# The development of a conceptual model in user research using an empathic design technique as the basis for user-centred design

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**Abstract:** There has recently been more awareness of user-centred design (UCD) due to instances of poorly designed products that are used in our daily lives. In order to improve the usability of products, many methods have been suggested to approach UCD. However, encouraging users into the design process encountered many difficulties. The two main problems in realising UCD were addressing the techniques of coordinating UCD meetings and the longer development cycle. Consequently, the practice of UCD principles is considered costly. This research aims to develop an economic model, based on empathic design, in order to support designers to develop their design concepts with a better understanding of the user. Firstly, this research investigated concept development. Secondly, a theoretical model was then proposed and, finally, this was assessed. In the first two stages, twenty designers were invited to construct the model while five more experts helped with the assessment. This research was concluded with a conceptual model which allows integration with a designer's individual design work.

***Keywords: user-centred design (UCD), empathic design, personas***

## 1. Introduction

### 1.1 Background

In our daily lives, our interaction has increased with various products that have more and more sophisticated functions. In addition, most products are required to satisfy a diverse range of users. It has been pointed out by Norman [8] that inadequately designed objects may not only induce negative emotions from the user but also sometimes put the user in a dangerous situation. To cope with this, a design philosophy, user-centred design (UCD), is promoted. UCD means that the design is based on the needs of the user [8].

Several methods can be conducted to realise a UCD including contextual design, participatory design and empathic design. ISO13407 [6], provides guidelines for the whole product process. In particular, it suggests inviting product users to join in with the whole design process. However, in practise, this is costly and time consuming. The drawbacks are mainly in two areas; the highly difficult technique of coordinating a UCD meeting and the long process of product development. As a result, participatory design and contextual design may not be suitable for a firm with a limited budget that wants to employ a UCD approach. Since it is necessary to hire real users to participate in the design process, it is important to have a good understanding of human behaviour. For instance, large companies such as Apple, Motorola and Microsoft have already integrated

anthropologists into their personnel in order to make their designs match their user's needs [2]. However, most small businesses do not have the budget to employ such professionals in their user research areas. In other words, gathering information on the needs of the consumer is costly and would be rarely used by small-scale enterprises. Consequently, empathic design is proposed as an alternative approach to UCD.

To achieve empathic design, products must still be developed taking the needs of the end-user's into consideration [4]. However, the key benefit is that designers can improve the design by using their imagination to become a user themselves. Additionally, the initial stage of the design process is user research and it is in this area where empathic design can be used the most. By using empathic design, UCD can reduce the product testing time, thereby successfully saving the product developer time and expense. By promoting empathic design to designers, it not only improves the product but might also change the behaviour of the design industry, due to the benefits of a cheaper method for designers to approach UCD.

In this paper, the authors introduce 'personas' as the main method of aiding a designer to use empathic design. Personas are defined as fictional characters used to represent the users of a product. Experts believe they are useful tools that can be used as a bridge for team communication. Additionally, they also bring other benefits, such as raising the focus of users. In our research, personas were used to construct a conceptual model to help designers perform their individual tasks. The advantage of using personas was investigated by this experiment.

Firstly, the authors look at the related work, including UCD, empathic design and the use of personas. Secondly, the methodology for the study is presented. The methods used in the experiments were semi-structured interviews, think-aloud protocols and observations. Twenty participants were tested in the first two phases. Consequently, the model was then preliminarily constructed and five experts were invited to assess it. The key research outcomes present a refined, economical conceptual model along with a few recommendations for future research.

## 1.2 Literature Review

**User-Centred Design (UCD):** User-centred design, which is often abbreviated to "UCD", is a design philosophy, focusing on design work that is based on the needs of the user. By following this concept throughout the whole design process, the product can be made more usable and understandable for the user [8]. The major difference between UCD and other design philosophies is that UCD attempts to optimise the user interface around how people can, want or need to work, rather than forcing people to change how they work to accommodate the system or function. Since more and more companies are now aware of the importance and benefits of UCD, they are also interested in designing objects which are close to the needs of end-users. Nevertheless, the products are various and the organisation of every enterprise may be different. Therefore, following UCD becomes a challenging task. In 1999, the International Organisation for Standardisation (ISO) formalised the process of UCD with ISO 13407. This provides a framework for applying human-centred design and evaluation techniques and is intended to supplement existing lifecycle models [1].Although ISO 13407 specifies the type of activities to be performed during the development of an interactive system, it does not demand nor recommend particular techniques or methods [1]. Consequently, various approaches have been

proposed to achieve UCD. The three main methods are participatory design, contextual design and empathic design.

