An interactive apparatus is disclosed. The interactive apparatus has an audio recording mode and an audio playback mode. Further, the interactive apparatus includes a writing tool for manually writing on an encoded writing medium, an audio input device for recording audio, an audio output device for playing the recorded audio. Moreover, the interactive apparatus has an optical unit for determining position on the encoded writing medium of the writing tool and for recognizing information on the encoded writing medium, wherein recognition of a recording-enabling graphical element on the encoded writing medium activates the audio recording mode and enables time-synchronization of creation of writing on the encoded writing medium with the writing tool and recording of the audio, and further wherein recognition of a playback-enabling graphical element on the encoded writing medium activates the audio playback mode and enables multiple techniques to control playback of the recorded audio.

Related U.S. Application Data

Continuation of application No. 12/264,828, filed on Nov. 4, 2008, which is a continuation of application No. 11/034,495, filed on Jan. 12, 2005, now Pat. No. 7,453,447, which is a continuation-in-part of application No. 10/803,806, filed on Mar. 17, 2004, which is a continuation-in-part of application No. 10/861,243, filed on Jun. 3, 2004, now abandoned.
Figure 4A

100A

encoded writing medium

100B

1st paragraph

2nd paragraph

encoded writing medium

record
Figure 4C

encoded writing medium

record

conversation with John on 1-3-2005

stop

410

490

450

200
the interactive apparatus activates an audio recording mode in response to recognition of a recording-enabling graphical element on the encoded writing medium 610

while recording audio using the interactive apparatus, creation of writing on the encoded writing medium with the writing tool and recording of the audio is time-synchronized using the interactive apparatus 620

the audio recording mode of the interactive apparatus is deactivated in response to recognition of at least one of a plurality of control-enabling graphical elements on the encoded writing medium 630

FIGURE 6A
the interactive apparatus activates an audio playback mode in response to recognition of a playback-enabling graphical element on the encoded writing medium 710

in the audio playback mode, information associated with the created writing on the encoded writing medium and the recorded audio associated with the writing on the encoded writing medium is retrieved and played using the interactive apparatus 720

the audio playback mode of the interactive apparatus is deactivated in response to recognition of at least one of the plurality of control-enabling graphical elements on the encoded writing medium 730

FIGURE 6B
INTERACTIVE APPARATUS WITH RECORDING AND PLAYBACK CAPABILITY USABLE WITH ENCODED WRITING MEDIUM

CROSS REFERENCE TO RELATED APPLICATION


BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention generally relates to writing mediums and devices that interact with writing mediums. More particularly, the present invention relates to interactive apparatus with recording and playback capability usable with encoded writing medium.

2. Related Art
When the computer was introduced, there was an initial thought that the computer would lead to a paperless world. However, the computer has created new uses for paper. Moreover, the paper environment continues to integrate with the electronic environment.

Typically, technologies that merge the paper environment and the electronic environment are costly compared to a conventional sheet of paper. Further, these technologies simply duplicate the fundamental functions of paper: storing a persistent image. None of these technologies bring interactive functionality to the paper environment.

Further, when an audio recording device and a writing medium are utilized together, there is no link between the writing on the writing medium and the recorded audio. That is, the audio recording device and the writing medium operate independently of each other. It is inconvenient and difficult to efficiently utilize both the audio recording device and the writing medium at the same time. Moreover, the recorded audio and the writing medium may be separated from each other and lost.

SUMMARY OF THE INVENTION

An interactive apparatus is disclosed. The interactive apparatus has an audio recording mode and an audio playback mode. Further, the interactive apparatus includes a writing tool for manually writing on an encoded writing medium, an audio input device for recording audio, an audio output device for playing the recorded audio. Moreover, the interactive apparatus has an optical unit for determining position on the encoded writing medium of the writing tool and for recognizing information on the encoded writing medium, wherein recognition of a recording-enabling graphical element on the encoded writing medium activates the audio recording mode and enables time-synchronization of creation of writing on the encoded writing medium with the writing tool and recording of the audio, and further wherein recognition of a playback-enabling graphical element on the encoded writing medium activates the audio playback mode and enables multiple techniques to control playback of the recorded audio.

In an embodiment, the interactive apparatus further comprises a memory unit for storing recorded audio and information associated with said writing. Also, the interactive apparatus includes a communication device for transmitting the position of the graphical element and the associated recorded audio to a remote storage location. The communication device may be a wireless communication device. The encoded writing medium may be paper encoded with a grid of dots. The writing tool may be one of a pen and a pencil.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and form a part of this specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the present invention.

FIG. 1A illustrates an encoded writing medium in accordance with an embodiment of the present invention.

