

# A Study on the Determinants of Form in Digital Camera as They Affect the Usability

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## ABSTRACT :

Nowadays, computers and computer-related products are omnipresent. It is no exaggeration to say that we would not be able to live and work without them. While these products have enhanced the efficiency of our life and work tremendously, it is also certain that the interface between man and these products have brought about not only inconveniences but also serious confusions. This particular study is intended to explore the problematic interfaces latent in the digital camera, one of the most popular hi-tech products today. Manufacturers of digital camera have been engaged in fierce competitions, developing them with the concepts 'thinness, lightness, shortness and smallness' in mind. These concepts or their way of making things, however, may lead to discrepancies between the image of the camera and the real needs of its users. This is a hypothetical question with which the author proceeds to

investigate the problems involved in the interface and later to propose the guideline on which camera design is to be implemented. First, the author elicited 75 requirements to be met in designing, by interviewing the subjects who actually used and evaluated the existing digital cameras. Then these requirements were structured into hierarchy consisting of four layers, in the top of which were located five groups of the requirements, that are, legibility of functions, prevention of complicated operations, flexible holding, support for easy adjustment, and simple and efficient operations. Then, the author proceeded to evaluate, by way of questionnaire survey, the eight major digital cameras from the point of 78 elements, the results of which were put to principal component analysis. One of the findings was that form and volume of the camera were most crucial in holding it. It was also found that the features of the eight cameras were neatly classified into four quadrants composed by first component, i.e. horizontal axis in scattered map (three dimensional form - details) and second component, i.e. vertical axis (functional features - human factors). This discovery is very important as an objective guideline for designing digital camera.

Key words: form, interface, volume, thinness, smallness

## ABSTRACTS :

This research is a key element of research the digital camera form of the decision (physique), briefly speaking, put the focus while carrying out the design of the digital camera, the releasing of important project that must be consulted, and examine the formulation of the method.

Through such a principle, make a review and analyze to market circulation and real products sold, emphasize that carries out the appraisal method to design important document with the view of the design method, and seen from physique, form of the products the relation of these important documents.

This research can be distinguished into the following six major stages

1. To check the design method of camera from important design elements
2. Arrangement and structure of the important design elements of the digital camera
3. Examining of the important design elements constructed after structured - Appraisal of the digital camera
4. The characteristic of various types and attribute of experiment person
5. Check the characteristic of digital camera from important design elements
6. Conclusion

## I. To check the design method of camera from important design elements

While researching the camera design method, collect and study the materials in leading research of this field, among them " design and analyze for the structure of the important design elements of the purpose with the camera design" ( YAMANAKA,Toshimasa design science research NO.73, Japan design association, PP.111-116, 1989), if study the research of earlier period of the orientation, there is " simulation using the camera of graph theory to camera design " (Mr. kawabata. Thesis 1985 of the university of Chiba) etc., from Professor YAMANAKA's research, I has understood numerous key elements which affects the structure procedure of camera design, and made a

self-criticism one by one. This has used " Check list designed for the camera " (Mr. tamura, the description engineering of university of Chiba, 1986),where gathers together to exactly come out. From 1031 design elements, eliminate too slight or the same attribute project of meaning, and weak connecting with design field , tactics ,etc., simplified 37 items.

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1. ホールディングが安全である
  2. 堅牢である
  3. 保守清掃が容易
  4. 電池交換が容易
  5. フィルム交換が容易
  6. 手にぴったりフィットする
  7. カメラを構えていて疲労が少ない
  8. 構えた姿勢で必要な操作が無理なく行える
  9. 置いたときの安定性が良い
  10. 操作が簡単である
  11. 片手操作ができる
  12. カメラブレが少ない
  13. 不必要に当たったり擦れたりする箇所がない
  14. 表示が適切
  15. パララックスがない
  16. 接眼窓のガラスは汚れたり曇ったりしにくく拭きやすい
  17. 視野がケラレたりしない
  18. ファインダーは覗きやすい
  19. 意図が確実に表現できる
  20. 操作部材の配置が煩雑でない
  21. 付属品を付けたとき、ボディー各部と干渉しない
  22. 露出設定をしなくても良い
  23. ピント合わせが不要
  24. 巻き上げは自動である
  25. 巻き戻しは自動である
  26. 感度の設定は自動である
  27. ストロボを内蔵している
  28. 誤操作に対する警告・防止が十分
  29. ストロボの位置は適当である
  30. グリップの位置・大きさは適当である
  31. ケース無しでも主要部は保護される
  32. 関連のある操作部材の連携が良い
  33. 汗や脂で滑ったりしない
  34. 操作時に表示を隠したりしない
  35. 携帯性、収納性が良い
  36. 左手の保持が容易である
  37. 操作時に必要な部材の機能を妨げない
- 

( Fig.1 )

Professor YAMANAKA through experts of camera design , appraisal the causality and carry on project these according to materials these all structure of important elements, with the designer's view finally, carry on design important elements clear appearing out by way of

constructing.

The above-mentioned research objects are all to the field of the film camera, but since marching toward 21st century, the markets of digital cameras expand rapidly, the film camera and digital cameras – which object of this research- differ from its form, operating, operating department product, fittings etc.. It has already demonstrated the great difference from "characteristic of several small-scale cameras that looks from the view of operating the tactics and anatomy" of another result of study, (TING chih-chiang, the thesis for the Doctorate of Japanese university, 2002). So for find out about several design important elements of camera one by one, at first based on the 37 items of Professor YAMANAKA's, carry on the definition of designing important elements of digital camera and discussion of every terms, apply several experiment of camera to, via shooting, using operating etc. for every assessment experiment, the appropriate design important document has appeared in the extraction one by one.

### **【Method】**

Experimental subjects at this stage are taking use experience person with digital camera as the principle, carry on interview, questionnaire, and apply KJ law etc..

### **【Experiment person】**

50 persons with experience of using digital cameras (22 male and 28 female aged from 21-25 years old, who majored in design department and science and engineering department)

### **【Sample】**

In the 2003 digit cameras sold (19 models / 12 brands)

### **【Experience method】**

The personnel who will participate in the experiment divide into 5 groups (every group is 8-12 people), give each group 3-4 models, every person experiment actually and operate one model about 30 minutes ( haphazard shooting /operate).

### **【Appraisal】**

After every group is using 19 models wholly, announce 37 items above-mentioned, after reading carefully, physique, part , type of attitude or feel it is an important item that operate, exhaust possible extraction and write down by way of document.

## 2 Arrangement and structure of the design important elements of the digital camera

After the above-mentioned extraction, have got key elements that connect with operation, exceeded 150 items, but cover the meaning of word among them and is equal to or demonstrate the extremely close behavior way. Belonging to these, the part which repeat the meaning is deleted, and consider further it is closed the connecting with, 75 projects have extracted with successful result narrowing the range, simplifying the meaning of a word.

