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(54) **METHODS AND SYSTEMS FOR ACCESSING CROWD SOURCED LANDSCAPE IMAGES**

(75) Inventors: **Lyle W. Paczkowski**, Mission Hills, KS (US); **Arun Rajagopal**, Leawood, KS (US); **Matthew Carl Schlesener**, Shawnee, KS (US)

(73) Assignee: **Sprint Communications Company L.P.**, Overland Park, KS (US)

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(22) Filed: **Jun. 8, 2012**

(51) **Int. Cl.**
H04M 3/493 (2006.01)

(52) **U.S. Cl.**
USPC **455/414.2**; 455/457; 455/456.3; 455/561; 345/419; 345/633

(58) **Field of Classification Search**
CPC H04W 4/02; H04W 4/021; H04W 4/023; H04M 1/72572; H04M 3/42348; G06T 1/00; G06T 3/0425; G06T 3/0484; G06T 3/1415; G06T 17/30047
See application file for complete search history.

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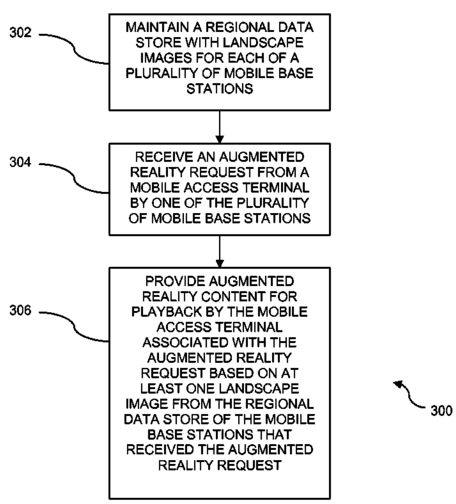
Primary Examiner — Rafael Pérez-Gutiérrez
Assistant Examiner — Keith Fang

(57) **ABSTRACT**

A method. The method comprises maintaining a regional data store of landscape models for each of a plurality of base stations, wherein each regional data store is proximate to its corresponding base station and wherein each landscape model is derived from a plurality of images of a landscape located proximate to the base station. The method further comprises receiving a request for a landscape image from a mobile access terminal in the serving area of a first base station, wherein the first base station is one of the plurality of base stations and wherein the request for the landscape image identifies a landscape model maintained by the first base station. The method further comprises transmitting the landscape image to the mobile access terminal by the first base station, wherein the landscape image is created based on the landscape model identified in the request.

19 Claims, 9 Drawing Sheets



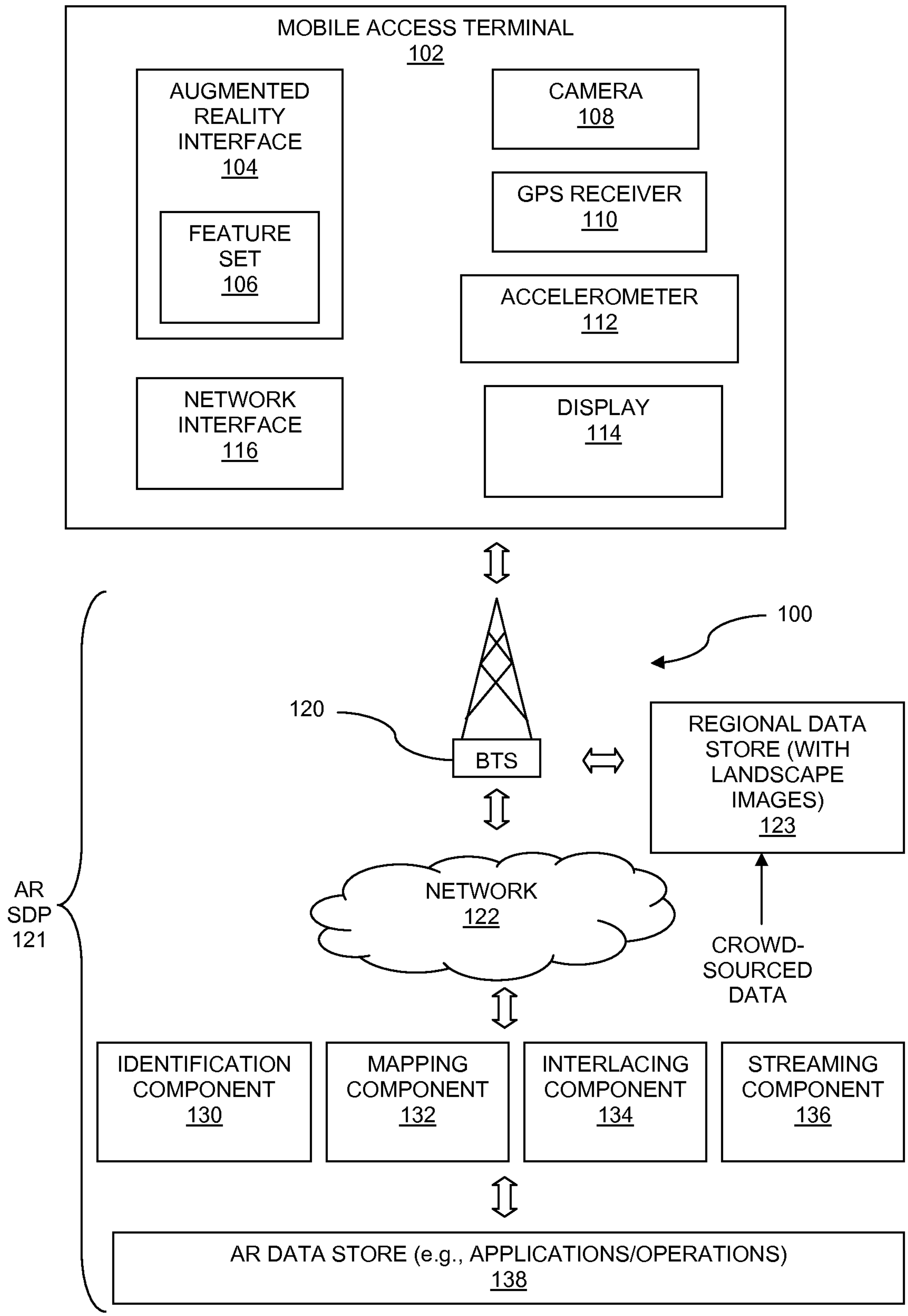

MOBILE ACCESS TERMINAL
102
AUGMENTED REALITY INTERFACE
104
FEATURE SET
106
CAMERA
108
GPS RECEIVER
110
ACCELEROMETER
112
NETWORK INTERFACE
116
DISPLAY
114
100
120
BTS
REGIONAL DATA STORE (WITH LANDSCAPE IMAGES)
123
AR SDP
121
NETWORK
122
CROWD-SOURCED DATA
IDENTIFICATION COMPONENT
130
MAPPING COMPONENT
132
INTERLACING COMPONENT
134
STREAMING COMPONENT
136
AR DATA STORE (e.g., APPLICATIONS/OPERATIONS)
138

FIG. 1A

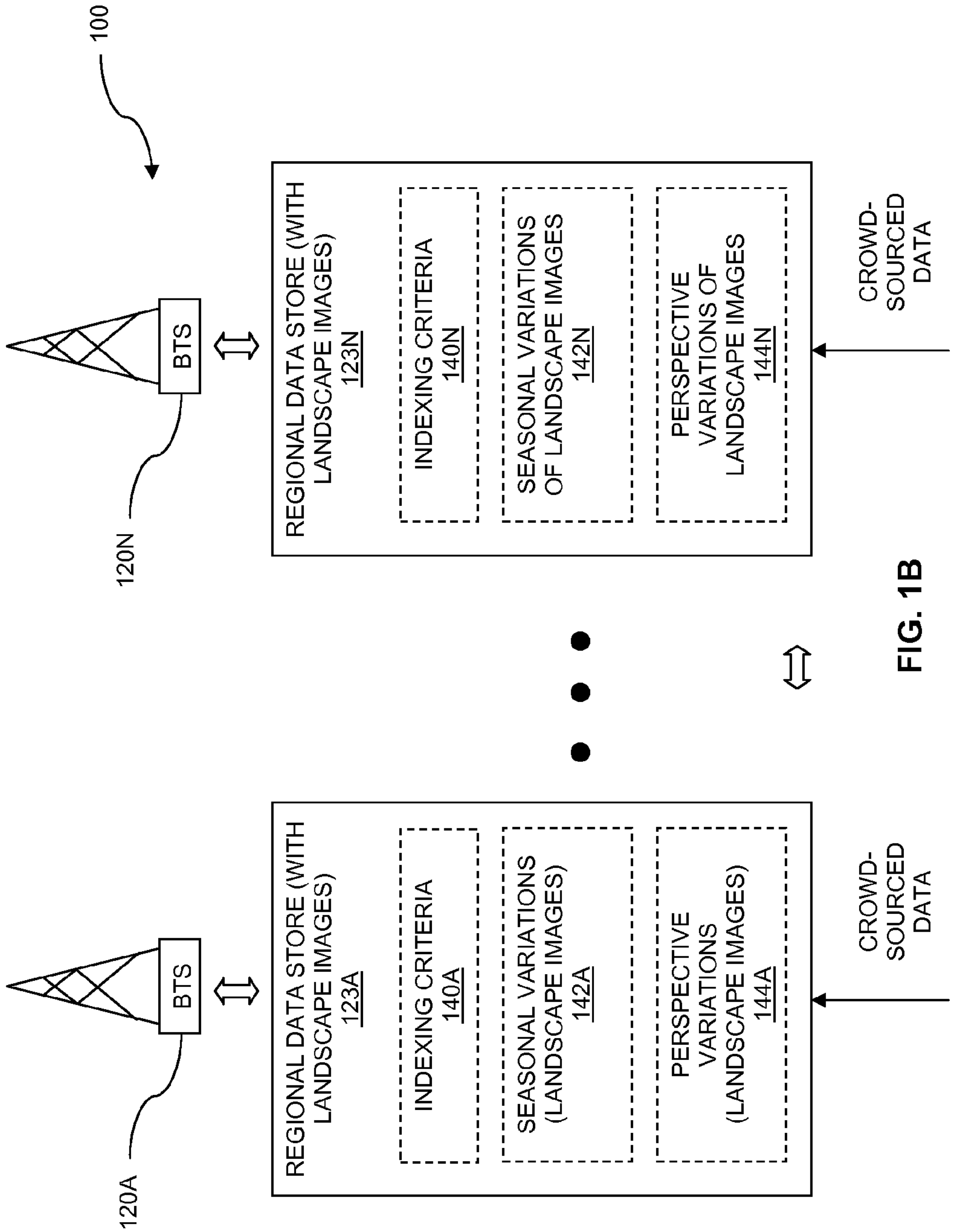

100
120N
BTS
REGIONAL DATA STORE (WITH LANDSCAPE IMAGES)
123N
INDEXING CRITERIA
140N
SEASONAL VARIATIONS OF LANDSCAPE IMAGES
142N
PERSPECTIVE VARIATIONS OF LANDSCAPE IMAGES
144N
CROWD-SOURCED DATA
120A
BTS
REGIONAL DATA STORE (WITH LANDSCAPE IMAGES)
123A
INDEXING CRITERIA
140A
SEASONAL VARIATIONS (LANDSCAPE IMAGES)
142A
PERSPECTIVE VARIATIONS (LANDSCAPE IMAGES)
144A
CROWD-SOURCED DATA

