1

Industrial Design

Editor：ZHANG Lufang

1.1 Introduction

When consumers face a wide variety of choices, they naturally tend to be attracted to those products that are well designed. But who can make changes in a product's design to make it work better or appear more pleasing? Industrial designers devote themselves to these goals. They are the people who design mass-produced products from cameras to cars, from phones to projectors, from computers to furniture and so on endlessly. They determine the way a product looks, feels, and how well it functions. Industrial designers develop the products you use every day.

A variety of methods exist to design products: from sketches to computer aided design software, from clay to foam molding, plus numerous other methods. The way to develop a product depends on the designer's vision for the end product and who will use it. By the time the product reaches the shelves of stores, it has been molded, sculpted, and re-worked many times by the designer.

Design is not just about how a product looks and feels. Design is concerned with how a product works. In today's world of proliferating information regarding economic change and technological innovation, the entire process of product development and marketing has become even more complex, and industrial design has become even more important. We sincerely hope that more and more designers can comprehend the true meaning of industrial design.

1.1.1 The Definition of Industrial Design

Industrial design is the profession that determines the form of a manufactured product. It includes two major concerns: the necessity to shape the product to suit the people who will use the product and the industrial processes necessary for the product's manufacture. Industrial designers work to make our lives more comfortable, pleasurable, and efficient. By studying people at work, at home, and in motion, they create products like office chairs that promote proper posture, kitchen tools that are comfortable for even elderly hands and toys that provide safe play and learning for all children. In particular, industrial designers pay special attention to the parts of a product that humans interact with, striving to provide universal access to products that are ecologically responsible and safe to use.

Industrial design is concerned with all aspects of machine-made products and their relationship to people and the environment. The designer is responsible for these products and their impact on society and nature. The designer is accountable for all the product's "human factors", which relate to engineering, safety, form, color, maintenance and cost. Industrial design deals with consumer products as well as industrial products.

Industrial design is a synthesis of the visual, emotional, functional and cultural. The representative definition of industrial design is as follow:

The International Council of Societies of Industrial Design (ICSID) revised its definition of industrial design at its 11th Annual Conference in Paris, 1980, as follows: it is called industrial design that, for the industrial products batch-manufactured, by training, technical knowledge, experience and visual feeling, the new quality and specification are given to material, structure, construction, shape, color, surface process and decoration.

Industrial designers generally devote themselves to the entire range of considerations necessary for the success of industrial products, or at least to several aspects of it. These concerns are: packaging, advertising, exhibiting, and market development. Industrial designers should contribute their technical knowledge, experience, and ability to visually assess to industrial design.

ICSID defines and illustrates the aims and tasks of industrial design as follows:

Aim Industrial design is a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services, and their systems in whole life cycles. Therefore, design is the central factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange.

Tasks Industrial design seeks to discover and assess structural, organizational, functional, expressive, and economic relationships, and tasks its profession with critical concerns:

(1) Enhancing global sustainability and environmental protection;

(2) Giving benefits and freedom to the entire human community, individual and collective;

(3) Considering final users, producers, and market protagonists;

(4) Supporting cultural diversity despite world globalization;

(5) Giving products, services, and systems forms that are expressive of and coherent with their proper complexity.

Industrial designers develop concepts and specifications through collection, analysis and synthesis of data guided by the special requirements of clients or manufacturers. They are trained to put forward clear and concise recommendations by means of drawings, models, and verbal descriptions. Both education and experience in anticipating psychological, physiological, and sociological factors, which might influence or be perceived by the target user, are essential qualities which industrial designers should cultivate. Industrial designers should also maintain a practical concern with regard to technical processes and requirements for manufacture, as well as marketing opportunities, economic constraints, distribution, and servicing processes.

1.1.2 Research Fields of Industrial Design

Traditionally, in terms of objects, industrial design covers four fields.

1.1.2.1 Product Design

Product design is concerned with the efficient and effective generation and development of ideas through a process that leads to new products.

Product designers conceptualize and evaluate ideas, making them tangible through products in a more systematic approach. Their role is to combine art, science, and technology to create tangible three-dimensional goods. This evolving role has been facilitated by digital tools that allow designers to communicate, visualize, and analyze ideas in a way that would have taken greater manpower in the past.

Product design is the main research area of industrial design, and an important activity that contributes to the creation of vast value for society. The purpose of product design is to develop new products and improve original products via various methodologies. Product design connects to human life closely and plays a vital role in current society. Previously, the common sense of product design was only concerned with the appearance of the product, but in recent years, with greater market competition and faster developing techniques, present product design has become more integrated innovative, aesthetics, and practical (Fig. 1.1). Therefore, enterprises have higher requirements for product designers. An excellent product designer should possess comprehensive talent. Product design, however, remains the main concern of industrial design.

