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WO 2010/062761 A1	**WO 2009/009106 A1**
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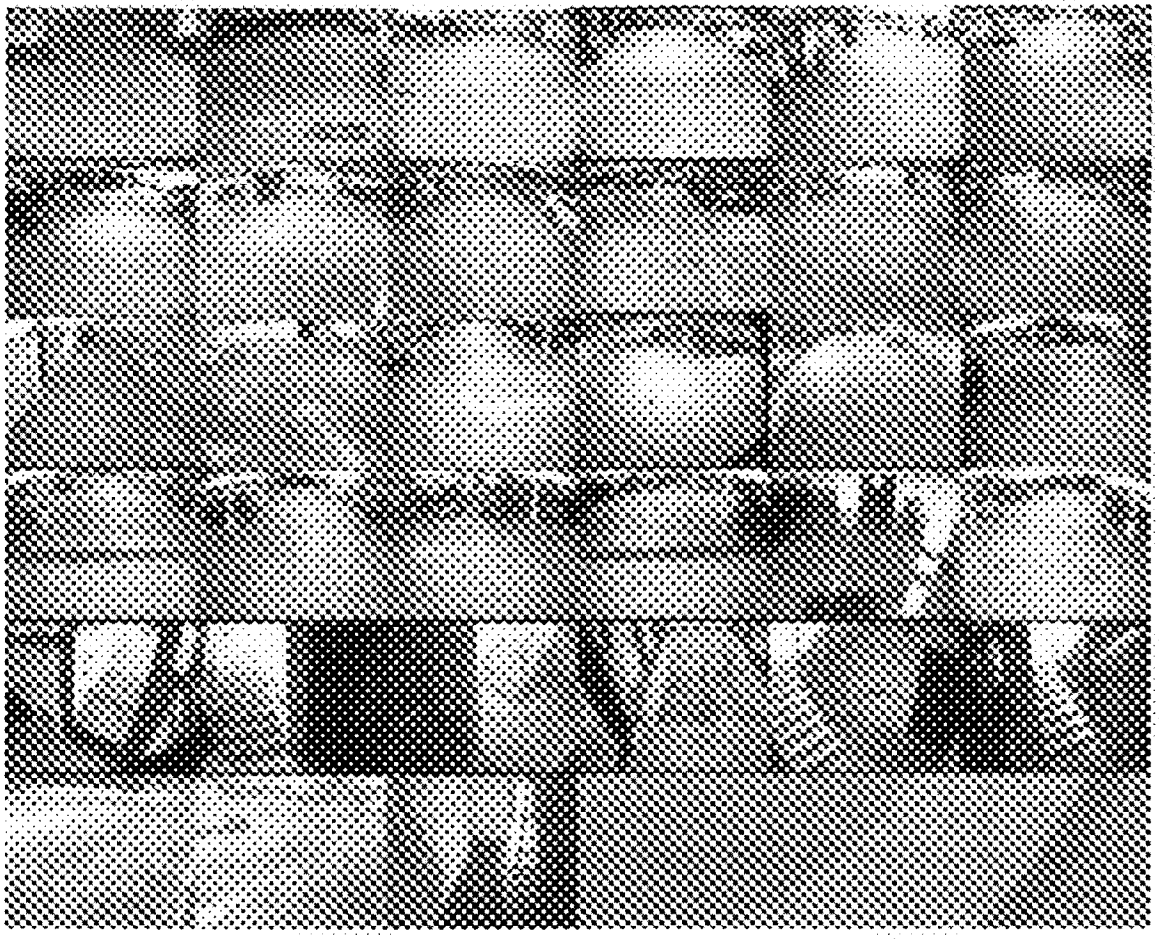

