

Multimodal Interface for Mobile Information Services

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Abstract: We believe that different people receive information differently. And, we divided individual reaction to information into four phases --- awareness, recognition, memory and understanding. We believe that every mechanism of awareness, recognition, memory and understanding, which are the elements of flow processes, has individuality. We then verified and considered the presence or absence of individuality in each phase.

Aiming to verify the presence or absence of individuality in awareness, we implemented services that detect individual behavioral states, determine the timing of information delivery and then deliver it, and then performed verification experiment. We verified whether or not emphasizing items individuals considered important in the information they received would affect their recognition. We then considered individuality in recognition and understanding. In the phase of "Memory", we performed a verification experiment concerning differences in memory depending on different presentation methods.

The individual was seen from three verification experiments by each phase. Hence, we believe that we can realize user-friendly information distribution methods by considering individuality in respective elements and changing information presentation methods accordingly. We also propose a method of modeling individuality toward service applications.

Key words: *Multimodal, Awareness, Sensing, Mobile Information Services*

1. Introduction

The recent development of mobile terminals has made it possible for consumers to obtain information irrespective of time and place. However, easier acquisition of information means that the amount of information transmitted to consumers has been mushrooming. Unable to process all incoming information, consumers unconsciously sift through information. Hence, providing information in expressive forms which consider individual characteristics has become one of the important needs of society.

We believe that different people receive information differently. We therefore believe that we can provide information in forms that are easy for consumers to process by individually controlling the nature of delivery in information distribution methods.

In this research, we divided individual reactions to information into four phases --- awareness, recognition, memory and understanding. We then verified and

considered the presence or absence of individuality in each phase.

We also propose a method of modeling individuality toward service applications.

2. Consideration of current information distribution services

We cite examples of email magazines and i-channels, which are prevalent in mobile terminals. In these information distribution services, users' personal information, e.g. birth date and genres of their interest, are registered beforehand and the users' current conditions are recognized based on the locations of base stations with which they regularly interact. Based on these data, we select information to be delivered and provide it. With the current method, we can consider only simple individuality and cannot consider detailed individuality, e.g. specific fields of interest and users' ongoing actions. Hence, there are cases in which

delivered information is wasted because we provide information that has nothing to do with users or we provide information when such information is unnecessary. Current information distribution methods include those using excessive production techniques targeting a large majority of people, such as TV commercials. They include cases in which users cannot receive precisely what the sender wants to communicate to users and thus information does not remain in users' memories. We attribute this to the fact that effective presentation methods differ among users.

Considering the above, we believe it is necessary to deliver information in manners by which users can easily receive information by understanding their physical and mental individualities, i.e. their fields of interest and preferences and their behavioral state.

3. Flow processes of receiving information

When a person receives information, two channels are primarily used: texts, visual images and layouts stimulate visual sensations, while sound effects, sound and melodies stimulate auditory sensations.

People become aware of those stimuli as signals, pay heed to the information carried by signals and then extract the information. They store the extracted information as knowledge. They use the stored knowledge to update and modify models that serve as individual criteria for value judgment. In case there is a defect in these flow processes, people do not take notice of information or cannot understand information, and are thus unable to smoothly receive information. We divided these flow processes into four phases – awareness, recognition, memory and understanding (Fig. 1).

4. Individuality in information presentation

In this research, we believe that every mechanism of awareness, recognition, memory and understanding, which are the elements of flow processes, has individuality. Hence, we believe that we can realize user-friendly information distribution methods by considering individuality in respective elements and changing information presentation methods accordingly. This chapter sheds light on the individuality of three of the four phases, excluding understanding.

4.1 Individuality in awareness

When people receive information, they receive stimuli through visual, auditory, cutaneous and other sensations. They become aware of the information by using changes in sensation. However, sensitivity to awareness significantly varies depending on what circumstances people are in when receiving stimuli. It is not preferable to present information by using stimuli that are used in the environment surrounding the people. In addition, people's actions are considered to heavily affect whether or not they can receive information. We define the combination of the environment in which we work with people and people's behavioral state as the situation. It is necessary to recognize the situation surrounding individuals and determine the mode of information presentation.