Fig. 1.1 Product design

1.1.2.2 Visual Communication Design

Visual communication design is the expression of ideas and information through a visible medium such as texts or images. Visual communication, as the name suggests, is a means of communication through visual aids and may be described as the conveyance of ideas and information in forms that can be read or looked upon. Visual communication design is a conceptually based, problem solving practice, which embraces many sub-disciplines, combining word and image in an unlimited variety of media to communicate an immeasurable array of messages that are both cultural and industrial in nature.

In the past, it commonly involved: planar designs such as advertisement, presswork, texts, labels, printing, and dyeing. As modern digital techniques have been advancing rapidly, visual communication design in modern industrial design should include graphic design, illustration, and animation for books, print, magazines, screen based media, interactive web design, short films, advertising, promotion, corporate identity, packaging design, and more (Fig. 1.2).

Fig. 1.2 Web design

1.1.2.3 Environmental Design

Environmental design is the process of addressing surrounding environmental parameters when devising plans, programs, policies, buildings, or products. Classical prudent design may have always considered environmental factors. It includes: architecture, urban planning, landscape architecture, and interior design. Environmental design is tightly connected to visual communication design and product design since modern industrial design can be considered as a systematic design integrating human beings, machines, and the environment (Fig. 1.3). The three fields mentioned above are linked, permeable, and interdependent with each other.

Fig. 1.3 Public sign design

1.1.2.4 Interaction Design

Interaction design is the study of devices with which a user can interact, in particular computer users. The practice typically centers on "embedding information technology into the ambient social complexities of the physical world". It can also apply to other types of non-electronic products and services, and even organizations. Interaction design defines the behavior (the "interaction") of an artifact or system in response to its users. Interaction design is one of the key skills used in creating an interface through which information technology can be manipulated. As products and services are increasingly being depended upon for information technology, interaction design is likely to become the key design area of this century. It focuses on using an interactive tool in a particular context to help end users complete a task or achieve an objective (Fig. 1.4).

Fig. 1.4 Interactive website design

1.1.3 Features of Industrial Design

1.1.3.1 Epoch Feature

The progress of science and technology has been providing the world with new materials, new methods, and new technology day by day. At the same time, these innovations have contributed greatly to social development. The history of industrial design has been a history of continual development and application of new materials and techniques. The epoch feature of modern industrial design may be defined as the application of new materials and techniques, while also striving to discover and define needs of the human spirit in changing times. As the level of human life is enhanced materially, people have greater demands for shape, color, and style of products. Modern industrial design must follow societal changes and create products that reflect the features of every epoch. The following examples of Nokia demonstrate the evolution of the epoch feature of industrial design (Fig. 1.5).

Fig. 1.5 Nokia mobile phones in different phases

1.1.3.2 Creativity

Creativity is the observation and analysis of existing objects by human mind; it is also the exploration of new objects by using sharp imagination and divergent thinking; and creative thinking provides break through moments that enable the thinker to depart from general ideas and encounter new ideas or conceptions. Since competition in the world market has become more intense day by day, design without creativity does not possess life force and will be eliminated by the market (Fig. 1.6).

Fig. 1.6 Creative design

1.1.3.3 Market Economy

Industrial design is a product of the market economy and also a stimulating force that helps markets to flourish. It is a strategic commercial action and the necessary way for an enterprise to win in the world market. So industrial design must take the economic benefit obtained in the market as the start-point, along with the enhancement of productive capability as its fundamental purpose. Without economic profit, industrial design has no life force.

1.1.3.4 Combination of Science and Art

Industrial design requires the synthesis of science and technology in the design and manufacturing process so that products with powerful functions and modern aesthetics may be created and enjoyed by many people. Industrial designers must use both scientific techniques and personal art talents, and they must thoughtfully merge them together in order to design delightful and usable products (Fig. 1.7).

Fig. 1.7 A series of Apple products

1.1.3.5 Human-Machine-Environment System

While engineering design concerns generally design of mechanical functions, industrial design aims to design objects into a system that includes both humans and the environment. Machines are operated and controlled by human beings. Therefore, when designing machines, industrial designers should approach design from the point of view of the machine-user. The designer should analyze the environment in which the machines are to be run, so that the machine operator, the machine, and the environment may work within a coordinated system. Achieving such a system will increase the benefits of the machines productivity and efficiency. For example, when designing a bicycle, the designer should determine who will ride it (child, adult, or professional) and where it will be ridden (flat street or mountainous region). And finally, the design should be carried out after thoroughly analyzing the Human-Machine-Environment.

1.2 Design Fundamentals

1.2.1 Design and Art

1.2.1.1 Difference Between Art and Design

The relationship of art and design is convoluted but complementary. Artists and designers both create visual compositions using a shared knowledge, but their reasons for doing so are entirely different. Some designers consider themselves artists, but few artists consider themselves designers.

1. Good art is inspired. Good design is motivated

Purpose is perhaps the most fundamental difference between art and design. Artists create art to share feeling with others, to allow the viewers to relate to it, learn from images, or be inspired by it. By contrast, when a designer sets out to create a new object, he or she always has a fixed starting point, such as conveying a message, an image, an idea, or initiating an action out of which an object may be shaped. The designer's job is not to invent something new, but to solve an existing problem. Design or modification of design almost always seeks to motivate the audience to do something: buy a product, use a service, visit a location, or learn certain information.

