TINATEL - A TALKING TEXT-EDITOR WITH TELEPHONE INTERFACE FOR SPEECH IMPAIRED PERSONS

Paul PANEK
Vienna, Austria

Abstract:

This system helps persons who are not able to speak to use the telephone network. It consists of a PC/AT, a speech synthesizer and an auto dialer. A specially adapted keyboard serves as the user interface. Since autumn 1991 the system has been in practical service. It is not only successful in opening access to the telephone network but also in entering into a conversation without the aid of others.

1. Introduction

The system was developed and implemented for Miss Martina HELA. Miss HELA is severely handicapped in motor control of her movements. She is not able to speak but understands what we say to her. She is also able to control her electronic wheelchair and can use a PC with the help of a head stick. The keyboard has been adapted to her special needs. A mask of thin metal is fixed just above the keyboard. It consists of small holes directly above each key. This construction ensures that only one single key can be pushed by the head stick. However, many programs require two or more keys to be pressed together to activate specific routines. This problem was solved by a hardware-adaptation inside the keyboard. An alternative to this solution can be special software [1].

What does conventional communication with Miss HELA look like? The first thing is to become aware of Miss HELA´s wish to begin a communication. If she wants so you have to help her because she is not able to speak herself. You begin to say the alphabet letter by letter (1..2 letters per second). Miss HELA will try to give a visible sign of agreement when you have reached the letter she wants to say. After the first letter has been identified you begin to say the alphabet again. In this way you put together single words, which eventually make up full sentences.

This kind of communication is toilsome and takes a lot of time. Another problem is that Miss HELA´s ability to strike up a conversation with someone herself is very restricted. It is necessary that all potential conversers are aware of this situation and try to be attentive and ask her if she wants to say something at the moment.

2. Description of the system

2.1 Components

The system consists of
a PC/AT,
a MULTIVOX Speech Synthesizer [2],
an auto dialer,
a pseudo hand-free talking device,
and the system software TINATEL.

2.2 Technical Background

The system software controls the components and supports the user interface. It has been implemented in the programming language TurboPascal.

For Speech synthesizer we decided to use a MULTIVOX Synthesizer [2] .This synthesizer offers a wide variation of speech parameters and has a moderate price also.

The auto dialer takes care of the establishment of a connection using pulse selection. It also consists of an alternation switch, allowing connection to a normal telephone transceiver using the subscriber line interface circuit while the TINATEL System is not in use.

The pseudo hand-free talking device: The system also consists of an individual subscriber set which is adapted to serve as an acoustic coupler. There is a microphone fixed on to the telephone receiver, and an audio amplifier, which makes the received signals audible in the whole room. The audio signals produced by the speech synthesizer and noise from anywhere else reach the microphone inside the telephone set, get transformed into electrical signals and sent to the receiver at the other end of the telephone line.

