ARTIFICIAL INTELLIGENCE (AI) BASED SYSTEMS AND METHODS FOR ENHANCING EMPLOYEE ENGAGEMENT AND OPTIMIZING OPERATIONAL WORKFLOWS

TECHNICAL FIELD

[0001] The present disclosure relates generally to the application of Artificial Intelligence (AI) based agents and virtual agents in operational workflows and more particularly relates to AI-based systems and methods for the enhancement of employee engagement and optimization of operational workflows.

BACKGROUND

[0002] The success of an organization depends largely upon the efficiency and efficacy of employees working for the organization and the operational workflows deployed. It is not only important for the organization to get the right people working with the right skills on designated tasks, but also how efficiently an organization can automate routine and monotonous tasks to achieve higher productivity. Some of the most well-documented challenges to the success of an organization are workforce shortages, insufficient skill levels of the employees, disinterest of the employees in routine and monotonous tasks, and employee inertia towards learning new skills and adapting to large-scale organizational restructuring. Furthermore, responsiveness to critical but important feedback is also often found to be non-uniform amongst the employees within the same organization.

[0003] Another challenging area for the smoother functioning of an organization is inertia toward collaboration amongst cross-functional teams. Because of the highly competitive atmosphere in an organization, different verticals within a singular business unit may not be amenable to comprehensive knowledge sharing thereby impeding the overall growth of the organization. The reasons for such observations may include personality biases, cultural biases, or a simple lack of adequate face-to-face communication because of the requirement of adherence to strict timelines for disparate project objectives. Statistics indicate that organizations with enhanced employee engagement outperform competing entities quite significantly. Furthermore, it is widely believed that emerging technologies such as generative Artificial Intelligence (AI) leveraging structured and non-structured organizational data can enhance employee engagement, bridge communication gaps, and streamline operational workflows.

[0004] However, current trends indicate that there is still a significant amount of untapped potential in generative AI, Large Language Models (LLMs), automation of tasks using AI-based agents, etc. that can be used to significantly improve employee engagement and business outcomes.

SUMMARY

[0005] According to an aspect of the present disclosure, there is provided a computer-implemented method. The computer-implemented method includes generating, by a controller, a plurality of employee digital twins of a plurality of respective employees by leveraging employee-specific data. The computer-implemented method further includes enabling, by the controller, exchange of information amongst a plurality of disparate groupings including one or more of a plurality of employee devices belonging to the plurality of respective employees, and the plurality of employee digital twins, for simulating business outcomes. The computer-implemented method also includes modifying, by the controller, the plurality of employee digital twins to optimize operational workflows.

[0006] According to another aspect of the present disclosure, there is provided a computing system. The computing system included a controller. The controller includes a memory unit comprising machine-readable instructions and a processor operably connected to the memory unit. The processor is configured to execute the machine-readable instructions, the machine-readable instructions when executed by the processor, enable the processor to generate a plurality of employee digital twins of a plurality of respective employees by leveraging employee-specific data. Furthermore, the processor is enabled to enable exchange of information amongsta plurality of disparate groupings including one or more of aplurality of employee devices belonging to the plurality of respective employees, and the plurality of employee digital twins, for simulating business outcomes. The processor is also enabled to modify the plurality of employee digital twins to optimize operational workflows.

[0007] In the context of the specification, the term “software agent” refers to a program that is designed to operate autonomously for a user or another software program and perform predefined tasks to achieve predetermined objectives. A software agent may be able to autonomously acquire data, process data, and generate an output that may be used by the user or the other software program.

[0008] In the context of the specification, the phrase "Artificial Intelligence (AI) agent" refers to a software agent that has been trained on large amounts of historical and real-time data to mimic the responses of a human agent. The AI agent is equipped with relatively larger amounts of automation when compared to other software agents and can set goals for itself without the intervention of the human agent or the operator.

[0009] In the context of the specification, the phrase "multi-agent framework" refers to a framework in which several AI agents, non-AI agents, and human agents can interact with each other to achieve complex objectives. The multi-agent framework generally has predefined protocols for the exchange of data and information amongst all the agents including AI agents, non-AI agents, and human agents. Some of the examples of frameworks through which multi-agent systems can be built, include Microsoft AutoGen, JAAD (Java Agent Architecture Development Framework), MASIF (Multi-agent frameworks Interoperability Framework), AgentSpeak, Apache Tuweni, GAMA (Generic Agent Modeling Platform), etc.

