# Visual Usability Design for Mobile Application Based on User Personality

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***Abstract*— Currently visual usability for mobile applications is a must, whilst more demand for personalized the design both aesthetic and personal preference dynamically. It was designed to ease people with high mobility. When designing user interface, designers focus on visual usability, user needs, and user preferences. Each user has different preferences about interface designs because of their personality. In this paper, we proposed a visual usability design for mobile application based on user personality. Our approach was based on psychological aspects that enabled to perform personal preference appointing to specific visual usability of preferred experiences. The objectives of this paper are to identify and formulate rules for interface design in mobile application based on user personality. Kansei engineering is a method to get user needs and user preferences based on his or her senses and cognition. Association rule mining and bond measure is a method for finding a relationship between user preferences and user personality.**

*Index Terms*—visual usability, Kansei engineering, personality traits, association rule mining

## I. Introduction

Mobile application is growing rapidly since early 1990s [1]. It was designed to ease people with high mobility. The characterized of mobile application are small screen size, limited connectivity, high power consumption, and limited input [2]. Nowadays, many mobile applications are neglected because of poor design user interface. An attractive user interface can help people work, improve efficiency, and earn loyalty [3].

When designing user interface, designers focused on some important measures such as visual usability, user's functional needs, and user preferences. Visual usability related to an understandable design. Kansei Engineering (KE) is a method to get user requirements and user preferences based on his or her senses and cognition. Kansei engineering is a technology for translating user needs regarding a specific product into design a satisfying product [4]. Each user has different preferences about interface designs because of their character or their personality [3]. Designers have to combine interface elements based on user personality. They require a system with rapid data that suitable with the user needs.

According to Holzinger [5], combinations between Human Computer Interaction and Knowledge Discovery, which on this paper are interface designs and user personality, can find information for decision support. Association rule mining is a method to predict information, find correlation from data, and decision support in Knowledge Discovery in Database or KDD [6]. Each functional component of operation in KDD support for intuitive dynamic behavior representation such as in visual usability requirement.

In this paper, we proposed an approach on how to construct a visual usability design for mobile application based on user personality. There are two reasons that make visual usability engineering become important to mobile application. First, mobile applications are growing rapidly and unpredictable. Second, user needs change over time.

The objectives of this paper were to identify and to formulate rules of interface designs in mobile application based on user personality. We focus to visual interface elements (background color, font color, layout navigation, screen area color, widget, and icon).

## II. Methodology

The methodology that using in this paper presented briefly on Fig. 1.

### *A. Identification of interface elements*

TABLE 1
Design Elements

| Background Color | Font color | Layout navigation | Screen area color | Widget | Icon |
|---|---|---|---|---|---|
| White | Dark | Springboard | Dark | Yes | 3D |
| Black | Light | List | Light | No | Flat |
| Green | | | | | |
| Blue | | | | | |
| Pink | | | | | |
| Colorful | | | | | |

The interface elements composed by layout, typography, color, imagery, and control [3]. In this

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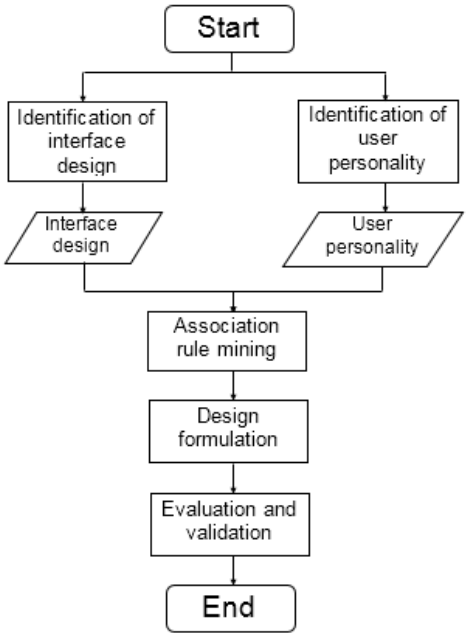


Fig. 1. Steps in design

paper we used six interface elements in presented on Table 1. We identified interface designs ($V_i$) by combining the interface elements ($X_i$). The interface designs stored in interface database. The data structure of this database is represented in Table 2.