FIG. 1

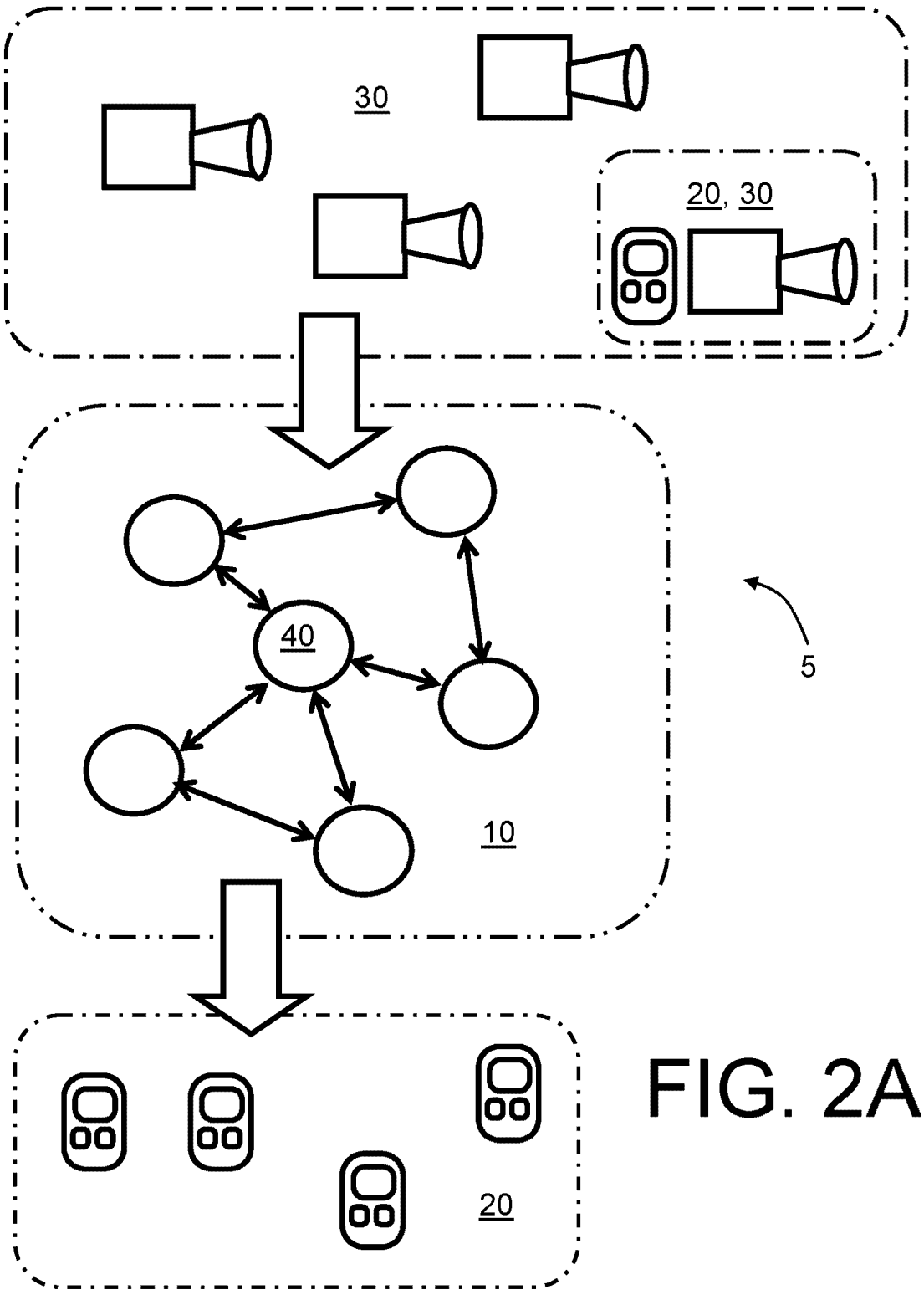

FIG. 2A

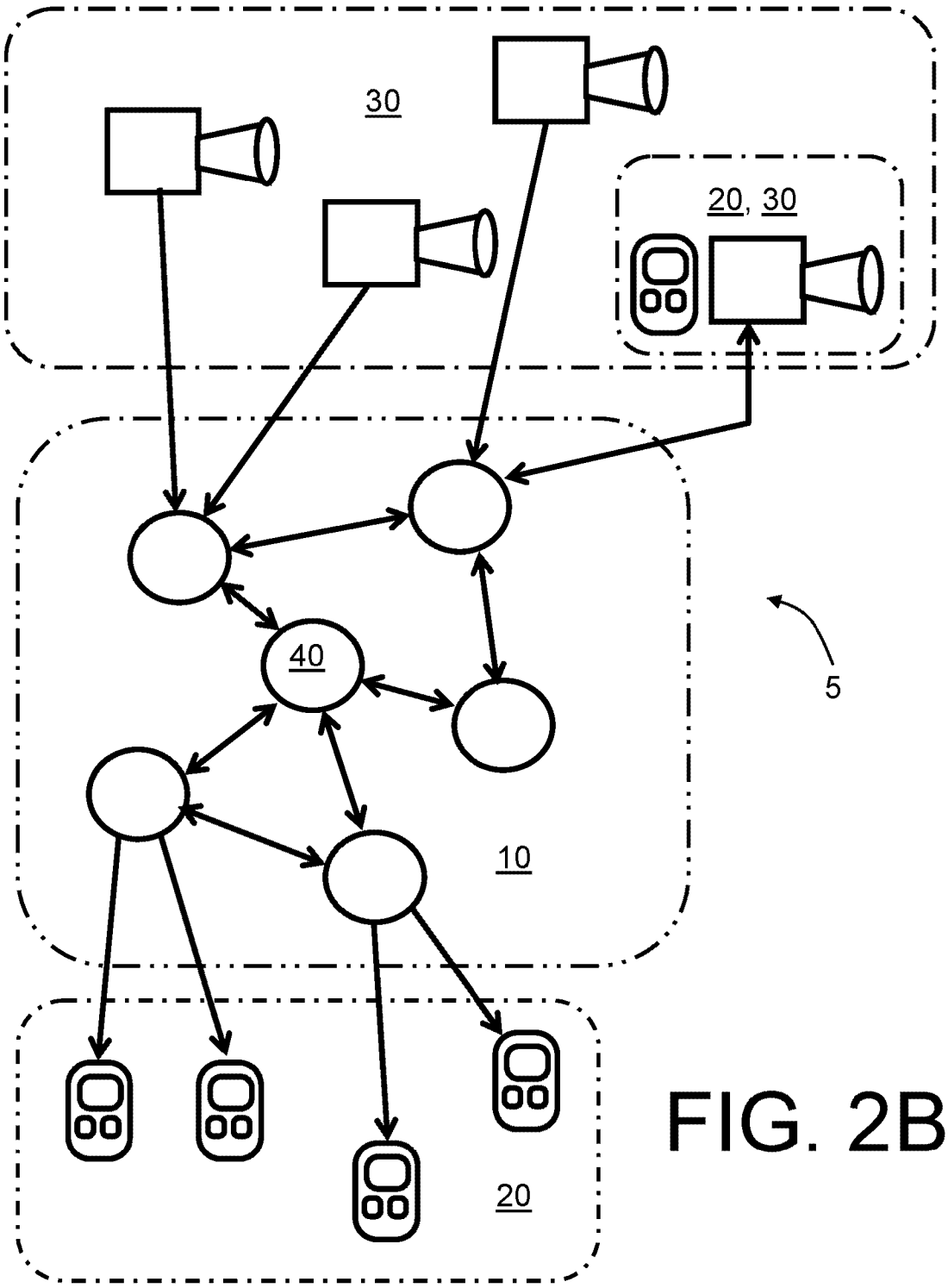

FIG. 2B

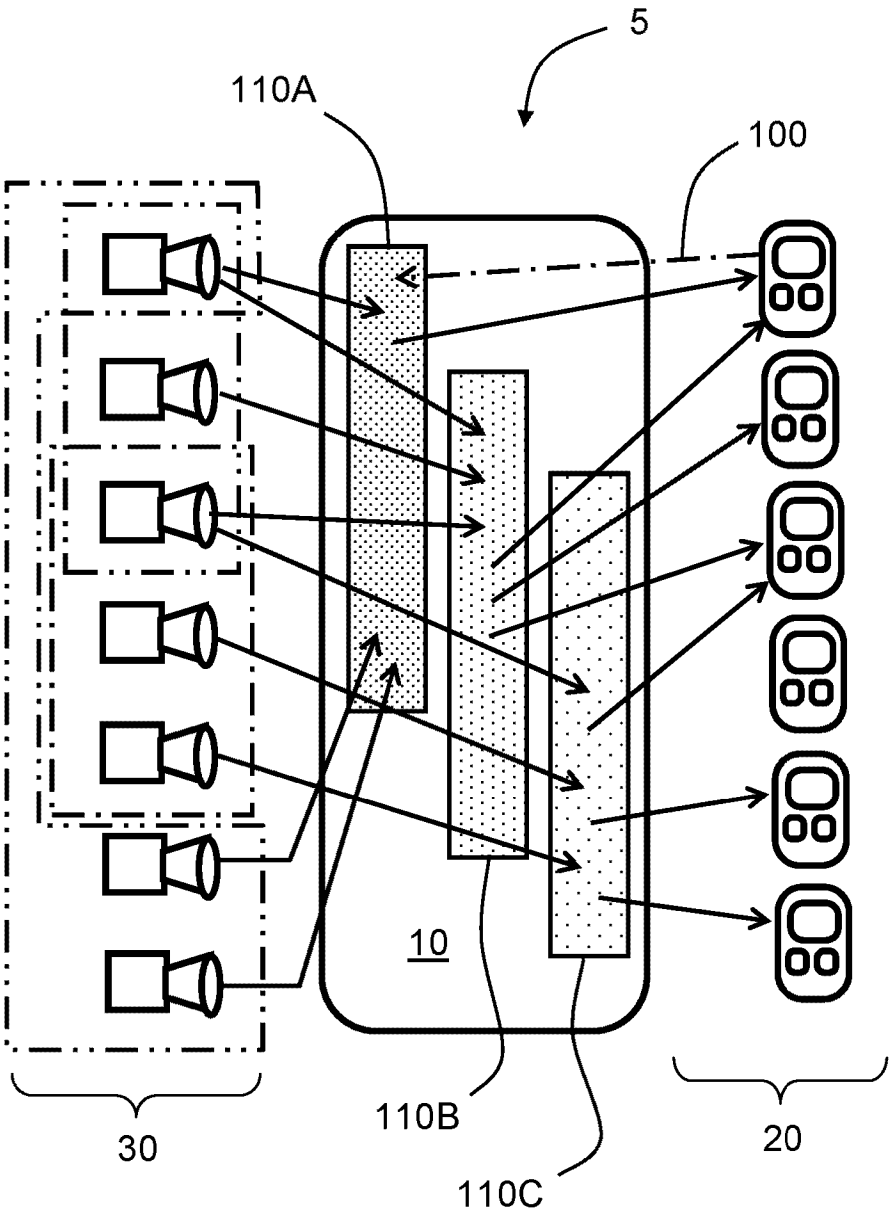

FIG. 3

SERVER NODE ARRANGEMENT AND METHOD

Technical Field

The present disclosure relates to server node arrangements, for example to server node arrangements which are operable to receive input data from multiple input devices and process the input data and to output corresponding output data, wherein the output data includes various types of data, for example graphical data, audio data, or other content in any dimension. Moreover, the present disclosure concerns methods of operating aforesaid server node arrangements, for example methods of operating server node arrangements for receiving input data from multiple input devices and processing the input data and to output corresponding output data, wherein the output data includes various types of data, for example graphical data, audio data, or other content in any dimension. Furthermore, the present disclosure relates to software products recorded on machine-readable data storage media, wherein the software products are executable upon computing hardware for implementing aforesaid methods.

