

<http://ansinet.com/itj>

ITJ

ISSN 1812-5638

INFORMATION TECHNOLOGY JOURNAL

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Research on Humanized Design of Computer-aided Machinery and Tools Products

Xia Zhi-Liang

Wenzhou Vocational and Technical College, Wenzhou. 325011, China

Abstract: Systematic exposition about Research on humanized design of Machinery and tools products, studies on Color analysis, Ergonomics, Tools products Aesthetics made design idea “people oriented” get fully reflected, we give “tool products” physical and emotional humanized concern by Machinery and tools products handle method and comfort performance, which made Machinery tools products enjoyment and pleasant and clarified the direction of machinery tools products’ development in future.

Key words: Humanized design, human-machine surface, ergonomics, molding aesthetic

INTRODUCTION

China is an agricultural country with plenty of agricultural resources, middle and small model agricultural machinery products has been Indispensable tools in agriculture, because of highly seasonal demand means machinery tools products can seed and rush-harvest in time no matter what weather it is, most agricultural tools products can meet these demands currently, but after satisfied the basic function, more and more people started to care color, model and humanized design. modern agricultural tools products in novelty appearance, comfort inside layout, beautiful lines and exquisite details and when using we can get physical and emotional relax help us get away from dull and dry work and load on mind, this advanced work efficiency and reduced accident by wrong handle.

With the development of computer technology especially computer-aided design technology (CAD/CAE/CAM), virtual reality technology and high performance graphics technology’s breakthrough (Gilboa *et al.*, 2006). Ergonomic is a technology which grow up from theoretical formula calculation, empirical data accumulation, simple application calculation to ergonomics design technology computer-aided. CATIA V6 provided various efficient ergonomics analysis tools and methods, that can comprehensively analyses all factors in the process of man-machine interaction and supply ergonomics design detailed solution for designers.

Color analysis: In considering the application of machinery tools products in countryside or farm, according to different education level consumers groups’ physical characters have different color interests, high level education consumer often like delicate, quiet color to equal the stimulation from too much information, the low education people live in peaceful condition receive less

information like fresh color especially ethnic minorities, so on the basis of division of different regions, high level education agricultural zone adopt light color series, but low level education zone or ethnic minorities adopt high lightness, fresh color to meet their need, the overall design flow chart of production color optimization method as Fig. 1 shows (Ye and Li, 2012).

Past machinery tools products mainly use gray or green, the hue tend to dark even without color, give person the feeling that old texture or lifeless, modern machinery agricultural tools products with elegantly appearance, neutral tones, proper function and color that content the work environment and aesthetic requirement.

In the process of color design, we should use rule of lightness, secondary color to match color, such as if machinery tools products’ main color is yellow (K point 10), to mix it we can choice background color which K point beyond 65, for example blue green tone, blue purple tone and mixture color with lower lightness. To guarantee it’s information can be identified clearly (Jayarami *et al.*, 2006).

If we take the main color hue as point 0, the adjacent hue in the hue ring extends to both sides in degrees value as number assemble from +180 to -180. It’s identification background color range rule as Fig. 2 shows.

We can see from picture 1, yellow has the most obvious contrast quality, the strong contrast of hue ring number it compared with other hues is 180, identification number is 120, weak identification number is 40. That’s to say half color in hue ring can bring sharp contrast with yellow, only 11 percent colors hard to identify because of near the yellow; contrast effort between orange and yellow is weak, the strong range point is 70, identification number is 180, weak identification is 110. Strong contrast range point between red and yellow is 60, identification number is 200, weak identification is 60; the blue’s corresponding number is 60, 240, 60; purple’s

