Pattern Design Bespoke System Considering Individual Differences in Affective Evaluation Using Multi-task CNN

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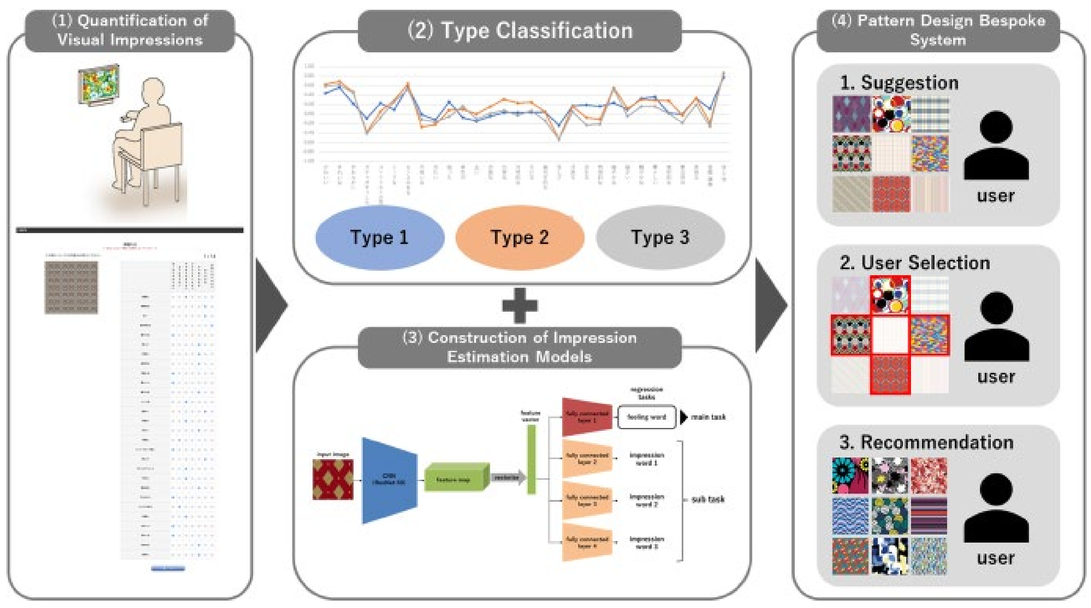
Introduction

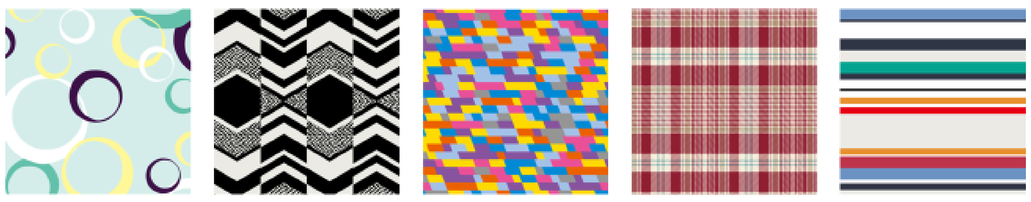
- Background
  - In product design, **affective evaluation** attracts attention
    - **Affective evaluation**
      - The feelings and impressions (aesthetics) evoked by surface properties of materials
      - An important factor in evaluating and judging the value and favorability of a product
      - ➢ **However, affective evaluation varies by individual**
  - In the fashion industry, customization and personalization are vital
    - e.g., custom products
    - ➢ **However, existing recommendation systems require a lot of data to find products that match the user's desired image**
- Purpose
  - **Construction of a pattern design bespoke system**
    - Match the user's desired image from a small amount of data
    - Focus on individual differences in affective evaluation

Proposed Method



(1) Quantification of Visual Impressions

- Subjective evaluation experiments
  - Participants: 4,440 non-experts recruited through crowdsourcing
  - Stimuli: 2,878 pattern images
  - Evaluation words:
    - 28 impression words, "like - dislike", "good - bad", "pleasure - discomfort", and "awakening – sedation"
  - Procedure:
    - Evaluated 28 impression words, "like - dislike", and "good - bad" on a seven-point Likert scale
    - Evaluated "pleasure – discomfort" and "awakening - sedation" on an Affect Grid