[0010] In the context of the specification, the phrase "generative AI algorithms" refers to AI-based algorithms that are capable of generating several types of content including textual content, audiovisual content, and synthetic data. Generative AI algorithms are generally trained on large amounts of data sourced through several online and offline repositories.

[0011] In the context of the specification, the phrase "Large Language Model (LLM)" refers to a type of generative AI model that is designed to perform natural language tasks like generation and comprehension. LLMs are built on machine learning and neural networks and are trained on large datasets to learn patterns and relationships between words and phrases. They can then create new text combinations that mimic natural language based on their training data. LLMs are typically trained on datasets with at least one billion parameters, which is a machine-learning term for the variables in the model that can be used to infer new content. LLMs are based on transformer-based architectures. Transformers are a deep learning architecture specifically designed for handling sequential data like text. They excel at understanding the relationships between words in a sentence and across sentences. This allows LLMs to learn the context and structure of language. Some of the well-known LLMs known in the art include GPT-3 (Generative Pre-trained Transformer 3), Jurassic-1 Jumbo, Megatron-Turing NLG (Natural Language Generation), WuDao 2.0, BLOOM (BigScience Large Open-science Open-access Multilingual Language Model), LaMDA (Language Model for Dialogue Applications), WuDao 2.0 English, Jurassic-1 GPT-J, Bard (Google AI), etc.

[0012] In the context of the specification, the phrase “workflow automation application” refers to a software program used to automate repetitive tasks between web-based applications, such as moving information from one web-based application to another. The automation of repetitive tasks can be achieved through the generation and integration of several customizable automated processes in the workflow automation application. In that regard, each automated process may include a trigger that initiates the process and one or more actions that need to be performed when the trigger condition is satisfied. Some of the applications of workflow automation applications include Zapier, Make, IFTTT (If This Then That), Pabbly Connect, Microsoft Power Automate, Tray.io, Workato, Zoho Flow.

[0013] In the context of the specification, the phrase “virtual agent” refers to a program capable of interacting with a user through their client devices. The virtual agent may manifest as a chatbot that may interact with the user through textual messages, or voice messages or may manifest as a visual graphical representation in the form of a human face or any other graphical representation such as an animal face or an emoji.

[0014] In the context of the specification, the phrase “service mesh” refers to an infrastructure layer that handles communication between several services in an application. Service mesh is generally deployed in an architecture involving containerized microservices, however for the specification the scope of the service mesh is envisaged to also include non-containerized microservices-based monolithic applications. In the context of the specification, service meshes are envisaged to allow the exchange of information between an application (including amongst microservices within the application) and several external data sources such as external databases, client devices, third-party software agents, and multi-agent frameworks. Furthermore, it is envisaged that for the specification, the service mesh allows secure communications between applications and programs through the implementation of features such as Transport Layer Security (TLS) encryption, authentication, and authorization. Furthermore, service mesh helps ensure data confidentiality and integrity by encrypting traffic. Service meshes also allowthe implementation of authorization policies to control which services access specific endpoints or perform specific actions.

[0015] In the context of the specification, a “scraper agent” is a virtual agent capable of automatically gathering and extracting from network resources such as websites, web-based, and local databases. The data gathered and extracted may be stored in a structured form such as relational databases, semi-structured form, or unstructured form such as implementing a data lake.

[0016] In the context of the specification, the term “historical” in the execution of a command refers to anything pertaining to a time instant(s) that is earlier than a time instant of an initiation of the command.

[0017] In the context of the specification, the term, “real-time”, refers to without intentional delay, given the processing limitations of hardware/software/firmware involved and the time required to accurately measure/receive/process/transmit data as practically possible.

