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PRIOR ART SEARCH REPORT

FOR

AI-Powered Personalized Multi-Agent Platform

Prepared By

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Contents

1 Key Features of the Invention

KF1: The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement.

KF2: The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done.

KF2a: The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts.

KF2b: Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions.

KF2c: API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.

KF3: The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences.

KF4: These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.

KF4a: Users have a dashboard where they interact with the LLM backed Avatars.

KF5: In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths.

KF6: In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data).

KF6a: Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

2 Result Summary

Key Features (KF)/ Results	KF1	KF2	KF2a	KF2b	KF2c	KF3	KF4	KF4a	KF5	KF6	KF6a
Result 1 *An Expert Digital Companion for Working Environments*	✓	✓	*	✓	X	✓	*	X	X	X	X
Result 2 *US11861704B2*	✓	*	*	*	*	X	X	X	X	X	X
Result 3 *US9830044B2*	✓	*	*	X	X	*	*	X	X	X	X
Result 4 *WO2021227325A1*	*	X	X	X	X	X	X	X	X	*	✓

Note: In the above table:
'✓' represents a likely presence of the key feature in the result,
'X' represents a likely absence of the key feature in the result, and
'' may suggest the presence of the key feature in the result, however not in an explicit manner.*

3 Prior-Art Search Summary

The Result Summary table (section 2, Page 4) in the report provides an overview of key features (listed in section 1 on Page 3) that are disclosed in each of the identified references.

The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement, leading to highly effective teams. The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done. The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts. Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions. API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.

The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences. Users have a dashboard where they interact with the LLM backed Avatars. These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise. In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths. In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data). Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

Result 1 (***An Expert Digital Companion for Working Environments***) discloses a digital companion (DC) for working environment. Result 1 seems to disclose an avatar that is referred to as hologram. Result 1 also seems to disclose a multi-agent platform which includes a personal DC and an expert DC. A personal DC is personalized based on the user's preferences and an expert DC is responsible for managing the physical or virtual environment. These DCs make use of technology fields such as, Web of Things (WoT), Knowledge Graph (KG), Deep Learning (DL), Multi-Agent Systems (MAS), and

Innovative User Interfaces e.g., Mixed Reality (MR). These DCs take advantage of the strengths of such technologies to assist workers in an office environment. The DCs mentioned in Result 1 also seem to have emotion detection capabilities. Result 1, however, does not disclose the concepts of running "what if" scenarios and creating a "digital twin". Result 1 also does not explicitly disclose the aspects of using the avatars to automate repetitive task, fill skill gaps and be used as a consultant.

Result 2 (US11861704B2) discloses a persona-driven and artificially intelligent avatar. The avatar may be utilized to represent an artificially intelligent virtual assistant that may perform actions on behalf of a user. In Result 2, the persona of the digital avatars may conform to one or more personality models consisting of one or more dimensions, where each dimension may be a specific property of the persona. For example, the 5-dimension Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN) model may be utilized for the personas of the digital avatars, or any other model may be utilized. Result 2, however, does not disclose the avatars being used to enhance employee efficiency and employee engagement. Result 2 also, does not disclose the concepts of running "what if" scenarios and creating a "digital twin". Result 2 also does not disclose the aspects of using the avatars to automate repetitive task, fill skill gaps and be used as a consultant.

Result 3 (*US9830044B2*) discloses techniques for implementing a team of virtual assistants that include multiple virtual assistants that are configured with different characteristics, such as different functionality, base language models, levels of training, visual appearances, personalities, and so on. The virtual assistants also interact with each other to carry out tasks for the users, which may be illustrated in conversation user interfaces. Result 3 also, does not disclose the concepts of running "what if" scenarios and creating a "digital twin". Result 3 also does not explicitly disclose the aspects of using the avatars to automate repetitive task, fill skill gaps and be used as a consultant.

Result 4 (*WO2021227325A1*) seems to disclose the concepts of creating a "digital twin". The digital twin created through digital methods is a virtual model of humans and physical entities in the information space. The digital twin uses data to simulate the behavior of physical entities in the real environment. Through the information fusion and data interaction between the virtual model and the physical entity, more optimization decisions are provided for the physical entity. Result 4, however, does not disclose the concepts of running "what if" scenarios. Result 4 also does not disclose the aspects of using the avatars to automate repetitive task, fill skill gaps and be used as a consultant.

The above-identified references in combination seem to disclose several key features such as an (1) AI-powered personalized multi-agent platform designed to enhance

employee efficiency, (2) personalized avatars wherein each embody a specific persona, (4) avatars equipped with emotion detection capabilities, (5) deep personalization by adapting to user preferences, and (6) creating a "digital twin" of the workplace environment.

However, **the mentioned references do not disclose some aspects of the proposed invention such as, (1) having a dashboard for the users to interact with the avatars, (2) running "what if" scenarios to see which teams are most optimized, and (3) running simulations on career development and career paths of employees.**

Furthe, the mentioned references do not explicitly disclose avatars providing the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short-staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.

Moreover, the mentioned references do not talk about a few engineered input fields used in the invention which include the holding period of the property, current debt, percentage of Single Family Homes (SFH) in that area, unemployment rate in the region, etc. Also, none of the references talk explicitly about the optimization of thresholds based on learning and feedback and the online-offline component used in the model.

Hence, based on the search we believe that the invention has a degree of novelty in light of the given references.

4 Prior Art Search Results

4.1 Result 1

Title of the Patent Document	An Expert Digital Companion for Working Environments
Publication information	2021, In Proceedings of the 11th International Conference on the Internet of Things, pp. 25-32.
Abstract	Research in proactive agents capable of anticipating users' needs has been conducted in different application areas, from agents aiming to help users accomplish their next task while using a text editor to digital assistants that provide support to medical professionals in hospitals. Considering these works and following the rapid development in machine learning, the growing adoption of the IoT, the prevalence of pervasive computing, and the various innovative user interfaces that are becoming mainstream, we propose the creation of expert digital companions. Expert digital companions are agents that know the specifics of an environment and the available physical equipment in a space as well as software components reachable in that environment. On their side, personal digital companions know the preferences of a specific user. The separation of concerns between expert and personal companions enables them to evolve independently. Thus, expert and personal digital companions collaborate to provide customized assistance to a user given her environment. In this paper, we present two expert digital companions for employees working in an office and a shopfloor environment that takes advantages of: the decoupling that the W3C WoT Thing Description provides to interact with and control devices and other tools; a Knowledge Graph to provide richer descriptions of elements in the environment; computer vision to perceive the physical world; and Mixed Reality as the medium to deliver assistance to workers.

4.1.1 Relevant Excerpts

Back to Result Summary
Back to Key Features

Relevant Excerpts from Specification
KF1: The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement.

