Two way interactive sound on a standalone Macintosh platform

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Recent policy statements released by both Federal and State governments indicate official willingness to explore the possibilities of the new technologies in language teaching at all educational levels. In this article, the author discusses his experiments in using the Macintosh computer as a standalone, two way interactive language teacher, with the ability to record and play back the learner's attempts at pre-recorded words and phrases in a genuinely interactive sense. Success has been achieved using the *MacRecorder*, the *AudioPalette* in *HyperCard 2* and *Authorware Professional*. These developments will prove of interest to those involved in computer-assisted language learning (CALL).

Introduction

The ability of the Macintosh to generate sound without the need for any additional hardware has been one of the unique features of the machine since its introduction in 1984. A sound output port has been part of the standard Macintosh interface since the first model was released. Now that some of the newer Macintosh models, such as the popular LC, are being shipped with their own built-in microphones, it is possible to input sound into the Macintosh without the need for any additional software, such as Farralon Computing's MacRecorder and associated software.

This new development will change how the user incorporates sound into his / her work and truly interactive sound is now possible without the need for any purchase on the part of the user. This paper will explore the use of two - way interactive sound on the Macintosh and its potential for language learning by looking at the use of Farralon's *MacRecorder* on the older Macintoshes, the use of the *AudioPalette* shipped with Hypercard 2 on the newer Macs and the ability of *Authorware Professional* to support interactive sound.

With the recent release of language and literacy policies both at the Federal and State levels, the time is ripe for an exploration and exploitation of the Macintosh as a standalone language teacher, without the need for additional devices such as CD-Roms and video-disk players. It is possible to develop simple floppy-disk based language teaching programmes that would be readily accessible in classrooms that have access to a newer Macintosh LC or an older machine with the addition of a MacRecorder.

Background

On the older Macintoshes, a ROM-based device called the *Sound Driver* was used to generate sound. With the introduction of the more powerful Apple Sound Chip on the Macintosh II in 1988, Apple developed the *Sound Manager*, a more sophisticated set of routines that utilise the superior features of the Apple Sound Chip.

Running under System 6.0 or later versions of the system software, all Macintoshes have the same sound-generating software, although the newer Macintoshes have more powerful sound-generating hardware (the Apple Sound Chip). With the introduction of system 6.0.7 for the LC, Classic and IIsi, Apple developed a new Sound Manager which included a "Sound Input Manager" that enables the selection of the sound input device via the Control Panel. Prior to the introduction of the LC and IIsi, the Macintosh lacked an inbuilt analog-to-digital converter and this function had to be performed by additional hardware such as Farralon's MacRecorder. The Sound Manager produces sound by the use of four synthesisers and, in particular, it is the sampled-sound synthesiser that plays digitally recorded sound that produces the most realistic audio effects of concern to the language developer. While some Macintoshes (eg. SE 30) are capable of producing stereo sound, this is not of concern in this discussion.

One limitation of the old Sound Manager operating under System 6 is the inability of the Macintosh to load and play two sounds simultaneously, despite the sound generator having 4-voice sound capability. System 7 has a more robust Sound Manager that has the ability to open more than one sound channel simultaneously and thus it is possible, under System 7, to play more than one sound at the same time. This development places the Macintosh on a par with such systems as the Amiga where multi-channel sound has been a standard feature. Another enhancement under System 7 is the possibility of voice-activated-recording, or VOX as Apple call it, and this enhancement will form the basis of future work by the writer.

Interactive sound developments produced under System 6.0.7 on an LC have not run successfully under System 7 installed on another LC. The

author has been told that Apple is aware of difficulties with audio under System 7 and is working on resolving these difficulties. At this point in time, the author has not developed under System 7 and an area of future work will be to produce similar developments using System 7, as well as exploring multi-channel sound and the above voice-activated-recording.

However, operating under System 6.0.7 on an LC, successful interactive language teaching software was produced using the MacRecorder, the AudioPalette with Hypercard 2 and Authorware Professional. These developments have been tested successfully on the SE, Classic and Macintosh II platforms, with the addition of the MacRecorder where necessary.