BRIEF DESCRIPTION OF THE FIGURES

[0018] The following detailed description of illustrative embodiments is better understood when read in conjunction with the appended drawings. To illustrate the present disclosure, exemplary constructions of the disclosure are shown in the drawings. However, the present disclosure is not limited to a specific device or a tool and instrumentalities disclosed herein. Moreover, those in the art will understand that the drawings are not to scale. Wherever possible, like elements have been indicated by identical numbers:

[0019] FIG. 1 illustrates an example representation of an environment related to at least some example embodiments of the present disclosure;

[0020] FIG. 2 illustrates a logical implementation of a controller for enabling several embodiments of the present disclosure, in accordance with an embodiment of the present disclosure;

[0021] FIG. 3 illustrates a computer-implemented method for enhancing employee engagement and optimizing operational workflows, in accordance with an embodiment of the present disclosure;

[0022] FIG. 4A illustrates an exemplary implementation of a plurality of virtual agents, in accordance with an embodiment of the present disclosure;

[0023] FIG. 4B illustrates an implementation of at least one virtual agent as a subject matter expert agent, in accordance with an embodiment of the present disclosure;

[0024] FIG. 4C illustrates a logical representation of a plurality of employee digital twins, in accordance with an embodiment of the present disclosure

[0025] FIG. 4D illustrates an implementation of a client application as a dashboard for an employee named Alex on an employee device, in accordance with an embodiment of the present disclosure;

[0026] FIG. 4E illustrates an implementation of a virtual agent acting as the communications-assist agent during an exchange of messages between two employees of an organization, in accordance with an embodiment of the present disclosure;

[0027] FIG. 5 illustrates a Kubernetes cluster for the orchestration of the containerized plurality of virtual agents, in accordance with an embodiment of the present disclosure;

[0028] FIG. 6A illustrates an implementation of a fourth pod hosted on a first worker node, in accordance with an embodiment of the present disclosure;

[0029] FIG. 6B illustrates an implementation of a first pod and third pod hosted on a second worker node, in accordance with an embodiment of the present disclosure; and

[0030] FIG. 6C illustrates an implementation of a second pod hosted on a third worker node, in accordance with an embodiment of the present disclosure.

[0031] The drawings referred to in this description are not to be understood as being drawn to scale except if specifically noted, and such drawings are only exemplary in nature.

DETAILED DESCRIPTION

[0032] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present disclosure. It will be apparent, however, to one skilled in the art that the present disclosure can be practiced without these specific details. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[0033] Reference in this specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. The appearances of the phrase “in an embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not for other embodiments.

[0034] Moreover, although the following description contains many specifics for the purposes of illustration, anyone skilled in the art will appreciate that many variations and/or alterations to said details are within the scope of the present disclosure. Similarly, although many of the features of the present disclosure are described in terms of each other, or in conjunction with each other, one skilled in the art will appreciate that many of these features can be provided independently of other features. Accordingly, this description of the present disclosure is set forth without any loss of generality to, and without imposing limitations upon, the present disclosure.

[0035] Various embodiments of the present disclosure provide artificial intelligence (ai) based systems and methods for enhancing employee engagement and optimizing operational workflows. The disclosure involves the generation of several virtual agents, employee digital twins, anti-employee digital twins, and one or more workplace digital twins to simulation workplace environments and operational workflows. For the generation of the virtual agents, the employee digital twins,the anti-employee digital twins, and the workplace digital twins, data may be sourced from several databases maintained by several services. These services may include Human Resource Information System (HRIS), Customer Relationship Management (CRM), Product Lifecycle Management (PLM), Enterprise Resource Planning (ERP), Communication Services such as those providing shared file locations, email, and instant messaging, etc. While sources of the data from business systems such as the HRIS, CRM, PLM, ERP, etc. strict adherence to data protection and privacy laws and regulations such as the General Data Protection Regulation (GDPR) and the California Consumer Privacy Act (CCPA)may be practiced. Such practices may include data minimization, encryption during transmittal and storage, anonymization, data security infrastructure, scheduled audits, etc. Furthermore, adherence to data protection and privacy laws and regulations may be automated using several custom-built and off-the-shelf web-based applications.

[0036] The virtual agents, the employee digital twins,the anti-employee digital twins, and the workplace digital twins may be trained on the sourced data using machine learning algorithms such as decision trees, logistic regression, random forest, gradient boosting, K-Nearest Neighbors, Support Vector Machines (SVM), and clustering algorithms. Furthermore, virtual agents, the employee digital twins, and the workplace digital twins may also have access to popularly used multi-agent frameworks such as Microsoft Autogent® and Large Language Models (LLMs) such as Bard (Google AI) and GPT-4 (Open AI). Furthermore, measures may be taken to address ethical issues related to AI. Such measures may include removing biases, enabling transparency in AI decision-making by implementing Explainable AI (XAI), drafting policies benefitting human employees and agents, and automating compliance with the drafted policies.

