AUDIOGRAPHIC SYSTEM AND ITS APPLICATION

ZOORINA BEE KADER MASTAN
ZAINAL ABIDIN AHMAD
Fakulti Kejuruteraan Elektrik
Universiti Teknologi Malaysia
Jalan Semarak
54100 Kuala Lumpur

Abstract

In enhancing the telephone service, audiographic system has been identified as the potential added value system. This paper describes the importance of audiographic system, system concept and feasible application areas.

1. Introduction

Human communicates with one another by listening, speaking, touching, writing and reading. More than 2000 years have passed since Confucious said "a picture is worth thousand words". If that is so, then transmitted picture or sketch might be worth many more in terms of time saved.

There are many ways for transmitting pictures over information networks, such as facsimile and video. Softwares are also used for sending computer graphics. As in videotext a software program transmits either the coordinates of pixels or instructions for creating colors and shapes under the control of a graphic protocol.

Another method of transmitting picture and voice is by using a voice/graphic terminal which is commonly known as a telewriting equipment, a sketchphone or an audiographic system. Integration of voice and data has also received a lot of interest especially on the sub scriber loop whereby audiographic teleconferencing can be economically utilized.

Audiographic system is aimed at users such as architects, construction companies, and hospitals which have obvious needs or ways to transmit graphic and voice material quickly to remote locations. Lorry drivers and workers of delivery service often must be given hand- drawn maps in advance to find their destinations. An audiographic system connection allows both parties to draw maps that can be easily read or understood.

In a situation where a telephone conversation is either unnecessary or could cause intrusion, for example, communication between a manager and his secretary during a conference involving urgent messages, can be undertaken by the audiographic system. Telewriting also enables people with voice and hearing disabilities to communicate effectively over a normal telephone line. Another potential application is in higher education where audiographic system can be connected up as an audiographic teleconferencing system, enabling members of the group to communicate over long distances as in classical teaching or conference method. Telewriting functions provide true dialogue communication.

2. System Concept.

For a more effective communication, handwritten information have been developed to complement traditional voice communication over the telephone system. Many investigations [1,4,7] have shown that hand writing and graphics, as well as voice, play a

valuable part in interactive person-to-person communication. Consequently audiographic terminal will enhance the future services of a telecommunication system by enabling verbal information (telephone) and hand written information (telewriting) to be transmitted simultaneously.

An audiographic terminal can transmit both voice and handwritten information consisting of text and drawing. Figure 1 is a functional block diagram of the terminal. As long as the telewriting interface is switched off, the terminal behaves like a normal voice telephone set for incoming and outgoing calls.