### B. Identification of user personality

We identified user personality using Big Five Factor (BFF) personality traits [7], the personality classified into five personality types: neuroticism, extraversion, openness, agreeableness, and conscientiousness. The personality traits presented in Table 3. We used this personality traits because this personality is suitable to describe relationship between human personalities and software engineering [8]. We used questionnaire from website International Personality Item Pool [9] to identified user personality traits. The user personalities stored in personality database.

We collected user profile ($F_j$) and identified their name ($N_j$), age ($A_j$), gender ($G_j$), email ($E_j$), personality ($P_j$). The data structure of this database is represented in Tabel 4.

### C. Association Rule Mining

In this section, we analyzed relationship between user personalities and interface designs using association rule mining. Association rule mining is a method to find relationship among data. The association rule is an implication of the form A → B [10], where A as antecedent and B as consequent. There are four measures in this method: support [10], confidence [10], lift [10], and bond [11]. Support is a measurement that indicates a probability A and B was chosen in the same time from all transactions. Confidence is a measurement that indicates probability B was be chosen when A was chosen. Lift is a measurement that indicates probability A and B was chosen at the same time. Bond is a measurement that indicated comparison between conjunctive support and disjunctive support. The formulation of the parameters is presented in (1). In this paper, we used user personalities as antecedent and interface designs as consequent. So this rule showed as user personality → interface design. In the following equation described four measures we deployed

$$Support(A \rightarrow B) = P(A \cap B) \quad (1)$$

$$Confidence(A \rightarrow B) = \frac{Count(A \cap B)}{Coun(A)} \quad (2)$$

$$Lift(A,B) = \frac{P(A \cap B)}{P(A)P(B)} \quad (3)$$

$$Bond(AB) = \frac{Support(\wedge(AB))}{Support(\vee(AB))} \quad (4)$$

Where:
*P:* Probability
A∩B: transaction that contain both item A and item B

### D. Formulation of interface designs based on user personality

Rules produced from association rule mining were used as formulation of interface designs based on user personality.

### E. Evaluate and validate the formulation

We designed the visual themes for application mobile to evaluate and validate the formulation. We constructed the hierarchy of interface designs. Then we used pairwise comparison to rank the best visual theme which was chosen by user.

## III. Computational Result

A computational experiment was set up to verify and validate at what extend the proposed system could fulfill the performance stakeholders required. A Java based application system in both PC-Windows 7 and

TABLE 2
DATA STRUCTURE OF INTERFACE DESIGNS DATABASE

| Design code | Back ground color | Font Color | Layout Navigation | Screen area color | Widget | Icon |
|---|---|---|---|---|---|---|
| $V_1$ | $X_{11}$ | $X_{21}$ | $X_{31}$ | $X_{41}$ | $X_{51}$ | $X_{61}$ |
| $V_2$ | $X_{12}$ | $X_{22}$ | $X_{32}$ | $X_{42}$ | $X_{52}$ | $X_{62}$ |
| ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| $V_i$ | $X_{1i}$ | $X_{2i}$ | $X_{3i}$ | $X_{4i}$ | $X_{5i}$ | $X_{6i}$ |

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TABLE 3
PERSONALITY TRAITS [7]

| Extraversion | Agreeableness | Conscientiousness | Neuroticism | Openness |
|---|---|---|---|---|
| Gregariousness | Morality | Self-dicipline | Anxiety | Imaginations |
| Activity level | Trust | Dutifulness | Self-consciousness | Artistic interest |
| Assertiveness | Altruism | Self efficacy | Depression | Emotionality |
| Excitement seeking | Modesty | Orderliness | Vulnerability | Intellect |
| Cheerfulness | Sympathy | Cautiosness | Impulsiveness | Adventurousness |
| Friendliness | Cooperation | Achievement striving | Angry hostility | Liberal |