[0037] Once generated, at least a portion of operational workflows may be delegated to one or more virtual agents, especially the operational workflows that are too repetitive or monotonous and operational workflows that are too complex to be handled by human personnel. Such virtual agents may leverage web-based automation applications to perform the assigned processes by integration with web-based applications such as spreadsheets, project management applications, inventory management applications, and the like. Furthermore, the virtual agents may be distributed in a hierarchal structure with a virtual agent acting as a central agent controlling all other virtual agents. The virtual agents may also be trained through machine learning algorithms to provide customized messages (such as during communication between two employees), feedback, scheduling, and task assignments to employees of the organization based on employee-specific data sourced from sources like the HRIS server and communications server. Managers may be able to plan operational workflows, gauge employee engagement, and simulate business outcomes and costs using the employee digital twins, the anti-employee digital twins, and the workplace digital twins.

[0038] The virtual agents may also be configured to operate as or leverage scraper agents collecting data and information from several sources generating expert-data repositories on given subjects. The expert data repositories may then enable one or more of the virtual agents to act as subject matter experts. The interactions of human employees with the virtual agents, the employee digital twins, the anti-employee digital twins, and the workplace digital twins may be enabled in all three modes of communication including text-based interactions, aural interactions, and visual interactions. Furthermore, the virtual agents, the employee digital twins, and the workplace digital twins may be constantly upgraded using real-world data, actual business outcomes, real-world translations, and human expertise for their constant evolution and to achieve higher accuracies and efficiencies.

[0039] The implementation of the virtual agents, the employee digital twins, the anti-employee digital twins, and the workplace digital twins may offer several advantages. For example, vast amounts of data may be processed to identify patterns and trends that human agents might miss. Forecast of future trends and outcomes based on historical data is made possible, enabling proactive decision-making. Potential risks and opportunities can be identified, helping businesses mitigate threats and capitalize on new avenues. Repetitive tasks can be automated, freeing up human resources for more strategic work. Business processes can be analyzed to identify inefficiencies and suggest improvements. Information can be processed and decisions can be made much faster than humans. Customer data may be analyzed to offer personalized products, services, and recommendations. Operations can be streamlined and costs reduced by optimizing resource allocation. Fraudulent activities can be identified much in advance, preventing financial losses. Inventory management and logistics can be optimized, reducing costs. New product ideas can be generated and product design optimized. Market trends can be analyzed to identify new opportunities. Therefore, the organization can be provided with a competitive advantage by enabling the organization to outpace competitors.

[0040] Furthermore, it is envisaged that the virtual agents, the employee digital twins, and the workplace digital twins may be deployed as containerized microservices using web-based applications such as Docker and orchestrated using web-based frameworks such as Kubernetes. Combining containerization and microservices offers several advantages. Containers isolate microservices from the underlying operating system, allowing the microservices to run on any system with a container runtime. This makes applications easier to deploy across different environments, from development machines to production servers. Containers are lightweight and share the kernel of the host system, resulting in faster startup times and lower resource consumption compared to virtual machines. This efficiency allows the packing of more microservices onto a single server, maximizing resource utilization. Since microservices are independent units, the microservices can be scaled up or down individually based on demand. By using container orchestration tools like Kubernetes, the scaling process can be automated for a highly responsive and elastic application. Microservices architecture promotes faster development cycles and easier deployments. Containers further streamline this process by providing a consistent environment for development, testing, and production. This agility allows developers to make changes and deliver new features quickly. If a single microservice crashes, it will not bring down the entire application. Containers isolate microservices from each other, preventing issues in one service from impacting others. This improves the overall stability and reliability of the application. Containers provide a familiar development environment for programmers. They can code, test, and deploy microservices using the same container image throughout the development lifecycle.