Background

Contemporary situations arise where it is desirable to combine input content from a plurality of input sources into a single output content without distorting the input content, for example without adding temporal latency to the input content or influencing its pixel resolution. Moreover, many situations do not require the combined output data to be stored, whereas other situations require storage of the combined output data for replay purposes. Such storage is beneficially achieved whilst preserving original accuracy, for example resolution, for high quality playback purposes.

Contemporary installations often include a myriad of input devices and data collection devices, for example analog and/or digital cameras connected to surveillance arrangements such as video recording systems; such video recording systems optionally include digital video recorders (DVR), network video recorders (NVR), personal video recorders (PVR). The contemporary installations are expensive and time consuming to construct for high quality surveillance purposes, because each source of input data is customarily connected to its own monitor, or several sources

of input data are all collected together in a high-resolution manner in order to utilize a shared monitor, wherein a mosaic picture is created showing images from all the sources of input data. Referring to FIG. 1, there is shown an illustration of a mosaic image generated by a vehicle park surveillance service setup, wherein the mosaic includes outputs from thirty three sources of input data. Alternatively, situations arise where it is desirable to collect audio data from a plurality of audio sources generating high-quality audio data; in such a situation, it is often desirable to select amongst the audio sources for being monitored, or it is desired to sum audio content from the audio sources, for example condenser microphones spatially disposed amongst an orchestra, to generate an overall high-quality composite signal to be appreciated by a multitude of people, for example as in digital broadcast of an orchestral concert.

There is currently a lack of cost-effective contemporary systems that are operable to handle a plurality of high-quality data from corresponding input sources, and that are devoid of many devices for conditioning and conveying the high-quality data. Contemporary video conferencing systems and applications usually support various types of devices and sources of input data, and usually different conferencing systems are linked mutually to work together. Such video conferencing systems are capable of being configured in an enormous number of potential combinations, which creates a problem of implementing efficient communication within such systems. It is conventional practice to employ a mutually common communication protocol within the systems, although certain sources of input data are transcoded to a negotiated format, which can result in degradation of certain images communicated via the systems.

Mobile wireless communication devices, for example smart phones, tablet computers, phablet computers, lap-top computers, wireless wrist-worn computers, are operable to generate content in a form of images, video, other photographic information, and audio data. Handling graphical content within such mobile devices consumes considerable power, which has implications for batteries employed to provide operating power to the mobile devices, for example when content is decoded and scaled to a desired size for presentation on pixel displays of the mobile devices. The aforesaid power consumption represents a problem when such mobile devices

are operated in a configuration, for example for providing video conferencing-type services for a group of users.

In a published PCT patent application WO/2010/062761 A1 (Windes et al; "*Method and System for Transforming and Delivering Video File Content for Mobile Devices*"), there is described a method and system for accessing video file content. When a user encounters a web page with video content, the user can select to view the video content and wait for the server to transcode the video file and to stream the transcoded video file to the user's client device. Alternatively, the user may request that the server transcodes the video file and then sends the transcoded video file to the user's device, where the transcoded video file will be stored. While waiting for the video to be transcoded, the user may browse other websites, for example. In addition, a user may request that the server transcodes the video file and then streams the transcoded video file to the user's device in real-time.

In a published US patent application US2012/0185530 A1 (Areef Reza; "*Method of streaming media to heterogeneous client devices*"), there is described a method of dynamically preparing a media clip for delivery from a server to a client. Media attributes comprising media playback formats compatible with the client are provided to the server. A request is made by the client to provide a media content item at a specified starting time, and the server identifies a source where a media content file related to the selected media content item is located. The server obtains the media file from the source, and obtains a transcoded media segment file having a playback format compatible with the client media attributes. The transcoded media segment file may further be prepared in a transport format that is compatible with transport format media attributes of the client device, and a location of the prepared transcoded media segment file may be communicated to the client for the client to access the media segment.

In a published EP patent application EP1725037 A2 (Hirooka; *"Client server system with display format conversion"*), there is described a client server system S including a plurality of client terminal devices capable of connecting with a display device, whose screen resolution is HD or SD, and a server device which provides image information to the plurality of client terminal devices through a wireless network N.

The server device is structured to include a sendable resolution determining program to make a CPU determine whether to convert HD image information into SD image information or not, and an image information sending program to make the CPU send SD image information attached with SD information to the plurality of client terminal devices.

In a published EP patent application EP1463332 A1 (Kellerman et al; *"Media processing system supporting different media formats via server-based transcoding"),* there are described systems and methods that reformat media. In one embodiment, a system may include, for example, a server, a first communications device and a second communications device. The server, the first communications device and the second communications device may be operatively coupled to a network. The second communications device may receive, from the first communications device, a device profile relating to the first communications device and may send the device profile and media content to the server. The server may reformat the media content based on the device.

In a published PCT patent application WO/2012/126964 A1 (Piemot et al; "*Method and System for Providing Media Optimization")*, there are described methods and systems for providing media optimization. In one implementation, a method of providing media optimization involves hosting a webpage at a content source, where the webpage contains media content and an instruction for optimizing the media content using an access network, receiving a request for the webpage at the content source from an end-user device, and sending the media content from the content source to the end-user device through the access network where the media content is optimized according to a technique specified in the instruction. Other implementations are also described.

In a published US patent application US2012/072529 A1 (Ahopelto; "*Conversion management system, method and computer program")*, there is described a method of managing content format conversion for transmission of converted content to a mobile device, wherein the method includes retrieving initial content, which includes video content, having a first format over a data communications network. The retrieved initial content is analysed based on an identification of data delivery

parameters relating to potential delivery of converted content and a determination is made as to whether or not the data delivery parameters meet predetermined criteria. The format of the initial content is converted to a second format only in response to a determination that the data delivery parameters meet the predetermined criteria. The converted content forms a message body of a message. A conversion management system configured to manage content format conversion for transmission of converted content to a mobile device, and a computer program for performing the method, are also provided.

In a published PCT patent application WO2009/009106 A1 (Grasset; *"Systems and Methods for Mirroring and Transcoding Media Content"),* there are described systems and methods for mirroring and transcoding media content. In some implementations, media content stored on a user equipment device is mirrored on a remote server, and the mirrored copy is transcoded and provided to other user devices in a media content format that is appropriate for the user devices. By so doing, there is provided a convenient and easy way for users to backup media content and access the media content from virtually any device, and also there is reduced the complexity and costs associated with maintaining reliable and consistent access to media content across various user devices.

In a published US patent application US20100223407 A1 (Dong et al; "*Media source device with digital format conversion and methods for use therewith"),* there is described a media source device including media files in either an original source format or in alternative digital formats, based on a content descriptor indicated by a client device from a plurality of content descriptors generated to represent possible transcodings of the source format. In the alternative, a media source device can receive a client device report and subsequent request for a media file. The media source device can send the media file to the client device in a particular digital format based on whether the content descriptor corresponding to the media file is compatible or incompatible with the client device. The bit rate used to send the media file to the client device can be adjusted based on the available transmit bit rate.