Farralon Computing's MacRecorder

Since the introduction of Farralon's MacRecorder in 1987, the Macintosh user has had the ability to record sounds and incorporate them into developments, most notably Hypercard stacks and games, as well as music software. The MacRecorder is a sound digitiser that can be attached to the Macintosh via either the modem or printer ports. The accompanying software includes a powerful sound editor in the SoundEdit program that enables the storing of sounds both as sound files or as sound resources in a format accessible by Hypercard. However, for the user interested in interactive sound developments such as language teaching, the external commands and functions (XCMDs and XFCNs) provided by Farralon in the form of the HyperSound Toolkit are a most powerful and easily used set of tools that enable the quick production of interactive sound stacks in Hypercard.

Version 2.0 (1989) of the HyperSound Toolkit requires Hypercard 1.2.1 or later, which in turn requires a system with 1 megabyte of RAM or more. Thus, it is possible to develop interactive audio on earlier Macintoshes such as the Plus and SE running under earlier versions of the system software. However, System 6.0.2 or later is recommended.

The HyperSound Toolkit provides the user with a set of external commands and functions that can be copied into Hypercard stacks without the need for additional utilities such as ResEdit or ResCopy. Of particular use in the development of an interactive language program are the Fplay XCMD and the Record XFCN. Along with Hypercard play command, it is a simple matter to record original sounds (words and sentences) into the Hypercard stack and paste buttons into the stack that enable the user to mimic the recorded sound and play it back for simple aural comparison purposes. Thus, the language learner can practice until satisfied with his / her performance and move on to another pre-recorded sound.

The sound input by the user in the practice or mimic mode is recorded into RAM and is not saved permanently. In comparison with the AudioPalette in Hypercard 2, no difficulties are encountered when closing the stack as there is no requirement to save the current sound being input by the user.

The Record XFCN provides a variety of recording quality types from 22 kHz (best quality) to 5 kHz. The author has found that recording sounds at 11 kHz provides an adequate compromise between recording quality and disk storage space. Also, a variety of compression rates, with a maximum of 8:1 compression, are provided for. It is thus possible for the developer to experiment with a choice of recording quality and compression rates that reach an acceptable compromise between quality and storage requirements, ever a problem with the recording of digitised sound. One second of sound, recorded at 22 kHz with no compression, requires approximately 22 kB of disk space.

The only restriction that the author found in developing on an LC running under System 6.0.7 was a difficulty in using a mouse-click to stop recording on the part of the learner. Thus, at this point in development, the available time for the user to mimic sound must be preset via the Record XFCN, although HyperSound Toolkit does enable the mouse to stop recording.

Using Farralon's MacRecorder and the associated HyperSound Toolkit, the author has developed a prototype interactive language learner for the Nyungar language of the south-west Aboriginal people of Western Australia. In this prototype, a graphic is displayed and the user has an ongoing screen-to-screen choice between Nyungar and English. On clicking a button, the user hears the chosen language spoken that relates to the graphic, while the text of the word or phrase is printed on the screen. Thus, the prototype would be suitable for the learning of a second language or in a bi-lingual situation where both languages are to be learnt or compared (see Fig. 1).

Figure 1.
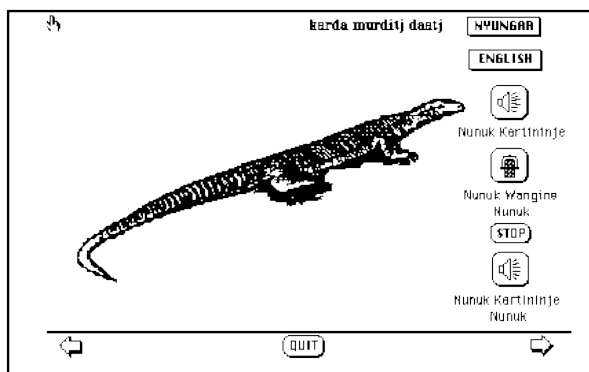
Farralon's MacRecorder enables the easy development of interactive sound that is usable on a variety of Macintosh platforms, from the older MacPlus to the newer Classic and beyond. The only requirement is that the end user also has a MacRecorder installed as additional hardware, to enable the input of voice. Current pricing of the MacRecorder, with the associated software including the powerful SoundEdit, is approximately $290. NetComm, the distributors of Farralon products, can also supply a voice digitiser, with the HyperSound software, for around $180.