[0041] Kubernetes builds on the benefits of containerized microservices by providing a robust orchestration platform. Kubernetes automates deployments and scaling of containerized microservices. Several instances of a service can be defined to run based on resource usage or other metrics, ensuring the application scales seamlessly to meet fluctuating demands. Kubernetes ensures application uptime by automatically replacing failed or unresponsive container instances. This self-healing capability minimizes downtime and keeps the application running smoothly. Kubernetes provides built-in load balancing, distributing traffic efficiently across multiple instances of a microservice. This optimizes performance and prevents bottlenecks. Microservices can discover each other automatically within the Kubernetes cluster. This eliminates the need for manual configuration and simplifies communication between services. Kubernetes efficiently allocates resources between containerized microservices, preventing resource waste and ensuring optimal utilization. Kubernetes itself is portable and can run on various platforms, including public clouds, private clouds, and on-premises infrastructure. This flexibility helps avoid vendor lock-in and allows the movement of the application across environments as needed. Kubernetes integrates well with DevOps practices, enabling continuous integration and continuous delivery (CI/CD) pipelines. This automation streamlines the development and deployment process for microservices.

[0042] Various embodiments of the present disclosure are described with reference to FIG. 1 to FIG. 6C.

[0043] FIG. 1 illustrates an example representation of an environment 100 related to at least some example embodiments of the present disclosure. The environment 100 includes a plurality of employee devices 102 (such asan employee device 102a, an employee device 102b, an employee device 102c, and an employee device 102d) running respective client applications 103a, 103b, 103c, and 103d. The plurality of employee devices 102 may be selected from a group consisting of notebook Personal Computers (PCs), desktop PCs, smartphones, tablet PCs, and the like. Furthermore, the plurality of employee device 102 may be assigned to a plurality of respective employees of an organization to which the present disclosure is directed. The plurality of client devices 102 is connected to a communication network 104. In several embodiments, the communication network 104 may be implemented through several combinations of wired and wireless protocols including High Definition Multimedia Interface (HDMI) cables, Video Graphics Array (VGA) cables, Ethernet, Wireless Fidelity (Wi-Fi), Wireless Interoperability for Microwave Access (Wi-Max), Bluetooth, ZigBee, Global System for Mobile Communications

(GSM), High-Speed Packet Access (HSPA), High-Speed Downlink Packet Access (HSDPA), Long Term Evolution (LTE), 5G, etc. without departing from the scope of the disclosure. In several embodiments, several extra layers of security through Secure Sockets Layer (SSL), Transport Layer Security (TLS), end-to-end encryption, use of device firewalls, and network firewalls may be built into the communication network 104.

[0044] The environment 100 further includes several other devices connected to the communication network 104 through their respective Application Program Interface (API) servers. For example, a Human Resources Information System (HRIS) server 122 is connected to the communication network 104 through an HRIS API server 124. The HRIS server 122 is configured to manage and organize employee data and streamline HR processes. The HRIS server 122 may store information on all the employees of the organization in a centralized or distributed database. Such information may include employee core data such as personal information(name, contact details, date of birth, emergency contact details), employment details (job title, department, start date, location, pay rate, employment status), benefits and compensations (details of health insurance, retirement plans, paid time off (PTO) allowances, bonuses, and other compensation details). Furthermore, the HRIS server 122 may store workforce management data such as time and attendance (records of work hours, clock-in/out times, breaks, overtime, and absences), performance management (performance reviews, CliftonStrengths, Core Value Index (CVI), goal setting records, feedback received, disciplinary actions), training and development (records of completed training courses, certifications earned, and skill development activities). The HRIS server 122 may also store compliance and legal data such as tax information (social security number, tax withholding details), immigration documents, and onboarding documents (signed contracts, retainership agreements, Non-Disclosure Agreements, etc.).

[0045] Further connected to the communication network 104 is an enterprise server 126 through an enterprise API server 128. The enterprise server 126 is configured to store, manage, and deliver critical data and applications to users across an entire organization. The data may include financial records, customer information, employee files, and business applications. The business applications may include Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) software, and web servers. Further connected to the communication network 104 is a workflow automation application server 130 through a workflow automation API server 132. The workflow automation application server 130 is configured to host a workflow automation application for the automation of several repetitive tasks between web-based applications, such as moving information from one web-based application to another. Also connected to the communication network 104 is a communications server 134 through a communications API server 136. The communications server 134 is configured to manage and store communications amongst several employees of the organization for which the embodiments of the present disclosure are being deployed. Such communications may include instant messages, official memos, circulars, company policy changes, periodic objectives, emails, etc.