2. Good art is interpreted. Good design is understood

Another difference between art and design is how the messages are interpreted by their respective audiences. Although an artist sets out to convey a viewpoint or emotion, it can be interpreted in different ways since art connects with people differently. Design is the very opposite. The fundamental purpose of design is to communicate a message and motivate the viewer to do something. If your design communicates a message other than the one you intended, and your viewer goes and does something based upon the unintended message, then the design has not met its requirement. Good art sends a different message to everyone. Good design sends the same message to everyone.

3. Good art is a taste. Good design is an opinion

Art is judged by opinion, and opinion is governed by taste. This goes back to our point about interpretation, but taste is more about people's particular likes and dislikes rather than the message they take away from a piece. Design has an element of taste, but the difference between good and bad design is largely a matter of opinion. A good design can still be successful without being your cup of tea. If it accomplishes its objective of being understood and succeeds in motivating people to do something, then whether it's good or not is a matter of opinion.

4. Good art is a talent. Good design is a skill

More often than not, an artist has natural ability. Of course, from a young age, the artist grows up drawing, painting, sculpting and developing his or her abilities. But the true value of an artist is in the talent they are born with. Good artists certainly have skills, but artistic skill without talent is worthless. Design is really a skill that is taught and learned. You do not have to be a great artist to be a great designer; you just have to be able to achieve the objectives of design.

Design and art are separated into two systems, but there are affinities between the two fields: one field may penetrate the other. The industrial designer should have the ability to discover beauty in art.

1.2.1.2 Aesthetic Principles

Here is a list of usefully aesthetic principles, which help in the creation or evaluation of design

1. Proportion and Scale

Proportion Any objective observation we make must include a discussion of proportion, for it is the rule of proportion in the examination of nature that causes us to observe an organized universe. Proportion involves the dimensional proportion between parts and also the sizes of surface areas in different colors. It should be no surprise that throughout history humans have used the concept of proportion found in nature as a golden rule, one based on ratio, to achieve balance, harmony, and beauty in the creation of product design (Fig. 1.8).

Scale Scale is the proportional relationships between parts of product and the human body, or proportional relationship between the entire product and the human body. Scale is not a fixed ratio; it is determined by every user's body size. The object of designing products is to serve people. Designers must consider how to "size products". To determine proper size of a product, designers consider the requirements of usage from the scale of the child to the adult in order to attain standards to measure products.

2. Unity and Variety: Definitions

Unity An element or the same morphological characteristics of the product appears several times in a consistent, quiet, and peaceful feeling. Product unity is reflected from the function and form, proportion and scale, linear style, color effects, and uniform texture.

Variety In the same object, differences may appear between the product's form elements or the same elements may be designed in another way to create a sense of diversity. Designers should strive to avoid inconsistency of form elements, which might create a sluggish, dull sense of design. Rather designers should aim to make the whole

Fig. 1.8 Proportion and scale

product exude a dynamic, lively, and attractive appearance. See examples in Fig. 1.9.

Fig. 1.9 Unity and variety

3. Symmetry and Balance

Symmetry Symmetry refers to the correspondence in size, shape, and relative position of elements in our product. The symmetrical shape of a product can enhance the psychological sense of security it imparts to the user, and this quality also makes people feel that function and form have achieved a coordinated aesthetic unity.

Balance The different parts that make up a product or the colors the designer designates to parts of the product should create a harmonious relationship in body mass. In product design, four key points help to obtain balance and symmetry: the balanced form of the product itself; the use of color to adjust either a light or heavy sense among the parts or the whole; the use of material to adjust the light and heavy sense; the use of decorative effects to balance the product. See examples in Fig. 1.10.

4. Rhythm and Cadence

Rhythm and cadence in industrial design duplicates properties found in nature and life. It manifests itself in movement of regular, periodic changes, and in repeated forms. It mirrors movements found in nature and all manifestations of life. The expressions of rhythm generally have four forms: continuous rhythm, gradient rhythm, staggered rhythm, and undulating rhythm. Products designed which mirror natural rhythm and cadence are quite wonderful, such as the products in Fig. 1.11.

Fig. 1.10 Symmetry and balance

Fig. 1.11 Rhythm and cadence

1.2.2 Engineering Fundamental

Many industrial designers emphasize product innovation, appearance, and artistic design, but they often overlook fundamentals of engineering. Industrial designers should have the ability to analyze and synthesize the multiple needs of marketing, sales, engineering, manufacturing, and servicing, and they must reconcile these needs with users in terms of satisfaction, value, and safety. So, they must have the fundamental knowledge of how things work and how things are made.