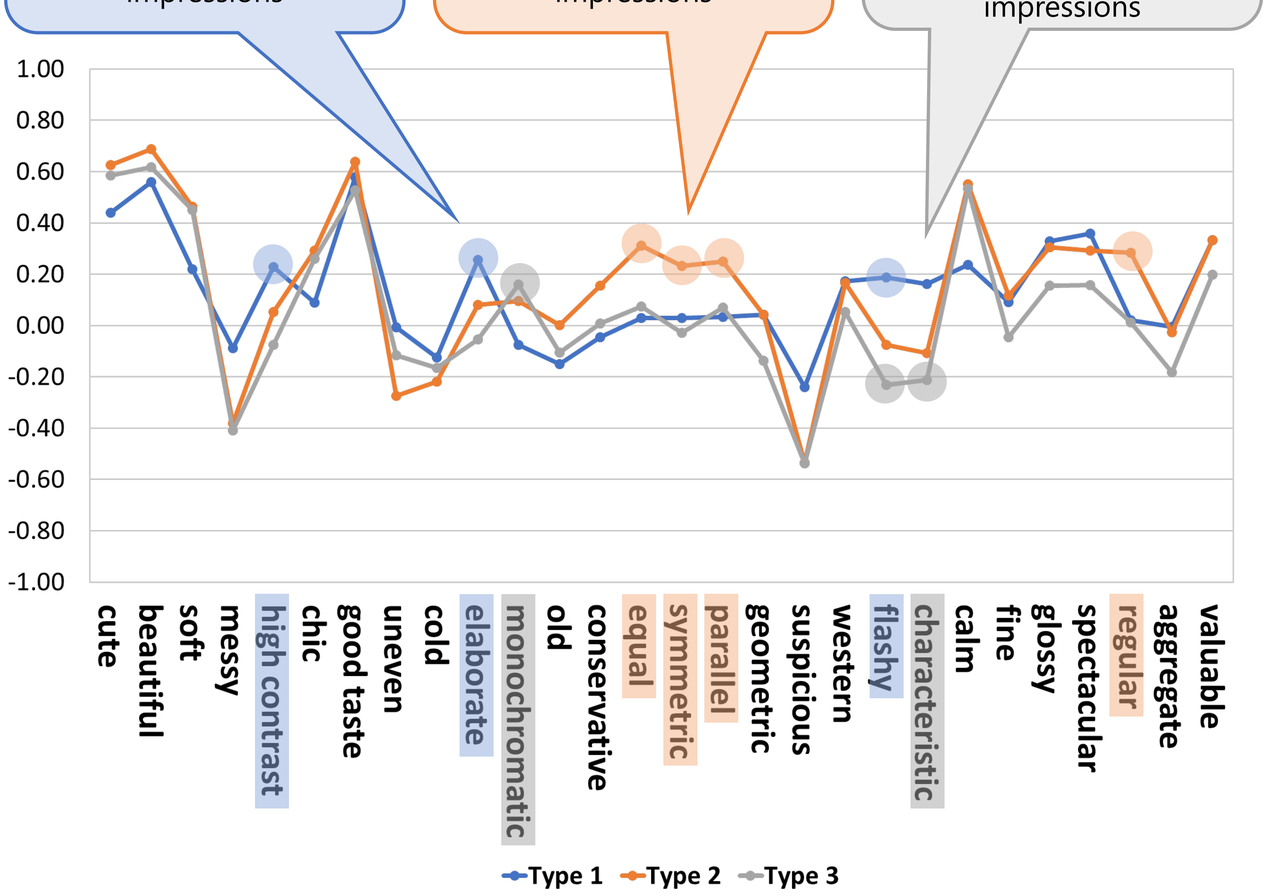
(2) Type Classification

- Cluster analysis based on correlation coefficients between 28 impression words and "like-dislike" (Ward method)

Type 1
Prefer "elaborate", "high-contrast", and "flashy" impressions

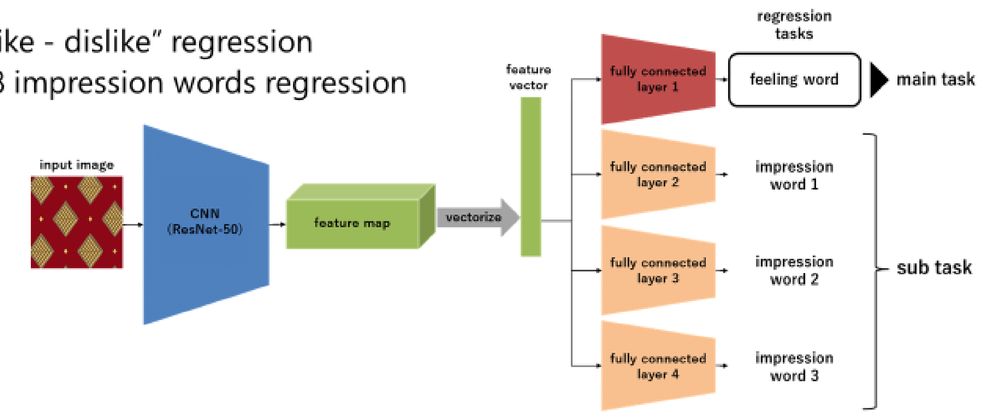
Type 2
Prefer "equal," "regular," "parallel," and "symmetric" impressions

