Understanding the Role of Multimodal Metaphors in E-Government Implementation: An Empirical Investigation

Mohammad Shkoukani, Yousef Elsheikh, Hesham Abusaimeh

1 Assoc Prof., Department of Computer Science, Applied Science University, Amman, Jordan
2 Asstt. Prof., Department of Computer Science, Applied Science University, Amman, Jordan
3 Assoc Prof., Department of Computer Science, Applied Science University, Amman, Jordan

m.shkokani@asu.edu.jo, yelsheikh@asu.edu.jo, h_saim.e@asu.edu.jo

ABSTRACT

Multimodal interaction metaphors have become a way to improve the usability of interactive systems, including e-government platform. This paper presents the experimental results of the inclusion of multimodal metaphors in e-government interfaces in order to enhance usability on the one hand, and trust between users on the other hand to eventually lead to the adoption and use of such interfaces on a large scale in the context under investigation. In this paper, multimodal metaphors that were used: visual and auditory stimuli and avatars. These investigations were evaluated by 40 users as it consisted of two different interfaces in each experiment to demonstrate the role of multimodal metaphors in the successful implementation of e-government interface platform. The results show the positive role of multimodal metaphors in increasing the level of usability in such interactive platforms on the one hand, and on the other hand increase the users trust, and learnability while interacting with those e-government platforms. Also, the results show the validity of the research approach adopted and the way in which users interact with e-government interface platform effectively and efficiently.

Keywords: Multimodal metaphors, e-government, e-services, usability, trust, human computer interaction

1. INTRODUCTION

Most platforms including e-government, which need to interact with users to deliver information either in one-way or two-way commonly used visual/pictorial channel with presentation of both printed text and graphics. But with the advent of multimedia technology, communication with users has become easier and faster by which is known as a multimodal interfaces, which are expected to add value when dealing with complex designs and get involved in the extraction of information from such interactive interface platforms including e-government [1]. This paper investigates the role of Multimodal metaphors (visual and auditory stimuli and avatars) on the successful implementation of e-government interface platform by focusing on aspects such as improving usability, learnability and build trust with users. This since the rate of usage of such interactive platforms is under expectations in the context under investigation [2]. This paper seeks to answer these questions:

Q1: Does the inclusion of multimodal metaphors (visual and auditory stimuli and avatars) affect aspects such as usability and build trust with users while using different interfaces of e-government platform?

Q2: To what extent can each of the multimodal metaphors in Q1 affect aspects such as usability and build trust with users while using different interfaces of e-government platform?

To answer these questions, two unrelated, independent groups of users participated in the empirical investigation of two different interfaces of e-government platform. The first interface includes texts to communicate the necessary information for the issuance of national identity, and is evaluated by the control group of users, while the second interface included a combination of multimodal metaphors (texts, images, recorded speech and avatars) to communicate the same information, and is evaluated by the experimental group of users. Three parameters for usability have been used in this paper, namely: efficiency (time taken to complete a task), effectiveness (percentage of tasks successfully completed) and user satisfaction and trust (post-experimental questionnaire with 5 statements rated on 5-point Likert scales in each interface) [3].

2. LITERATURE REVIEW

In spite of the progress made by some governments in the development of interactive e-services provided to users, there are still some challenges, especially in how to bring users to interact with these services effectively and efficiently [4, 5, 6, 7]. Design issues related to interactive e-services, including usability, are believed to be among the major challenges that governments face these days in order to enable users to communicate with different interfaces of the e-government platform, and thus ignorance in these issues often leads to failure in the development of such services in both developed and developing countries alike [8, 9, 10].

To move forward in the development of interactive e-services without any challenges mentioned, there is a need to focus on improving the usability of such e-services on the one hand and the interfaces through which the services are linked on the other hand. This implies the need for the development of multimodal e-government interfaces from the viewpoint of users and otherwise would face difficulty when they come to interact and communicate with those interfaces and e-services [11, 12]. In other words, good level of usability for the interfaces of the e-government platform is not
measured through the number of e-services provided to users, but is measured by whether the e-services provided meet the needs and expectations of its users [9, 10].

In recent years, studies have shown that multimodal interaction metaphors have the potential to increase the usability of many types of interactive systems [13, 14, 15, 16]. Examples of these metaphors are: speech sounds (recorded or synthesized), non-speech sounds (auditory icons or ear cons), and avatars with facial expressions [17]. A study of [13] found that the inclusion of multimodal metaphors in educational and recreational environments significantly affects the users’ learning outcomes, especially with the increase in user performance. In addition, they found that the increase in the user experience significantly affect the recall memory activities and recognition capabilities across all interactive platforms that have been evaluated. Experience was also found increasing steadily with the increase in the complexity of the learning tasks for each platform used in their study. Another study of [14] investigated the role of both the avatar with facial expressions and body gestures to increase the usability of e-commerce interface platform.

