

A Usability Study of Adaptive Interfaces for Interactive Voice Response System

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ABSTRACT

Interactive voice response (IVR) systems in developing nations are mostly key-press based IVR because of difficulties with speech recognition in under-supported languages and accents. Navigation problems in such IVR systems results in time consuming interaction.

In this work, we propose and evaluate two approaches of adaptive user interface to enable faster access to information in key-press based IVR systems.

Categories and Subject Descriptors

H.5.2 [User Interfaces]: Voice I/O

General Terms

Design, Experimentation, Human Factors

Keywords

Interactive Voice Response, Adaptive Interface, Interactive Design, IVR Utilization, Voice Application, Voice System

INTRODUCTION

Interactive Voice Response (IVR) systems are emerging medium for information access due to high penetration of telecommunication systems. At present, IVR systems provides access to different information, e.g. status of credit card bill, via either key-presses or voice prompts. Though voice prompts are more natural, however they require robust speech recognition techniques which are only available for limited languages and accent, e.g. English (US and UK). The menu structure of IVR system is decided at the time of deployment and remains static thereafter. This static nature of the menu affects navigation inside the IVR, since the options appearing later in the menu take more time to reach. It also affects the total content that can be served via IVR, since increasing the content also increases the menu size. That is why, navigation inside an IVR system has got enormous attention in research community [4, 5].

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In this work, we propose and investigate performance of two approaches for adaptive user interface in IVR system in order to reduce navigation time. Our adaptive approaches dynamically rearranges menu options in the IVR. We are reporting the performance of proposed adaptive system in comparison with a baseline system (a non-adaptive system similar to currently available IVR systems).

METHODOLOGY

We designed, implemented and deployed three systems in an academic institute which were used by 56 participants of Winter School organized at the institute. This real world study was conducted in three phase. In the first phase, we deployed an IVR system similar to currently available IVR systems (hereafter referred to as Default). Next two phases of experiment had our prototypes of adaptable IVR systems:

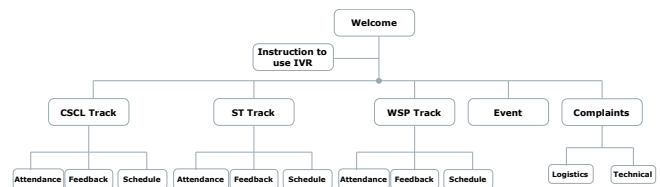


Figure 1: Default menu diagram (Phase 1): The IVR menu of Default had 5 menu options; the first 3 options correspond to each research track in Winter School; each track option had 3 sub-options. The 4th and 5th options were “Event” and “Complaints”. A caller could get the detailed information for events in Winter School by selecting the “Event” option. “Complaint” option provided users to lodge a technical or logistic complaint.

- Phase1 (9th Dec - 17th Dec): In this phase Default system was deployed in which the menu options remained same till the end of phase. Figure 1, shows the standard menu that we implemented in Default.
- Phase2 (17th Dec - 22nd Dec): We deployed our 1st prototype IVR system, named as Hierarchical, which rearranges the menu options based upon descending number of times options were accessed in past by the individual caller. The rearrangement was done automatically within a specific level (i.e. sub-options of same parent option) but not across the levels (i.e. between option and its sub-options).

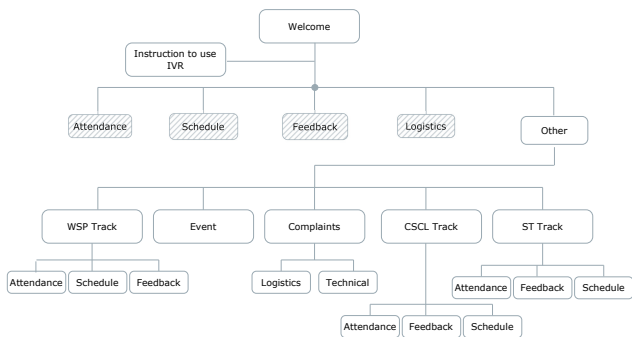


Figure 2: Direct menu diagram (Phase 3): The menu that one of the student from WSP track got while calling to Direct. The first 4 options at the top level were “Attendance”, “Schedule”, “Feedback” and “Logistics”. These options were accessed more number of times in the past than other options at leaf node of the IVR menu.

Statistic	Default	Hierarchical	Direct
Average	5.046	5.200	3.130
Median	4	4	2
Variance	7.220	4.789	1.562

Table 1: IVR utilization: Statistics for IVR Turn for each system. Lower values indicate that lesser number of inputs are required to access the information.

- Phase3 (22nd Dec -23rd Dec): We deployed our 2nd prototype IVR system named as Direct. Direct presented the top 4 most accessed menu options among the leaf nodes of Default as shown in Figure 2. The 5th option in this IVR menu was “other”. By selecting the “other” option, users got the menu options same as in Hierarchical.

All the 3 systems allowed the caller to barge-in (i.e. to select an option before it is announced by IVR). We collected the data pertaining to each usage system through call logs, audio recording (callers were aware about recording) and post experiment survey.

RESULTS AND CONCLUSION

We measured the system performance based on IVR utilization and Average Handle Time:

- IVR Utilization: IVR utilization is defined as IVR turns per call. An IVR turn is an input in the form of one or more key-presses for menu selection. In our experiment, a low IVR utilization factor for our experiment should be interpreted as less number of user inputs required to access the desired information.

Table 1 shows Direct was best as callers were able to access the desired information in fewer IVR turns (or input) as compared to other IVR systems. We found no significant difference among the IVR turns in a call for Default and Hierarchical (t-Test, p-value=0.2) because of their structural similarity in menu representation. However, IVR turns per unit time calculated as IVR turns per call divided by call duration shows that Hierarchical was approximately 3 times faster (0.024 vs. 0.078) than default in accessing desired option (t-Test, p-value=0.003), see Table 2.

Statistic	Default	Hierarchical	Direct
Average	0.024	0.078	0.062
Median	0.062	0.069	0.047
Variance	0.00	0.002	0.001

Table 2: IVR utilization per unit time. Higher values indicate that callers were able to enter the requested input quickly.

- Average Handle Time (AHT): AHT signifies the average call duration. Ideally, a system should have low AHT value. We compare systems on difference in AHT which shows Direct has outperformed other system and analysis shows result is statistically significant (ANOVA, $F(2,446) = 2.894$, p-value = 0.05) see Table 3.

System	AHT (in seconds)
Default	45.14
Hierarchical	42.29
Direct	34.68

Table 3: Average Handle Time for each IVR system.

We could run *Direct* for two days only, but findings are consistent with literature that shows that broad IVR design perform tasks faster with greater satisfaction [1]. Results from our real-world study show that adaptive IVR systems may provide better performance than existing systems; a post-study survey also indicated that participants were satisfied with the way in which information was presented in the adaptive IVR systems. In a related work, Lavie et al. [2] have suggested that performance gain with adaptive interfaces for older population may be even better than that achieved with younger participants (as it was in our experiment).

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