In a published US patent application US 20070121651 A1 (Casey et al; *"Network-based format conversion"*), there are described various implementations that provide

solutions for converting content, such as audio files and/or streams, video files and/or streams, other data files and/or the like. In an implementation, there is provided for facilitating the provision of media services to one or more subscribers. In a set of implementations, for example, media conversion services are optionally performed according to a subscriber's profile, such that the conversion services can be provided, in some cases, on the fly while providing the media to the subscriber, allowing the subscriber to obtain content in the necessary format without having to specify in each instance the formats in which various content should be provided.

In a published PCT patent application WO/2002/023375 (Santossio; *"Method and Apparatus for Providing Device-Specific Formatted Data to A Plurality of Browser-Enabled Devices"),* there is described a method and system for facilitating communications between a content delivery server and a plurality of browser-enabled devices, including both wired and wireless devices. The method includes a step of initiating a request for data by a user using a browser-enabled device, where the request includes indicia of device and browser type. The request is transmitted from the browser-enabled device to the system's content delivery server across a communication network such as the Internet®. The request is received by the content delivery server, which then retrieves the data requested by the user from networked data servers or from a third-party server. The data is formatted by the content delivery server as a function of the indicia of device and browser type. The formatted data is finally transmitted from the content delivery server to the browser-enabled device across the communication network.

In a published PCT patent application WO/2003/005228 (Hafizullah; *"Method and System for Providing Access to Content Associated with an Event"),* there is described a content delivery system for delivering content received from one or more external sources to end users of the system via multiple communication paths. In an example, content such as a voice signal transmitted via a telephone network is received by a first server of the content delivery system. The first server alone or in concert with a second server converts and encodes the voice signal into a streaming format. In response to a request from an end user to receive the content via a selected communication path, the content delivery system converts and decodes the content, if necessary, to transmit the content via the selected communication path.

The end user uses a computing device in communication the selected communication path to receive the content.

In a published US patent application US 20110078532 A1 (Stanislav et al, "*Method and system for low-latency transfer protocol*"), there is described a method and system for providing computer-generated output and in particular graphical output. The system includes a network configured to carry digital information. The system includes a server in communication with the network, wherein the server is configured to execute an application and a cloud engine module. The application provides a graphical output. The output capturing and encoding engine module is further configured to intercept the graphical output from the application on the server. The output capturing and encoding engine module is further configured to convert the graphical output into at least one of: graphical commands and video codec data. The output capturing and encoding engine module is further configured to transmit the converted output over the network. The system includes a client in communication with the server over the network, the client configured to execute a graphics and video decoding and rendering engine module. The graphics and video decoding and rendering engine module is configured to, responsive to receiving the transmitted converted output, rendering the graphical output. The graphics and video decoding and rendering engine module is configured to intercept graphics and video decoding and rendering inputs at the client. The graphics and video decoding and rendering engine module is configured to transmit the intercepted user inputs to the output capturing and encoding engine module.

In a published US patent application US2006/0085534 A1 (Ralston et al; "*Video monitoring application, device architectures, and system architecture*"), there are described systems and methods for compressing and decompressing still image and video image data in mobile devices and monitoring applications. Corresponding mobile device and camera architectures, and service platform architectures for transmitting, storing, editing and transcoding still images and video images over wireless and wired networks and viewing them on display-enabled devices are also provided.

In a published US patent application US2010/0232518 A1, (Coleman; "*System and method for streaming video to a mobile device*"), there are described systems and methods for streaming video information to a hand-held device, wherein the methods include dynamically modifying video image properties of captured video frames to generate video data packets of a size suitable for transmission over a low bit-rate channel to a hand-held device for viewing. The systems and methods may dynamically and automatically control image properties via a hardware capture card device driver to produce a video data packet of a desired maximum data size, such that subsequent compression and coding strategies produce a data packet suitable for transmission to the hand-held device for decoding and decompression to display the streaming video in near real-time.

In a published US patent application US20130054827 A1 (Ustream Inc.; *"On-Demand Selection of Transcoding Formats for Multimedia Broadcast Streams"),* there is described an on-demand multimedia stream processing system for receiving multimedia streams from broadcasters and for processing the streams for viewing on a wide range of client devices. To decrease the use of computing resources, processing jobs are started and stopped based on user demand. When a multimedia stream is received from a broadcaster, the processing system does not start processing the multimedia broadcast stream until a request for a processed stream is received. The processing system automatically terminates processing jobs when the audience of a processed stream drops to zero or some other stop condition is met.

In a published EP patent application EP2448287 A1 (Sony Corporation; "*Image processing device, image processing method, and image processing system"),* there is disclosed an image processing device including: a generating section, a plurality of pieces of stream data with different display sizes being created in advance for each of a plurality of video contents, wherein the device is configured to generate stream data of one stream of a multiple video reproduced image for simultaneously displaying not less than two video contents selected from the plurality of video contents by performing parameter transcoding using the stream data created in advance.

Summary

The present disclosure seeks to provide an improved server node arrangement which is capable of reducing processing requirements of rendering devices which are operable to render content data received thereat from the server node arrangement.

The present disclosure also seeks to provide an improved surveillance system and/or video conferencing system.

The present disclosure seeks to provide an improved method of operating a server node arrangement which is capable of reducing processing requirements of rendering devices which are operable to render content data received thereat from the server node arrangement.

According to a first aspect, there is provided a server node arrangement as claimed in appended claim 1: there is provided a server node arrangement which is coupled via a communication network to a plurality of source devices of input data, and to one or more output devices, wherein the server node arrangement is operable to receive data content from the plurality of source devices of input data, to process the data content for supplying to the one or more output devices, wherein the server node arrangement is operable to host one or more processes which are operable to process the data content into a form which is compatible to a native data rendering format of the subset of the one or more output devices~~.~~,

wherein the server node arrangement is operable to host one or more processes which are operable to process the data content into a form which is compatible to a native data rendering format of the one or more output devices,

further wherein each of the one or more output devices is operable to render the data content from the plurality of source devices of input data simultaneously; and

further wherein the server node arrangement is operable to supply the processed data content to the one or more output devices in a manner compatible with a region-of-interest (ROI) of the one or more output devices.

The present invention is of advantage in that processing the content data at the server node arrangement into a format which is natively compatible with the one or more source devices is capable of saving computing effort.

In practice, the native data rendering format is often RGB or YUV2, but typically the image is delivered in compressed format using an appropriate resolution. Such a situation, for example, corresponds to being compatible with a native data rendering format. Beneficially, the format is easy to convert from the delivered form to the native data rendering format within minimal amount of processing needed in the one or more output devices, for example decompression and possible colour conversion. Beneficially, the data content is supplied to a rendering device in a requested form that is a native format, compressed format or similar that is most suitable for the rendering device.

Optionally, the server node arrangement is operable to combine the data content received from the plurality of source devices to generate a combined signal for supplying to the one or more output devices.

Optionally, the plurality of source devices include one or more cameras, and the one or more output devices are operable to render one or more images collected from the one or more cameras simultaneously.

Optionally, the one or more images are collected from a same camera, thereby showing temporal changes within a given scene.

Optionally, the plurality of source devices include one or more audio sources, and the one or more output devices are operable to render one or more audio signals collected from the one or more audio source devices simultaneously.

Optionally, in the server node arrangement, the plurality of source devices are monitoring devices, and the one or more output devices are graphical display devices which are operable to render one or more images received thereat, and wherein the

server node arrangement is operable to implement the one or more processes as a surveillance system and/or a video conferencing system.

Optionally, the server node arrangement is operable to implement the one or more processes for TV/Video broadcasting/multicasting.

Optionally, the server node arrangement is operable to implement the one or more processes for image browsing via Internet.

Optionally, the server node arrangement is implemented such that the server node arrangement includes one or more servers, wherein the one or more servers are, at least in part, implemented in the one or more output devices and/or the plurality of source devices.