**Participatory Design (PD)**: PD originated from Scandinavia in the 70s. This method promotes the idea that users should be involved in the design project throughout the whole design process. Moreover, it focuses on the equal footing between designers and users; in other words, it is a type of democratic thinking that encourages design decisions to be made cooperatively by users and designers. Due to the nature of PD, the lifecycle of the design process is usually quite long. In addition, because sometimes the user does not understand their own needs, the designer is still the interpreter between the user and the product [4]. As a result, the skills of designers are still a key factor for product development.

**Contextual design (CD):** Contextual design was developed by Hugh Beyer and Karen Holtzblatt in 1998. It adapts the idea in participatory design which invites users to take part in design activities. Additionally, it describes how great product ideas come from the integration of and detailed understanding of a customer's needs, with an in-depth understanding of technology [2]. Therefore, CD begins by understanding how customers work by observing their context of use that is called "contextual inquiry". It also incorporates anthropology to enhance the recognition of customer behaviour and forms a platform to help cross-functional teams to explore the actual needs of the customer.

**Empathic Design:** This is an approach to UCD where the designer attempts to get closer to the lives and experiences of users and to apply the knowledge from end-users in the design process, in terms of empathic design [4]. The goal of empathic design is to ensure that the product or service designed meets the needs of the end-users and is usable [4].Nevertheless, the users are indirectly involved in the design project. It therefore tends to become 'designer-centred' instead of UCD. Additionally, the professionals in empathic design promote the use of observation although sometimes it is difficult to have the chance to freely observe the users in a particular situation. Consequently, in this research, "personas" are used to overcome these issues and enhance the use of empathic design.

**Personas:** Personas have been widely used in the computer science domain since Alan Cooper [3] first promoted them in his book, "The Inmates are Running the Asylum". Personas depict various types of real users who can represent a group of people. The two main benefits of the use of personas are for communication between teams and helping designers to focus more on their users [5]. More findings, in terms of the use of personas, have been researched by Microsoft. In their work, they used personas to develop their popular software, such as "Office" and "Messenger", and found that the use of personas were a great benefit to design tasks. However, even here, the authors also use personas as the key technique and, inheriting many of the advantages from work previous to this research, we intend to investigate how personas can help a designer to develop their product concept in their individual work. In other words, this research will not concentrate on communications between teams, one of the biggest beneficial functions. Instead, this study will investigate the aspects which help the individual designer to work.

## 2. Methodology

The goal of this research is to develop a conceptual model to enhance the abilities of the designer in user research. To achieve this, the specified objectives are to explore the design context of the designer and to evaluate the theoretical model. According to the objectives, the research plan is divided into three phases: Phase one is the investigation into the designers' context of concept development; Phase two is the introduction of the personas into design tasks; Phase three is the construction and the evaluation of the conceptual model . The purpose of the first two phases is to develop the conceptual model. The final stage is for the evaluation of the model and recommendations. The detailed experiment will be explained later.

Although this research is relevant to various product categories, in order to examine the comparable information in this experiment, the researchers defined some control factors. Firstly, we assigned the same product in all the design tasks in which designers were asked to develop their product concepts. Additionally, the interviewees were asked to have a similar background and to be able to manage the development of their design concept for a single product. Moreover, the designated task was confined to designing a product for use by an individual instead of a multi-user product. Also, the specified design task needed to cover all the elements in "form and function".

