

# Methodology for Rapid Prototyping and Testing of ASR Based User Interfaces

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## Abstract

One of the greatest challenges in the design of speech recognition based interfaces is about the navigation through the service menu structure. On the one hand, the interactions based on human machine dialogues force a high level of hierarchical structuring of services, and on the other hand, it is necessary to wait for the last phases of the user interface development to obtain a global vision of the dialogue problems by means of user trials.

To tackle these problems, when Telefónica Móviles España began developing its voice portal, great care was taken in establishing a methodology based on rapid prototyping of the user interfaces, so that designers could integrate the process of design of voice interfaces with emulations of the navigation through the flow charts. This was also the starting point for a specific software product (SIS PRUEBA) which addresses the needs of rapid prototyping of these user interfaces from the earliest stages of the design and analysis phases.

SIS PRUEBA has been applied to this and to other types of voice and data services. For example, in complex services like "CINES" (to request information about cinemas, films, etc.) and "FINANZAS" (to consult financial information), the use of this methodology helped to review and to apply recommendations of the speech interfaces usability guide on concrete points of the flow charts and, consequently, the time and resources needed to redesign the critical parts of the user interface were reduced dramatically. In addition, SIS PRUEBA has also been successfully applied to prototype simpler services, like "ALERTAS" (which allows to program alert messages about football).

## INTRODUCTION

Telefónica Móviles España (TME) is continuously providing new services to its customers and a main objective is to ensure their usability. One of the key services deployed during 2002 was the Voice Portal (e-moción voz). This service provides a single entry to many information retrieval services already available via SMS, but with a voice and a DTMF user interface. The whole service provides hierarchical navigation on pre-recorded or synthetic speech contents like news, weather forecast, horoscope or stock news. It also allows complex queries, like films shown in a specific theatre, all obtained by a complex information retrieval service that can be managed by both speech recognition and more traditional DTMF commands.

The DTMF commands are used as a backup solution when the system detects several speech recognition errors, though the user can also select this mode of interaction at any time. The voice portal also handles three types of

users: new, intermediate and expert users. This feature, though it is very convenient for users, makes the design, evaluation and validation of the user interface much more difficult and time consuming.

One of the greatest challenges in the design of speech recognition based interfaces, is about the navigation through the service menu structure. On the one hand, the interactions based on dialogues with the users force a high level of hierarchical structuring of services, and on the other hand, it is necessary to wait for the last phases of the user interface development to obtain a global vision of the dialogue problems by means of trials with users [3, 7].

## APPLYING USER-CENTRED SERVICE DEVELOPMENT METHODOLOGY WITH SIS-PRUEBA

TME has started up a methodology based in use cases that represent the basic requisites to be accomplished by the system. The development process requires an increasing refinement of the requisites. The success criteria are met

when the specifications in the use cases are met, and these are the basis for the tests [3, 4, 6]. A thorough description of the Unified Process can be found in Jacobson and Rumbaugh [2].

The development methodology also defines the following essential concepts:

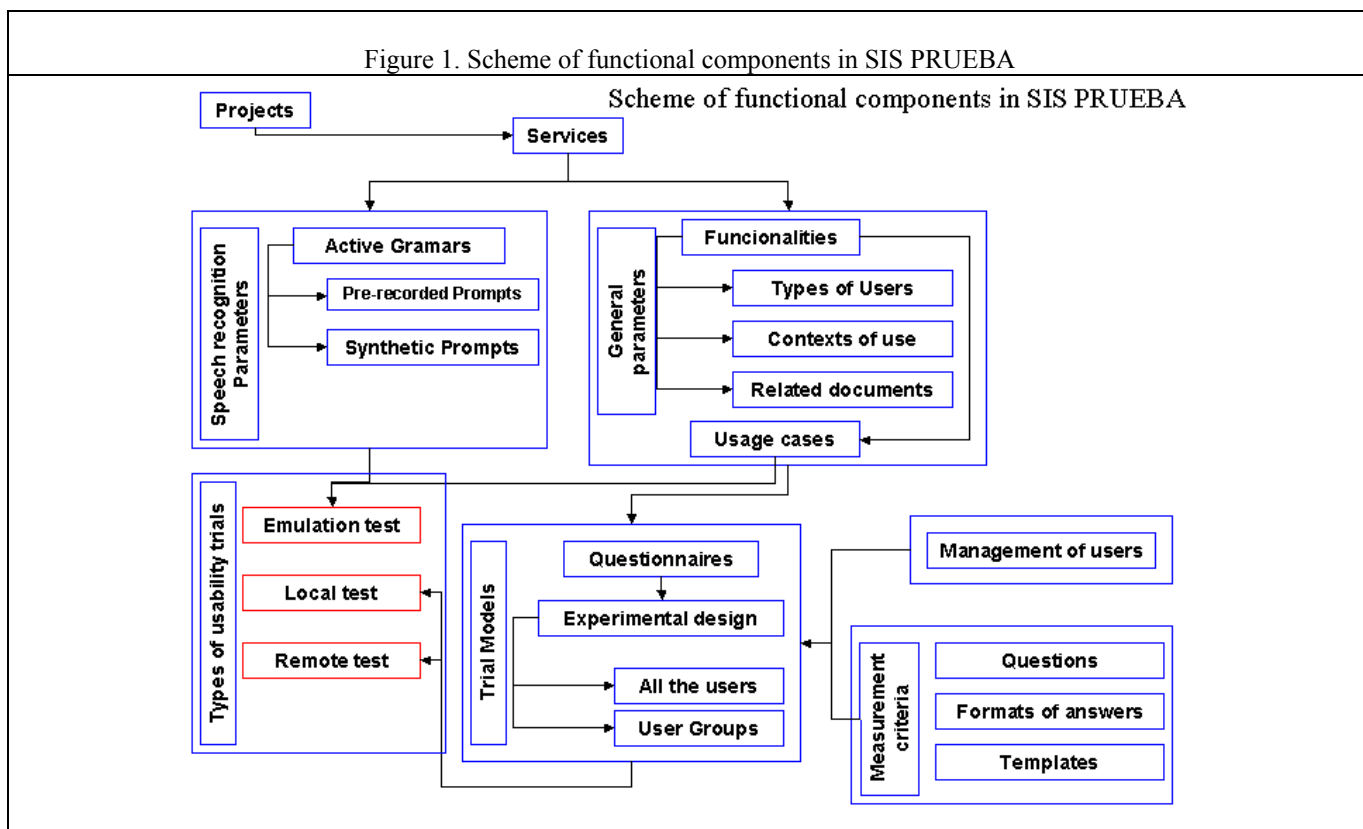
**User:** the definition for the different types of users must include the cognitive and motor requirements and previous experience or training for the use of the system under consideration.

**Functionality:** it is the component implemented or to be implemented in a service or system that allows the user to achieve an objective.

**Context of use:** this is composed of all the variables and situations that form the environment in which the user is immersed while is using the system. This concept includes other users, equipment, physical and social environment, noise conditions, etc.

**Use case (or usage scenario):** this is a representative set of all the conditions and actions that the user has to carry out in order to achieve his or her relevant objectives.

**Test case:** it represents a concrete situation with which you validate system and user requirements as specified in a use case. A test case is itself a process, including several components: work scenario, test procedure, and test evaluation.



With all these concepts two aggregates are built:

- The use case model, that represents all the user types and all the possible use cases, and
- The tests model, which selects a representative set of the use case model together with its associated test cases, all by means of an experimental design.

SIS PRUEBA allows two types of experimental designs:

- Within-subjects designs, in which all users go through all possible test combinations, and
- Between-subjects designs: in these designs the users are grouped by the type they belong to and this determines the final combinations of tests they will perform.

Finally, the tests generated by the program can be used in two different formats:

- Tests performed and answered in paper and pencil, and
- Published tests in Internet which can be answered from remote locations.

Figure 1 shows the components of the SIS PRUEBA tool.

### WORKING WITH SIS-PRUEBA FOR TESTS MANAGEMENT AND RAPID PROTOTYPING

SIS-PRUEBA is a software tool developed by Telefónica I+D in collaboration with Telefónica Móviles, which provides methods to manage usability tests and to store all required data so that a design template can be produced and afterwards manipulated in MS-Visio™. The template and associated libraries allow for rapid prototyping on flowcharts in design time.