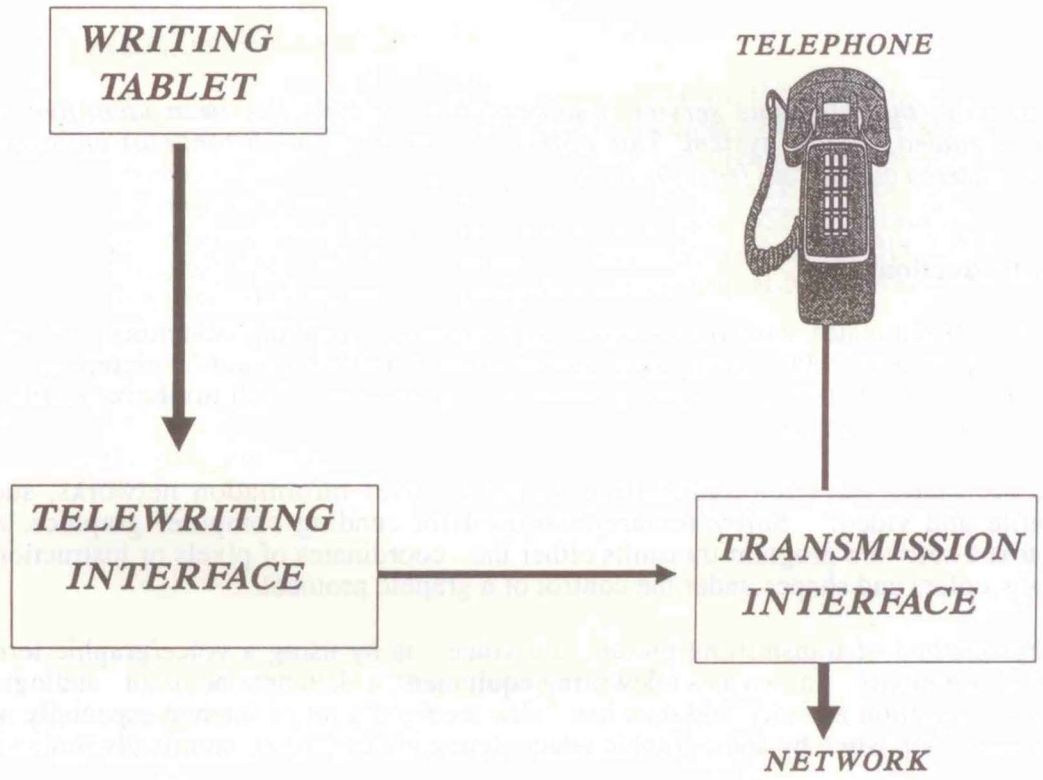

Figure 1: Functional Block Diagram Of An Audiographic Terminal

Handwritten information consists of traces. A trace being a curve of arbitrary shape which starts from a defined position and ends at another defined position. In the sending module of the telewriting part, handwriten information and control data are both converted into a digital signal which is the coded representation of the basic graphic elements (the traces). Next, the digital signal is converted into another format that is suitable for transmission. In the receiving module, the incoming data is converted into the original digital signal format corresponding to the encoding technique being used in the sending module. This conversion enables the coordinate data and the control data to be separated so that the written information can be reproduced by sequentially reconstructing the individual traces. Thus the effect of the pen movement on the paper is retained during reproduction.

The coordinate data representing the points sampled in the input device must be low pass filtered to recover the continuous information. A linear interpolation algorithm can be used to generate a set of continuous grid point as near as possible to the original trace.

3. Technical Requirements

The fundamental devices required in this system are the Input and the Output devices. There are various types of input and output devices available in the market. The study and investigations made by the author indicated that the properties of the pressure sensitive rubber pad which allow the hand to be rested on the paper while writing or drawing using ordinary pencil or ballpoint pen on plain paper proved to be the most cost effective input device. The small size, low cost thermal printer has been identified as the suitable output device. Figure 2 indicates the above input and output devices.

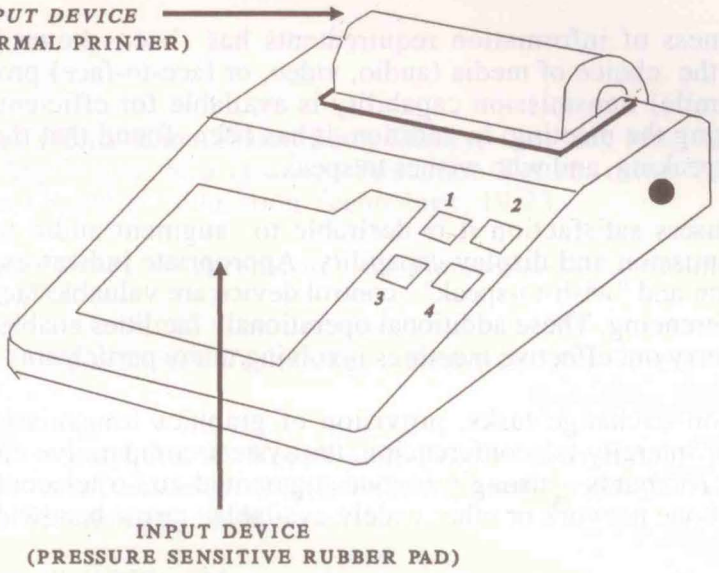

Figure 2: Input And Output Device Of The Audiographic System

The handwriting of the input device is represented by three superimposed time functions along the X, Y and Z axes which requires only a small bandwidth. It has been determined experimentally [7] that the maximum frequency of data derived from handwriting input devices is 15 Hz. Thus 30 samples per second (Nyquist rate) are sufficient to described handwriting completely. However the rate of 40 samples per second is recommended to allow smooth reconstruction of the original writing. As the X and Y coordinates are independent 40 coordinates pairs are produced a second. The Z part is a binary interpretation of the pen-down status; X-Y coordinate pairs are only sampled when the pen is down. The coordinates are interpreted as a set of two integers between 0 and 511, requiring 18 bits per point on a two dimensional plane. Excluding the synchronization and control bits, the resulting rate is 720 bits/s.