FIG. 1B

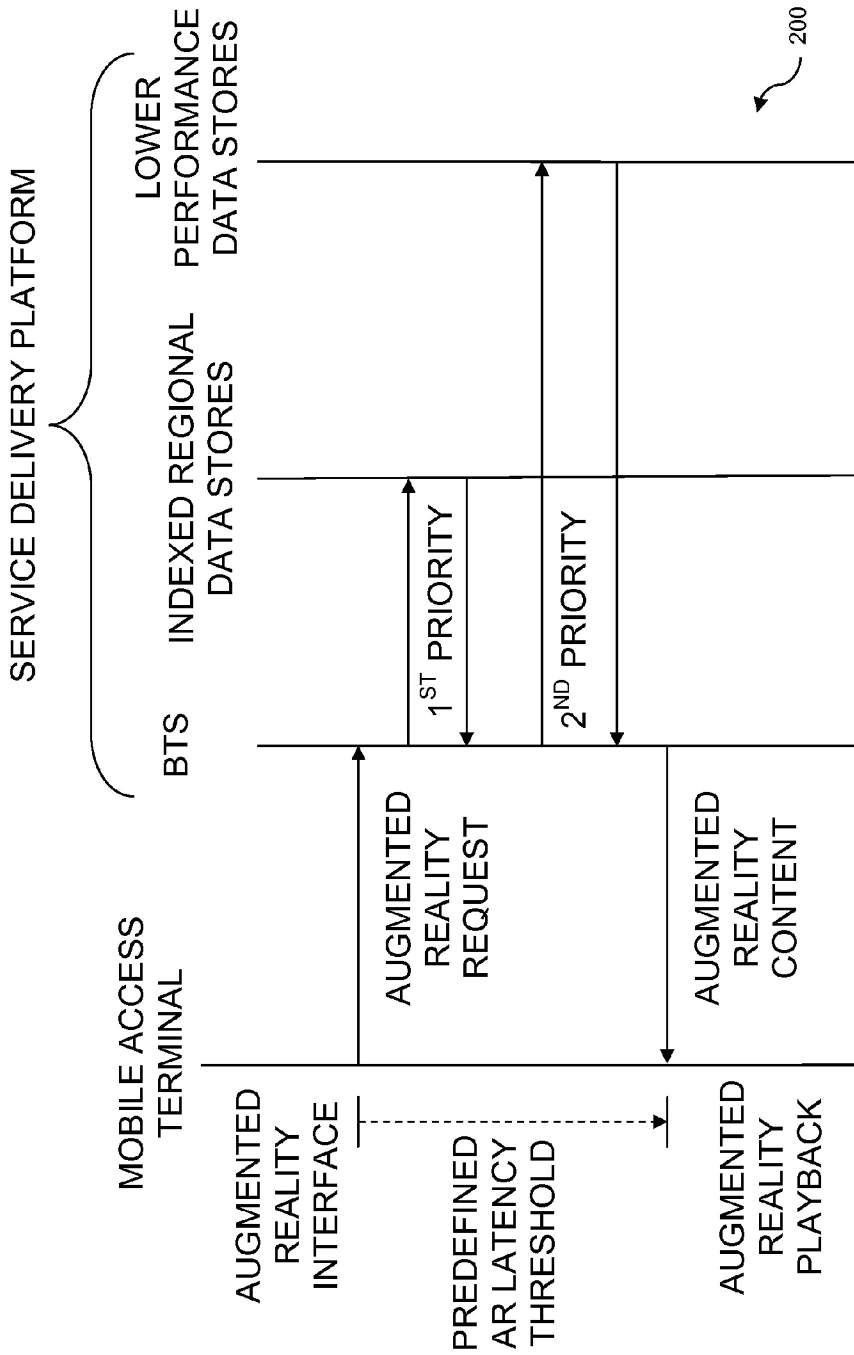

SERVICE DELIVERY PLATFORM
MOBILE ACCESS TERMINAL
BTS
INDEXED REGIONAL DATA STORES
LOWER PERFORMANCE DATA STORES
AUGMENTED REALITY REQUEST
1ST PRIORITY
2ND PRIORITY
AUGMENTED REALITY CONTENT
AUGMENTED REALITY INTERFACE
PREDEFINED AR LATENCY THRESHOLD
AUGMENTED REALITY PLAYBACK
200

FIG. 2

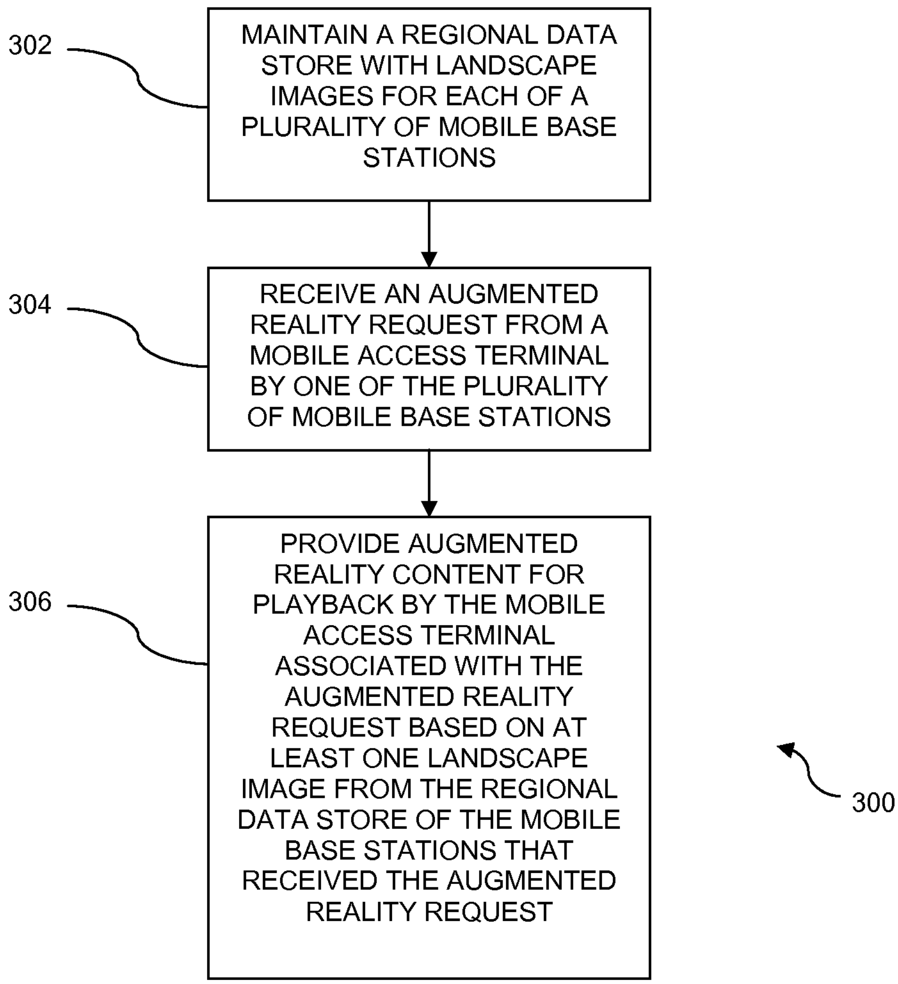
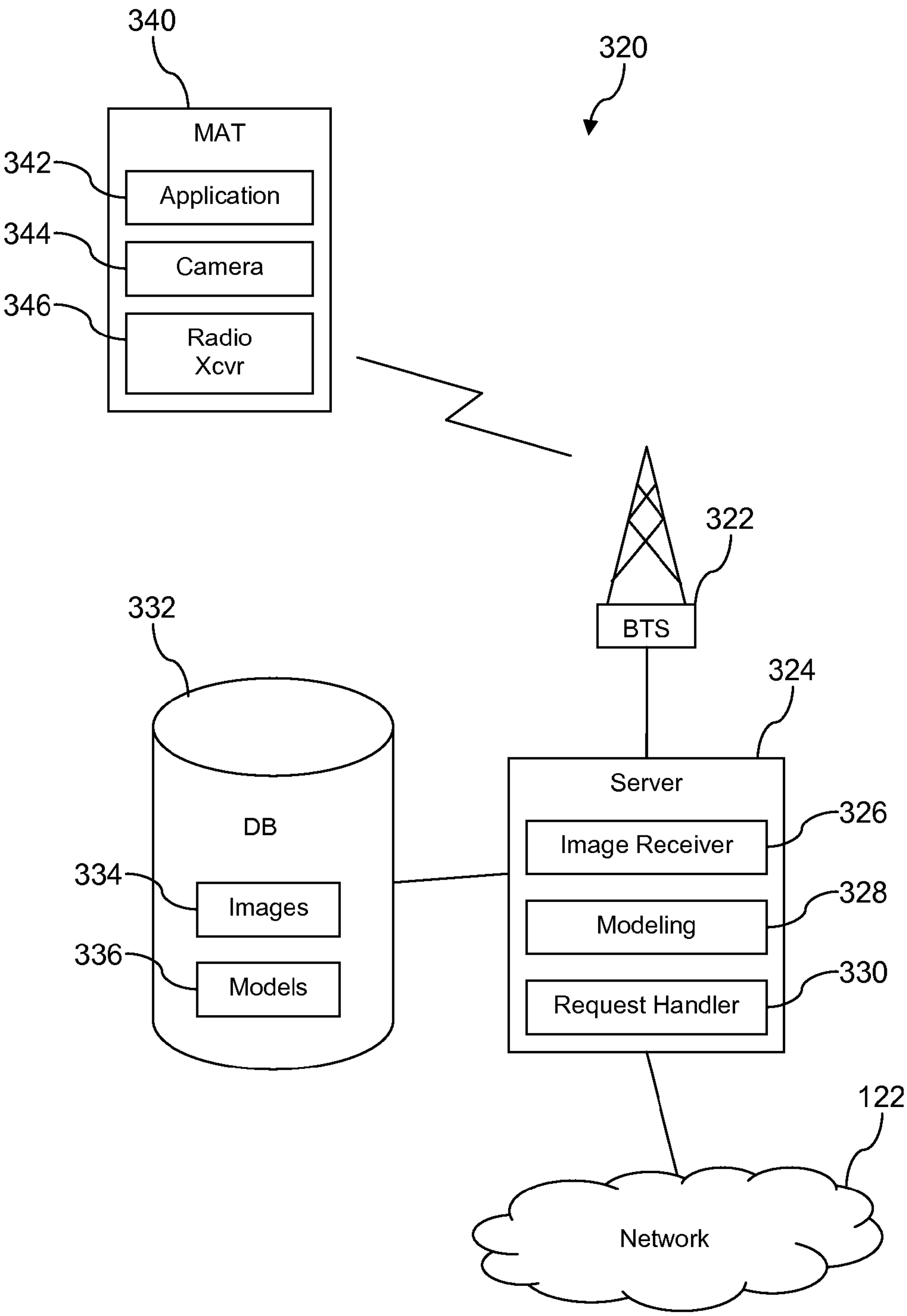

302
MAINTAIN A REGIONAL DATA STORE WITH LANDSCAPE IMAGES FOR EACH OF A PLURALITY OF MOBILE BASE STATIONS
304
RECEIVE AN AUGMENTED REALITY REQUEST FROM A MOBILE ACCESS TERMINAL BY ONE OF THE PLURALITY OF MOBILE BASE STATIONS
306
PROVIDE AUGMENTED REALITY CONTENT FOR PLAYBACK BY THE MOBILE ACCESS TERMINAL ASSOCIATED WITH THE AUGMENTED REALITY REQUEST BASED ON AT LEAST ONE LANDSCAPE IMAGE FROM THE REGIONAL DATA STORE OF THE MOBILE BASE STATIONS THAT RECEIVED THE AUGMENTED REALITY REQUEST
300

FIG. 3



340
320
MAT
342
Application
344
Camera
346
Radio
Xcvr
322
BTS
332
324
DB
Server
326
Image Receiver
334
Images
328
Modeling
336
Models
330
Request Handler
122
Network

