

RESEARCH AND PROPOSAL FOR NEXT-GENERATION MOBILE PHONE MANUALS EMPLOYING USER EXPERIENCE DATA

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ABSTRACT:

With the advances being made in digital information device multifunctionality and networking in recent years, there has been a tendency for users not to understand how to use such devices and thus under-utilize their functionality, as typically seen with mobile phones[1-5]. One factor contributing to this problem is user manuals, which usually count around 800 pages in the case of mobile phones in Japan, are not adequately serving their purpose.

We have proposed a new system for the ideal next-generation mobile phone manual. We focused on users' experiences operating mobile phones. We first built a rule base for filtering manual information that was extracted based on users' experiences operating mobile phones, and then by crosschecking the latest operation log entry with the rule base whenever a user encounters a problem, the system is able to instantly provide onscreen information to assist the user with the necessary operation for the current context. As for the system's core functionality, namely its realtime advice function and step-up advice function, we have already conducted tests proving its effectiveness through computer simulations targeting 40 users. Most of the testees agreed to add the realtime advice function and step-up advice function on their own mobile phones. The proposed system will assist usability of mobile phones for all generations from aged through child.

Key words: Mobile phone manual, User Experience, Information Filtering, Usability, Customize

I. INTRODUCTION

In proportion to progress the information society, many intelligent digital devices make people annoy how to operate them and cause people digital divides [1]. With the advances being made in digital information device multifunctionality and networking in recent years, there has been a tendency for users not to understand how to use such devices and thus under-utilize their functionality, as typically seen with mobile phones. One factor contributing to this problem is user manuals, which usually count around 800 pages in the case of mobile phones in Japan[6,7], are not adequately serving their purpose. Mobile phone manuals are long, users do not read the whole thing when they first buy a product, and the manual is often not nearby when there are operation-related problems. Even with handsets that have operation manual data stored internally, it is difficult to search for the necessary information, making such internal information impractical (Figure 1).

When users do not know how to operate their mobile phone, they usually ask someone who does, instead of looking in the manual, because they can get only the necessary information from that person, without troublesome effort of referring to the manual. The point is filtering manual information just fit to user's requirement at the current context for only that user who has had unique experience operating mobile phones. We have proposed a new system for the ideal next-generation mobile phone manual stored on each handset. We first built a rule base for filtering manual information that was extracted based on users' experiences of operating mobile phones, and then by crosschecking the latest operation log entry with the rule base whenever a user encounters a problem, the system is able to instantly provide onscreen information to assist the user with the necessary operation for the current context. As for the system's core functionality, namely its realtime advice function and step-up advice function, we have already conducted tests proving its effectiveness through computer simulations targeting 40 users. As subsection 5.4.2. shows, most of the testees agreed to add the realtime advice function and step-up advice function on their own mobile phones. The proposed system will assist usability of mobile phones for all generations from aged through child.

Before introduce our proposal, we will show you actual problems with mobile phone user's manual, and analysis of user's frequent operational error patterns using a mobile phone simulator.



An example of mobile phone manual. An example of on-screen navigation.

Fig.1 Examples of paper manual and on-screen navigation

2. PROBLEMS WITH MOBILE PHONE USER'S MANUALS

Manuals are for providing end users with the information necessary to use the product or service in question [8,9]. Mobile phone manuals in Japan are comprised of two thick volumes that together may total around 800 pages [6,7]. They cannot be read all in one sitting right after the user's purchase, they never seem to be on hand when there is an operation-related problem, and when they are on hand, it is never easy to find the necessary information. Mobile phone manuals in electronic form on the Web offer the exact same content as the paper manuals that come with the product [10], and thus have the same problems mentioned above. In recent years, some mobile phones have been offering onscreen manuals, but they are mainly text based, it requires a great deal of work to find the desired information, and beginners who are not used to operating a mobile phone cannot adequately utilize them. It is therefore obvious that mobile phone manuals in their current form are problematic in a great many ways.

The next section looks into actual usage by mobile phone users and the current state on the end actually providing mobile phones.

2.1 STUDY ON ACTUAL USAGE BY MOBILE PHONE USERS

In studying actual usage by mobile phone users, user interviews employing a three-point task analysis method based on Human Design Technology (HDT) [11] were conducted to 19 users. Specifically, a detailed study on information acquisition, understanding, decisions, and operation was conducted for a series of tasks comprised of obtaining the mobile phone, using it, and changing models, which are the principal stages of mobile phone usage. Interview results revealed the following problems with mobile phones.