4. Human & Technical Factors Consideration

In considering the teleconferencing requirements in Malaysia, human conversational behaviour and technical factors will influence the criteria on the design of the system. The effect of human and technical factors on teleconference have been studied thoroughly by G. W. Jull and C. A. Billowes [8]. The study also considered the relative effectiveness of various technical options for teleconferencing including audio, augmented audio and video systems.

It has been found [8] that the teleconferencing meetings differ in a number of aspects from face-to-face meetings. They have lower effectiveness for some tasks. The effectiveness of

audio teleconferencing can be improved under some circumstances by the provision of visual indicators of participants and graphics transmission facilities.

Research on an experimental augmented-audio conferencing service [1] has been carried out within the Department of Communication, Communication Research Center, Ottawa, Canada. This service between the Communication Research Center and Department of Communication Headquarters seperated by 12 miles was commissioned in 1973. It is an audio-graphic system and provides an audio channel with a bandwidth variable up to 15 KHz, a speaker identification channel, electro-writers and facsimile transmission. Its principal application is that of a flexible research facility, for behavioral and technical studies.

The effectiveness of information requirements has been shown [10] to be relatively insensitive to the choice of media (audio, video, or face-to-face) provided that a suitable graphic (facsimile) transmission capability is available for efficient document exchange prior to or during the meeting. In addition, it has been found that the participants want to know who is speaking and who wishes to speak.

To meet the users satisfaction it is desirable to augment audio teleconferencing with graphics transmission and display capability. Appropriate indicators to acknowledge the speaker location and "wish-to-speak" control device are valuable facilities for augmenting audio teleconferencing. These additional operational facilities enable to restore the system capability to carry out effective meetings involving many participants.

For information exchange tasks, provision of graphics transmission capability is also necessary. For intercity teleconferencing, the system comparative cost and ease of access to potential participants strongly favour augmented-audio teleconferencing using the switched telephone network or other widely-available arrow bandwidth channels.

5. Educational Teleconferencing: A Specific Utilization Of Audiographic Terminal

Audio graphic terminal is an essential device for the low cost Teleconferencing system suitable for Educational Telephone Network. Its features enable voice and sketch to be transmitted for purpose of discussion and sending of hard copies of tutorial materials or the like. Currently the teleconferencing system uses video and telewriting system which requires separate voice channel and high cost. No hard copy is produced by this system. However with the introduction of the new technique of transmission of sketch during the absence of voice in the telephone conversation which is known as "gapping technique", audiographic teleconferencing system can be used to minimize the cost and at the same time produce the hard copy of the sketch transmitted. Three party or more teleconferencing system can utilize the audiographic terminal with "gapping technique". This terminal is able to transmit sketch to all party connected to it which make the teleconferencing system very effective especially for remote educational or off- campus education.

In Malaysia, Universiti Sains Malaysia (USM) has operated the audio-teleconferencing system connecting to all its ten off-campus education centers. The off- campus academic program managed by Universiti Sains Malaysia's (USM) Center for Off-Campus Studies (COCS) uses a hybrid form of distance education system. In this system a document or a sketch is displayed on the system monitor. The disadvantage of this system is that production of the hard copy of the document or sketch is not possible and the cost of the telewriting equipment is expensive. Hence, with the introduction of audio graphic system, the author has the confidence that it will enhance the audio teleconferencing facility and at the same time improve, upgrade and add value to remote educational and off-campus education.

6. Conclusion

The plain old telephone service has been the basic and prime communication needs for years and will continue to be so in the near future. However, the telephone service must be enhanced to meet the requirement of a society with high technology awareness. Thus, in meeting these challenges the audiographic system is envisaged as the positive aspects of telephone service enhancement which will create and sustain interest to the public as compared to videophone. The users are expected to frequently use the service for the purpose of speeding up the business activities, create better business understanding, save money, avoid inconveniences, provide economic and effective communication.

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