[Introduction, Page 1, Col. 2 , Para [001]] This paper follows the vision of Digital Companions (DCs) that assist human users navigating an increasingly complex world [10], in which a plethora of IoT devices and their services are available, but can remain underutilized by people or can even interfere with their activities by adding steps to accomplish them. Unlike popular digital assistants (e.g., Siri and Alexa), a DC is capable of actively perceiving the environment, it knows about the available services and devices, and it can assess a person's current context in order to proactively compute and deliver relevant and personalized assistance [9]. **To achieve this, we propose two types of DCs, namely personal and experts. A personal DC is in charge of assisting and looking after its user, it has learnt relevant information about her, including preferences and relationships with other users. In contrast, an expert DC manages a physical or virtual environment, it knows about the different roles a person can play in such an environment and it is responsible for communicating the code of conduct that should be followed. Moreover, an expert DC communicates with personal DCs to provide them with information, access to services, and devices in the environment it manages.**

[Conclusion and Future Work, Page 7, Col. 2 , Para [003]] The future work of this research is plentiful on making the different research areas converge. **To enable higher autonomy levels on DCs, we will bring them to a Multi-Agent System (MAS) ecosystem.** This will entail looking into agents and artifact models, and agents communication protocols. To provide a richer representation of environments and relevant aspects of an application domain, we will keep scouting and utilizing standardized knowledge models, to enable interoperability with future implementations of DCs. In this way, expert DCs made available in different locations could seamlessly work with unknown personal DCs. Regarding personal DCs, means to learn user's habits and preferences will be implemented. Additionally, more sophisticated means to perceive the environment through computer vision will be explored [40]. Finally, ways for DCs to interact with users trough Mixed Reality and other innovative user interfaces will be investigated in more depth.

KF2: The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done.

[Introduction, Page 1, Col. 2 , Para [001]] This paper follows the vision of Digital Companions (DCs) that assist human users navigating an increasingly complex world [10], in which a plethora of IoT devices and their services are available, but can remain underutilized by people or can even interfere with their activities by adding steps to accomplish them. Unlike popular digital assistants (e.g., Siri and Alexa), a DC is capable of actively perceiving the environment, it knows about the available services and devices, and it can assess a person's current context in order to proactively compute and deliver relevant and personalized assistance [9]. To achieve this, we propose two types of DCs, namely personal and experts. **A personal DC is in charge of assisting and looking after its user, it has learnt relevant information about her, including preferences and relationships with other users.** In contrast, an expert DC manages a physical or virtual environment, it knows about the different roles a person can play in such an environment and it is responsible for communicating the code of conduct that should be

followed. Moreover, an expert DC communicates with personal DCs to provide them with information, access to services, and devices in the environment it manages.

[System Architecture, Page 4, Col. 2 , Para [003]] Scene controller. **It manages the hologram that a DC is currently displaying for the user. A hologram can provide information, allow controlling equipment, or display warnings**. Information holograms provide users with insights regarding the environment, e.g., information about the current process running on a robot. Control holograms enable the user to interact with equipment in the environment, e.g., displaying a button to turn on and off the lights. Warning holograms are displayed when a condition that deserves attention is met e.g., the CO2 is higher than a normal index. Warning holograms are used to inform a user to take action or to inform them about an action taken by a DC.

[Conclusion and Future Work, Page 7, Col. 2 , Para [003]] The future work of this research is plentiful on making the different research areas converge. To enable higher autonomy levels on DCs, we will bring them to a Multi-Agent System (MAS) ecosystem. This will entail looking into agents and artifact models, and agents communication protocols. To provide a richer representation of environments and relevant aspects of an application domain, we will keep scouting and utilizing standardized knowledge models, to enable interoperability with future implementations of DCs. In this way, expert DCs made available in different locations could seamlessly work with unknown personal DCs. **Regarding personal DCs, means to learn user's habits and preferences will be implemented. Additionally, more sophisticated means to perceive the environment through computer vision will be explored [40]. Finally, ways for DCs to interact with users trough Mixed Reality and other innovative user interfaces will be investigated in more depth.**

KF2a: The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts.

[Introduction, Page 1, Col. 2 , Para [002]] DCs operate on the Web, given their ability to interconnect documents, devices, virtual services, and even abstract concepts. **Furthermore, DCs take advantage of technology fields that have traditionally evolved separately, but which can be merged to create powerful system that assist humans. Those fields are: the Web of Things (WoT), Knowledge Graph (KG), Deep Learning (DL), Multi-Agent Systems (MAS), and Innovative User Interfaces e.g., Mixed Reality (MR).** In this paper, we present expert DCs that take advantage of the strengths of such technologies to assist workers in an office and a shopfloor environment. Thus, workers are supported, informed and made aware of available services in such spaces, and of actions that can be taken to achieve their tasks, as well as to make their working spaces more comfortable.

KF2b**:** Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions.

[Related Work, Page 1, Col. 2 , Para [003]] In parallel to the agents field, other research areas have called out for a human-centric evolution of technologies to enhance human capabilities and assist people on diverse aspects of their lives. As proposed in [29], this could be achieved by making technologies converge and build on the strengths of one another. Wilks [37] defined an artificial companion as a helpful cognitive agent that knows the habits of a user, talks to her, entertains her, and assists her in simple tasks. Wilks also predicted that artificial companions were going to be deeply researched within the language and speech research areas. As Wilks pointed out, with the raise in popularization of digital assistants (e.g., Siri, Alexa, and Google Assistant), research in conversational AI has had huge advancement on the recent years [16]. **In [26] an artificial companion that considers the implications of empathy and theory of mind is proposed, a companion that learns by imitation. The concept of empathy and emotional connection between humans and companions has been carried over to recent years [23].** Moreover, in [6] an assistant for medical personnel is proposed, in which agent technologies and Mixed Reality are used to present relevant and contextual information to physicians in charge of critical time-dependent pathologies.

KF2c: API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.

KF3: The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences.

[Conclusion and Future Work, Page 7, Col. 2 , Para [002]] **In this paper, we presented a demonstrator of an expert DC that assists employees working in an office, as well as an expert DC for a shopfloor environment. Their objective is to improve workers comfort, productivity and keep them safe, by monitoring the current environmental conditions, providing them with means to control and interact with equipment and devices available in such environments, and by keeping them in the loop of automated processes.** These expert DCs have been built by combining technology fields that have evolved independently, but which strengths have been combined. That is, thanks to the machine-readable descriptions of interfaces of Things (i.e., TDs) available in an environment, an expert DC is able to get readings from sensors, obtain information about current processes on devices, and even control them. Those TDs are part of a KG able to provide richer descriptions of the Things. Moreover, other concepts are represented in the KG, such as pollution, rain, and their thresholds. This provides a DC with the knowledge to inform about abnormal environmental conditions. Furthermore, by using a Mixed Reality head-mounted display and an object detection algorithm, an expert DC is able to provide contextualized assistance according to the object a user is looking at. Additionally, Mixed Reality is used by the DC to communicate with the user in an intuitive

manner by overlaying information on the physical world that otherwise would be hidden. In this paper, we focus on the implementation of expert DCs responsible for physical environments, providing homogeneous assistance across users. In following steps of our research, clear separation of concerns will be achieved by limiting the communication with users to personal DCs. **Hence, a personal DC would communicate with an expert DC to gather information about the current state of devices and the environment it manages. It will then use such information to personalize assistance for its user according to previously learnt knowledge.**

KF4: These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.