Later, 75 project come out to collect general like experience of precede study, think it must be the structure demonstrating a certain form in the important elements of whole design, and such an assumption is also established. Mr. yamanaka's research appropriate applied method of "contractual model". And this research take discussion method first, and use KJ law to collect 75 important elements, similar every project on the high side organize into groups, construct this project melting in order to the view that is appraised.

### 26 groups based

1	つかむ所は手にとって適当である	14	収納しやすいサイズである
2	確実に機器を保たれる(支えられる)	15	操作しないとき、取り扱い易い
3	手にフィットする	16 <sup>o</sup>	内蔵部品の交換は便利である
4	手のひらに収まるボディサイズである	17 <sup>o</sup>	手軽に操作する
5	片手操作ができる	18	省力の姿勢で行うこと
6	身体機能の変化に対応した持ち方	19	自然な姿勢で物を持つ
7	操作部品の配置がわかり易い	20	安定感のあるボディ
8	操作部材の配置が適切である	21	接眼部のガラスは汚れたり曇ったりしにくく、拭き易い。
9	機能を選択し易いインターフェースである	22	アングルフリーである。
10	視力の変化に対応するインターフェース	23	意図が確実に表現できること。
11	視覚的なインターフェースが適切である	24	ストロボの位置は適当である。
12	撮影するものを確認し易い	25	振り歩きが安全である。
13	お知らせ機能の多元化である	26	上、下、左、右、いろいろ方向に動かし易い。

( Fig.2 )

Divided 75 items into 26 groups based on working technique, operational purpose separately at first, among them has contained and transformed with other projects into low and shut, or possess the individual event group of the unique meaning. This stage mainly place on being constructed and melted in the organization related to operating, sum up 75 projects into 26 projects at the second stage, and then via the third stage and summing up 5 projects appeared after the 4th stage (as follows) Can be called the greatest principle project.

1." utilize many kinds of operation of sense organ at the same time(with understand relevant to

connect with while being easy) ".

2." preventing department material, complexity of department product while operating ".

3." holding easy to adapt to ".

4." convenience while putting in order

5." simple and easy and get everything ready operation condition of efficiency ".

If since digital camera it is for designing important elements for composition view, belong to degrees of on the high side concept not abstract of still at one stage 26 project come out to combine, via 4<sup>th</sup> stage 5 items that come out appeared after summing up of stage, can call great design important document of principle most and then. Such a structure appears at this stage, direct against the main design object while carrying out the design work of the digit camera, also can become the use which confirm the table to consider effectively.

### 3. Examining of the important design elements constructed after structured - Appraisal of the digital camera

The important elements of above-mentioned design are correlated with the function ones. Using the those informations develops the designing operation step by step more probably. One the other hand, it can be used to evaluate new developed products. On this stage, it evaluate the elements by using a real finished-products as a sample. We will evaluate 75 items and its construction

#### 【Design of the questionnaire】

First of all, we design the questionnaire by using the 75 items of the constructive stage as the foundation. In the design, we consider if the participant is easy to answer the questionnaire.

Therefore, the item "the easy to be hold" is separated into three items. They are "You can hold the digital camera exactly with one hand", "You can pick up the digital camera with one hand" and "You have to hold the camera with your both hands". Otherwise, the item "Durable design" shows extremely different impressions for the examinee between before-using and after-using. It is divided into the two items as "The first impression of the camera is the Durable design" and "after several using, I think the camera has the Durable design".

In this way, there are 78 items on the questionnaire (Table. I)

Table. I The following is the contents of 78 items:

1	: Can hold certainly: You can pick up the digital camera with one hand easily
2	: Can hold certainly: You can hold the digital camera with one hand easily



3	:	Can hold certainly:You have to hold the camera with your both hands
4	:	Durable design:after several using,I think the camera has the Durable design ”
5	:	Durable design: (when not using) The first impression of the camera is very durable
6	:	It is easy to exchange the battery
7	:	It is easy to exchange the memory card
8	:	Operating buttons are all within the range of activity of the fingers
9	:	It is easy to judge which finger is suitable to press the button
10	:	You don't feel tired easily while holding camera
11	:	You can hold the digital camera with a comfortable posture
12	:	The camera is stable when being put on the flat surface.
13	:	It is easy to operate the digital camera
14	:	It is easy to sway the camera while taking a picture
15	:	The expression of the characters is appropriate
16	:	The expression of brushing the style is appropriate
17	:	The display of the LCD is appropriate
18	:	It is not easy to have fog on the view finder
19	:	It is easy to clean the view finder
20	:	The view of the view finder is nice
21	:	You are able to set up what you need and you are able to operate it immediately
22	:	It is easy to operate
23	:	While setting up adding accessories, it will interfere to operate the digital camera.
24	:	After setting up adding accessories, it is not easy to hold the digital camera
25	:	There is abundant correspondence to the warning and preventing while making a mistake to operate the digital camera
26	:	The position of the flash is proper
27	:	The size of holding slice is proper
28	:	The position of the holding slice is proper
29	:	Without the cover set and the box, the main part of the camera is also protected
30	:	It has good connection of the relative operating parts.
31	:	Your sweat will influence you to hold the digital camera
32	:	While operating, you may not accept some visual information of the camera
33	:	While operating, you may not accept some auditory information of the camera
34	:	It is easy to carry with you
35	:	It is easy to store the digital camera
36	:	It is easy to hold the digital camera with the assistance of the left hand
37	:	While operating, it will not interfere the main Function
38	:	While holding, the shape of the camera is identical to the palm
39	:	In connection with the main operative parts, it is easy to figure out the

	position of the buttons
40	: It is easy to understand the functional menu of the digital camera
41	: It is easy to set up the functional menu.
42	: It is easy to distinguish the relationship of every item while using the returning button
43	: The digital camera possesses the round shaping
44	: The digital camera can prevent the interference of the outside light and avoid reflecting
45	: You can know what happens through the change of the lights(ex: the display of the power light)
46	: While shooting, you are under the comfortable posture
47	: While shooting, you are under the stable posture
48	: Your wrist is under the comfortable posture while holding camera
49	: Your elbow is under the comfortable posture while holding camera
50	: The digital camera is small and simple
51	: The state of ON/ OFF is easy to tell
52	: The shape of the holing slice is proper
53	: It is easy to store
54	: While using, it is easy to operate from all directions
55	: It is easy to watch the LCD screen
56	: While holding camera, you feel unnatural and uncomfortable
57	: The sharp of the digital camera have a sense of stability
58	: It is convenient while operating the digital camera
59	: The digital camera possess the broad visual angle
60	: It is also easy to shoot when you are walking.
61	: You are safe when you are walking and shooting
62	: It is easy to take the digital camera with you
63	: The size of the characters is appropriate
64	: Even though your hands are unstable and swaying because of the increase of ages, it is still easy to operate the digital camera
65	: It is easy to distinguish all kinds of characters, even having the lower visual ability.
66	: It is easy to distinguish all kinds of characters, even having the lower visual ability.
67	: It is easy to distinguish the information in the LCD screen, even having the lower visual ability
68	: It is easy to hear all cuing sounds, even having the lower auditory ability
69	: It is easy to turn on and turn off by just one hand
70	: It is easy to turn on and turn off by just one hand when minimizing the digital camera
71	: It is easy to understand all parts of the product
72	: The minimizing size of the digital camera can be placed in your palm