1) When purchasing

- Users want to compare different models by operating the actual device instead of mockups or looking in catalogs.
- Technical terms and loan words from foreign languages are incomprehensible when comparing models.
- Contract agreements are incomprehensible.

2) When using

- Listed features cannot be put to practical use.
- There are features and services that users either do not understand or do not know how to use.
- When users do not know how to operate their mobile phone, they ask someone who does, instead of looking in the manual.
- Users want manuals that are better suited to their needs and easier for them to understand.

3) When changing models

- Users want to know which models are best suited for them.
- Users do not have a good understanding of new features.

The actual results of the questionnaire about mobile phone manuals were as follows:

Q1. *When do you read the manual?*

- Immediately after purchase: -----2 r. (respondents)
- Don't read as a general rule, unless there's something I don't understand: -----11 r.

- Don't read at all: -----6 r.
- Q2. *Do you know about online manuals?*
- Know about and have used: -----2 r.
- Don't know about them, but if they were made available would want to use more convenient manuals: — 6 r.
- Don't know about them and probably wouldn't use them in the future: -----11 r.

The results of this questionnaire reveal the following two points.

- 1) Mobile phone users want information and support in the purchasing, usage, and model change stages, but there is barely any instruction available, and even when there is, it is spotty.
- 2) Current manuals are hampered by the strong negative image of being hard to use and hard to understand, and this prevents them from being utilized effectively.

2.2 CURRENT STUDY ON MANUAL CREATION

The following points are clear after interviewing the manual planning and design divisions at mobile phone manufacturers and the manual creation divisions at manual creation companies.

- 1) Since carriers make bulk purchases of mobile phones from manufacturers, product and manual specifications are severely limited.
- 2) Carriers require that all operation procedures be covered.
- 3) Since inquiries for users are concentrated on carrier call centers, it is difficult for users' needs and opinions to reach manufacturers and manual creation companies.
- 4) Since the mobile phone market is nearing the saturation level, manufacturers and manual creation companies are seriously considering cost-cutting measures for manuals. The realization that paper manuals are reaching a limit in terms of customer satisfaction and cost is beginning to come to the fore.

2.3 DEMANDS FOR NEXT-GENERATION MANUALS

Studies conducted thus far clearly show that users want a broad range of information and support relating to the use of mobile phones, and this desire does not stop at manuals. It is therefore time to study comprehensive information services that include manuals by means of some form of electronic medium, but unless the system that is built has advantages not only for users, but also for carriers, manufacturers, manual creation companies, and other companies related to the provision of mobile phone products and services, it is clear that vast investments to cover the necessary development costs will be impossible.

3. SYSTEM MODEL PROPOSAL FOR NEXT-GENERATION MANUALS

The ideal manual for users is one that precisely provides only the necessary information when they are having problems operating their mobile phone. For example, users who do not know how to send their phone number to someone else via their phone's infrared transmission feature will probably ask someone who does,

instead of referring to the manual. The reason for this is, unlike manuals, people will provide only the information that is necessary and no more.

In order for a system to be able to provide a system similar to a user asking someone else, it must comprehend the current state of users' problems. And to comprehend the current state of users' problems, the system must have log data for each individual's mobile phone operations up to this point, and it must be able to predict the feature the user wants, based on that log data and the operation state at the current point. If the system knew the feature the user wanted to use, it would be able to filter information from the manual data and provide the user with the operation procedure for the target feature from the present usage condition.

The effectiveness of this algorithm will be examined later in this proposal. The model we are proposing for a next generation manual system, as shown in Figure 2, delivers a wide range of individual information services, starting with a custom service for operation information on mobile phones, as mentioned above, through internal device functionality and over the network. On the manufacturer and carrier end, the system is able to rapidly grasp detailed customer information that can then be used in improving services and developing products.

The next chapter looks into the utilization of operation log information, which is the core of this system model.

