US 20180189802A1

(19) **United States**

(12) **Patent Application Publication**

HAMMOND et al.

(10) **Pub. No.: US 2018/0189802 A1**

(43) **Pub. Date: Jul. 5, 2018**

(54) **SYSTEM, METHOD AND COMPUTER PROGRAM PRODUCT FOR SENSORY SIMULATION DURING PRODUCT TESTING**

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(21) Appl. No.: **15/396,934**

(22) Filed: **Jan. 3, 2017**

Publication Classification

(51) **Int. Cl.**

G06Q 30/02	(2006.01)
G06T 11/60	(2006.01)
G06F 17/30	(2006.01)

(52) **U.S. Cl.**

CPC ... ***G06Q 30/0201*** (2013.01); ***G06F 17/30023*** (2013.01); ***G06F 17/30867*** (2013.01); ***G06T 11/60*** (2013.01)

(57) **ABSTRACT**

A sensory simulation product testing method, system, and computer program product, include extracting at least one pain point associated with a user from a database, correlating at least one of an environment factor, a context factor, and a sentiment factor with the at least one user pain point, and creating an augmented reality in which to immerse the user to test a product based on the at least one of the environment factor, the context factor, and the sentiment factor.

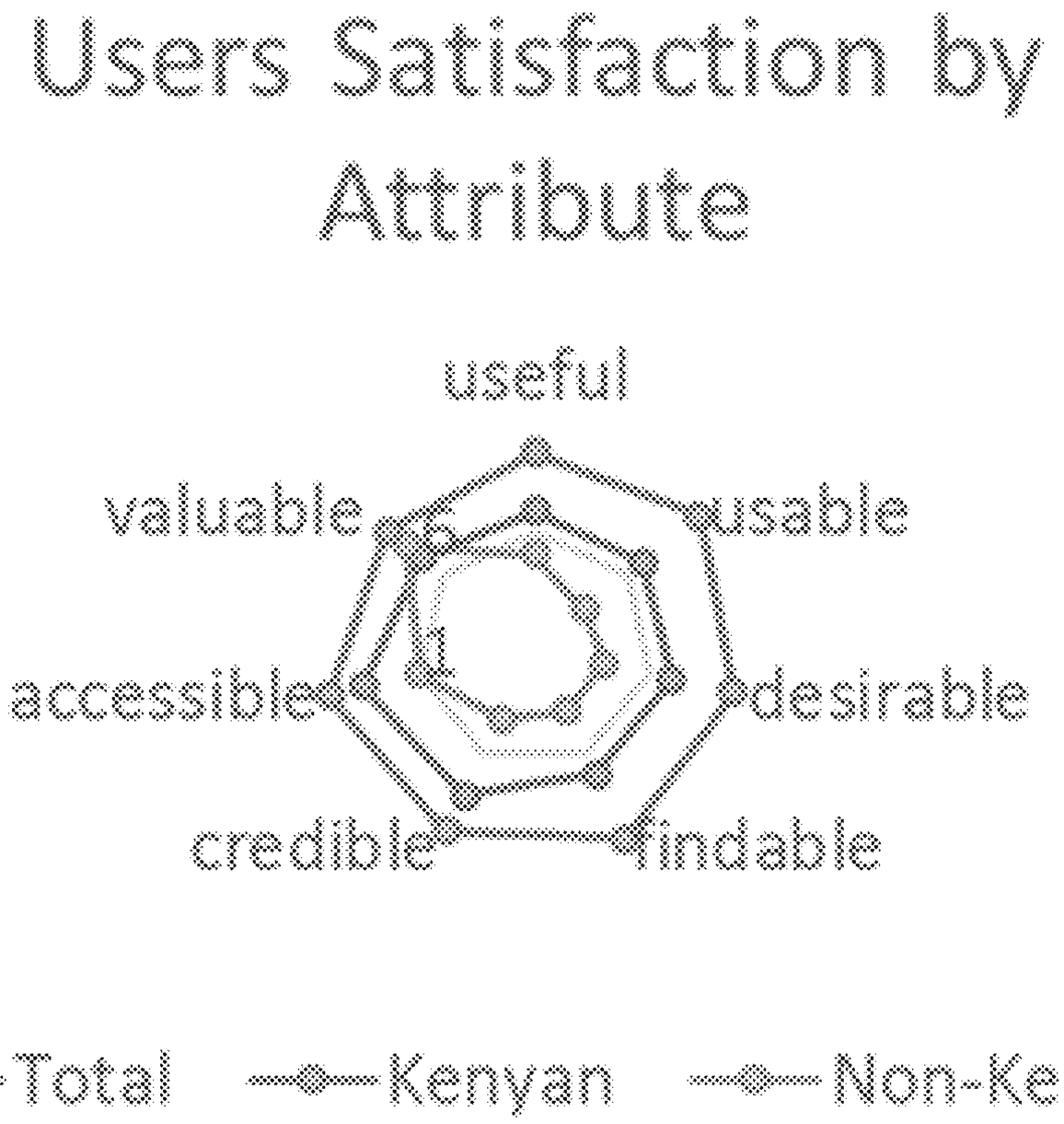


FIG. 1