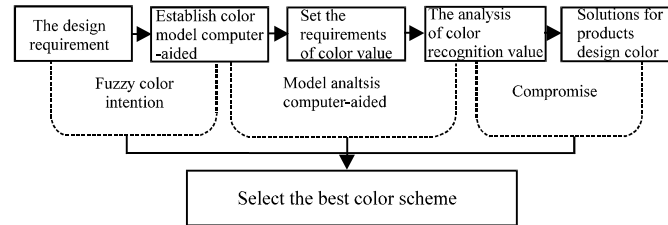


Fig. 1: Overall design flow chart of production color optimization method

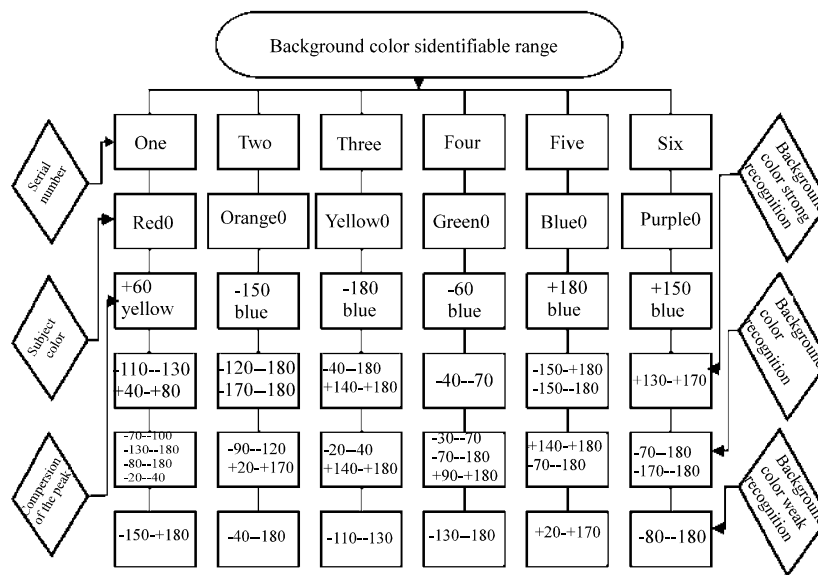


Fig. 2: Color contrast relationship between primary color and secondary color

corresponding number is 40, 200, 120; the blue which produce least contrast with other colors it's corresponding number is 30, 210, 120. According to these statistics, we can draw a conclusion that yellow has a larger identification than other colors, although blue has less strong identification range than orange, it's weak identification range far less than orange, so it has a stronger contrastive than orange (Liu, 2007). The root reason is the point of yellow and blue are close to both ends of black-white-gray color vitta.

By improve the uncertain problems encountered in the stage of product color design, when demander can't give accurate color image expectations, it can help designer quickly find product color solution meet the demander target color image in the limited range and used as reference for the designers. At last, verify the feasibility of color analysis and method by agricultural product's color design examples.

Conditional reasons analysis: Agricultural products should take something into consideration what are the

farmers avoided, such as add a trailer at the back to highlight the idea of "Having no male heir is the gravest of the three cardinal offences against filial piety"

Black and white usually used in car industry but represents ominous in countryside, so we should adjust these two colors in using light and dark tone.

Human-machine engineering analysis: When using Agricultural products in the process of field operation, as the noise, shaking, oil pollution, bad operation climate and environment. Operators' bodies begin to fall and easy to produce stress and fotigue after long time work, which lead to low production efficiency even cause accidents. In order to reduce accidents, first agricultural products' handling behavior such as: Using, repairing and inspection have to match the operators' physiological and psychological characteristics. In the design preliminary stage we must get a full acquaintance of agricultural products' application range and suitable operation size range for our body parts, be familiar with relative anthropometric data and using condition. For example the

most common unsafe problems steering and connection aspects in hand tractor, rotary cultivator, micro tillage machine and scarifier, so we often see some operators can not complete work steering and operational requirements even with two arms when doing a wide margin body retortion, for their low height (Renke, 2000). The cockpit seat position, the observation window size, the operating rod size, the repair space form, all these factors are according to human body's size must meet the result of characters analysis for human's psychological and physiological and suitable activities data range.