The results showed the importance of using facial expressions to create an effective interaction with the B2C interface platform. [15] Investigated the role of the multimodal metaphors to increase the usability of mobile services and applications. The results showed that the inclusion of multimodal metaphors both visual and auditory ones would improve the usability of mobile interface applications. Therefore, it is recommended to take these metaphors in mind when designing user interfaces of mobile applications. [16] Investigated the role of multimodal metaphors on the user’s understanding, reasoning and engagement in the e-feedback interface platform through three parameters to assess the usability of these interfaces, namely: effectiveness, efficiency and user satisfaction. The results showed an increase in usability in terms of effectiveness, efficiency and user engagement through the inclusion of multimodal approach to the e-feedback interface platform.

As the growing number of users of e-government services calls for universal access, multimodal interaction metaphors have become one of the potential solutions to access and adopt such these e-services, especially for those who suffer from disabilities or have some literacy barriers to do so. Those interaction metaphors simply provide users with multiple modes to interact and communicate with system interfaces effectively and efficiently [9]. Very limited studies have been conducted in this regard. [1] Examined the role of the multimodal avatar-based interaction metaphor on the usability of e-government interfaces in terms of efficiency, effectiveness and user satisfaction and trust. The results confirmed that the inclusion of expressive avatars in e-government interfaces improves the usability, user trust, response time to messages and the completion of the tasks assigned to them in a more accurate time. This paper re-investigates the role of multimodal interaction metaphors in the successful implementation of e-government interfaces, but in a different context of a developing country, namely Jordan, where access to technological resources remain uneven for different reasons [7] in order to move towards achieving “world-class” Jordanian e-public services.

3. EXPERIMENTAL PLATFORM DESIGN

Two e-government interfaces were deliberately developed to answer questions in this paper, as shown in figures 1 and 2, respectively. The first interface included texts, graphics and images to communicate the necessary information for the issuance of national identity, and is evaluated by the control group of users in the context given, while the second interface included a combination of multimodal metaphors (texts, graphics, images, recorded speech and avatars) to communicate the same information, and is evaluated by the experimental group of users in the context given as well. Three parameters for usability have been used in this paper, namely: efficiency (time taken to complete a task), effectiveness (percentage of tasks successfully completed) and user satisfaction and trust. These three variables were considered dependent variables while the independent variable was the method used to communicate the information (textual and multimodal) necessary for the issuance of national identity in the given context.

40 users were selected at random individual basis to participate in the experiment, as shown in table 1. Users were classified according to their age, gender, education and knowledge of using computers and especially the Internet.

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<th>Table 1: Population description</th>
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These users were distributed into two groups independent of each other; the first group (control group) to test the textual version interface only and the second group (experimental group) to test the multimodal version interface. Each group consisted of 20 users who have been
randomly selected to participate individually in the experiment, but in one of the two groups only without the other. After filling in all profile information of users in the experiment, a brief explanation was given to every user, whether from the control group or the experimental group, on how to accomplish the task of filling out the online form for the issuance of national identity by using different input modalities, as shown above in figures 1 and 2, respectively. These tasks were developed in order to measure the ease of communication and access to information on the one hand and on the other hand the clarity of the requirements of issuing national identity on the Internet in the given context. After that, users were given some instructions to fill out the two interfaces using different input modalities. The first interface enabled users to employ traditional input modes, such as text and images to fill the application form for the issuance of national identity, while the second interface included various input modes, such as text, images, graphics, recorded speech and avatars to do the same task as above in the given context. After the completion of each user’s task(s), he/she begins to answer a number of questions, same to both interfaces except post-questions, to measure the usability of the interface he/she dealt with in terms of three parameters, namely: efficiency in terms of the average time needed to accomplish the tasks in both interfaces, effectiveness in terms of the percentage of tasks accomplished successfully by users in both interfaces and user satisfaction with the inclusion of multimodal metaphors in e-government interfaces.