SENSORY SIMULATION PRODUCT TESTING METHOD 100

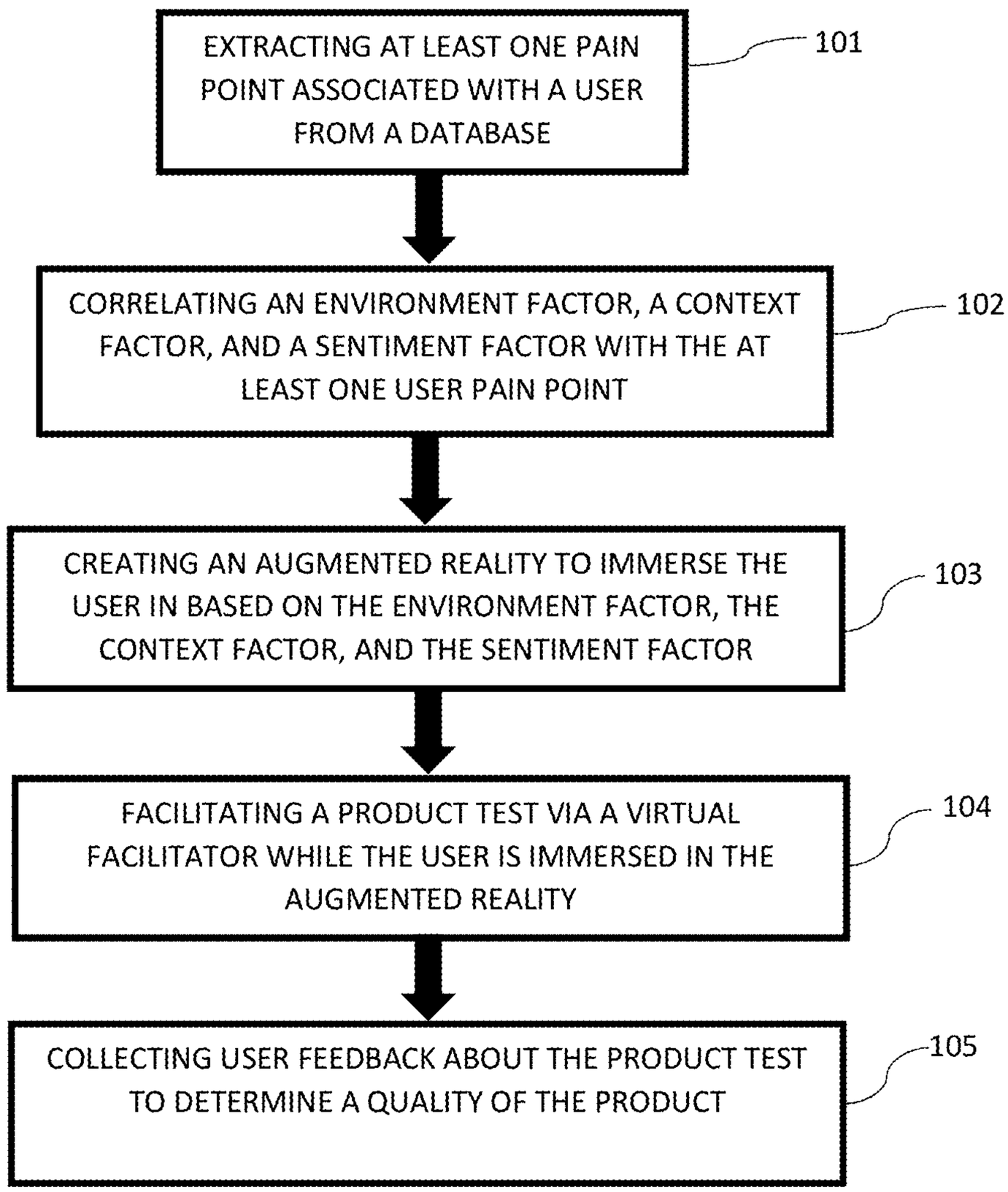


FIG. 2

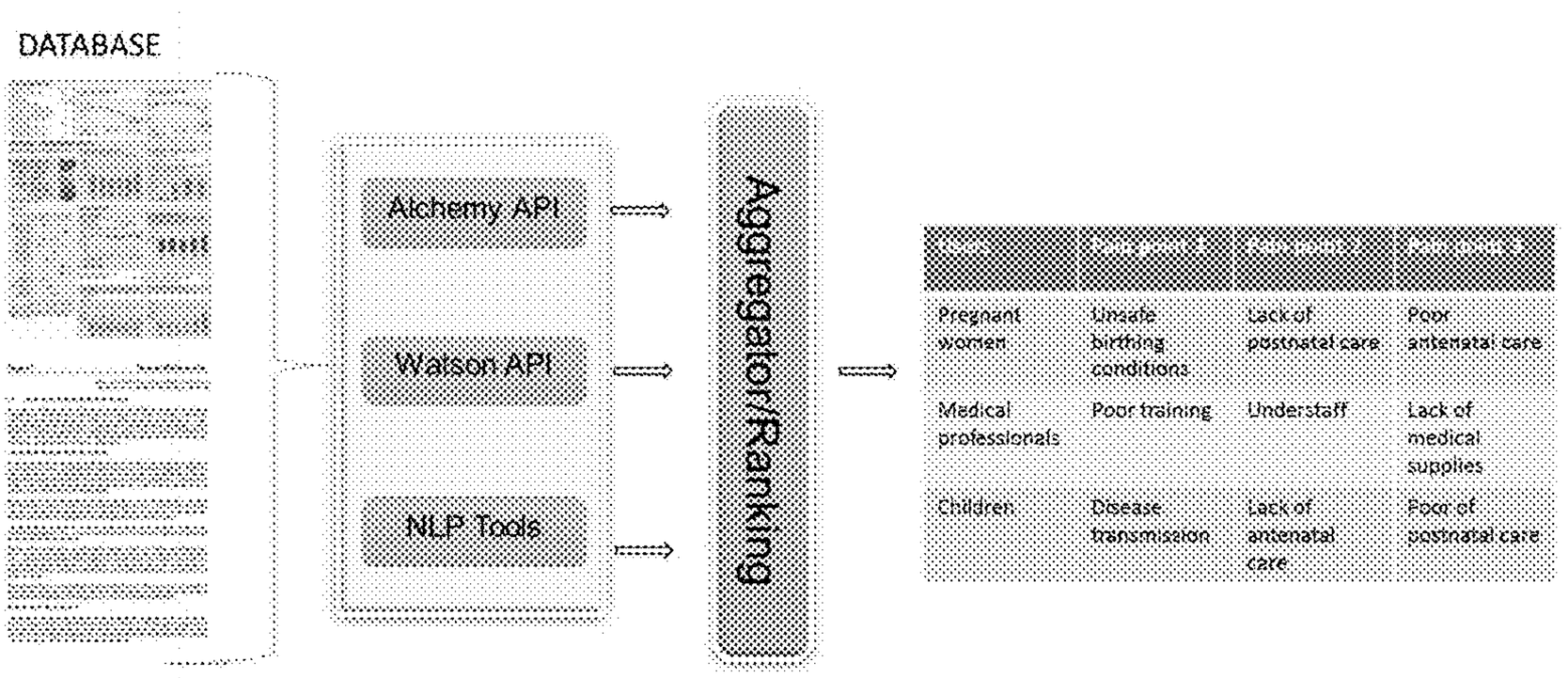

DATABASE
Alchemy API
Watson API
NLP Tools
Aggregator/Ranking
Pregnant women
Unsafe birthing conditions
Lack of postnatal care
Poor antenatal care
Medical professionals
Poor training
Understaff
Lack of medical supplies
Children
Disease transmission
Lack of antenatal care
Poor postnatal care

FIG. 3

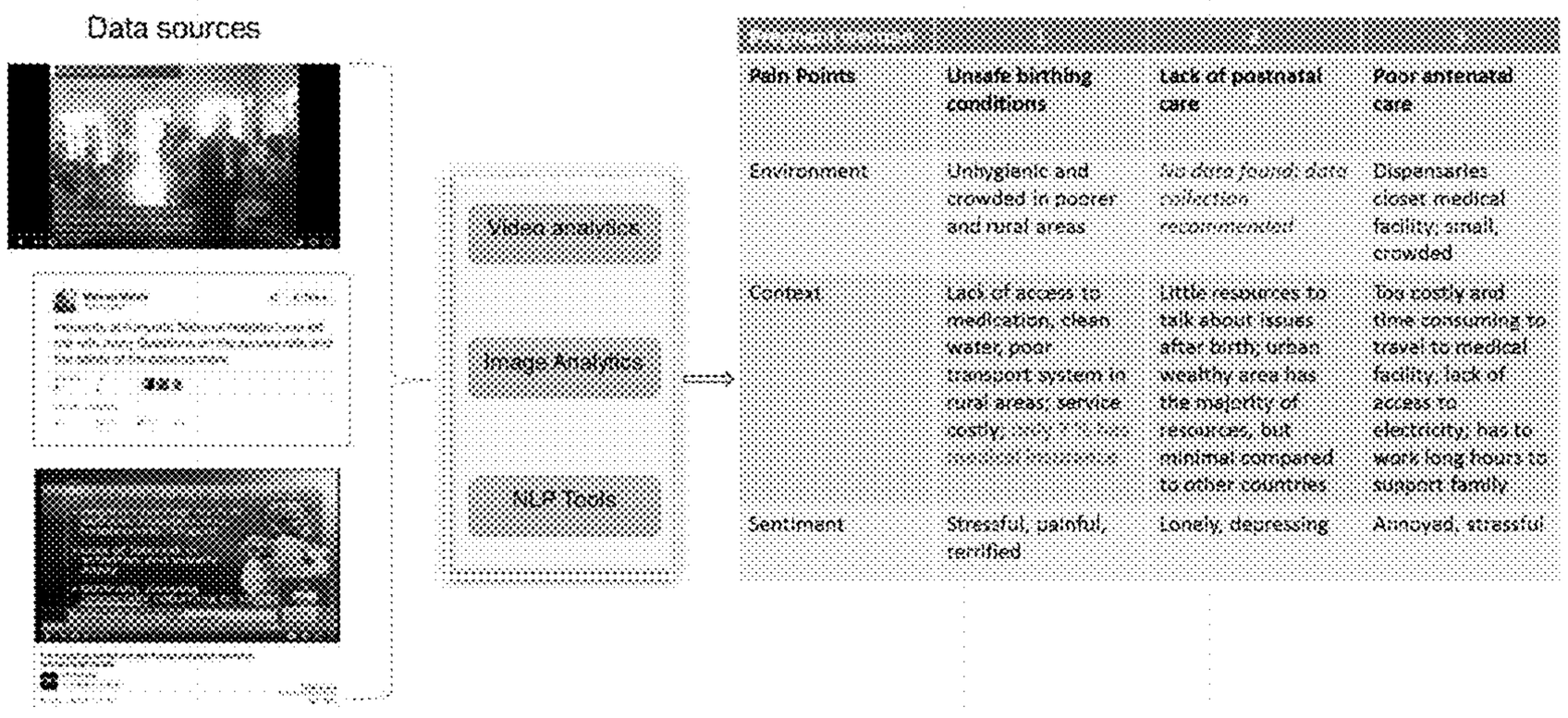

Data sources
Video analytics
Image Analytics
NLP Tools
Pain Points
Unsafe birthing conditions
Lack of postnatal care
Poor antenatal care
Environment
Unhygienic and crowded in poorer and rural areas
No data found; data collection recommended
Dispensaries closet medical facility; small, crowded
Context
Lack of access to medication, clean water, poor transport system to rural areas; service costly,
Little resources to talk about issues after birth; urban wealthy area has the majority of resources, but minimal compared to other countries
too costly and time consuming to travel to medical facility, lack of access to electricity, has to work long hours to support family
Sentiment
Stressful, painful, terrified
Lonely, depressing
Annoyed, stressful

