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(54) **CONCEALED METADATA TRANSMISSION SYSTEM**

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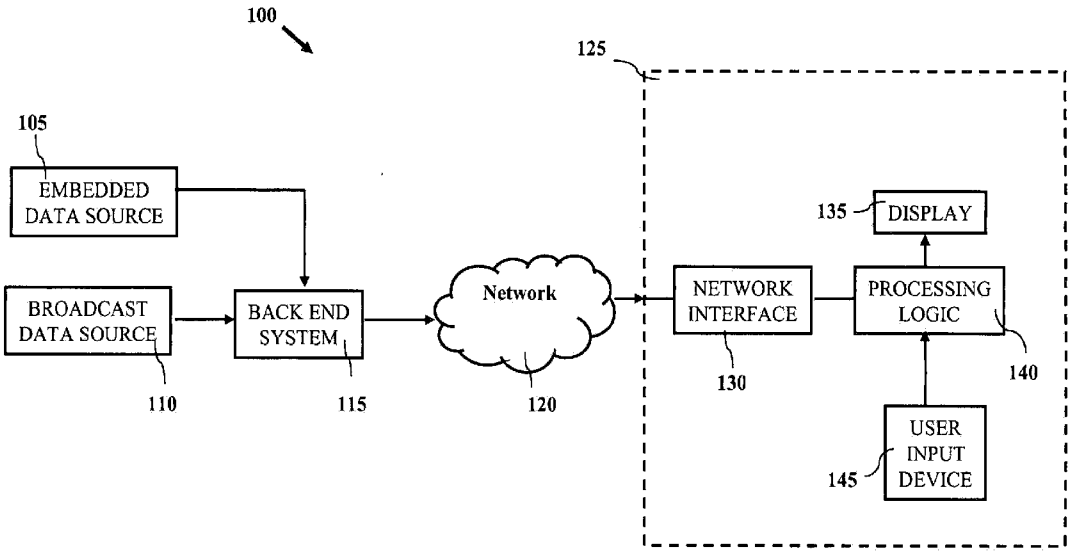
(57) **ABSTRACT**

System and method for embedding and concealing data within a video signal such that the embedded data is displayed within an unused portion of a video display area such that the embedded data is not visually offensive. In one embodiment the encoding of metadata may be executed by translating or adjusting pixel values of the video signal within the secondary image area, such that the pixel values are repurposed to contain the metadata and wherein the metadata is visually imperceptible.



