Towards effective telephone-based delivery of government services

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Abstract

Government regulations have combined with a tremendous growth in prepaid cellular telephony to bring telephone connectivity to an unprecedented number of South African citizens – thus creating an ideal platform for delivering services to a wide cross-section of the population. A further advantage of telephone-based services is the relatively low levels of infrastructure and user sophistication at which such services can operate. We believe that useful services can be delivered to citizens equipped with nothing but a normal telephone, and requiring no more than the ability to understand and respond to spoken commands. Such a verbal interface is highly appropriate from a cultural perspective in South Africa, where a strong oral tradition exists amongst a substantial pre-literate or semi-literate population.

Practically realizing the potential of telephone systems for government service delivery poses a number of interesting scientific questions. Most importantly, the majority of current telephone-based services are aimed at users with a high level of literacy, technical and otherwise, and little is currently known about the appropriate deployment of such services for users outside that mould. We have therefore embarked on a programme aimed at understanding how to develop efficient, effective, and usable telephone-based interfaces to informational and transactional systems, within a developing-world context. Several variables are expected to influence users' experience of such systems; our initial experiments have focused on the following set: mother tongue, gender, age, level of functional literacy, and mean family income. These variables are likely to interact with various aspects of the interface design; to explore these interactions, we have designed two classes of interfaces – one using speech recognition and the other using keypresses.

We report on initial findings that are serving as a base for the design of our next phase of experiments and extensions to the technology framework.

1. INTRODUCTION

The "Government to citizen e-governance" project is a three-year research and development project aimed at understanding issues around enabling effective electronic service delivery to citizens in a developing world context and to developed technology that will enable such service delivery.

The project is being undertaken by CSIR in South Africa and the Fraunhofer-Gesellschaft: Research Institute for Open Communication Systems (FOKUS) in Germany. FOKUS has developed the Enago Open Services Platform (IKV++ Technologies) which is an advanced, standards-based, distributed, object-oriented application integration middleware platform allowing for effective integration of government services and multiple delivery mechanisms. CSIR has experience in technological innovation aimed developing and adapting technology to developing world conditions such as that which exist in South Africa.

The project investigates 'non connectivity barriers' to accessing electronic government services. We are specifically interested in extending e-government access beyond conventional web interfaces to provide citizen's access via telephone-based services. Our approach on the project includes building on existing learning and undertaking field experiments involving citizens from various cultural and socio-economic backgrounds.

This paper specifically looks at issues presented by telephone-based delivery of government services. We provide the necessary context in section 2 and consider usability issues associated with telephone-based delivery in section 3. In section 4 we describe our experimental methodology. In section 5 we conclude with preliminary results and discuss future work.

2. BACKGROUND

E-government could easily be viewed as a luxury best left to developed countries with substantial budgets and not something that we should concern ourselves with as a developing country. We argue that the opposite is true. Precisely because we do not have the kind of budgets that will allow for huge efficient bureaucracies to provide quality services to citizens we need to look at technology that can enable us to deliver services to all despite constraints that exist. E-government services in South Africa need to: improve the efficiency and quality of government services, ensure that government services are delivered to all levels of society at the most convenient times and locations, grow government's portfolio of services, create government service transparency, and provide citizens with feedback mechanisms.

Effective implementation of e-government in South Africa requires research not only on technology but also on issues specific to our context such as multiculturalism, multilingualism, literacy, technology literacy and socio economic patterns. Local research and development on these issues can lead to an improved understanding and stimulate indigenous technological innovation in e-government technology.

In South Africa approximately 3 million people have Internet access (Goldstuck 2002). This represents approximately 1 in 15 South Africans. On the other hand there are 13.5 million cell phone subscribers (approximately 1 in 3 South Africans), which is estimated to grow to 21 million subscribers in 2007 (Knott-Craig, 2002). By September 2002 South Africa's national fixed line operator, Telkom, reported over 4.9 million fixed access lines (just over in 1 in 10 South Africans). From these statistics it is clear that telephonic access has by far the biggest potential to reach citizens to enable electronic service delivery.

