Proposal on operator-assisted E-Government Systems

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***Abstract*—Japan is ranked 18th in the world in the 2012 United Nation's e-Government database. People experience poor system usability due to bureaucratic wording (jargon) and non-universal interfaces. For a better e-Government system experience, we propose an operator-assisted e-Government system. In this system, operators at a call center assist applicants by giving application process guidance as well as taking over keyboard operation for people with low IT literacy. Jargon is a major obstacle in Web site usability; therefore, we propose an analysis tool for evaluating current Web sites based on a phrase difficulty index. Evaluation experiments on a prototype system suggested that operator-assisted application shortened the process time by 20% compared to conventional solo application. Also, errors were negligible for operator-assisted application. Calculated process times obtained from the analysis tool showed good agreement with the experimental results. The proposed e-Government system will greatly help to accelerate system usage by the elderly and people with low IT literacy.**

Keywords-e-Government; call center; Web site usability; jargon; operator-assisted application.

I. INTRODUCTION

The Japanese-Government has promoted an e-Government system since 2006. However, the acceptance of the system is not as high as expected. According to the United Nation's e-Government database in 2012, Japan ranked 18th in the world, while the Republic of Korea has remained on top for years [1]. Many studies on e-Government system usability were carried out and major issues were pointed out such as bureaucrat wording (jargon) and the lack of uniform interfaces among systems. Instead of fully redesigning the current e-Government systems, usability improvement of current system is desired in view of economy and speed.

We propose an e-Government system with a call center operator assistance for applicants to improve the user interface. The operator talks with applicants over the phone to help with the application process and takes over keyboard operation for applicants who are not familiar with Personal Computers (PCs) and the Internet. The proposed system's effectiveness was examined through model system experiments to measure the process time and errors in the application contents.

We use our proposed phrase difficulty rank evaluation tool for usability analysis of current Web sites. The evaluation tool is useful to determine the possibility of improving usability by adding the call center functionality for current e-Government systems.

Section 2 describes related work on e-Government systems and their usability issues. Objectives of this study are discussed in Section 3, and the model system experiments are explained in Section 4. The experimental results are given in Section 5, followed by the conclusions.

II. RELATED WORK ON E-GOVERNMENT SYSTEM USABILITY ISSUES

Web site usability issues have been discussed for years [2], [3]. At the beginning stage of the e-Government system, both governments and citizens expected the systems would be quickly and widely accepted. However, the adaption rate of e-Government systems is slower than e-commerce and other Web-site-based systems.

Fuchs clearly pointed out substantial differences between e-commerce and e-Government systems, e.g., no competition for the same services, lack of uniform outlooks, and subdivided territorial levels due to broad public administration scopes [4]. These findings explain why current e-Government systems' one-stop interfaces cannot be used for different applications (tax payment, passport application, etc.) and why system usability is usually lower than that of e-commerce systems [5-8].

Wording (jargon and technical terms) is a significant indication of low usability of e-Government Web sites [8]. Applicants are forced to take time to learn the jargon on the e-Government Web site pages. When jargon must be used in Web pages, proper explanation should be included. Also, application process guidance should be given on the Web page for applicants. We found that some e-Government Web sites have links to operation manuals, but most of applicants would not willingly spend time to either read the huge manuals in detail or even notice the attachments.

Gauvin et al. found that age is a markedly higher demographic determinant of Internet usage than education, income, gender, and urbanity [10]. Thus, assisting the elderly with the Internet and e-Government system operations has become an important issue for governments to better serve their citizens in view of e-inclusion [11], [12], [13]. Kim reported that "mass digital literacy campaigns" for several tens of millions of elderly, government officials, and housewives were carried out as Information Technology (IT) education programs in Korea, which has been consistently at the top of the e-Government system usability ranking. This is one of the key success factors for Korean e-Government systems [14], but such an education system is not always applicable to the large population of senior people like in Japan. Moreover, Internet access platform expands from the fixed line communication by PCs to smart-phones and

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tablets. Preparing education programs which cover all the different access platforms takes time and may not be ready when the evolution occurs on IT networks. This paper proposes a new user assistance system, which has better applicability than the user education.

III. PROPOSED E-GOVERNMENT SYSTEM

3.1 A proposed system function

Senior citizens and other people with low IT literacy require proper assistance to use an e-Government system. Therefore, call centers have been used as help desks to assist applicants with the e-Government system [15], [16]. Call center operators assist applicants by helping with the application process and answering applicants' questions on jargon. The call center system offers the flexible service by training operators for the access platform evolution. On the other hand, data protection and applicants' privacy protects are remaining issues for the call center system [13].