Optionally, the server node arrangement is also used, for example, in TV/video broadcasting/multicasting, namely for applications that include simultaneous source cameras and/or video sources. The server node arrangement is also suitable for image browsing over the Internet using simple devices that obtain information from multiple images which are properly created for needs of the display. In some solutions, a resolution and a format for the display is fixed or includes only few choices, for example a standard setting, and the content is created for the solution; in some solutions, a given device has to deliver information of the display (or window) resolution and format the information to the server node arrangement to enable proper adjustments to be performed. Sometimes, some or all users have access to adjust the visibility of each source separately in their display, and this information is also needed to be delivered to the server node arrangement.

Optionally, in the server node arrangement, the one or more output devices are operable to define in a message to the server node arrangement one or more parameters which define one or more native formats in which the one or more output devices require their data content to be supplied from the server node arrangement.

Optionally, the server node arrangement is operable to supply the processed data content to the at least a subset of one or more output devices in a manner

compatible with a region-of-interest (ROI) of the subset of the at least a subset of the one or more output devices.

Optionally, the server node arrangement is implemented, at least in part, in a cloud computing environment.

Optionally, the server node arrangement is operable to store content data from the one or more sources of input data content in its original resolution, and to supply the data content to the one or more output devices in a format which is compatible with a native format of the one or more output devices.

Optionally, in the server node arrangement, the content data content includes at least one of: images, video, audio, sensor signal data.

Optionally, the server node arrangement is operable to process data content there through in a manner allowing for dynamically-changeable image rescaling in response to user input at the one or more output devices.

According to a second aspect, there is provided a method of processing data in a server node arrangement which is coupled via communication network to a plurality of source devices of input data, and to one or more output devices, wherein the server node arrangement is operable to receive data content from the plurality of source devices of input data, to process the data content for supplying to at least a subset of the one or more output devices, wherein the method includes:

hosting one or more processes at the server node arrangement which are operable to process the data content into a form which is compatible to a native data rendering format of the one or more output devices;

rendering the data content from the plurality of source devices of input data at each of the one or more output devices simultaneously; and

operating the server node arrangement to supply the processed data content to the one or more output devices in a manner compatible with a region-of-interest (ROI) of the one or more output devices.

Optionally, the method includes implementing the plurality of sources as monitoring devices, and the one or more output devices as graphical display devices which are operable to render one or more images received thereat, wherein the method includes operating the server node arrangement to implement the one or more processes as a surveillance system and/or a video conferencing system.

Optionally, the method includes operating the server node arrangement to combine the data content received from the plurality of source devices to generate a combined signal for supplying to the one or more output devices.

Optionally, the method includes rendering one or more images at the one or more output devices simultaneously, wherein the one or more images are collected from one or more cameras included within the plurality of source devices.

Optionally, the method includes: collecting the one or more images from a same camera; and showing temporal changes within a given scene.

Optionally, the method includes rendering one or more audio signals at the one or more output devices simultaneously, wherein the one or more audio signals are collected from one or more audio source devices included within the plurality of source devices.

Optionally, the method includes operating the server node arrangement to implement the one or more processes for image browsing via Internet.

Optionally, the method includes implementing the server node arrangement so as to include one or more servers, wherein the one or more servers are, at least in part, implemented in the plurality of source devices.

Optionally, the server node arrangement is also used, for example, in TV/video broadcasting/multicasting, namely for applications that include simultaneous source cameras and/or video sources. The server node arrangement is also suitable for image browsing over the Internet using simple devices that obtain information from multiple images which are properly created for needs of the display. In some solutions, a resolution and a format for the display is fixed or includes only few choices, for example a standard setting, and the content is created for the solution; in some solutions, a given device has to deliver information of the display (or window) resolution and format the information to the server node arrangement to enable proper adjustments to be performed. Sometimes, some or all users have access to adjust the visibility of each source separately in their display, and this information is also needed to be delivered to the server node arrangement.

Optionally, the method includes operating the one or more output devices to define in a message to the server node arrangement one or more parameters which define one or more native formats in which the one or more output devices require their data content to be supplied from the server node arrangement.

Optionally, the method includes operating the server node arrangement to supply the processed data content to the at least a subset of one or more output devices in a manner compatible with a region-of-interest (ROI) of the subset of the at least a subset of the one or more output devices.

Optionally, when implementing the method, the server node arrangement is implemented, at least in part, in a cloud computing environment.

Optionally, the method includes operating the server node arrangement to store data content from the one or more source devices of input data in its original resolution, and supply the data content to the one or more output devices in a format which is compatible with a native format of the one or more output devices.

Optionally, when implementing the method, the data content includes at least one of: images, video, audio, sensor signal data.

Optionally, the method includes operating the server node arrangement to process data content therethrough in a manner allowing for dynamically-changeable image rescaling in response to user input at the one or more output devices.

According to a third aspect, there is provided a software product recorded on machine-readable data storage media, wherein the software product is executable upon computing hardware for implementing the method pursuant to the second aspect.

It will be appreciated that features of the invention are susceptible to being combined in various combinations without departing from the scope of the invention as defined by the appended claims.

Description of the diagrams

Embodiments will now be described, by way of example only, with reference to the following diagrams wherein:

FIG. 1 is an illustration of a mosaic of images;

FIG. 2A and FIG. 2B are illustrations of a system including a server node arrangement for providing processing of data communicated therethrough; and

FIG. 3 is an illustration of data exchanges occurring within the system of FIG. 2.

In the accompanying diagrams, an underlined number is employed to represent an item over which the underlined number is positioned or an item to which the underlined number is adjacent. A non-underlined number relates to an item identified by a line linking the non-underlined number to the item. When a number is non-underlined and accompanied by an associated arrow, the non-underlined number is used to identify a general item at which the arrow is pointing.

Description of embodiments

In describing embodiments, abbreviations will be used as defined in Table 1.

Table 1: Abbreviations and acronyms

Abbreviation or acronym	Definition
BGR24	Blue-Green-Red in a 8 bit x 8 bit x 8 bit format
CAT	Category 5 cable is a twisted pair cable for carrying signals
DVR	Digital Video Recorder
H.264	H.264/MPEG-4 Part 10 or AVC (Advanced Video Coding) is a standard for video compression, and is a common contemporary format for recording, compression and distribution of high definition video
IP	Internet Protocol
MJPG	Motion JPEG (M-JPEG or MJPEG) is a video format in which each video frame or interlaced image field of a digital video sequence is separately compressed at a JPEG image
NVR	Network Video Recorder
PVR	Personal Video Recorder
LAN	Local Area Network (for example IEEE802)
ROI	"Region of Interest" used in this disclosure to describe a region of interest of a graphical display of an output device, or a region of interest within a spatial region, for example a geographical region
YCbCr	A family of colour spaces used as a part of a colour image pipeline in video and digital photographic systems, wherein Y' is a luma component, and Cb and Cr are blue-difference and red-difference chroma components respectively
YUV	A colour space typically used as a part of a colour image pipeline, wherein a colour image or video taking human perception into account is encoded, providing as a benefit reduced bandwidth requirements for chrominance components when communicating corresponding encoded data, thereby enabling transmission errors or compression artefacts to be often more efficiently masked by human perception than used a "direct" RGB-representation
WLAN	Wireless Local Area network (for example IEEE 802.11)

In overview, with reference to FIG. 2, the disclosure is concerned with a system indicated generally by **5**. The system **5** comprises a server node arrangement denoted by **10** which is operable to provide a simple and effective method of outputting various kinds of graphical content, audio content and/or other types of content in any dimension in one or more output devices **20**, wherein the content for the one or more output devices **20** is derived from multiple sources **30** of input data on demand, for example for live monitoring and/or playback purposes; the method beneficially employs parallel data processing techniques that are controlled from the server node arrangement **10**, for example from a controlling server node **40** thereof, wherein the techniques are executed in a given output device **20**, namely "client", in a server of the server node arrangement **10** or in combination thereof. Optionally, the server node arrangement **10** includes one or more data servers. Optionally, a sub-set of the one or more data servers is implemented as one or more cloud servers. Optionally, the server node arrangement **10** is implemented, at least in part in a

source of input data, namely in at least one client device. Optionally, a server node of the server node arrangeent **10** is located in a transmitting client device, and also in the receiving device, even though this is potentially not an optimal solution. Moreover, the server node arrangement **10** beneficially includes one or more servers, of which, optionally, one or more servers are located in a cloud computing environment. Furthermore, one or more client devices can be either a source client or a destination client, or any combination thereof.