FIG. 4

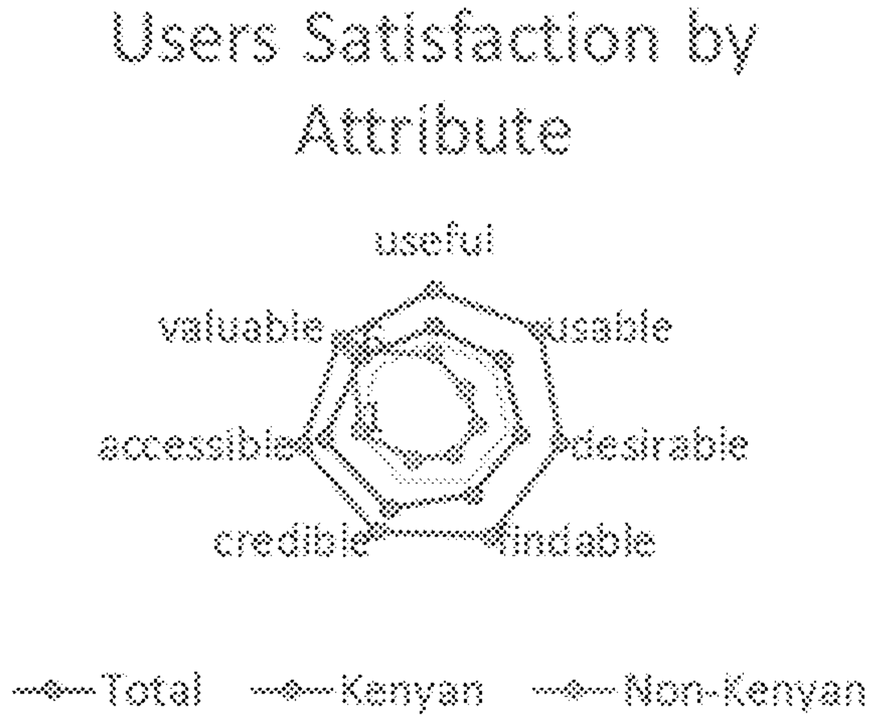

Users Satisfaction by Attribute
useful
usable
desirable
findable
credible
accessible
valuable
Total
Kenyan
Non-Kenyan

FIG. 5

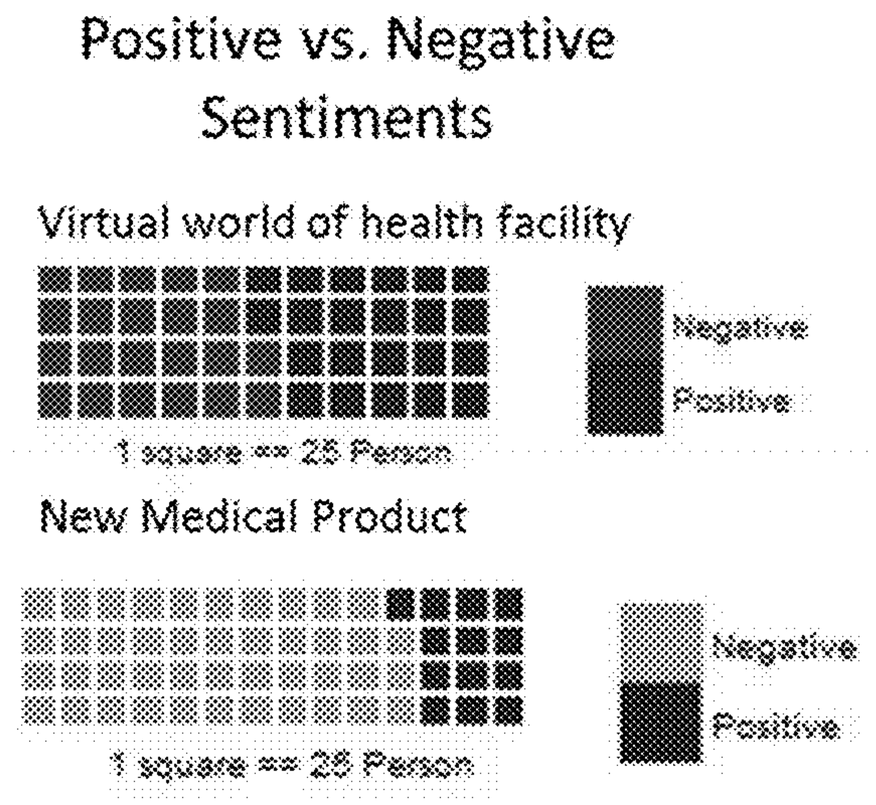
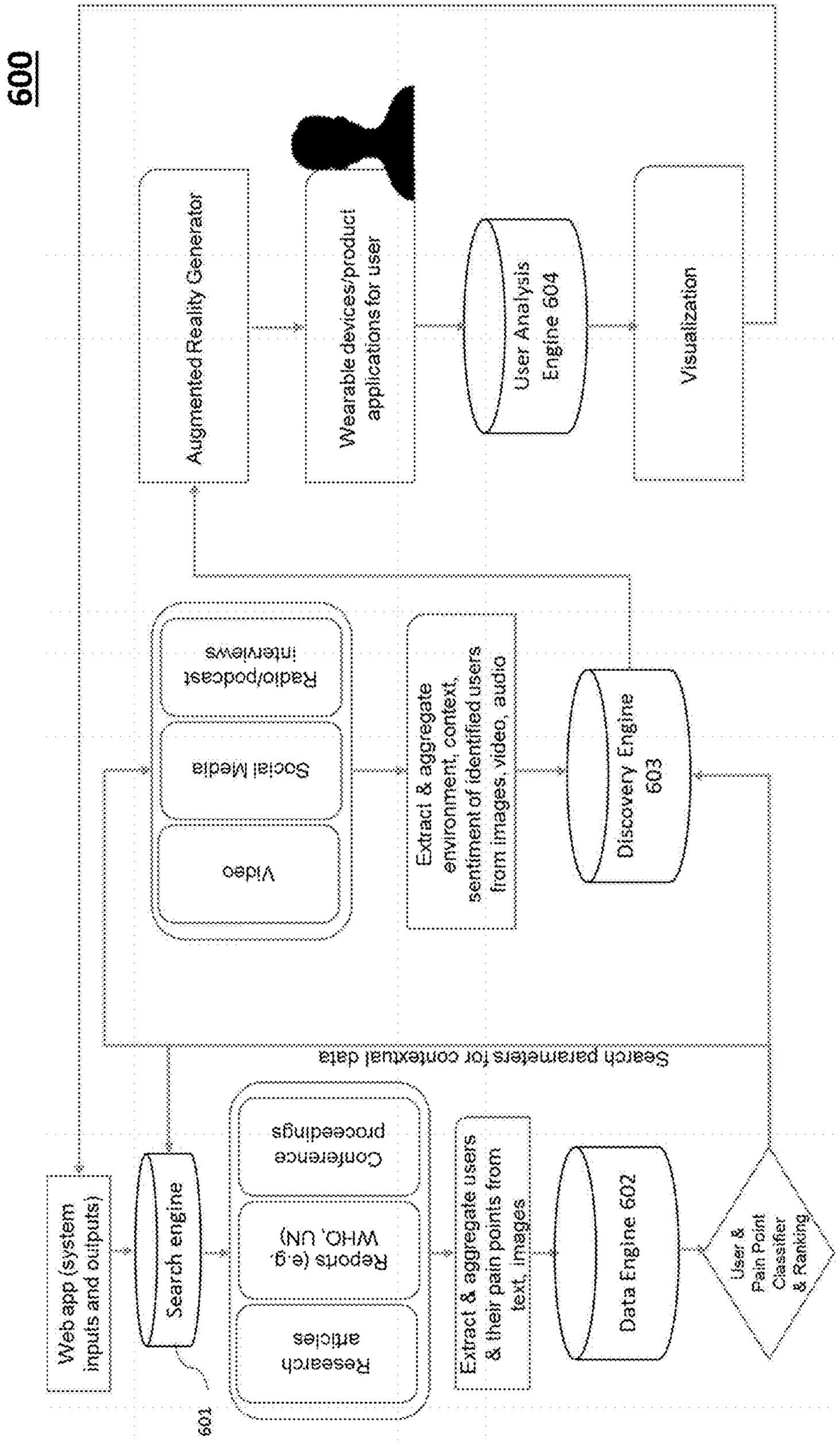