### 2.1 Phase 1 - The investigation into designers' context of design

The purpose of phase 1 is to explore the problems and weaknesses of the present design work in user research and concept development. In this phase, designers with an industrial design background were invited to take part in the test. The interview process took about 30 minutes. A portable device for personal use was specified to simplify the use of the personas. The authors chose "MP3 player for the group: 25-34 office ladies" for the experimental task.

During this phase, semi-structured interviews were undertaken in order to acquire details of the interviewee's background. In addition, think-aloud protocols (TAP) were applied in which the users were asked to say whatever they were thinking, doing and feeling as they underwent their task. Furthermore, we also noted the technique "observations" in order to analyse the design tasks. In addition, the authors used NVivo to analyse the qualitative results, which were found to be useful in finding a pattern using the efficient coding method. NVivo is a popular and significant software package for organising and analysing qualitative data. By coding and analysing the subsequent pattern, a test theory can be built [9].

### 2.2 Phase 2 - The introduction of the personas into design tasks

The second phase is to introduce the personas in order to investigate how the personas can help with the design task. Before the task is examined, some assumptions are proposed: The designers are trained to have the essential knowledge for design and they are assumed to have the imagination for the fictional character operation. Otherwise, the participants and the target task remained the same as for the first phase.

The persona should be developed from the anthropology survey, except for the name and the photos, according to the previous literature. This is to avoid stereotyping a persona from familiar names and photos. Additionally,

for reasons of ethics, it is essential to protect any private and personal data. Therefore, this study licensed photos from the FERET database (Figure.1 the left side). The names were chosen from the most popular names on the website. The profile of the persona was taken from a lady who was located in our target market segment. Due to the limited time available, the author only assigned one persona, as the illustration in the right side of Figure.2 shows.


Figure.1 The left side is example photos from the FERET database. The right side is the persona in this task.

Task 2 took 10-15 minutes and the participants were asked to design applying the same conditions as the first phase. The only difference was they needed to develop their concept using a specified persona provided. The persona is located within the same market segment, 25 to 34 year-old office ladies. The process launched think-aloud protocols to gather data. Additionally, semi-structured interviews were used to reveal the options for building the conceptual model in the next phase.

### 2.3 Phase 3 - The construction of the theoretical model

In the last phase, the author proposes a conceptual mode for designers. Five more experienced participants were invited to help assess and refine the model. The participants in this phase were asked to design a product following the proposed model. The conditions of the design tasks were the same as the previous tasks in phases 1 and 2.

## 3. Results and Discussions

### 3.1 Phase 1

**The context of the present design:** We used NVivo as the tool to transcribe and code the information. Thirteen of the designers were from Asia, six of them were from Europe and one was from the US. As we can see from table 1 below, industrial designers were interviewed in the first and second phases. Within the group there were thirteen senior designers with more than five years of work experience. Five of the group were junior designers with between six months and up to five years experience. The final group member was a senior design student who had only run independent design projects and group projects.However, six of the designers felt that they needed to study the market on their own before they design. Consequently, to avoid unfairness in the experiment, the researchers provided the same product information and only asked them to develop their product ideas.

Furthermore, the designers were asked to describe their present methods of practising design and their general design cycle for a project. Interestingly, when the question was asked, "Does the user matter in your design projects?" only nine of them answered "Yes", whereas ten responded that they did specify users but tried to ensure the design covered all user groups in order to gain maximum benefits. The final participant believed that users were not important in their design. This pattern will be compared in the design task to see if the interview answers were identical to their design behaviour.

The project cycle, on average, takes between one and three months. With regards to the design behaviour, several methods were used to inspire design ideas. Most of the designers tended to get the design concept by sketch, brainstorming and information gathering.

**Design Task Analysis (before and after the use of persona):** Table 2 shows how the designers developed their product concept. As can be seen, seven of them were product-centred, which means the designer only considered the shape, regardless of the user. Three of the designers tended to be designer-centred with five tending to be both designer-centred and user-centred. Finally, five of the designers were UCD but were easily distracted.