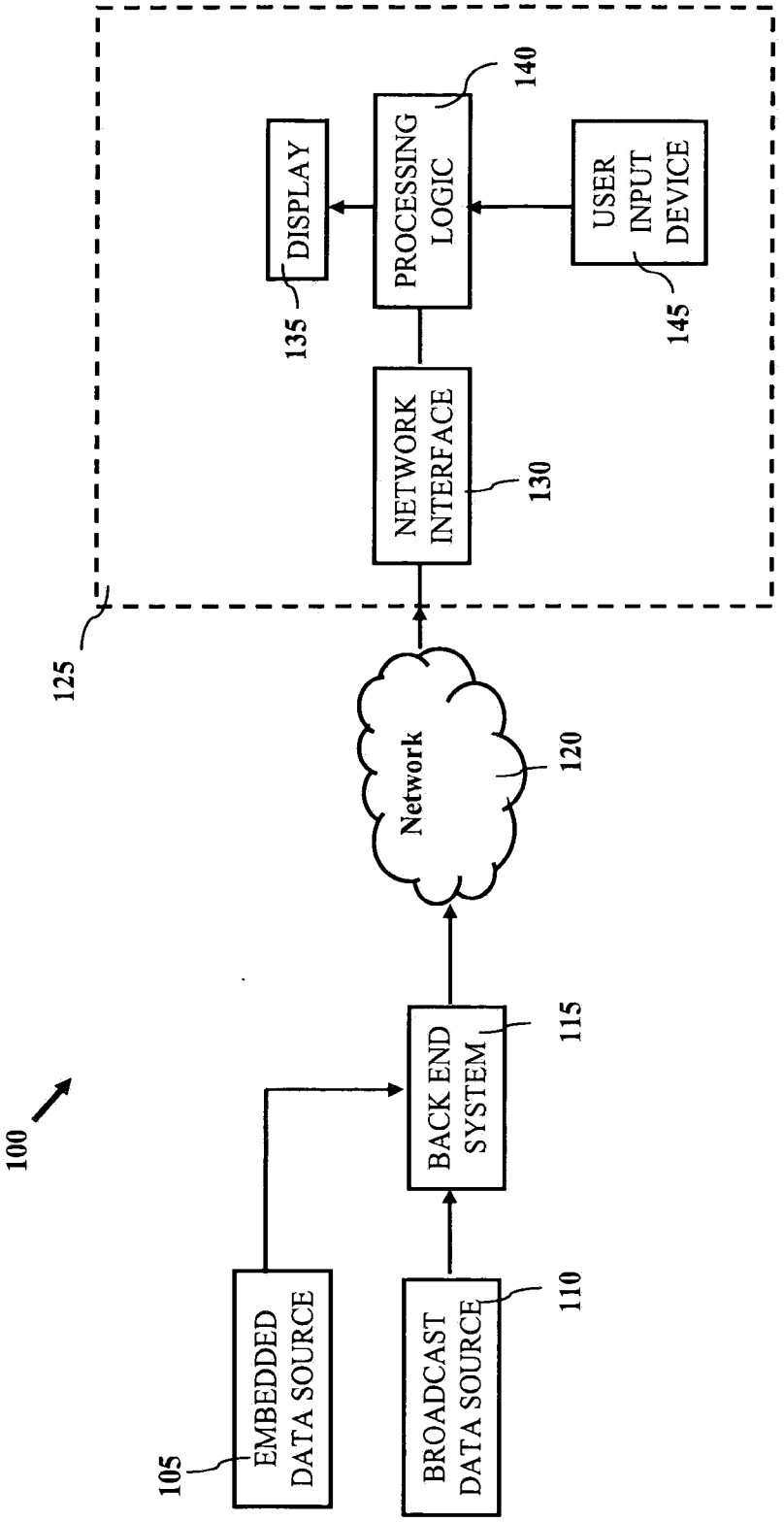

100
105
EMBEDDED DATA SOURCE
110
BROADCAST DATA SOURCE
115
BACK END SYSTEM
120
Network
125
130
NETWORK INTERFACE