Positive vs. Negative Sentiments
Virtual world of health facility
1 square == 25 Person
Negative
Positive
New Medical Product
1 square == 25 Person
Negative
Positive

FIG. 6


600
Augmented Reality Generator
Wearable devices/product applications for user
User Analysis Engine 604
Visualization
Video
Social Media
Radio/podcast interviews
Extract & aggregate environment, context, sentiment of identified users from images, video, audio
Discovery Engine 603
Search parameters for contextual data
Research articles
Reports (e.g. WHO, UN)
Conference proceedings
Extract & aggregate users & their pain points from text, images
Data Engine 602
User & Pain Point Classifier & Ranking
Web app (system inputs and outputs)
Search engine
601

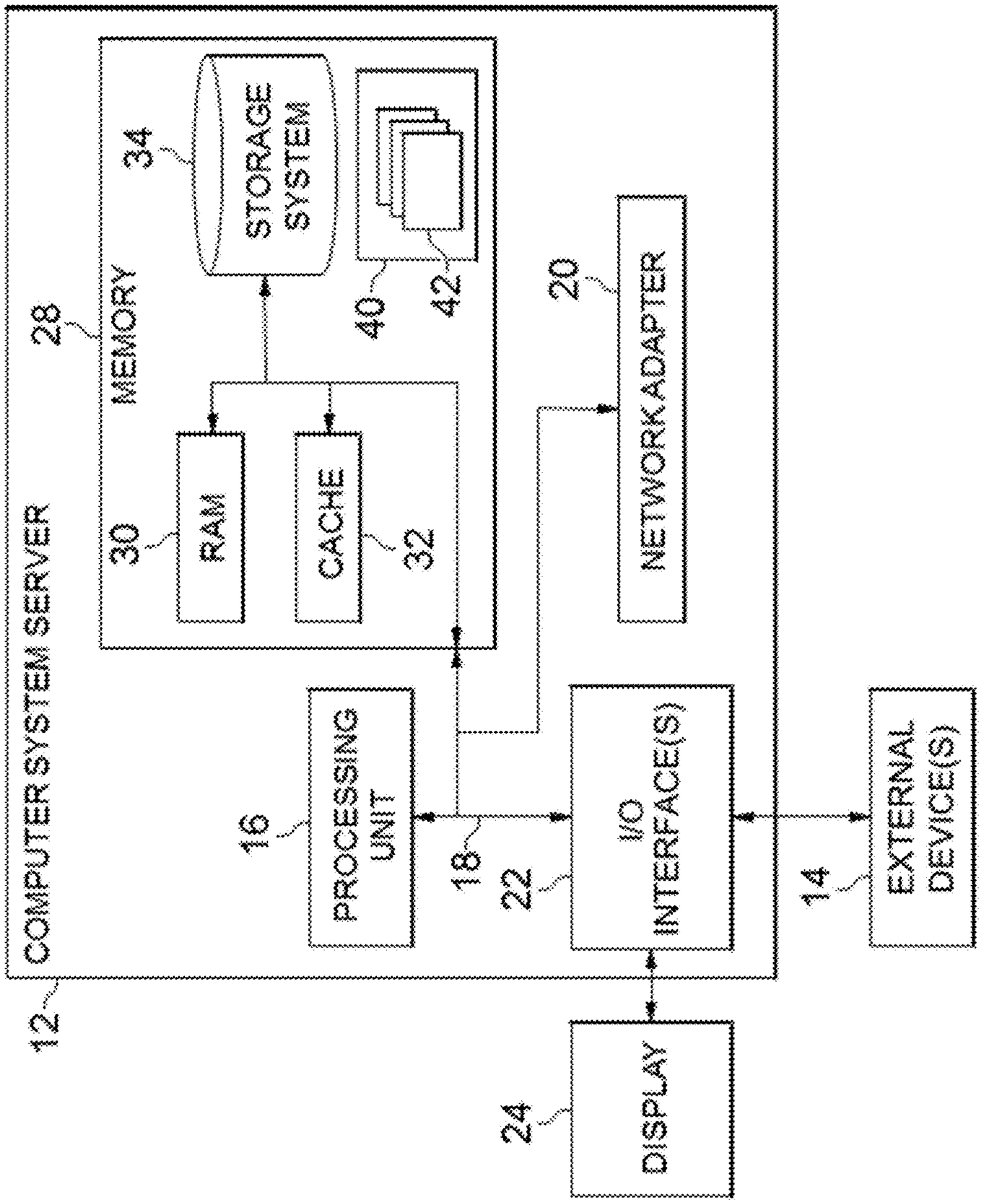

COMPUTER SYSTEM SERVER
12
28
MEMORY
34
STORAGE SYSTEM
40
42
30
RAM
CACHE
32
20
NETWORK ADAPTER
16
PROCESSING UNIT
18
22
I/O INTERFACE(S)
14
EXTERNAL DEVICE(S)
24
DISPLAY