At first it might seem to be a disadvantage that not only the speech signals but also the other noise signals from the room are transmitted. In practice however it turns out to be a help because in many cases Miss HELA is able to produce sounds which can be easily interpreted as agreement or disagreement. Therefore the additional transmitted sound slightly increases the transfer rates.
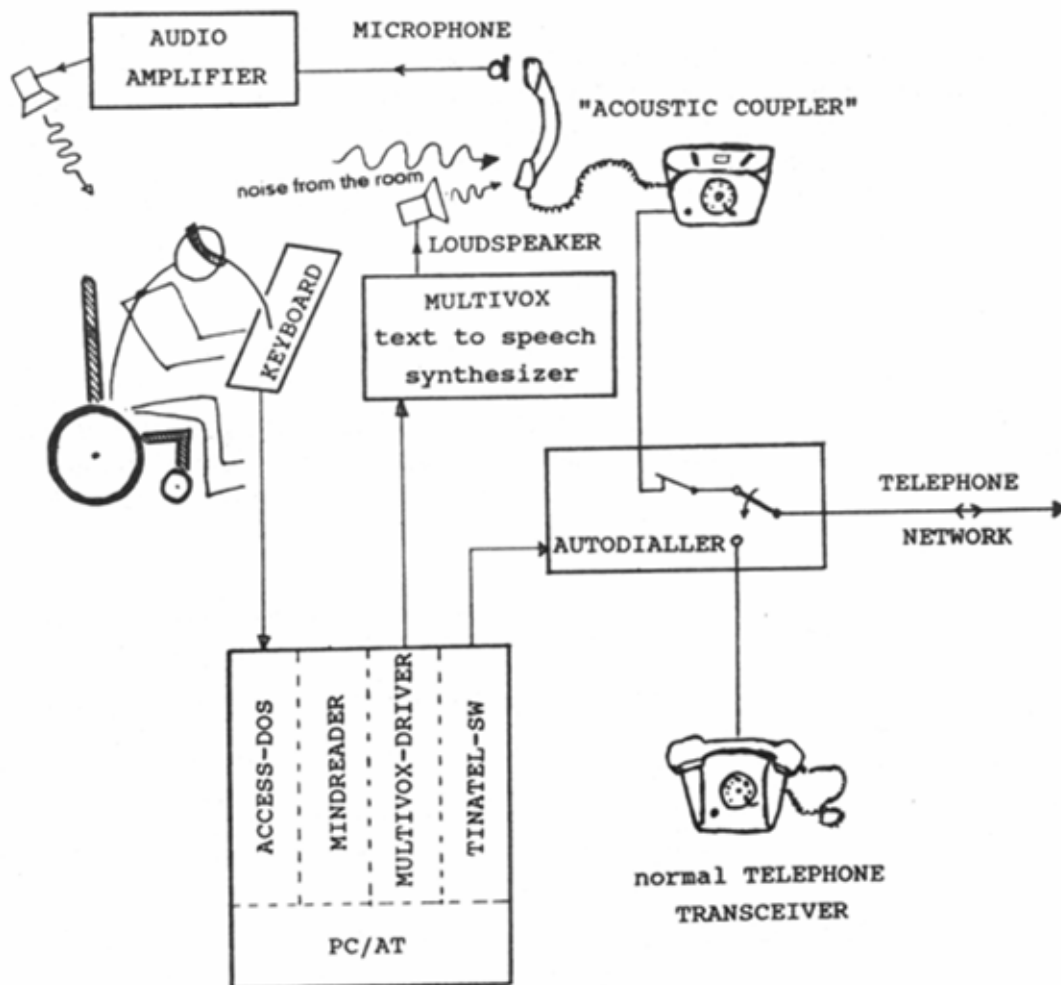
Fig. 1, Components of the TINATEL system

2.3 Operating Procedure

The telephone system meets the requirements to be totally controllable by the keyboard of the PC/AT. There is only the power supply line which has to be switched on and off with an external switch.

While forming concepts for this project it soon became clear that there are fundamental dilemmas in planning an optimal system. On the one hand side Miss HELA has a very slow typing-speed, on the other hand side she also makes a lot of mistakes. What should a user interface look like in order to allow her a fast and safe operating?

In order to increase the effective speed of writing it is possible to select whole phrases (text modules) with only a few keys. These text modules are stored in a separate file and can be changed offline. Another device is MINDREADER [3] - an intelligent text editor. Miss HELA uses this editor to write texts offline. This means she is able to prepare texts she wants to send via speech synthesizer before starting the telephone connection. The MINDREADER calculates statistics about the words often typed by the user. When the user begins typing a new word, the MINDREADER uses these statistics to propose what this word will be, based on the letters typed until now. The reduction of keys necessary to be pressed is about 25 per cent. [*]

To minimize mistakes while pressing keys we use ACCESS-DOS [1] as background software. In the actual version of the TINATEL system the main purpose of ACCESS-DOS is to increase the pause before activating the keyboard's auto repeat function. If a wrong key has been pressed, the consequences should be limited. Therefore menus with additional requests for confirmation have been implemented.