4.2 Individuality in recognition

When people become aware of a change in stimuli, they try to recognize what the information is. Even if the same information is provided, different people think about or understand the information differently. These phenomena take place because people receiving information have different feelings and evaluation

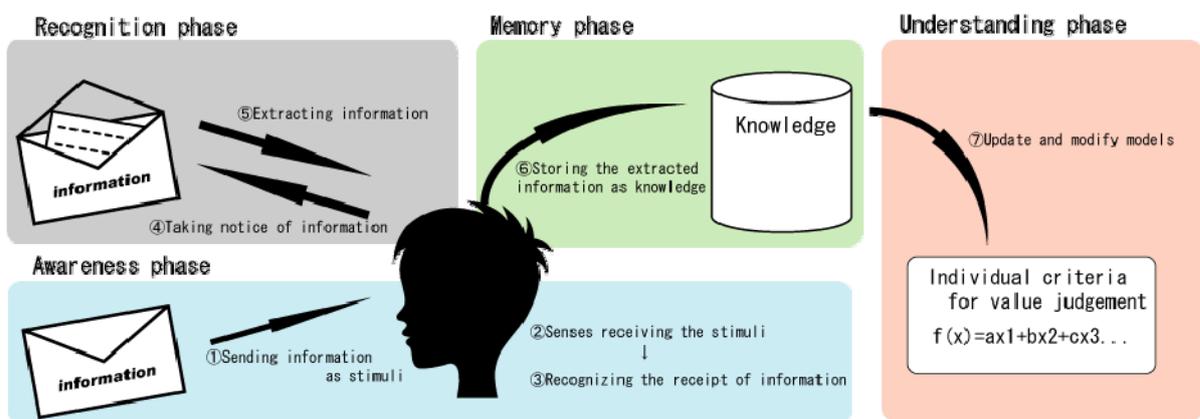


Fig. 1 Flow of information receipts by humans

criteria about information. Since different individuals emphasize different items, it is believed that appropriate modes of expression differ depending on the item they emphasize. In addition, since people's feelings and evaluation criteria vary depending on the information they recognize and understand, we need to have information presentation skills that understand what feelings or evaluation criteria individuals have about different information.

4.3 Individuality in memory

After recognizing and understanding information, people store the content of the information, their impression and so forth in their brain. They then take actions by using their memory. In this research, we assume that there is a difference in memory mechanism among individuals. We believe that individuality in memory is affected by stimuli used to present information. Since different people have different sensations that are prominent when receiving information, it is necessary to provide information in manners that stimulate individually effective sensations. In this research, individuality is examined by classifying stimuli into visual stimulation, which is overwhelmingly used in current information distribution, auditory stimulation and complex stimulation that combined both visual and auditory stimulations.

5. Verification experiment concerning individuality in awareness

Aiming to verify the presence or absence of individuality in awareness, we implemented services that detect individual behavioral states, determine the timing of information delivery and then deliver it, and then performed verification experiment.

5.1 Experiment contents

In performing this experiment, we implemented an information distribution service in which sensing devices were used to understand individual circumstances. This system senses circumstances surrounding users, using GPS and acceleration sensors. The sensing information was used to determine whether or not information is delivered to users. The information to be delivered is displayed on a small permeable HMD (Fig. 2). Information is browsed using the accompanying cruciform operation interface.

We provided the implemented information

distribution service in the Odaiba area and had test subjects use the service over the course of a day. In the experiment, we tabulated from the system log the number of times information was delivered during the day, the number of times the delivered information was browsed and the number of non-operational times, and verified whether or not the presence or absence of the considerations of circumstances will affect people's awareness.



Fig. 2 Display image of a small permeable HMD

5.2 Experiment results

The number of test subjects was 13 (considering individuality: 9; without considering individuality: 4).

Results of the experiment are described in Table 1 below.