FIG. 1B illustrates a section of the encoded writing medium of FIG. 1A in greater detail in accordance with an embodiment of the present invention.

FIG. 2 illustrates an interactive apparatus in accordance with an embodiment of the present invention.

FIG. 3A illustrates a block diagram of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention.

FIG. 3B illustrates a block diagram of the interactive apparatus of FIG. 2 in accordance with another embodiment of the present invention.

FIGS. 4A, 4B, and 4C illustrate an audio recording mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention.

FIGS. 5A, 5B, and 5C illustrate an audio playback mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention.

FIG. 6A illustrates a flow chart showing the audio recording mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention.

FIG. 6B illustrates a flow chart showing the audio playback mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with these embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention.

FIG. 1A illustrates an encoded writing medium 100 in accordance with an embodiment of the present invention.
In one embodiment, the encoded writing medium 100 is paper encoded with a grid of dots compatible with technology described in detail in the following U.S. Pat. Nos. assigned to Anoto, a Swedish company, and are incorporated herein by reference in their entirety: 6,502,756; 6,548,768; 6,570,104; 6,586,688; 6,663,008; 6,666,376; 6,667,655; 6,674,427; 6,689,966; 6,698,660; 6,722,574; 6,732,927; and 6,836,555. By reading a pattern of dots on the paper, a position (e.g., X and Y coordinates) on a predefined map can be determined. It should be understood that other types of encoded writing mediums may be utilized.

Continuing, FIG. 1B illustrates a section 10 of the encoded writing medium 100 of FIG. 1A in greater detail in accordance with an embodiment of the present invention. As depicted in FIG. 1B, each dot is slightly displaced from the X-axis and from the Y-axis.

FIG. 2 illustrates an interactive apparatus 200 in accordance with an embodiment of the present invention. As shown in FIG. 2, the interactive apparatus 200 includes a writing/position detection and 205 and an expansion end 210 for coupling a removable functionality expansion unit 220. The writing/position detection end 205 includes a writing tool 230 and optics that uses light 240 to detect the dot pattern for determining position on the encoded writing medium 100. The interactive apparatus 200 may be utilized by a user. In an embodiment, the interactive apparatus 200 is shaped for use as a writing instrument by the user.

A block diagram of the interactive apparatus 200 of FIG. 2 in accordance with an embodiment of the present invention is illustrated in FIG. 3A. As shown in FIG. 3A, the interactive apparatus 200 includes a processor 250, an optical detector 258, an optical emitters 260, a memory unit 254, an audio input device for recording audio, an audio output device for playing audio, a communication device 256, and a writing tool 262. The writing tool is used for manually writing on the encoded writing medium 100. Examples of writing tools include a pen and a pencil. The processor 250, the optical detector 258, and the optical emitters 260 form an optical unit, which determines position on the encoded writing medium 100 of the interactive apparatus 200 and recognizes information on the encoded writing medium 100. In particular, the position of the writing tool 262 on the encoded writing medium 100 is determined. In an embodiment, the optical emitters are a light-emitting diode while the optical detector is a light-sensitive sensor for recording a two-dimensional image, which is processed to determine position on the encoded writing medium 100. Examples of light-sensitive sensors include a CCD sensor or a CMOS sensor.

The interactive apparatus 200 has an audio recording mode for recording audio via the audio input device 264 and an audio playback mode for playing the recorded audio via the audio output device 252. In an embodiment, the recorded audio is stored in a digital format by the audio recording component/device of the interactive apparatus 200. As will be described below, recognition of a recording-enabling graphical element on the encoded writing medium activates the audio recording mode and enables time-synchronization of creation of writing on the encoded writing medium with the writing tool and recording of the audio. Further, recognition of a playback-enabling graphical element on the encoded writing medium activates the audio playback mode and enables multiple techniques to control playback of the recorded audio. The memory unit 254 may store recorded audio 278 and information 276 associated with the created writing on the encoded writing medium 100. Information 276 may include position data, character recognition information, etc. Additionally, the memory unit 254 may store code/instructions for providing the functionality of the interactive apparatus 200. The optical unit enables the interactive apparatus 200 to recognize graphical elements on the encoded writing medium 100 that activate/deactivate corresponding functionality of the interactive apparatus 200. Also, optical unit may capture and store optical images of writing on surface of the encoded writing medium 100 during recording of the audio in the audio recording mode.

In an embodiment, multiple techniques for controlling playback of the recorded audio may include using control-enabling graphical elements to control playback of the recorded audio and using the created writing and the time-synchronization to indicate where to start playback of the recorded audio based on location of the writing tool 262 on the created writing on the encoded writing medium 100. This facilitates dynamically creating visual cues for the audio on the encoded writing medium 100 with the writing tool 262 of the interactive apparatus 200.