When analysing the interview results, we found that one of the weaknesses of the designers' present work is that, regardless of their experience, there was less user-centred design. When we examined the status of the user-centred designers, when interviewed, the participants expressed that they were designing for the users. However, during the design tasks, the UCD designers were, unconsciously, designer-centred rather than user-centred. Another drawback was that most designers were concerned with the design shape rather than functional design. Hence, we may summarise that the designers, without the support from a user research team, tended to ignore the users in their design.

As shown in Table3. and from interviews and observations, the designers were able to explore more design ideas. Additionally, the designers were found to use shorter timescales to make decisions. There might, however, be some errors attributed to the training effect, due to the same product for the same users assigned to the same users twice. Nevertheless, the supportive point from the interviews is that three of them had done the "MP3" project for the same group and one of them had designed the same product for a different group. However, there was no significant difference to the other designers.

One more important finding came to light when they were asked whether they felt the later concepts they made contradicted the previous task. All of those designers who were designer-centred and product centred felt that the later designs were more likely to be suitable for the 24-35 year-old office ladies. However, the designers with more UCD in Task 1 said they did not feel there was a contradiction. They felt that Task 2 helped them to specify a design concept, such as a warm colour domain to red.

Nevertheless, the participants highlighted concerns which included the fact that the use of personas may make the product too personal and cause the failure of a market approach. Also, personas are difficult to collect. Moreover, designers concerned that only one persona may narrow the market. After we provided more personas

for them to select from, they all felt satisfied and the worry of the representation of the personas was eliminated.

Table 1. The background of the participants

| Samples | Academic Background | Work Experience* | Job function | Project Lifecycle* | User Centred? | General design behaviour | Note |
|---|---|---|---|---|---|---|---|
| 1 | Yes | Senior | Design | 1-3m | B | Similar work gathering | *Work experience: 1. >5 years: Senior 2. <5 years: Junior 3.School project student<br>*Project Lifecycle: m: Month w: Week d: Day<br>*User Centred? A: Design will consider users B: Try to cover all users C: User is not considered in my design |
| 2 | Yes | Junior | Design | 1-3m | B | Brainstorming/Similar work gathering/ Scenarios/sketch | |
| 3 | Yes | Junior | Design | <5m | A | Similar work gathering/Sketch | |
| 4 | No | Senior | Design | 1-3m | A | Brainstorming /Similar work gathering | |
| 5 | Yes | Senior | Design | 1-3m | B | Sketch/Discussion/Similar work gathering | |
| 6 | Yes | Senior | Design | 1m | C | Sketch | |
| 7 | Yes | Junior | Design | 1m | B | Sketch | |
| 8 | Yes | Student | Design | 1-2w | B | Sketch /User data gathering | |
| 9 | Yes | Senior | Design+ Marketing | 3-5d | B | Sketch/ Brainstorming /User data gathering/ Similar work gathering/ Sports | |
| 10 | Yes | Junior | Design+ Marketing | 1-3m | A | Sketch/ Brainstorming /User data gathering/ Similar work gathering | |
| 11 | Yes | Senior | Design+ Marketing | >6m | B | Sketch/ Brainstorming /User data gathering | |
| 12 | Yes | Senior | Design+ Marketing | 1-2m | A | Sketch/ Brainstorming /User data gathering | |
| 13 | Yes | Senior | Design | 2-3m | B | Sketch/ Brainstorming /User data gathering/ Similar work gathering | |
| 14 | Yes | Senior | Design+ Marketing | 1-3m | A | Sketch/Brainstorming/User data gathering | |
| 15 | Yes | Senior | Design | 1-4w | A | Sketch/Brainstorming/User data gathering | |
| 16 | Yes | Senior | Design | 1-3m | B | Sketch | |
| 17 | Yes | Senior | Design+ Marketing | 1-3m | A | Inspiration from different product areas/ Similar work gathering/Sketch/Brainstorming | |
| 18 | Yes | Junior | Design | 1-4w | A | Similar work gathering/Sketch/Brainstorming | |
| 19 | Yes | Senior | Design | 1-2m | A | Marketing trend surveys/User data gathering/Sketch | |
| 20 | Yes | Senior | Design | 1-3m | B | Similar work gathering/Brainstorming/Sketch | |