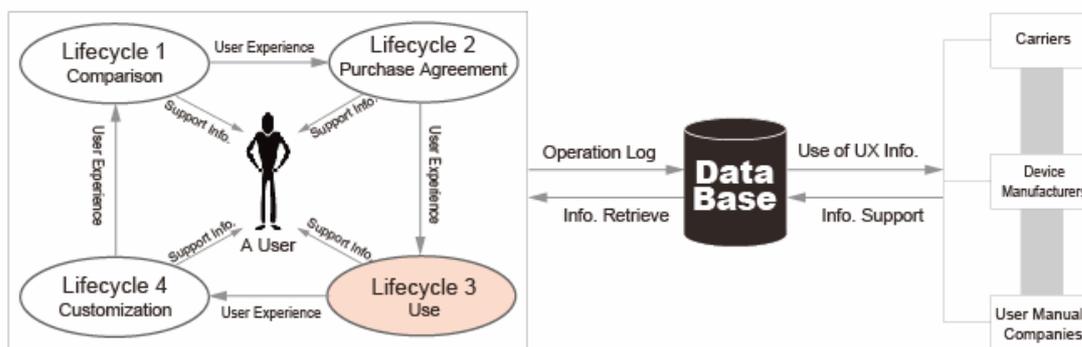


Fig.2 The model of Next Generation Manual System.

4. ACQUISITION TEST FOR OPERATION LOG INFORMATION USING A MOBILE PHONE SIMULATOR

Operation logs can be mined for clues into users' experiences operating mobile phones. We used a mobile phone simulator built on a PC to conduct tests to see what sort of information could actually be obtained.

4.1. CREATING A MOBILE PHONE SIMULATOR

We programmed our mobile phone simulator using e-SIM's Rapid PLUS 8.1 [12], a development tool used in developing device-embedded software and evaluating usability. The mobile phone model we chose for the test was NTT DoCoMo's P901iS, a popular model in Japan, and we built the interface for it on a PC screen. Figure 3 shows the screens created on the mobile phone simulator. Test subjects carried out designated tasks by using

the mouse to click mobile phone keys on the PC screen, and their operation logs that resulted were recorded on the PCs at 0.1 second intervals.

Figure 4 is a flowchart for the simulator and shows representative transition screens (Figure 5).

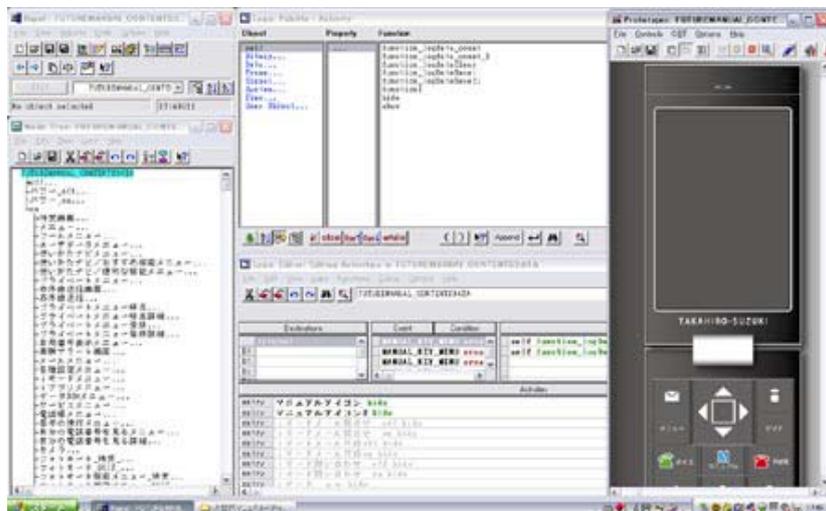


Fig.3 The mobile phone simulator programmed with e-SIM's Rapid PLUS 8.1.

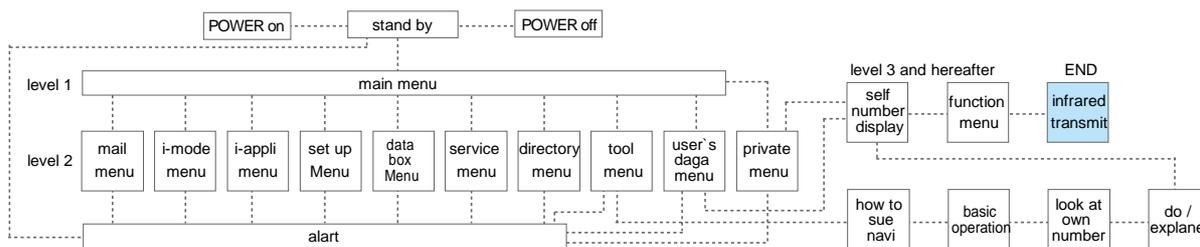


Fig.4 A flowchart for the simulator



Fig.5 Representative transition screens of the simulator.