Optionally, the multiple sources **30** include at least one camera, and that multiple images are collected from that at least one camera which are replayed at different times within the system **5** when in operation: for example, multiple images from a same camera can be displayed by the system **5** to show temporal changes within a given scene, for example such changes corresponding to a disappearance of an item from the given scene, for example corresponding to an act of theft.

In FIG. 2, the server node arrangement **10** beneficially includes a plurality of server nodes, for example to spread computing effort. One output device **20** optionally functions as a multicast client that receives content data from a single server node, and the output device **20** can then deliver the content data to multiple destination output devices **20**, or multiple destination output devices **20** coupled in a mutually common spatially local network, for example a mutually common local area network (LAN).

Optionally, a given source **30** of input data is operable to deliver content data from multiple sources **30** of input data to the server node arrangement **10**. Moreover, optionally, a given device coupled to the server node arrangement **10** is capable of operating as an input and output proxy server. Moreover, the sources **30** of input data can be any device or software processing executing upon computing hardware which is operable to output analog or digital signals including image information, video information and other graphics information.

Beneficially, in the system **5** as illustrated in FIG. 2, including the sources **30** of input data and the output devices **20** together with the server node arrangement **10**, is capable in operation to save a large amount of communication bandwidth provided

within the system, because the output content for each destination client is constructed and encoded especially taking into account data processing capabilities of individual rendering devices and/or software employed for implementing the system. Optionally, a server node of the server node arrangement **10** is located in a transmitting client device, and/or also in the receiving device, even though the latter is potentially not an optimal solution.

The system **5** in FIG. 2 is capable of handling data from a diverse range of source devices, for example a camera input, desktop content, 3-D camera inputs and microphone inputs. Moreover, output devices in FIG. 2 include, for example, internal (in-device) displays, external displays, 3-D displays, 3-D printers, loudspeakers, and similar. For example, for effective 3-D printing, it is possible that a printed 3-D object is generated from a diverse range of sources such as cameras or files.

The system **5** in FIG. 2 is operable such that rendering client devices, for example the output devices **20**, require less decoding capacity, because content is delivered to them via the server node arrangement **10** in a desired encoded format, size and quality for a specified region of interest (ROI), for example content from one or more surveillance cameras providing images from a spatial region to be monitored for security purposes against theft. Moreover, audio data is delivered in a desired format and quality for output devices **20** or destination clients. In operation, the system is capable of avoiding problems arising when a content encoding format is not supported in device decoders, for example in one or more of the output devices **20**, or the content is incompatible for other unknown reasons. Similarly, decoding and processing of other types of data does not consume more resources than necessary in the system, and usually no transcoding is necessary. Moreover, less communication bandwidth is required when transferring data within the system when contents are delivered in respect of a desired region of interest (ROI) or quality, as compared in contradistinction to a situation wherein all images or data are delivered in full accuracy from all sources of input data to all output devices, namely rendering clients. Thus, in the system of FIG. 2, the rendering client can request images, video, other graphical data and/or audio data on demand from the server node arrangement **10** which adapts supplied content specifically to the needs of the rendering client.

In the system **5** of FIG. 2, any sort of analog or digital image, video, graphics data, and audio input that are connected to the system **5** can be utilized as sources of input data, namely sources **30**. For example, first thirty cameras providing a first thirty images presented in FIG. 1 are analog, and they are each coupled in communication with the server node arrangement **10** via coaxial cable arrangement connection to a digital capture electronic circuit board (card) arrangement of a surveillance system hosted by the system **5**. This digital capture circuit boards arrangement is operable to transform analog image signals into a digital YCbCr format, also known as a YUV2 format. Moreover, a last three cameras providing the mosaic of images in FIG. 1 are digital cameras, wherein two of the digital cameras have been connected via a CAT 5 network cable and one of the digital cameras has been connected via a wireless data link, for example utilizing WLAN protocol, accommodated in a local area network (LAN) of the system **5**.

The digital cameras, for example when implemented as "IP cameras", of the system **5** differ from the analog cameras in that the digital cameras are not required to be used in combination with the aforesaid digital capture card arrangement, because the digital cameras include digital processing circuits within their housings, and their outputs are thus already encoded to digital format, for example YCbCr, RGB, MJPG or H.264. The system **5**, as aforementioned, is capable of accommodating other types of sources of input data, for example audio and graphics input sources, wherein their outputs are beneficially processed in a similar manner to aforesaid surveillance cameras, but in their own native formats; in other words, the system **5** is operable to interpret input data to the server node arrangement **10** in such a way that it can be effectively decoded for constructing corresponding output signals to be provided to the output devices **20**.

If one or more input signals from the sources **30** are transmitted via the server node arrangement **10** to more than one rendering device, for example more than one output device **30**, the system **5** is operable to decompress the input signals only once, when the input signals are provided in a compressed manner to the server node arrangement **10**, and corresponding decompressed information stored in a memory cache as long as a new input signal replaces the old one. Even though the

decoded input signal replaces the input signal that was previously decompressed, there are operating situations in the system **5**, wherein the signals are not always decompressed, for example in an event that there are no output devices **20** that require the input signal in a decompressed format or with different resolution. Thus, one or more input signals received from the one or more sources **30** are decoded within the server node arrangement **10** only when one or more of the output devices **20** require such a decompressed form of content to be provided to them. Decoding within the server node arrangement **10** is not required at all, requiring the one or more output devices **20** to decode data thereat, when all the rendering devices, for example all the output devices **20**, request the input data generated by one or more of the sources **30** from the server node arrangement **10** with a mutually similar resolution and in a format as delivered from the one or more sources **30** to the server node arrangement **10**.

On account of server node arrangement **10** including computing hardware which is operable to execute one or more software products in order to provide its processing functionalities, the server node arrangement **10** can be configured to process data received from the one or more sources **30** of input data into various forms which are requested by one or more of the output devices **20**, namely rendering devices. On such functionality provided by the server node arrangement **10** is a "Mixin" functionality, wherein the system **5** is operable to generate a combination of decompressed input signals provided from the one or more sources **30** to generate a collection signal, referred to as a "Mixin signal". Moreover, for the Mixin functionality, the server node arrangement **10** is operable to encode and/or decode the Mixin signal into a format that is optimal for a given output device **20**, namely rendering device. The rendering device defines, for example in a request message sent from the rendering device to the server node arrangement **10**, the location of one or more signals (ROI, Region of Interest) as well as a quality of audio content required, and the system **5** is operable to collect corresponding pertinent input signals from sources **30** by decompressing and transforming, where appropriate, their native format into an optimal format defined by a coding method employed in the rendering device.