Our proposed system extends the call center operator function from verbally assisting applicants to taking over keyboard operation for applicants [17], [18]. This would greatly reduce the burden on low-IT-literacy applicants. This system is expected to reduce the application process time as well as minimize the operation and application errors.

As discussed in the previous section, e-Government systems which contain a large amount of jargon result in poor Web site usability and high possibility of making errors in the application process. Solo application process time may be longer through difficult Web sites than through operator-assisted application. Also, fewer errors in operator-assisted application are expected than on solo application. From this viewpoint, we believe that e-Government Web site usability can be measured based on process time and application error rates. These assumptions were verified through experiments and explained in the following Section.

We also propose a numerical analysis tool in terms of jargon difficulty in usability evaluation of current Web site. The jargon difficulty index definitions are given for the major phrases used on the Web pages. The difficulty levels are then applied to process time calculations for applications with and without operator assistance. By using the analyzed results (expected times and error rates), e-Government system owners can predict the call center effectiveness for current e-Government systems.

3.2 The system configuration

Operators located at call centers for e-Government systems talk with applicants over the phone (Fig. 1). During the application process, the applicant and operator share the Web pages of the application system through their respective PC displays (Fig. 2). The page sharing system is implemented by the following technologies:

a. Applicant identification: The applicants are given separate identification numbers (e.g., phone numbers) to correspond with the operator over the phone and Web pages.

b. Web page sharing between the applicant and the operator: Two Web page sets are prepared from the current e-Government system database: (a) Web pages for applicants and (b) those for operators. During the operator-assisted application process, the operator works on the PC keyboard and fills in the application form on the operator Web pages based on the conversation with the applicant. The application contents are stored in the database at the call center.

c. Confirmation of application contents: When the operator finishes keyboard work, the Web pages are displayed on the applicant's PC so that the applicant can check if the contents are the same as what the applicant gave to the operator. After content confirmation, the applicant clicks on the register button on the Web page and finalizes the application form to be sent from the call center database to the e-Government system.

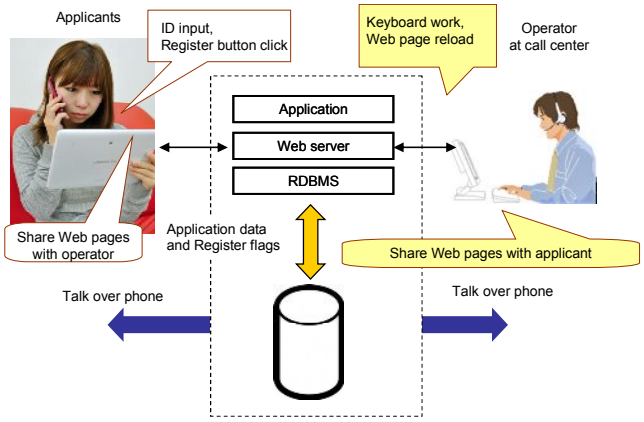

Figure 1. Proposed configuration for operator-assisted e-Government system.

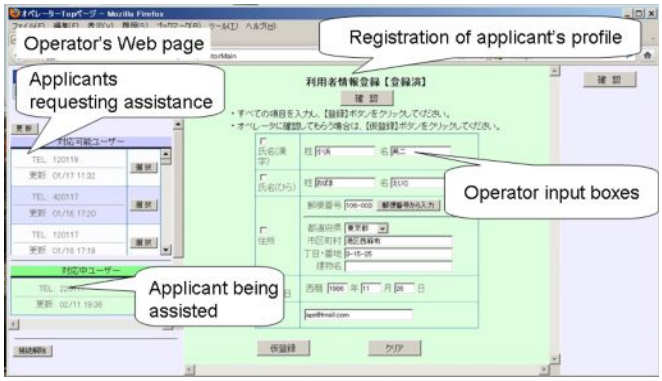

Figure 2. Example of operator's page on operator's display.

3.3 An evaluation tool for Web site usability

There are many materials to determine the difficulty level of kanji (Chinese characters used in Japanese language), mainly prepared for non-Japanese speakers. Basic Japanese words are also classified for Japanese students and foreigners [19]. However, most of the jargon found in e-Government Web sites are not included in the current basic word classifications and no difficulty levels are available. E-Government jargon requires a much higher reading level

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than for students because they are not common in text books, newspapers, and magazines.