4.2. TASK TEST FOR MOBILE PHONE OPERATION

In our test, we asked the test subjects to perform a task that consisted of using the infrared transmission feature to exchange a designated address and phone number that had been registered in advance. We then extracted and analyzed the resulting operation log information. There were 46 test subjects, all university students, and the test procedure was as follows (Figure 6):

- 1) The test subjects answered a questionnaire about their frequency of usage of the various features on the mobile phone they are currently using.
- 2) The team led a demonstration of the demo screen to teach the test subjects how to use the simulator.
- 3) The test subject used the simulator to perform the designated task.
- 4) We analyzed the questionnaire results and operation logs from the test subjects.

The test rules were as follows:

- 1) The task time limit was three minutes.
- 2) The address and phone number were both dummy data pre-registered on the simulator.
- 3) The simulator was designed to display an alert screen whenever a test subject selected a feature that was not necessary in achieving the task. After that, test subjects would continue with the task, starting from a standby screen.



Fig.6 Task test for mobile phone operation with a PC simulator

4.3. ANALYSIS OF TEST RESULTS

4.3.1. ANALYSIS OF TEST ON USING INFRARED TRANSMISSION FEATURE

Based on the pre-test questionnaire and the test results, we noted, as expected, a high rate of task achievement for the majority of the test subjects who had a great deal of experience using an infrared transmission feature (Figure 7).

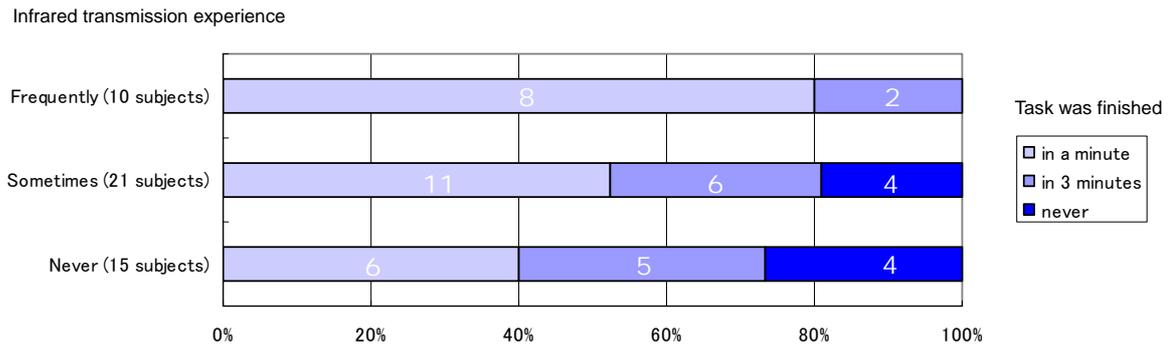


Fig.7 Correlation between Infrared transmission experience and test success

4.3.2. ANALYSIS OF OPERATION LOGS

We compared the operation paths of each test subject. The greatest number of operations by a test subject in completing the task totaled 199, while the least number was 5. We can see how the test subject who had the most operations repeatedly went in and out of the same menu screens a number of times. Such operation paths are unique to each test subject, and they reflect the subject's experience using the feature in question, as well as reveal the subject's planning and mental model for achieving the task.

4.3.3. ANALYSIS OF OPERATION SUCCESS AND FAILURE

Looking closer at the operation logs, we see that test subjects frequently either pressed the clear or off button after not performing any operations for several seconds or pressed either of those buttons after scrolling through the menu. Such operation paths show that subjects were trying to start over after not finding the feature they wanted and can be labeled operation failures (Figure 8). The pressing of the confirm button rather than the clear or off button can be interpreted as a progression toward the target feature, and therefore, it is considered an operation success (Figure 9). In this manner, test subjects made their way to the final goal of the task via their own mental model, along the way, they experienced minor successes and failures. We can safely assume that test subjects who got lost in a maze of failures would have liked some information support suited to their particular situation.

4.3.4. EXTRACTION OF FREQUENT OPERATIONAL ERROR PATTERNS

To show the operation tendencies of the test subjects, we graphed the total number of menus they selected by order of frequency. Figure 10 is a graph of the menus that test subjects selected at level one on the simulator flowchart. The User's Data Menu, which had the highest frequency, is the correct menu to select in reaching the target feature. However, the Directory Menu and Tool Menu, which were close numbers in frequency, have no direct relation with the infrared transmission function. It seems that the test subjects who selected the latter two menus were probably either thinking that they would start by searching for their own number from the

directory or that the infrared transmission function was in the Tool Menu.