How things work How things work includes numerous fields: elementary engineering, basic mechanics, structures, electronics, elementary science, basic physics, chemistry, and elementary mathematics. Nowadays, consumers welcome a number of multi-functional products. For example, the BMW kid's bike (Fig. 1.12) can easily be converted into a regular children's bicycle by fitting the pedal unit and chain (which is supplied) and in no time, even young, small riders will be good to go. This model is a pushbike and bicycle, all in one, suitable for children from about 2.5 years (without pedals) up to 6 years of age (with pedals).

Fig. 1.12 BMW kid's bike

How things are made How things are made must survey the basic properties of materials, such as wood and wood composites, ferrous and non-ferrous metals, non-ferrous metals, thermoplastic and thermo set plastics and glass. With the further development of scientific research, many new materials are applied to industrial design and production. For example, The Beetle (Fig. 1.13) is an extremely thin, flexible keypad, with a beautiful multi-colored metallic effect, similar to a beetle's back. The range of colors can be determined using different metals, and the surface pattern of the UV Gel layer can be customized using various techniques.

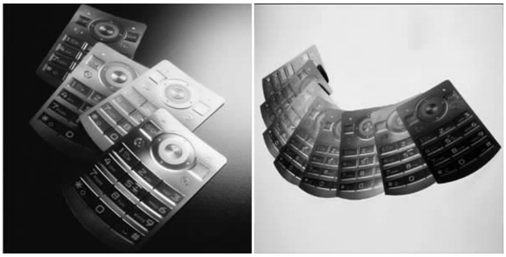

Fig. 1.13 Flexible keypad

1.2.3 Ergonomics

1.2.3.1 Definition

Why is the video recorder one of the most frustrating domestic items to operate? Why do some car seats leave you aching after a long journey? Why do some computer workstations confer eyestrain and muscle fatigue? Such human irritations and inconveniences are not inevitable. Ergonomics is an approach which puts human needs and capabilities at the focus of designing technological systems.

The International Ergonomics Association (IEA) gives the definition of ergonomics: ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

1.2.3.2 The Components of Ergonomics

1. Human System

Ergonomics aims to maximize harmony between humans, machines, and the environment in different working spaces (Fig. 1.14). Core areas of study relating to ergonomics are discussed below and shown in the figures. Familiarity with the human physiological system is necessary to conduct research on ergonomics.

2. Anthropometry

This is the branch of ergonomics that deals with body shape and size. People come in all shapes and sizes. So you need to take these physical characteristics into account whenever

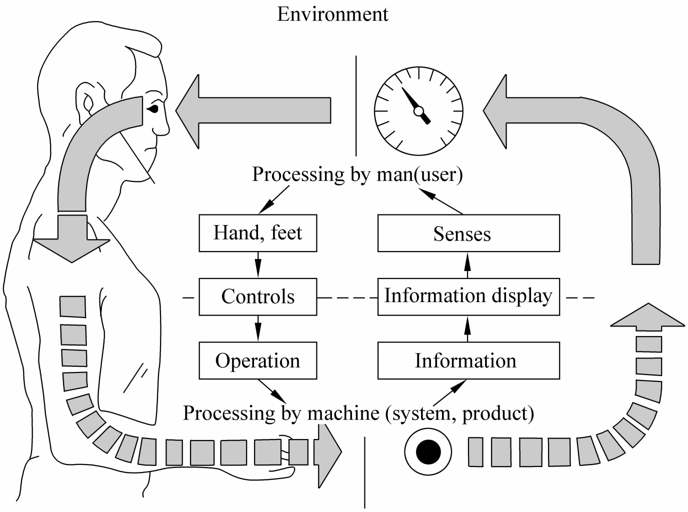

Fig. 1.14 Human-machine interaction

you design anything that someone will use—from something as simple as a pencil to something as complex as a car.

Percentiles are shown in anthropometry tables, and they tell you whether the measurement given in the tables relates to the "average" person, or someone who is above or below average in a certain dimension.

If you look at the heights of a group of adults, you'll probably notice that most of them look about the same height. This "same height" will be near the average and is shown in anthropometry tables as the fiftieth percentile, often written as "50th%". This means that it is the most likely height in a group of people. If we plotted a graph of the heights of our group of people, it would look similar to this (Fig. 1.15). Notice that the graph is symmetrical. So that 50% of people are of average height or taller and 50% are of average height or smaller. The graph tails off to either end, because fewer people are extremely tall or very short. To the left of the average, there is a point known as the 5th percentile, because 5% of the people are shorter than this particular height. The same

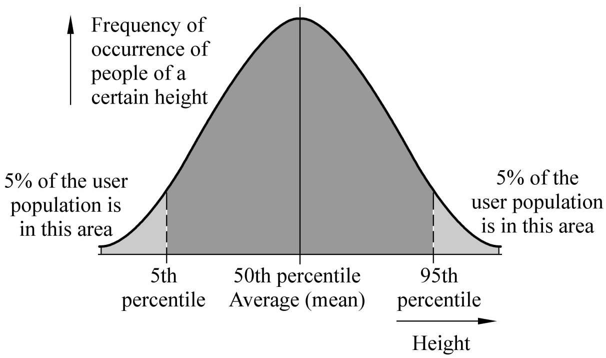

Fig. 1.15 Percentage

distance to the right is a point known as the 95th percentile, where only 1 person in 20 is taller than this height. For example, if we were designing a door, we would choose the dimension of people's height and pick the 95th percentile; if designing a chair, you would choose the sitting height and pick the 50th percentile. Deciding whether to use the 5th, 50th or 95th percentile value depends on what you are designing and who you are designing it for.