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         *** aktuelles Menü: Editor / Telephon / TELEPHON-BUCH ***
F1 HILFE                                    Esc = Ende

F2 Telefon-Menü      F7 Phrasen_holen      F3 Schalter/Files/OPTIONEN/Parameter

F4 Synthese_Wort     F5 Wort_zurück
                                              F8  Cursor --> Textende
F9 Synthese_Satz     F10 Satz_zurück
---- Cline: 3 -- Ccol: 1 --  Lineoffset: 1 -------------------------------------
                         A | matthias 82 27 762
                         B | Bärbl 82 50 813
HALLO, WIE GEHT ES       C | Karin Hofbauer 8439745 \ Heideng.
ARBEIT. ABER ES IST      D | Karlusch Waltraut 3014784\ Nordmanng.
                         E | Kurti 82 48 253
WIE FUNKTIONIERT DA      F | gabi strodl/pfarre hietzing 82 34 94 20
WAR JA RECHT ANGETA      G | bikri 82 70 933
PACKST.   IST ABER J     H | Fahrtendienst Haas 27700
PRÜFUNG ZU VERSUCHE

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Status:        -- Lesen --              -- Tasten ansagen --

    *** Hörer abgehoben ***

            TINATEL Version 1.04, 26.Nov.1991
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Fig. 2, TINATEL user screen

There is also a help system available (context related and guided by index).

When Miss HELA wants to make a telephone call she first starts the text editor MINDREADER to write the text she wants to say someone by phone. When she has finished, she starts the TINATEL

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[*] The MINDREADER software package was originally written for the English language, and therefore all the redundancy present in the German language is not exploited for further key-pressed reduction rate. For example, extra characters (ä,ö,ü,ß) are not expected, and prefixes and suffixes are tailored for the English language.

program and loads the text she has just written with the MINDREADER-Editor into the Editor of the telephone system. Then she opens the integrated telephone book and selects the person she wants to phone. The system begins to establish the telephone connection. If the person answers the phone, Miss HELA presses a key and the speech synthesizer reads the prepared text. During conversation every key pressed by Miss HELA is said by the speech synthesizer ("Alpha" for the "A"-key, "Bravo" for the "B"-key, "Wrong letter" for the "Delete"-key and so on). Some answers or questions which are often used have been pre-stored in the phrase file. They can be selected as a whole sentence out of a menu and are sent to the speech synthesizer immediately.

3. Problems

After having solved some smaller problems which have occurred within the first test calls the system works very successfully. Most of Miss HELA´s friends who know her well needed about a quarter of an hour to get used to the synthetic articulation and the particular situation. But then communication became possible without any restrictions.

Another problem is unsolved until now: When strangers ring up they usually cannot cope with the unexpected situation to communicate with a "synthesizer". To ease this situation we wrote a "welcome-text" read by the synthesizer to inform about the special way of communication necessary for having a conversation with Miss HELA. Nevertheless that problem cannot yet be said to be solved.

4. Transfer-Rates

The rates of transferred information are very different. In the direction towards the user the rate of spoken communication is reached. That is about 100 bits per second [4]. In the other direction from Miss HELA to her counterpart the transfer-rates decreases enormously. For example there has been a conversation which lasted for about 30 minutes. During this period Miss HELA pressed 281 keys. 46 of them were wrong and therefore followed by the delete-key. In addition Miss HELA´s counterpart associated (guessed) 26 letters. Computing the net transfer-rate we get 281-2*46+26=215 letters (keys) within 30 minutes. Let one letter be 7 Bits, then the transfer-rate is 215*7/(30*60)=0.84 Bit per second.

This example relates to a phone call without using prepared text (written offline) and without using fix phrases (text-modules). The transfer-rate increases significantly when prepared texts are used. The transfer-rates also depend on the condition and disposition of Miss HELA and on the ability of her counterpart to interact. If you have an idea what she would like to say immediately after you have heard the first few letters of the word you can say it. If your idea is right Miss HELA presses the space-key and begins the next word.

5. Conclusion

The TINATEL-System offers the ability to begin a conversation without the help of anyone else. That was not possible before. In general the system is only used for communication with persons who are very well-known to the user.

6. References

[1] Trace Research and Development Center, University of Wisconsin-Madison: "Access-DOS", Wisconsin, USA, 1991.

[2] Technological University of Budapest: "MULTIVOX- Sprachsynthesesystem", Hungary, 1990,91.

[3] dba Brown Bag Software: "MINDREADER Version 2.00", Campbell, USA, 1988.

[4] Kommenda, M.:"Ein- und Ausgabe von Sprache", Vorlesungsskriptum, pp 131, Vienna 1991.