Type 3
Prefer "monochromatic" impressions, don't like "flashy" and "characteristic" impressions



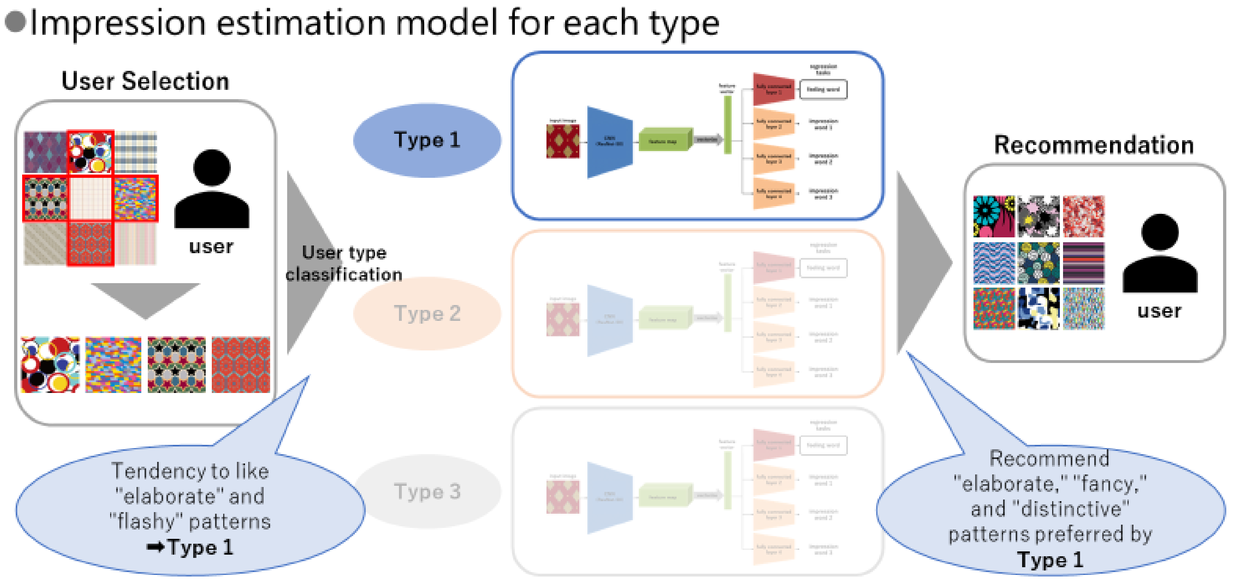
(3) Construction of Impression Estimation Models

- Multi-task learning
  - Methods for solving multiple tasks with a single model
    - ➢ Common factors can be acquired across tasks, improving the prediction accuracy of the model
  - Main task: "like - dislike" regression
  - Sub tasks: 28 impression words regression



(4) Pattern Design Bespoke System

- Impression estimation model for each type



Result

- Overall impression estimation model

evaluation words	correlation coefficient
cute	0.70
beautiful	0.67
soft	0.81
messy	0.86
high contrast	0.80
chic	0.67
good taste	0.51
uneven	0.78
cold	0.76
elaborate	0.81
monochromatic	0.88
old	0.63
conservative	0.67
equal	0.79
symmetric	0.78
parallel	0.81
geometric	0.78
suspicious	0.81
western	0.61
flashy	0.85
characteristic	0.86
calm	-0.10
fine	0.80
glossy	0.71
spectacular	0.75
regular	0.78
aggregate	0.73
valuable	0.69
Average of impression words	**0.72**
like – dislike (multi)	**0.67**
like – dislike (single)	**0.65**

negative correlation	r<0.0
no correlation	0.0≦r<0.2
weak positive correlation	0.2≦r<0.4
medium positive correlation	0.4≦r<0.7
strong positive correlation	0.7≦r

- Correlation coefficients of 28 impression words
  - Average : 0.72
- Correlation coefficients of "like - dislike": 0.67
  - Correlation coefficient of single-task model: 0.65
  - ➢ **Improved accuracy**

The usefulness of multi-task learning

Conclusion

- Construction of a pattern design bespoke system considering individual differences in affective evaluation
  - Quantification of visual impressions
    - Evaluated 28 impression words, "like - dislike", "good - bad", "pleasure - discomfort", and "awakening - sedation"
  - Cluster analysis based on impression and "like - dislike" correlation coefficient
    - Classified into three types
  - Impression estimation modeling by multi-task learning
    - More accurate than single-task models
- Future study
  - Construct impression estimation model for each type