Table 1.1 shows the average Chinese adult body, including height, arm length, shoulder width (Fig. 1.16), etc. All measurements are in centimeters, except for body weights, which are in kilograms.

Table 1.1 Data of Chinese adult

	Man			Woman		
	Short (5th)	Average (50th)	Tall (95th)	Short (5th)	Average (50th)	Tall (95th)
1. Stature	158.3	167.8	177.5	148.4	157.0	165.9
2. Forward grip reach	50.5	55.0	59.6	45.5	49.7	53.6
3. Chest depth	18.6	21.2	24.5	17.0	19.9	23.9
4. Eye height	147.4	156.8	166.4	137.1	145.4	154.1
5. Shoulder height	128.1	136.7	145.5	119.5	127.1	135.0
6. Elbow height	95.4	102.4	109.6	89.9	96.0	102.3
7. Knuckle height	68.0	74.1	80.1	65.0	70.4	75.7
8. Sitting height	85.8	90.8	95.8	80.9	85.5	90.1
9. Sitting eye height	74.9	79.8	84.7	69.5	73.9	78.3
10. Sitting elbow height	22.8	26.3	29.8	21.5	25.1	28.4
11. Popliteal height	38.3	41.3	44.8	34.2	38.2	40.5
12. Buttock-popliteal length	42.1	45.7	49.4	40.1	43.3	46.9
13. Buttock-knee length	51.5	55.4	59.5	49.5	52.9	57.0
Body weight	48	59	75	42	52	66

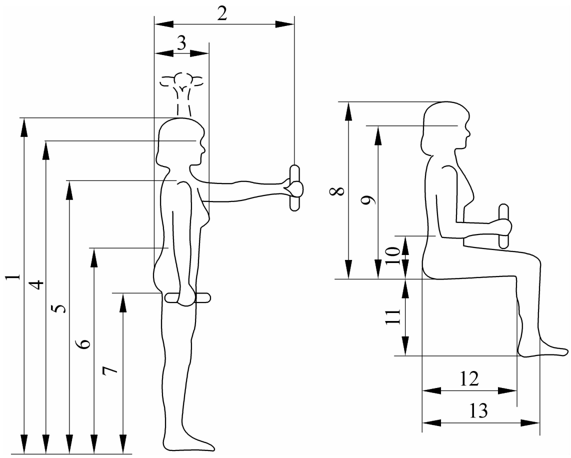

Fig. 1.16 Human size

(See Table 1.1 for the meaning of 1,2,3,…,13)

3. Posture

Posture is often imposed by the task or the workplace. We have many postures in everyday activities such as sitting in office chairs, looking at the computer, driving, standing for long periods of time, or even sleeping.

The select characteristic of a job determines the best basic posture: sitting, standing, or a variety of different workstations with different options for human posture. Figure 1.17 provides a selection procedure for the best basic posture.

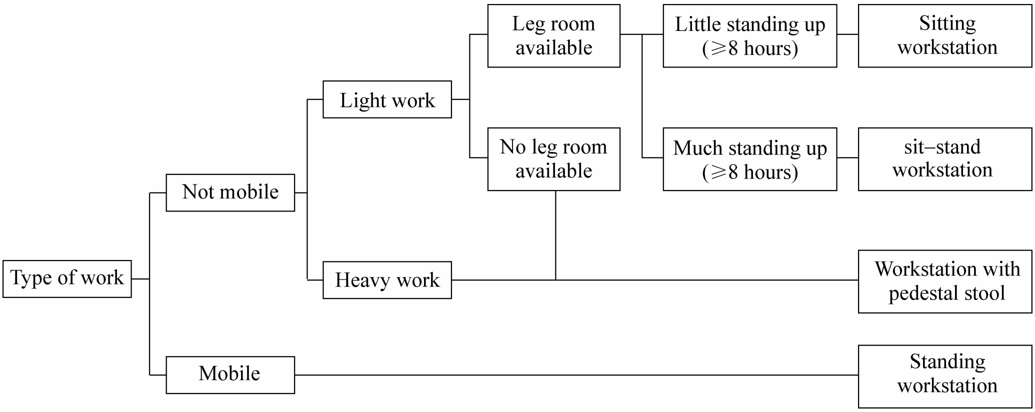

Fig. 1.17 A selection procedure for the best basic posture

1) **Sitting and standing**

Working for long periods in a seated position occurs mostly in offices, but also occurs in industry, such as assembly and packaging work, and sometimes for machine operation. Creating a good ergonomic working arrangement is important to protecting a person's health. The ergonomist gives the reference about where and how to position your keyboard, monitor, and office chair so you can work, read, and type comfortably and safely (Fig. 1.18)①. In general, the maximum work area is the area within comfortable reach of your extended arm, while the normal work area is within the limits of a comfortable sweeping movement of your arm, with your elbow bent at a right angle or less (Fig. 1.19).