73	: It is easy to shoot by one hand without any difficulty
75	: The size of the LCD screen is proper
76	: The size of the digital camera is suitable to put in the bag
77	: The size of the digital camera is suitable to put in the clothes pocket
78	: The lenses do not protrude from the camera body too much while not using

(Table.1)

You have to answer those question by Five-point Likert scale. The following is the contents of

Five-point Likert scale:

+2 It is very easy (Wonderful ∙ Totally Agree)

+1 It is easy (Good ∙ Partially Agree)

0 It is ordinary (Neither Agree or Disagree)

-1 It is difficult (It's bad ∙ Partially Disagree)

-2, It is very difficult (It's very bad 、Totally Agree)

デジタルカメラの形態と操作要素の 調査アンケート		非常に容易 非常に同意	やや容易 やや同意	普通	やや困難 やや不同意	非常に困難 非常に不同意
製品名: お名前: 年齢: 性別: 職業: 視力状況: <input type="checkbox"/> 近視 <input type="checkbox"/> 遠視 <input type="checkbox"/> 老眼 <input type="checkbox"/> その他: 種別: 機種:						
1	ホールドイングの確実さについて:片手でカメラを取り上げることができる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	ホールドイングの確実さについて:片手だけで確実にカメラを構えることができる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	ホールドイングの確実さについて:必ず両手でカメラが構えられる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	丈夫なデザインについて:何回も使用して見た後、このカメラは丈夫なデザインを備えていると感じる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	丈夫なデザインについて:(未使用時)第一印象でこのカメラは丈夫に見える。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6	電池の出し入れなどの容易さ。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7	記録媒体の出し入れなどの容易さ。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8	操作ボタン類(スイッチ、ボタン)の配置は指の行動範囲内にされている。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9	どの指でどのボタンを操作するかが判別容易である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10	カメラを構えていて疲労が少ないと感じる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11	構えた姿勢で必要な操作が無理なく行える程度は?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12	カメラを置いた時の安定程度は?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13	操作が簡単である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14	使用する際カメラぶれ程度はどれくらい?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15	絵文字の表示が適切である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16	印刷部分の表示が適切である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17	液晶画面内の表示が適切である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18	接眼部のガラスは曇ったりしにくいである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19	接眼部のガラスは拭きやすい形状である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

デジタルカメラの形態と操作要素の 調査アンケート		非常に容易 非常に同意	やや容易 やや同意	普通	やや困難 やや不同意	非常に困難 非常に不同意
20	ファインダーは覗きやすい形状である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21	やりたいことがすぐ分かること。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22	操作部材の配置が煩雑でない。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23	付属品をつけた時、ボディ各部と干渉しない。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24	付属品をつけた時、カメラを構える姿勢に干渉しない。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25	誤操作に対する警告、防止が十分である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26	ストロボの位置は適当である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27	グリップの大きさは適当である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28	グリップの設定位置は適当である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29	ケース無しでも、主要部は保護されている。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30	関連のある操作部材の連係が良い。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31	汗や脂で滑りやすくなり、カメラを構えることに影響が出る程度はどれくらい?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32	操作時に視覚的の表示を隠したりしないこと。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33	操作時に聴覚的の表示を隠したりしないこと。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34	携帯性が良い。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35	収納性が良い。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36	左手の保持が容易である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37	操作時に必要な部材の機能を妨げない。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38	手のひらの確みにしっかり馴染むこと。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39	主な操作部は一目見てどこに何かあるかを把握できるようにすること。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40	機能遊びの部分が把握しやすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

デジタルカメラの形態と操作要素の 調査アンケート		非常に容易 非常に同意	やや容易 やや同意	普通	やや困難 やや不同意	非常に困難 非常に不同意
41	機能の設定が行いやすいである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42	回転式での選択は各項目の前後関係が分かりやすい表示である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43	全体の丸みを帯びたフォルムである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44	外光の乱反射を防ぐことである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45	お知らせライトの設定などで、すぐに認知できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46	柔な姿勢で撮影できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47	安定した姿勢で撮影する。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48	手首が自然な状態でカメラを持てる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49	肘が自然な状態でカメラを持てる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50	小型でシンプルなスタイルである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51	ON/OFFの状態が一目で分かること。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52	グリップの造形角度が適当である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53	収納しやすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54	上、下、左、右、いろいろな方向に動かしやすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55	液晶モニターを見やすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56	カメラを構える時、手の平や指などが自然と感じる程度はどれくらい?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57	安定感があるボディ形状である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58	手軽に操作できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59	アングルフリーである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60	握り歩きが容易である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61	握り歩きが安全である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

デジタルカメラの形態と操作要素の 調査アンケート		非常に容易 非常に同意	やや容易 やや同意	普通	やや困難 やや不同意	非常に困難 非常に不同意
41	機能の設定が行いやすいである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42	回転式での選択は各項目の前後関係が分かりやすい表示である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
43	全体の丸みを帯びたフォルムである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44	外光の乱反射を防ぐことである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45	お知らせライトの設定などで、すぐに認知できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46	柔な姿勢で撮影できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47	安定した姿勢で撮影する。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
48	手首が自然な状態でカメラを持てる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49	肘が自然な状態でカメラを持てる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50	小型でシンプルなスタイルである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51	ON/OFFの状態が一目で分かること。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52	グリップの造形角度が適当である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53	収納しやすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
54	上、下、左、右、いろいろな方向に動かしやすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55	液晶モニターを見やすい。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56	カメラを構える時、手の平や指などが自然と感じる程度はどれくらい?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57	安定感があるボディ形状である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58	手軽に操作できる。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59	アングルフリーである。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60	握り歩きが容易である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61	握り歩きが安全である。	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

(Table.2)

【Experimental subjects】

We have 52 effective questionnaires which participate in experimental subjects in result. Age of 52 subjects distribute from 21 years old to 83 years old, 27 of man , 25 of woman, for (near-sighted 100~500 degree presbyopia 100~450 degree) eyesight, and all have the experience of using the digital camera wholly.