TABLE 4
DATA STRUCTURE OF USER PERSONALITY DATABASE

| ID | Name | Age | Gender | Email | Personality |
|---|---|---|---|---|---|
| $F_1$ | $N_1$ | $A_1$ | $G_1$ | $E_1$ | $P_1$ |
| $F_2$ | $N_2$ | $A_2$ | $G_2$ | $E_2$ | $P_2$ |
| ..... | ..... | ..... | ..... | ..... | ..... |
| $F_j$ | $N_j$ | $A_j$ | $G_j$ | $E_j$ | $P_j$ |

Android-JellyBeans Machines was then constructed. The details are as follows.

### A. *Identification of interface elements*

In order to fulfill the evaluation, we collected 30 interface designs from Android visual themes in Google Store. The interfaces design presented on Table 5.

### B. *Identification of user personality*

We collected questionnaire for identification user personality. Based on [12], we collected 30 respondents for this experiment (13 females and 17 males). Reference [12] shows that the number of respondents used in Kansei research from 30 to 120 respondents does not affect the result of determinants design. Respondents were given a questionnaire with 5 Likert's scales. We used a questionnaire on International Personality Item pool [9]. We identified 11 respondents with personality of openness types, 4 respondents with personality of neuroticism types, 9 respondents with personality of consciousness types, 4 respondents with personality of agreeableness types, and 2 respondents with personality of extraversion types.

### C. *Association Rule Mining*

In objective to obtain the rules for interface designs based on user personality, we collected questionnaire respondent's preferences of 30 interface designs. Respondents were given a questionnaire with 5 Likert's scale. The result of questionnaire in presented on Table 6.

TABLE 5
INTERFACE DESIGNS

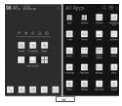
| Code | V01 | V02 | V03 | V04 | V05 |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Code | V06 | V07 | V08 | V09 | V10 |
| |  |  |  |  |  |
| Code | V11 | V12 | V13 | V14 | V15 |
| |  |  |  |  |  |
| Code | V16 | V17 | V18 | V19 | V20 |
| |  |  |  |  |  |
| Code | V21 | V22 | V23 | V24 | V25 |
| |  |  |  |  |  |
| Code | V26 | V27 | V28 | V29 | V30 |
| |  |  |  |  |  |

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TABLE 6
PERSONALITY AND INTERFACE DESIGNS

| Participant Code | Personality Code | Interface Design Code |
|---|---|---|
| P001 | F02, F03, F07, F08, F09, F11, F13, F14, F15, F16, F 18, F25, F26, F28, F29, F30 | V08, V09, V14, V15, V16, V25 |
| P002 | F01, F03, F07, F08, F09, F11, F12, F13, F17, F18, F19, F20,F21 ,F22, F23, F25, F26, F28, F29, F30 | V01, V02, V03, V04, V05, V08, V15, V17, V20, V21, V22 |
| P003 | F02, F06, F07, F09, F10 ,F11, F13, F15, F16, F17, F18, F19, F22, F25, F26, F27, F28, F29 | V01, V04, V06, V07, V09, V10, V11, V14, V16, V17, V22, V28, V29 |
| …… | ..... | …….. |
| P030 | F01, F02, F03, F04, F05, F06, F09, F10, F11, F13, F16, F22, F23, F27, F30 | V01, V02, V03, V04, V05, V06, V07, V10, V11, V13, V14, V15, V16, V18, V19, V20, V21, V22, V23, V24, V30 |

TABLE 7
ASSOCIATION RULES PRODUCED

| Inference relationship | Support | Confidence | Lift | Bond |
|---|---|---|---|---|
| Sympathy →V1 | 0.76 | 0.83 | 1.39 | 0.76 |
| Self-discipline→ V4 | 0.86 | 1.00 | 1.36 | 0.76 |
| Sympathy → V4 | 0.73 | 0.94 | 1.48 | 0.73 |
| …… | ……. | …… | …….. | …. |
| Sympathy & self-Discipline → V1 & V4 | 0.60 | 0.83 | 1.39 | 0.53 |

We deployed libraries from Weka Version 6.11 [13] to process the data. The minimum support, minimum confidence, minimum lift and maximal number of possible rules were set to 0.5, 0.8, 1.0, and 100. The mining process result was 100 association rules. Next, we used bond measure to find strong rules. Minimum bond is set as 0.5. A total number of 20 association rules are generated as shown in Table 7.