FIG. 7

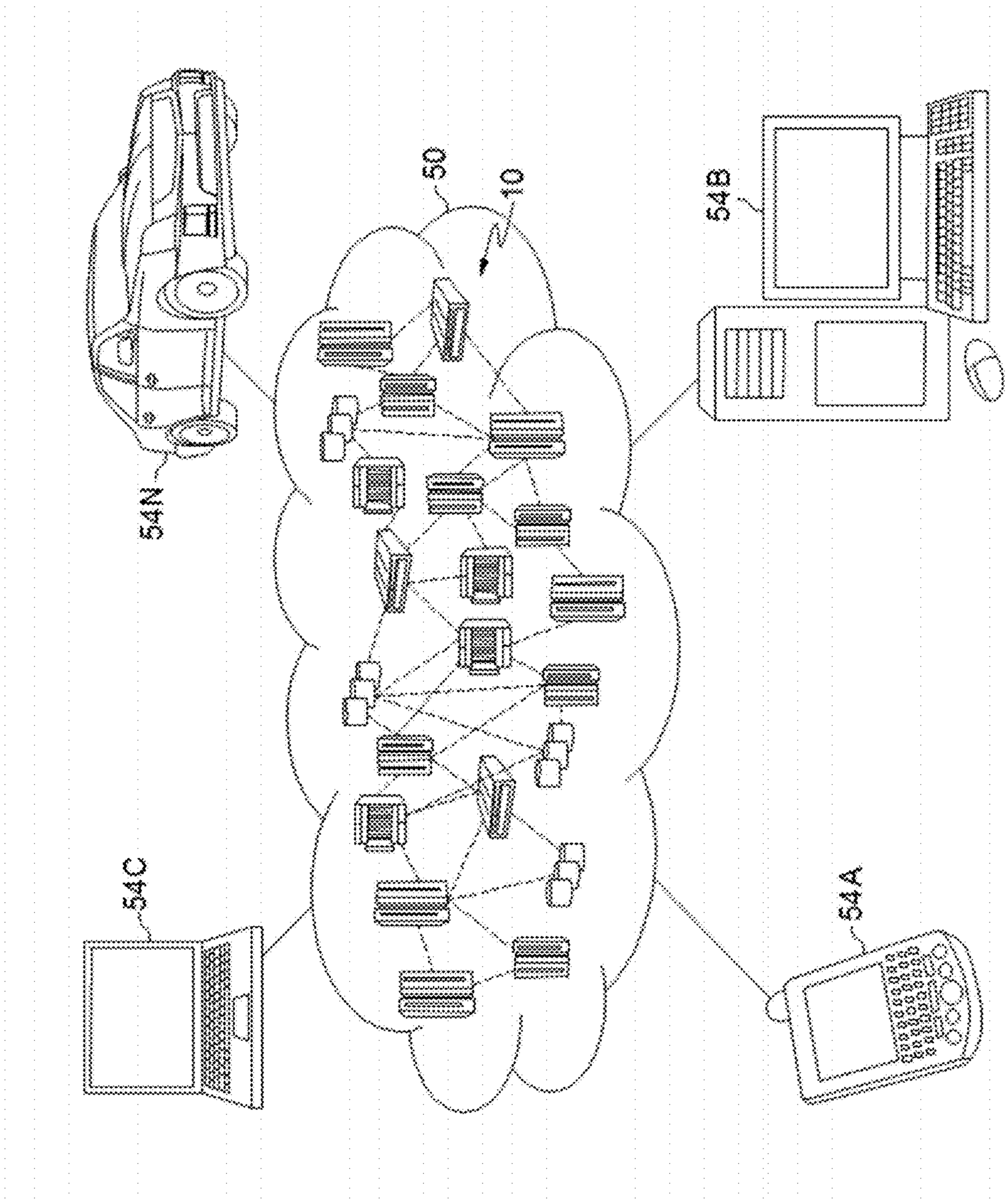


FIG. 8

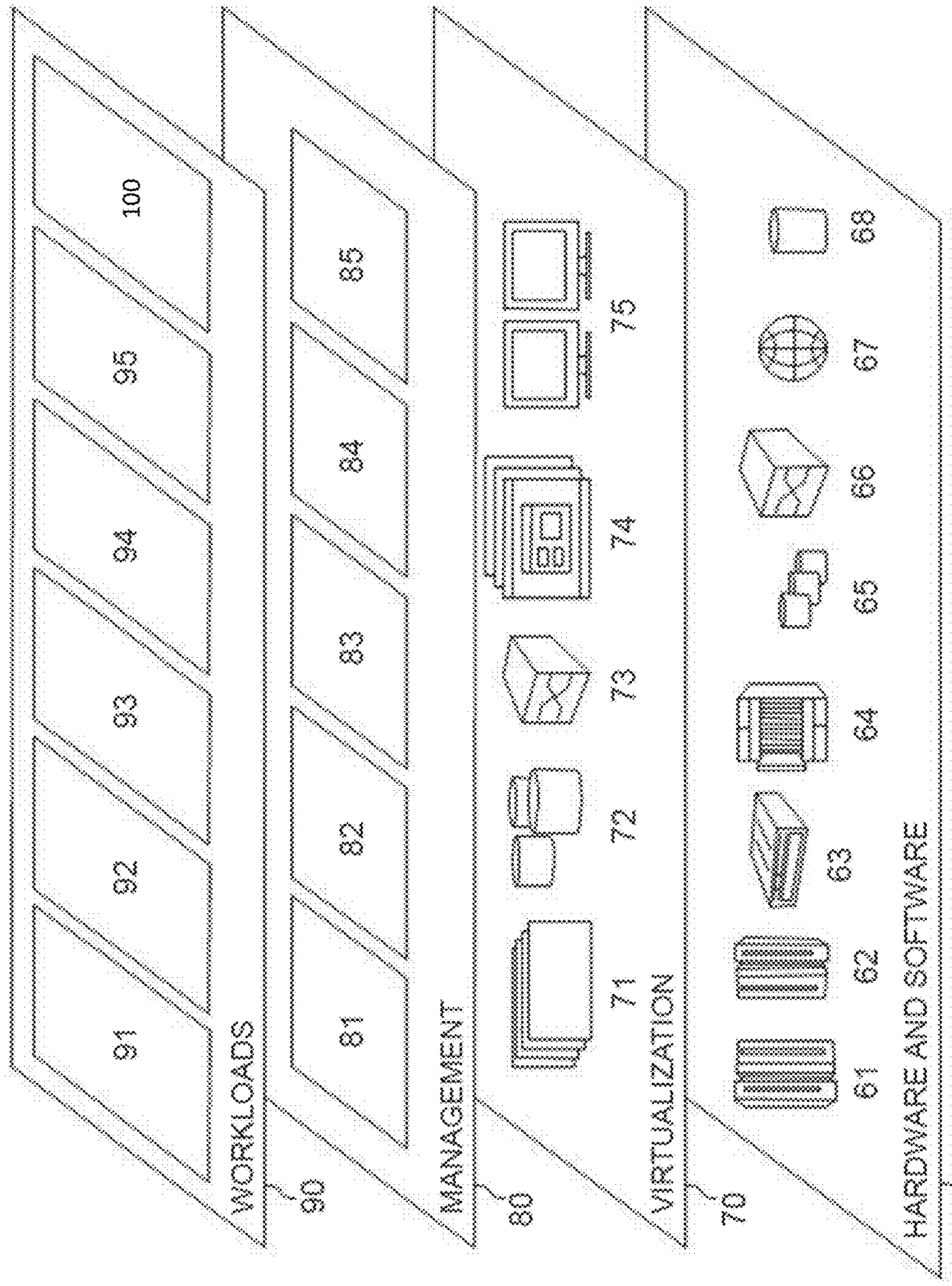

100
95
64
63
92
91
WORKLOADS
90
85
84
83
82
81
MANAGEMENT
80
75
74
73
72
71
VIRTUALIZATION
70
68
67
66
65
64
63
62
61
HARDWARE AND SOFTWARE
60

FIG. 9

SYSTEM, METHOD AND COMPUTER PROGRAM PRODUCT FOR SENSORY SIMULATION DURING PRODUCT TESTING

BACKGROUND

[0001] The present invention relates generally to a sensory simulation product testing method, and more particularly, but not by way of limitation, to a system, method, and computer program product for identifying target users, their "pain points" (i.e. problems or issues), context and experience from various data sources, to create an augmented reality for the testing of new products.

[0002] Products and services developed to address problems in the markets do not account for the contextual information of users. For example, a product released in the United States market versus a product released in the African market may be required to be designed differently based on differing problems the users face while using the products. The process for collecting and processing contextual information can be cumbersome. To save time, development teams make assumptions about users to achieve progress. However, development teams often develop solutions that are irrelevant and scale poorly.

[0003] For example, in a sub-Saharan African context, current usability testing methods for ICT-related technologies is limited to specific demographic(s) who have the means to obtain transport, smartphone devices, computers, and internet. Design researchers often obtain limited feedback about new products and services from users that do not necessarily represent the intended target users. Moreover, lab-based settings might introduce biases to users' feedback due to the users not being in their natural environment when testing a product.

[0004] Conventional product techniques have considered requesting that the users "imagine" themselves in a scenario similar to a use case for the product. However, these techniques cannot provide accurate product test results.

SUMMARY

[0005] In an exemplary embodiment, the present invention can provide a computer-implemented sensory simulation product testing method, the method including extracting at least one pain point associated with a user from a database, correlating at least one of an environment factor, a context factor, and a sentiment factor with the at least one user pain point, and creating an augmented reality in which to immerse the user to test a product based on the at least one of the environment factor, the context factor, and the sentiment factor.

[0006] One or more other exemplary embodiments include a computer program product and a system.

[0007] Other details and embodiments of the invention will be described below, so that the present contribution to the art can be better appreciated. Nonetheless, the invention is not limited in its application to such details, phraseology, terminology, illustrations and/or arrangements set forth in the description or shown in the drawings. Rather, the invention is capable of embodiments in addition to those described and of being practiced and carried out in various ways and should not be regarded as limiting.

[0008] As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Aspects of the invention will be better understood from the following detailed description of the exemplary embodiments of the invention with reference to the drawings, in which:

[0010] FIG. **1** exemplarily shows a high-level flow chart for a sensory simulation product testing method **100**;

[0011] FIG. **2** exemplarily shows one exemplary embodiment of step **101**;

[0012] FIG. **3** exemplarily shows one exemplary embodiment of step **102**;

[0013] FIG. **4** exemplarily depicts an output according to a first exemplary embodiment of step **105**;

[0014] FIG. **5** exemplarily depicts an output according to a second exemplary embodiment of step **105**;

[0015] FIG. **6** exemplarily depicts a high-level system architecture for a system **600** that can execute the method **100**;

[0016] FIG. **7** depicts a cloud computing node according to an embodiment of the present invention;

[0017] FIG. **8** depicts a cloud computing environment according to an embodiment of the present invention; and

[0018] FIG. **9** depicts abstraction model layers according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0019] The invention will now be described with reference to FIG. **1-9**, in which like reference numerals refer to like parts throughout. It is emphasized that, according to common practice, the various features of the drawing are not necessarily to scale. On the contrary, the dimensions of the various features can be arbitrarily expanded or reduced for clarity.