The communication device 256 is configured to communicate with network 268 and computer system 272 via communication link 266. The network 268 has a data storage unit 270 while the computer system 272 has a hard drive 274. In an embodiment, the communication device 256 is a wireless communication device while the communication link 266 is a wireless communication link. The communication device 256 may transmit at least a portion of the information 276 associated with the created writing on the encoded writing medium 100 and at least a portion of the recorded audio 278 to a remote location such as the data storage unit 270 and the hard drive 274 to manage memory capacity or for long-term storage.

FIG. 3B illustrates a block diagram of the interactive apparatus 200 of FIG. 2 in accordance with another embodiment of the present invention. The discussion of FIG. 3A applies to FIG. 3B except as noted below. In FIG. 3B, a removable functionality expansion unit 220 is coupled to the interactive apparatus 200. The removable functionality expansion unit 220 includes an audio input device 264, an audio processing unit 284, and a memory unit 284. The memory unit 284 may store recorded audio 278 and information 276 associated with the created writing on the encoded writing medium 100.

FIGS. 4A, 4B, and 4C illustrate an audio recording mode of the interactive apparatus 200 of FIG. 2 in accordance with an embodiment of the present invention. Referring to FIG. 4A, the encoded writing medium 100A initially may have no writing (printed writing or manual writing). Alternatively, the encoded writing medium 100B initially may have printed writing and/or manual writing. The interactive apparatus 200 may be utilized to draw the recording-enabling graphical element 410 on the encoded writing medium 100A. Alternatively, the recording-enabling graphical element 410 may be preprinted on the encoded writing medium 100A. The interactive apparatus 200 is configured to recognize the recording-enabling graphical element 410 and then to activate the audio recording mode of the interactive apparatus 200. The recording-enabling graphical element 410 shown in FIG. 4A is exemplary. The design of the recording-enabling graphical element 410 may be different than that shown. In response to recognizing the recording-enabling graphical element 410, the audio recording mode of the interactive appa-
ratus 200 is selected. The recognition may involve tapping on the recording-enabling graphical element 410 and following audio prompts given by the interactive apparatus 200. This enables dynamic tagging of audio to the encoded writing medium 100A and 100B via the recording-enabling graphical element 410. That is, audio and the encoded writing medium are visually integrated.

[0030] Continuing with FIG. 4B, once the interactive apparatus 200 is in the audio recording mode, the interactive apparatus 200 records audio. While recording the audio, the interactive apparatus 200 may be utilized to manually write on the encoded writing medium 100A, 100B, and 100C. Moreover, the interactive apparatus 200 time-synchronizes the creation of writing 490 on the encoded writing medium 100 with the writing tool 262 and recording of the audio. The audio may be recorded digitally into the memory unit 254 and 284 and/or stored remotely from the interactive apparatus 200. Also, the interactive apparatus 200 obtains information associated with the created writing 490 on the encoded writing medium 100. The information may include position data, character recognition information, etc. The encoded writing medium 100A provides an example of writing notes and recording the class lecture.

[0031] Continuing, the encoded writing medium 100B provides an example of reviewing and editing printed writing and/or manual writing and recording audio comments in addition to or instead of written comments. Lastly, the encoded writing medium 100C provides an example of writing notes while recording a conversation. The interactive apparatus 200 may capture and store optical images of the writing (printed writing or manual writing) on the surface of the encoded writing medium 100A, 100B, and 100C during recording of the audio in the audio recording mode. This enables the generation and printing of another encoded writing medium having the same writing (printed writing or manual writing) on the surface of the encoded writing medium for use by another user having an interactive apparatus. As described above, the recorded audio, information associated with the created writing 490 on the encoded writing medium, and optical images of the writing (manually created and preprinted) may be stored locally and/or in a remote storage location such as the data storage unit 270 and the hard drive 274.

[0032] In an embodiment, multiple techniques for controlling playback of the recorded audio may include using control-enabling graphical elements 450 (See FIGS. 5A, 5B, and 5C) to control playback of the recorded audio and using the created writing 490 and the time-synchronization to indicate where to start playback of the recorded audio based on location of the writing tool 262 on the created writing 490 on the encoded writing medium. This facilitates dynamically creating visual cues for the audio on the encoded writing medium with the writing tool 262 of the interactive apparatus 200.

