Factors Affecting Usability of Telecommunications Services by People with Disabilities

Mr. Nicolas Hine, Dr. William Beattie & Dr. John Arnott,
MicroCentre, Applied Computer Studies Division, University of Dundee, Scotland.
Phone. +44 1382 344711, E–mail: nhine@mic.dundee.ac.uk

Abstract

This paper presents an interim attempt to develop a method of anticipating and recording the problems that users with disabilities face as they attempt to use telecommunications services and the potential solutions that might address the problems. This analysis is part of the wider question of finding the services that users need, and the needs that they have for adaptations to the services as they are currently presented or are foreseen to be presented.

Key words: Disabled users, Telecommunications services, User Requirements

1. Introduction

The use of telecommunications services involves the user interacting with a complex set of elements and the performance of a wide variety of activities. Modern and future services will allow the use of a variety of media, both in the manipulation of the services and for the exchange of information.

If a user has a disability, it could make a service unusable. With such a complex system, it is necessary to isolate the location of the barrier that is preventing the user from using the service. The notion of barriers has been explored and presented in past activities considering the use of telecommunications services. In its simplest form it proposes barriers at three levels, the Terminal, the Network and the Services [Hine (1991)]. An unusable terminal may prevent access to the network. Network access and interaction procedures that are unusable will be a barrier preventing access to the service. An unusable service will be a barrier preventing access to the information being made available by the service. More detailed analysis reveals that factors such as media and user procedures at each of these levels further complicate the situation.

These factors have been built into a structured approach that allows the dominant barrier that could be preventing access to mobile services to be isolated. This structure recognises both Goal Tasks and Enabling Tasks interactions [Whitefield et al (1991)], and seeks to take into consideration the user's ability, interactions associated with the services, the network and the terminal, and the media involved at each of these levels. The structure has been developed as a system that can be used to record the initial state of the users potential interaction with a services in order to identify potential barriers in individual cases. As these are investigated from available literature or experimentally, potential solutions can be recorded

within the structure, and the implications for each proposed solution on the rest of the system highlighted. In this way, the structure can be used as a “road map” from initial analysis of potential problems, to the final solution, together with the reasoned argument for a preferred solution.

In this paper, the structure will be presented and explained. It will then be illustrated with a worked example where the use of a mobile telecommunications system is to be made usable by people who have difficulty speaking.

2. The Process of Identifying Requirements

When considering the user’s needs and the problems that user face, it should be recognised that there are a number of factors that affect the usability of telecommunications services for all users. These include:

- The Task that need to be performed
- The User’s Abilities to perform the tasks and use the service
- The Telecommunications Systems available which provide the service
- Cost/Availability of the service

If a user experiences difficulties in interacting with multimedia telecommunications or mobile telecommunications services, the cause may be difficult to isolate within these various factors. Even if the cause may be pinpointed, the most appropriate solution may be difficult to determine, as a solution based on a change in one factor may cause a new problem with another factor.

Suugested steps in the process at arriving at a workable system by isolating problems and finding solutions are detailed below:

1) Describe the set of factors that affect the usability of services. This description is recorded on the prepared form.
2) This allows problems to be highlighted and possible solutions to be recorded.
3) Impliment a possible solution.
4) Reconsider the description outlined in the form to check if the sloution has repercussion on another aspect of usability.
5) Repeat steps 4 and 5 until a stable more and usable system has been implimented or until all possible solutions have been attempted.

3. Detailed breakdown of Factors Affecting Usability of Telecommunications Services

3.1 Task

The user of any service has two types of task to perform when using a service. These are :-

Goal Tasks - what the user wants to do. This might be to Give/Get/Exchange information with a remote person/machine. To perform the goal task the user may have a requirement that might be met by using a telecommunications service - i.e. the service may allow them to achieve the goal.

Enabling Tasks - what the user has to do to get the system & media ready to do a goal task. so that the goal task can be performed. This will include the user procedures required to prepare the system and the need to control the preparation of media so that it is suitable for use by the service. For example, procedures governing the capture and editing of material may be needed if the material is to be used by a particular service.

3.2 User's Abilities

The users ability to use a service will depend on a number of factors including :

Sight
Hearing
Speech
Dexterity
Intellect
Education/Training/Experience

Loss or impairment of any of these abilities could result in a user having difficulties interacting with the media conveyed by a telecommunications service, using a telecommunications terminal, or following the user procedures necessary to place or successfully conduct a call.

3.3 Telecommunications System

The telecommunications system consists of terminal equipment interconnected by a complex network infrastructure, over which information is exchanged according to the functionality of the particular telecommunications services being used.

3.3.1 Service

The first choice facing a user is to decide what their goal task is. This will allow them to chose a service that can enable them to achieve their goal. Having chosen the service, there are a number of attributes of the service that could affects it's usability for this user. These include:

Ability of service to handle media: The service may pass information in a media that is not useable or may be difficult for the user to use.

