

# A Survey on IVR Based Human Computer Interaction for Blind People Using Normal Keyboard

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**Abstract**— In this paper we describe about the technologies that can adapt advantages of the IVR systems to access the personal computer by visually impaired person. Here we utilize the emerging technologies of CHI (Computer-Human-Interaction) to provide a virtual interface for the completely blind people to control and perform some operations on their PC. Our aim is to collaborate the techniques followed by the IVR systems along with the methods which enables the visually challenged people to access the computer like a normal user without any special training which normally they need in other methods.

**Keywords**— IVR systems, CHI, Computer access by blind.

## I. INTRODUCTION

IVR (Interactive Voice Response) is the interactive way of automatic technologies through a recorded voice in which the respondent gives the answer by pressing the keys in the available items. The normal advantages of the IVR systems include the confidentiality, economy, autonomy and improving the data quality of the system applications including the monitoring, information services and booking of transportation etc.,. The most important application of IVR system is that conducting the survey for the quality and usability of the products which are launched, new to the market through a digital medium [1].

The concept of accessibility and usability is the main focus in the IVR systems which enables the all classes of people to get an introduction to the digital world. At 1963 Bell labs introduced “the Voder”. The IVR blueprint is the **DTMF** mobile phone systems which uses the in-band signaling. It provides the transmission of audible tones from 300hz to 3.4 kHz in the form of the human voice.

At the initial stage the technology remains the complex using the **DSP** (Digital Signal Processing). The system should use the stored procedures of digitized speech on the disk and give the response based on the human’s DTMF actions. The response fully depends on the appropriate recorded messages.

At 1990’s **Computer Telephony Integration (CTI)** was used with the IVR systems. Thus, it became vital for telephony companies make decisions for the queries made by the customer.

## II. OPERATION OF IVR

Customer service systems are not fully satisfied with the IVR systems based on the efficiency of the method that it followed.

This system mainly focused on the expense that the customer service centers used to get the call from the customer and to prompt the services automatically. It is difficult to construct the system which consists of a series of audio descriptions, denoting the choices or the list of actions that has to be carried out for the satisfaction of the user.

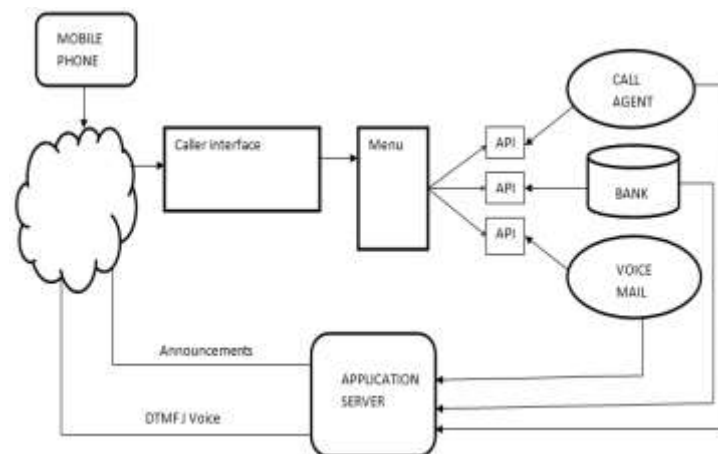


Fig. 1 General Architecture Of IVR Systems

The response to this voice description is provided by the key pressing event, that has to be carried out by the DTMF signal to PSTN node. Once the touch tone key is pressed the flow of the call is transferred to the next set of hierarchy of choices available to the customer queries. The whole action is monitored by the IVR system to eliminate the remaining choices except the one which was selected by the customer [2].

By the way the customer service centers avoid the usage of human needs to server their customers.thereby reducing the cost of the company to recruit human.

#### A. Technologies Used

**DTMF** (Dual Tone Multi Frequency) uses the transmission of signaling over the voice frequency band and the switching center frequency of the mobile stations. The predefined **grammar** (“Directed” Dialogues) prompts the user to select the options from the given menu. The dialogues are based on the natural language and it is more interactive.