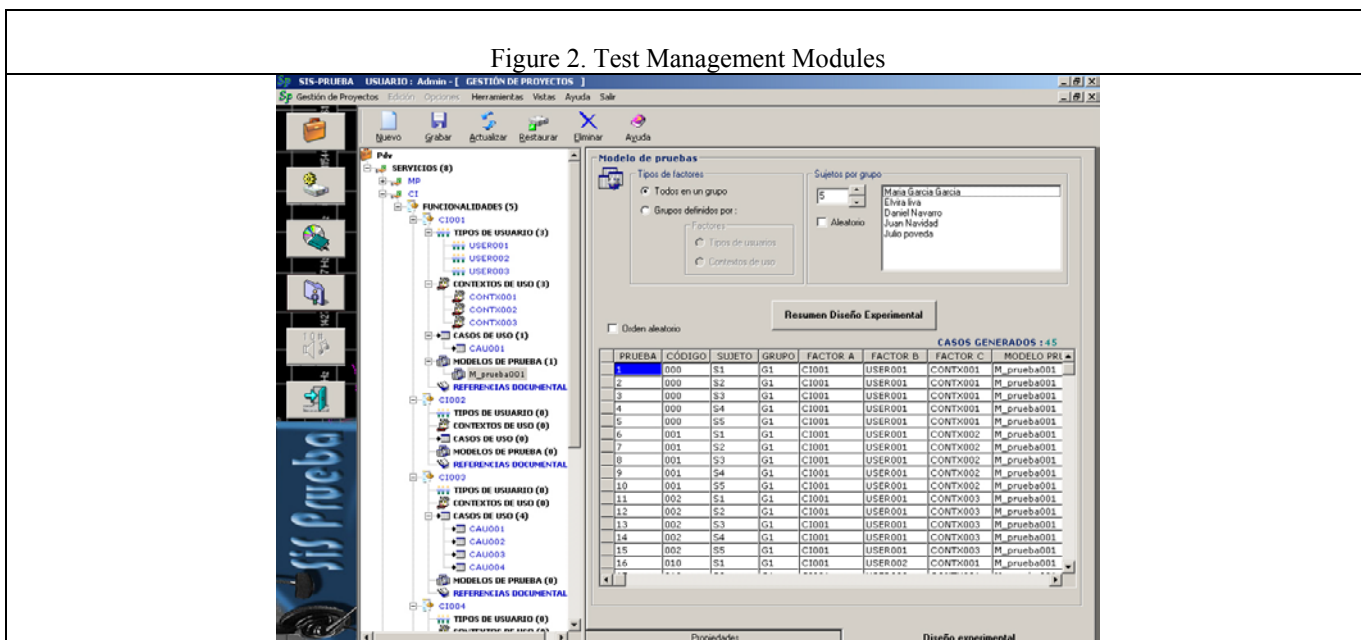
Practical use of SIS PRUEBA comprises the following steps:

1. Introduce all components of the methodology for your project in a single database. Each project can create and maintain all definitions as stated previously, i.e., functionality, user types, use contexts, etc.
2. Create test models by combining the different concepts and using basic experimental designs.
3. Create usability criteria, questions for user tests and all associated tools as required in actual usability tests.

4. Provide user tests in both "paper and pencil" and "remote testing" (either web or e-mail) formats. This module allows the automatic capture of the generated data.

Figure 2 shows the main interface of the program for the management of the usability tests.