135
DISPLAY
140
PROCESSING LOGIC
145
USER INPUT DEVICE

Fig. 1A

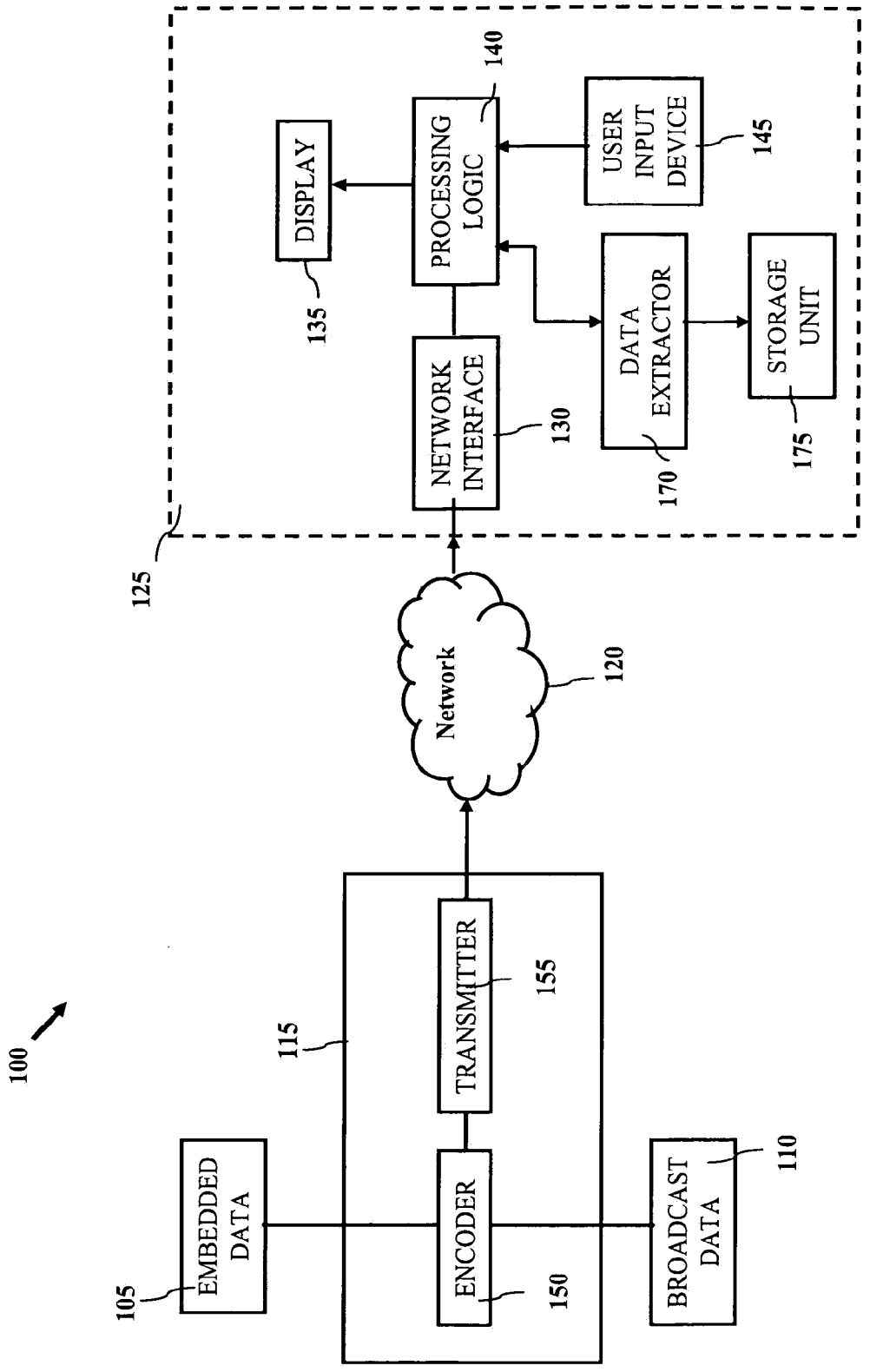
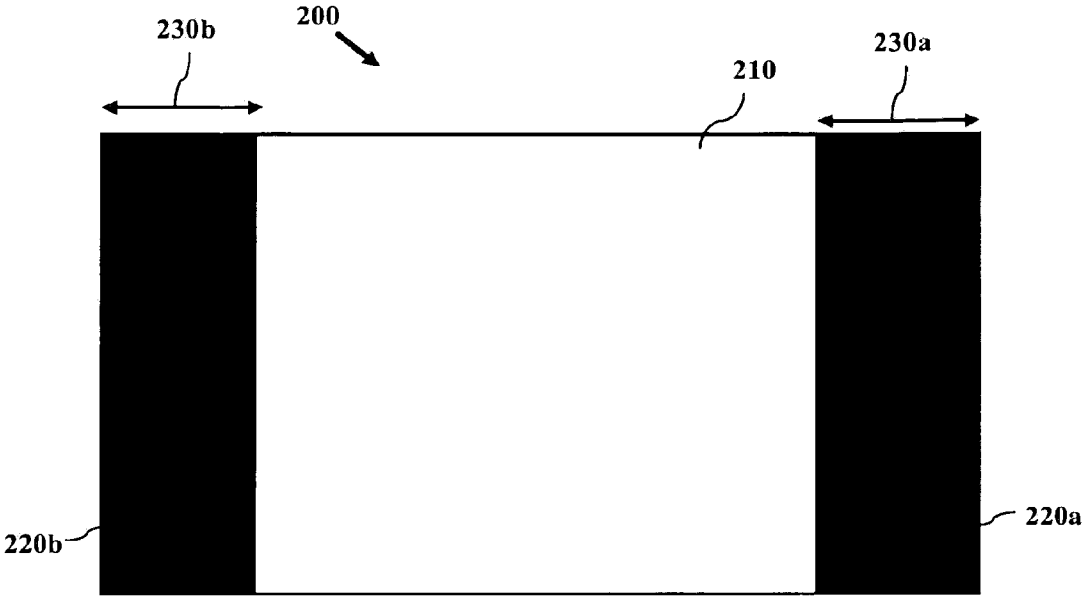