【Sample】

From put into 19 types for experiment uses, exhaust to reduce the number of type as possible, but these types must accord with various physique change, and form of characteristic to possess too. Experiment sample that it is regarded as this stages that it is following to draw 8 types after screening:



(Fig.3)

## Result

According to the score of every assessment, we can understand the reason of each the characteristic of the types. For example, for the item 'can grasp certainly' that it is easy that SONY-UI0 shoots the behavior with one hand, but when must operate at the same time with both hands, it is a state extremely difficult to grasp. And this type of CASIO EX-Z35 on the other hand, is not only easy to operate with single-handed, but also is smooth when must operate at the same time with the both hands. This demonstrates relevant on condition that hold, appraisal is not simply depending on physique miniaturization. It is a cause settlement condition to the miniaturization type attitude key element and can interpret as.

(Table.3)

	CASIO-EX-MI		CASIO-EX-Z3		Fuji-S304		Nikon 3100		Nikon 4300		SANYO MZ2		CASIO-EX-Z3		Sony-U-10	
	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD
1	1.62	0.65	1.27	0.65	0.08	1.03	1.42	0.53	0.81	0.62	-0.31	0.69	1.13	0.59	1.46	0.66
2	1.40	0.74	0.35	1.19	-0.63	1.08	1.58	0.49	0.50	0.84	-0.73	0.62	0.10	0.99	0.90	1.04
3	-0.50	0.89	0.19	1.16	1.18	0.71	-0.67	0.85	0.35	1.12	1.31	0.67	0.79	0.95	-0.75	0.92
4	0.08	0.80	0.15	0.63	0.53	0.78	0.96	0.68	0.94	0.66	0.44	0.60	0.44	0.89	-0.27	0.83

5	-0.23	1.01	0.21	0.91	1.08	0.81	1.02	0.75	1.23	0.67	1.02	0.57	0.69	0.95	-0.23	0.93
6	0.48	1.22	0.00	1.07	0.20	0.95	0.77	0.80	0.52	0.89	0.63	0.83	0.79	0.66	0.81	0.94
7	0.46	1.12	0.31	1.07	0.43	0.85	0.87	0.65	0.67	0.85	-0.27	0.92	0.75	0.58	0.67	1.01
8	0.85	0.89	0.44	0.84	0.12	1.00	1.06	0.69	0.60	0.63	-0.46	0.72	0.65	0.68	0.58	0.99
9	0.96	0.76	0.21	1.06	0.16	0.92	1.00	0.65	0.58	0.72	-0.52	0.80	0.71	0.60	0.48	0.95
10	0.17	0.89	-0.17	0.99	-0.67	0.98	1.46	0.57	1.02	0.66	-1.42	0.66	-0.12	0.93	0.40	0.93
11	0.02	1.01	-0.23	1.15	-0.12	1.17	1.56	0.57	1.17	0.54	-0.94	0.77	0.27	0.88	0.33	0.99
12	-0.81	1.06	-0.21	0.84	1.49	0.70	1.19	0.68	1.62	0.52	1.65	0.58	1.21	0.57	1.08	0.80
13	0.56	0.95	0.23	1.05	-0.24	0.92	0.85	0.86	0.52	0.64	-0.37	0.86	0.62	0.88	0.77	1.03
14	-0.29	1.01	-0.46	0.75	-0.06	1.09	0.58	0.82	0.65	0.85	-0.38	1.16	-0.04	0.83	-0.19	0.94
15	0.50	0.84	-0.02	1.05	0.18	0.92	0.87	0.68	0.54	0.77	-0.08	0.76	0.46	0.66	-0.21	0.95
16	0.13	1.04	-0.31	1.23	0.00	1.12	0.62	0.74	0.29	0.95	0.27	0.86	0.29	0.74	-0.35	1.02
17	0.62	0.92	1.02	0.66	0.78	0.72	0.83	0.75	0.69	0.82	0.60	0.74	0.65	0.65	-1.02	0.82
18	0.63	0.76	-0.23	0.93	0.75	0.76	0.75	0.76	0.63	0.71	0.38	0.71	0.42	0.69		
19	-0.23	1.12	-0.94	1.13	-0.20	0.97	0.81	0.88	0.65	0.83	-1.04	0.88	0.08	0.85		
20	0.00	1.04	-0.96	1.00	0.27	0.97	0.46	0.66	0.40	0.60	-0.10	0.84	0.38	0.62		
21	0.52	0.64	0.10	0.93	-0.18	0.94	0.37	0.76	0.33	0.78	-0.37	1.02	0.54	0.77	0.17	0.85
22	0.58	0.63	-0.02	0.82	-0.39	0.91	0.27	0.76	0.19	0.83	-0.60	0.81	0.15	0.82	0.37	0.92
23	0.17	0.58	-0.29	0.82	0.14	0.66	0.13	0.52	-0.10	0.60	0.13	0.39	-0.08	0.55	-0.08	0.58
24	0.21	0.79	-0.42	0.82	-0.02	0.67	0.15	0.72	-0.13	0.65	-0.04	0.44	-0.29	0.72	-0.46	0.80
25	0.21	0.88	-0.35	1.04	-0.10	0.80	0.12	0.67	-0.10	0.79	-0.33	0.64	-0.23	0.77	-0.19	0.81
26	1.10	0.63	0.90	0.69	0.75	1.01	0.94	0.60	0.96	0.55	0.81	0.65	-0.02	1.12	0.10	0.84
27	-0.42	1.12	-0.69	0.87	0.20	1.19	1.40	0.63	1.15	0.66	-0.15	0.91	0.02	0.97	-0.50	1.01
28	-0.71	0.86	-0.63	0.98	0.06	1.18	1.50	0.60	1.06	0.69	-0.52	0.82	-0.10	0.88	-0.79	0.79
29	-0.35	1.05	0.02	0.91	-0.65	1.31	0.13	0.88	-0.19	0.90	0.10	0.90	-0.48	0.97	0.98	0.75
30	0.13	0.62	0.02	0.77	-0.25	0.76	0.38	0.65	0.37	0.76	-0.40	0.69	0.27	0.65	0.35	0.70