[0020] With reference now to the example depicted in FIG. **1**, the sensory simulation product testing method **100** includes various steps to identify target users, their so called "pain points" (i.e. problems or issues concerning them) and correlate the pain points with context, environment, and experience from various data sources to create an augmented reality for the testing of new products. As shown in at least FIG. **8**, one or more computers of a computer system **12** according to an embodiment of the present invention can include a memory **28** having instructions stored in a storage system to perform the steps of FIG. **1**.

[0021] Thus, the sensory simulation product testing method **100** according to an embodiment of the present invention may act in a more sophisticated, useful and cognitive manner, giving the impression of cognitive mental abilities and processes related to knowledge, attention, memory, judgment and evaluation, reasoning, and advanced computation. A system can be said to be "cognitive" if it possesses macro-scale properties—perception, goal-oriented behavior, learning/memory and action—that characterize systems (i.e., humans) generally recognized as cognitive.

[0022] Although one or more embodiments (see e.g., FIGS. **7-9**) may be implemented in a cloud environment **50**

(see e.g., FIG. **8**), it is nonetheless understood that the present invention can be implemented outside of the cloud environment.

[0023] In step **101**, at least one pain point (e.g., a problem or issues concerning them) of a target user of the product is extracted from a database. The database can include literature about the target user (and/or a user profile created and provided by the user) and searches for recent literature about the topic from online databases. Using Natural Language Processing (NLP) tools, a specialized application programming interface (API) such as Waston API, Alchemy API, etc., step **101** can identify users, at least one pain point of the user, and demographic and geographic background from verified data sources. Step **101** aggregates the pain point(s) from the various data sources in the database and ranks the pain points with the highest frequency of mention.

[0024] As exemplarily shown in FIG. **2**, pain points for a product associated with prenatal care is shown for potential users. Each potential user (i.e., a pregnant women, a medical professional, and children) has pain points extracted and ranked from a database (e.g., data sources).

[0025] In step **102**, at least one of an environment factor, a context factor, and a sentiment factor are correlated with the pain points of the users using one of NLP tools, image analytics, and video analytics from data sources. For example, pregnant women have a pain point of unsafe birthing conditions (as extracted in step **101**), and, in step **102**, the "reasons" why the pain point occurs is correlated with the pain point. As exemplarily shown in FIG. **3**, by analyzing videos, Twitter™ posts, etc., step **102** can correlate that the environment conditions of "unhygienic and crowded in poorer and rural areas" are a cause of (or correlated with) the pain point. Also, the sentiment of the pain point can be correlated with the pain point. A user's Twitter™ post can be analyzed to correlate a sentiment of "stressful, painful, and terrified" with the pain point.

[0026] That is, step **102** searches and identifies contextual data from various sources (e.g. video, social media, image, audio) that relate to the identified pain points. Using image and video analytics and NLP tools, step **102** extracts contextual data and matches it to the user pain points.

[0027] In step **103**, an augmented reality is created to immerse the user in based on the correlated pain point to environment factor, context factor, and sentiment factor. That is, wearable can be used to measure a user's reaction to the augmented reality and product in the augmented reality environment. A target user using the augmented reality device matches (or is similar to) the demographic and geographic background identified. The augmented reality can be visible to the user through a screen (e.g., in lab testing) or a wearable (e.g., remote testing)

[0028] That is, step **103** creates an augmented reality test environment based on the analysis from step **102** for a wearable device/screen that takes the contextual data (e.g. small room, people speaking Swahili, babies crying, etc.) and allows users to see, hear, and participate in the augmented environment while using the product being tested. The wearable device can be connected to the system to measure a user's stress/anxiety levels during testing.

[0029] In step **104**, the product test in the augmented reality is facilitated by a virtual facilitator embedded in the augmented reality. The facilitator (e.g., a person who facilitates the testing) is a virtual person that mimics a person in the users natural environment (e.g. a nurse) and interacts with the user in their natural language (e.g. Kiswahili, English, etc.). The facilitator is created in the augmented reality based on the environment factors and context factors correlated in Step **103**. Thus, the user can test the product not only in the environment as created in step **103** but also with a typical (e.g., familiar) facilitator who would also normally be in the environment with the user while the product is being used. For example, a facilitator can be a nurse in a busy hospital who interacts with the user.

[0030] In step **104**, after the virtual facilitator gives instruction, the user enters the augmented reality that was created by step **103**. For example, the augmented reality can include small crowded room with parents, infants; a nurse comes out every thirty minutes to ask for a patient and the sounds of people speaking in Swahili and Luo about topics related to being in a health facility, babies crying, babies coughing, etc. while the facilitator is still in the sight of the user. While the augmented environment is playing, the user is introduced to the new product and the user is asked to test the product.

[0031] It is noted that the wearable device measures the users stress/anxiety levels during testing (e.g., collecting feedback as described later).

[0032] In step **105**, user feedback about the product test is collected to determine a quality of the product for the environment of the user. That is, a product may work perfectly in a lab setting but the product can have issues during actual use in a typical use setting (e.g., a lab versus a busy hospital). The user is able to provide feedback about the product in an environment similar to an actual use case of the product.

[0033] That is, in step **105**, the user's audio and interactions with the product during testing are collected and analyzed. Step **105** can automatically calculate the time a user spends on completing each task of the product and the user satisfaction with the product. A system can analyzes the sentiment of the testing environment and the product.

[0034] As exemplarily shown in FIGS. **4** and **5**, step **105** can create a visual output of the analyzing data. For example, a user satisfaction by attribute as shown in FIG. **4** can be created by analyzes the feedback in step **105**. Also, positive and negative sentiments can be graphed for the product or for the augmented reality that was created as shown in FIG. **5**. In this manner, step **103** can create a "better" or "more accurate" augmented reality for the user based on the feedback.

[0035] FIG. **6** exemplarily depicts a high-level system architecture for a system **600**. The system includes a search engine **501** which can extract at least one pain point associated with the user from research articles, reports, conference proceedings, etc. The pain points are extracted, aggregated, and ranked. The data engine **502** and discovery engine **503** can correlate the pain points with an environment factor, a context factor, and a sentiment factor based on discovered external images, video, social media, etc. The augmented reality generator can generate the augmented reality based on the environment factor, the context factor, and the sentiment factor including creating a facilitator typical to the environment and the product (e.g., if the environment is a hospital and the product is a blood pressure device, the facilitator can be a nurse or a doctor). The user analysis engine **504** can collect and analyze user feedback to determine a quality of the product.

[0036] Thereby, the system **60** can use NLP, video analytics, and image analytics to obtain contextual, environment, and sentiment data about users and use the contextual data to create an augmented reality for user testing. The users can test the product in the augmented reality that is facilitated by a facilitator (e.g., a person likely to be facilitating the product use in reality) so that the most natural and honest feedback about a product can be obtained. While the example above was directed to medical care, any product in any environment (e.g., police, firefighter, education, construction, etc.) can be tested.

[0037] Exemplary Aspects, Using a Cloud Computing Environment

[0038] Although this detailed description includes an exemplary embodiment of the present invention in a cloud computing environment, it is to be understood that implementation of the teachings recited herein are not limited to such a cloud computing environment. Rather, embodiments of the present invention are capable of being implemented in conjunction with any other type of computing environment now known or later developed.

[0039] Cloud computing is a model of service delivery for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. networks, network bandwidth, servers, processing, memory, storage, applications, virtual machines, and services) that can be rapidly provisioned and released with minimal management effort or interaction with a provider of the service. This cloud model may include at least five characteristics, at least three service models, and at least four deployment models.

[0040] Characteristics are as follows:

[0041] On-demand self-service: a cloud consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with the service's provider.