[Related Work, Page 2, Col. 1 , Para [002]] In parallel to the agents field, other research areas have called out for a human-centric evolution of technologies to enhance human capabilities and assist people on diverse aspects of their lives. As proposed in [29], this could be achieved by making technologies converge and build on the strengths of one another. **Wilks [37] defined an artificial companion as a helpful cognitive agent that knows the habits of a user, talks to her, entertains her, and assists her in simple tasks. Wilks also predicted that artificial companions were going to be deeply researched within the language and speech research areas.** As Wilks pointed out, with the raise in popularization of digital assistants (e.g., Siri, Alexa, and Google Assistant), research in conversational AI has had huge advancement on the recent years [16]. In [26] an artificial companion that considers the implications of empathy and theory of mind is proposed, a companion that learns by imitation. The concept of empathy and emotional connection between humans and companions has been carried over to recent years [23]. Moreover, in [6] an assistant for medical personnel is proposed, in which agent technologies and Mixed Reality are used to present relevant and contextual information to physicians in charge of critical time-dependent pathologies.

[Related Work, Page 1, Col. 2 , Para [003]] **Autonomous agents capable of supporting people in performing routine, time-consuming, and difficult tasks have been a subject of research for several decades. In the mid-90s, Maes [20] identified the need for competent and trustworthy agents capable of supporting people in environments that were becoming increasingly complex due to the popularization of personal computers and the imminent digitization of several industries. In [4] a system of agents capable of supporting a human-organization in performing tasks such as scheduling meetings and monitoring events is presented.** Moreover, York-Smith [39] takes an office desktop use case to create proactive agents for assisting users perform common tasks. These and other research on the agents field have not only demonstrated that software agents can work for and collaborate among each other to help on tasks that are simple for humans, but which require constant communication, negotiation, and organization among several software agents. These works have also produced research on the importance of behavioral characteristics that must be considered when creating agents, such as proactivity [39].

KF4a: Users have a dashboard where they interact with the LLM backed Avatars.
KF5: In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths.
KF6: In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data).
KF6a: Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

4.1.2 Relevant Figure

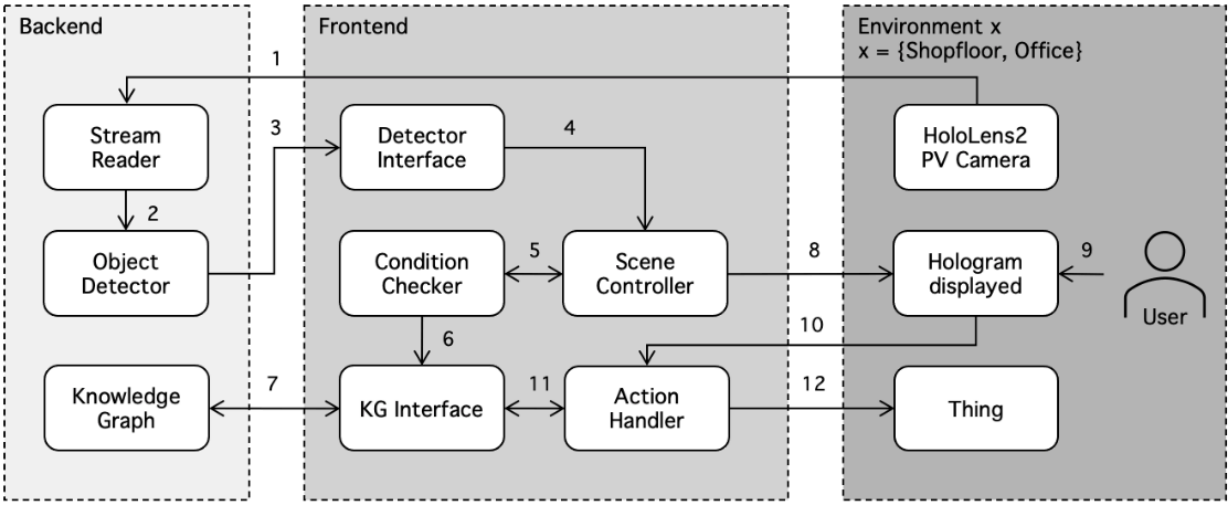

Figure 4: The flow between the different components and the environment

4.2 Result 2

Patent Document No.	Assignee	Inventors	Date of Publication
US11861704B2	Graphen Inc	Ching-Yung Lin Danny Lo-tien Yeh Yizhou Shen Yihan Wang Yuting An Xinwei Li	January 2, 2024
Title of the Patent Document	Persona-driven and artificially-intelligent avatar		
Abstract	A system for providing a persona-driven and artificially-intelligent avatar is disclosed. The avatar may be utilized to represent an artificially-intelligent virtual assistant that may perform actions on behalf of a user, such as actions related to personal shopping for the user. Notably, the avatar may influence artificial intelligence algorithms supporting the functionality of the virtual assistant via quantifiable traits of a persona of the avatar. In particular, the quantifiable traits of the persona of the avatar may be utilized to range bound the controlling parameters of the algorithms such that the virtual assistant represented by the avatar performs		

	actions that conform to the ranged-bounded controlling parameters. Metrics corresponding to the performance of the virtual assistant may be tracked, and the system may modify parameters of the virtual assistant based on the metrics so as to adjust future actions performed by the virtual assistant for the user.