100
105
EMBEDDED DATA
115
ENCODER
150
TRANSMITTER
155
BROADCAST DATA
110
Network
120
125
NETWORK INTERFACE
130
PROCESSING LOGIC
140
DISPLAY
135
USER INPUT DEVICE
145
DATA EXTRACTOR
170
STORAGE UNIT
175

Fig. 1B

Fig. 2



300
330a
320a
310
330b
320b

Fig. 3

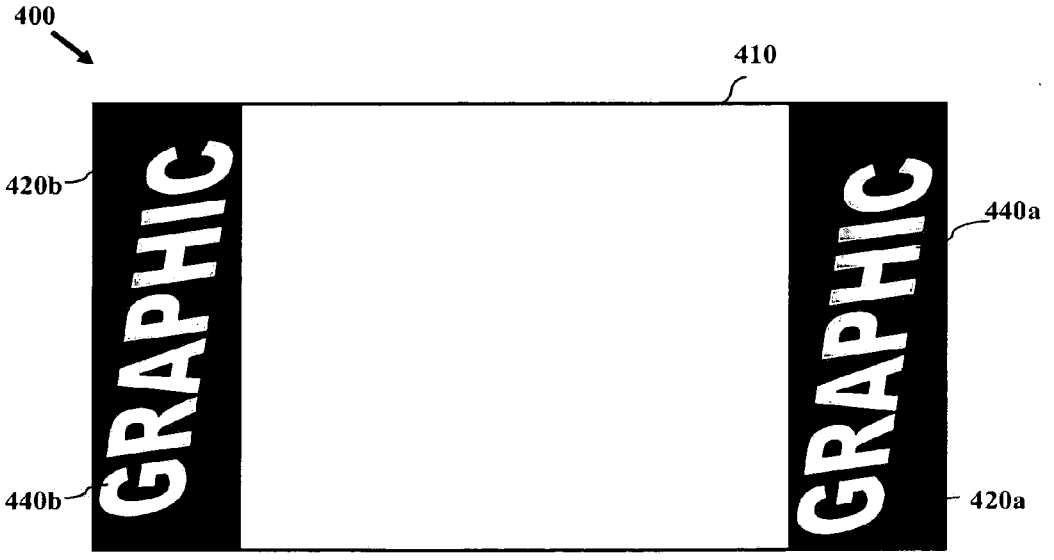

400
410
420b
GRAPHIC
440a
GRAPHIC
440b
420a

Fig. 4

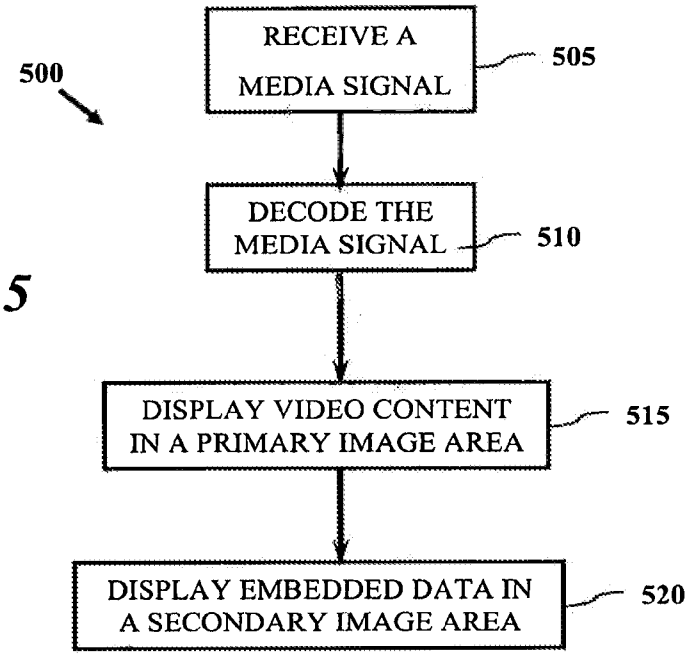

500
RECEIVE A MEDIA SIGNAL
505
DECODE THE MEDIA SIGNAL
510
DISPLAY VIDEO CONTENT IN A PRIMARY IMAGE AREA
515
DISPLAY EMBEDDED DATA IN A SECONDARY IMAGE AREA
520