FIG. 4

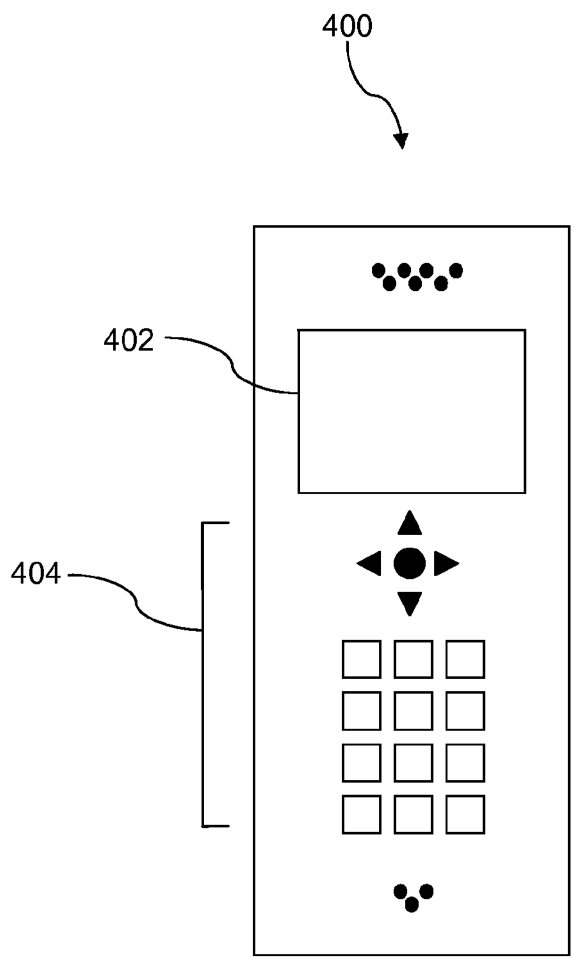


FIG. 5

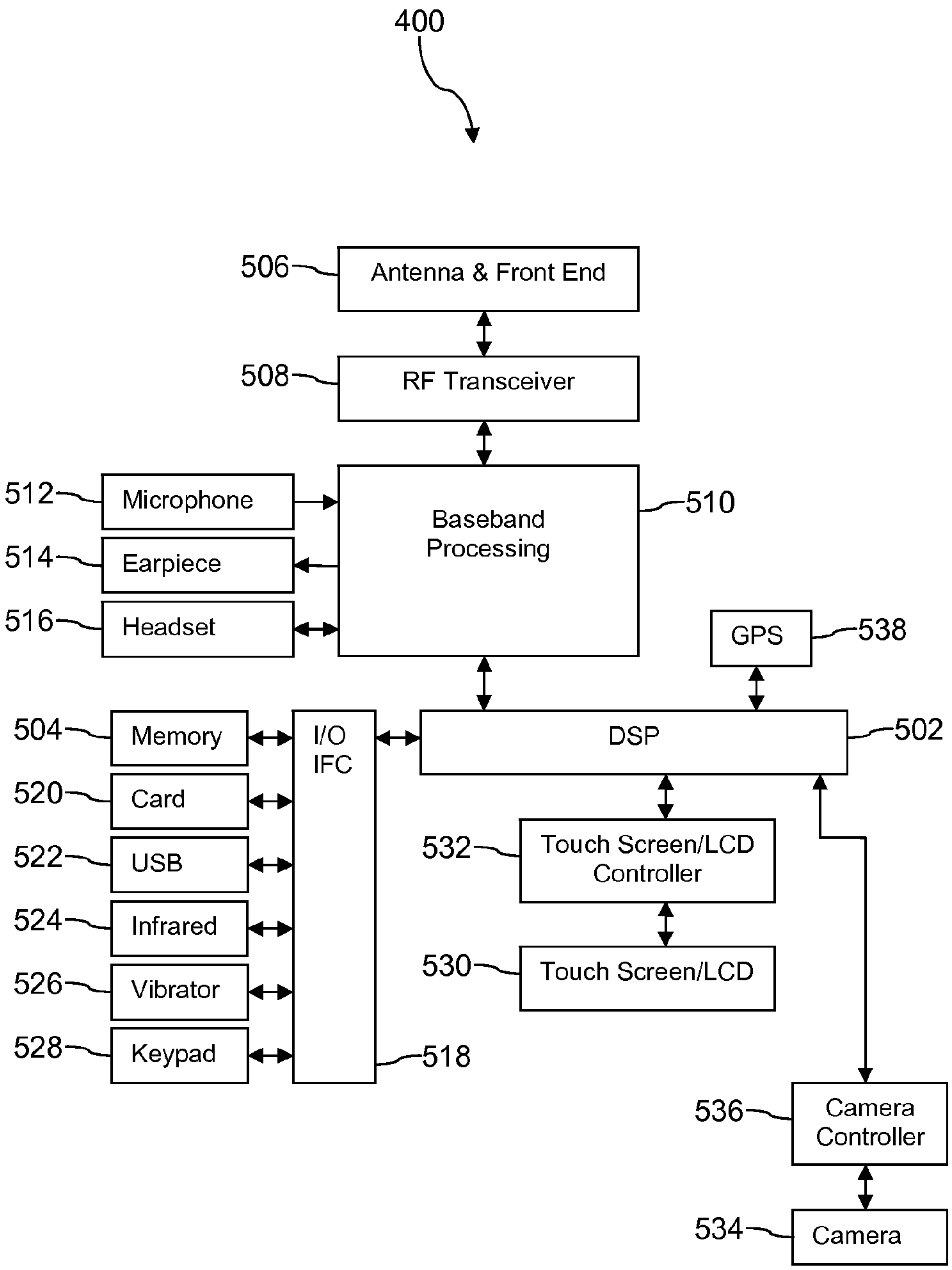

400
506
Antenna & Front End
508
RF Transceiver
512
Microphone
514
Earpiece
516
Headset
Baseband Processing
510
GPS
538
504
Memory
520
Card
522
USB
524
Infrared
526
Vibrator
528
Keypad
I/O IFC
518
DSP
502
532
Touch Screen/LCD Controller
530
Touch Screen/LCD
536
Camera Controller
534
Camera

FIG. 6

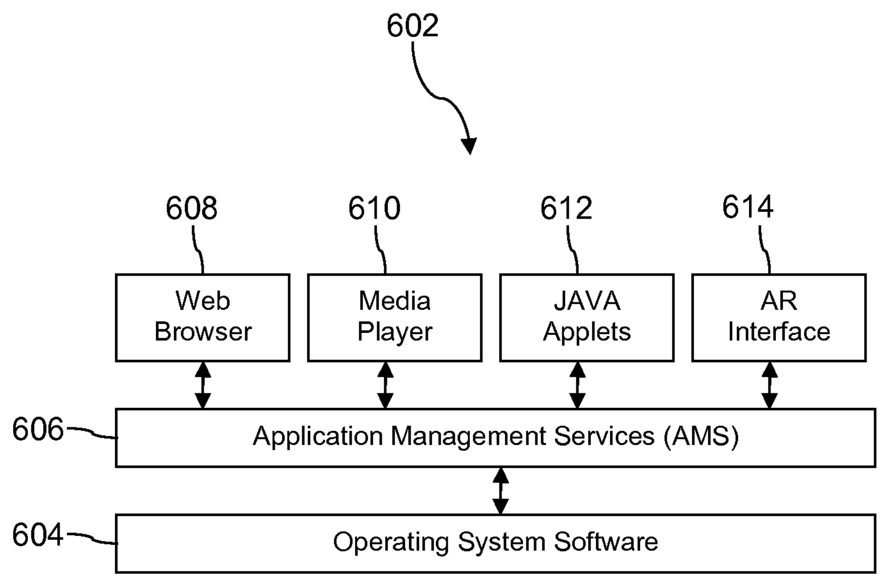

602
608
610
612
614
Web Browser
Media Player
JAVA Applets
AR Interface
606
Application Management Services (AMS)
604
Operating System Software

FIG. 7A

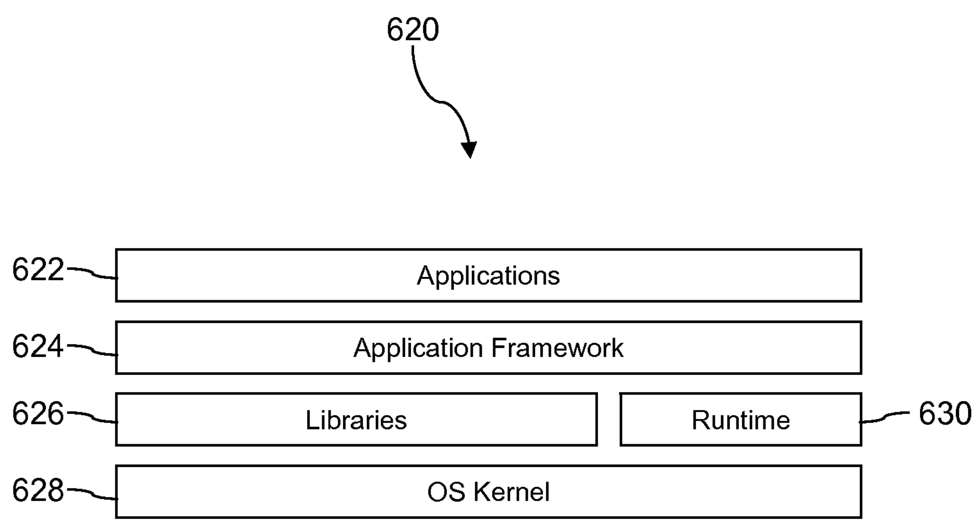

620
622
Applications
624
Application Framework
626
Libraries
Runtime
630
628
OS Kernel

FIG. 7B

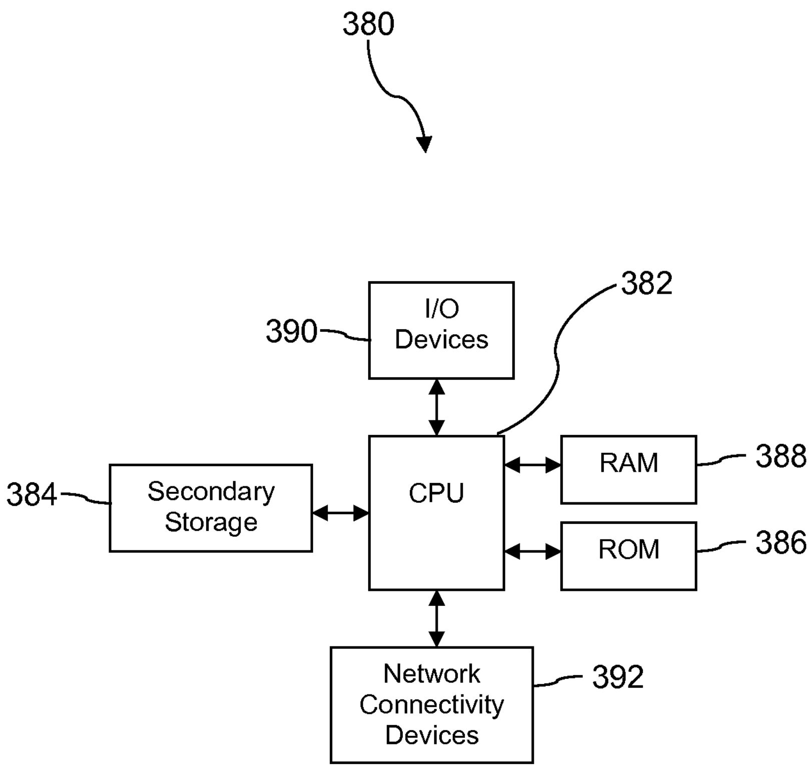

380
382
I/O
Devices
390
CPU
RAM
388
384
Secondary
Storage
ROM
386
Network
Connectivity
Devices
392

FIG. 8

METHODS AND SYSTEMS FOR ACCESSING CROWD SOURCED LANDSCAPE IMAGES

CROSS-REFERENCE TO RELATED APPLICATIONS

None.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

Not applicable.