**TTS** (Text To Speech) synthesis is used to speak complex and dynamic information examples are e-mail, news reports or weather information systems. The voice is not the robotic one, the real voice of the human is split into several fragments and concatenated while giving answer to the customer queries.

**ACD** (Automatic Call Distribution) is used for greetings and announcements.

IVR call flows use the scripting languages such as the voice **XML**, **SRGS**, **SSML**. It converts the webserver to application server.

**ARU** (Audio Response Unit) provides the basic unit for response against the key press of the responder by DTMF method. It needs the information from the database such as the caller-id and server information such as the day, date and time.

#### B. Limitations Of IVR

The main limitation of the IVR system is that even when the customer has equipped with the personal computer he/she doesn't able to access the IVR system through that personal computer later on. In this way the user cannot utilize the full capability of the personal computer such as traversing the IVR system to yet a particular destination of their queries

For example, some orders may be placed by the customer in an electronic shopping and if the customer wants to know about the status of that order like where's the products now, when it will yet shipped & the time where we will get that product.

Normal message access system previously known as the autonomous systems prompt the user to select one of the formally stored messages. Thus the user is not involved in this framework of the automated message response systems. Thereby we produce a system which will enable the users to access the IVR system through a personal computer they are having, to give input directly to a server of the IVR & get the actual response.

#### C. Impact of Voice Over IVR

The persona theory of IVR is defined as the personality of the speech interface inferred by the users based on the behavior of the voice user interface.

The quality of voice which can be used in the IVR made an impact on emotional qualities such as happy, sad. The gender impact of the voice also made an effort on the IVR systems. The female voice is more attractive than the man's voice despite that no synthetic voice given by a person. Their quality is not as good as the human, such that they are not real voice other than the previous speech recordings [3].

The voice has also the social interface theory, for example. The voice has the name (starts with the hi! I am John! Then the users has the immediate response & interact more directly, frequently & include more response.)

In this paper, we conduct an experiment of two cases.

- i.) To find the male & female voices where it can exhibit the personalities accurately.
- ii.) Whether the voice selected made any impact on the user disclosure.

Experiment: 1

For the best results for this experiment 23 individuals are selected and their voices are recorded in the form of test scripts. The upbeat, professional and sympathetic tracks are evaluated by the selected users.

Experiment: 2

To calculate the impact of the voice based on the IVR system several users were assigned & the comparison of voice type, system voice gender, & the gender of the user were plotted in the bar graph. By conducting this experiment MDASI-IVR system's usability scale was found out

### III. INCORPARATING IVR SYSTEM FOR COMPUTER ACCESS

So far we have discussed about the usage of IVR systems for enabling both the normal & the blind users to automatically do the Job for their needs.

Now, we move on to the accessibility of the computer system by blind people through the IVR system. First, we focus on the emerging of Technologies from the blind people's perspective to access the information or the control the computer operations in the personal computing.

The first most technology of the blind other than the Braille is the **OPTACON**.

**OPTOCON** is an electronic device such that it performs the conversion of printed documents into the vibrating tactile stimulus. In 1800's, Louis Braille [4] created an entirely new tactile alphabet system where the blind person's senses it through the touch and recognizes what's there in the document printed earlier. But in this method the reader needs some help from other persons to transcribe the materials under reading

Here the electronic machine which converts the printed documents into the image with the help of the vibrator pins the pen size camera is used to capture the images & the result is the degenerated images.

However the problem with this design is as follows.

1. The size of the camera cannot reach some edge of books.
2. The finger becomes tired after working with the optacon instrument.

By using this kind of OPTACON device the books can be read easily by the blind people rather than reading a Braille book. In Braille the reading capacity is 10-12 work per minute where as using OPTACON can increase the word rate up to 40-60 words per minute.

#### A. Substitution of a Restricted Visual Channel

The During 1980's the usage of external electronic devices for accessing the information of computer data as implemented large scale other than **OPTACON** one of the device that provide the substitution for screen access by the blind people is the TOUCH & TALK workstation [5].