Next, we studied the graph of the menus selected at level two (Figure 11). Here, too, we found that the menus Infrared Reception and Directory Search, which contain terms that bring to mind the designated task but do not have a direct link with infrared transmission, were frequently selected.

By studying these graphs, we can clearly see a pattern of operational errors that users easily succumb to when trying to perform the designated task.

Pattern A

Button	Display	Time (sec.)	Duration (sec.)
Conferm	Main menu	17.8	0.8
↓	Tool menu	26.4	8.6
Clear	Tool menu	26.8	0.4

Pattern B

Button	Display	Time (sec.)	Duration (sec.)
Conferm	Main menu	78.8	0.8
↓	Tool menu	79.2	0.2
↓	Tool menu	79.4	0.2
↓	Tool menu	79.6	0.2
↓	Tool menu	79.8	0.2
↓	Tool menu	80.0	0.2
↓	Tool menu	80.2	0.2
↓	Tool menu	80.4	0.2
↓	Tool menu	80.6	0.2
↓	Tool menu	80.8	0.2
↓	Tool menu	81.0	0.2
↓	Tool menu	81.2	0.2
Clear	Tool menu	81.4	0.2

Operation success

Button	Display	Time (sec.)	Duration (sec.)
Menu	Stand by	2.8	0.0
0*	Main menu	4.4	1.6
i-mode	Self number disp.	11.6	7.2
5	Function menu	13.2	1.6
Conferm	Infrared transmit	16.4	3.2

* short cut key

Fig.9 A log pattern of operation success

Fig.8 Log patterns of operation failures

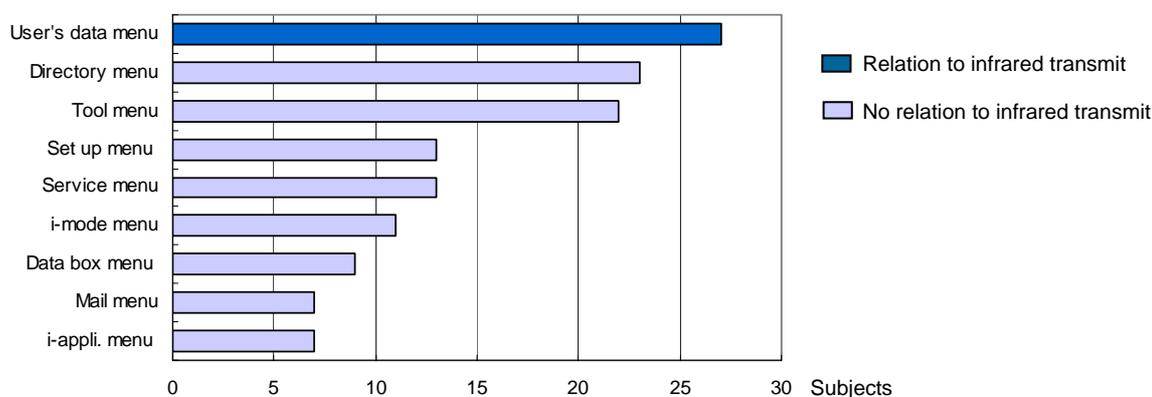


Fig.10 The total number of menus at level one the test subjects selected by order of frequency