4.2.1 Relevant Excerpts

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Relevant Excerpts from Specification
KF1: The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement.
[Detailed Description, Col. 12, Lines 29-67 & Col. 13, Lines 1-5]] In certain embodiments and referring now also to FIG. 2 , the software application may include one or more digital avatars 202 *a-z* that may be provided as a selection 201 to a user or device. The digital avatars 202 *a-z* may be programs or functions of the software application that may be visually rendered or otherwise presented (e.g. such as by audio or other means) to a user or device via the software application to represent one or more AIVAs. In certain embodiments, the digital avatars 202 *a-z* may appear like a movie character, a video game character, a rendered human character, an animal, or as anything. **The digital avatars 202 *a-z* may have personas programmed for them that have features, characteristics and/or parameters including, but are not limited to, personality, background experience (e.g. programmed educational experience or learned experience from use of the avatars 202 *a-z*), appearance, age, virtual physical condition, digital clothing/fashion style, virtual physical mannerisms, behaviors, any other characteristic, or a combination thereof. In certain embodiments, the persona of the digital avatars 202 *a-z* may conform to one or more personality models consisting of one or more dimensions, where each dimension may be a specific property of the persona**. For example, the 5-dimension Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN) model may be utilized for the personas of the digital avatars 202 *a-z*, the 16 *pf* model with 16 dimensions may be utilized, or any other model may be utilized. For the OCEAN model, the dimensions of the persona may be on a scale from 1-5 (or any other suitable scale), where 1 is the lowest level for exhibiting the particular characteristic and 5 is the highest level for exhibiting the particular characteristic. In certain embodiments, each of the digital avatars 202 *a-z* may have their own persona, however, in certain embodiments, groups of avatars 202 *a-z* may share a persona and/or have an overlap in persona. The features, characteristics, and/or parameters of the personas of the digital avatars 202 *a-z* may be utilized

to decide the range of the controlling parameters of AIVAs, which may be programs and/or functions implemented by one or more OLRMs 204 *a-z*, to perform one or more actions on behalf of a user or device. In certain embodiments, the features, characteristics, and/or parameters of the personas of the digital avatars 202 *a-z* may be mapped to the parameters of the AIVAs implemented by the one or more OLRMs 204 *a-z* by utilizing a mapping function of the system 100.

KF2: The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done.

[Detailed Description, Col. 19, Lines 1-45]] **At step 804, the method 800 may include generating a first digital avatar 202 *a* to represent the first AIVA provided in step 802. Additionally, other digital avatars 202 *b-z* may be generated to represent other AIVAs generated in step 802. In certain embodiments, the first digital avatar 202 *a* may have a first persona including characteristics, parameters, traits, and/or features mapped to parameters of the first OLRM 204 *a*, such as by utilizing a mapping function of the system 100.** In certain embodiments, the characteristics, parameters, traits and/or features of the first persona of the first digital avatar 202 *a* may be utilized to set ranges for the parameters of the first OLRM 204 *a* for controlling the actions performed and/or facilitated by the first OLRM 204 *a* for the first virtual assistant. Similarly, the other digital avatars 202 *b-z* may have corresponding personas that are mapped to parameters of their corresponding OLRMs 204 *b-z*. In certain embodiments, the generating of the first digital avatar 202 *a* (and other digital avatars 202 *b-z*) may be performed and/or facilitated by utilizing the first user device 102, the second user device 111, the OLRMs 204 *a-z*, the server 140, the server 150, the server 160, the communications network 135, any combination thereof, or by utilizing any other appropriate program, network, system, or device. At step 806, the method 800 may include providing the first digital avatar 202 *a*, along with any other digital avatars 202 *b-z*, to a computing device (e.g. first user device 102 and/or second user device 111) for selection by a user and/or device. For example, the first digital avatar 202 *a* and any other digital avatars 202 *b-z* may be visually rendered on a mobile application or a web page utilized by a user of the system 100. In certain embodiments, the digital avatars 202 *a-z* may be presented to the user as audio, video, any type of media content, or any combination thereof. At step 806, the method may also include receiving the selection of a particular digital avatar 202 *a-z* for performing actions on behalf of the user and/or device. For the purposes of this method 800, the user or device may select the first digital avatar 202 *a* from a plurality of digital avatars 202 *a-z* presented to the user or device. In certain embodiments, the selection of the digital avatars 202 *a-z* may be performed and/or facilitated by utilizing the first user device 102, the second user device 111, the OLRMs 204 *a-z*, the server 140, the server 150, the server 160, the communications network 135, any combination thereof, or by utilizing any other appropriate program, network, system, or device.

KF2a: The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts.
[Detailed Description, Col. 11, Lines 28-50]] In certain embodiments, the database 155 may store algorithms facilitating the operation of the avatars 202 *a-z*, virtual assistants, and/or OLRMs 204 *a-z*, algorithms for determining the performance metrics associated with the virtual assistants and/or avatars 202 *a-z*, artificial intelligence algorithms, machine learning algorithms, algorithms for recommending and implementing investment strategies, algorithms for facilitating online shopping, algorithms for facilitating online education, algorithms for facilitating video game play and objectives, algorithms for facilitating the operation of a vehicle, algorithms for facilitating management consulting services, algorithms for facilitating social network interactions and functionality, algorithms for performing any operations and/or calculations performed by the system 100, any type of algorithm, or any combination thereof. In certain embodiments, the database 155 may be configured to store any information generated and/or processed by the system 100, store any of the information disclosed for any of the operations and functions disclosed for the system 100 herewith, store any information traversing the system 100, or any combination thereof. Furthermore, the database 155 may be configured to process queries sent to it by any device in the system 100.
KF2b: Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions.
[Detailed Description, Col. 12, Lines 29-67 & Col. 13, Lines 1-5]] In certain embodiments and referring now also to FIG. 2 , the software application may include one or more digital avatars 202 *a-z* that may be provided as a selection 201 to a user or device. The digital avatars 202 *a-z* may be programs or functions of the software application that may be visually rendered or otherwise presented (e.g. such as by audio or other means) to a user or device via the software application to represent one or more AIVAs. In certain embodiments, the digital avatars 202 *a-z* may appear like a movie character, a video game character, a rendered human character, an animal, or as anything. The digital avatars 202 *a-z* may have personas programmed for them that have features, characteristics and/or parameters including, but are not limited to, personality, background experience (e.g. programmed educational experience or learned experience from use of the avatars 202 *a-z*), appearance, age, virtual physical condition, digital clothing/fashion style, virtual physical mannerisms, behaviors, any other characteristic, or a combination thereof. **In certain embodiments, the persona of the digital avatars 202 *a-z* may conform to one or more personality models consisting of one or more dimensions, where each dimension may be a specific property of the persona. For example, the 5-dimension Openness, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN) model may be utilized for the personas of the digital avatars 202 *a-z*, the 16 *pf* model with 16 dimensions may be utilized, or any other model may be utilized. For the OCEAN model, the dimensions of the persona may be on a scale from 1-5 (or any other suitable scale), where 1 is**

the lowest level for exhibiting the particular characteristic and 5 is the highest level for exhibiting the particular characteristic. In certain embodiments, each of the digital avatars 202 *a-z* may have their own persona, however, in certain embodiments, groups of avatars 202 *a-z* may share a persona and/or have an overlap in persona. The features, characteristics, and/or parameters of the personas of the digital avatars 202 *a-z* may be utilized to decide the range of the controlling parameters of AIVAs, which may be programs and/or functions implemented by one or more OLRMs 204 *a-z*, to perform one or more actions on behalf of a user or device. In certain embodiments, the features, characteristics, and/or parameters of the personas of the digital avatars 202 *a-z* may be mapped to the parameters of the AIVAs implemented by the one or more OLRMs 204 *a-z* by utilizing a mapping function of the system 100.