An important functionality of the system **5**, as aforementioned, is to combine signals from the sources **30** of input data, for example by employing data processing

techniques such as resizing images and oversampling images and/or audio signals, for generating a combined signal, for example the Mixin signal, for a given region of interest (ROI) to the one or more output devices **20**. For example, in the system **5**, input image signals are combined at the server node arrangement **10** with an output collection signal by employing a resize function provided in the server node arrangement **10**, for example by employing, for example, a supersampling computing algorithm, a cubic or a linear method; it is thereby feasible to retain a signal quality which is as high as practically possible before combining the input image signals and output collection signal to provide a final output signal for sending to the output devices **20**.

The system 5 is beneficially operable to employ encoding using an encoding method which is best suited for each rendering device, for example output device **20**, for example customized to each output device **20** at the server node arrangement **10** in response to each device making its encoding requirements known to the server node arrangement **10** by sending an encoding request message thereto. Thus, the server node arrangement **10** is capable of creating a dedicated output which is customized for each of the output devices **20**, or groups of such output devices **20** which have mutually similar encoding requirements.

In operation of the system **5**, occasions arise where audio data, and other types of data, need to be combined. Many types of data can simply be assembled together to generate combined data, for example concatenated audio data files. In other situations, temporal merging of data files is required, for example a plurality of audio files are combined temporally in parallel to generate combined data, for example mixing of individual microphone signals during recording of an orchestral concert to generate an overall recording of the concert. Such mixing and combination of signals is a functionality provided by the system **5**. When multiple audio signals are mutually combined, it is beneficial to utilize methods which preserve original audio volume, yet without adding additional or excessive noise. In an example where the multiple audio signals correspond to multiple persons speaking together in conference, it is advantageous that the system **5** adjust a relative volume of the voices of the person so that they are mutually similar in volume, for example in a telephone conferencing situation or a video conferencing situation. In another example, a selection of an

audio source for conveying to the output devices **20** is based upon a most active camera source and/or on a highest volume audio source, for example where the system **5** is required to function as an intruder surveillance system.

When the system **5** is employed for video conferencing purposes, the sources **30** and the output devices **20** are beneficially pre-defined. A communication device of a given user participating in such a video conference may optionally act as both an output device **20** as well as a source **30** of input signals to the system **5**; similar considerations pertain mutatis mutandis to telephone conferencing. In surveillance applications, the output devices **20** and the sources **30** may be at mutually different locations. In certain situations, the output devices **20** each have a mutually different region of interest (ROI) and thus each require signals from a different combination of sources **30**. Such flexibility is accommodated by the system **5**. Thus, beneficially, a process executing in the system **5** requests a resolution required for region of interest (ROI) from the render device for a given desired output signal. The region of interest (ROI) can also pertain to an area of a display of a given output device **20** for which image data being processed by the server node arrangement **10** is to be adapted for presentation at the output device **20**. For example, a native display resolution of a given output device **20** is 800 pixels x 480 pixels, and is communicated to one or more processes executing upon the server node arrangement **10** as being a region of interest (ROI). In certain situations, a display area, namely "window", of a given output application may be potentially smaller than the native resolution of the display, requiring scaling up of content image for presentation, by employing for example a cubic or a linear method; as aforementioned, such scaling up is beneficially executed at the server node arrangement **10**, or by a combination of processing in the server node arrangement **10** and the given output device **20** having the aforesaid native display resolution. Optionally resizing of content received at the output device **20** is performed by processing in computing hardware included in the output device **20**. Scaling down is needed when the native resolution in presentation and/or region of interest (ROI) "window" is smaller than the resolution of the input source/sources. This resizing is also beneficially executed at the server node **10**, but optionally it can also be performed by processing data in computing hardware included in the output device **20**.

The system **5** is capable of operating to generate the mosaic of images as illustrated in FIG. 1, as aforementioned. Moreover, the system **5** is operable to generate the mosaic to include content from any number of sources **30** of input data, for example digital video cameras and/or analog video cameras. Furthermore, the mosaic can be beneficially rearranged as required under software control in a flexible manner, for example to ease human strain when monitoring the images, for example at a surveillance control centre. The mosaic is generated in real-time and is illustrated to have a 6 x 6 image format, but is reconfigurable, if required, to other formats, for example 1 x 1, 1 x 2, 2 x 3, 9 x 6 and so forth. Moreover, the size of images in the mosaic can vary; for example thirty three images in FIG. 1 can also be represented as a single big image that uses an area of four small images together with thirty two smaller images. There can be many different sizes of images in the mosaic image and the aspect ratios of the images can also be varies. The arrangement of images, optionally, can vary dynamically based on the user needs and the variations will be informed to the server node arrangement to enable optimal data "Mixin" and data delivery.

Aforementioned embodiments are capable of saving considerable amounts of computing capacity at a rendering device of the system **5**, namely one or more of the output devices **20**. Such saving is achieved by the server node arrangement **10** constructing and returning to the rendering device exactly the desired size of content in a suitable format for the rendering device. Such computation savings potentially increase operating reliability of the system **5**, because a large amount of the data processing required is executed in a centralized manner at one or more server nodes of the server node arrangement **10**. Moreover, such centralized processing decreases a processing capacity required in rendering devices, namely the output devices **20**. Moreover, the system **5** is capable of saving a considerable amount of energy associated with processing data for following reasons:

(i) a given rendering device of the system **5** decompresses content received thereat in a native raw format, thereby avoiding a need to consume power at the rendering device for transformation operations; and

(ii) the given rendering device is capable of using the content received thereat directly, without needing to scale the content, thereby avoiding a need for post-processing in the given rendering device.

When the rendering device is a low-power portable device, such reduction in power consumption associated with data processing potentially enables the rendering devices to continue operating from battery power sources for longer periods, before the associated batteries need to be replaced or recharged. Moreover, the system **5** is capable of reducing a volume of data to be communicated from the server node arrangement **10** to the one or more output devices **20**, namely rendering devices, because the region of interest (ROI) of a given rendering device is often much smaller than the combined contents. For example, if thirty items of analog-to-digital (ADC) converted 750 pixel x 576 pixel resolution images and three items of digital 1024 pixel x 768 pixel resolution images are transmitted from thirty three surveillance cameras, as per FIG. 1, to a given rendering device whose display has a native resolution of 800 pixels x 640 pixels, then the server node arrangement **10** in its processes saves both image area and communication transfer capacity by a factor of 38.4 times. Moreover, as aforementioned, the rendering device does not need to resize the images to fit into a smaller display screen of the rendering device. Embodiments as described in the foregoing are especially useful when implementing video surveillance systems, wherein video capture is stored in the server node arrangement **10**, and where video output supplied from the server node arrangement **10** to one or more rendering devices can simultaneously be watched in real-time or playback modes. The video can, for example, be stored in full resolution at the server node arrangement **10**, and supplied to the one or more rendering devices in a format which is efficient and suitable for them. Similar considerations pertain when the system **5** is employed for recorded video conferences.

The system **5** is capable of accomplishing automatic video image synchronization if a given rendering device receives one image at a time via a communication network coupling the server node arrangement **10** to the given rendering device, for example via the Internet, although other types of communication networks are additional or alternatively employed, for example proprietary customized communication networks, for example high-security dedicated networks. In this case, the server node arrangement **10** constructs the image to be encoded from each source **30** of input data in real-time.

The system **5** makes it possible to transmit real-time live content to several rendering devices, even when some of the rendering devices are slower in their ability to perform data processing in comparison to other of the rendering devices, because the server node arrangement **10** constructs encoded images in a customized manner for each rendering device as soon as it is requested by the rendering device; for example, the slower rendering devices do not delay a rate at which images are provided to the faster rendering devices. In such a manner of operation, the system **5** is capable of supporting rendering devices which are operable, in a manner akin to the sources **30**, to transmit their own input signals to the server node arrangement **10**, and then to receive a latest sent image for a precise region-of-interest (ROI) it desires to present on its graphical display.