BACKGROUND

Augmented reality (AR) refers to a direct or indirect view of the physical, real-world environment whose elements (e.g., sound, graphics) are augmented based on computer-generated input (e.g., accelerometer, GPS data, textual data). In this manner, AR enhances one's current perception of reality. By contrast, virtual reality replaces the real world with a simulated one.

AR is may be performed as an application being executed on a portable device to display information in context with environmental elements. For example, an AR application running on a portable device may be used in a golf context to show distances to a fairway or green in text. For example, the portable device, such as a mobile phone, may take a picture of a portion of a golf course, possibly including a putting green and a flag positioned in the hole. The AR application may analyze the picture, determine a distance to the flag, and superimpose a textual message such as "90 yards to flag" over the picture presented on a display of the portable device. Further, an AR application running on a portable device may be used in an outdoor context to show compass parameters, position information, or points of interest relative to the physical environment in which one resides. Further, an AR application running on a portable device may be used in a gaming context, in which objects in the physical environment in which one resides becomes part of a game experience. With AR, computer-generated graphics (e.g., words and/or lines) are often overlaid onto the real-world view provided by a camera view of a portable device.

Implementation of AR may be computationally intensive, and thus device resources (e.g., processor cycles and memory) may be overwhelmed during AR operations. In such case, use of AR negatively affects other applications or operations of a portable device. Further, the computationally-intensive aspect of AR means it may be limited to the highest cost/performance chipsets and devices.

SUMMARY

In an embodiment, a method is disclosed. The method comprises maintaining a regional data store of landscape models for each of a plurality of base stations, wherein each regional data store is proximate to its corresponding base station and wherein each landscape model is derived from a plurality of images of a landscape located proximate to the base station. The method further comprises receiving a request for a landscape image from a mobile access terminal in the serving area of a first base station, wherein the first base station is one of the plurality of base stations and wherein the

request for the landscape image identifies a landscape model maintained by the first base station. The method further comprises transmitting the landscape image to the mobile access terminal by the first base station, wherein the landscape image is created based on the landscape model identified in the request.

In some embodiments, a system is provided. The system comprises a plurality of base stations. The system also comprises a plurality of regional data stores, wherein each regional data store is associated with a distinct one of the plurality of base stations and wherein each regional data store comprises landscape images corresponding to a coverage area of its associated base station. With the system, an augmented reality request for a mobile access terminal is received by one of the plurality of base stations, which is nearest to the mobile access terminal. With the system, at least one landscape image of the regional database for the nearest base station is used to build augmented reality content corresponding to the augmented reality request.

In some embodiments, a base station is provided. The base station comprises a processor and a non-transitory computer-readable medium in communication with the processor. The non-transitory computer-readable medium stores augmented reality servicing instructions that, when executed, cause the processor to receive an augmented reality request from a mobile access terminal. The augmented reality servicing instructions, when executed, further cause the processor to identify one of a plurality of landscape images corresponding to the augmented reality request and accessible to the base station. The augmented reality servicing instructions, when executed, further cause the processor to stream augmented reality content corresponding to the augmented reality request based on the identified landscape image.

In some embodiments, a method is provided. The method comprises maintaining a regional data store of landscape images for each of a plurality of base stations. The method also comprises receiving an augmented reality request from a mobile access terminal by one of the plurality of base stations. The method also comprises providing augmented reality content for playback by the mobile access terminal associated with the augmented reality request based on at least one landscape image from the regional data store of the base station that received the augmented reality request.

These and other features will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

FIGS. **1**A and **1**B illustrate a system in accordance with embodiments of the disclosure;

FIG. **2** illustrates a chart showing operations of the system of FIG. **1**A and FIG. **1**B in accordance with embodiments of the disclosure;

FIG. **3** illustrates a method in accordance with embodiments of the disclosure.

FIG. **4** is an illustration of a system according to an embodiment of the disclosure.

FIG. **5** illustrates a mobile access terminal in accordance with embodiments of the disclosure;

FIG. **6** shows a block diagram of the mobile access terminal of FIG. **4** in accordance with embodiments of the disclosure;

FIGS. **7**A and **7**B illustrate software environments that may be implemented by a mobile access terminal in accordance with embodiments.

FIG. **8** illustrates an exemplary computer system suitable for implementing the several embodiments of the disclosure.

DETAILED DESCRIPTION

It should be understood at the outset that although illustrative implementations of one or more embodiments are illustrated below, the disclosed systems and methods may be implemented using any number of techniques, whether currently known or not yet in existence. The disclosure should in no way be limited to the illustrative implementations, drawings, and techniques illustrated below, but may be modified within the scope of the appended claims along with their full scope of equivalents.

Augmented reality (AR) applications are often specific to a particular use (e.g., a golf application, a compass application, or a gaming application) and are separately installed on a device. Further, each AR application may not be compatible with the various types of portable devices that are available to customers. Further, AR mapping/location framing is often limited to identifiable manmade objects, because identifying changing landscapes may be difficult and/or more computationally-intensive. In part, the difficulty is due to changes in rural or changing landscapes throughout a year or throughout a season. For example, it may be challenging to develop computer programming that identifies a location decorated with Christmas decorations in December as being substantially the same location as seen in July; that identifies a location having an ice skating rink in January as being substantially the same location as seen in July as a pond; that identifies a landscape with brilliant fall colors as the same location as seen in March with no colorful leaves. These issues prevent the widespread deployment of AR technology on portable consumer devices.

The present disclosure teaches a system for gathering images of landscapes at a base station, storing the images in a local or regional data store maintained by the base station, and analyzing the images to identify sub-sets of the images that are associated to the same landscape. For example, a first sub-set of images may be associated with a dominating mountain, a second sub-set of images may be associated with a meadow having a waterfall at one end of the meadow, a third sub-set of images may be associated with an open plain with a river snaking through the foreground. Each sub-set of images may be analyzed to develop a kind of composite of the images and/or a model of the landscape feature that is the subject of the images. The sub-set of images may be analyzed to produce a three dimensional view of the landscape feature, for example a two dimensional view of the subject landscape feature from any perspective in a circle around the landscape feature. In an embodiment, the sub-set of images may be analyzed to produce a four dimensional view of the landscape feature, for example the three dimensional view described as viewed at different times of day and/or as viewed at different seasons of the year and/or as viewed under different weather conditions.

The images may be provided to a base station by mobile access terminals, for example mobile phones having cameras, that have taken the images while in the coverage area of the base station of a landscape feature that is proximate to the base station. The images may be provided by virtue of the mobile access terminal sending the image embedded in a message directed to a family member or a colleague via the base station. The user of the mobile access terminal may have provided permission to the operator of the base station, for example a wireless service provider, to make a copy of any images that the mobile access terminal transmits via a base station operated by service provider for the purpose of contributing to composing landscape models.

Storing and processing the images at the base station may consume less network bandwidth than a centralized landscape modeling solution, in that the images may already be passing through the subject base station in any case. Additionally, because the images are presumed to be taken proximate to the base station, an inherent sorting of images occurs that makes the analysis of images and the allocation of images to sub-sets based on association to local landscape features easier. For example, a base station maintaining sub-sets of images related to the Grand Teton mountain does not have to handle images associated with the Grand Canyon; a base station maintaining sub-sets of images related to the Grand Canyon does not have to handle images associated with the Grand Teton mountain.

A user taking a picture of a landscape feature with a mobile access terminal may send the picture from the mobile access terminal to the base station and request information about the landscape feature, such as what is the name of the landscape feature? What are some of the physical characteristics of the landscape feature? What does the landscape feature look like at a different time of day, in a different season, in different weather conditions, from a different perspective? The base station may analyze the picture or image to match it to one or more landscape models that the base station maintains. When the base station identifies a landscape model matching the picture sent in the request, appropriate information is accessed and transmitted to the mobile access terminal. Alternatively, the base station identifies the landscape model, extracts an image of the landscape from the landscape model that corresponds with the requested image parameter (time of day, season of year, perspective), and sends the image to the mobile access terminal. In an embodiment, the base station may provide the GPS coordinates of the base station to the mobile access terminal for storing with the picture and/or image.

Some base stations may share images or landscape model data, for example when the base stations may be proximate to the same landscape features. For example, given the scale of the Grand Teton, it can be said that a plurality of base stations are proximate to the Grand Teton, in the sense that images of the Grand Teton may be transmitted from mobile access terminals in the coverage areas of multiple base stations. As an alternative embodiment, some or all of the image storing, landscape model generation, and landscape model information requests may be handled by a central data store.

While the description above has referred to landscapes, it is understood that the teachings herein are applicable to other objects besides landscape features. For example, a similar data store of images of trees may be created and sorted into sub-sets, where each sub-set of tree images is associated with a particular tree, for example an Engleman Spruce tree.

Some embodiments of the disclosure are directed to a network-based augmented reality (AR) service delivery platform having regional data stores with indexed landscape images to expedite providing a response to an augmented reality request. The AR service delivery platform is compatible with different types of mobile access terminals having different capabilities. With the AR service delivery platform, at least some operations to prepare AR content are performed by a network, and then the AR content is delivered to an AR interface being executed by a mobile access terminal for playback. The AR interface enables various types of AR requests and the presentation of corresponding AR content without requiring a user to actively interact with multiple AR applications. In other words, the AR interface either supports all available AR content provided by the AR service delivery platform or acts as an intermediary to access AR applications supported by the AR service delivery platform. In this manner, at least some of the computational burden of preparing AR content can be separated from mobile access terminals, and the management of AR presentations on a mobile access terminal is facilitated.

In at least some embodiments, all AR manipulations are performed by the AR service delivery platform, and then AR content is streamed to each mobile access terminal for playback. Alternatively, in other embodiments, AR manipulations may be performed by an AR application executing at the base station and with reference to the local data store associated with the base station, where the AR manipulations are performed substantially decoupled from other base stations and other computing servers remote from the base station. To support AR operations, mobile access terminals may provide some information to the AR service delivery platform in the form of an AR request. For example, a mobile access terminal may send an AR request to the AR service delivery platform, where the AR request includes information such as a picture frame (or frames), global positioning system (GPS) data, and accelerometer data. In response, the AR service delivery platform performs various operations to build the AR content to be streamed to the mobile access terminal that sent the AR request. As disclosed herein the AR service delivery platform may maintain a regional data store of crowd-sourced landscape images for each of a plurality of base stations, receive an augmented reality request for a mobile access terminal via one of the plurality of base stations (e.g., the base station that is nearest to the mobile access terminal), and provide a response to the augmented reality request using the crowd-sourced landscape images of the regional data store for the nearest base station. Alternatively, in an embodiment, the crowd-sourced landscape images may be stored in a centralized location, where the landscape images may be stored with metadata that identifies the base station that is closest to the subject landscape images. As used herein, the term "crowd-sourced" images such as landscape images refers to submissions of images or videos from the general public over time.