[0046] Further, connected to the communication network 104 is a server system 106 and a storage device114. The server system 106 is envisaged to run an application enabling several embodiments of the present disclosure. In that regard, the server system 106 may be representative of a single device, a cluster of servers, a cloud-based infrastructure, server farms, and the like, without departing from the scope of the disclosure. The server system 106 is envisaged to include hardware capabilities such as a controller 108.The controller 108 includes a processor 110 and a memory unit 112.The processor 110 may be selected from a group consisting of a microcontroller, a general-purpose processor, a System on Chip (SoC), a Field Programmable Gate Array (FPGA), an Application Specific Integrated Circuit (ASIC), and the like. The memory unit 112 may be selected from a group consisting of volatile memory units such as, but not limited to, such as Static Random Access Memory (SRAM) and Dynamic Random Access Memory (DRAM) of types such as Asynchronous DRAM, Synchronous DRAM, Double Data Rate SDRAM, Rambus DRAM, and Cache DRAM, etc.

[0047] The storage device 114 may be a non-volatile memory device of the types including Read-Only Memory (ROM), Erasable Programmable Read-Only Memory (EPROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory, and the like. The storage device 114 may store machine-readable instructions for enabling several embodiments of the present disclosure. During run-time, the machine-readable instructions may be loaded into the memory unit 112 for execution by the processor 110 to enable several embodiments of the present discloser. The storage device 114 may further store several forms of data generated and received during the working of the several embodiments of the present disclosure. The machine-readable instructions stored in the storage device 114 may enable several services and microservices such as a plurality of virtual agents 116. Furthermore, the machine-readable instructions may enable at least one workplace digital twin 118 to emulatea workplace environment of the organization or a business unit for which several embodiments of the present disclosure may be implemented.

[0048] In several embodiments, the at least one workplace digital twin 118may be generated based on historical and real-time organizational data. There may be several steps involved in the generation of the at least one workplace digital twin 118. Such steps may include the identification of goals intended to be achieved from the at least one workplace digital twin 118. Such goals may include improving efficiency, identifying bottlenecks, or testing process changes. The next step may include data collection. The data may be collected from IT system logs, transaction data, and employee interviews stored on the enterprise server 126, the HRIS server 122, and the communications server 134. The next step may be mining and visualization. Process mining techniques may be used to analyze collected data to identify patterns, variations, and bottlenecks in the processes. Furthermore, the findings may be translated into visual representations such as flowcharts and process maps. Furthermore, a model representing the workplace environment may be built using simulation software, low-code platforms, spreadsheets/databases, etc. The model may further be integrated with IT systems for real-time monitoring and upgradation. Furthermore, the algorithm of the model may be adapted for testing and validation of performance by comparing the model with real processes and outcomes.

[0049] In addition, the machine-readable instructions enable a plurality of employee digital twins 120. The plurality of employee digital twins 120 are digital representations of the plurality of respective employees that capture their skills, knowledge, experience, behaviors, and preferences. The plurality of employee digital twins 120 essentially are virtual profiles that reflect individual working styles and contributions of the plurality of respective employees. For building the plurality of employee digital twins 120, data may be sourced from the enterprise server 126, the HRIS server 122, and the communications server 134. Other sources of data may include targeted surveys. The data collected may be integrated and analyzed for example using machine learning tools, to identify patterns, relationships, and insights into the behavior of the plurality of employees. Based on the results of the analysis, the plurality of employee digital twins 120 may be generated.

[0050] Furthermore, the storage device 114 may also enable the generation of several databases during the working of the several embodiments disclosed in the present disclosure enabling several elements of the embodiments to access and store information. Such databases may include relational databases for structured data and NoSQL databases for unstructured data. The storage device 114 may also enable the implementation of data lakes for storing large volumes of raw data, enabling advanced analytics and machine learning capabilities. Furthermore, data stored in the storage device 114 may be encrypted through either symmetric or asymmetric encryption depending upon specific applications. Furthermore, the encryption may be applied to certain files/partitions or entire disks depending on several factors such as cost and hardware resources available.