Fig. 5

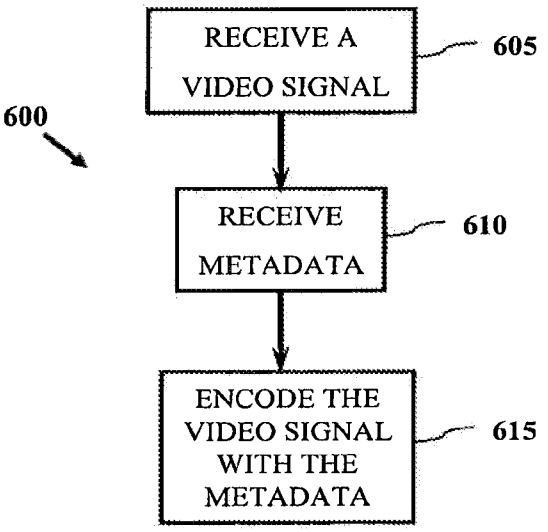

600
RECEIVE A VIDEO SIGNAL
605
RECEIVE METADATA
610
ENCODE THE VIDEO SIGNAL WITH THE METADATA
615

Fig. 6

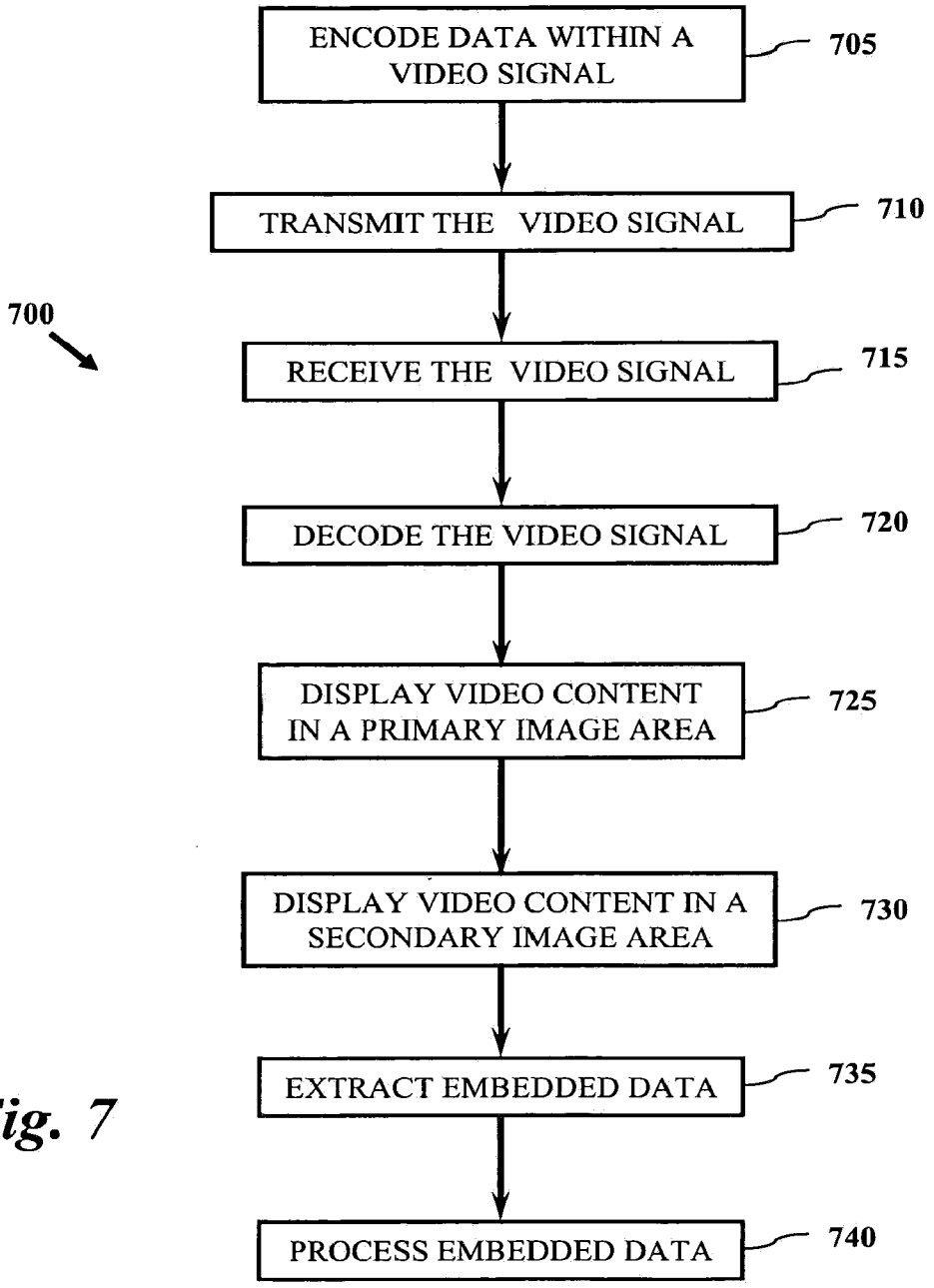

700
ENCODE DATA WITHIN A VIDEO SIGNAL
705
TRANSMIT THE VIDEO SIGNAL
710
RECEIVE THE VIDEO SIGNAL
715
DECODE THE VIDEO SIGNAL
720
DISPLAY VIDEO CONTENT IN A PRIMARY IMAGE AREA
725
DISPLAY VIDEO CONTENT IN A SECONDARY IMAGE AREA
730
EXTRACT EMBEDDED DATA
735
PROCESS EMBEDDED DATA
740

Fig. 7

CONCEALED METADATA TRANSMISSION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of and claims priority benefit to commonly-owned parent application U.S. Ser. No. 11/657,779, filed on Jan. 24, 2007 and entitled "Concealed Metadata Transmission System" which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates in general to a method and apparatus for passing metadata through networks, cable and satellite systems, or broadcasts without corrupting or losing data.

BACKGROUND OF THE INVENTION

[0003] Traditional television broadcasting devices have enabled additional broadcast related information to be transmitted along with broadcast programs, (e.g., closed captioning). In analog television formats, such as NTSC, additional information is encoded in the vertical blanking area (VBI). As television formats progress to all digital systems the VBI is no longer utilized for carrying information. Digital systems enable information to be encoded in the picture frame user area as defined by MPEG systems. With the expansion of high bandwidth networks providing an increasing volume of information and the adoption of digital transmission networks, there exists a need for providing additional information along with broadcasted audio and video content. One way existing broadcast systems have supplied additional information with broadcasted media is to rely on separate transmission paths such as phone lines or the internet. As additional broadcast related data is passed through networks, cable and satellite systems, or broadcast plants, the additional broadcast data is susceptible to corruption or loss of data.

[0004] Accordingly, there is a need in the art to provide a system or method able to provide additional information along with media content without the need of a separate transmission path wherein the additional information is not corrupted or lost.

SUMMARY OF THE EMBODIMENTS

[0005] Disclosed and claimed herein are systems, methods and apparatus for encoding and displaying data embedded within unused portions of a video signal. In one embodiment, a method includes a media signal having a first display format from a broadcast source, wherein the signal comprises video content and embedded data. The received media signal is then decoded. Video content may then be displayed in a primary image area of a display device, the primary image area having a second display format. A secondary image area may then be displayed simultaneously with the video content, wherein the secondary image area is outside the primary area and contains the embedded data. The method further includes, concealing embedded data within the secondary image area such that the embedded data is not visually offensive.