The images or videos may be recorded (i.e., snapped or taken) and transmitted from the same types of portable devices that are available to consumers for viewing AR content. As an example, when an end-user records an image or video on their portable device, an AR interface application may inquire whether the image or video can be used as part of a crowd-sourced data store for the AR service delivery platform. Additionally or alternatively, the user may have previously opted to submit certain types of images or videos for the crowd-sourced data store. In some embodiments, an end-user that submits images or videos for the crowd-sourced data store may receive some type of compensation such as money, coupons, reduced costs for use of the AR service delivery platform, and/or upgraded features for the AR service delivery platform. In accordance with some embodiments, the AR service delivery platform operations may involve overlaying crowd-sourced content with information as described herein. Additionally or alternatively, the AR service delivery platform may identify and report information related to crowd-sourced content without image overlay typical of AR (another mechanism for presenting information such as email, text, SMS, may be used).

As an example, an end-user on vacation may photograph the Grand Teton mountain with a smartphone. The photograph is subsequently submitted as part of a Multimedia Messaging Service (MMS) message to a data store related to AR services. The photograph and/or MMS message may include metadata such as geographic location information, time/date information, compass heading information, and accelerometer information. Over time, many such photographs or videos could be collected from end-users (e.g., tourists) at different geographic locations, different times of day/year, and/or different angles.

The amount of crowd-sourced data that could be stored by the regional data stores is potentially unlimited. In order to organize crowd-sourced images or videos, some effort may be made to promote submissions of images or videos based on time criteria, geography criteria, or perspective criteria. These same criteria may be used for indexing crowd-sourced images. For example, in at least some embodiments, the landscape images for each regional data store is indexed using time-based indexing (identifying time of day, a calendar date, or a season), geography-based indexing (identifying a geographic location where a camera still or video is shot) and/or perspective-based indexing (identifying a direction/angle for a camera still or video).

In accordance with at least some embodiments, the AR service delivery platform improves presentation of AR content on mobile access terminals with limited performance capabilities since the mobile access terminal only needs to render streaming AR content provided by the AR service delivery platform. This allows lower-end devices with lesser chipsets to provide AR experiences and thus the availability and monetization of AR is broadened across many types of mobile access terminals.

FIGS. **1**A and **1**B illustrate a system **100** in accordance with embodiments of the disclosure. As shown in FIG. **1**A, the system **100** comprises a mobile access terminal **102** in communication with an AR service delivery platform **121** via a base station (BTS) **120**. The mobile access terminal **102** represents, for example, a cellular phone, a smart phone, a personal digital assistant (PDA), a tablet computer, or another mobile device. In FIG. **1**A, the mobile access terminal **102** is shown to comprise an AR interface **104** configured to present AR content received from the AR service delivery platform **121**. The AR interface **104** comprises a feature set **106** that defines the types of AR content that can be presented.

The feature set **106** may vary for different mobile access terminals **102** and/or may vary over time for a particular mobile access terminal **102**. For example, the feature set **106** may correspond to sensor compatibilities, screen resolution, network speed, and/or rendering capabilities of the mobile access terminal **102**. In other words, the feature set **106** of the AR interface **104** is based on the performance characteristics of other components of the mobile access terminal **102** such as camera **108**, GPS receiver **110**, accelerometer **112**, display **112**, and network interface **116**. Other features of the mobile access terminal **102** that may be considered with the feature set **106** include a microphone, a speaker, and software applications that reside on the mobile access terminal **102**. The scope of the feature set **106** can be enhanced to include any feature that is either resident on the mobile access terminal **102** or can be provided to the end-user through a wireless peripheral (e.g., a Bluetooth peripheral) or a wired peripheral that can be attached to the mobile access terminal **102**.

In accordance with embodiments, the camera **108** operates to record video and/or still photographs using an electronic image sensor. The GPS receiver **110** provides location and time information based on GPS satellites. In alternative embodiments, another satellite-enabled self-location function is used instead of GPS. The accelerometer **112** is a sensor-based tool to measure mobile access terminal parameters such as acceleration, movement, and orientation. The display **114** corresponds to a liquid crystal display (LCD) screen or other display technology. The display **114** may be a touch screen in some embodiments. Further, the resolution and color scheme of the display **114** may vary for different mobile access terminals **102**. The network interface **116** corresponds to one or more wireless technology communication modules to enable the mobile access terminal **102** to transmit information to or receive information from BTS **120**.

As an example, the mobile access terminal **102** may transmit an AR request to the BTS **120** using the AR interface **104**. The AR interface **104** may generate AR requests upon request from a user. Additionally or alternatively, the AR interface **104** may generate AR requests using predetermined settings of the AR interface **104**. The predetermined settings may be determined based on a selection of available settings by a user, a selection of AR interests by a user, a geographic location of the mobile access terminal **102**, or user profile information that identifies user interests.

Upon reception of an AR request, the BTS **120** accesses a regional data store **123** with landscape images as part of the AR service delivery platform **121** to build AR content corresponding to the AR request. In FIG. **1**A, the operations of the AR service delivery platform **121** are performed over a network **122** by an identification component **130**, a mapping component **132**, an interlacing component **134**, and a streaming component **136**. In some embodiments, each of the components **130**, **132**, **134**, **136** corresponds to a separate computing/memory resource (e.g., a server). In such case, each of the components **130**, **132**, **134**, **136** may be optimized to perform their particular function. Alternatively, the components **130**, **132**, **134**, **136** may be hardware components or software components of a single server. In either case, the components **130**, **132**, **134**, **136** may have access to at least one AR data store **138** that supports AR operations. In some embodiments, one or more of the components **130**, **132**, **134**, **136** correspond to BTS components. For example, the identifying component **130** and/or the mapping component **132** may be part of the BTS **120** and may access the regional data store **123** with landscape images during the process of building AR content for delivery to the mobile access terminal **102**.

The regional data store **123** may be part of the BTS **120** or may be accessible via the network **122** or an Internet connection. In other words, the location of the regional data store **123** may vary, provided the regional data store **123** is indexed or uniquely identified by its related BTS **120** and can provide information back to the mobile access terminal within predetermined latency thresholds. Further, the mobile access terminal **102** may communicate with the network **122** or Internet for AR service delivery platform operations without involvement the BTS **120** (e.g., based on a WiFi connection).

In at least some embodiments, the identification component **130** is configured to receive an augmented reality request from a mobile access terminal **102**, to identify a context for the augmented reality request, and to identify the feature set **106** supported by the mobile access terminal **102** associated with the augmented reality request. The mapping component **132** is configured to map the identified feature set **106** and the context to a subset of available augmented reality applications or operations. The context may be determined, for example, from information (a dataset) provided with the AR request such as camera stills/video, GPS data, and/or accelerometer data. When the mobile access terminal **102** is in a rural landscape or changing urban area, the operations of the identifying component **130** and/or the mapping components **132** are facilitated by access to the regional data store **123** (with rural or changing landscape images) as described herein. Alternatively, when the mobile access terminal **102** is in a non-rural area (i.e., with man-made objects), the operations of the identifying component **130** and/or the mapping components **132** may be facilitated by access to the regional data store **123**, which may store non-rural images in addition to the rural landscape images. Images, applications, or operations that are not in the regional data store **123** may be stored in the AR data store **138**.

The interlacing component **134** is configured to execute the subset of available augmented reality applications and to generate augmented reality content corresponding to the augmented reality request. The streaming component is configured to stream the augmented reality content to the mobile access terminal **102** associated with the augmented reality request for playback. As an example, if the AR request comprises a camera image, the AR content provided by the AR service delivery platform **121** for playback may comprise the camera image (or an image regional data store **123** of landscape images) interlaced with AR image content such as words, lines, identifiers, gaming graphics, or other AR content. Similarly, if the AR request comprises a camera video, the AR content provided by the AR service delivery platform **121** for playback may comprise the camera video (or a video from the regional data store of landscape images **123**) interlaced with AR image content such as words, lines, identifiers, gaming graphics, or other AR content. Audible sounds also may be included with AR content for playback by a mobile access terminal **102**.

In at least some embodiments, the AR service delivery platform **121** is configured to provide AR content in response to an AR request in accordance with a predefined AR latency threshold. The predefined AR latency threshold balances the costs of providing AR content with the AR service delivery platform **121** while maintaining a suitable streaming speed for AR content that promotes widespread and ongoing use of AR by mobile access terminals **102**. For example, the design and operation of the identification component **130**, the mapping component **132**, the interlacing component **134**, and the streaming component **136** may be based on the predefined AR latency threshold. The predefined AR latency threshold may be determined based on experiments or estimates to determine a suitable latency that does not negatively affect the interaction of a user with AR content. Without limitation to other embodiments, the predefined AR latency threshold may be between about 0.1 second and about 0.5 second (i.e., 2 to 10 AR content frames per second). In another embodiment, the predefined AR latency threshold may be between about 0.5 second to about 5 seconds. In another embodiment, the predefined AR latency threshold may be between about 5 seconds and about 1 minute. In some embodiments, the predefined AR latency threshold varies for different quality of service (QoS) tiers applied to different devices, different user accounts, or different groups (premium tier, business tier, or economy tier).

In some embodiments, the predefined AR latency threshold is achieved for the AR service delivery platform **121** due to hardware of the interlacing component **134** being optimized to interlace images/video with augmented reality content. Additionally or alternatively, the predefined AR latency threshold is achieved for the AR service delivery platform **121** due to a synchronization protocol implemented by at least one of the identification component **130**, the mapping component **132**, the interlacing component **134**, and the streaming component **136** to expedite alignment of the augmented reality request with the augmented reality content. Additionally or alternatively, the predefined AR latency threshold is achieved for the AR service delivery platform **121** based on localized caching used by the identification component **130** to expedite identifying the context for the augmented reality request and the feature set **106** supported by the mobile access terminal **102** associated with the augmented reality request.

A local cache may be stored, for example, by the BTS **120** or a high-speed data store nearby the BTS **120**. In some embodiments, the regional data store **123** corresponds to the local cache and stores images used by the identification component **130**. More specifically, the identification component **130** may compare a picture frame included with the augmented reality request to the images in the regional data store **123** to expedite identifying the context for the augmented reality request. Because changing landscape images are difficult to compare to images created of the same location under different conditions, compared to man-made objects, the regional data store **123** may use time-based indexing, geography-based indexing and/or perspective-based indexing to compare landscape images.

Time-based indexing may identify a landscape image in the regional data store **123** according to a date (month and day) or season associated with the landscape image. Additionally or alternatively, time-based indexing may also identify a landscape image according to a morning, mid-day, evening, or night designation associated with a landscape image. Geography-based indexing may identify a landscape image in the regional data store **123** according to a geographic location associated with a landscape image in the regional data store **123**. Perspective-based indexing may identify a landscape image in the regional data store **123** according to a direction or angle associated with a landscape image in the regional data store **123**. The regional data store **123** may likewise store other AR applications/operations used to build and stream AR content to the mobile access terminal **102** in response to an AR request.

In FIG. **1**B, a plurality of BTSs **120**A-**120**N are shown for the system **100**, where the BTSs **120**A-**120**N correspond to different geographic regions (e.g., corresponding to a BTS wireless service coverage area or other placement criteria). As shown, each of the BTSs **120**A-**120**N comprises a corresponding regional data store **123**A-**123**N with indexing criteria **140**A-**140**N, seasonal variations **142**A-**142**N of the landscape images, and perspective variations **144**A-**144**N of the landscape images. In some embodiments, the regional data stores **123**A-**123**N also may comprise man-made object images to facilitate AR service delivery platform operations for mobile access terminals **102** that are in city or urban geographic locations. However, man-made objects are usually easier to identify and may not need to be indexed in the manner described herein for landscape images. As shown, each of the regional data stores **123** may be updated using crowd-sourced data as described herein. The amount of crowd-sourced data that could be stored by the regional data stores **123**A-**123**N is potentially unlimited. Accordingly, some effort may be made to promote submissions of images or videos based on time criteria, geography criteria, or perspective criteria (i.e., the same types of criteria used for indexing). Further, redundant images or videos may be deleted from the regional data stores **123**A-**123**N as needed.