The structure, size, shape, material, quality of agricultural tool's every part can influence the controllability, flexibility, stability and comfort index when human using and all design data must in the light of users' body data. For better solution of "human-machine-environment" when designing product, tools offered by computer-aided design software include: Human body model generation, gender height percentage definition, ergonomics product generation, ergonomics control technology, motion generation and advanced visual simulation. First put forward human-machine design and analysis solution in computer-aided software (Table 1).

As the mechanical structure, power device, operation control are relatively complex which made the operation control surface full of different buttons, pull rods and instruments, the control surface with complex disorder, different sizes and foreign languages lead to inconvenience use and cognitive obstacles, if the operators handle machine on the basis of experience, ignore safety operation procedures or requirements, easy to cause sudden accident. Scientific and reasonable operation interface not only simple and clear, easy to understand, the use instructions have a strong guide improve the operation efficiency, guarantee the safety of handling and machine operation. The interface is the main surface for operator and instrument's connection, the position of interface visual angle, display effect and buttons; size and arrangement for the operation lever on the stage have an important influence on if it reasonable, comfortable, efficiency and no cognitive impairment when the operators observe and using (Zheng *et al.*, 2001). For there are various agricultural products kinds, we can't explain each one, but their basic principle is; the interface design should in the light of the information easy to accept, to ensure operators get messages quickly and correctly.

When handling big model agricultural tools keep a seated position over a long period against body health and long time work is easy to make operator feel intensity and tired, it reduced produce efficiency, so we better adopt the design idea "sitting and standing" alternate as Fig. 3 shows.



Fig. 3: "Sitting and standing" alternate design

Table 1: Computer-aided human-machine analysis
Computer-aided ergonomic analysis

Human body data measure	Establishment of virtual products	Work posture simulation	User evaluation
Trunk	Seat	Sitting posture	Comfort
Bone	Controller	Standing	Visibility
Head	Agricultural tool	Sitting standing interaction	Interactive
Neck	Environment	Walking	Environmental quality

How to decide the size of hand wheel of manipulator and crank has a close connection with it's using method and purpose. As Fig. 4 shows the appropriate rotation radius and handling grasp part size under different conditions. Reasonable surface make products beautiful and easy to handle, that pleasant operator and raise working efficiency.

Human-machine data: To ensure the data scientific accuracy, the body data's measured under the situation that the testee without shoes, closes or less closes, the result different from common use state the data measured should be corrected, that's mean product's design data is the original data with the heel height and clothing thickness. In addition, different clothing thickness in different seasons, so the correction values are different. For the fitness machine using environment and method if fixed, so the clothes correction value also be determined (Zhang, 2011). We can adjust human body size based on fitness equipment service space make the correction value project based on various thickness clothes.

In order to design tools equipments fit for human's physical and emotional characters, help operator in comfort condition when working. It demands designers for agricultural tools products must fully understand scope of application and human body size in the preliminary products design process and be familiar with human body measure data property and using condition.

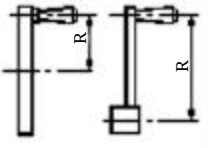
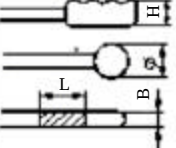
Rockinghandle	Application characteristi	Advise R point t (mm)	Controller	Type	Advise size (mm)
	Turn multi circles	20-51		Normal	20-51 (more than 75)
	Turn round quickly	28-32		Ball	30-32
	Adjust pointer to a Position	60-65		Flat	B more than 5
	Follow-up control	51-76			