The system **5** is thus capable of being used to provide two-way real-time communication between a plurality of participating parties, for example as in a video conference. Image processing executed in the server node arrangement **10**, for example scaling, makes it possible to have a very large number of simultaneous participants with video connection. If several rendering devices have a mutually similar region of interest (ROI) on their graphical displays, it is feasible for the server node arrangement **10** to serve similar images to several mutually similar rendering devices, for example mutually-similar models of smart phone. Moreover, during video surveillance or a video conference, a given participating party can select to have a closer look at a particular camera image of interest in the mosaic, or studying facial features of a another participating party to the video conference; such flexibility is achieved by the rendering device of the given participating party sending a request to the server node arrangement **10** to process content for the rendering device of the given participating party in a modified manner, for example with different scaling and/or resolution. Such a modified manner of processing the content at the server node arrangement **10** is, for example, achievable by the given participating user applying a finger swiping motion to a touch screen of the rendering device of the given participating party, or using a mouse click or similar. Such modified manner of processing the content can also include using a modified aspect ratio to images, for anisotropic rescaling of defined image content and so forth, and/or performing color enhancement on certain portions of an image or sequence of video images, for example high-lighting certain regions of the images.

In FIG. 3, a rendering device, namely an output device **20**, sends a request **100** to the server node arrangement **10** to supply data content in a defined manner for the output device **20** in relation to a specified process **110A** hosted by the server node arrangement **10**; for example, the specified process **110A** is an occurrence of a video conference, a residential or vehicle park surveillance service or real-time relayed sporting events. The server node arrangement **10** is capable of supporting a plurality of processes **110A**, **110B**, **110C** concurrently, wherein certain rendering devices can optionally subscribe to a plurality of processes simultaneously so that their users can switch rapidly between processes. Such switching is beneficial, for example, when the system **5** is employed to monitor and control a petrochemicals facility or a hospital facility wherein multiple activities are occurring simultaneously, for example mobile ambulance services and emergency and accident departments which are required to be coordinated with the mobile ambulance services.

CLAIMS

We claim:

1. A server node arrangement (10) which is coupled via a communication network to a plurality of source devices (30) of input data, and to one or more output devices (20), wherein the server node arrangement (10) is operable to receive data content from the plurality of source devices (30) of input data, to process the data content for supplying to the one or more output devices (20),

wherein the server node arrangement (10) is operable to host one or more processes (110) which are operable to process the data content into a form which is compatible to a native data rendering format of the one or more output devices (20),

further wherein each of the one or more output devices (20) is operable to render the data content from the plurality of source devices (30) of input data simultaneously.; and

further wherein the server node arrangement (10) is operable to supply the processed data content to the one or more output devices (20) in a manner compatible with a region-of-interest (ROI) of the one or more output devices (20).

2. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to combine the data content received from the plurality of source devices (30) to generate a combined signal for supplying to the one or more output devices (20).

3. The server node arrangement (10) as claimed in claim 1, wherein the plurality of source devices (30) include one or more cameras, and the one or more output devices (20) are operable to render one or more images collected from the one or more cameras simultaneously.

4. The server node arrangement (10) as claimed in claim 3, wherein the one or more images are collected from a same camera, thereby showing temporal changes within a given scene.

5. The server node arrangement (10) as claimed in claim 1, wherein the plurality of source devices (30) include one or more audio sources, and the one or more output devices (20) are operable to render one or more audio signals collected from the one or more audio source devices simultaneously.

6. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to implement the one or more processes (110) as a surveillance system (5).

7. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to implement the one or more processes (110) as a video conferencing system (5).

8. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to implement the one or more processes (110) for TV/Video broadcasting/multicasting.

9. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to implement the one or more processes (110) for image browsing via Internet.

10. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) includes one or more servers, wherein the one or more servers are, at least in part, implemented in the plurality of source devices (30).

11. The server node arrangement (10) as claimed in claim 1, wherein the one or more output devices (20) are operable to define in a message (100) to the server node arrangement (10) one or more parameters which define one or more native formats in which the one or more output devices (20) require their data content to be supplied from the server node arrangement (10).

12. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is implemented, at least in part, in a cloud computing environment.

13. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to store data content from the one or more source devices (30) of input data in its original resolution, and supply the data content to the one or more output devices (20) in a format which is compatible with a native format of the one or more output devices (20).

14. The server node arrangement (10) as claimed in claim 1, wherein the data content includes at least one of: images, video, audio, sensor signal data, text data.

15. The server node arrangement (10) as claimed in claim 1, wherein the server node arrangement (10) is operable to process data content therethrough in a manner allowing for dynamically-changeable image rescaling in response to user input at the one or more output devices (20).

16. A method of processing data in a server node arrangement (10) which is coupled via a communication network to a plurality of source devices (30) of input data, and to one or more output devices (20), wherein the server node arrangement (10) is operable to receive data content from the plurality of source devices (30) of input data, to process the data content for supplying to the one or more output devices (20), wherein the method includes:

hosting one or more processes (100) at the server node arrangement (10) which are operable to process the data content into a form which is compatible to a native data rendering format of the one or more output devices (20);

rendering the data content from the plurality of source devices (30) of input data at each of the one or more output devices (20) simultaneously; and

operating the server node arrangement (10) to supply the processed data content to the one or more output devices (20) in a manner compatible with a region-of-interest (ROI) of the one or more output devices (20).

17. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to combine the data content received from the plurality of source devices (30) to generate a combined signal for supplying to the one or more output devices (20).

18. The method as claimed in claim 16, wherein the method includes rendering one or more images at the one or more output devices (20) simultaneously, wherein the one or more images are collected from one or more cameras included within the plurality of source devices (30).

19. The method as claimed in claim 18, wherein the method includes: collecting the one or more images from a same camera; and showing temporal changes within a given scene.

20. The method as claimed in claim 16, wherein the method includes rendering one or more audio signals at the one or more output devices (20) simultaneously, wherein the one or more audio signals are collected from one or more audio source devices included within the plurality of source devices (30).

21. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to implement the one or more processes (110) as a surveillance system (5).

22. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to implement the one or more processes (110) as a video conferencing system (5).

23. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to implement the one or more processes (110) for TV/Video broadcasting/multicasting.

24. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to implement the one or more processes (110) for image browsing via Internet.

25. The method as claimed in claim 16, wherein the method includes implementing the server node arrangement so as to include one or more servers, wherein the one or more servers are, at least in part, implemented in the plurality of source devices.

26. The method as claimed in claim 16, wherein the method includes operating the one or more output devices (20) to define in a message (100) to the server node arrangement (10) one or more parameters which define one or more native formats in which the one or more output devices (20) require their data content to be supplied from the server node arrangement (10).

27. The method as claimed in claim 16, wherein the server node arrangement (10) is implemented, at least in part, in a cloud computing environment.

28. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to store data content from the one or more source devices (30) of input data in its original resolution, and supply the data content the one or more output devices (20) in a format which is compatible with a native format of the one or more output devices (20).

29. The method as claimed in claim 16, wherein the data content includes at least one of: images, video, audio, sensor signal data, text data.

30. The method as claimed in claim 16, wherein the method includes operating the server node arrangement (10) to process data content therethrough in a manner allowing for dynamically-changeable image rescaling in response to user input at the one or more output devices (20).

31. A software product recorded on machine-readable data storage media, wherein the software product is executable upon computing hardware (10, 20, 30) for implementing the method as claimed in claim 16.