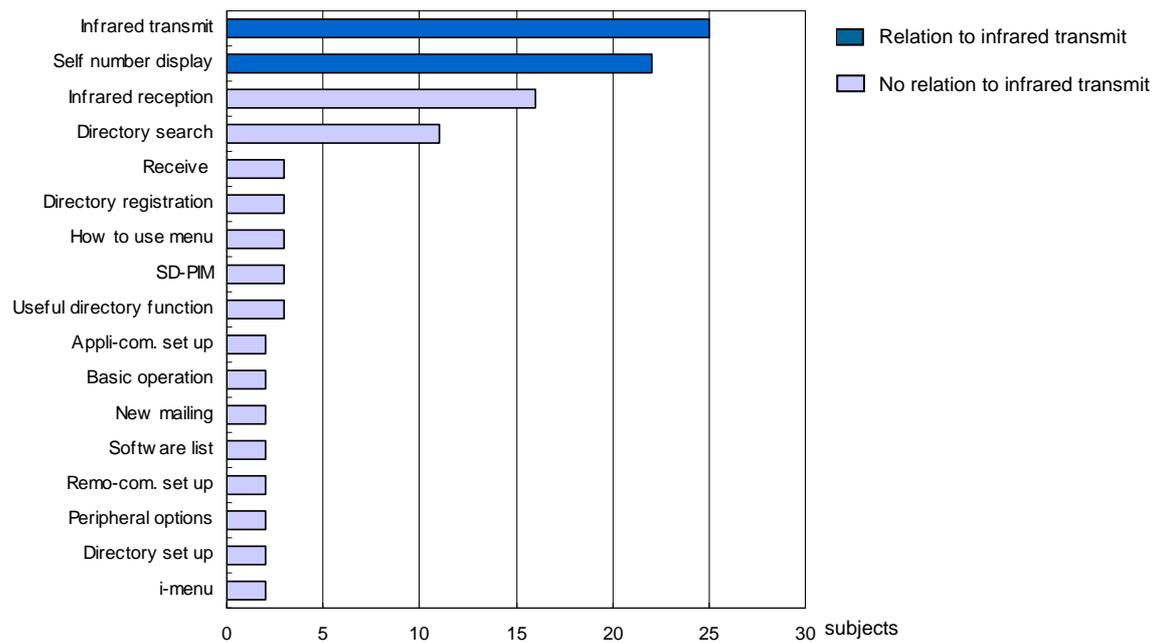


Fig.11 The total number of menus at level two the test subjects selected by order of frequency

5. USER EVALUATION TEST FOR CUSTOM INFORMATION SUPPORT BY INFORMATION FILTERING

The test outlined in the preceding chapter shows that we can use operation log information from numerous users attempting to access a particular function to extract a pattern of operational errors that they easily succumb to. Based on this, we can see the potential for filtering and providing manual information suited to a user's situation at the time he or she succumbs to operation problems. This can be done by creating conditional statements from the operational error patterns and then integrating them in advance into a system with a rule base that defines target features as decision statements. We therefore built a mobile phone simulator incorporating two information support functions (realtime advice and step-up advice) and then tested its effectiveness.

5.1. ALGORITHMS FOR REALTIME ADVICE AND STEP-UP ADVICE

Realtime advice is an information support function that uses realtime filtering to provide users with manual information suited to their situation whenever they succumb to operation problems. It consists of the following algorithm:

- 1) We define the operational error pattern for the model in question as conditional statements, build a rule base that defines the target features as decision statements, and then load them onto the device itself.
- 2) The system records and stores operation logs for success and failures by feature from the operation histories of users' thus far.
- 3) The user's current operation log information is totaled with the information from 2 above.

- 4) If the result from 3 above exceeds the operational error threshold after a crosscheck with the rule base, predicted feature choices are displayed as realtime advice on the mobile phone's screen.
- 5) The system makes its way through the operation procedure to the target feature by having users select the feature they want from among narrowed down choices.

The next step is step-up advice, in which the system detects specific features for which the user has proficiency and then provides information on related but even more advanced features, thereby prompting the user to use new features. The algorithm for this is as follows:

- 1) We define the proficiency pattern for the desired feature as conditional statements, build a rule base that defines even more advanced features as decision statements, and then load them onto the device itself.
- 2) The system records and stores proficiency data based on successes by feature in the operation log thus far.
- 3) The user's current operation log information is totaled with the information from 2 above.
- 4) If the result from 3 above exceeds the operational error threshold after a crosscheck with the rule base, predicted advanced feature choices are displayed as step-up advice on the mobile phone's screen.
- 5) The system makes its way through the operation procedure to the target feature by having users select the feature they want from among narrowed down choices.

5.2. CREATING A MOBILE PHONE SIMULATOR

We added the following functions to the mobile phone simulator described in Chapter 4 when performing the user evaluation test for custom information support.

1) Interface

- Added an M (manual) button to the mobile phone's control area to activate realtime advice and step-up advice (Figure 12).
- Added a transition screen and program for both types of advice.

2) Task for testing for realtime advice.

- As was previously mentioned, the test subjects used the infrared transmission feature to exchange a pre-registered address and phone number.

3) Conditions for activating realtime advice

Realtime advice activated whenever any of the following three operational error patterns, which were the most prominent in test described in Chapter 4, were detected.

- [Directory Menu => Confirm => Directory Search => Confirm => Return] + [Tool Menu => Confirm => Return]
- [Tool Menu => Confirm => Infrared Reception => Confirm => Return] + [Directory Menu => Confirm => Return]
- [Directory Menu => Confirm => Directory Search => Confirm => Return] + [Tool Menu => Confirm => Infrared Reception => Confirm => Return]

4) Task for testing step-up advice

- Use the camera feature to take and save one photo.