	No. of deliver times	No. of browsing times	Browsing ratio (%)	Non-operational ratio (%)
Considering individuality	44.2	12.8	32.41	55.84
Without considering individuality	64.5	13.0	20.16	76.90

Table 1 Results of the verification experiment concerning individuality in awareness

Table 1 indicates that information distribution that took individual circumstances into account increased the browsing ratio of information and decreased the non-operational ratio. The decreased non-operational ratio shows that we could deliver information in situations when the test subjects could easily become aware of the information. Based on these results, it can be safely said that consideration of individual circumstances makes it possible to present information that takes individuality in people's awareness into account.

6. Verification experiment concerning individuality in recognition and understanding

In this experiment, we verified whether or not emphasizing items individuals considered important in the information they received would affect their recognition and understanding. We then considered individuality in recognition and understanding.

6.1 Experiment contents

We had the test subjects freely spend time in Odaiba for half a day, during which time we delivered information to their mobile telephones. After the conclusion of the experiment, we had them write the information they remembered from among the information delivered to their mobile phones. We performed a comparative verification based on the average number of correct answers.

In this experiment, we delivered information employing different presentation methods, i.e. different font sizes and colors, for different individuals. By performing a questionnaire survey in advance for the test subjects about the content of information they pay attention to, we changed font sizes and colors for items which they considered important (Fig. 3). We then performed comparative experiments between the uniform information presentation method and the presentation method with changed font sizes and colors to verify whether or not using different presentation methods for different people will help support people’s recognition and understanding.

6.2 Results and consideration

The number of test subjects was 33 (considering individuality: 12; without considering individuality1). Results of the experiment are described in Table 2 below.

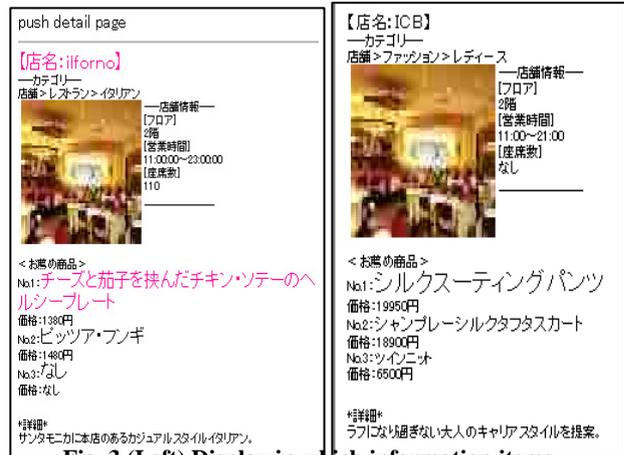


Fig. 3 (Left) Display in which information items considered important by individuals are emphasized (Right) Display in which information is uniformly presented.

	Total no. of replies	Average no. of correct answers
Considering individuality	34	2.83
Without considering individuality	14	1.4

Table 2 Results of the verification experiment concerning individuality in recognition and understanding verification experiment

Table 2 indicates that emphasis on the items noted by individuals led to the increased average number of correct answers. In addition, the number of replies to the delivered information increased. This demonstrates that we could enhance degrees of understanding and recognition by emphatically presenting information items regarded important by individuals.

7. Verification experiment concerning individuality in memory

7.1 Experiment contents

In this experiment, we provided product information to nine test subjects in our laboratory via personal computers and performed memory tests 10 minutes later. We prepared one Power Point sheet per one piece of information and instructed the test subjects to memorize informational descriptions shown on the display. A Power Point sheet used is shown in Fig. 4. For the memory test 10 minutes later, we prepared a form with five blanks and had the test subjects write what they remember in the order of recall. Only answers that

were verbatim were regarded correct while partially false or ambiguous answers were considered incorrect, and the percentages of correct answers for different presentation methods were compared.