A further advantage of telephone-based services is the relatively low levels of infrastructure and user sophistication at which such services can operate. We believe that useful services can be delivered to citizens equipped with nothing but a normal telephone, and requiring no more than the ability to understand and respond to spoken commands. Such a verbal interface is highly appropriate from a cultural perspective in many developing countries, where a strong oral tradition exists amongst a pre-literate or semi-literate population.

Based on the above, a significant portion of our research therefore concerns gaining improved understanding on telephonic access in our context. This research will enable us to develop technology to overcome obstacles to telephone based delivery of government services.

3. TELEPHONIC ACCESS IN THE SOUTH AFRICAN CONTEXT: USABILITY ISSUES

Graphical user interfaces have been studied intensively in the past two decades, and there has been tremendous progress in determining how to develop usable solutions with such interfaces. Some of the principles developed for graphical interfaces can be generalized to spoken interfaces. In particular, principles crucial for any user interface, regardless of modality include: careful user modelling, thorough understanding of the task domain, and utilization of the characteristics of the underlying technologies. Another principle that holds equally true for graphical and spoken interfaces is the importance of usability testing: by involving trial users (outside the design team) throughout the design process, an improved product can be developed in a reduced amount of time.

These principles will go some way in assisting us with the development of user interfaces for the services we wish to develop. However, the specific nature of the spoken interface – especially for users with limited literacy and technological experience – is certain to introduce issues that have not been considered before in the delivery of services for e-government. (Most importantly, the principles of dialog design for efficient and effective user interaction should be understood. Also, we need to understand how requirements for trust and accountability are satisfied with a telephone-based interface). We will therefore develop a programme of carefully designed experiments to study usability issues when a spoken (telephone-based) interface is used to deliver e-government services.

3.1 The influence of culture

The South African context provides a good example of the cultural issues that should be addressed when developing user interfaces for e-government service delivery in the developing world. South Africa has 11 official languages (in addition to several languages

that do not have "official" status), and there are wide disparities within and between the various language groups in socio-economic standing and literacy (PANSALB; SAARF). Before 1994, a racially selective elite ruled the country in non-democratic fashion, and this history has fostered a deep mistrust in government. Compensating for these historical injustices requires particular attention to the needs of citizens who are functionally illiterate, do not speak a "world language" (such as English), and have been denied access to the benefits of modern technology.

This situation calls for the development of services that explicitly take into account the variables that will influence the user's interaction with the service. These variables include: Language of choice, Age group, Gender, Level of functional literacy, and Mean family income. We intend to investigate the role of these variables in user access to e-government services. A full understanding of all these issues is not achievable within the scope of our project, but it seems reasonable that analyses of general media access (for example, the "Living Standards Measure" developed to assess the impact of advertisements (SAARF)) will form a suitable basis for initial work.

3.2 Input modalities: speech recognition vs. touch tone

By the reasoning of Section 2, our focus is on *spoken* telephone-based interfaces, as opposed to data-mode interfaces such as WAP or WIG. Such spoken interfaces can obtain user input in the form of keypresses also known as "touch-tone" or "Dual Tone Multi-Frequency" (DTMF) input, or spoken commands (using speech recognition). Touch-tone systems are generally more robust and easier to implement, but speech recognition promises a more natural user interface – which can be particularly important for users with limited technical and general literacy.

The requirement that the interface should function in the caller's language of choice further complicates this trade-off: current speech-recognition interfaces are still restricted to a limited set of languages. Thus, if current availability were an overriding concern, touch-tone would be the only feasible input option. However, there is a strong likelihood that speech recognition will become available in several additional South African languages in the coming years, and we therefore decided to include a comparison of both interface modalities as a major contrast in our study.