	CASIO-EX-MI		CASIO-EX-Z3		Fuji-S304		Nikon 3100		Nikon 4300		SANYO MZ2		CASIO-EX-Z3		Sony-U-10	
	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD
31	-0.67	0.99	-0.96	1.07	0.25	0.93	0.63	0.56	0.52	0.54	-0.79	0.77	-0.46	0.93	-0.38	1.04
32	-0.23	1.10	-0.56	0.95	-0.16	0.75	0.37	0.65	0.00	0.55	-0.75	1.04	-0.27	0.86	-0.17	0.96
33	-0.62	1.16	-0.69	0.95	-0.16	0.67	0.17	0.54	-0.10	0.53	-0.42	0.77	-0.23	0.80	-0.04	0.94
34	1.98	0.14	1.75	0.65	-1.49	0.67	0.75	0.76	-0.35	0.73	-0.94	0.63	0.37	0.76	1.65	0.48
35	1.96	0.19	1.75	0.65	-1.65	0.59	0.62	0.71	-0.48	0.60	-0.52	0.84	0.50	0.77	1.67	0.47
36	0.17	1.10	0.60	0.86	0.96	0.77	0.79	0.79	0.90	0.71	-0.04	0.94	0.83	0.83	0.21	1.32
37	0.56	0.95	0.21	1.03	0.57	0.80	0.87	0.65	0.54	0.72	0.04	0.92	0.19	0.65	0.31	0.93
38	-0.96	1.06	-0.87	0.94	0.47	0.94	1.75	0.43	1.27	0.56	-0.56	0.72	-0.31	0.87	-0.96	0.68
39	0.65	0.87	0.08	1.07	-0.10	0.80	0.96	0.81	0.62	0.79	-0.04	0.85	0.38	0.79	0.27	0.86
40	0.27	0.92	0.06	0.95	0.08	0.76	0.67	0.70	0.56	0.63	-0.29	0.82	0.17	0.83	0.12	0.82
41	0.40	0.81	0.19	0.96	-0.14	0.77	0.73	0.68	0.54	0.72	-0.37	0.83	0.38	0.84	0.15	0.91
42	0.10	0.86	-0.06	0.95	0.41	0.80	0.73	0.65	0.77	0.67	0.60	0.86	0.56	0.77	0.06	0.86
43	-0.92	0.87	-0.81	0.88	-0.08	0.99	1.29	0.72	0.58	0.88	-0.42	0.69	0.23	0.85	0.23	0.82
44	-0.29	0.95	-0.42	0.93	0.29	0.64	0.27	0.62	0.00	0.52	-0.31	0.64	0.15	0.66	-0.33	0.73
45	-0.04	0.88	-0.31	0.93	0.22	0.75	0.42	0.69	0.10	0.60	0.12	0.58	0.27	0.81	0.00	0.88
46	0.44	1.06	0.21	0.95	-0.18	1.04	1.33	0.61	1.04	0.55	-0.83	0.67	0.21	0.79	0.58	0.93
47	0.13	0.96	-0.25	0.87	0.53	0.92	1.23	0.61	1.12	0.47	-0.52	0.60	0.50	0.80	0.06	0.97
48	0.50	0.93	-0.02	0.89	-0.06	1.07	1.31	0.72	1.00	0.55	-0.63	0.62	0.33	0.85	0.29	0.95
49	0.42	0.86	0.21	0.66	-0.06	0.83	1.21	0.74	0.85	0.63	-0.46	0.57	0.40	0.66	0.46	0.80
50	1.67	0.58	1.58	0.53	-1.80	0.44	0.52	0.69	-0.60	0.56	-1.38	0.68	0.02	0.69	1.50	0.72
51	0.77	1.05	0.50	0.99	0.39	0.89	1.10	1.02	0.94	0.74	0.92	0.58	0.85	0.91	1.19	0.68
52	-0.73	0.94	-0.90	0.86	-0.04	1.10	1.35	0.68	0.92	0.62	-0.50	0.82	0.10	0.90	-0.58	0.69
53	1.88	0.32	1.75	0.68	-1.57	0.60	0.62	0.76	-0.52	0.60	-0.38	0.86	0.25	0.85	1.60	0.60
54	0.69	0.95	0.63	0.79	0.67	0.73	0.77	0.77	0.87	0.52	0.31	0.64	0.73	0.68	0.27	0.94
55	1.12	0.85	1.50	0.54	1.20	0.66	1.23	0.61	0.96	0.55	0.90	0.56	1.02	0.64	-1.00	1.16
56	-0.56	0.93	-0.60	0.84	-0.39	0.91	1.13	0.56	0.60	0.77	-0.90	0.45	-0.13	0.94	-0.71	0.86
57	-0.13	1.24	0.04	0.85	0.94	0.83	0.98	0.69	1.08	0.58	1.12	0.58	0.65	0.58	0.27	1.15
58	0.60	1.06	0.23	1.15	-0.47	1.02	0.92	0.70	0.62	0.68	-0.79	0.74	0.54	0.75	0.63	0.88
59	-0.12	0.85	0.02	0.99	0.47	0.98	0.46	0.69	0.67	0.73	0.08	0.70	0.37	0.62	-0.58	1.01
60	0.71	1.01	0.29	0.99	-0.41	1.05	1.10	0.66	0.58	0.79	-0.73	0.68	0.17	0.83	0.23	1.17

	CASIO-EX-M1		CASIO-EX-Z3		Fuji-S304		Nikon 3100		Nikon 4300		SANYO MZ2		CASIO-EX-Z3		Sony-U-10	
	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD	平均	SD
61	-0.19	0.90	-0.13	0.92	0.00	1.10	0.85	0.53	0.50	0.69	-0.71	0.60	-0.04	0.85	-0.13	0.98
62	1.69	0.61	0.92	0.96	-1.10	0.82	0.98	0.66	0.23	0.58	-0.71	0.82	0.54	0.82	1.56	0.53
63	0.15	1.15	0.13	1.19	0.22	0.94	0.96	0.59	0.38	0.74	0.33	0.70	0.37	0.73	-0.65	1.16
64	-1.06	0.84	-1.08	1.02	-0.76	1.02	0.79	0.63	0.46	0.75	-1.19	0.73	-0.19	1.07	-0.94	0.84
65	-0.67	0.98	-0.96	1.16	-0.31	1.08	0.58	0.77	0.12	0.78	-0.63	0.62	-0.31	0.82	-1.15	0.74
66	-0.85	0.89	-0.90	1.09	-0.37	1.10	0.50	0.77	-0.10	0.84	-0.63	0.59	-0.44	0.91	-1.27	0.68
67	-0.40	1.04	0.10	1.06	-0.14	0.95	0.56	0.69	0.10	0.79	-0.04	0.48	-0.19	0.90	-1.23	0.67
68	-0.54	0.95	-0.56	0.97	-0.49	1.02	-0.04	0.71	-0.50	0.67	-0.58	0.79	-0.25	0.85	-0.71	0.91
69	0.58	1.18	0.13	1.11	-0.82	1.00	1.08	0.67	0.08	0.78	-0.83	0.70	-0.37	0.88	0.56	0.93
70	0.63	1.09	0.40	0.93	-1.10	0.85	0.81	0.81	-0.19	0.88	-1.31	0.72	-0.17	0.91	0.69	1.01
71	0.38	0.86	-0.02	1.01	0.06	0.87	0.77	0.77	0.37	0.73	-0.10	0.77	0.35	0.81	0.15	0.99
72	1.23	0.72	1.21	0.74	-1.86	0.44	0.17	0.85	-0.63	0.71	-1.50	0.67	-0.46	0.97	1.37	0.76
73	0.42	1.21	0.21	1.26	-1.20	0.86	1.25	0.68	0.12	0.85	-1.23	0.58	-0.48	0.82	0.17	1.17
75	0.46	0.84	1.27	0.62	0.61	0.79	0.77	0.64	0.63	0.65	0.87	0.56	0.60	0.79	-1.27	0.76
76	1.96	0.19	1.88	0.37	-1.37	0.71	0.62	0.88	-0.29	0.77	-0.71	0.72	0.19	0.98	1.73	0.48
77	1.92	0.27	1.81	0.48	-1.96	0.19	-0.44	0.97	-1.35	0.68	-1.73	0.52	-0.94	0.82	1.29	0.66
78			0.62	0.65	-1.27	0.79	0.42	0.77	0.08	0.67	0.46	0.82	-0.21	0.72		

(Table.3)



## 4. The various characteristics of each types and experiment subject's attribute

According to the average score of each appraisal of each types, it is possible for us to understand and grasp the characteristic of various types, but mostly are partial appraisal meaning. If depict this type completely from numerous types this characteristic possessed of type is really difficult. So try to be based on the results of thinking of 52 experiments person certain reaching the characteristic which collects out the types of every sampled this stage, we have carried on principal analysis.