[0042] Broad network access: capabilities are available over a network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs).

[0043] Resource pooling: the provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to demand. There is a sense of location independence in that the consumer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).

[0044] Rapid elasticity: capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

[0045] Measured service: cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

[0046] Service Models are as follows:

[0047] Software as a Service (SaaS): the capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client circuits through a thin client interface such as a web browser (e.g., web-based e-mail). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

[0048] Platform as a Service (PaaS): the capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including networks, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

[0049] Infrastructure as a Service (IaaS): the capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls).

[0050] Deployment Models are as follows:

[0051] Private cloud: the cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on-premises or off-premises.

[0052] Community cloud: the cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on-premises or off-premises.

[0053] Public cloud: the cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

[0054] Hybrid cloud: the cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

[0055] A cloud computing environment is service oriented with a focus on statelessness, low coupling, modularity, and semantic interoperability. At the heart of cloud computing is an infrastructure comprising a network of interconnected nodes.

[0056] Referring now to FIG. **7**, a schematic of an example of a cloud computing node is shown. Cloud computing node **10** is only one example of a suitable node and is not intended to suggest any limitation as to the scope of use or functionality of embodiments of the invention described herein. Regardless, cloud computing node **10** is capable of being implemented and/or performing any of the functionality set forth herein.

[0057] Although cloud computing node **10** is depicted as a computer system/server **12**, it is understood to be operational with numerous other general purpose or special purpose computing system environments or configurations.

Examples of well-known computing systems, environments, and/or configurations that may be suitable for use with computer system/server **12** include, but are not limited to, personal computer systems, server computer systems, thin clients, thick clients, hand-held or laptop circuits, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputer systems, mainframe computer systems, and distributed cloud computing environments that include any of the above systems or circuits, and the like.

[0058] Computer system/server **12** may be described in the general context of computer system-executable instructions, such as program modules, being executed by a computer system. Generally, program modules may include routines, programs, objects, components, logic, data structures, and so on that perform particular tasks or implement particular abstract data types. Computer system/server **12** may be practiced in distributed cloud computing environments where tasks are performed by remote processing circuits that are linked through a communications network. In a distributed cloud computing environment, program modules may be located in both local and remote computer system storage media including memory storage circuits.

[0059] Referring again to FIG. **7**, computer system/server **12** is shown in the form of a general-purpose computing circuit. The components of computer system/server **12** may include, but are not limited to, one or more processors or processing units **16**, a system memory **28**, and a bus **18** that couples various system components including system memory **28** to processor **16**.

[0060] Bus **18** represents one or more of any of several types of bus structures, including a memory bus or memory controller, a peripheral bus, an accelerated graphics port, and a processor or local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnects (PCI) bus.

[0061] Computer system/server **12** typically includes a variety of computer system readable media. Such media may be any available media that is accessible by computer system/server **12**, and it includes both volatile and non-volatile media, removable and non-removable media.

[0062] System memory **28** can include computer system readable media in the form of volatile memory, such as random access memory (RAM) **30** and/or cache memory **32**. Computer system/server **12** may further include other removable/non-removable, volatile/non-volatile computer system storage media. By way of example only, storage system **34** can be provided for reading from and writing to a non-removable, non-volatile magnetic media (not shown and typically called a "hard drive"). Although not shown, a magnetic disk drive for reading from and writing to a removable, non-volatile magnetic disk (e.g., a "floppy disk"), and an optical disk drive for reading from or writing to a removable, non-volatile optical disk such as a CD-ROM, DVD-ROM or other optical media can be provided. In such instances, each can be connected to bus **18** by one or more data media interfaces. As will be further depicted and described below, memory **28** may include at least one program product having a set (e.g., at least one) of program modules that are configured to carry out the functions of embodiments of the invention.

[0063] Program/utility **40**, having a set (at least one) of program modules **42**, may be stored in memory **28** by way of example, and not limitation, as well as an operating system, one or more application programs, other program modules, and program data. Each of the operating system, one or more application programs, other program modules, and program data or some combination thereof, may include an implementation of a networking environment. Program modules **42** generally carry out the functions and/or methodologies of embodiments of the invention as described herein.

[0064] Computer system/server **12** may also communicate with one or more external circuits **14** such as a keyboard, a pointing circuit, a display **24**, etc.; one or more circuits that enable a user to interact with computer system/server **12**; and/or any circuits (e.g., network card, modem, etc.) that enable computer system/server **12** to communicate with one or more other computing circuits. Such communication can occur via Input/Output (I/O) interfaces **22**. Still yet, computer system/server **12** can communicate with one or more networks such as a local area network (LAN), a general wide area network (WAN), and/or a public network (e.g., the Internet) via network adapter **20**. As depicted, network adapter **20** communicates with the other components of computer system/server **12** via bus **18**. It should be understood that although not shown, other hardware and/or software components could be used in conjunction with computer system/server **12**. Examples, include, but are not limited to: microcode, circuit drivers, redundant processing units, external disk drive arrays, RAID systems, tape drives, and data archival storage systems, etc.

[0065] Referring now to FIG. **8**, illustrative cloud computing environment **50** is depicted. As shown, cloud computing environment **50** comprises one or more cloud computing nodes **10** with which local computing circuits used by cloud consumers, such as, for example, personal digital assistant (PDA) or cellular telephone **54**A, desktop computer **54**B, laptop computer **54**C, and/or automobile computer system **54**N may communicate. Nodes **10** may communicate with one another. They may be grouped (not shown) physically or virtually, in one or more networks, such as Private, Community, Public, or Hybrid clouds as described hereinabove, or a combination thereof. This allows cloud computing environment **50** to offer infrastructure, platforms and/or software as services for which a cloud consumer does not need to maintain resources on a local computing circuit. It is understood that the types of computing circuits **54**A-N shown in FIG. **8** are intended to be illustrative only and that computing nodes **10** and cloud computing environment **50** can communicate with any type of computerized circuit over any type of network and/or network addressable connection (e.g., using a web browser).

[0066] Referring now to FIG. **9**, an exemplary set of functional abstraction layers provided by cloud computing environment **50** (FIG. **8**) is shown. It should be understood in advance that the components, layers, and functions shown in FIG. **9** are intended to be illustrative only and embodiments of the invention are not limited thereto. As depicted, the following layers and corresponding functions are provided:

[0067] Hardware and software layer **60** includes hardware and software components. Examples of hardware compo-

nents include: mainframes **61**; RISC (Reduced Instruction Set Computer) architecture based servers **62**; servers **63**; blade servers **64**; storage circuits **65**; and networks and networking components **66**. In some embodiments, software components include network application server software **67** and database software **68**.

[0068] Virtualization layer **70** provides an abstraction layer from which the following examples of virtual entities may be provided: virtual servers **71**; virtual storage **72**; virtual networks **73**, including virtual private networks; virtual applications and operating systems **74**; and virtual clients **75**.

[0069] In one example, management layer **80** may provide the functions described below. Resource provisioning **81** provides dynamic procurement of computing resources and other resources that are utilized to perform tasks within the cloud computing environment. Metering and Pricing **82** provide cost tracking as resources are utilized within the cloud computing environment, and billing or invoicing for consumption of these resources. In one example, these resources may comprise application software licenses. Security provides identity verification for cloud consumers and tasks, as well as protection for data and other resources. User portal **83** provides access to the cloud computing environment for consumers and system administrators. Service level management **84** provides cloud computing resource allocation and management such that required service levels are met. Service Level Agreement (SLA) planning and fulfillment **85** provide pre-arrangement for, and procurement of, cloud computing resources for which a future requirement is anticipated in accordance with an SLA.

[0070] Workloads layer **90** provides examples of functionality for which the cloud computing environment may be utilized. Examples of workloads and functions which may be provided from this layer include: mapping and navigation **91**; software development and lifecycle management **92**; virtual classroom education delivery **93**; data analytics processing **94**; transaction processing **95**; and, more particularly relative to the present invention, the sensory simulation product testing method **100**.

[0071] The present invention may be a system, a method, and/or a computer program product at any possible technical detail level of integration. The computer program product may include a computer readable storage medium (or media) having computer readable program instructions thereon for causing a processor to carry out aspects of the present invention.