### *D. Formulation of interface designs based on user personality*

By implementing the rules, we developed formulation of interface designs based on user personality that present in Table 8.

### *E. Evaluate and Validation*

We design three application mobile visual themes based on the formulation to evaluate and validate the formulation. The visual themes is presented in Table 9. The hierarchy of interface designs and alternative visual themes in presented in Fig. 2. We used pairwise comparison with 5 scales (1 is equal, 2 is moderate, 3 is strong, 4 is very strong, and 5 is extreme) to process the data. We used hypothetical data with Montecarlo approach to evaluate and validate the formulation.

The result of ranked by 30 hypothetical data agreeableness types, consciousness types, and openness types. The detail are follows. For agreeableness type, the most favorite color for background color is pink (0.67), for font color is light (0.75), for screen area color is dark (0.80), and for icon is 3D (0.80). The result is presented in Table 10.

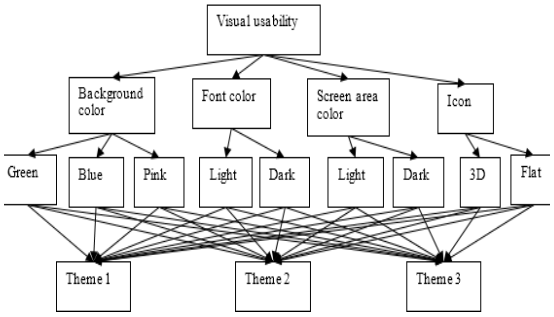


Fig. 2. Structured of interface design

The most favorite visual theme is theme 2 (0.51), second is theme 1 (0.36), and the last is theme 3(0.13). The result of the favorite visual theme is presented in Fig. 3.

For consciousness type, the most favorite color for background color is blue (0.66), for font color is light (0.80), for screen area color is dark (0.75), and for icon is flat (0.83). The result is presented in Table 11. The most favorite visual theme is theme 3 (0.51), second is theme 2 (0.28), and the last is theme 1 (0.21). The result of the favorite visual theme is presented in Fig. 4.

For openness type, the most favorite color for background color is blue (0.36), for font color is light (0.83), for screen area color is dark (0.80), and for icon is flat (0.75). The result is presented in Table 12. The most favorite visual theme is theme 3 (0.44), second is theme 1 (0.43), and the last is theme 2(0.13).

The result of the favorite visual theme is presented in Fig. 5.

Application based on personality showed that it required both personality and interface designs as input, and formulation of interface designs as output. The formulation is generated from association rule mining and bond measure. The result showed that our approaches have succeeded to capture different personal preference on a scalable visual usability.

TABLE 8
FORMULATION OF INTERFACE DESIGNS BASED ON USER PERSONALITY

| Personality | Background Color | Font color | Layout navigation | Screen area color | Widget | Icon |
|---|---|---|---|---|---|---|
| Agreeableness | Pink | Light | Springboard | Dark | No | 3D |
| Consciousness | Blue | Light | Springboard | Dark | Yes/No | Flat |
| Openness | Blue | Light | Springboard | Dark | No | Flat |