To the result of principal analysis of all experiment samples, the inherent value (固有値) and 寄與率 of every principal as below chart.

Table.4

主成分分析		主成分									
		1	2	3	4	5	6	7	8	9	10
CASIO-MI	固有値	20.932	5.143	4.942	4.662	3.789	3.175	3.064	2.792	2.407	2.160
	寄与率(%)	27.542	6.767	6.502	6.135	4.985	4.178	4.032	3.674	3.167	2.843
	累積寄与率(%)	27.542	34.309	40.811	46.946	51.931	56.108	60.140	63.814	66.981	69.824
CASIO-Z3	固有値	17.568	11.449	7.839	6.437	5.302	4.896	4.322	3.834	3.005	2.739
	寄与率(%)	22.815	14.868	10.180	8.360	6.885	6.358	5.613	4.979	3.902	3.557
	累積寄与率(%)	22.815	37.684	47.864	56.224	63.109	69.468	75.081	80.060	83.962	87.519
FUJIFILM-S304	固有値	26.362	6.177	4.615	4.071	3.221	3.065	2.793	2.490	2.082	1.931
	寄与率(%)	34.236	8.022	5.994	5.287	4.183	3.981	3.627	3.234	2.705	2.508
	累積寄与率(%)	34.236	42.258	48.252	53.539	57.722	61.703	65.330	68.564	71.269	73.777
Nikon-3100	固有値	14.327	8.042	4.963	4.810	3.530	3.242	2.981	2.905	2.448	2.180
	寄与率(%)	18.606	10.444	6.446	6.247	4.584	4.210	3.871	3.772	3.179	2.831
	累積寄与率(%)	18.606	29.050	35.495	41.742	46.326	50.537	54.408	58.180	61.359	64.190
Nikon-4300	固有値	19.798	6.526	4.936	4.240	3.796	3.458	3.227	2.745	2.523	2.426
	寄与率(%)	25.712	8.475	6.410	5.506	4.930	4.491	4.191	3.565	3.277	3.150
	累積寄与率(%)	25.712	34.187	40.597	46.103	51.033	55.524	59.715	63.279	66.556	69.707
SANYO-MZ2	固有値	18.216	8.696	6.070	4.792	4.091	3.932	3.407	3.166	2.662	2.583
	寄与率(%)	23.657	11.294	7.883	6.223	5.313	5.106	4.425	4.111	3.457	3.354
	累積寄与率(%)	23.657	34.951	42.833	49.057	54.369	59.475	63.900	68.011	71.468	74.823

Sony-U10	固有値	18.961	5.972	4.650	3.852	3.593	3.164	2.760	2.602	2.287	2.122
	寄与率(%)	25.974	8.181	6.370	5.276	4.922	4.335	3.781	3.564	3.133	2.907
	累積寄与率(%)	25.974	34.156	40.526	45.802	50.724	55.059	58.839	62.404	65.537	68.444
Sony-P7	固有値	28.343	7.129	4.526	3.835	2.935	2.572	2.299	2.219	2.080	1.773
	寄与率(%)	36.809	9.258	5.877	4.980	3.811	3.340	2.986	2.882	2.701	2.302
	累積寄与率(%)	36.809	46.067	51.944	56.924	60.735	64.075	67.061	69.943	72.644	74.947

(Table.4)

View whole view, the 寄與率 of first principal is low, only sony p7 is over 50% of accumulation rates up to the third main principal . Execution always track type to must carry out inherent to worth I more than main appraisal of composition, and this stage's main purposes for collecting characteristic with every types, regard first principal as centre, consider the second and the third principal with high 寄與率 also, carry on the annotation explanatory note of the combining type to the characteristic of every type.

Viewed wholly, last 78 important elements of project this research several camera via making a review this time, the clear appraisal of digitals cameras has reached, no matter which the first and the second principal of types all demonstrates the holding, operating; Especially the cause , in the project correlating with form , the natural one is come out conspicuously. Therefore learn the design about several camera type body, that is to say that establishes the characteristic on relevantly in the size of three-dimensional, hold the appraisal of movements and relevant request and is all regarded as the importance project, such clear expression of consciousness quilt will come out. In this research, the cameras of the long and thin attitudes used, and ultra thin such attitude camera ,etc. the operation characteristic that the difference that the forms of 3 axle directions of vertical , crosswise , height change produces , produce great influence in execution result to designing and operating. Learn via the appraisal of 78 projects that the small-scale digit camera main appraisal view is, result apt to use formed because of characteristic of physique. This shows that must be common via 3D the form of the size of attitude and detail is established and can be established.

## 5. Check characteristics of digital camera from important design elements

For 8 types appraised this time, each one's characteristic attribute is already gradually abundant understood. These interaction and make a self-criticism small-scale several design key element 78 interaction of project of camera of these, person who obtains 52's experiment after going through the second stage (the arrangement of the design important document of the digit camera and structure stage), based on and then to carry on the averages of the appraisal results of 78 projects separately according to 8 types, analyze with the principal analysis that examines the relation of these.

Table.5 The following picture shows the results:

主成分分析	第 1 軸	第 2 軸	第 3 軸	第 4 軸	第 5 軸
固有值	3.480	2.327	1.294	0.399	0.223
寄与率(%)	43.504	29.091	16.172	4.993	2.791
累積寄与率(%)	43.504	72.595	88.766	93.760	96.550

(Table.5)

Though the inherent value of third principal has exceeded 1.0, but the obvious disparity between the second and the third principal is great, and accumulated 寄与率 has presented 72% at the second principal stage. It has already had the judgments of the main characteristic possessed the abundant condition , so rely mainly on the first and the second principal to annotate.

### 【Relation between 78 projects】

The 1<sup>st</sup> and 2<sup>nd</sup> principal of 78 projects appear just as attached list, using such a result to put the 1st principal in the horizontal axle, putting the second principal after the vertical axle appear out by scatter diagram.