[0072] The computer readable storage medium can be a tangible device that can retain and store instructions for use by an instruction execution device. The computer readable storage medium may be, for example, but is not limited to, an electronic storage device, a magnetic storage device, an optical storage device, an electromagnetic storage device, a semiconductor storage device, or any suitable combination of the foregoing. A non-exhaustive list of more specific examples of the computer readable storage medium includes the following: a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a static random access memory (SRAM), a portable compact disc read-only memory (CD-ROM), a digital versatile disk (DVD), a memory stick, a floppy disk, a mechanically encoded device such as punch-cards or raised structures in a groove having instructions recorded thereon, and any suitable combination of the foregoing. A computer readable storage medium, as used herein, is not to be construed as being transitory signals per se, such as radio waves or other freely propagating electromagnetic waves, electromagnetic waves propagating through a waveguide or other transmission media (e.g., light pulses passing through a fiber-optic cable), or electrical signals transmitted through a wire.

[0073] Computer readable program instructions described herein can be downloaded to respective computing/processing devices from a computer readable storage medium or to an external computer or external storage device via a network, for example, the Internet, a local area network, a wide area network and/or a wireless network. The network may comprise copper transmission cables, optical transmission fibers, wireless transmission, routers, firewalls, switches, gateway computers and/or edge servers. A network adapter card or network interface in each computing/processing device receives computer readable program instructions from the network and forwards the computer readable program instructions for storage in a computer readable storage medium within the respective computing/processing device.

[0074] Computer readable program instructions for carrying out operations of the present invention may be assembler instructions, instruction-set-architecture (ISA) instructions, machine instructions, machine dependent instructions, microcode, firmware instructions, state-setting data, configuration data for integrated circuitry, or either source code or object code written in any combination of one or more programming languages, including an object oriented programming language such as Smalltalk, C++, or the like, and procedural programming languages, such as the "C" programming language or similar programming languages. The computer readable program instructions may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider). In some embodiments, electronic circuitry including, for example, programmable logic circuitry, field-programmable gate arrays (FPGA), or programmable logic arrays (PLA) may execute the computer readable program instructions by utilizing state information of the computer readable program instructions to personalize the electronic circuitry, in order to perform aspects of the present invention.

[0075] Aspects of the present invention are described herein with reference to flowchart illustrations and/or block diagrams of methods, apparatus (systems), and computer program products according to embodiments of the invention. It will be understood that each block of the flowchart illustrations and/or block diagrams, and combinations of blocks in the flowchart illustrations and/or block diagrams, can be implemented by computer readable program instructions.

[0076] These computer readable program instructions may be provided to a processor of a general purpose computer, special purpose computer, or other programmable data processing apparatus to produce a machine, such that the

instructions, which execute via the processor of the computer or other programmable data processing apparatus, create means for implementing the functions/acts specified in the flowchart and/or block diagram block or blocks. These computer readable program instructions may also be stored in a computer readable storage medium that can direct a computer, a programmable data processing apparatus, and/or other devices to function in a particular manner, such that the computer readable storage medium having instructions stored therein comprises an article of manufacture including instructions which implement aspects of the function/act specified in the flowchart and/or block diagram block or blocks.

[0077] The computer readable program instructions may also be loaded onto a computer, other programmable data processing apparatus, or other device to cause a series of operational steps to be performed on the computer, other programmable apparatus or other device to produce a computer implemented process, such that the instructions which execute on the computer, other programmable apparatus, or other device implement the functions/acts specified in the flowchart and/or block diagram block or blocks.

[0078] The flowchart and block diagrams in the Figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present invention. In this regard, each block in the flowchart or block diagrams may represent a module, segment, or portion of instructions, which comprises one or more executable instructions for implementing the specified logical function(s). In some alternative implementations, the functions noted in the blocks may occur out of the order noted in the Figures. For example, two blocks shown in succession may, in fact, be executed substantially concurrently, or the blocks may sometimes be executed in the reverse order, depending upon the functionality involved. It will also be noted that each block of the block diagrams and/or flowchart illustration, and combinations of blocks in the block diagrams and/or flowchart illustration, can be implemented by special purpose hardware-based systems that perform the specified functions or acts or carry out combinations of special purpose hardware and computer instructions.

[0079] The descriptions of the various embodiments of the present invention have been presented for purposes of illustration, but are not intended to be exhaustive or limited to the embodiments disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the described embodiments. The terminology used herein was chosen to best explain the principles of the embodiments, the practical application or technical improvement over technologies found in the marketplace, or to enable others of ordinary skill in the art to understand the embodiments disclosed herein.

[0080] Further, Applicant's intent is to encompass the equivalents of all claim elements, and no amendment to any claim of the present application should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

What is claimed is:

1. A computer-implemented sensory simulation product testing method, the method comprising:

extracting at least one pain point associated with a user from a database;

correlating at least one of an environment factor, a context factor, and a sentiment factor with the at least one user pain point; and

creating an augmented reality in which to immerse the user to test a product based on the at least one of the environment factor, the context factor, and the sentiment factor.

2. The computer-implemented method of claim **1**, further comprising facilitating the product test via a virtual facilitator embedded in the augmented reality while the user is immersed in the augmented reality.

3. The computer-implemented method of claim **1**, wherein the creating creates a facilitator to facilitate the product test based on an individual associated with the environment factor.

4. The computer-implemented method of claim **1**, wherein the extracting extracts the at least one pain point from the database by using at least one of Natural Language Processing (NLP), image analytics, and video analytics.

5. The computer-implemented method of claim **1**, wherein the extracting extracts a plurality of pain points and aggregates and ranks the plurality of pain points of the user based on demographic and geographic background data in the database.

6. The computer-implemented method of claim **1**, wherein the correlating correlates the at least one of the environment factor, the context factor, and the sentiment factor with the at least one user pain point by determining environment, context, and sentiment causes of the at least one user pain point from a plurality of data sources including social media, video sources, and audio sources.

7. The computer-implemented method of claim **1**, further comprising collecting user feedback about the product test to determine a quality of the product.

8. The computer-implemented method of claim **7**, wherein a virtual reality device collects the user feedback.

9. The computer-implemented method of claim **1**, wherein the extracting extracts a plurality of pain points associated with the user and ranks the plurality of pain points such that the augmented reality is created to reflect the pain points ranked highest.

10. The computer-implemented method of claim **2**, wherein the facilitator comprises an individual associated with the product and the environment factor.

11. The computer-implemented method of claim **1**, embodied in a cloud-computing environment.

12. A computer program product for sensory simulation product testing, the computer program product comprising a computer-readable storage medium having program instructions embodied therewith, the program instructions executable by a computer to cause the computer to perform:

extracting at least one pain point associated with a user from a database;

correlating at least one of an environment factor, a context factor, and a sentiment factor with the at least one user pain point; and

creating an augmented reality in which to immerse the user to test a product based on the at least one of the environment factor, the context factor, and the sentiment factor.

13. The computer program product claim **12**, further comprising facilitating the product test via a virtual facilitator embedded in the augmented reality while the user is immersed in the augmented reality.

14. The computer program product claim **12**, wherein the creating creates a facilitator to facilitate the product test based on an individual associated with the environment factor.

15. The computer program product claim **12**, wherein the extracting extracts the at least one pain point from the database by using at least one of Natural Language Processing (NLP), image analytics, and video analytics.

16. The computer program product claim **12**, wherein the extracting extracts a plurality of pain points and aggregates and ranks the plurality of pain points of the user based on demographic and geographic background data in the database.

17. The computer program product claim **12**, wherein the correlating correlates the at least one of the environment factor, the context factor, and the sentiment factor with the at least one user pain point by determining environment, context, and sentiment causes of the at least one user pain point from a plurality of data sources including social media, video sources, and audio sources.

18. The computer program product claim **12**, further comprising collecting user feedback about the product test to determine a quality of the product.

19. A sensory simulation product testing system, said system comprising:

a processor; and

a memory, the memory storing instructions to cause the processor to perform:

extracting at least one pain point associated with a user from a database;

correlating at least one of an environment factor, a context factor, and a sentiment factor with the at least one user pain point; and

creating an augmented reality in which to immerse the user to test a product based on the at least one of the environment factor, the context factor, and the sentiment factor.

20. The system of claim **19**, embodied in a cloud-computing environment.

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