FIG. **2** illustrates a chart **200** showing operations of the system **100** of FIG. **1**A and FIG. **1**B in accordance with embodiments of the disclosure. As shown in chart **200**, an AR request is initiated by an AR interface **104** of a mobile access terminal **102**. The AR request is received by an AR service delivery platform **121** that includes a BTS **120**, indexed regional data stores **123** (local cache), and lower performance or non-local data stores **138** (assuming some data does not fit within the regional data stores **123**). Upon receipt of the AR request, the AR service delivery platform **121** operates to build AR content corresponding to the AR request. As shown, the AR service delivery platform **121** preferably performs AR operations to build the AR content using the indexed regional data stores **123**. If an indexed regional data store **123** is not available or is otherwise limited, the AR service delivery platform **121** performs AR operations to build the AR content using a non-regional or lower performance data store **138**. Once the AR content is ready, the BTS **120** streams the AR content to the mobile access terminal **102** for playback.

In various embodiments, the AR service delivery platform **121** manages AR content delivery for many mobile access terminals **102**. In such case, the AR service delivery platform **121** may vary its operations depending on the capabilities of mobile access terminals **102** and/or the amount of AR request traffic. For example, the identification component **130** may identify that the mobile access terminal **102** corresponds to a type of device that can effectively perform some or all operations to build AR content. In such case, the AR service delivery platform **121** responds to an AR request by denying AR service (the mobile access terminal **102** may still be able to generate its own AR content) or with instructions regarding which operations will be performed by the mobile access terminal **102** and which operations will be performed by the AR service delivery platform **121**. The AR service delivery platform **121** then builds fractional AR content to stream to a corresponding mobile access terminal **102**. Upon receipt, the mobile access terminal **102** combines the fractional AR content from the AR service delivery platform **121** with other fractional AR content prepared by the mobile access terminal **102** for playback via the AR interface **104**.

As another example, the identification component **130** may identify that AR traffic exceeds a threshold. In such case, the AR service delivery platform **121** responds to an AR request by denying AR service (the mobile access terminal **102** may still be able to generate its own AR content) or with instructions regarding which operations will be performed by the mobile access terminal **102** and which operations will be performed by the AR service delivery platform **121**. In some embodiments, the AR service delivery platform **121** may deny AR service to those mobile access terminals **102** that are capable of generating their own AR content. For example, the AR service delivery platform **121** may store a list or table of mobile access terminal types and their capabilities (e.g., processor, memory, operating system, or other capabilities) for use with determining the AR operations that can be performed by different mobile access terminals **102**. Additionally or alternatively, the AR service delivery platform **121** may deny AR service according to a predetermined customer-tier scheme (device or subscription-based service). The customer-tier scheme may correspond to a multi-tier service based on one-time or repeating subscription fees. Additionally or alternatively, the customer-tier scheme may be based on a class or type of device corresponding to different mobile access terminals **102**. For example, certain smartphones may receive the highest tier of AR service provided by the AR service delivery platform **121**, while other smartphones receive a lower tier of AR service provided by the AR service delivery platform **121**

In response to heavy AR traffic conditions, the AR service delivery platform **121** is able to build fractional AR content to stream to corresponding mobile access terminals **102**. Upon receipt, the mobile access terminal **102** combines the fractional AR content from the AR service delivery platform **121** with other fractional AR content prepared by the mobile access terminal **102** for playback via the AR interface **104**.

Alternatively, the AR service delivery platform **121** may be configured to perform all AR operations to build AR content, but exceeds the predefined AR latency threshold for some or all mobile access terminals **102**. In such case, the quality (latency) of AR service may be based on a predetermined customer-tier scheme (device or subscription-based service).

FIG. **3** illustrates a method **300** in accordance with embodiments of the disclosure. The method **300** may be performed by AR service delivery platform components such as those disclosed herein. As shown, the method **300** comprises maintaining a regional data store **123** with landscape images for each of a plurality of base stations **120** (block **302**). At block **304**, an AR request for a mobile access terminal **102** is received by a nearest one of the plurality of base stations **120**. At block **306**, AR content is provided for playback by the mobile access terminal **102** associated with the AR request based on at least one landscape image from the regional data store **123** of the nearest base station **120**.

In at least some embodiments, the method **300** may comprise additional steps. For example, the method **300** may further comprise gathering multiple versions of at least one landscape image over time for each regional data store **123**, where the multiple versions of the at least one landscape image are associated with seasonal variations for the at least one landscape image. Additionally, the method **300** may comprise gathering multiple versions of at least one landscape image over time for each regional data store **123**, where the multiple versions of the at least one landscape image are associated with perspective variations for the at least one landscape image. Additionally, the method **300** may comprise updating the landscape images for each regional data store **123** based on crowd-sourced data gathered as previously described herein and eliminating redundant landscape images for each regional data store **123**.

In some embodiments, the method **300** may comprise steps related to indexed landscape images as described herein. For example, the method **300** may comprise mapping a geography-based index of landscape images for each regional data store **123** to augmented reality operations to expedite building augmented reality content corresponding to the augmented reality request. The method **300** may further comprise mapping a time-based index of landscape images for each regional data store **123** to augmented reality operations to expedite building augmented reality content corresponding to the augmented reality request. The method **300** may further comprise mapping a geography-based index of landscape images for each regional data store **123** to augmented reality operations to expedite building augmented reality content corresponding to the augmented reality request. The method **300** may further comprise mapping a perspective-based index of landscape images for each regional data store **123** to augmented reality operations to expedite building augmented reality content corresponding to the augmented reality request. In some embodiments, the method **300** may further comprise extracting at least one of location information, compass information, and accelerometer information from the augmented reality request and using the extracted information to access an indexed landscape image and augmented reality content in the regional data store **123** of the base station **120** that received the augmented reality request to provide augmented reality content corresponding to the augmented reality request.

In some embodiments, the receiving step, the identifying step, the mapping step, the executing step, and the streaming step of method **300** are performed in accordance with a predefined AR latency threshold. The predefined AR latency threshold may be determined based on experiments or estimates to determine a suitable latency that does not negatively affect the interaction of a user with AR content. Without limitation to other embodiments, the predefined AR latency threshold may be between 0.1-0.5 seconds (i.e., 2 to 10 AR content frames per second). In another embodiment, the predefined AR latency threshold may be between about 0.5 second to about 5 seconds. In another embodiment, the predefined AR latency threshold may be between about 5 seconds and about 1 minute. In some embodiments, the predefined AR latency threshold varies for different quality of service (QoS) tiers applied to different devices, different user accounts, or different groups (premium tier, business tier, or economy tier). As an example, the predefined augmented reality latency threshold may be set based on high-performance hardware for interlacing images with augmented reality content. Additionally or alternatively, the predefined augmented reality latency threshold may be set based on a synchronization protocol to align the augmented reality request with the streamed augmented reality content. Additionally or alternatively, the predefined augmented reality latency threshold may be set based on a local caching scheme for images used to determine the context of the augmented reality request.

In various embodiments, the AR service delivery platform **121** manages AR content delivery for many mobile access terminals **102**. In such case, the method **300** may deny AR service or vary its operations depending on the capabilities of mobile access terminals **102** and/or the amount of AR request traffic. For example, the identifying step may identify that the mobile access terminal **102** corresponds to a type of mobile access terminal **102** that can effectively perform some or all operations to build AR content. In such case, the method **300** may respond to an AR request by denying AR service (the mobile access terminal **102** may still be able to generate its own AR content) or with instructions regarding which operations will be performed by the mobile access terminal **102** and which operations will be performed by the AR service delivery platform **121**. The AR service delivery platform **121** then builds fractional AR content to stream to a corresponding mobile access terminal **102**. Upon receipt, the mobile access terminal **102** combines the fractional AR content from the AR service delivery platform **121** with other fractional AR content prepared by the mobile access terminal **102** for playback via the AR interface **104**. In some embodiments, the AR service delivery platform **121** may deny AR service according to a predetermined customer-tier scheme (device or subscription-based service) as described herein. Alternatively, in response to heavy AR request traffic, the AR service delivery platform **121** may be configured to perform all AR operations to build AR content, but exceeds the predefined AR latency threshold for some or all mobile access terminals **102**. In such case, the quality (latency) of AR service may be based on a predetermined customer-tier scheme (device or subscription-based service) as previously described herein.

Turning now to FIG. **4**, a system **320** is described. In an embodiment, system **320** comprises a mobile access terminal **340** a base transceiver station **322**, a server computer **324**, a data store **332**, and the network **122**. Some of the features of the system **320** are similar to those of system **100** described above, but the differences are better explained by employing a separate drawing and separate description. The server **324** is closely coupled to and co-located with the base transceiver station **322**, for example at the foot of a tower, proximate to an equipment cabinet of the base transceiver station **322** or sharing the same equipment cabinet housing the electronics of at least some of the base transceiver station **322**. The data store **332** is closely coupled to the server computer **324**, is co-located with the server computer **324**, and may share the same equipment cabinet housing as the server computer **324**. While a single mobile access terminal is shown in FIG. **4**, it is understood that more mobile access terminals **340** may be present in the system **320** at one time or another time.

The data store **332** comprises a plurality of images **334** and models **336**. The images may be provided to the data store by mobile access terminals, for example the mobile access terminal **340** may take a picture with a camera **344** of the mobile access terminal **340** and send the picture to the base transceiver station **322** via a radio transceiver **346** of the mobile access terminal **340**. The mobile access terminal **340** may send the picture in a MMS message to the network **122** to be delivered to a family member or to a colleague. The base transceiver station **322** may detect the presence of the picture and send a copy to the server **324**, for example pursuant to an agreement by a user of the mobile access terminal **340** to willingly share pictures in a crowd sharing agreement.

The server computer **324** may comprise and execute an image receiver application **326**, a modeling application **328**, and a request handler application **330**. The image receiver application **326** may receive the picture from the base transceiver station **322**, process the picture into a desired image format, and write the image to the images **334** of the data store **332**. The modeling application **328** may process the images **334** to identify sub-sets of images that are associated with a common entity, for example a common landscape feature, a common object such as a tree, or a common object such as a flower, and create a model of the entity based on the sub-set of images. The modeling application **328** maintains one or more models of objects, for example landscape features or other objects. When the new image is stored into the images **334** portion of the data store **332**, the modeling application **328** may revise or refine the object model associated with the sub-set of images that the new image is incorporated into. In an embodiment, the server computer **324**, for example the modeling application **328** or the image receiver **326**, may delete some of the images based on an aging-out strategy or based on the image being represented in part in an object model stored in the models **336** portion of the data store **332**.

The mobile access terminal **340** may execute an application **342** that promotes the user of the mobile access terminal **340** sending a picture to the server computer **324** to obtain information about the picture. For example, the user may request via the application **342** that an identity of an object shown in the picture be identified. The request handler **330** may attempt to match the picture to one of the models stored in the models **336** portion of the data store **332**. When a match is found, information linked to or associated with the subject matching model may be searched to satisfy the request from the mobile access terminal **340** and/or the application **342**. The information may be an identity of the object, for example "The Grand Teton Mountain," and this text may be displayed by the mobile access terminal **340** superimposed over the picture concurrently displayed by the mobile access terminal **340**. Alternatively, the mobile access terminal **340** may pronounce the name "The Grand Teton Mountain," for example via a speaker of the mobile access terminal **340**.

The user may request to see an image of the object that is pictured, for example a landscape feature, shown under different conditions than those seen in the picture the user provides in his or her request, for example at a different time of day, a different season of the year, from a different viewing perspective either closer or farther away or from a different angle or during different weather conditions. The request handler **330** may match the picture sent with the request to an object model, execute a process of extracting a suitable image from the object model based on the request, and send the image back to the mobile access terminal **340** for presentation on a display of the mobile access terminal **340**.