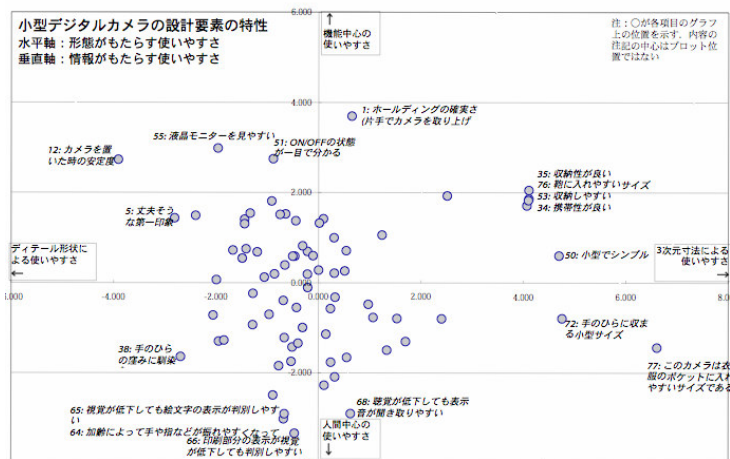
Table.6 As the high value of 寄與値 to every axle:

There are the positive directions of the horizontal axes	
35	It is easy to store the digital camera
76	The size of the digital camera is suitable to put in the bag
53	It is easy to store
34	It is easy to carry with you
50	The digital camera is small and simple
70	It is easy to turn on and turn off by just one hand when minimizing the digital camera
77	The size of the digital camera is suitable to put in the clothes pocket
There are the negative directions of the horizontal axes	
12	The camera is stable when being put on the flat surface.
5	Durable design: (when not using) The first impression of the camera is very durable
38	While holding, the shape of the camera is identical to the palm

(Table.6)

Etc. What can be understood from the information found out, this is that one each belongs to the axis structure easy to use brought up because of physique factor. It is at pros to part in, especially it demonstrates volume size the project not whole it that is to say form of 3D the easy to use; In the part of the negative direction is relevant projects easy to use that form because of establishment of the detail mostly.

This also shows that the appraisal small digital camera domain main appraisal view via 78 items, the ones that formed by the thing that physique is set up are easy to use, must establish by contained all kinds of 3D size factor and detailed form treatment of such factors as sure equalization point etc.



( Fia.4 )

Table.7 Then check the distribution state of the vertical axle

There are the positive directions of the vertical axles	
I	Can hold certainly:You can pick up the digital camera with one hand easily
55	It is easy to watch the LCD screen
51	The state of ON/ OFF is easy to tell
There are the negative directions of the vertical axles	
68	It is easy to hear all cuing sounds, even having the lower auditory ability
65	It is easy to distinguish all kinds of characters, even having the lower visual ability.
64	Even though your hands are unstable and swaying because of the increase of ages, it is still easy to operate the digital camera
66	It is easy to distinguish all kinds of characters, even having the lower visual ability.

(Table.7)

Etc.What can understand from these projects finds out; this is that one brings up the axis structure easy to use because of information factor of the information.At positive part in because of organization's key element forming it is the easy to use, it is the project taking comprehensive and every engineering design as main fact that is distributed among them in other words. On the other hand part of negative direction with the relevant on because (age increase) and form project group that eyesight decay it for its representative. In other words, process easy to use project distribute on among them with human characteristic of itself.

Definition of receiving two axles after the result that came out appearing in the scatter diagram is analyzed and summing up one by one, it was that ' detail that both ends presented the about horizontal axle, (left) ' and ' form not whole the that characteristic of change ( of the settlements of size of 3D ) not all kinds of more form to be the apt to use (right ) ' '. Its structure can be regarded as ' the user-friendliness that bring up because of form '. On the vertical axle, go to what both ends appear ' use while being easy while being relying mainly on function (Part One) ' and ' it is the relying mainly on people it is the apt it use (Part Two ) ' can regard their structures as ' what has been brought up because of information the easy to be

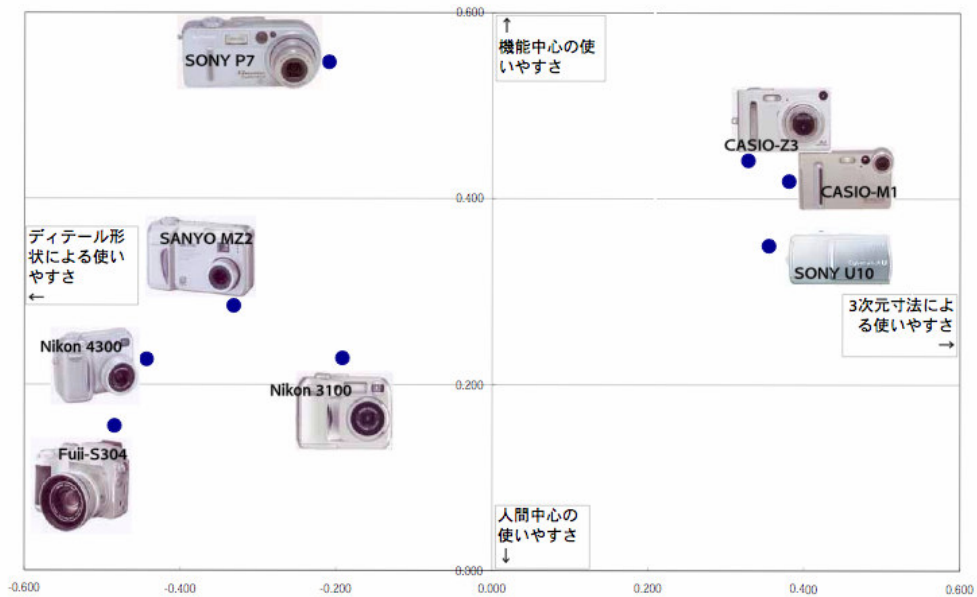
use '.