The innovation of Computer – Human – Interaction (**CHI**) make the computers more accessible, productive & reliable to the programmers.

**ATARI 1040ST** based computer is used as the Touch & Talk workstation. The components of this system are a talker, a texture pad and a device which sends & receive data over a telephone line.

The texture pad acts as the pseudo-display, which was coupled with the speech synthesizer, the columns on the texture pad was used to control the reading and scrolling down actions combined with actions made by the user with the help of the finger. The speed of the cursor reading depends upon the speed of the user's finger move on the pad.

This system also converted as the one which can be accessed by the keypad method. The navigation keys were used to make the scroll down actions and the command keys such as the previous line, next line were also used to make the talking terminal to read the contents of the document displayed on the computer screen.

#### B. Audio as an Interface

Disclosed computer interface provides the interface to operate the graphical user interface with the help of stereo & filter round effects. This method includes the axis from the client window divided into 4 parts, left, right, top & bottom. As if the user moves the pointer to the exclusively from the left side. When the cursor points to the right side, the sound shifts to the right side.

When the pointer is at the top or bottom, the sound, pitch will increase / decrease according to the user reaction to the tactile mouse feedback.

Based on the intensity of the sound that the user hears the position of the cursor was found out by this mechanism. Even the colors of different shapes in the screen can also be found out. When the cursor is in center position then the round will be common on both sides of the speaker [6].

#### C. Tools for Graphics and Icons

As the round effects enables only the position of the cursor & the items on the screen it was not enough for the blind to access the icons & the files from the system screen.

Thus the enhanced disclosure tool will locate, the objects at the screen & also help them to operate on those objects. The clicking on the button will causes the voice annotations for the encounter. When the mouse is rolled over the icon, the audio description of the icon is played as the blind can identify what they can do with that icon and the operations on it [7].

##### 1) Schematic Diagram Access:

Technologies helped the blind to access the icons & the folders and do some operations on it. But for the gathering of knowledge of the systems or to understand some flow of system executions & programs.

By this method a blind user can create, read or edit one type of data flow diagrams we are normally used in the software engineering. The mapping of the original diagram to the suitable tactile diagram is taken by the software design [8].

The diagrams which can be given to the blind user are, real world images, maps, schematic diagrams, charts & graphical user interface. GUI normally uses the WIMP (Windows Icon Menu Pointer).

The concept of object oriented program is taken here to denote the diagrams in the schematic forms. The objects & the relationship between the objects can be taken here to elaborate the images to the blind people.

**World – Mellor RTSA** approach is the high level design used to point the real – time software.

The diagrams are first converted to the DFD diagram with contest and then map on in the tactile form of charts ( $N^2$  charts).

The rules for converting the ordinary DFD to  $N^2$  chart is

1. The transformations are written at the top to bottom diagonal.
2. The connection which is outward from the transformation is given in the same row

3. The inward connection of the transformation is written on the same column

2) *Accessing the Screen Content:*

Modern world companies now allow every blind person to access the standard computer. The software used is called as “Screen Readers”. Screen Readers run behind on all programs and tells the behind person what is on the screen [9]. The low vision people may not need this one as the magnification function is present on a windows screen itself. The simplicity of the screen reader is that it can be installed from the CD very easily.

This is very much more efficient than the Braille’s system because the user has to touch the Braille display with their fingers as it took a large amount of time.

The most complexity of the screen reader is adapted from one software to another. For example, the mail application will be differ from the Microsoft Word application. The animations are not supported by this type of screen reader. Navigating a particular document is also not possible with the help of screen readers [10].

The people are in need for the hot keys that helps them to navigate to a particular location of the computer documents. Example one hot key can explain the meaning of the current word in screen or the other key will go to the specific location such as browser or the music files they listened to.

Moreover the image content are not fully visible or explained by this mechanism. The animations & videos also need some description in the text from the provide access to the information by blind.

The normal tasks that the blind people can do with normal computer are Reading Newspapers, Checking e-mail, Essay Writing, Chatting or Voice communication etc.