However, recent developments by Apple in the provision of built-in sound input capability in some of the newer machines have, in a sense, dated the MacRecorder, although its use is essential for interactive sound on the older Macintoshes. It is to these recent developments that I now turn.

The AudioPalette and Hypercard 2

One of the most exciting developments in recent times has been the provision by Apple of in-built sound input capability into the newer machines such as the Macintosh LC and the IIsi. A small microphone is shipped with these machines thus enabling the purchaser to record and incorporate sounds into developments without the need for any additional purchase of hardware or software.

The Sound Manager in system 6.0.7, under which these newer machines must operate (ignoring System 7 upgrades), incorporates a new Sound Input Manager. Via the Control Panel, the user can select a sound input device (if more than one is connected) and can record alert sounds using the simple audio palette provided with the Sound Input Manager.

However, the shipping of Hypercard 2 and the AudioPalette (within the Audio Help stack) in the newer machines, including the Classic, open up new vistas of the potential use of interactive sound in Hypercard stacks.

Using the AudioPalette, it is a simple matter for the user to record his/her own sounds and incorporate them into stacks that enable the playback of the recorded sound by the clicking of a usual Hypercard button. In particular, the Addresses with Audio and the Appointments with Audio that are shipped with the newer machines, along with Hypercard 2, demonstrate the ease with which sound can be incorporated into Hypercard stacks. Apple's manual HyperCard Basics explains the use of sound in these stacks.

A most useful and informative on-line help for the use of the AudioPalette within HyperCard is provided in the form of the AudioHelp stack shipped with the new machines. For the experienced HyperCard developer, an examination of the scripting within this stack will provide useful information as to how the developer might access the various

AudioPalette commands, such as Record, Play and Delete, in further developmental work.

The author has done this and has been successful in developing interactive sound on the Macintosh, using the various commands available to the AudioPalette on the newer machines. To use all the features of the AudioPalette, including the recording of sound, it is necessary to be operating under System 6.0.6 or later. Thus, it is possible to use HyperCard 2 and the AudioPalette on the older SE and Plus, although System 6.0.7 is not recommended for the Plus or SE. Of course, on these machines a digitiser such as the MacRecorder will be necessary as an in-built microphone is not provided.

Users of Audio... under the Edit Menu in HyperCard 2 will be familiar with the AudioPalette in its visible form. However, it is possible to invoke the AudioPalette without it being visible to the user and it is in this form that it is of use to the interactive language developer. By sending commands to the AudioPalette, it is possible to Record and Play sounds from the invisible palette. Thus, the AudioPalette enables the developer to produce fully interactive language lessons based on the Macintosh without the need for any further hardware or software requirements, given the machine has an in-built microphone such as the LC (see Fig.1).

In developing an interactive language program, the author had several areas of difficulty that were not easily resolved. One of the major difficulties was encountered in closing the language stack without intimidating the user with various dialogue boxes calling for the saving of the current "Attempt" in the AudioPalette. The AudioPalette automatically will wish to save the current sound into a stack, as this was the prime purpose of its development, to enable the recording of sounds into stacks. If the developer allowed the sound to be saved onto disk, problems with storage space would arise as well as difficulties in replacing previous stored attempts with current attempts.

An examination of the scripting for the Play Sound button generated by the AudioPalette when a sound is saved drew the authors attention to the DeleteSnd command. Thus, in closing the stack, the current user's attempt could be saved and consequently deleted from the stack. Also, by locking the screen, it was possible to make these actions transparent to the user so that closing the stack could occur with no user confusion.