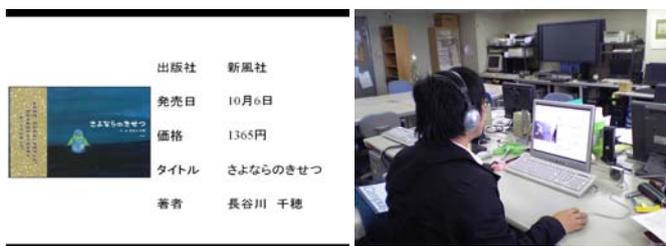


Fig. 4 Power Point sheet used during the experiment

Fig. 5 Actual experiment scene

As for content, we used a book whose content would not be affected by several stimuli. The experiment was performed with the following five explanatory items: title, author, publishing company, date of publication and price, and carried out in three presentation methods, i.e. by text, sound and both text and sound. As for the text, we used the same font. We showed every test subject two Power Point sheets each in every presentation method, i.e. a total of 12 sheets. Figure 5 shows an actual experiment scene.

7.2 Experiment results

The number of test subjects was 29. Based on the average ratio of correct answers of each test subject, differences were calculated for each presentation method. Presentation methods with which the ratio of correct answers was lower than the average ratio of correct answers by 10% or more were regarded as being disadvantageous. When the ratio of correct answers was below 10%, changes in each presentation method were considered nil. Figure 6 shows experiment results.

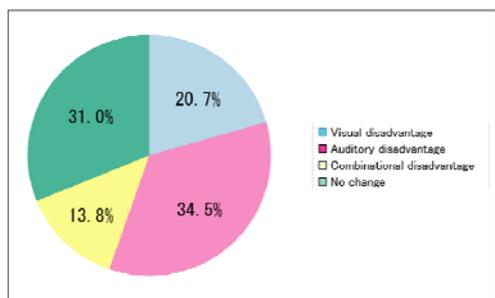


Fig. 6 Differences in memory depending on different presentation methods

As shown in Fig. 6, the order of disadvantages was as

follows: auditory disadvantage, no change, visual disadvantage and combinational disadvantage. This result shows that 69% of the test subjects had stimuli that they responded badly to when memorizing information. Since each of the three types of stimuli that they responded badly to accounted for certain percentages, we believe that different people have different sensations that they responded badly to.

8. Individual modeling in multimodality

We strive to realize information distribution that takes individuality into consideration by sensing the daily habits of individuals without placing burdens on users. To this end, we propose a method of modeling individuality in each of the awareness, recognition and memory phases from sensing information.

- (1) Estimation of individual circumstances (modeling of awareness)

We believe that we can estimate situations without causing physical and mental burdens on users by having individuals wear sensing devices to obtain data. The sensing devices are designed to estimate a) the external environment and b) individual behavior.

- a) Measure the types and degrees of stimuli that users are receiving by sensing the outside conditions with GPS, for example
- b) Measure the tiredness of users and degrees of concentration by sensing behavioral state and mental conditions with the acceleration sensor, pulsimeter, etc.

Based on the aforementioned two types of information, we estimate whether or not users can receive information and, if they can, what stimuli will be effective.

- (2) Estimation of individual evaluation criteria (modeling of recognition)

Through the accumulation of individual behaviors, we learn and analyze the natural behavior of users (movements, behavior and system operation). We then read their individual reactions to the system's delivery methods and determine what their fields of interest are and what they consider important. By doing so, we believe that we can estimate and model evaluation criteria and establish a system in which the system can learn.

- (3) Information presentation considering individual modality (modeling of memory)

Based on (1) and (2), we present information to those

who receive information. We devised three presentation methods: visual information presentation centering on texts and images using the monitor of mobile phones; auditory information presentation centering on sound using speakers and earphones; and visual information presentation that does not cause burdens on behaviors in the outside world using permeable HMD. We present information in a manner in which receivers can readily receive information from among these three methods. We then evaluate delivery methods based on users' reactions to the presentations, e.g. their behaviors and actions, and learn models

We believe that by using the aforementioned three methods, we can control the way in which individuals receive information and thus realize an information distribution service with which individuals can easily receive information.

9. Summary and Future Prospects

In this research, we separated the way in which individuals receive information into four phases – awareness, recognition, memory and understanding, and shed light on individuality in the three phases except for “understanding.” In addition, we performed a verification experiment concerning the individuality of each phase. Based on experiment results, we proposed a method of modeling the way in which individuals receive information.

As for the challenges facing us, we need to implement the method of service application proposed in this report, and perform assessment experiments with the aim of verifying its usefulness.

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