5) Condition for starting step-up advice

- Automatically starts when a step-up advice task is completed.

6) Content of step-up advice

- Information on setting the screen size, which is related to the camera feature, is provided.

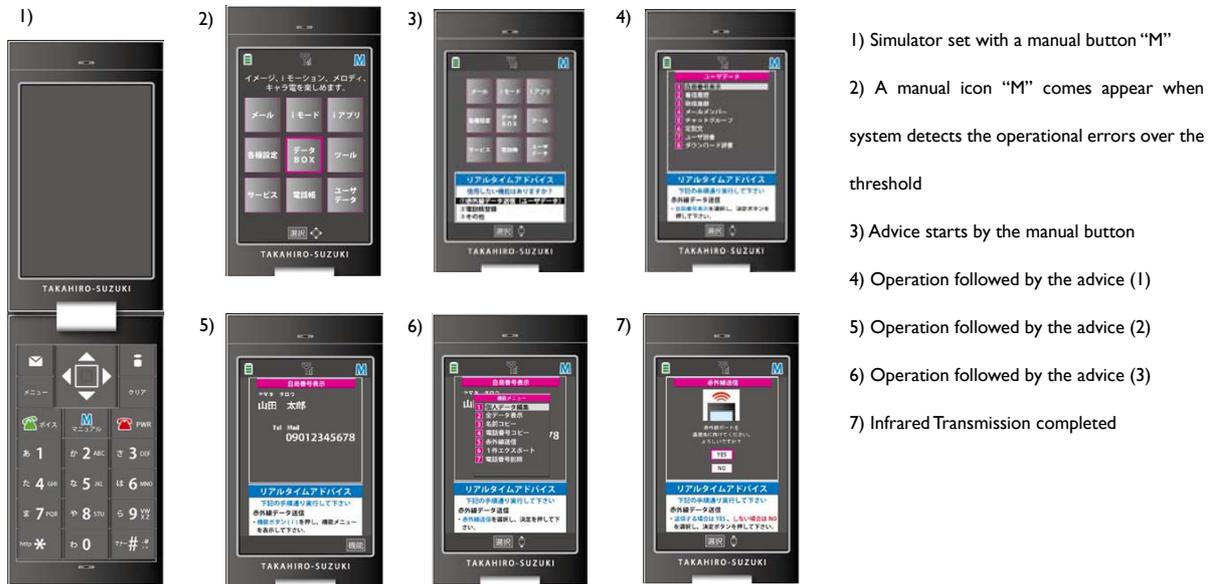


Fig.12 Representative transition screens of the realtime advice feature

5.3. USER EVALUATION TEST FOR CUSTOM INFORMATION SUPPORT

In this test, we had test subjects perform two tasks: use the infrared transmission feature to exchange a designated address and phone number that had been registered in advance and use the camera feature to take and then save one photo.

The test subjects this time were comprised of forty university students that had not participated in the previous test. The test rules were the same as last time. The test procedure consisted of steps 1, 2, and 3, just like last time. Step 4 was newly added as follows, and results were analyzed at the end in step 5.

4) We had test subjects, for whom realtime advice was activated, answer a questionnaire about the effectiveness of the advice. We had all the test subjects experience step-up advice and had them answer a questionnaire about its effectiveness.

5.4. ANALYSIS OF TEST RESULTS

5.4.1. ANALYSIS OF TEST RESULTS FOR REALTIME ADVICE

Based on the questionnaire completed before the test and test results, we can see a trend in test subject affiliation and test results. This is illustrated in Figure 13. This time, there was only one test subject who could not complete the task in three minutes, which is much less than the 8 test subjects out of the 46 in the previous test. Specifically, when comparing the test subjects from both tests who had no infrared feature experience, we found a significant difference of 5%. Out of the 40 test subjects this time, realtime advice

activated for seven of them, and out of those seven, six of them were able to complete the task in three minutes. The one test subject who could not had no experience with the infrared feature. Overall, this makes it clear that realtime advice contributed to an increased success rate for the task.



Fig13 Correlation between Infrared transmission experience and test success with realtime advice

5.4.2.ANALYSIS OF QUESTIONNAIRE RESULTS

We had the seven test subjects who used real time advice answer a questionnaire, and all of them selected the response “Realtime advice was helpful.” Furthermore, five of them selected the response “I would like it on my own mobile phone.” This clearly shows that realtime advice is effective in providing effective information to users who are having trouble operating their mobile phone (Figure 14).