[0006] Other aspects, features, and techniques of the invention will be apparent to one skilled in the relevant art in view of the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIGS. **1**A-**1**B depict embodiments of simplified system diagrams of one or more aspects of the invention;

[0008] FIG. **2** depicts a representative example of regions in which data may be embedded within the display area of a video signal, according to one embodiment;

[0009] FIG. **3** depicts a representative example of regions in which data may be embedded within the display area of a video signal, according to one embodiment;

[0010] FIG. **4** depicts a representative example of regions in which data can be embedded within the display area of a video signal, according to one embodiment;

[0011] FIG. **5** depicts a method of displaying embedded data according to one embodiment;

[0012] FIG. **6** depicts a method of embedding data according to one embodiment; and

[0013] FIG. **7** depicts method steps illustrating a system for encoding and displaying data according to one embodiment.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0014] One aspect of the present invention is directed to displaying embedded data within a secondary image area of a display device, wherein the data is concealed. In one embodiment, the invention relates to video signal processing logic or a display device. The invention may be housed in the display device or may be separate and utilized as a component of a video signal interface such as a set top box. This embodiment may also be connected through a video signal interface to the display. To that end, the invention may be housed in a set-top box which provides a video signal to a display device for presentation of video content.

[0015] In one embodiment, data is embedded into a video signal through an encoding process. The encoding process may be through adjustment of pixel values such that the data is visually imperceptible or otherwise concealed. The adjustment of the pixels may be through translating lumen components of a plurality of pixels, illuminating pixels at varying intensities, illuminating pixels at varying black or white intensity levels, scrolling intensity values within a specified image area, varying the intensity of a graphic that scrolls in a particular image area or translating color difference components of pixel values.

[0016] Another aspect is to provide a system for encoding data within a video signal wherein the encoded data is passed through a network, cable or satellite system without corruption or loss of data. In one embodiment of the invention, metadata is encoded into a video signal and transmitted to a receiving device. The system provides a network interface which is capable of decoding the media signal and processing logic to display video content from the broadcasted media signal. Video content from the video signal is displayed in a primary image area and the encoded metadata is displayed in a secondary image area such that the encoded metadata is embedded in the video signal in a visually imperceptible manner and extractable for later use and/or storage. Once embedded data is extracted it may be available for storage in a memory device or subsequent use as guide data, program data to convey upcoming programming information, data to

upgrade manufactures display devices, metadata or user accessible data. The embedded data may also convey network communications data for messages from the network to affiliates, closed captioning data which can then be displayed over the primary video, content advisory data, forensic data used to identify video content and/or audience measurement data.

[0017] When implemented in software, the elements of the invention are essentially the code segments to perform the necessary tasks. The program or code segments can be stored in a processor readable medium. The "processor readable medium" may include any medium that can store or transfer information. Examples of the processor readable medium include an electronic circuit, a semiconductor memory device, a ROM, a flash memory or other nonvolatile memory, a floppy diskette, a CD-ROM, an optical disk, a hard disk, a fiber optic medium, a radio frequency (RF) link, etc. The code segments may be downloaded via computer networks such as the Internet, Intranet, etc.

[0018] Referring now to the drawings, FIGS. **1**A-**1**B illustrate one or more embodiments of a system **100** capable of implementing one or more aspects of the invention. In the embodiment of FIG. **1**A the system **100** includes a back end system **115** which receives embedded data and broadcast data for transmission over network **120** to client side module **125**. In one embodiment broadcast data source **110** may include data streams in a multitude of forms (e.g., National Television Standards Committee (NTSC), PAL, Digital Satellite System (DSS), Digital Broadcast system (DBS), Advanced Television Standards Committee (ATSC), etc.).

[0019] In one embodiment the embedded data source **105** provides guide data, device updates, metadata or user accessible data encoded by back end system **115** for transmission or a media signal to client side system **125**. Client side system **125** receives the broadcasted media signal via network interface **130** and may provide the media signal to processing logic **140**. In one embodiment network interface **130** may be an analog or digital television tuner. Processing logic **140** provides the media signal to a display device **135** and may receive input from a user input device **145**. Display device **135** receives video content and embedded data which then may be displayed.

[0020] FIG. **1**B depicts one embodiment of system **100** wherein the back end system **115** may further comprise an encoder **150** and a transmitter **155**. Encoder **150** may execute a process for embedding data into broadcast data which may then be packaged. Transmitter **155** may produce a media signal including the embedded data. The client side system **125** may further comprise a data extractor **170** which may extract embedded data from a video portion of a broadcasted media signal and provide the data to storage unit **175**. Storage unit **175** may be a memory device or included in processing logic **140** for storing extracted data.