KF2c**:** API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.

KF3: The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences.

[Detailed Description, Col. 17, Lines 28-50]] In certain embodiments, the learning and reasoning modules of the OLRMs 204 *a-z* of the virtual assistants may be configured to train and update a variety of models of the OLRMs 204 *a-z* to seek patterns, anomalies, relationships, and correlations within and between the datasets imported from the database 155. For example, in one embodiment, the learning and reasoning modules of the OLRMs 204 *a-z* may train, test, and refine models on the pre-processed data such as, but not limited to, market indicators and social network data obtained by the observations modules by utilizing various unsupervised machine learning methodologies. The machine learning methodologies may include, but are not limited to, reinforcement learning and deep learning. In certain embodiments, the learning and reasoning modules may provide market trend prediction and sentiment analysis, develop investment strategies based on the trained models, and update the strategies by re-training the models based on the monitored performance results of the virtual assistants when performing actions on behalf of a user or device. **In certain embodiments, for each avatar, different models, different machine learning methods, and different strategy development methodologies may be utilized in accordance with the parameters, traits, and/or characteristics of the persona of the avatar representing a particular virtual assistant.**

[Detailed Description, Col. 19, Lines 1-45]] At step 804, the method 800 may include generating a first digital avatar 202 *a* to represent the first AIVA provided in step 802. Additionally, other digital avatars 202 *b-z* may be generated to represent other AIVAs generated in step 802. In certain

embodiments, the first digital avatar 202 *a* may have a first persona including characteristics, parameters, traits, and/or features mapped to parameters of the first OLRM 204 *a*, such as by utilizing a mapping function of the system 100. In certain embodiments, the characteristics, parameters, traits and/or features of the first persona of the first digital avatar 202 *a* may be utilized to set ranges for the parameters of the first OLRM 204 *a* for controlling the actions performed and/or facilitated by the first OLRM 204 *a* for the first virtual assistant. Similarly, the other digital avatars 202 *b-z* may have corresponding personas that are mapped to parameters of their corresponding OLRMs 204 *b-z*. In certain embodiments, the generating of the first digital avatar 202 *a* (and other digital avatars 202 *b-z*) may be performed and/or facilitated by utilizing the first user device 102, the second user device 111, the OLRMs 204 *a-z*, the server 140, the server 150, the server 160, the communications network 135, any combination thereof, or by utilizing any other appropriate program, network, system, or device. At step 806, the method 800 may include providing the first digital avatar 202 *a*, along with any other digital avatars 202 *b-z*, to a computing device (e.g. first user device 102 and/or second user device 111) for selection by a user and/or device. For example, the first digital avatar 202 *a* and any other digital avatars 202 *b-z* may be visually rendered on a mobile application or a web page utilized by a user of the system 100. In certain embodiments, the digital avatars 202 *a-z* may be presented to the user as audio, video, any type of media content, or any combination thereof. **At step 806, the method may also include receiving the selection of a particular digital avatar 202 *a-z* for performing actions on behalf of the user and/or device. For the purposes of this method 800, the user or device may select the first digital avatar 202 *a* from a plurality of digital avatars 202 *a-z* presented to the user or device.** In certain embodiments, the selection of the digital avatars 202 *a-z* may be performed and/or facilitated by utilizing the first user device 102, the second user device 111, the OLRMs 204 *a-z*, the server 140, the server 150, the server 160, the communications network 135, any combination thereof, or by utilizing any other appropriate program, network, system, or device.
KF4: Users have a dashboard where they interact with the LLM backed Avatars. These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.
KF4a: Users have a dashboard where they interact with the LLM backed Avatars.

KF5: In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths.
KF6: In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data).
KF6a: Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

4.2.2 Relevant Figures

300

	Low	High
Openness	•Less information sources •Less operating financial instruments •Less models •Tend to use traditional models	•More information sources •More instruments •More models •Tend to use new models •Tend to self-improve
Conscientiousness	•Less complex models •Random factor leads to breaking the rule	•Complex models •Strictly follow the models •Tend to trade at higher frequency if at higher information acquisition
Extroversion	•Tend not to interact with other avatars •Low risk tolerance •Relatively more complex observation module •Tend to trade long term	•Tend to interact with other avatars to get information •Relatively high risk tolerance •Tend to trade short term
Agreeableness	•Tend to be competitive among avatars •Tend not to trust other avatars	•Tend to follow herd behavior •Tend to trust information sources
Neuroticism	•Tend to calculate risk before an action •Tend to self-improve after a loss	•High random factor that may lead to overtrade