Another major difficulty in developing a successful stack was to get a pre-recorded sound to play back the first time. Pre-recorded sounds (words and phrases) would only play back after an attempt to record was made by the user. This gave rise to the use of a "kludge" which was actioned on opening the stack. A message was sent to the AudioPalette to record for a very short time, at low volume level. This then enabled the immediate playback of pre-recorded sound from cards in the stack.

However, the greatest developmental difficulty lay in having both the pre-recorded sound and the user's current attempt both available for play back, for comparison purposes. The use of the AudioPalette's Copy and Paste routines enabled a very clumsy and slow system to work. However, by by-passing the AudioPalette's play command and using the play command from within HyperCard itself, it was possible to have the two sounds available for play-back and comparison. This process required the use of the above mentioned kludge to get the system to work.

One limitation of the AudioPalette that cannot be avoided is the slight delay involved in responding to the Record command. Under MacRecorder, using the Record XFCN, the response is immediate. Under the AudioPalette in HyperCard 2, a delay of a few seconds is inevitable while the palette is initialised and activated. The same delay is inherent in using the record facilities in the new Sound Manager in the Sound Control Panel. I feel that this is a point that Apple should endeavour to improve upon. However, this delay is by no means unworkable and a interactive sound system can be developed that is usable. The user can stop recording by clicking the mouse button that then sends a stop message to the AudioPalette. No difficulties were encountered in this, in contrast to the MacRecorder.

Using the MenuMaker provided within the PowerTools stack of HyperCard 2, the author developed two menus for incorporation within a stack. Thus, the Language can be chosen (a choice of two) and the gender of the Speaker (male or female) can be set (see Fig. 2).

Figure 2.
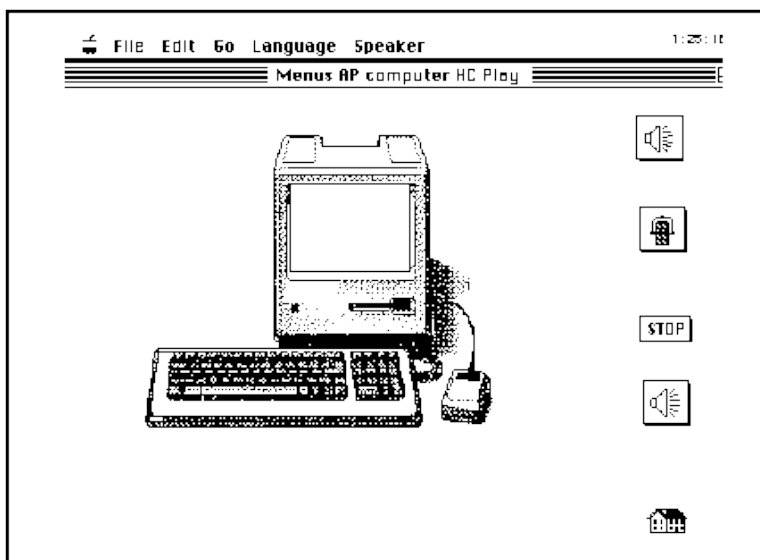
Using a very simple concatenation process, it is possible to develop very simple scripting that will handle a variety of sounds spoken in two languages by two speakers. In the script given below for the playback button KEYBOARD, lang and sex are global variables generated by the above two menus.

```
on mouseUp
  Global Count,lang,sex,name,newname
    -- identify KEYBOARD
  put 1 into Count -- button id number for later replay
  put "keyboard" into name
  -- playsound routine
  put lang&sex&name into newname
  play newname
    if lang contains E then
      put name into background field id 17 -- write name on screen
    end if
    if lang contains O then
    put name&" other" into background field id 17 -- write name on
      screen
  end if
end mouseUp
```

This same script can be used, with minor adjustments, for a variety of buttons on the same screen, with E representing English and O the other language. original sounds are pre-recorded and saved in the form of lang&sex&name eg. EMkeyboard identifies the English Male version of the sound for "keyboard". Thus, the use of the AudioPalette provides a very efficient, if not elegant, means for interactive sound on the Macintosh.