Table 2. The design behaviour of the participants

| Samples | Design Tendency | Colour Scheme | Form | Special Functions? | Style/Tactile | Note |
|---|---|---|---|---|---|---|
| 1 | Product Centred | Blue | Simple like an iPod | Wifi/ Convenient | Fashion | Design Tendency: To observe the respondents design behaviour.<br>1.Product Centred: Designer cares about the shape more than about the user<br>2. Designer Centred: Designer uses themselves as the user to approach the design<br>3. Designer Centred + *UCD The designers design by UCD, but after a few minutes, they become designer-centred. The research asks them why they change. They then realise they are designer-centred when asked "is this element for 25-34 year-old office ladies?"<br>4. *User centred: Designers consider the user in their design but easily get distracted (They can be UCD when asked "why did they give this element?" |
| 2 | Designer Centred + *UCD | White with some pattern | Not specified | Not specified | Organic | |
| 3 | Designer Centred | Red or Pink | Sweet/ Stylish | Not Specified | Feminine and Elegant | |
| 4 | Product Centred | Cannot decide now | Not specified | Simple MP3 | Feminine | |
| 5 | Designer Centred | Black, to cover wider variety of users | Smooth/ Technology | Sound quality/Easy to play | Shiny surface for acceptance by the market | |
| 6 | Product Centred | Pink series or multi-coloured mix | Round/ Delicate/ Match the dress | Simple keys | Elegant | |
| 7 | Designer Centred + *UCD | Soft colour such as pink or white | Accessory | Friendly interface. | Plastic but metallic look | |
| 8 | Product Centred | Red/Pink | Lipstick look | Simple buttons to operate | Shiny Plastic | |
| 9 | Designer Centred + *UCD | Feel happy/pink series | Simple/Neat/ Accessory | /Easy interface and to charge up | Delicate/ Fashion | |
| 10 | * UCD | Many colour selections such as red/pink series | Simple/Clear | Can be used on the bus | Metallic | |
| 11 | Product Centred | White series/ Shiny bright series/Pink series | Round/ Friendly/ Slim/Neat/ Easy to carry | Easy interface/ Shortcut to save files/ Rapid wireless to download albums | Rubber / Leather (soft feeling) | |
| 12 | Designer Centred +*UCD | Silver +Black | Simple | Internet /Plug and Play and auto sorting | Metallic +Plastic | |
| 13 | Designer Centred | Cannot decide now (Multiple selection) | Simple like an iPod/ Square | Easy key/Touch panel | Plastic but metallic feeling | |
| 14 | Designer Centred + *UCD | Pink/Feminine colour | Accessory to match the handbag | Bluetooth/Can have a mirror | Shiny/Plastic | |
| 15 | *UCD | Light pink | Curved | Not important | Comfortable | |
| 16 | Product Centred | Silver and Green | Rectangular | DAB, Recorder/Subwoofer/ Camera/Digital frame/ Lighter | Metallic and plastic | |
| 17 | *UCD | Luxurious/Elegant | Smooth | Simple | Soft/ Comfortable | |
| 18 | Designer Centred + *UCD | Simple | Simple | Easy to share with friends/Easy download | Not specified | |
| 19 | *UCD | Fashion colour | Shaped like perfume/ Accessory | Not specified | Feminine | |
| 20 | *UCD | Bright colour/Yellow | Round /Funny shape | Earphone match the MP3 | Cute/Plastic | |

Table 3. The design behaviour of the participants using the personas.