Fig. 4: Reasonable size of handling grasp part and appropriate rotation radius

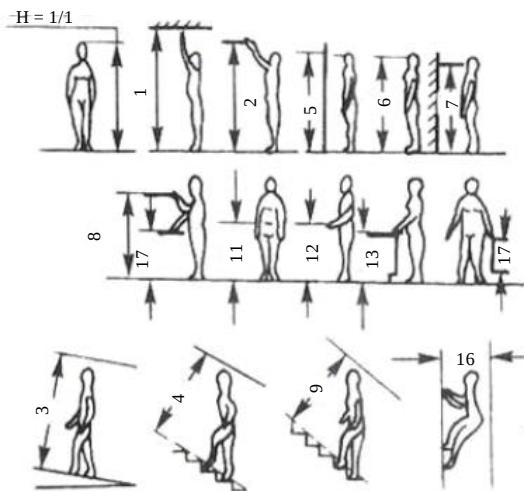


Fig. 5: Equipment picture of human height standing posture

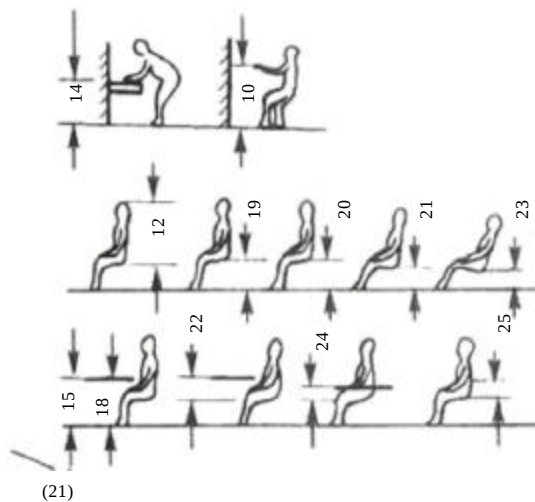


Fig. 6: Equipment picture of human height sitting posture

such as driving position and size of observation window, shape and size of the handle, form and size of repair space in loader, scraper. In the design we should put equipment operating organization concentrate on human's main handle position, the direction should also be consistent with most habits of operators, that's make operator's motion safety and effect as Fig. 5 shows.

The feet with supported is an important part to keep health sitting posture. Hold back S position is better to support body weight than humpback position, the human stability derive from feet. Feet must be lay on the floor or placed in a strong feet stool don't be dangled. The most comfortable knee bends from 85 to 110°C (Fig. 6).

Equipment size based on human height, we can make a statistical analysis of measure data according to the probability and mathematical statistics theory and obtain the user size, statistical rule and characteristic parameters (Fig. 7).

Human-machine interactive analysis

Products semantics principle: As education degree in countryside is slow, they can't receive too much word information, when design the agricultural tools products' button and handle use graphic symbols or thumbnail, simplified graph, arrow in instruction can give consumers prompts, this method is practical for unfamiliar consumer or operator, besides current standard guide design we also need to perfect agricultural tools identification system, build a guiding system design code library based on Chinese characteristic cultural background, at the same time develop other assistant method to help operator master the using method of every button quickly.

Human-machine interface doesn't mean simple equipments and tools or analyses human's psychological characteristic simply. The surface is the most important part to form the system. A good surface can improve agricultural tool's efficiency and the user experience extremely. But because of complex design environment and object-oriented lead to design evaluation standard