FIG. 3

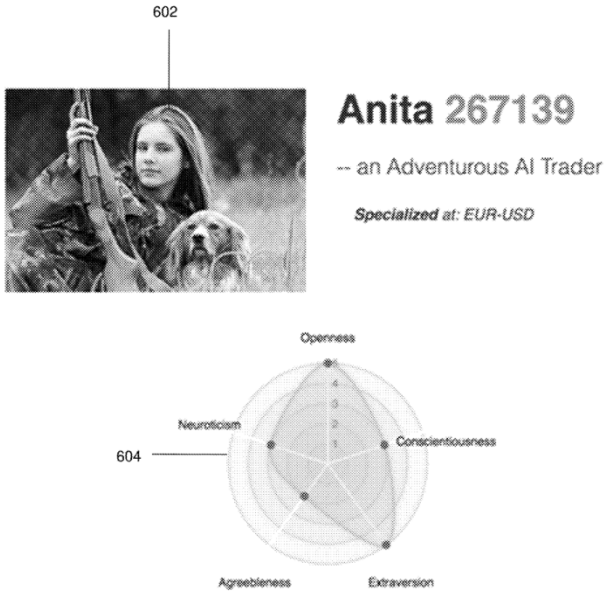

FIG. 6

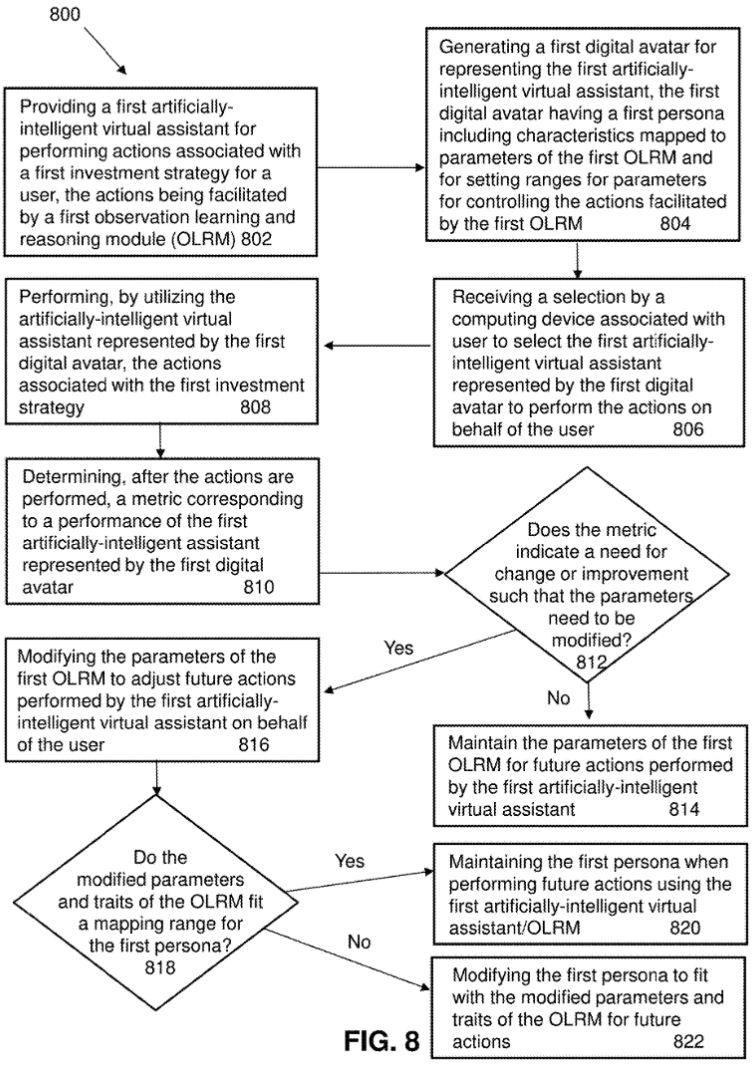

FIG. 8

4.3 Result 3

Patent Document No.	**Assignee**	**Inventors**	**Date of Publication**
US9830044B2	Verint Americas Inc	Fred A Brown Tanya M Miller	November 28, 2017
Title of the Patent Document	Virtual assistant team customization		

Abstract	Techniques and architectures for implementing a team of virtual assistants are described herein. The team may include multiple virtual assistants that are configured with different characteristics, such as different functionality, base language models, levels of training, visual appearances, personalities, and so on. The characteristics of the virtual assistants may be configured by trainers, end-users, and/or a virtual assistant service. The virtual assistants may be presented to end-users in conversation user interfaces to perform different tasks for the users in a conversational manner. The different virtual assistants may adapt to different contexts. The virtual assistants may additionally, or alternatively, interact with each other to carry out tasks for the users, which may be illustrated in conversation user interfaces.

4.3.1 Relevant Excerpts

Back to Result Summary
Back to Key Features

Relevant Excerpts from Specification
KF1: The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement.
[Detailed Description, Col. 2, Lines 34-49]] In some implementations, a virtual assistant service may provide a variety of tools to enable end-users, trainers, and others to connect with and/or use a team of virtual assistants. The virtual assistant service may provide a virtual assistant trainer interface to trainers in order to build characteristics of the virtual assistants. In some instances, a trainer may identify a virtual assistant through the trainer interface and interact with the virtual assistant over a period of time to teach the virtual assistant how to interact with users. In other instances, a trainer may provide input directly through the trainer interface to configure characteristics of a virtual assistant, such as configuring responses that should be provided for particular types of input, configuring tasks that should be performed, and so on. In yet further instances, a trainer may otherwise provide input to train a virtual assistant.
KF2: The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done.

[Detailed Description, Col. 2, Lines 19-33]] This disclosure describes, in part, techniques and architectures for implementing a team of virtual assistants. **The team may include multiple virtual assistants that are configured with different characteristics, such as different functionality, base language models, levels of training, visual appearances, personalities, and so on. The characteristics of the virtual assistants may be configured by trainers, end-users, and/or a virtual assistant service.** The virtual assistants may be presented to end-users in conversation user interfaces to perform different tasks for the users in a conversational manner. The different virtual assistants may adapt to different contexts (e.g., conversation context, location of the user, content that is output, calendar events, etc.). **The virtual assistants may additionally, or alternatively, interact with each other to carry out tasks for the users, which may be illustrated in conversation user interfaces.**

[Detailed Description, Col. 18, Lines 21-24]] **FIG. 7 illustrates an example virtual assistant trainer interface 700 to set or configure characteristics of a virtual assistant. Here, a trainer may configure characteristics of a finance virtual assistant 702.**

[Detailed Description, Col. 18, Lines 25-41]] **The virtual assistant trainer interface 700 may include an input field 704 to set a name of the finance virtual assistant 702, a drop-down menu 706 to upload an image to be associated with the finance virtual assistant 702 (e.g., configure a visual appearance of a virtual assistant), and an input field 708 to input a description of the finance virtual assistant 702 (e.g., capabilities, the types of training that the finance virtual assistant 702 has been subjected to, information about the trainer, and so on).** The virtual assistant trainer interface 700 may also include an input field 710 to specify an action (e.g., verb) and object (e.g., noun) to be associated with a particular task selected through a drop-down menu 712. **The action and object may additionally be associated with a response through selection of a response in a drop-down menu 714 and/or text input through an input field 716. The trainer may save any changes to the finance virtual assistant 702 by selecting a button 718.**

KF2a: The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts.

[Detailed Description, Col. 17, Lines 38-47]] **FIG. 6 illustrates an example virtual assistant trainer interface 600 to review and configure base language models of virtual assistants. As noted above, a base language model may form the basis of a virtual assistant's language and may include a set of language units, with each language unit mapping a set of inputs (e.g., user queries or questions) to a task or response.** Here, a trainer has selected to configure a base language model of a sports virtual assistant 602. In particular, the trainer has selected a particular concept of the base language model, namely a basketball concept 604.