We propose an evaluation tool to determine the phrase difficulty rank for jargon appearing in e-Government Web sites. The difficulty rank definition is given by assigning unique difficulty indexes as extended ranks in the Balanced Corpus of Contemporary Written Japanese (BCCWJ) [20]. The BCCWJ covers a wide range of popular phrases found in books, magazines, newspapers, and Web sites.

The index assignments are ranked as follows.

Rank 1: Phrases found in "Kanji (Chinese characters) 2100 [19]." This rank corresponds to the basic words at the reading level of junior high school students.

Rank 2: Phrases not listed in "Kanji (Chinese characters) 2100," but have 100 or more search results in the BCCWJ.

Rank 3: Phrases which have 10 to 99 search results in the BCCWJ.

Rank 4: Phrases which have less than 9 search results in the BCCWJ or only some of the words in the phrases are found in the BCCWJ.

Analysis of Web site usability is carried out as follows.

Step 1: List all the phrases used in an e-Government Web site.

Step 2: Assign phrase ranks to the listed phrases per the above-mentioned indexes.

Step 3: Obtain a summary of phrase ranks, which appear in a particular application theme (described below) before filling in one of the input boxes of the Web page.

The phrase ranks are also applied to the expected process time calculations by solo and operator-assisted applications, as described in Section V-3.

IV. EVALUATION EXPERIMENTS

4.1 Application themes

Evaluation experiments were carried out to confirm the effectiveness of the proposed system for improving system usability, as discussed in Sections 2 and 3. The measured parameters for usability comparison between current application systems and the proposed one were processing time and the number of application errors.

Based on current e-Government and e-application systems, six application themes were prepared on a Web server as a set of Web pages and databases. The themes were designed from simple to complicated processes as well as those which require good understanding of the process and jargon (Table 1). The design concepts for the themes are listed below.

Theme A: Registration of applicant profile; Applicant's name, address, etc. This theme focuses on the correct inputs for the application form.

Theme B: Certificate of residence: Applicants are guided to register their new bike. One of the requested documents is the certificate of residence. This theme examines if the applicant can choose the proper document required for bike registration.

Theme C: Family register certificate: Applicants are guided to change the legal domicile for their new passport.

The theme examines if the applicant does not mix the old and new domiciles, as well as current living address (note: in Japan, the legal domicile and the living address may not be the same).

TABLE I. NUMBER OF PHRASES IN APPLICATION THEMES CLASSIFIED BY PHRASE RANK.

Rank	A Regis-tration	B Resi-dence certifi-cate	C Family Regis-ter	D Confer-ence	E In-come tax	F Tax certifi-cate
1	5	0	0	0	6	4
2	2	3	2	2	7	9
3	0	2	2	8	11	13
4	0	1	0	5	11	13

Theme D: Technical conference registration: Applicants are requested to fill in the registration form for a technical conference. The theme is prepared to examine if the correct options have been selected and calculate the registration fee under given conditions (member discount, etc.).

Theme E: Income tax calculation: A simplified tax calculation system is provided. Applicants are requested to input the total income as well as deductions of life insurance, social insurance, and medical expense. The theme examines if the applicant can understand the deduction system described with a large amount of jargon and make correct calculations for the related deduction items.

Theme F: Tax payment certificate: The applicants need the tax payment certificate for housing loan refinancing. The certificate application form is complicated and difficult to understand due to the jargon. The theme design concept is similar to Theme E, testing information access and correct calculations.

4.2 The experiment design

Each test participant was given a separate identification number. The test participants were divided into either a solo application group or operator-assisted application group. The solo application group simulated conventional application systems. The operator-assisted application group was established to confirm the advantages of the proposed system.

The test participant and operator had their own PCs and displays, but they could not look at the other's. The applicant's profile (name, address, birth date, etc.) was given as a fictitious identity and was commonly applied to all the test participants.

4.3 The experiment process

Applicant action steps are summarized in Table 2. The solo application group tried to complete all the themes themselves. A test participant read a theme and understood what information and actions were necessary to complete the application. When the test participant could not understand

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TABLE II. APPLICANT ACTION STEPS.

Steps	Items	Actions for solo application	Applicant's actions for operator-assisted application
1	Read and understand theme	Web search for jargon and information of application process.	Asks operator to explain application process and gets advice over phone.
2	Fill input box	Types in requested contents in input box of Web page.	Answers to operator's question and allows the operator fill in input box.
Above steps are repeated until the last input box of Web page is filled.			
n	Confirmation	Checks the input results and clicks "Confirmation" button to proceed.	Shares Web page with operator. Clicks "Confirmation" button after input results confirmation to proceed.

the technical terms and jargon in the theme expression, he/she had to use Internet search engines for guidance and explanations and process the application the Web pages.