[0033] At FIG. 4C, the audio recording mode of the interactive apparatus 200 may be deactivated in response to recognition of at least one of the plurality of control-enabling graphical elements 450 on the encoded writing medium 100C. The recognition may involve tapping on the control-enabling graphical element 450 and following audio prompts given by the interactive apparatus 200. The interactive apparatus 200 may be utilized to draw the control-enabling graphical element 450 on the encoded writing medium 100C. Alternatively, the control-enabling graphical element 450 may be preprinted on the encoded writing medium 100C. The control-enabling graphical element 450 shown in FIG. 4C is exemplary. The design of the control-enabling graphical element 450 may be different than that shown.

[0034] FIGS. 5A, 5B, and 5C illustrate an audio playback mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention. Referring to FIG. 5A, the interactive apparatus 200 is configured to recognize the playback-enabling graphical element 420 and then to activate the audio playback mode of the interactive apparatus 200. The playback-enabling graphical element 420 shown in FIG. 5A is exemplary. The design of the playback-enabling graphical element 420 may be different than that shown. In response to recognizing the playback-enabling graphical element 420, the audio playback mode of the interactive apparatus 200 is selected. The recognition may involve tapping on the playback-enabling graphical element 420 and following audio prompts given by the interactive apparatus 200. The interactive apparatus 200 may be utilized to draw the playback-enabling graphical element 420 and the control-enabling graphical elements 450 on the encoded writing medium 100C, wherein the control-enabling graphical elements 450 control playback of the recorded audio in the audio playback mode. Alternatively, the playback-enabling graphical element 420 and the control-enabling graphical elements 450 may be preprinted on the encoded writing medium 100C. The control-enabling graphical elements 450 shown in FIG. 5A are exemplary. The design of the control-enabling graphical elements 450 may be different than that shown. The interactive apparatus 200 is configured to recognize the control-enabling graphical elements 450 and then to enable controlling playback of the recorded audio in the audio playback mode of the interactive apparatus 200.

[0035] Continuing with FIG. 5B, once the interactive apparatus 200 is in the audio playback mode, the recorded audio 278 is associated with the writing 490 on the encoded writing medium 100C is retrieved. The recorded audio 278 is played using the interactive apparatus 200. The recorded audio may be retrieved from local storage such as memory units 254 and 284.

[0036] Also, the recorded audio may be retrieved from remote storage such as the data storage unit 270 and the hard drive 274 via the communication link 266. Moreover, information associated with the created writing 490 on the encoded writing medium 100C may be retrieved from the local storage (e.g., memory units 254 and 284) and/or remote storage (e.g., the data storage unit 270 and the hard drive 274) via the communication link 266. While in the audio playback mode, the interactive apparatus 200 may be utilized to recognize the control-enabling graphical elements 450. The recognition may involve tapping on the control-enabling graphical elements 450 and following audio prompts given by the interactive apparatus 200. Controls such delay, pause, play, rewind, forward, fast forward, fast rewind, speed, and stop are provided by the control-enabling graphical elements 450.

[0037] As described above, multiple techniques for controlling playback of the recorded audio may include using control-enabling graphical elements 450 to control playback of the recorded audio and using the created writing 490 and the time-synchronization to indicate where to start playback of the recorded audio based on location of the writing tool 262 on the created writing 490 on the encoded writing medium 100C.

[0038] At FIG. 5C, the audio playback mode of the interactive apparatus 200 may be deactivated in response to rec-
ognition of at least one of the plurality of control-enabling graphical elements 450 on the encoded writing medium 100C. The recognition may involve tapping on the control-enabling graphical element 450 and following audio prompts given by the interactive apparatus 200.

[0039] FIG. 6A illustrates a flow chart 600 showing the audio recording mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention. Reference is made to FIGS. 1A-SC.

[0040] At Block 610, the interactive apparatus 200 activates an audio recording mode in response to recognition of a recording-enabling graphical element 410 on the encoded writing medium 100. The recording-enabling graphical element 410 may be drawn with the writing tool 262 or may be preprinted on the encoded writing medium 100. The recognition may involve tapping on the recording-enabling graphical element 410 and following audio prompts given by the interactive apparatus 200.

[0041] Further, at Block 620, while recording audio using the interactive apparatus 200, creation of writing on the encoded writing medium 100 with the writing tool 262 and recording of the audio is time-synchronized using the interactive apparatus 200.

[0042] Furthermore, at Block 630, the audio recording mode of the interactive apparatus 200 is deactivated in response to recognition of at least one of the plurality of control-enabling graphical elements 450 on the encoded writing medium 100. The recorded audio 278 and information 276 associated with the created writing on the encoded writing medium 100 may be stored locally (e.g., memory units 254 and 284) and/or in a remote storage location such as the data storage unit 270 and the hard drive 274. Also, the recorded audio 278 and information 276 associated with the created writing on the encoded writing medium 100 may be retrieved later during the audio playback mode in response to recognition of other graphical elements or location of the writing tool 262 on created writing on the encoded writing medium 100.