Activities where considerable force has to be exerted or where the work place has to be frequently changed should be carried out in a standing position.

2) **Operating**

When using hand-held tools, the wrist should be kept as straight as possible. Do not bend the wrist, rather use curved tools instead. Bending the wrist can be prevented by correctly locating the handgrips on the tool (Fig. 1.20).

① 1′=1 ft=0.3048 m; 1″=1 in=25.4 mm

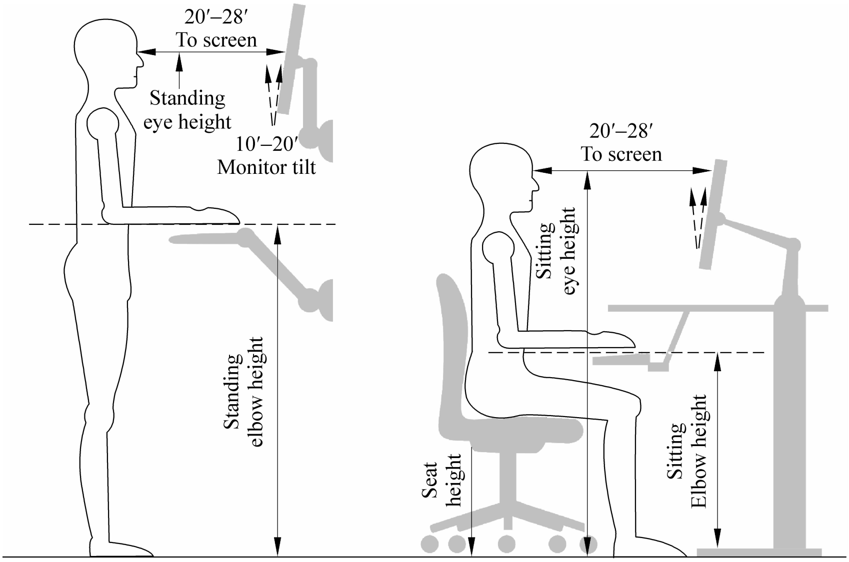

Fig. 1.18 The dimension of sitting and standing for people using computer

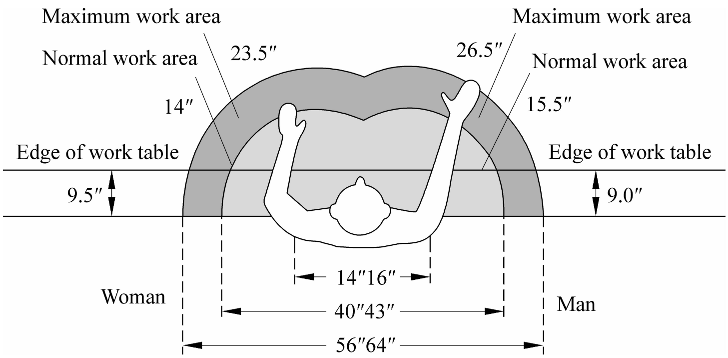

Fig. 1.19 The work area of hand when people sitting

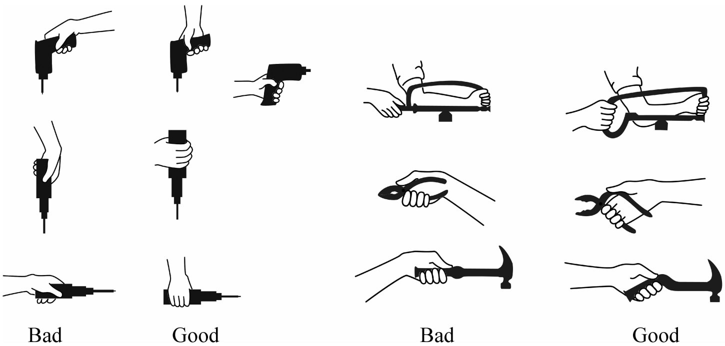

Fig. 1.20 Bad versus good operating

4. Display

1) **Visibility**

Color Although the eye can distinguish between a large numbers of colors, it is advisable to use only the following five colors for color discrimination of controls: red, orange, yellow, green and blue. Five points should be kept in mind:

(1) The difference with respect to the background color and the contrast;

(2) The association which people make with some colors, such as red for danger or green for safe;

(3) Reduced color discrimination (color blindness);

(4) The color and lighting of the surroundings;

(5) The strong attraction of color.

Contrast Good contrast contributes to legibility. Whether characters are legible or not depends on contrast, that is, the difference in brightness between the text and the background. Contrast has an even greater influence on legibility than lighting. Some examples are illustrated in Fig. 1.21.