A test participant in the operator-assisted application group directly talked with the operator (one of the authors) instead of making a phone call. After the test participant chose a theme, he/she asked the operator for guidance. With the operator's guidance, the test participant gave information to the operator. The operator looked at the application Web page and worked on the keyboard. After finishing the input process, the operator told the test participant to update the Web page so that the test participant could confirm the given information correctly appeared in the application form. When the test participant confirmed the application form, he/she clicked on the "register" button on the Web page and the application was completed.

V. EVALUATION OF EXPERIMENT RESULTS

5.1 Test participants

Thirty-seven participants (20 students and 17 office workers) were divided into 27 solo applicants and 10 operator-assisted applicants. The operator-assisted group was smaller than the solo-application group, because the preliminary experiments showed highly consistent results for both the process time and errors in the operator-assisted applications. The participant profiles were classified by generation and years of PC experience (Fig. 3).

5.2 Experimental results

Both time and error comparisons suggest the effectiveness of operator assistance during the application process.

Figure 4 shows the experimental results of the average processing times for both solo and operator-assisted applications. Solo application took 20% more time to finish the latter three themes (D, E and F) than operator-assisted one. Error rates are also compared between solo and operator-assisted applications (Fig. 5). Operator-assisted application significantly reduced errors compared to solo

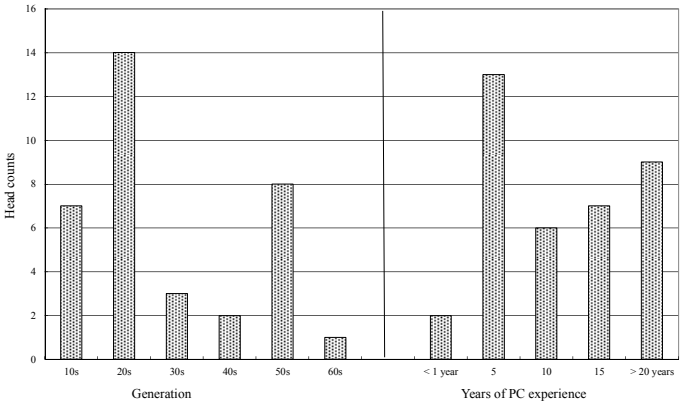

Figure 3. Test participant profiles (generation and years of PC experience).

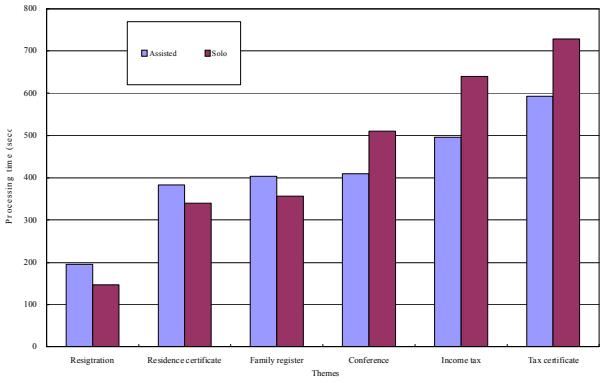

Figure 4. Experimental results of average processing times for operator-assisted and solo applications.

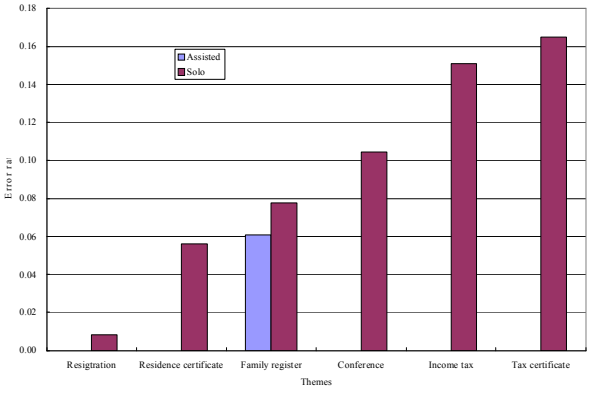

Figure 5. Experimental results of error rates for operator-assisted and solo applications.

application except the theme C, on which some participants confused the living address with the legal domicile and gave wrong information to the operator.