[0051] Other devices connected to the communication network 104 may include a multi-agent framework server 146 through a multi-agent framework API server 148. The multi-agent framework server 146 is configured to be hosting a multi-agent framework 147. In addition to enabling the tackling of complicated tasks, the multi-agent framework allows the design of new agents with specific skills and knowledge, allowing them to specialize in particular aspects of a problem. This expertise can be combined to achieve a more comprehensive and effective solution. Furthermore, connected to the communication network 104 is a first LLM server 138 through a first LLM API server 140 and a second LLM server 142 through a second LLM API server 144. The first LLM server 138 hosts a first LLM application 139 and the second LLM server hosts a second LLM application 143.

[0052] It is to be noted here that the HRIS API server 124, HRIS API server 124, the enterprise API server 128, the workflow automation API server 132, the communications API server 136, the multi-agent framework API server 148, the first LLM API server 140, and the second LLM API server 144 allow seamless integration capabilities with several sources leveraged for the working of the of the embodiments disclosed. API integration offers several advantages. For example, pertaining to efficiency and productivity the API integration allows automation of repetitive tasks, saving time and reducing errors, creation of seamless processes across different applications, reduction of manual data entry and ensuring consistency, etc. When it comes to customer experience, API integration delivers tailored experiences based on customer data, improves customer satisfaction through efficient service, and provides consistent interactions across different channels. On business growth and innovation fronts, API integration enables the creation of new products and services, supports business growth by handling increased workloads, differentiates the business through unique integrations, and provides access to valuable insights for informed decision-making.

[0053] When it comes to cost reduction, API integration automates processes, eliminates manual labor, and efficiently utilizes existing systems and data. Other benefits of API integration include the ability to adapt to changing business needs and market conditions, fostering teamwork and information sharing, and protecting sensitive data through secure API endpoints. However, the embodiments discussed in the present disclosure are not limited to API-based integration alone. Data integration may also be performed through ETL (Extract, Transform, Load), iPaaS (Integration Platform as a Service), middleware, and other technologies that might be introduced in the foreseeable, without departing from the scope of the disclosure.

[0054] FIG. 2 illustrates a logical implementation 200 of the controller 108 for enabling several embodiments of the present disclosure, in accordance with an embodiment of the present disclosure. The controller 108 includes the plurality of virtual agents 116, the plurality of employee digital twins 120, and theat least one workplace digital twin 118, a first service mesh 210, and a second service mesh 220. The machine-readable instructions for implementing the first service mesh 210 and the second service mesh 220 may also be stored in the storage device 114 and loaded in the memory unit 112 during runtime for execution by the processor 110. The plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 are communication with the plurality of client applications 103a, 103b, 103c, and 103d through a first service mesh 210. Furthermore, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 are in communication with the HRIS server 122, the enterprise server 126, the workflow automation application server 130, the communications server 134, the multi-agent framework server 146, the first LLM server 138 and the second LLM server 142 through a second service mesh 220. It is also envisaged that communication and exchange of data and information amongst the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may also be facilitated by one or more of the first service mesh 210 and the second service mesh 220.

[0055] FIG. 3 illustrates a computer-implemented method 300 (hereinafter also referred to as “the method 300”) for enhancing employee engagement and optimizing operational workflows. The method steps of the method 300 may be carried by the controller 108 through the processor 110 executing the machine-readable instructions loaded into the memory unit 112 during runtime. The method 300 begins at Step 302, when the processor 110 generates the plurality of virtual agents 116 with AI capabilities. In that regard, the plurality of virtual agents 116 is provided access to employee-specific data stored with the HRIS server 122, the enterprise server 126, and the communications server 134. In that regard, it is envisaged that the plurality of virtual agents 116 may be provided with machine-learning algorithms such as decision trees, logistic regression, random forest, gradient boosting, K-Nearest Neighbors, Support Vector Machines (SVM), and clustering algorithms. The plurality of virtual agents 116 using the machine learning algorithms would be able to extract valuable insights about the plurality of employees and operational workflows in the organization from the employee-specific data and other data accessed from the HRIS server 122, the enterprise server 126, and communications server 134. In several alternate embodiments, the plurality of virtual agents 116 may leverage AI agents and non-AI agents provided by the multi-agent framework147, the first LLM 139 and the second LLM 143 to generate the insights from the data accessed from the HRIS server 122, the enterprise server 126, and communications server 134.