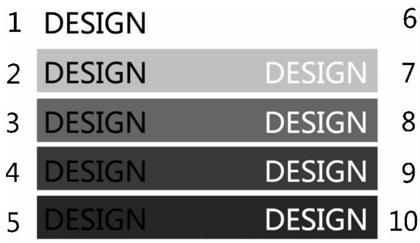

Fig. 1.21 1 and 10 are the most legible

2) **Comprehension**

Diagrams Diagrams should be used to support text or as a substitute for text. The use of diagrams has become even more attractive now that computer programs are available for helping those who are not skilled enough to draw diagrams. However, the number of options offered by the computer is, in fact, so large that users with little graphical knowledge may well produce diagrams which are incomprehensible. Diagrams should be such that they can be understood by everyone, and captions should be legible. The correct letter size will enhance legibility. This often requires reducing the amount of text, and therefore the user is encouraged to dispense with all irrelevant information (Fig. 1.22). Here are a few guidelines:

(1) Titles and captions should not consist entirely of capitals (Fig. 1.23);

(2) Abbreviations must make sense: do not allow the computer to truncate words at random;

(3) Different types of shading must be easy to distinguish from each other;

(4) Optical vibration caused by more patterns must be avoided;

(5) The scale should match the units being used;

(6) The subdivision of the scale must be sensible.

Fig. 1.22 Characters without much ornamentation are the most legible

Fig. 1.23 Text consisting entirely of capital letters is not legible

Pictograms or icons In principle, symbols are not bound to a particular language. It seems to be a good idea to replace written signs by symbols such as pictograms or icons, in public places where many people with different languages come together. However, many of these pictograms are, in actual fact, poorly understood. Here are a few guidelines that help to avoid confusion:

(1) Bear in mind cultural differences, a picture of a knife and fork can mean a simple snack bar in one country but a luxury restaurant in another.

(2) People should have a simple mental image of what is meant to be represented by the pictogram (Fig. 1.24). In many people's minds a door can represent either an entrance or an exit; it is therefore difficult to represent these concepts by two different pictograms.

(3) More stylized pictograms, further removed from reality, are less well understood.

(4) Use only pictograms which represent a single concept, not a combination of concepts.

Fig. 1.24 Icons for a remote control

1.2.3.3 The principles of ergonomics

1. Decide for whom you are designing

Anthropometry tables provide measurements of different body parts for men and women, from babies to the elderly, and data is presented by nationalities and age groups. So first of all, you need to know exactly who you are designing for. The group of people you are designing for is called the user population.

2. Decide which body measurements are relevant

You need to know which parts of the body are relevant to your design. For example, if you were designing a mobile phone, you would need to consider the width and length of the hand, the size of the fingers, as well as grip diameter. You wouldn't be concerned much about the height or weight of the user.

3. Decide whether you are designing for the "average" or extremes

The variation in the size and shape of people also tells us that if you design to suit yourself, it will only be suitable for people who are the same size and shape as you, and you might "design out" everyone else.

4. Think about other human factors

You may need to add corrections for the clothing that people wear. Have you considered shoe heights in your design? You generally add 20 mm for fairly flat shoes, and more if you think users will be wearing high heels. If your product is to be used somewhere cold, can it still be used if someone is wearing gloves or other bulky clothing? For example, if you were designing tools for changing car wheels, it's more than likely that they would be used in cold and wet weather. People need to grip harder if their hands are wet and cold, and they need to exert more force to carry out tasks than they would if they were warm and dry. You may also need to consider people's eyesight and hearing abilities. Can they read the small labels on the remote control that you've designed? Is there enough light to read by them? Can they hear an alarm bell above the general noise in the room?

1.2.4 Expression of Design

Designers can't design anything without having conceptual notions and visual notation methods. If a good design idea only stays in the designer's brain and is not translated into the material world, the notion remains useless. Thus the process called design expression is of critical importance.

In product design, the clear expression of conceptual thinking and innovative approaches in a manner that is accurate, rapid, appropriate, and expressed in multi-dimensional visual form is of utmost importance. Keeping these criteria in mind can help the designer to get inspiration, transmit design creatively, and carry out design communication. Soon others will be able to understand and identify the designer's ideas. They will be able to offer feedback to the designer or designing team or be able to offer some kind of judgment about the design. This is one important aspect of the entire design process.

1.2.4.1 Sketch

Sketch is the basis of design work. A good concept may disappear in an instant if the designer can't express it at once. Sketch is a swift way to record this flash of inspiration for later use (Fig. 1.25). An excellent design always starts from rough sketches. By practicing sketching, we can cultivate and enhance abilities of observation and perception of visual space and shape.