The system **320** may be embodied at a plurality of base transceiver stations in the network of a wireless service provider. For example, a wireless service provider may operate more than 50,000 base transceiver stations across the United States, and a substantial number of these 50,000 base transceiver stations may be provided with the server computer **324** and the data store **332** as described with reference to FIG. **4** above. While it is contemplated that a majority of the modeling and request handling operations will be performed at the server computer **324** that is co-located with the base transceiver station **322**, some of this processing may be performed centrally or some of the image data may be shared with a central image repository or a regional image repository. For example, in some regions dominated by an important regional landscape feature such as the Grand Canyon, the Grand Teton Mountain, the Niagra Falls, regional or central processing of images may provide some advantages. In an embodiment, in some regions the processing of images and requests may be shared between the local base transceiver station **322** and regional or centralized processing resources.

FIG. **5** illustrates a mobile access terminal **400** in accordance with embodiments of the disclosure. The mobile access terminal **400** of FIG. **5** is operable for implementing aspects of the present disclosure such as the features and operations of mobile access terminal **102**, but the present disclosure should not be limited to these implementations. The mobile access terminal **400** may take various forms including a wireless handset, a pager, a personal digital assistant (PDA), a gaming device, or a media player. The mobile access terminal **400** includes a display **402** and a touch-sensitive surface and/or keys **404** for input by a user. The mobile access terminal **400** may present options for the user to select, controls for the user to actuate, and/or cursors or other indicators for the user to direct. The mobile access terminal **400** may further accept data entry from the user, including numbers to dial or various parameter values for configuring the operation of the handset. The mobile access terminal **400** may further execute one or more software or firmware applications in response to user commands. These applications may configure the mobile access terminal **400** to perform various customized functions in response to user interaction. Additionally, the mobile access terminal **400** may be programmed and/or configured over-the-air, for example from a wireless base station, a wireless access point, or a peer mobile access terminal **400**. The mobile access terminal **400** may execute a web browser application which enables the display **402** to show a web page. The web page may be obtained via wireless communications with a base transceiver station, a wireless network access node, a peer mobile access terminal **400** or any other wireless communication network or system.

FIG. **6** shows a block diagram of the mobile access terminal **400**. While a variety of known components of handsets are depicted, in an embodiment a subset of the listed components and/or additional components not listed may be included in the mobile device **400**. The mobile access terminal **400** includes a digital signal processor (DSP) **502** and a memory **504**. As shown, the mobile access terminal **400** may further include an antenna and front end unit **506**, a radio frequency (RF) transceiver **508**, a baseband processing unit **510**, a microphone **512**, an earpiece speaker **514**, a headset port **516**, an input/output interface **518**, a removable memory card **520**, a universal serial bus (USB) port **522**, an infrared port **524**, a vibrator **526**, a keypad **528**, a touch screen liquid crystal display (LCD) with a touch sensitive surface **530**, a touch screen/LCD controller **532**, a camera **534**, a camera controller **536**, and a global positioning system (GPS) receiver **538**. In an embodiment, the mobile access terminal **400** may include another kind of display that does not provide a touch sensitive screen. In an embodiment, the DSP **502** may communicate directly with the memory **504** without passing through the input/output interface **518**. Additionally, in an embodiment, the mobile access terminal **400** may comprise other peripheral devices that provide other functionality.

The DSP **502** or some other form of controller or central processing unit operates to control the various components of the mobile access terminal **400** in accordance with embedded software or firmware stored in memory **504** or stored in memory contained within the DSP **502** itself. In addition to the embedded software or firmware, the DSP **502** may execute other applications stored in the memory **504** or made available via information carrier media such as portable data storage media like the removable memory card **520** or via wired or wireless network communications. The application software may comprise a compiled set of machine-readable instructions that configure the DSP **502** to provide the desired functionality, or the application software may be high-level software instructions to be processed by an interpreter or compiler to indirectly configure the DSP **502**.

The DSP **502** may communicate with a wireless network via the analog baseband processing unit **510**. In some embodiments, the communication may provide Internet connectivity, enabling a user to gain access to content on the Internet and to send and receive e-mail or text messages. The input/output interface **518** interconnects the DSP **502** and various memories and interfaces. The memory **504** and the removable memory card **520** may provide software and data to configure the operation of the DSP **502**. Among the interfaces may be the USB port **522** and the infrared port **524**. The USB port **522** may enable the mobile access terminal **400** to function as a peripheral device to exchange information with a personal computer or other computer system. The infrared port **524** and other optional ports such as a Bluetooth® interface or an IEEE 802.11 compliant wireless interface may enable the mobile access terminal **400** to communicate wirelessly with other nearby handsets and/or wireless base stations.

The keypad **528** couples to the DSP **502** via the interface **518** to provide one mechanism for the user to make selections, enter information, and otherwise provide input to the mobile access terminal **400**. Another input mechanism may be the touch screen LCD **530**, which may also display text and/or graphics to the user. The touch screen LCD controller **532** couples the DSP **502** to the touch screen LCD **530**. The GPS receiver **538** is coupled to the DSP **502** to decode global positioning system signals, thereby enabling the mobile access terminal **400** to determine its position.

FIG. **7**A illustrates a software environment **602** that may be implemented by the DSP **502**. The DSP **502** executes operating system software **604** that provides a platform from which the rest of the software operates. The operating system software **604** may provide a variety of drivers for the handset hardware with standardized interfaces that are accessible to application software. The operating system software **604** may be coupled to and interact with application management services (AMS) **606** that transfer control between applications running on the mobile access terminal **400**. Also shown in FIG. **7**A are a web browser application **608**, a media player application **610**, JAVA applets **612**, and AR interface **614** (corresponding to AR interface **104**). The web browser application **608** may be executed by the mobile access terminal **400** to browse content and/or the Internet, for example when the mobile access terminal **400** is coupled to a network via a wireless link. The web browser application **608** may permit a user to enter information into forms and select links to retrieve and view web pages. The media player application **610** may be executed by the mobile access terminal **400** to play audio or audiovisual media. The JAVA applets **612** may be executed by the mobile access terminal **400** to provide a variety of functionality including games, utilities, and other functionality. The AR interface **614** may be executed by the mobile access terminal **400** to initiate AR requests and to playback AR content. The AR content is provided by an AR service delivery platform as described herein. Alternatively, some AR content or fractional AR content may be provided by the mobile access terminal **400** as described herein.

FIG. **7**B illustrates an alternative software environment **620** that may be implemented by the DSP **502**. The DSP **502** executes operating system software **628** and an execution runtime **630**. The DSP **502** executes applications **622** that may execute in the execution runtime **630** and may rely upon services provided by the application framework **624**. Applications **622** and the application framework **624** may rely upon functionality provided via the libraries **626**.

FIG. **8** illustrates a computer system **380** suitable for implementing one or more embodiments disclosed herein. The computer system **380** includes a processor **382** (which may be referred to as a central processor unit or CPU) that is in communication with memory devices including secondary storage **384**, read only memory (ROM) **386**, random access memory (RAM) **388**, input/output (I/O) devices **390**, and network connectivity devices **392**. The processor **382** may be implemented as one or more CPU chips.

It is understood that by programming and/or loading executable instructions onto the computer system **380**, at least one of the CPU **382**, the RAM **388**, and the ROM **386** are changed, transforming the computer system **380** in part into a particular machine or apparatus having the novel functionality taught by the present disclosure. It is fundamental to the electrical engineering and software engineering arts that functionality that can be implemented by loading executable software into a computer can be converted to a hardware implementation by well known design rules. Decisions between implementing a concept in software versus hardware typically hinge on considerations of stability of the design and numbers of units to be produced rather than any issues involved in translating from the software domain to the hardware domain. Generally, a design that is still subject to frequent change may be preferred to be implemented in software, because re-spinning a hardware implementation is more expensive than re-spinning a software design. Generally, a design that is stable that will be produced in large volume may be preferred to be implemented in hardware, for example in an application specific integrated circuit (ASIC), because for large production runs the hardware implementation may be less expensive than the software implementation. Often a design may be developed and tested in a software form and later transformed, by well known design rules, to an equivalent hardware implementation in an application specific integrated circuit that hardwires the instructions of the software. In the same manner as a machine controlled by a new ASIC is a particular machine or apparatus, likewise a computer that has been programmed and/or loaded with executable instructions may be viewed as a particular machine or apparatus.

The secondary storage **384** is typically comprised of one or more disk drives or tape drives and is used for non-volatile storage of data and as an over-flow data storage device if RAM **388** is not large enough to hold all working data. Secondary storage **384** may be used to store programs which are loaded into RAM **388** when such programs are selected for execution. The ROM **386** is used to store instructions and perhaps data which are read during program execution. ROM **386** is a non-volatile memory device which typically has a small memory capacity relative to the larger memory capacity of secondary storage **384**. The RAM **388** is used to store volatile data and perhaps to store instructions. Access to both ROM **386** and RAM **388** is typically faster than to secondary storage **384**. The secondary storage **384**, the RAM **388**, and/or the ROM **386** may be referred to in some contexts as computer readable storage media and/or non-transitory computer readable media.

I/O devices **390** may include printers, video monitors, liquid crystal displays (LCDs), touch screen displays, keyboards, keypads, switches, dials, mice, track balls, voice recognizers, card readers, paper tape readers, or other well-known input devices.

The network connectivity devices **392** may take the form of modems, modem banks, Ethernet cards, universal serial bus (USB) interface cards, serial interfaces, token ring cards, fiber distributed data interface (FDDI) cards, wireless local area network (WLAN) cards, radio transceiver cards such as code division multiple access (CDMA), global system for mobile communications (GSM), long-term evolution (LTE), worldwide interoperability for microwave access (WiMAX), and/or other air interface protocol radio transceiver cards, and other well-known network devices. These network connectivity devices **392** may enable the processor **382** to communicate with the Internet or one or more intranets. With such a network connection, it is contemplated that the processor **382** might receive information from the network, or might output information to the network in the course of performing the above-described method steps. Such information, which is often represented as a sequence of instructions to be executed using processor **382**, may be received from and outputted to the network, for example, in the form of a computer data signal embodied in a carrier wave.

Such information, which may include data or instructions to be executed using processor **382** for example, may be received from and outputted to the network, for example, in the form of a computer data baseband signal or signal embodied in a carrier wave. The baseband signal or signal embedded in the carrier wave, or other types of signals currently used or hereafter developed, may be generated according to several methods well known to one skilled in the art. The baseband signal and/or signal embedded in the carrier wave may be referred to in some contexts as a transitory signal.

The processor **382** executes instructions, codes, computer programs, scripts which it accesses from hard disk, floppy disk, optical disk (these various disk based systems may all be considered secondary storage **384**), ROM **386**, RAM **388**, or the network connectivity devices **392**. While only one processor **382** is shown, multiple processors may be present. Thus, while instructions may be discussed as executed by a processor, the instructions may be executed simultaneously, serially, or otherwise executed by one or multiple processors. Instructions, codes, computer programs, scripts, and/or data that may be accessed from the secondary storage **384**, for example, hard drives, floppy disks, optical disks, and/or other device, the ROM **386**, and/or the RAM **388** may be referred to in some contexts as non-transitory instructions and/or non-transitory information.

