obtained by scanning illustrations or pictures in Chinese medical textbooks by using mobile terminals. With VR technology, users can use wearable devices such as HTC Vive or VR helmet to experience the processing of Chinese herbal medicines through the handle.

The digital TCM system breaks the limitations of traditional methods such as plane and passive reading by using computer, mobile terminal and VR equipment as carriers, and adopting mobile Internet technology, 3D model animation technology, man-machine interaction technology, big data and artificial intelligence technology. It has played an important role in TCM application and laid solid foundation for the inheritance and popularization of TCM.



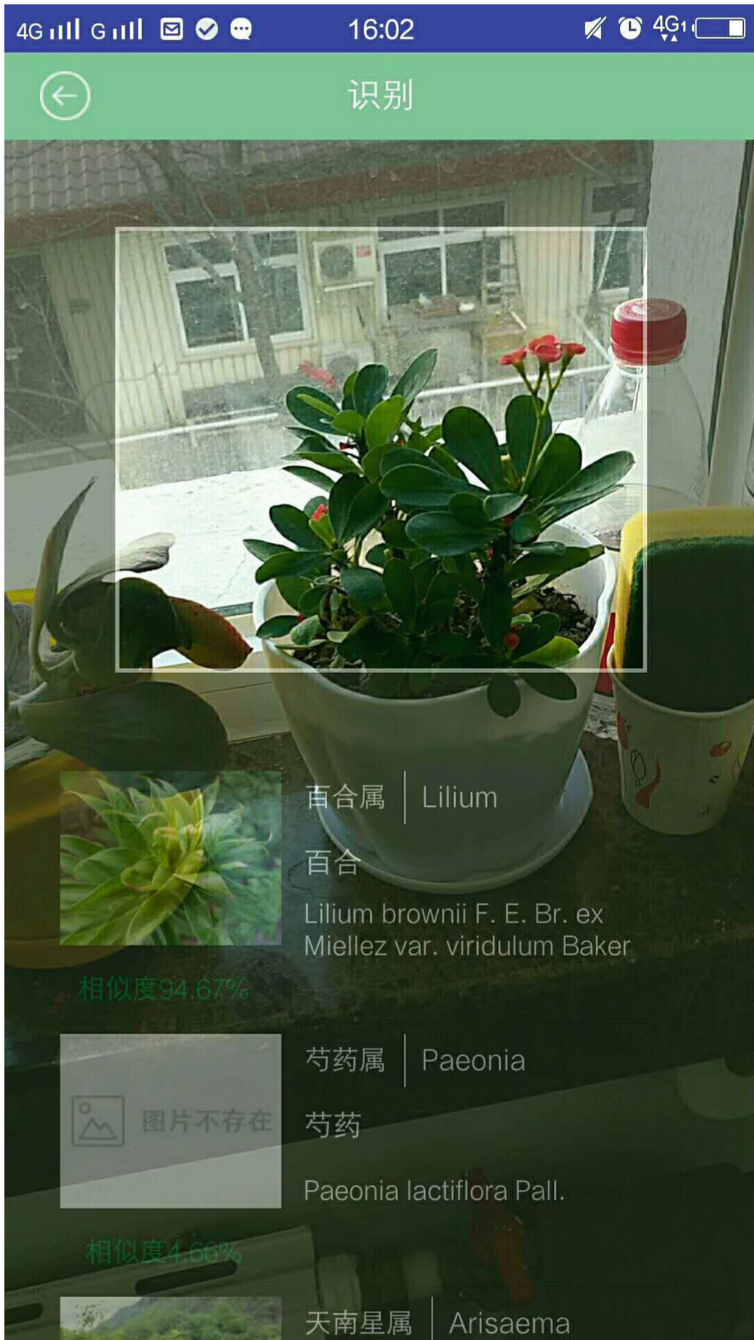


Fig. 12.

## 2.4 Meaning of Dimensional Design

The concept of dimensional design can be applied in various industries, to form a new multi-dimensional design system. Combined with the concept of “thinking angle” mentioned above, these new multi-dimensional conceptual designs are collectively referred to as dimensional design. The concept of dimensional design is a breakthrough in multi-design framework under the Internet environment and is an interpretation of design in terms of content, interaction, carrier and technical means.

With the development of new media technologies, more technical elements are being incorporated in dimensional design. The traditional design system is represented by technologies such as mobile Internet, AR, VR, man-machine interaction, big data and AI. The hardware and technical means are an important guarantee for dimensional design.

Future virtual world formed by Internet shall own complete system of world view, which is different from the physical world in terms of expression, communication and other aspects. A new design system is to be built to serve the online world view. In the future, the boundary between virtuality and reality will become increasingly vague, and dimensional design emerges as the times require. In the future, design will cover more dimensions and design languages will also be diversified. They will be more enriched in voice, audition, interaction, immersion and artificial intelligence.

Dimensional design, a parallel existence of traditional design, is a new mode of design thinking, and will no longer be subject to traditional constraints of discipline, tools, performance, industry, etc. It shall be broader, more diversified, intelligent and cross-dimensional.

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