	手成分	
	1	2
1 ホールディングの確実さについて：片手でカメラを取り上げることができ	0.854	3.697
2 ホールディングの確実さについて：片手だけで確実にカメラを構えること	1.242	1.058
3 ホールディングの確実さについて：必ず両手でカメラが構えられる	-1.992	0.064
4 丈夫なデザインについて：何回も使用して見た後、このカメラは丈夫なデ	-1.669	0.722
5 丈夫なデザインについて：(未使用時) 第一印象でこのカメラは丈夫に見	-2.809	1.433
6 電池の出し入れなどの容易度	-0.640	1.525
7 記録媒体の出し入れなどの容易度	-0.440	1.375
8 操作ボタン類(スイッチ、ボタン)の配置は指の行動範囲内にきている	0.098	1.419
9 どの指でどのボタンを操作するかが判別容易である	0.022	1.321
10 カメラを構えていて疲労が少ないと感じる	0.237	-0.571
11 構えた姿勢で必要な操作が無難なく行える程度は?	-0.854	0.197
12 カメラは置いた時の安定程度は?	-3.904	2.731
13 操作が簡単である	0.306	0.998
14 使用する際カメラぶれの程度はどれくらい?	-0.665	-1.218
15 絵文字の表示が適切である	-0.654	0.991
16 印刷部分の表示が適切である	-0.683	-0.395
17 液晶画面内の表示が適切である	-1.442	1.408
18 液晶部のガラスは曇ったりしにくいである	-1.192	0.882
19 液晶部のガラスは拭きやすい形状である	-0.508	-1.424
20 ファインダーは覗きやすい形状である	-0.962	-0.702
21 やりたいことがすぐ分かること	0.310	0.209
22 操作部材の配置が煩雑でない	0.973	-0.480
23 付属品をつけた時、ボディ各部と干渉しない	0.151	-1.140
24 付属品をつけた時、カメラを構える姿勢に干渉しない	0.244	-1.760
25 誤操作に対する警告、防止が十分である	0.553	-1.656
26 ストロボの位置は適当である	-0.749	1.512
27 グリップの大きさは適当である	-2.056	-0.718
28 グリップの位置は適当である	-1.947	-1.288
29 ケース無しでも、主要部は保護されている	1.334	-1.494
30 関連のある操作部材の連携が良い	0.325	-0.322
31 片手操作で構えやすくて、カメラを構えることに影響が出る程度はどれく	-0.867	-2.493
32 操作時に視覚的表示を隠したりしないこと	0.321	-2.090
33 操作時に聴覚的表示を隠したりしないこと	0.114	-2.275
34 携帯性が良い	4.107	1.864
35 収納性が良い	4.107	2.052
36 左手の保持が容易である	-1.330	1.541
37 操作時に必要な部材の機能を妨げない	-0.460	0.587
38 手のひらの窪みにしっかり馴染むこと	-2.688	-1.639
39 主な操作部は一目見て、どこに何かあるかを把握できるようにすること	-0.214	0.687
40 機能遊びの部分が把握しやすい	-0.208	-0.107
41 機能の設定が行いやすいである	0.004	0.280
42 回転式での選択は各項目の前後関係が分かりやすい表示である	-1.413	0.753
43 各機能の表示がわかりやすいである	-1.280	-0.032
44 外光の乱反射を防ぐことである	-0.398	-1.339
45 お知らせライトの設定などで、すぐに認知できる	-0.423	-0.554
46 楽な姿勢で撮影できる	-0.105	0.600
47 安定した姿勢で撮影する	-1.487	0.544
48 手首が自然な状態でカメラを持てる	-0.501	0.587
49 肘が自然な状態でカメラを持てる	-0.308	0.820
50 小形でシンプルなスタイルである	4.700	0.600
51 ON/OFFの状態が一目で分かること	-0.879	2.745
52 グリップの高形角度が適当である	-1.840	-1.275
53 収納しやすい	4.070	1.710
54 上、下、左、右、いろいろな方向に動かしやすい	-0.912	1.812
55 液晶モニターを見やすい	-1.961	2.985
56 カメラを構える時、手の平や指などが自然と感じる程度はどれくらい?	-0.775	-1.841
57 安定感があるボディ形状である	-2.396	1.490
58 手軽に操作できる	0.547	0.712
59 アンダフリップである	-1.280	-0.239
60 握りやすさが容易である	0.513	0.264
61 握りやすさが安全である	-0.309	-0.996
62 持ち歩きやすい	2.513	1.926
63 表示される文字の大きさが適切である	-1.054	0.124
64 距離によって手や指などが隠れやすくてこのカメラを確実に構えら	-0.878	-3.019
65 視覚が低下してもこのカメラの絵文字の表示が判別しやすい	0.863	-2.909
66 視覚が低下してもこのカメラの印刷部分の表示が判別しやすい	0.464	-3.336
67 視覚が低下してもこのカメラの液晶モニター内の表示が判別しやすい	-0.528	-1.743
68 聴覚の低下になってもこのカメラの表示音が聞き取りやすいである	0.627	-2.900
69 片手で開け閉めなどの操作がしやすいである	1.536	-0.793
70 片手だけで開け閉めなどができる機構を持ったコンパクトなサイズである	2.407	-0.800
71 各部の設計意図が分かりやすい	-0.213	0.192
72 手のひらに収まる小形サイズ	4.760	-0.794
73 片手のまま無理なく撮影することができる	1.704	-1.301
74 液晶モニターは小さい感じがしないサイズである	-1.439	1.305
75 このカメラは胸に入れやすいサイズである	4.098	1.828
76 このカメラは表型のポケットに入れやすいサイズである	6.607	-1.435
77 収納式でレンズ部は本体から出っ張りが少ない	1.071	-0.771

( Fig.5 )

In the field of the small digital camera, function relying mainly on mankind's characteristic and relying mainly on engineering design, the completely different part of the two has been already clear to come out. We can learn these small digital camera several key elements of the design of camera most important part with important document that physique correlated with after remitting whole condition. And, the mode of combination of the little size in the large size of the whole form and detail place, it is also that important item is clear gradually too. What is moreover using these to design important document, if understand for difficult matter the

mediation that want to pay attention to mechanism efficiency and the two of it of mankind's characteristic efficiency at the same time appears. Based on above-mentioned two axle structure set up, after putting the sample machine used for testing, demonstrate the phenomenon like picture. (Fia.6)



(Fia.6)

Characteristics of 8 types can be clearly classified out in structure of horizontal axle and vertical axle. According to such 2 main points reasons as ' the speciality of the form ' and ' the speciality that the information of the information operate ', establishment of its attribute and characteristic while carrying out the design of the small-scale digit camera thereafter, clear and easy gradually.

## 6. Conclusion

This research is a discussion that is directed against the camera physique key element of group of the decision digit, go on arrangement to design important document at first, and these important document, from the appraisal course to this kind of products, an important document correlated with the design of the digit camera, analyze by way of structurization, 78 projects of important document that is it produce to collect the design of several cameras of its result, it has been already got too definitely that can really be suitable for this kind of products and appraise, and after passing through the appraisal procedure and carrying on the discussion to the camera that is already commercialized actually, the clear one learns the characteristic structure in the design of several cameras can be tenable with the composition in such 2 great key elements as the key element of physique and key element of the function can divide it for the whole in key element of physique ( Large size) and size of detail ( Small size), it is actually difficult for the two to appear with the most proper state at the same time, and can also be divided into the design taking organization as starting point and design taking human characteristic as starting point in key element of the function, the mediation of the two of it also demonstrates the state of facing a difficult choice.

It can be said to be via these results appearing out in exploration of the above, carry out several physique of camera design homework policy at, from only via rely on experience rule and in the design that carry out in the past, use many kinds of methods to analyze with the objective angle, is it can understand actual way of guide line of characteristic of products also can using flexibly ceremony prove even effective even more to think.