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TABLE 9
THE APPLICATION MOBILE VISUAL THEMES

| Theme | Screenshot |
|---|---|
| 1 |  |
| 2 |  |
| 3 |  |

TABLE 11
EVALUATION AND VALIDATION BY CONSCIOUSNESS TYPES

| Factor | Weight | Rank | Criteria | Weight | Rank |
|---|---|---|---|---|---|
| Background color | 0.50 | 2 | Blue | 0.66 | 1 |
| | | | Pink | 0.24 | 2 |
| | | | Green | 0.10 | 3 |
| Font color | 0.25 | 3 | Light | 0.80 | 1 |
| | | | Dark | 0.20 | 2 |
| Screen area color | 0.15 | 1 | Dark | 0.75 | 1 |
| | | | Light | 0.25 | 2 |
| Icon | 0.10 | 4 | Flat | 0.83 | 1 |
| | | | 3D | 0.17 | 2 |

TABLE 12
EVALUATION AND VALIDATION BY OPENNESS TYPES

| Factor | Weight | Rank | Criteria | Weight | Rank |
|---|---|---|---|---|---|
| Background color | 0.50 | 2 | Blue | 0.36 | 1 |
| | | | Green | 0.44 | 2 |
| | | | Pink | 0.30 | 3 |
| Font color | 0.25 | 3 | Light | 0.83 | 1 |
| | | | Dark | 0.17 | 2 |
| Screen area color | 0.15 | 1 | Dark | 0.80 | 1 |
| | | | Light | 0.20 | 2 |
| Icon | 0.10 | 4 | Flat | 0.75 | 1 |
| | | | 3D | 0.17 | 2 |

## IV. CONCLUSION

Our visual usability design approach for mobile have succeeded to capture user preference and represented each components in the visual domain. The psychological personal traits have been embedded into the system to map user responses according to the preferred features and visual appearance. We identified there is a relationship between interface designs and user personality. Our evaluation step proved scalable real world preference to well matched with our approaches. In the future it is required to integrate dynamic visual usability personal change into our current approach.

TABLE 10
EVALUATION AND VALIDATION BY AGREEABLENESS TYPES

| Factor | Weight | Rank | Criteria | Weight | Rank |
|---|---|---|---|---|---|
| Background color | 0.50 | 1 | Pink | 0.67 | 1 |
| | | | Green | 0.23 | 2 |
| | | | Blue | 0.10 | 3 |
| Font color | 0.25 | 2 | Light | 0.75 | 1 |
| | | | Dark | 0.25 | 2 |
| Screen area color | 0.15 | 3 | Dark | 0.80 | 1 |
| | | | Light | 0.20 | 2 |
| Icon | 0.10 | 4 | 3D | 0.80 | 1 |
| | | | Flat | 0.20 | 2 |

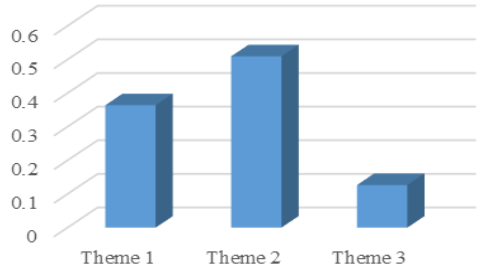


Fig. 3. The favorite visual themes by agreeableness types

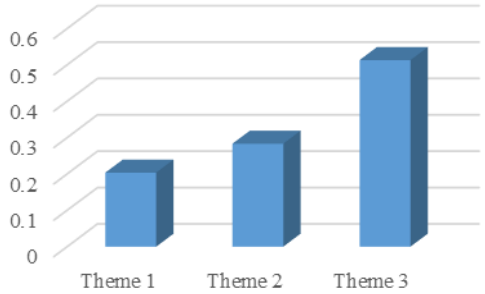


Fig. 4. The favorite visual themes by consciousness types

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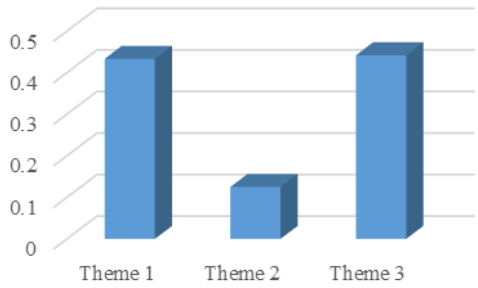


Fig. 5. The favorite visual themes by openness types

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