[0021] Referring now to FIG. **2** which depicts an exemplary embodiment of the display area **200** of a display device. Display area **200** is composed of a primary image area **210** and secondary image areas **220***a* and **220***b*. High definition broadcasts may be provided with an aspect ratio of 16:9 providing a 1920×1080 image format wherein the entire display area **200** is utilized by an active image. However, during commercial segments of a high definition broadcast, only a portion of the picture area maybe utilized. Commercials are typically encoded in a standard definition format which presently carries an aspect ratio of 4:3. Additionally, any standard definition programming displayed in a 16:9 display device or otherwise may occupy only a portion of the display area. Typically a 720×480 image is displayed in a 4:3 aspect ratio which occupies the primary image area **210**. The secondary image areas **220***a* and **220***b* are typically reserved as a solid black color forming pillar bars around the active image area **210**. These secondary regions may be referred to as pillar bars or pillarbox display regions. The secondary image area widths **230***a* and **230***b* may have a width of 600 pixels with a 1920×1080 format (280 with a 1280×720 format) when a centered 4:3 image is produced. With a 1920×1080 format and a centered 4:3 image there are 1,296,000 unused pixels that may be repurposed for data (648,000 per frame with interlaced 1080 format). With a 1280×720 format and a centered 4:3 image there are 403,200 unused pixels that could be repurposed for data. Methods for scaling a 4:3 image into these video formats vary and the exact number of pixels also vary. In one embodiment of the invention, the pillar bar region may contain 50,400 to 162,000 bytes of embedded data when each pixel is treated as a discrete element. According to one aspect of the invention, imbedded data may be concealed as visually imperceptible to users of the display device. According to one embodiment, pixels may be coded as varying black intensities which appear as solid black, wherein the black intensity levels correspond to binary data levels. While the present disclosure makes reference to the standard aspect ratios of 4:3 and 16:9, it should be appreciated that the invention is equally applicable to other aspect ratios or display formats.

[0022] FIG. **3** depicts one embodiment in which a display area **300** is composed of primary image area **310** and secondary image areas **320***a* and **320***b*. The secondary image areas **320***a* and **320***b* of display area **300**, which may be referred as letter bars, contain unused portions below and above the active image area with dimensions **330***a* and **330***b*. As with the embodiment of FIG. **2**, data may be embedded into the unused secondary image areas **320***a* and **320***b* and may be concealed as visually imperceptible.

[0023] FIG. **4** depicts one embodiment of the invention wherein a display area **400** with primary image area **410** may further contain graphic images **440***a-b* overlaid on secondary image areas **420***a-b*. During commercial segments, or periods where the entire display area is not utilized, broadcasted media sources may display commercial logos or insignias in letter bars or pillar bars of the display area. In one embodiment of the invention, data may be additionally embedded into graphic images **440***a-b* that are displayed in the secondary image areas **420***a-b* of the display area **400**. Through encoding techniques data would be concealed and visually imperceptible to viewers according to one embodiment of the invention.

[0024] Referring now to FIG. **5**, a process **500** for displaying video content according to one embodiment of the invention is depicted. Process **500** begins with block **505** in which a media signal containing video content with embedded data is received. In one embodiment, the received media signal may be broadcasted with a first display format (e.g., a 16:9 aspect ratio). Process **500** then continues with block **510** wherein the media signal is decoded by processing logic (e.g., processing logic **140**) such that video content may be presented to a user on a display device (e.g., display **135**). At block **515** video content may be displayed in a primary image area of a display device where the primary image area has a second display format (e.g., 4:3 aspect ratio). Block **520** continues with displaying a secondary image area (e.g., sec-

ondary image areas **220***a-b*) on the display device, wherein the secondary image area is outside the primary area and contains the embedded data. The embedded data may be concealed within the secondary image area. In one embodiment, the embedded data may be concealed through translating pixel values of the video signal within the secondary image area.

[0025] Referring now to FIG. **6**, a process for displaying video content according to one embodiment of the invention is depicted. Process **600** begins with block **605** for receiving a video signal and proceeds to block **610** for receiving metadata which may be guide data, program related information or data for device operation. In one embodiment, the video signal may be a high definition television signal. As previously discussed, the video signal may be formatted as a NTSC, PAL, DSS, DBS or ATSC television signal. Process **600** is continued with block **615** encoding the metadata into the video signal. According to one embodiment, the metadata is encoded into the video signal but in a manner such that the metadata is visually imperceptible and concealed within the secondary image area such that the metadata is extractable from the video signal.

[0026] In one embodiment, the encoding of metadata may be executed by translating or adjusting pixel values of the video signal within the secondary image area, such that the pixel values are repurposed to contain the metadata and wherein the metadata is visually imperceptible. Translating or adjusting the pixel values may be executed by adjusting one or more lumen components of a plurality of pixels. The lumen components may be adjusted by illuminating pixels at varying intensities, illuminating pixels at varying black or white intensity levels or adjusting values of the pixel such that lumen intensities may be interpreted as binary data.

[0027] According to one embodiment of the invention, translating of pixel values may be accomplished by scrolling lumen intensity values within a secondary image area or within a graphic in the secondary image area. According to another embodiment of the invention, a varying intensity graphic that scrolls through the secondary image area may also be utilized to conceal embedded data.

[0028] Translating of pixel values may be accomplished by translating color difference components of the pixel values according to another embodiment of the invention.