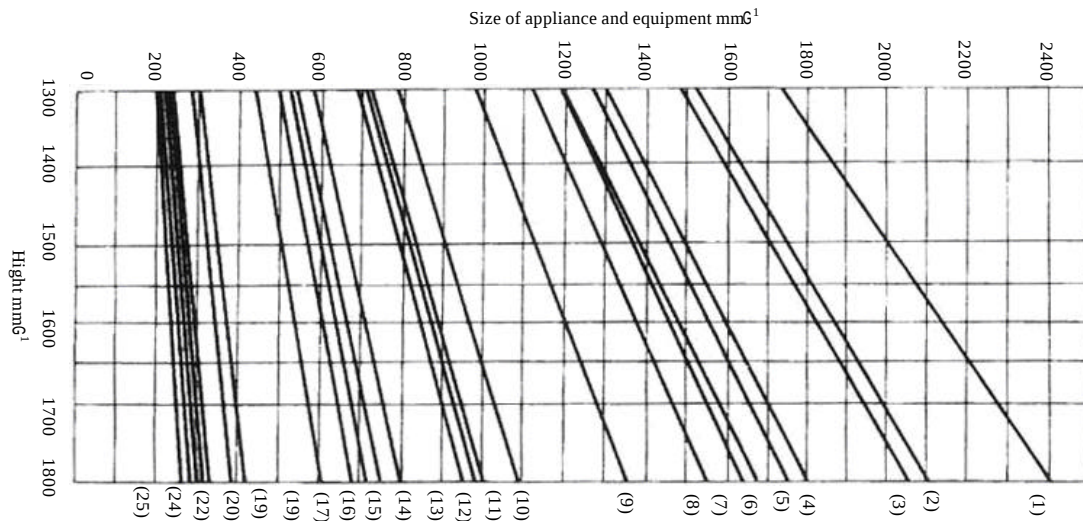


Fig. 7: Tool size picture based on human height

difficult in the practical application, agricultural tools controller surface visual factors need corresponding display in various environments.

Consistent principle: Consistent principle means keep four categories coordination, function, emotion, environment, sound effect can't stand alone. The surface of electrical information product should keep agreement: from color to tensity, even in order to highlight one side by contrast a united style is important. The factors included in design surface are widely, but we must take them as a whole which indivisible, the result is the materialized form, but the form represents the times, national aspects of consciousness, reflect human's aesthetic psychological activity eventually.

Usability principle: To guarantee consumers using the agricultural tools products easily, every design should has a qualitative and quantitative analysis, which is combination of rational and emotional thoughts. Trying to reduce emotional factors, the man-machine interface usability is the most basic humanization design goal. In order to reflect the usability, the interface have some features such as: Easy to use, the using term in interface should be standardization and uniformity, with helping function, fast response system and lower system cost, stronger fault-tolerant ability. Design should not repeat word for word what others say and should not take it for granted, foundation of design is correct, systemic fact and data, with closely theoretical analysis can convince people by reason, touch people by emotion.

CONCLUSION

Based on computer-aided agricultural tool product design research, mainly apply ergonomics model in application computer-aided to analyses whether agricultural tool meet the requirements of ergonomics and whether product design and operational requirements reasonable to complete product's optimization design. Experiment shows human's whole body and various postures can be repeated inspection and analysis comprehensively system, to assess the user's comfort degree reflected when using and compare with published the comfort data in the database.

"People-oriented" and "simple but not easy modern design idea" has been mainstream design oriented idea in the new century, especially in the machine tools product appearance, interior design direction, "the main design factor-human" and "human, machine and environment live in harmony" rule has been the main way of thinking during design good product in the new era, humanity is the requirements of design in the new century and mainstream in market, realize humanity care to this group who use machinery agricultural tools products.

ACKNOWLEDGMENT

Fund program: 2012 Teacher's professional development project of visiting scholars in institutions of higher education (FX2012125).

REFERENCES

- Gilboa, G., N. Sochen and Y.Y. Zeevi, 2006. Variational denoising of partly textured images by spatially varying constraints. *IEEE Trans. Image Process.*, 15: 2281-2289.
- Jayaram, U., S. Jayaram, I. Shaikh, Y.J. Kim and C. Palmer, 2006. Introducing quantitative analysis methods into virtual environments for real-time and continuous ergonomic evaluations. *Comput. Ind.*, 57: 283-296.
- Liu, C.P., 2007. Using VBA to design curved surface based on CATIA software. *J. Guizhou Univ. Nat. Sci.*, 24: 495-495.
- Renke, H., 2000. *Industry Design History*. 1st Edn., Beijing Institute of Technology Press, Beijing, China.
- Ye, Z.H. and X. Li, 2012. Model evaluation based on emotional furniture industrial design elements. *J. Int. Adv. Comput. Technol.*, 22: 73-78.
- Zhang, Y., 2011. The main design strategies and soft orientation recognition of underground space. *Beijing Inst. Technol. J.*, 6: 137-140.
- Zheng, S.F., M. Xu and X.P. Ni, 2001. Development and application of 3D digital general parts/standard parts library based on CATIA V5. *J. Aeronautic Standard Qual.*, 6: 7-10.