[0043] FIG. 6B illustrates a flow chart 700 showing the audio playback mode of the interactive apparatus of FIG. 2 in accordance with an embodiment of the present invention. Reference is made to FIGS. 1A-SC.

[0044] At Block 710, the interactive apparatus 200 activates an audio playback mode in response to recognition of a playback-enabling graphical element 420 on the encoded writing medium 100. The playback-enabling graphical element 420 may be drawn with the writing tool 262 or may be preprinted on the encoded writing medium 100. The recognition may involve tapping on the playback-enabling graphical element 420 and following audio prompts given by the interactive apparatus 200.

[0045] Further, at Block 720, in the audio playback mode, the recorded audio 278 associated with the writing on the encoded writing medium 100 is retrieved. The recorded audio 278 is played using the interactive apparatus 200. The recorded audio may be retrieved from local memory (e.g., memory units 254 and 284) and/or from a remote storage location (e.g., data storage unit 270 and the hard drive 274) via a wireless link. Control-enabling graphical elements 450 on the encoded writing medium 100 may be used. Also, information 276 associated with the created writing on the encoded writing medium 100 may be retrieved from local memory (e.g., memory units 254 and 284) and/or from a remote storage location (e.g., data storage unit 270 and the hard drive 274) via a wireless link.

[0046] Furthermore, at Block 730, the audio playback mode of the interactive apparatus 200 is deactivated in response to recognition of at least one of the plurality of control-enabling graphical elements 450 on the encoded writing medium 100. Also, the recorded audio 278 and information 276 associated with the created writing on the encoded writing medium 100 may be maintained in local memory (e.g., memory units 254 and 284) and/or in remote storage location (e.g., the data storage unit 270 and the hard drive 274) and may be retrieved later during the audio playback mode in response to recognition of other graphical elements or location of the writing tool 262 on created writing on the encoded writing medium 100.

[0047] The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order to best explain the principles of the invention and its practical application, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the Claims appended hereto and their equivalents.

What is claimed is:
1. An interactive apparatus comprising:
a writing tool; a position determination unit configured to determine position of said writing tool on a writing medium; and
an audio input device configured to record audio data in synchronization with position determination of said writing tool.
2. The interactive apparatus of claim 1, further comprising a memory unit operable to store audio data and position data.
3. The interactive apparatus of claim 1, further comprising a communication device for transmitting recorded audio data and position data to a remote storage location.
4. The interactive apparatus of claim 3, wherein said communication device comprises a wireless communication device.
5. The interactive apparatus of claim 1, wherein said writing medium comprises paper encoded with a grid of dots.
6. The interactive apparatus of claim 1, wherein said writing tool is one of a pen and a pencil.
7. The interactive apparatus of claim 1, wherein said audio output device is further configured to play said audio data in synchronization with position determination of said writing tool.
8. The interactive apparatus of claim 7, wherein said writing medium includes a non-electronic recording-enabling graphical element and a non-electronic playback-enabling graphical element.
9. The interactive apparatus of claim 1, wherein said position determination unit comprises a processor, an optical emitter, and an optical detector.
10. The interactive apparatus of claim 9, wherein said position determination unit is further configured to capture and store optical images of writing on a surface of said writing medium.
11. An interactive apparatus comprising:
   a writing tool;
   a position determination unit configured to determine position of said writing tool on a writing medium; and
   an audio output device configured to play audio data in synchronization with position determination of said writing tool.

12. The interactive apparatus of claim 11, further comprising a memory unit operable to store audio data and position data.

13. The interactive apparatus of claim 11, wherein said writing medium comprises paper encoded with a grid of dots.

14. The interactive apparatus of claim 11, wherein said writing tool is one of a pen and a pencil.

15. The interactive apparatus of claim 11, wherein said writing medium includes a non-electronic recording-enabling graphical element and a non-electronic playback-enabling graphical element.

16. The interactive apparatus of claim 11, wherein said position determination unit comprises a processor, an optical emitter, and an optical detector.

17. A method comprising:
   determining position of a writing tool on a writing medium; and
   recording audio data in synchronization with said determining position of said writing tool.

18. The method of claim 17, further comprising
   playing said audio data in synchronization with said determining position of said writing tool.

19. The method of claim 17, wherein said writing medium comprises paper encoded with a grid of dots.

20. The method of claim 17, wherein said writing tool is one of a pen and a pencil.