Figure 2. Test Management Modules



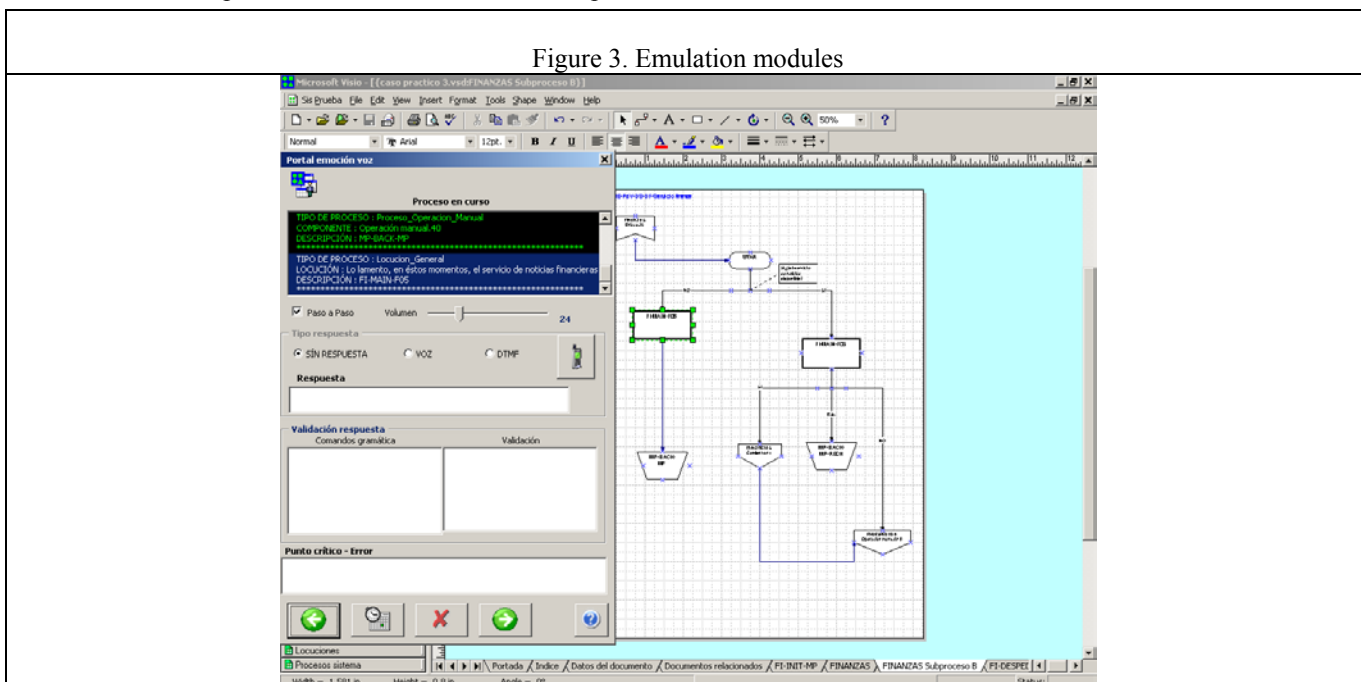
SIS PRUEBA has an emulation module, which requires the following steps for its use in a particular project:

1. Introduce in a project database voice grammars (syntax and expressions), DTMF commands, stored voice recordings and synthetic speech files.
2. Produce the template in Microsoft Visio™: a template

is a customized Visio file for the particular project and contains all necessary data as stored previously in the project database.

3. Design the prototype of the service, using the previously produced template in Microsoft Visio™. The template allows to consult on-line the corporate voice

Figure 3. Emulation modules



services usability guide and also allows to emulate and quickly prototype any data or voice services over the produced diagrams.

## RESULTS OBTAINED WITH SIS-PRUEBA IN A REAL SERVICE OF TELEFÓNICA MÓVILES

SIS PRUEBA has been applied for testing actual voice and data services of Telefónica Móviles España [1]. For example services for information retrieval about cinemas, finances, and weather forecast, as well as services for premium and subscription services. SIS PRUEBA allowed to manage usability trials of the pre-commercial prototype combining 3 different user types (new, intermediate, expert), 3 contexts (silent and noisy environment, and handsfree use of the telephone), and use cases for 2 types of services included in the voice portal (horoscope, as representative of a simple navigation, and cinema, as representative of a complex query service). 14 users participated in the trials. Results of these usability trials allowed to greatly refine the dialogues and to identify critical points.

Generally speaking it is possible to emphasize three characteristics of these interventions:

- The trials are exclusively based on the design flowcharts, thus not requiring any implementation of the system in any platform. With SIS PRUEBA it is possible to emulate system and user behavior in a variety of services, so the design team can identify strong and weak points with a good detail level and taking into account many contextual variables.
- These quick tests are based on design and development documents. For this reason the communication and detection of incidences are faster, and the accomplishment of iterative cycles of trials is made possible.
- The results are presented in the form of human computer dialogue (GOMS models) [3]. For this reason it is possible to infer the behavior of the users, apart from detecting errors in the dialogue design.

By means of the application of this methodology it is possible to detect different types of errors or uncertainties in the design, and present the following advantages that allow a quick solution to them [1, 7]:

- To detect the tactically important points on listings in which the speech recognition system and the users make more errors.
- To evaluate in which points of the flow diagram the number of navigation steps are increased and, consequently, the risk of the user abandoning the service.
- To locate ambiguous and long prompts for the user.
- To be able to include a parallel vocabulary of synonymous commands for the speech

Figure 3 shows the interface of the program to emulate the speech recognition based system.

- recognition system, by means of the detection of commands emitted by the users during the trials.
- To evaluate alternatives to error handling mechanisms.
- To locate tactically important points in navigation to invoke help.
- To evaluate the alternative use of the interaction by DTMF commands, or mixed voice DTMF navigation.
- To find solutions to the harmonization of DTMF and Voice commands across different services.
- To evaluate the turn-taking process.

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