The AudioPalette provides two levels of sound quality - Best at 22 kHz and Good at 11 kHz. Compression of Best quality sound is available at the ratios of 3:1 and 6:1. Similar storage requirements to those stated for the MacRecorder are required.

In summary, the AudioPalette shipped with the newer machines, along with HyperCard 2, provides a very powerful, versatile and flexible means for the development of interactive language learning on the newer Macintoshes, without the need for any additional purchase of hardware or software.

Interactive Sound using *Authorware Professional*

Developing interactive sound using the authoring language Authorware Professional proved to be quite demanding and it would appear that little work has been done in Australia on exploring the use of Authorware Professional in interactive sound. In the final event, use had to be made of external commands provided from the United States of America to achieve interactivity.

Authorware users will be familiar with its icon-based authoring system and the use of stored sound via the Sound Icon. Also, the SoundWave software shipped with Authorware provides similar recording and editing features to Farralon's SoundEdit. Authorware can work with sounds only in the form of files and any sound resources from HyperCard that the user may wish to incorporate into Authorware must first be converted to the file format before they can be used via the Sound Icons. SoundWave supports three recording qualities, 22, 11 and 7 kHz, with currently no compression available under Authorware 1.6.

A MacRecorder is shipped with each purchase of Authorware Professional and it is the use of this device that enables the incorporation of interactive sound within Authorware. Although the in-built microphone and sound input port that is supplied with the LC (and others) can be used for the recording of sounds into SoundWave during development, the end user must, at this stage, rely on the MacRecorder connected to either the modem or printer port, for the use of interactive sound in a program's run-time version.

In its version 1.6 release notes, Authorware states that it will support only the XCMDs and XFCNs compatible with Hypercard 1.x and that a later release will support XCMDs in the HyperCard 2 format. It was this statement that lead the author to do preliminary investigations of the compatibility of the external commands and functions provided with Farralon's HyperSound Toolkit with Authorware Professional. Initially, the Record XFCN and FPlay XCMD were loaded into Authorware via the usual Load Function... option in the Variables menu. Although something appeared to be happening during the Record phase, no sound would playback. Further experimentation with HyperSound's InputLevel XFCN and EraseSnd XCMD indicated that these functions operated from within Authorware. However, the Fplay command would not work.

At this stage, contact was made with Learnware Inc., the Australian distributors of Authorware Professional. Learnware informed me that they were currently awaiting the arrival from the United States of a set of external commands that would achieve the desired end of interactive sound. These commands eventually arrived and were shipped out to me.

Examination of these commands using the utility ResEdit identified the existence of a Record XFCN with a resource ID identical to HyperSound's Record XFCN and a SndPlay XFCN different from HyperSound's FPlay. An interesting point to note is that these external functions must be pasted into Authorware Professional using ResEdit for them to work. It is not sufficient to use the Load Function... provided in the variables menu. Also, the writer suspects that the above SndPlay function may be the same as that provided with the current Sound Manager.

With some adjustment of the arguments in the Record XFCN (changing the port to 2 for the modem and setting the record time to non-zero), success was achieved in the development of an Authorware program that enabled the play back of a pre-recorded sound (via the usual sound icon) and the recording and play back of sound via buttons on the screen. Thus, the basic technical skills were now available for the further development of interactive sound using Authorware.