[Detailed Description, Col. 17, Lines 48-67 & Col. 18, Lines 1-4]] As illustrated, the virtual assistant trainer interface 600 presents a base language model 606 for the basketball concept 604. The base

language model 606 includes language units 608 and 610. For example, the language unit 608 includes a set of input 612 that is mapped to a response 614 (or task). **Although the set of input 612 is illustrated as questions, the set of input 612 may alternatively, or additionally, include any type of user input (e.g., statements, phrases, etc.). The sports virtual assistant 602 may provide response 614 for any of the set of input 612. In some instances, input can be modified to include a sport concept. Through the virtual assistant trainer interface 600, the trainer may reconfigure the base language model-606 by adding content to the set of input 612, updating the response 614, and/or adding an additional language unit through a button 616.** The trainer may also change a data source that is accessed to formulate a response (e.g., a data source used to find a score of a game). In this example, the trainer has added content "hoops score" to the set of input 612, so that this phrase corresponds to a response of "the score is [ ]" (where brackets indicate information to be filled in). In some instances, a base language model for another sport may be created by adding another concept and selecting the concept to be included as a concept for a base language model.
KF2b: Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions.
KF2c: API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.
KF3: The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences.
[Detailed Description, Col. 13, Lines 61-67]] Entity that is associated with a virtual assistant. For example, a virtual assistant may have been generated by or for a particular user, application (e.g., program), company, service provider, device, etc. (e.g., personalized for a user, associated with a user's account, associated with a company, etc.). **[Detailed Description, Col. 14, Lines 1-5]]** As noted above, a team of virtual assistants may include virtual assistant with different characteristics. As such, the team of virtual assistants may be associated with different modules, entities, storage locations, method of implementation, and so on.

KF4: These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.
[Detailed Description, Col. 17, Lines 48-67 & Col. 18, Lines 1-4]] As illustrated, the virtual assistant trainer interface 600 presents a base language model 606 for the basketball concept 604. The base language model 606 includes language units 608 and 610. For example, the language unit 608 includes a set of input 612 that is mapped to a response 614 (or task). **Although the set of input 612 is illustrated as questions, the set of input 612 may alternatively, or additionally, include any type of user input (e.g., statements, phrases, etc.). The sports virtual assistant 602 may provide response 614 for any of the set of input 612. In some instances, input can be modified to include a sport concept. Through the virtual assistant trainer interface 600, the trainer may reconfigure the base language model-606 by adding content to the set of input 612, updating the response 614, and/or adding an additional language unit through a button 616.** The trainer may also change a data source that is accessed to formulate a response (e.g., a data source used to find a score of a game). In this example, the trainer has added content "hoops score" to the set of input 612, so that this phrase corresponds to a response of "the score is [ ]" (where brackets indicate information to be filled in). In some instances, a base language model for another sport may be created by adding another concept and selecting the concept to be included as a concept for a base language model.
KF4a: Users have a dashboard where they interact with the LLM backed Avatars.
KF5: In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths.
KF6: In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data).