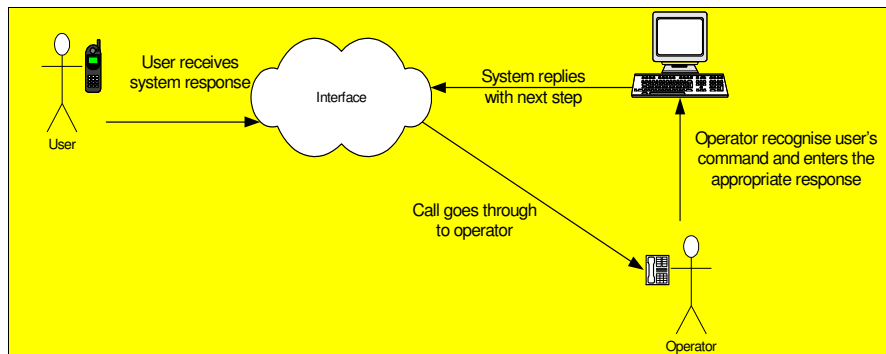## 4.   EXPERIMENTAL METHODOLOGY

4.1 Workshops

The issues raised above clearly require inputs from experts in a variety of disciplines. To gain access to such expertise, we have initiated a series of workshops with specialists on topics such as human-computer interfaces, cultural factors, and government services. These workshops have provided us with a wide range of opinions on the interface approaches we should attempt, the user populations we should investigate, and the evaluation criteria for assessment of the various approaches. Below, we describe the application that was targeted for our development, and the initial development that was undertaken.

4.2 Application Selection

To investigate the HCI issues, a practical service delivery application was selected, based on a few criteria. The application had to be complex enough to explore the issues raised above. It also had to be feasible with a telephone-only interface, and be practically relevant for non-specialized users. We decided to implement a system that would make it possible for telephone users to obtain information on, and apply for support from, the Unemployment Insurance Fund (which is currently of much interest to the South African Department of Labour (SA Department of Labour).

4.3 Technology support for experiments

The experiments to be conducted require technological support in the form of a DTMF and speech recognition system. We have developed a first working version of the DTMF system and a "Wizard of Oz" mock-up of a speech-recognition system. Wizard of Oz refers to an approach that is commonly used in developing and prototyping speech recognition systems (Dey, 1997). In a Wizard of Oz, a human operator imitates the working of the recognition component as illustrated in Figure 1 below. The current version of these systems will be enhanced and extended based on the results of experiments conducted and to introduce more functionality that is complex.

Fig. 1. Diagrammatic representation of the Wizard of Oz speech recognition experiment

5.   PRELIMINARY RESULTS AND FUTURE WORK

We have performed an initial analysis of the DTMF-based system described above, using the methodology of Heuristic Evaluation (Nielsen, 1994:78-79). This evaluation demonstrates the complexity of designing such interfaces: although the system was broadly judged to be successful, it was found to be lacking in unexpected ways by users from specific cultural backgrounds. For example:

- ❑ Certain evaluators found terms such as "valid" or "menu" to be confusing.
- ❑ Commands such as "to do X, press Y" were judged too authoritarian in certain cultural settings; evaluators preferred "If you would like to do X, press Y".
- ❑ Even though the system cannot be used to obtain money directly, some evaluators felt that it was not sufficiently "secure" or "private".

These initial findings will serve as input for a further round of improvement to our touch-tone-based system; we have also refined the system using speech recognition based on these experiences. Both systems are also being translated into an indigenous language.

The next phase of the project will be a usability test involving "naïve" users from various population groups. We have established contacts with a number of multi-purpose community centers (MPCCs), and visitors to these centers will be employed as experimental users. The first set of experiments will focus on two fundamental issues, namely speech vs. touch-tone, and the importance of home-language interfaces. As with the Heuristic Evaluation, general user comments will again be an important source of information for a further round of improvements.

6.   CONCLUSION

During the execution of the project so far we have interacted with a wide range of stakeholders and experts on issues ranging from actual government services, access statistics in South Africa, Human Computer Interface issues and more. Our experiences in the regard has been very positive and it is clear that there is a shared view that research on e-government in South Africa is an important issue and that much work remains to be done. The project is enabling co-operation between South African scientists and their German counterparts benefiting both.

The results of the project will be integrated in a practical technology demonstrator aimed at showing the potential of improved government to citizen service delivery based on local research and development.

7.   REFERENCES

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