[0029] Referring now to FIG. **7**, a system for encoding and displaying video content according to one embodiment of the invention is depicted. Process **700** begins with block **705** for encoding data within a video signal. Process **700** continues with block **710** in which a media signal containing video content with embedded data is transmitted and block **715** in which a video signal is received. Process **700** then continues with block **720** wherein the media signal may be decoded by processing logic, a set top box or other client side system (e.g., processing logic **140**). At block **725** video content is displayed in a primary image area of a display device. Block **730** continues with simultaneously displaying video content in a secondary image area (e.g., secondary image area **220***a-b*) on the display device. In block **735** the embedded data is extracted by decoding the video signal. Block **740** provides processing of the embedded data, wherein data may be stored in a memory device, utilized by the system to update device parameters or provide programming content. The embedded data may also contain network communications data for messages from the network to affiliates, displayable closed captioning data, content advisory data that may used to block objectionable programs, decodable forensic data to identify video content and/or decodable audience measurement data.

[0030] While certain exemplary embodiments have been described and shown in the accompanying drawings, it is to be understood that such embodiments are merely illustrative of and not restrictive on the broad invention, and that this invention not be limited to the specific constructions and arrangements shown and described, since various other modifications may occur to those ordinarily skilled in the art. Trademarks and copyrights referred to herein are the property of their respective owners.

What is claimed is:

1. A method comprising:
receiving a broadcast media signal comprising video content and embedded data; and
decoding the media signal.

2. The method of claim **1** wherein the embedded data is concealed within a plurality of pixels.

3. The method of claim **1** wherein the embedded data is characterized by a plurality of pixel intensity differences.

4. The method of claim **1** wherein the embedded data is concealed within a scrolling varying intensity graphic.

5. The method of claim **1** wherein the embedded data comprises at least one of: guide data, program related information, network messages, audience measurement data, forensic markers, closed captioning, data for device operation, and content advisory data.

6. The method of claim **1** wherein the embedded data is embedded in audio data.

7. The method of claim **1** further comprising displaying the embedded data simultaneously with the video content on a display device, wherein the embedded data is concealed and visually imperceptible.

8. The method of claim **7** wherein the embedded data is displayed in at least one display edge area less than three pixels in thickness.

9. The method of claim **7** wherein the embedded data is displayed in a secondary image area outside a primary viewing area where the video content is displayed.

10. The method of claim **9** wherein the secondary image area comprises a letterbox less than three pixels high.

11. The method of claim **9** wherein the secondary image area comprises a pillarbox less than three pixels wide.

12. An apparatus comprising:
a network interface that receives a broadcast media signal comprising video content and embedded data; and
a processor coupled to the network interface and configured to decode the media signal.

13. The apparatus of claim **12** wherein the processor is further configured to display the embedded data within a plurality of pixels.

14. The apparatus of claim **12** wherein the processor is further configured to display the embedded data as a plurality of pixel intensity differences.

15. The apparatus of claim **12** wherein the processor is further configured to display the embedded data as a scrolling varying intensity graphic.

16. The apparatus of claim **12** wherein the embedded data comprises at least one of: guide data, program related information, network messages, audience measurement data, forensic markers, closed captioning, data for device operation, and content advisory data.

17. The apparatus of claim **12** wherein the embedded data is embedded in audio data.

18. The apparatus of claim **12** wherein the processor is further configured to display the embedded data simultaneously with the video content on a display device, wherein the embedded data is concealed and visually imperceptible when decoded and displayed.

19. The apparatus of claim **18** wherein the embedded data is displayed in at least one display edge area less than three pixels in thickness.

20. The apparatus of claim **18** wherein the embedded data is displayed in a secondary image area outside a primary viewing area where the video content is displayed.

21. The apparatus of claim **20** wherein the secondary image area comprises a letterbox less than three pixels high.

22. The apparatus of claim **20** wherein the secondary image area comprises a pillarbox less than three pixels wide.

23. A computer program product comprising a non-transitory processor-readable medium tangibly embodying non-transitory program instructions thereon that when executed cause a processor to:

receive a broadcast media signal comprising video content and embedded data; and

decode the media signal.

24. A system comprising:

means for receiving a broadcast media signal comprising video content and embedded data; and

means for decoding the media signal.

25. An apparatus comprising:

a video content input;

a metadata input; and

an encoder coupled to the video content and the metadata, the encoder to execute one or more actions to translate pixel values of the video signal, such that those pixel values are repurposed to contain the metadata, and wherein the metadata is concealed and visually imperceptible when decoded and displayed.

26. A method comprising:

inputting video content;

inputting metadata; and

encoding the video content and the metadata by translating pixel values of the video signal, such that those pixel values are repurposed to contain the metadata, and wherein the metadata is concealed and visually imperceptible when decoded and displayed.

27. A computer program product comprising a non-transitory processor-readable medium tangibly embodying non-transitory program instructions thereon that when executed cause a processor to:

input video content;

input metadata; and

encode the video content and metadata by translating pixel values of the video signal, such that those pixel values are repurposed to contain the metadata and wherein the metadata is concealed and visually imperceptible when decoded and displayed.

28. A system comprising:

means for inputting video content;

means for inputting metadata; and

means for encoding the video content and metadata by translating pixel values of the video signal, such that those pixel values are repurposed to contain the metadata and wherein the metadata is concealed and visually imperceptible when decoded and displayed.

* * * * *