KF6a: Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

4.3.2 Relevant Figures

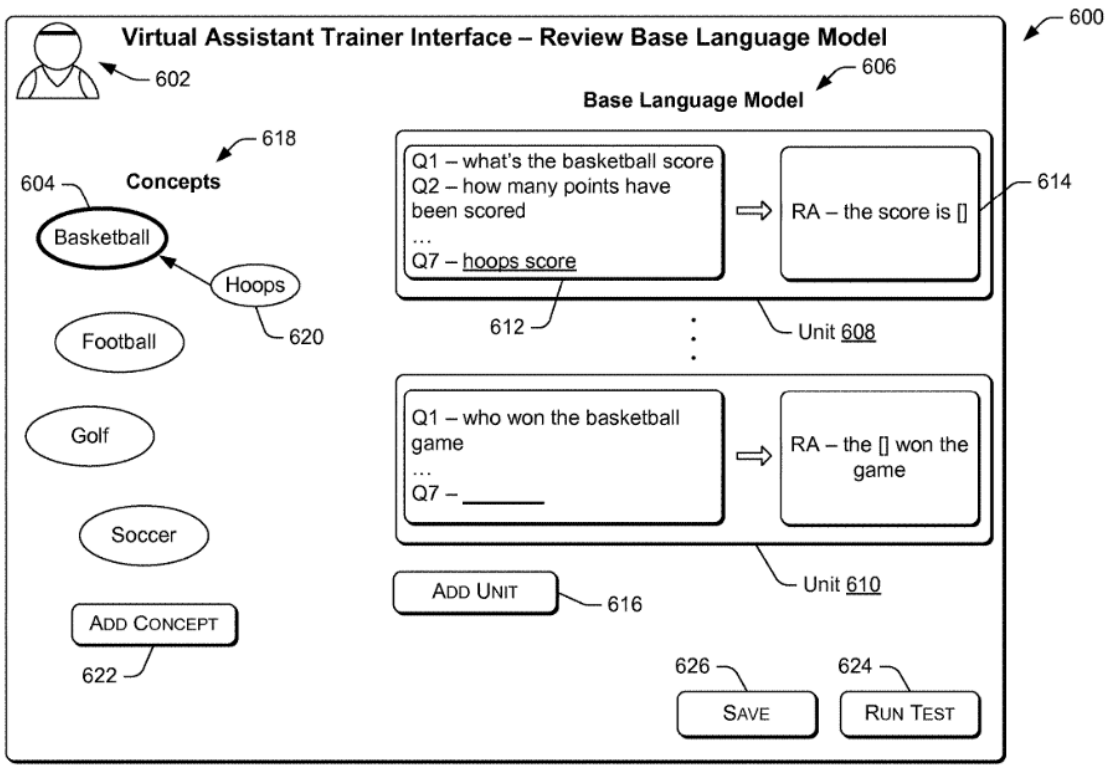

FIG. 6

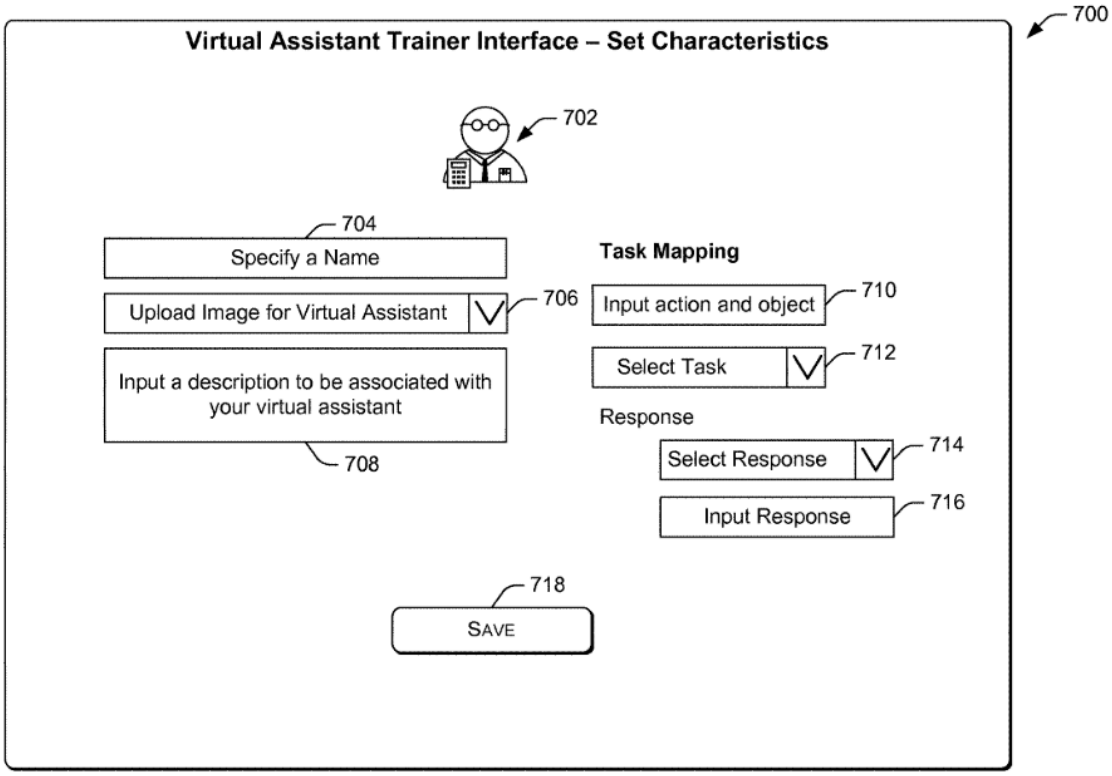

FIG. 7

4.4 Result 4

Patent Document No.	Assignee	Inventors	Date of Publication
WO202122732 5A1	China Electronics Technology	Hu Changming Ben Kecun Zhang Liu Xie Xieguo Lv Longquan Feng Zhanying	November 18, 2023
Title of the Patent Document	Digital twin-based production process simulation and optimization method		
Abstract	On the basis of flexible production requirements on multiple varieties, small batches and variable paces, a manufacturing operation management system and a data acquisition and control system based on big data are constructed to improve the intelligent level of production logistics and the professional level of assembly		

	process equipment and form an assembly intelligent workshop using a batch product pulsation production line and a developed product intelligent assembly unit as main bodies, thereby providing more optimization decisions for physical entities by means of information fusion and data interaction between virtual models and the physical entities.

4.4.1 Relevant Excerpts

Back to Result Summary
Back to Key Features

Relevant Excerpts from Specification
KF1: The present invention relates to an AI-powered personalized multi-agent platform designed to enhance employee efficiency and employee engagement.
KF2: The present invention proposes LLM-backed personalized avatars wherein each avatar is designed to embody a specific set of skills, experience (knowledge base), and persona (personality, purpose, and preferences) that best align with their job to be done.
KF2a: The avatars are powered by state-of-the-art LLMs like GPT-4, enabling them to understand and generate human-like text, perform complex language tasks, and adapt to various communication styles and contexts.
KF2b: Equipped with emotion detection capabilities, the avatars perceive and respond to user emotions.

KF2c: API integration with top HR Management and HRIS Platforms (Workday, Oracle, etc), to leverage company data and "add on" to these platforms.
KF3: The platform offers deep personalization by adapting to individual user preferences, professional needs, and work habits. This includes customizing interactions based on the user's personality, purpose, and preferences.
KF4: Users have a dashboard where they interact with the LLM backed Avatars. These avatars provide the employee with the resources to 1) agentive features to automate repetitive tasks, 2) help fill skill gaps where an employee/team is short staffed, and 3) be used as consultants for various subject matters, trained with deep subject matter expertise.
KF4a: Users have a dashboard where they interact with the LLM backed Avatars.
KF5: In an embodiment, one agent will possess the capability to analyze data and run "what if" scenarios to 1) see which teams are most optimized and 2) allow employees to run simulations on career development and career paths.
KF6: In an embodiment, a "digital twin" is created for the employee by capturing employee personality, purpose (CliftonStrengths, CVI), preferences, and data integrated from HR management systems (e.g., performance data).
[Detailed Ways, Page 6, Lines [12-15]] **The digital twin model of the production process adopts the unified expression DTws=DTequip∪DTprod∪DTpers∪DTenv, where DTws is the digital model of the workshop production process, DTequip is the equipment digital twin model, DTprod**

is the product digital twin model, DTpers is the personnel digital twin model, and DTenv It is an environmental twin model.

[Detailed Ways, Page 6, Lines [17-20]] **Based on digital twin information, statistical learning, and deep learning technology, complete the professional diagnosis of the operating status of the assembly shop, realize the notification, determination, processing, tracking, analysis, recovery and closure of abnormalities, forming a closed loop of abnormal management of the workshop, and improving the abnormal handling Timeliness**.

KF6a: Digital replicas of the workplace environment and needs are developed to simulate and optimize team compositions and workflows.

[Background Technique, Page 1, Lines [42-46]] **With the development of the information age, digital twin technology has become one of the methods to realize intelligent manufacturing. The digital twin is to create virtual models of physical entities in the information space through digital methods, and use data to simulate the behavior of physical entities in the real environment. Through the information fusion and data interaction between the virtual model and the physical entity, more optimization decisions are provided for the physical entity.**

[Detailed Ways, Page 6, Lines [12-15]] The digital twin model of the production process adopts the unified expression DTws=DTequip∪DTprod∪DTpers∪DTenv, where DTws is the digital model of the workshop production process, DTequip is the equipment digital twin model, DTprod is the product digital twin model, DTpers is the personnel digital twin model, and **DTenv It is an environmental twin model.**

[Detailed Ways, Page 6, Lines [22-27]] **Real-time collection of quality data, associating the collected data with production orders, batches and other information, discovering potential quality risks and problems in time, realizing rework and repair, quality visualization, and traceability management of the entire quality process, using accumulated historical data for Statistical analysis and data-driven equipment state modeling, non-linear predictive models, parameter optimization techniques and alarm strategies for different types of equipment objects, accurately grasp the deterioration trend of equipment status, prevent equipment abnormalities, and ensure smooth production.**

[Detailed Ways, Page 6, Lines [41-42]] **The process flow simulation is performed in the digital twin model again, the progress deviation of each work step in the actual assembly is calculated, and a new round of process flow optimization is completed.**

[Detailed Ways, Page 6, Lines [45-50]] In actual assembly operations, the process flow is often not in the best state, the station settings are unreasonable, and there is a large difference in the operating time

of each station. The assembly tools and equipment in the station are relatively traditional, the assembly efficiency is low, and the process data cannot be automated. Collection is not conducive to quality monitoring and process traceability, and the final assembly efficiency is improved by further optimizing the process flow, balancing the station beat, and improving the assembly capacity of the station.

5 Listing of other related Patent Literatures

5.1 Patent Literatures

Patent Document No.	Assignee/Inventors	Title
US11501259B2	Mips Systems Inc	Training an avatar to assist a user in career advancement
US9729592B2	PERSAIS LLC	System and method for distributed virtual assistant platforms
US20210264372A1	Imi Material Handling Logistics Inc	Automated human resources management and engagement system and method

6 Appendix

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