5.3 Experimental result analyses

Process time calculation was carried out using the proposed analysis tool for each experiment theme. Table 4 shows part of the analysis table for Theme E (Income tax calculation). In this example, the first input box is the medical expense tax deduction amount. Prior to filling in this box, the applicant has to understand the meaning of jargon such as "Medical expense tax deduction," "Medical insurance supplementation," and "Hospital expense grant". The phrase ranks for the jargon are given based on the rules explained in Section 3.3. A time factor is then applied to each phrase based on Table 3. The time factors were optimized by fitting the measured times in the experiments to time factor parameter sets. The time factor sum was calculated, and calculated time was obtained for solo application by multiplying the sum and a unit time defined to the input process. Following this process for the entire theme table, the total calculated time was examined. Operator-assisted time is also provided in Table 4.

The differences between solo application and operator-assisted application are:

a. Jargon search and time taken to understand was shorter for operator-assisted application than solo application because the operator could give proper advice to the applicants on the meaning of jargon and operation process.

b. Time to fill in an input box for operator-assisted application was longer than solo application. This was due to the conversation between the applicant and the operator to transfer the necessary information to fill the input box.

c. Verification process was added to the operator-assisted application. After the operator completed filling in the input boxes, he/she had to ask the applicant to check the box contents and to verify the application form. This process is not necessary for solo application.

The calculated times for six themes are shown in Fig. 6 and compared to the experimental results both for solo and operator-assisted applications. The calculated times showed good agreement with the measured results in the experiments. Processing time calculation would be useful to examine current e-Government Web sites in terms of the effectiveness of call center operators to obtain better user interfaces.

VI. CONCLUSION AND FUTURE WORK

We proposed an e-Government system with extended call center functionality. Call center operators talk with applicants over the phone and assist them by helping with the application process and taking over keyboard operations for applicants who are not familiar with PCs and the Internet, such as senior citizens. The proposed system's effectiveness was confirmed through model system experiments by measuring the process time and errors of the application contents for both solo and operator-assisted applications.

The experimental results suggest that the process time for complicated Web sites can be shorten by 20% by operator-assisted application compared to solo application. Also, errors which occurred in solo application were negligible in operator-assisted applications. We also proposed a phrase difficulty rank evaluation tool usability analysis of current Web sites. Analyzed results showed good agreement with the measured processing time for all the themes in the experiments.

These results indicate that the proposed e-Government system will greatly help to accelerate system usage by senior citizens and other people with low IT literacy.

For the future work, we intend to develop the error rate calculation method on the current e-Government Web sites for further site usability analysis. Some other indexes would be considered for the error rate calculation in addition to the proposed phase difficulty rank.

TABLE III. TIME FACTORS VS. PHRASE RANK.

Phrase rank	*Time factor*
1	1
2	1.3
3	1.6
4	1.9

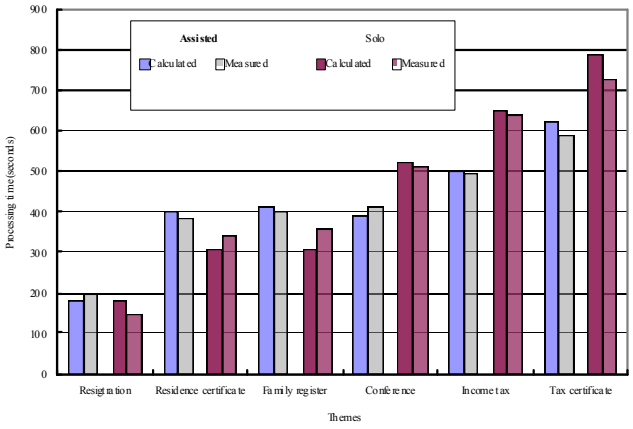

Figure 6. Comparisons of calculated and measured processing times for both solo and operator-assisted applications.

TABLE IV. PART OF ANALYS TABLE FOR THEME E (INCOME TAX CALCULATION)

Application steps	Jargon	Phrase rank	Input items	Time factor	Time factor sum	Solo application calculated time	Operator-assisted application calculated time
Read theme and understand/search	Medical expense tax dedction	2		1.3			
(Note 1)	Medical insurance supplementation	4		1.9			
	Hospital expense grant	4		1.9			
	Major medical expense	2		1.3			
	Family medical expense	3		1.6			
	One-off maternity benefit	3		1.6	9.6	96	30
Fill input box			Medical expense tax deduction amount			10	20
Verification between applicant and operator (Note 2)						—	10
Read theme and understand/search	Social insurance tax deduction	3		1.6			
(Note 1)	National pension	1		1			
	National health insurance	2		1.3			
	Nursing-care insurance	2		1.3			
	Unemployment insurance	3		1.6	6.8	68	30
Fill input box			Social insurance deduction amount			10	20
Verification between applicant and operator (Note 2)						—	10
Note 1: For solo application						Units in seconds	
Note 2: For operator-assisted application							

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