User procedures - media I/O & editing: The service may have a procedure for manipulating the media that the user does not understand or has difficulty

performing. It may be that the **procedure** itself is difficult, or that the **representation** of the procedure is difficult for the user to recognise or follow. An example of a difficult **procedure** could be that the user cannot respond quickly enough when they want to suspend or resume the audio or video channel in response to what they see or hear. An example of a **representation**al difficulty could be that the user does not perceive any method of suspending or resuming the audio or video when they want to do so. It may be that the representation of the procedure within the user interface is not clear or is in a media that the user has difficulty with.

User procedures - control of service: The procedure for controlling the behaviour of the service may be difficult for the user, again because of a difficult procedure or because the representation of the procedure is not presented in a way that the user can perceive or comprehend. An example might be the procedure for adding a new bookmark or address to the list maintained by the service client.

3.3.2 Network

Having selected a service, at least in principle, the user has to select a network infrastructure that will support the service. The capabilities of the network may restrict the choice of specific example of a service that the user can make. For example, if the only network available is a digital mobile telecommunications network, the users will not be able to choose a videophone service, but may be able to choose instead a voice or text phone service. With a wider choice of network, the user has a wider choice of service that could allow them to achieve their goal task. In addition, however, the network may have call set-up and control procedures that may present problems to the user.

In principle, therefore, the attributes that affect the usability or suitability of a network infrastructure could include:

Ability of network to handle media: The suitability of a network for transporting a particular media depends largely on its bandwidth capability. It may be that a particular network could have sufficient bandwidth for a part of the duration of a call, but this bandwidth cannot be guaranteed or is likely not to be available through the call.

User procedures - control of network: The **procedures** for accessing a service or placing a call may be difficult for a user to perform or to comprehend because the user has difficulty perceiving the media involved the **representation** of the call control procedure. For example, the **procedure** for calling a service may be difficult to remember because it involves the entry of a sequence of abstract codes. Alternatively, the procedure for calling a service may be difficult to follow because the feedback **representing** a given point in the procedure comes in the form of audible tones that a user may have difficulty hearing, or whose meaning may be unfamiliar.

3.3.3 Terminal

Having selected a service and network infrastructure, the user needs a terminal through which they can exchange information and interact with the network and service. The terminal has a set of attributes which determines its suitability in a given context, and may introduce problems for a particular user. These include:

Ability of terminal to handle media: The terminal will need to have the appropriate functions to allow it to handle the required media, preserving the appropriate quality and time dependant characteristics of the information conatined in that media.

Physical human/computer interface - media I/O & editing: The user must be able to present information to the system and to perceive information from it.

Physical human/computer interface - control of system: The terminal should provide the user with the means of recording their intentions to change and control the behaviour of the terminal, network and service.

User procedures - media I/O & editing: Even if the user can physically interact with the terminal and it's interface, they may have difficulty performing the procedures necessary to control the flow of information in and out of the system. For example the **procedure** for adjusting the volume of an audio signal is too dificult to do for someone with intellectual impairments because it may involve typing in a string with volume level parameters that the user has difficulty remembering. Alternatively the user does not see any indication on the service or terminal interface that gives a **representation** of the procedure that needs to be followed to adjust the volume of the audio signal.

User procedures - control of system: Again, although the user may be capable of manipulating the user interface of the terminal, they may have difficulties with the procedures involved in controling the terminal. For example, the user might not be able to perform the sequence of operations required by the **procedure** to store or retrieve information in the terminal because they don't have a conceptual model of the process involved or what the terminal is doing with the information. A problem may occur, however, because the user does not understand or find a **representation** within the user interface of the procedure to be followed.

The difficulty with such an analysis is that the site of a problem may be difficult to locate specifically in the service, network or terminal. It is, however, important to attempt to be rigorous in such an analysis, as a change at one point in the system could have implications for the behaviour in another element in the system.

4. User Requirements Form

4.1 Example Of Completed User Requirements Form

UMPTI-DUMPTI User Requirements Form

User Characteristics:	Non-Speaking User
Goal Task:	Communicate with another human user

Service: Audio Telephony

Attribute	**Description**	**Problem**	**Suggested Solution**
Media Handling Ability	Speech quality audio	P1 - User cannot speak, so cannot use the communication medium of the service.	The problem is terminal dependent as the terminal is effectively the service client. S1.1 - Check if terminal can be used to send text using the keypad. S1.2 - Check if the terminal can have a text telephone added to it. This may require a computer to be plugged into the terminal. S1.3 - Change terminal so that other media can be used for communication.
User Procedures - Procedure for Media I/O & Editing	No service specific procedure	no problem	
User Procedures - Representation of Media I/O & Editing Procedures	No service specific procedure	no problem	
User Procedures - Procedure for Control of Service	No service specific procedure - service automatically invoked when call connection is made	no problem	