Usually, designers need to be able to sketch in order to communicate with other designers or customers. Excellent sketching ability is an asset. Designers who need to

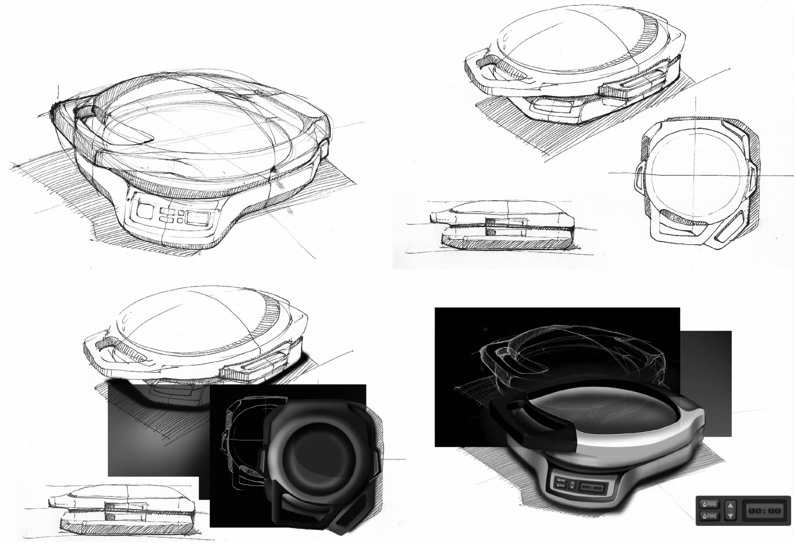

Fig. 1.25 Sketches of electric baking pan

sketch should have training that imparts knowledge on perspective theory, accurate form, colors, light, shadow, and material performance. Sketching also emphasizes cultivation of the ability to express characteristics vividly and clearly.

With the development of computer technology, computer sketching has been developed to satisfy the needs of the times. It is an effective way to make up the gap between the traditional computer aided design (CAD) system and industrial design. Computer-based design software and hardware has typically been tailored towards producing sharp, precise drawings and images.

1.2.4.2 2D rendering

Rendering is the process of creating the actual 2D image (Fig. 1.26). Design is a detailed work. Rendering can express the designer's innovations accurately, represent the complete shape, structure, and color. Rendering can also enhance the understanding between designer and viewer. Without the right expression we can't judge and communication correctly.

Advances in computer science may serve to illustrate changes that have taken place in

Fig. 1.26 2D renderings

the design field. Hand-drawn sketches can no longer meet current design and production needs. Computer-based 2D and 3D digital image production has brought limitless vitality to industrial design. Nowadays, 2D graphics are very important in design process. Some software is often used to create 2D rendering. Adobe Photoshop, CorelDraw, and Adobe Illustrator are used very common.

Adobe Photoshop is a graphics editing program developed and published by Adobe Systems. It is the current market leader for commercial bitmap and image manipulation software. It has been described as "an industry standard for graphics professionals".

Adobe Illustrator is a vector graphics editor developed and marketed by Adobe Systems.

CorelDraw is a vector based program, similar to Adobe Illustrator. At present, many people use it to produce 2D renderings.

In the era of computer graphics, although CAD can improve efficiency and enhance effectiveness, it is impossible to replace the hand-drawn sketch. The hand-drawn sketch has always the quickest and most effective way to records inspiration.

1.2.4.3 3D rendering

Once a program is selected, the details of the design are further explored. This includes colors, materials, the rationality of the interface and size, and engineering. 3D rendering is the process in which the 3D software on computer automatically converts 3D frame models into 2D images (Fig. 1.27). Through 3D computer software and rendering technology, 3D rendering is able to deliver the appearance of a product from different angles in order to reflect the creativity and artistic design concept.

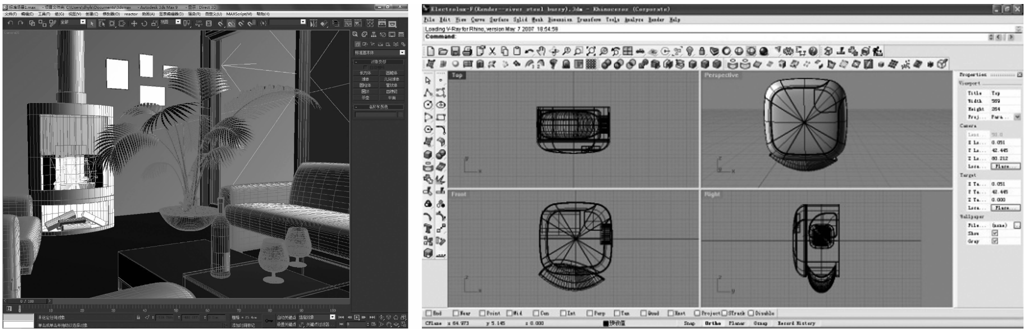

Fig. 1.27 3D renderings

Rendering can reach the veritable effect of products by the expression of shape, color, and texture. The most important meaning of conveying correct information is to make people know the features of new products and their visual effect in certain environments.

Many kinds of software can be used to achieve 3D design, such as Autodesk 3ds Max, Rhinoceros 3D, Solid Works, Pro/ENGINEER, and so on.

Autodesk 3ds Max software provides powerful, integrated 3D modeling, animation, rendering, and compositing tools that enable artists and designers to more quickly ramp up