We had all 40 of the test subjects answer a questionnaire about the step-up advice they experienced. Out of those 40, 32 selected the response “Step-up advice is convenient,” and out of those 40, 28 selected the response “I would like it on my own mobile phone.” This clearly shows that step-up advice, which teaches users about more advanced mobile phone features in a timely manner, will be accepted by users as information support that encourages mobile phone proficiency (Figure 15).

As you can see, both realtime advice and step-up advice were effective tools for our test subjects.

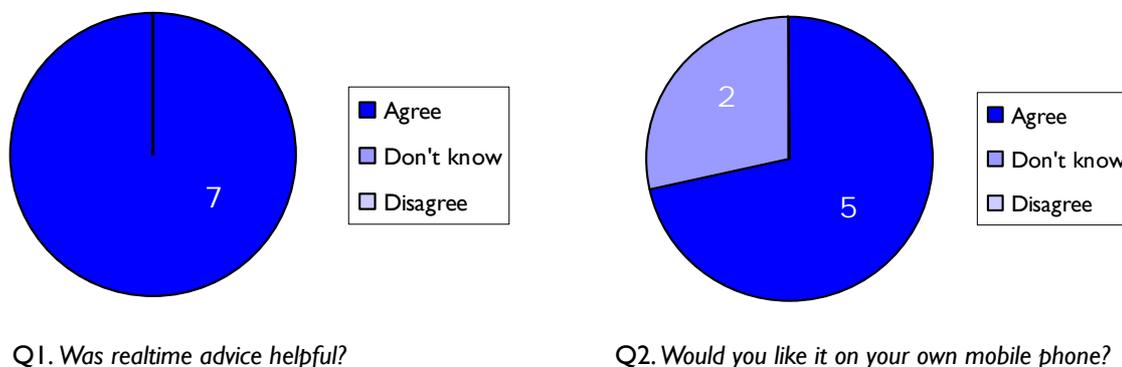


Fig.14 Effectiveness of realtime advice

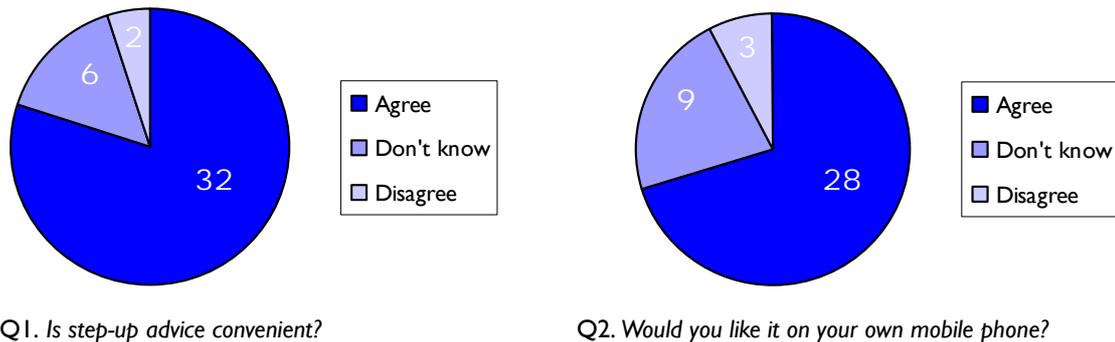


Fig.15 Acceptance of step-up advice by users

6. CONSIDERATIONS AND FUTURE ISSUES

Our tests thus far have clearly shown that custom information support suited to how a user is currently using his or her mobile phone, such as realtime advice and step-up advice, is very effective, and therefore it would be worth it to implement such custom information in the form of a next-generation manual. Such information support based on user experiences can be useful in supporting users in variety of forms, which in addition to the use and customization in the system model proposed in Chapter 3, also includes comparisons and purchase agreements.

At the same time, such user experiences can provide many hints for carrier and manufacturer service and product development, and the implementation of such a next-generation manual system would be desirable for everyone involved in the mobile phone market.

Implementing a custom information support feature on mobile phones runs up against the problem of how to compactly compile a database of user failure patterns and success patterns. The system would initially be built by compiling usability test data and user queries to call centers and so on into a database, but it would then be necessary to automatically extract failure patterns and success patterns over time from the operation logs of system users and use them to enhance the database.

Our research was limited to mobile phones, but the next-generation manual system we proposed could also prove effective for many other types of devices.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to Yamagata Intech Corp. for funding this research.

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