In an embodiment, the computer system **380** may comprise two or more computers in communication with each other that collaborate to perform a task. For example, but not by way of limitation, an application may be partitioned in such a way as to permit concurrent and/or parallel processing of the instructions of the application. Alternatively, the data processed by the application may be partitioned in such a way as to permit concurrent and/or parallel processing of different portions of a data set by the two or more computers. In an embodiment, virtualization software may be employed by the computer system **380** to provide the functionality of a number of servers that is not directly bound to the number of computers in the computer system **380**. For example, virtualization software may provide twenty virtual servers on four physical computers. In an embodiment, the functionality disclosed above may be provided by executing the application and/or applications in a cloud computing environment. Cloud computing may comprise providing computing services via a network connection using dynamically scalable computing resources. Cloud computing may be supported, at least in part, by virtualization software. A cloud computing environment may be established by an enterprise and/or may be hired on an as-needed basis from a third party provider. Some cloud computing environments may comprise cloud computing resources owned and operated by the enterprise as well as cloud computing resources hired and/or leased from a third party provider.

In an embodiment, some or all of the functionality disclosed above may be provided as a computer program product. The computer program product may comprise one or more computer readable storage medium having computer usable program code embodied therein to implement the functionality disclosed above. The computer program product may comprise data structures, executable instructions, and other computer usable program code. The computer program product may be embodied in removable computer storage media and/or non-removable computer storage media. The removable computer readable storage medium may comprise, without limitation, a paper tape, a magnetic tape, magnetic disk, an optical disk, a solid state memory chip, for example analog magnetic tape, compact disk read only memory (CD-ROM) disks, floppy disks, jump drives, digital cards, multimedia cards, and others. The computer program product may be suitable for loading, by the computer system **380**, at least portions of the contents of the computer program product to the secondary storage **384**, to the ROM **386**, to the RAM **388**, and/or to other non-volatile memory and volatile memory of the computer system **380**. The processor **382** may process the executable instructions and/or data structures in part by directly accessing the computer program product, for example by reading from a CD-ROM disk inserted into a disk drive peripheral of the computer system **380**. Alternatively, the processor **382** may process the executable instructions and/or data structures by remotely accessing the computer program product, for example by downloading the executable instructions and/or data structures from a remote server through the network connectivity devices **392**. The computer program product may comprise instructions that promote the loading and/or copying of data, data structures, files, and/or executable instructions to the secondary storage **384**, to the ROM **386**, to the RAM **388**, and/or to other non-volatile memory and volatile memory of the computer system **380**.

In some contexts, the secondary storage **384**, the ROM **386**, and the RAM **388** may be referred to as a non-transitory computer readable medium or a computer readable storage media. A dynamic RAM embodiment of the RAM **388**, likewise, may be referred to as a non-transitory computer readable medium in that while the dynamic RAM receives electrical power and is operated in accordance with its design, for example during a period of time during which the computer **380** is turned on and operational, the dynamic RAM stores information that is written to it. Similarly, the processor **382** may comprise an internal RAM, an internal ROM, a cache memory, and/or other internal non-transitory storage blocks, sections, or components that may be referred to in some contexts as non-transitory computer readable media or computer readable storage media.

In at least some embodiments, the computer system **380** corresponds to an base station having a processor (e.g., processor **382**) and a data store storing landscape images for a coverage area of the base station. The base stations also comprises a non-transitory computer-readable medium in communication with the processor and storing augmented reality servicing instructions that, when executed, cause the processor to receive an augmented reality request from a mobile access terminal. The augmented reality servicing instructions, when executed, may further cause the processor to identify one of the landscape images in the database corresponding to the augmented reality request. The augmented reality servicing instructions, when executed, may further cause the processor to stream augmented reality content corresponding to the augmented reality request based on the identified landscape image.

In some embodiments, the augmented reality servicing instructions, when executed, may further cause the processor to identify a season and perspective for the augmented reality request and to identify one of the landscape images based on the identified season and perspective. The augmented reality servicing instructions, when executed, may further cause the processor to index crowd-sourced updates to the landscape images and to eliminate redundant images. The augmented reality servicing instructions, when executed, may further cause the processor to extract at least one of location information, compass information, and accelerometer information from the augmented reality request and to use the extracted information to access an indexed landscape image in the regional data store to prepare the augmented reality content corresponding to the augmented reality request.

In some embodiments, augment reality servicing instructions, when executed, may further cause the processor to respond to an augmented reality request with a service denial response or with fractional augmented reality content upon identifying that the mobile access terminal is a type of mobile access terminal that is capable of generating the augmented reality content within a predefined augmented reality latency threshold. Additionally, the AR service delivery platform instructions, when executed, further cause the processor to respond to an augmented reality request with a service denial response or with fractional augmented reality content upon identifying a heavy augmented reality request traffic condition. Additionally, the AR service delivery platform instructions, when executed, further cause the processor to respond to an augmented reality request with a augmented reality content that does not comply with a predefined AR latency threshold when a heavy augmented reality request traffic condition exists. In some embodiments, certain mobile access terminals may receive AR service during heavy AR request traffic conditions while other are denied AR service based on a subscription plan or other criteria.

While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods may be embodied in many other specific forms without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted or not implemented.

Also, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component, whether electrically, mechanically, or otherwise. Other examples of changes, substitutions, and alterations are ascertainable by one skilled in the art and could be made without departing from the spirit and scope disclosed herein.

What is claimed is:

1. A method of accessing landscape images comprising:

maintaining a plurality of regional data stores of landscape models for each of a plurality of base stations, wherein each of the plurality of base stations is associated with one of the plurality of regional data stores, and wherein each regional data store is co-located with its corresponding base station and only maintains landscape models associated with landscapes located proximate to its corresponding base station;

analyzing, by a base station of the plurality of base stations, a plurality of landscape images to identify a sub-set of the plurality of landscape images that are associated with a same landscape located proximate to the base station, wherein the subset of the plurality of landscape images are associated with at least one of seasonal variations or time of day variations for the same landscape, and wherein the plurality of landscape images are provided to the base station by a plurality of mobile access terminals that took the plurality of landscape images of one or more landscapes located proximate to the base station while in a coverage area of the base station;

developing, by the base station, a landscape model for the same landscape based on the analyzing;

receiving, by the base station, a request for a landscape image of the plurality of landscape images from a mobile access terminal in a serving area of the base station, wherein the request for the landscape image identifies the landscape model maintained in the regional data store of the base station;

identifying, by the base station, the landscape image in the regional data store of the base station corresponding to the request; and

transmitting, by the base station, the landscape image to the mobile access terminal, wherein the landscape image is created based on the landscape model identified in the request.

2. The method of claim **1**, further comprising gathering multiple images of a landscape over time for each regional data store, wherein the multiple images of the landscape are associated with variations of perspective of the landscape.

3. The method of claim **1**, further comprising:

updating at least one landscape model of one of the regional data stores based on crowd-sourced images of at least one landscape associated with the at least one landscape model; and

eliminating redundant images of at least one landscape for at least one of the regional data stores.

4. The method of claim **1**, further comprising mapping a geography-based index of images of at least one landscape for at least one of the regional data stores to augmented reality operations to expedite building augmented reality content corresponding to an augmented reality request.

5. The method of claim 1, further comprising mapping a perspective-based index of images of at least one landscape for at least one of the regional data stores to augmented reality operations to expedite building augmented reality content corresponding to an augmented reality request.

6. The method of claim 1, further comprising mapping a time-based index of images of at least one landscape for at least one of the regional data stores to augmented reality operations to expedite building augmented reality content corresponding to an augmented reality request.

7. The method of claim 1, further comprising:

extracting at least one of location information, compass information, or accelerometer information from the request for the landscape image; and

accessing an indexed landscape image and augmented reality content in the regional data store of the base station based on the extracted information to provide augmented reality content corresponding to the augmented reality request.

8. A system for accessing landscape images comprising:

a plurality of base stations; and

a plurality of regional data stores that each comprise a plurality of landscape models, wherein each of the plurality of base stations is associated with one of the plurality of regional data stores, and wherein each regional data store is co-located with its corresponding base station and only maintains landscape models associated with landscapes located proximate to its corresponding base station,

wherein a base station of the plurality of base stations, which is nearest to a mobile access terminal, is configured to:

analyze a plurality of landscape images to identify a sub-set of the plurality of landscape images that are associated with a same landscape located proximate to the base station, wherein the subset of the plurality of landscape images are associated with at least one of seasonal variations or time of day variations for the same landscape, and wherein the plurality of landscape images are provided to the base station by a plurality of mobile access terminals that took the plurality of landscape images of one or more landscapes located proximate to the base station while in a coverage area of the base station,

develop a landscape model for the same landscape based on the analysis,

receive an augmented reality request for the mobile access terminal,

identify the landscape model of the plurality of landscape models,

identify at least one of the sub-set of the plurality of landscape images associated with the landscape model in the regional data store of the base station corresponding to the augmented reality request, and

stream augmented reality content corresponding to the augmented reality request based on the identified at least one of the sub-set of the plurality of landscape images in the regional data store of the base station.

9. The system of claim 8, wherein at least one of the regional data stores comprises different versions of at least some of the plurality of landscape images, where the different versions are associated with different seasons throughout a year.

10. The system of claim 8, wherein at least one of the regional data stores comprises different versions of at least some of the plurality of landscape images, where the different versions are associated with different perspective variations.

11. The system of claim 8, wherein at least one of the regional data stores receives updates to its plurality of landscape images based on crowd-sourced data.

12. The system of claim 8, wherein at least one of the regional data stores comprises an indexing control scheme for its plurality of landscape images to expedite building the augmented reality content corresponding to the augmented reality request.

13. The system of claim 8, wherein the augmented reality request comprises geographic location information, and wherein the geographic location information is used to access an indexed landscape image stored by the base station to build the augmented reality content corresponding to the augmented reality request.

14. The system of claim 8, wherein the augmented reality request comprises accelerometer information, and wherein the accelerometer information is used to access an indexed landscape image stored by the base station to build the augmented reality content corresponding to the augmented reality request.

15. The system of claim 8, wherein the augmented reality request comprises time information, and wherein the time information is used to access an indexed landscape image stored by the base station to build the augmented reality content corresponding to the augmented reality request.

16. A base station (BTS), comprising:

a processor;

a regional data store co-located with the base station that stores a plurality of landscape models, wherein the regional data store only maintains landscape models associated with landscapes located proximate to the base station; and

a non-transitory computer-readable medium in communication with the processor and storing augmented reality servicing instructions that, when executed, cause the processor to:

analyze a plurality of landscape images to identify a sub-set of a plurality of landscape images that are associated with a same landscape located proximate to the base station, wherein the subset of the plurality of landscape images are associated with at least one of seasonal variations or time of day variations for the same landscape, and wherein the plurality of landscape images are provided to the base station by a plurality of mobile access terminals that took the plurality of landscape images of one or more landscapes located proximate to the base station while in a coverage area of the base station,

develop a landscape model for the same landscape based on the analysis,

receive an augmented reality request from a mobile access terminal,

identify the landscape model of the plurality of landscape models,

identify one of the sub-set of the plurality of landscape images associated with the landscape model in the regional data store corresponding to the augmented reality request, and

stream augmented reality content corresponding to the augmented reality request based on the identified one of the subset of the plurality of landscape images.

17. The base station of claim 16, wherein the augmented reality servicing instructions, when executed, further cause the processor to identify a season and perspective for the

augmented reality request and to identify the one of the subset of the plurality of landscape images based on the identified season and perspective.

18. The base station of claim **16**, wherein the augmented reality servicing instructions, when executed, further cause the processor to index crowd-sourced updates to the plurality of landscape images and to eliminate redundant images.

19. The base station of claim **16**, wherein the augmented reality servicing instructions, when executed, further cause the processor to extract at least one of location information, compass information, and accelerometer information from the augmented reality request and to use the extracted information to access an indexed landscape image in the regional data store to prepare the augmented reality content corresponding to the augmented reality request.

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