4. RESULTS AND DISCUSSION

4.1 Measurement of Efficiency (Time-To-Task Completion)

T-test was run on the data collected by each user participated in the experiment. Each user answered 3 questions (tasks) on the interface of which he or she is dealing with. This is in order to analyze and calculate the time spent by each user to answer each question from those given questions. As shown in Figure 3, the results showed that the average time to complete all the tasks was significantly less in the group that used multimodal interface compared with the group that used the textual interface ($t = 1.69, CV = 1.71, p <0.05$). The reason for this result was the inclusion of different input modes, such as recorded speech and avatars in the multimodal interface. During the experiment, users of the textual interface were forced to give more visual emphasis on texts and images to understand the information that was delivered to complete the issuance of national identity successfully and without errors, which led to the dispersion of attention most of the time, especially among those who do not have experience in dealing with such interactive interfaces. In contrast, users of the multimodal interface, they were able to focus their attention on the visual instructions that need to be followed in filling out the application form, and in the meantime listening to the communicated information and instructions together, giving them better focus and therefore faster response to the tasks to be accomplished. With respect to the results on the extent of the complexity of the task and its relationship to the time necessary to complete the task.
Accordingly, the inclusion of multimodal metaphors, such as recorded speech and avatars showed more effectiveness in the presentation of information for e-government interfaces from the use of texts only.

As shown in figure 5 time spent by users in the experimental group to perform both of recall (t = 3.90, cv= 1.65, p <0.05) and recognition tasks (t = 2.39, cv= 1.65, p <0.05) was less than the time spent by users in the control group. This means that the inclusion of multimodal metaphors to the experimental interface will help users of those interfaces in the call tasks more than those related to the recognition tasks. In other words, users in the recall tasks can take a longer time to get the communicated necessary information, while the case is different for the users of the recognition tasks, where the aim is to choose the right answer from a range of options.
4.3 Measurement of User Satisfaction

The results showed that users of the multimodal interface were generally more satisfied in the use of e-government interfaces than those who use the textual interface. The use of non-traditional input modes such as recorded speech and Avatar was interesting and attractive to users in the experimental group, where users expressed a more positive attitude towards visual-audio communication of the content in question. However, despite the ease of e-government interfaces that were tested, The results showed difference, but not much between the two groups of users satisfaction on the use of non-conventional input methods to interactive interfaces for e-government (questions 1 to 5 illustrate this in figure 7).

![User satisfaction results](image)

Figure 7: User satisfaction results

5. CONCLUSION

This study included 40 users to perform an empirical investigation on the usability of two interactive e-government interfaces developed for this purpose. The first interface included texts, graphics and images to communicate the necessary information for the issuance of national identity, and is evaluated by the control group of users in the context given, while the second interface included a combination of multimodal metaphors (texts, graphics, images, recorded speech and avatars) to communicate the same information, and is evaluated by the experimental group of users in the context given as well. The results showed that the inclusion of multimodal metaphors (texts, graphics, images, recorded speech and avatars) can improve the efficiency of e-government applications in the given context. This was all through the following: 1) the difference in the total time to complete the required tasks, where it was less when multimodal metaphors were included compared to other traditional interface in order to communicate information on e-government, 2) the difference in the total number of tasks accomplished successfully by users, where it was somewhat lower for users of text based interface of those who use multimodal based interface, 3) Despite the ease of government experimental platforms, the overall impression was more positive for those who use a multimodal-based interface of those who use the text-based interface. The results of this paper addressed the importance of multimodal metaphors in promoting users’ learnability and trust on the one hand and on the other hand the usability of e-government interfaces with regard to the level of achievement and satisfaction of users.

ACKNOWLEDGEMENT

The authors are grateful to the Applied Science Private University, Amman, Jordan, for the full financial support granted to cover the publication fee of this research article.

REFERENCES


AUTHOR PROFILES
Mohammad Shkoukani is currently working as an associate professor in Applied Science University. He received his B.Sc. degree from Applied Science University, Amman, Jordan in 2002, M.Sc. and Ph.D. degrees from The Arab Academy for Banking and Financial Sciences, Amman, Jordan, in 2004, and 2009 respectively, all in Computer Information Systems. His research interests include Agent Oriented Software Engineering, System Analysis and Design, and Electronic Commerce Applications.

Yousef Elsheikh is an assistant professor of Information Technology at the Applied Science University. He holds PhD in Informatics from University of Bradford, UK and MSc in Information Technology from University of the West of England, UK. He is currently working as a faculty staff member in Computer Science department at the Applied Science University. His research interests includes conceptual modeling, e-business applications, information systems engineering, knowledge based representations, Ontologies and issues in software engineering.

Hesham Abusaimeh received his B.Sc. degree from Applied Science University, Amman, Jordan in 2003, and M.Sc. degree from New York Institute of Technology in 2004, both in computer His Ph.D. degree in computer science in the field of wireless sensor networks communication and routing protocols from Loughborough University, UK in 2009. His research interests include Network and Controls, Routing Protocols, Network Lifetime and Consumption Energy, wireless sensor networks, and web applications security.