The author has done this with two simple prototypes, the first similar to the above work on the AudioPalette and the MacRecorder.(see Fig. 3). A comparison with the earlier work was attempted in that two languages were to be available to the user. As with the AudioPalette in HyperCard 2, difficulties were encountered in having both the original sound and the user's current attempt available for comparison.
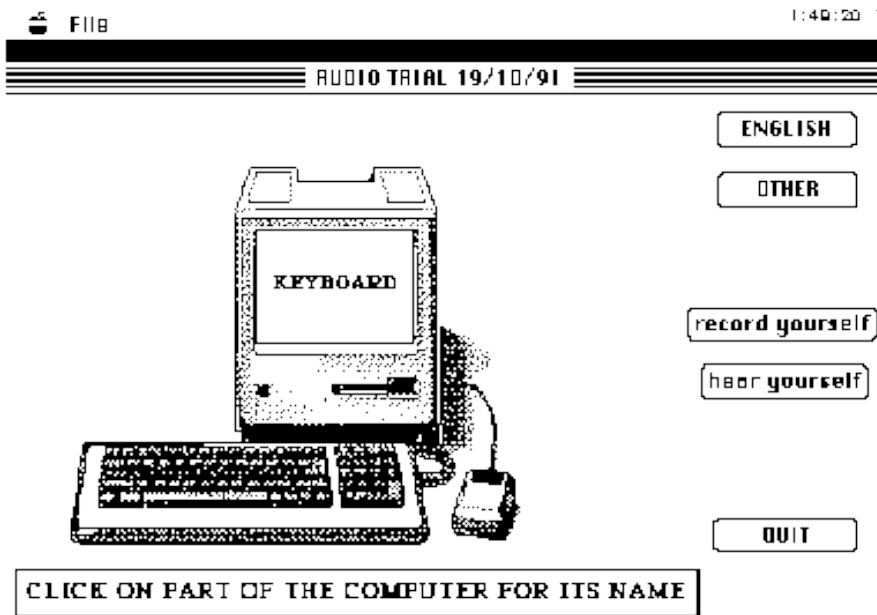

Figure 3.

To achieve this end, the structure of the authoring became increasingly complex, with interactions embedded within further interactions. However, it is possible to have both the stored sound and the user's attempt immediately available for comparison.

Using the Menu option as one of the possible interaction responses, it is possible to incorporate a selection of language or speaker as a menu item rather than an on-screen button. However, the structure of the authoring

became very complex and convoluted. As each specific pre-recorded sound is accessed via a particular sound icon (with its name), there is not the elegance nor flexibility provided say from within the scripting of Hypercard that enables elegant and efficient handling of many sounds or options of language type or speaker gender. To achieve an additional choice of speaker gender will require even further branching of logic and duplication of flow lines within each branch. If there were a way within Authorware to access pre-recorded sounds other than by particular sound icons, then the system might be usable for more complex interactive language authoring.

Despite this restriction on the scope of Authorware, the writer has developed a simple prototype using just one language alone (with no choice of speaker) that has met with approval from developers in the field. (see Fig. 4). This has involved the use of characters and phrases in Chinese Mandarin. The user clicks on the character to hear its Mandarin rendition and can practice mimicking the sound and hear the replay of both original sound and the attempt. The authoring level to achieve this end is relatively simple and efficient and the speed of access to the recording and play back facilities is more than satisfactory.
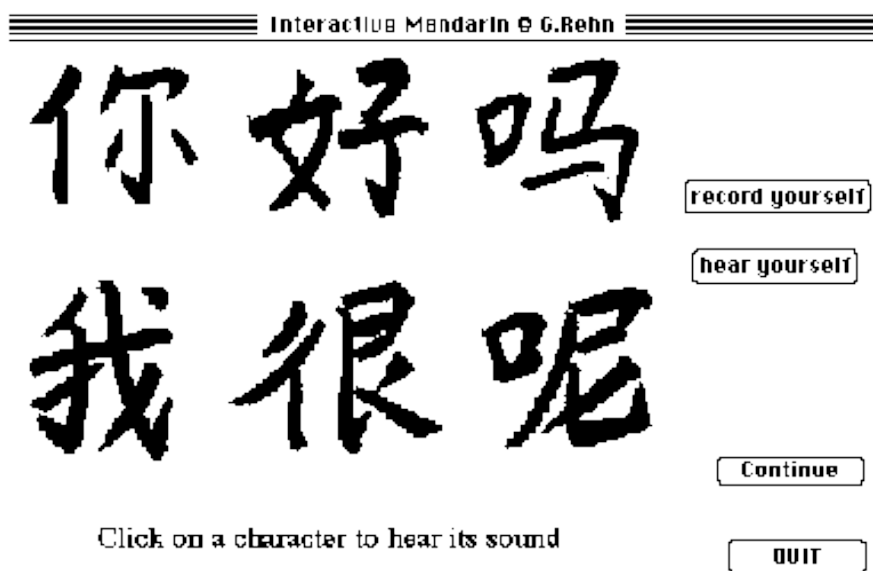