| Samples | Colour Scheme | Form | Special Functions? | Style/Tactile |
|---|---|---|---|---|
| 1 | White | Like a T-shirt | Wifi/ Convenient | Clothes feel of material |
| 2 | Red | Rectangular/Small | Agenda/Reminder/Schedule/Inspired quote to cheer up her mood | Plastic |
| 3 | White | Organic | The ability to share functions with friends | Some pattern on the plastic |
| 4 | Monotone/Simple | Rectangular/ Bigger screen but lightweight | Touch panel/ Reminder/Easy operation/ Music download /Share | Soft Surface |
| 5 | White | Smooth/Portable | Easy/Good sound/Enough music storage | Shiny Surface |
| 6 | White | Round | Play/Radio | Plastic |
| 7 | Pink | Cosmetic box | Easy keys | Shiny Plastic |
| 8 | Pink | Lipstick | Simple play<br>Earphone design resembles earrings | Plastic/Looks elegant |
| 9 | Cute Pink | Small/Portable/ Rectangular | Update files easily | Fashionable/ Leather |
| 10 | Red/Black | Simple | As simple as it can be | Simple/Elegant and professional looking/ Metallic hair silky |
| 11 | Light bright colour | Round smooth/ Square | MP3/Recorder/<br>Calorie measurement | Shiny plastic/Metallic look |
| 12 | High contrast colour with grey | Round smooth/ Square | MP3/Photo viewer<br>Internet friendly/Upload and download friendly | Soft material |
| 13 | Pinky white with a flower pattern | Round smooth/ Square | Easy buttons with big touch screen/Photo Viewer/Sharing function | Shiny plastic |
| 14 | White with pink | Round smooth/ Square with curve for easier handhold | News/Music downloading from the internet | Soft on the back side for easy grasp/Shiny mirror screen |
| 15 | White with pink blue/red/orange /purple | Sportive | Calorie calculation<br>Changeable cases for different moods | Soft material |
| 16 | Pink brown | Simple neat square | Small games to kill time | Soft material |
| 17 | White with Silver | Simple neat square | Simple | Comfortable |
| 18 | Light/Soft colour | Lightweight smooth square | Easy to keep notes | Not easy to get dirty/Shiny plastic |
| 19 | Red with black | Rectangular with feminine curves | Contact detail/reminder/ Photo viewer | Shiny plastic |
| 20 | Pink | Organic/ Interesting form | Can share music and photos with friends | Soft plastic |

### 3.3 Phase 3:

**The evaluation of the model:** As can be seen in Figure 2, the model is concluded from the previous phases, with these points as follows:

1. To employ personas as the basis to construct their product concepts.
2. Multi-personas are used to eliminate the bias of using only one persona.
3. The personas can be used within their present design work.

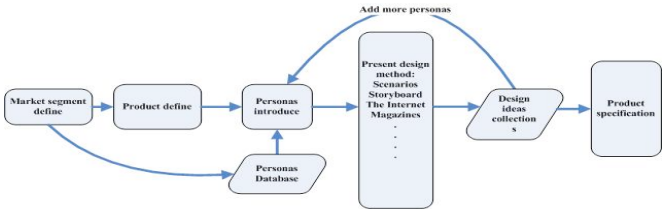


Figure 2: The concept model for development of design concepts

After the evaluation, the five designers gave the following comments.

1. The model is found to be systematic, but needs training and time to practise.
2. The personas help with the decision making but, after specifying the personas, the ideas are narrowed.
3. Designers can be inspired by the information that comes with using the personas but too many personas make the ideas more diverse.
4. Designers found it difficult to build a persona and suggested the researchers develop a CAD to help with this work.

### 3.4 The refined conceptual model

After phase 3, we modified the model with the suggestions made by the senior designers. Figure 4 demonstrates the flow from the given product task to the specifications of the end product. The detailed ideas are as follows:

1. After the project is defined, the stakeholder can introduce the personas into the design work.
2. The personas are located within the market segment.
3. Cooperation with the present design tools: Most designers have their own favourite way to assist the creation of their ideas. The personas do not conflict with any of the present tools. Instead, this research suggests that designers imagine themselves as the personas and within various scenarios, interact with the tools they use.
4. After the collection of design ideas, the stakeholder may face two difficulties. Firstly, they may worry that the use of one persona may bring bias into the design. Additionally, focusing on the persona may lead to insufficient design ideas. This study proposes a procedure to check for this. The first is to check whether the design idea created is suitable for the persona. In other words, this check ensures the design is a UCD. The second is to check whether enough ideas are created or whether the designers should decide to employ more personas to complete the design ideas.
5. The personas should be created in sequence. Only when the design concept for one is complete can an additional persona be created. This is to avoid the problem of too many personas used at the same time, making the design distractive again.