*D. Screen Readers:*

A screen reader is the interface between the operating system, its program & the user. The main aim is to read out the given text into the human voice output to the blind people. The normal screen reader price ranges from \$250 to \$1500.

Whenever we want to use some screen readers, we have to evaluate whether the selected one is compatible with our operating system, can it be supported Braille display [11]. The key strokes for the function are also carried into account when we buy new screen reader software.

The top reasons of why the screen readers use not the best is

1. Page layout is confusing the screen reader.
2. Application conflicts arise due to the screen reader.

3. Form labels play a major role.
4. The pictures are not containing the ALT descriptions.
5. Unknown crash of the screen reader.

30 percentages of the blind users made as frustrates while facing any one of these problems. It is the job of the developers to eliminate these frustrations from the users, including the “illegal operation” or while executing the programs with the “fatal error”.

During normal execution also the frustration such as the pop-up boxes, hard features and the dialog boxes also can occur.

The technology must be assistive to enhance the screen readers, the math formula can be better understood by the screen readers.

Other than the software related issues some of the general problems of the text which leads to the frustration of the user as follows.

1. Quantity of information
2. Order of presentation of information
3. Usage of pauses.
4. Prosody
5. Speech Quality & Pronunciations
6. Alarms & Beep sound of warning

TABLE I  
TYPES OF SCREEN READERS

Sl.No	Tools	Description
1.	BRLTTY	Using Braille display for Linux console.
2.	Cake Talking	Blind Musicians can make use of it.
3.	COBRAIO	Enable the blind user to enlarge the screen.
4.	Dolphin Pen	A USB driver which acts as the screen reading device.
5.	JAWS	Converts the text & components of windows of speech, configuration files are also included.
6.	NVDA	Open source Windows screen reader.
7.	ORCA	Free open source for GNOME desktop works with Firefox.
8.	Voice Over	MAC OS screen reader for various applications.
9.	Windows Eye Professional	Screen reader for windows with enhanced Braille support.
10.	System Access	Work with windows OS also used to access applications in windows. (ie. MS Word, IE etc.)

Lets of research have been done to find out how to improve the usability of the computer screen readers. The four To eliminate the error in the information a sequence of recalls needs to be carried out whether there is repeat of information in the present.

Quantity of speech plays a major role in screen readers as the large information may not be digested by the knowledge of the blind people [12].

The information should be on the order form so that the hierarchy of information is accepted by the user.

While reading a big passage the break is needed at regular intervals, because it is tough to recall all information at a glance by users.

As the speech is mandatory output its quality must be high & the pronunciation of words should be in regular manner.

Success & failure should be indicated by the different non-speech tones to evaluate the work done by the blind user on the computer screen.

1). *Usage of Voice Commands:* With Screen Reader:As the voice command becomes effective for the computer system to read out the content of the screen by creating a software program. Eight blind users are used to test the prototype created.

The main design of the prototype depends upon the natural language **grammar**. A sequence of rules for constructive a word from the alphabets of a particular language is called as **grammar**. The semantic of the language is not given by the grammar rather than finding out the string manipulation [13].

Some examples of voice c commands are READ HEADLINES, REPEAT SENTENCE, SKIP PARAGRAPH and INCREASE VOLUME.

The simulation method includes the participants to use both the screen readers and the proposed software to identify the answer from a given record newspaper.

The response time taken by the participants to answer is 70 percentages faster than the older methods. During the experiment the users suggested that more commands such as SKIP, BACK, REPEAT can be added.

#### IV. CONCLUSIONS

Thus we explained all the concepts that are related to the universal access of the computers by all classes of users. The utilization of IVR system concepts was studied and we are focusing on incorporating such concepts into the accessing of computer applications by the blind people. Hereby we are

Trying to propose a system for Computer-Human-Interaction(CHI) which leads a virtual interface for the visually impaired people to know the content in computer just by pressing the key in the keyboard according to the instructions of the computer itself in the form of voice. Hence we can avoid the special training needed by blind people (eg.BRAILLE).The future work will include the adding of hot keys in the interface for specific applications.

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