Figure 4.

In the packaging of the product for distribution, it is necessary that the external commands be pasted (using ResEdit) into the run-time version of Authorware (Run APM). Also, at this stage, it has not been possible to

package the developed file and Run APM together. Thus, the end user needs the version of Run APM with the necessary XCMDs pasted in.

However, the potential of Authorware Professional for interactive language learning is great, as long as the developer is not overly ambitious in terms of what is wanted. Several languages can be incorporated with patience and a tolerance for tedium in authoring, as well as a selection of speaker types. Nevertheless, possibly the greatest use will be found in simple applications of language learning whereby only one language and one speaker is to be used. Authorware's ability to incorporate colour and a wide range of graphics, as well as the ease of development of a computer-managed learning environment might make it an ideal tool for the development of interactive language in the school system.

Conclusion

In this paper, the author has discussed the use of the Macintosh computer as a standalone language-learning tool, with the necessary addition of minimal hardware and software requirements. The simplest system for the novice developer is Farralon's MacRecorder and the associated HyperSound Toolkit. These enable the rapid development of interactive language-learning software without the requirement of any additional programming, scripting or authoring skills. The finished product is able to be used on all levels of Macintosh, from the Mac Plus upwards. The only additional requirement is the purchase of a MacRecorder. The system will operate under older versions of HyperCard.

The AudioPalette with HyperCard 2 and the newer Macintoshes provides a very flexible and powerful tool for the developer that is reasonably proficient in HyperTalk, the authoring language of HyperCard. A complex structure including choice of language and speaker can be achieved with efficiency, elegance and minimal scripting. Menus can be incorporated via the Menu Maker although the author finds it more convenient to have the choice of language and speaker available via a button on the screen. The same code can be utilised for a variety of sounds and phrases, thus minimising the tedium of repetitive scripting.

With Authorware Professional, the developer now has access to a set of external commands that enable the development of interactive sound. While the development of sophisticated structures is possible, the icon-based nature of Authorware, while a strength in other development situations, is a limitation in more complex language teaching structures, such as choice of language and speaker. The strength of Authorware will lie in its ability to use colourful graphics as a motivation to language learning.

The major point to be gleaned from the above discussion is that it is possible to use the Macintosh as a standalone interactive audio language - teacher. Thus, it is possible to develop language courses that are floppy - disk based and that are accessible in a variety of learning environments, which have a simple Macintosh platform. While it may be desirable to have mass-storage on CD-Roms, such requirements are not essential.

The writer is particularly interested in examining the enhancements offered in the new Sound Manager, such as voice activated sound and multi-channel sound replay. Of particular concern is whether or not the access time to the record facilities of the Sound Manager (and the AudioPalette) can be sped up. Such experimentation will require the writer to develop skill in the writing of external commands in a programming language such as Pascal, so that the full enhancements of the Sound Manager can be exploited, without reliance on presently available XCMDs.

With the release of language policies at the State and Federal levels that will make the learning of a second language mandatory for the school child, and with the intention to increasingly utilise modern technologies in language teaching in the classrooms, the time is most auspicious for developers and language specialists to examine closely the use of computer-based, interactive-audio language-learning on standalone micro-computers, including the Macintosh.

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