User Procedures - Representation of Service Control Procedures	No service specific procedure - service automatically invoked when call connection is made	no problem	

Network: GSM Digital Mobile Network

Attribute	Description	Problem	Suggested Solution
Media Handling Ability	Speech quality digital audio	Service based problem - see service section above	
User Procedures - Procedure for Control of Network	Terminal dependent procedure - Specific buttons are used to call network, to give call address and to close call	no problem	
User Procedures - Representation of Network Control Procedures	Terminal dependent procedure - No instructions, buttons used have function marked on or near them. Some feedback given on an LCD display	no problem	

Terminal

Attribute	Description	Problem	Suggested Solution
Media Handling Ability	Speech quality digital audio	Terminal media function is OK - problem with chosen service media - see service section above.	
Physical Interface - Media I/O & Editing	Button press to suspend and resume speech transmission	no problem	
Physical Interface - System Control	Button presses - function specified on button or buttons used to select from menu on LCD display	no problem	
User Procedures - Procedure for Media I/O & Editing	Use specified buttons to suspend and resume speech transmission	no problem	

User Procedures - Representation of Media I/O & Editing Procedures	No instructions or help. Buttons used have function marked on or near them	no problem	
User Procedures - Procedure for Control of System	Use specified buttons to control call and configure terminal.	no problem	
User Procedures - Representation of System Control Procedures	No instructions. Feedback given on an LCD display. Buttons used have function marked on or near them	no problem	

4.2 Procedure For Completing The User Requirements Form

The principle purpose of the user requirements form is to record an argument that explores the problems that arise when a given user seeks to use a service through a terminal connected to a network. The example above can be used to illustrate the procedure for completing the form.

1. Record the impairment characteristics of the user.

2. Record the goal task

3. Record at the head of each table block the chosen service, network and terminal that have been selected to enable the user to achieve the goal.

4. Work through each block and describe the characteristic of each element of the table. The characteristics can be found by studying the catalogues found in Deliverable 1 of the UMPTIDUMPTI project.

5. Work through each problem cell and consider the problems that could arise as a result of the system characteristics at that point and the impairments of the user. Prefix each problem with a problem number. In the example above only one problem was recorded. Had the user also had a manual dexterity impairment, other problems would have been recorded, particularly at the cells describing the physical interface. These would have become P2, P3 .... etc.

6. Propose solutions to the problems, relating the solutions to the problems. In the example, solutions to problem 1 are identifies as S1.1, S1.2 ..... etc.

7. Review the solutions to see if they cause new problems. If the user in the example above had an additional manual dexterity impairment, Solution S1.1 would probably produce a new Problem P1.1.1 in the area of the terminal physical interface with solutions S1.1.1.1. It can be seen that the problem and solution identifiers rapidly grow long and cumbersome. This is not likely to cause difficulties, however, as solutions that result in many new problems are unlikely to be optimal solutions.

8. Solution S1.3 in the example above suggested using a different terminal. In this case it would be most appropriate to start a new form with details of the new terminal, and commence a new analysis.

By following this procedure, potential problems and solutions can be identified, and the consequences explored.

5. Conclusions

The process outlined in this paper allows user requirements for the usability of telecommunications services to be analysed, problems to be highlighted and solutions to be suggested and investigated. It has been used to flag issues for a variety of different users under consideration by the ACTS UMPTIDUMPTI Project prior to pilot stuudies taking place. Results of these studies can be logged in the forms and subsequent problems and solutions highlighted.

In general, this method illustrates the wide range of factors that may influence the usability of a telecommunications service, particularly for users with disabilities.

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7. References

Whitefield A., Byerley P., Denley I., Esgate A., May J., Integration of Services for Human End-Users (1): Design Principles, Enabling States Analysis amd a Design Method, in Integrated Broadband Communications: Views from Race, Usage Aspects by P. Byerley and S. Connell (Eds.), Elsevier Science Publishers B. V. , North-Holland, 1992 (ISBN 0-444-89391-1), pp. 123-151.

Hine N.A., People with Special Needs and Service Access, in Integrated Broadband Communications: Views from Race, Usage Aspects by P. Byerley and S. Connell (Eds.), Elsevier Science Publishers B. V. , North-Holland, 1992 (ISBN 0-444-89391-1), pp. 201-230.

Charles S., Edmonds E., Galer M., Murray B., Nicolle C., Reid., Rousseau N., HCI Tools and Methods Handbook, The HCI Service, Loughborough, 1991.

UMPTIDUMPTI (1996), Deliverable D02, Minimum Requirements

IPSNI ii (1995). CD-ROM Integrated Telecommunications For People With Special Needs.