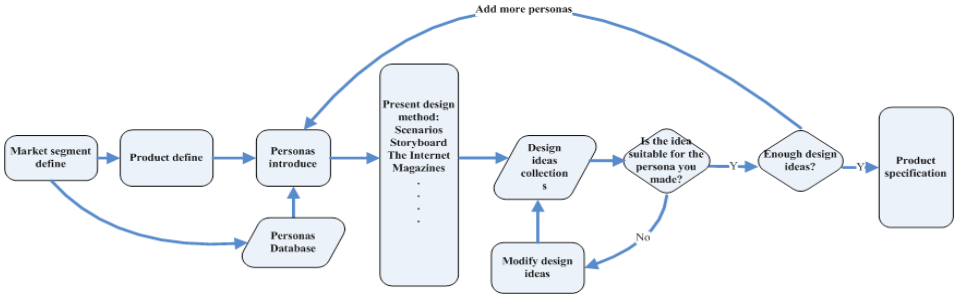


Figure.4: The conceptual model for designers to practise UCD

### 3.5 The research limitation

There were three design tasks within this research and each task took 10-15 minutes to design. We analysed the difference between the use of personas and the original work. For this research, we can still see a significant difference, even when given a shorter time to complete the tasks. Although in the real world most designers spend more time on concept development, the limitation here is that the longer the time in the experiments, the more difficult it is to find designers to participate in this experiment.

Moreover, the experiment focused on the trend of the UCD approach. Even thought we did not use the Kansai Database to describe the product, we can still observe that the design has been improved after the use of personas. Additionally, this model only evaluated a design for portable devices.

## 4. Conclusions

### 4.1 The research conclusions

During this research, we found that present design work tends to fail in relation to UCD. Nevertheless, personas can be used to reinforce UCD and can even mix with present design tools in user research. With the assistance of the conceptual model based on the use of personas, designers are not only undertaking user-centred design but are also inspired by the personas to create more design ideas. To conclude, this model can help designers integrate their users into their individual design tasks with lower costs.

### 4.2 The Recommendations

For future studies, below are some suggestions taken from this experiment:

1. A real product can be made from the evaluation model used with the end-users, instead of simply testing with designers.
2. This model only evaluated a product for personal use. To extend the use of the model, a multi-user product, such as a living-room product, can be chosen to enhance the concept.
3. Develop a CAD to assist designers to build their own personas database. This would incorporate random names and photographs, the ability to create multi-persona characters and use tutorials to make the UCD approach much easier.
4. The CAD can be used for the evaluation of the model and can make it easier to collect more respondents.

## 5. Acknowledgement

I wish to thank the database provider, Face Recognition Technology (FERET).

## 6. References

[1] Bevan, N and Curson, L. (1999) *Planning and implementing User-centred design*, CHI, 1999, Adjunct proceedings Pittsburgh, ACM Press, New York, VS.

[2] Beyer, H. and Holtzblatt, K. (1998) *Contextual design: Defining Custom-Centered System*, Morgan Kaufmann, San Francisco.

[3] Cooper, A. (1999). *The inmates are running the asylum*. Macmillan.

[4] Dorothy, L. and Rayport, J.F. (1997) *Spark Innovation Through Empathic Design*. Boston: Harvard Business Review Nov-Dec 1997. Reprint #97606, page 107.

[5] Grudin, J. and Pruitt, J. (2002) *Personas, participatory design and product development: an Infrastructure for engagement*. Paper presented at the Participatory Design Conference 2002, Malmo, Sweden.

[6] ISO DIS 13407(1999) *User-centred design process for interactive systems*.

[7] Koskinen, I. (2003) *Empathic Design – Users experience in product design*, IT Press, Finland.

[8] Norman, D. (1988). *The design of everyday things*, Doubleday, New York.

[9] Weitzman, E. A. and Miles, M. B. (1995) *Computer programs for qualitative data analysis*. London, Sage.