[0056] At Step 304, the processor 110 delegates at least a portion of the operational workflows pertaining to the organization to one or more of the plurality of virtual agents 116. For example, repetitive and monotonous tasks may be delegated by the processor 110 to the one or more of the plurality of virtual agents 116. In that regard, the plurality of virtual agents 116 would access the workflow automation application facilitated by the workflow automation application server 130. Such tasks may include downloading attachments from an e-mail and adding them to a shared drive, updating an inventory list in spreadsheet software, and automating publishing on social media. Delegating the repetitive and monotonous tasks to the plurality of virtual agents 116 would boost productivity and enhance employee interest in more creative operational workflows such as lead generation, ideation, brainstorming, and cross-functional communication.

[0057] In addition, the plurality of virtual agents 116 have been trained in data stored with the HRIS server 122, the enterprise server 126, and the communications server 134. As mentioned before, the HRIS server 122 may store workforce management data such as time and attendance (records of work hours, clock-in/out times, breaks, overtime, and absences), performance management (performance reviews, CliftonStrengths, Core Value Index (CVI), goal setting records, feedback received, disciplinary actions), training and development (records of completed training courses, certifications earned, and skill development activities). The HRIS server 122 may also store compliance and legal data such as tax information (social security number, tax withholding details), immigration documents, and onboarding documents (signed contracts, retainership agreements, Non-Disclosure Agreements, etc.).The enterprise server 126 is configured to store, manage, and deliver critical data and applications to users across an entire organization. The data may include financial records, customer information, employee files, and business applications. The business applications may include Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) software, and web servers. The communications server 134 is configured to manage and store communications amongst several employees of the organization for which the embodiments of the present disclosure are being deployed. Such communications may include instant messages, official memos, circulars, company policy changes, periodic objectives, emails, etc.

[0058] Therefore, in addition to automation of certain repetitive and monotonous tasks, one or more virtual agents of the plurality of virtual agents 116 may also be delegated operational workflows involving mentorship/coaching, social media management, finance, sales, engineering, and other fields, without departing from the scope of the disclosure. In several embodiments, the plurality of virtual agents 116 may work individually to perform assigned tasks. In several alternate embodiments, the plurality of virtual agents 116 may collaborate forming several groups of virtual agents to accomplish complex tasks and simulate business processes such as brainstorming, project reviews, collaborative problem solving, cross-functional team meetings, quality circles, strategy planning sessions, role-playing and simulations, customer journey mapping, retrospective meetings, lead generation, ideation, market research, hiring optimization, organization restructuring, focus groups, and the like.

[0059] FIG. 4A illustrates an exemplary implementation 400 of the plurality of virtual agents 116, in accordance with an embodiment of the present disclosure. The plurality of virtual agents 116 is envisaged to include at least four virtual agents, AGENT_A 116a, AGENT_B 116b, AGENT_C 116c, and AGENT_D 116d. However, a person skilled in the art will appreciate that, in several embodiments, the plurality of virtual agents 116 may include more agents other than AGENT_A 116a, AGENT_B 116b, AGENT_C 116c, and AGENT_D 116d.Furthermore, AGENT_C 116c is envisaged to be a central agent. Furthermore, AGENT_C may be provided with human-like traits in accordance with one or more personality frameworks (for example, Big Five, HEXACO, Myers-Briggs Type Indicator (MBTI), Enneagram, DiSC, etc.). For example, AGENT_C 116c is further equipped with human-like personality traits such as high openness, high conscientiousness, high extraversion, moderate agreeableness, and low neuroticism. Furthermore, CliftonStrengths may be defined for AGENT_C 116c including activator, focus, and connectedness. CVI of AGENT_C 116c may further indicate innovator and merchant-like qualities. Furthermore, AGENT_C 116c would simulate preferences like clear, direct communication with actionable insights, collaborative discussions, and action-oriented to drive the next steps.

[0060] The operational workflows assigned to AGENT_C 116c may include central coordination (orchestration of activities of other virtual agents, such as AGENT_A 116a, AGENT_B 116b, and AGENT_D 116d, dynamically assigning tasks based on real-time data, user preferences, and workload), dynamic adaptation (interactions and task assignments based on real-time data and user feedback), and continuous learning (learning from interactions, user feedback, and performance data to improve efficiency and effectiveness over time). However, the provision of human-like personality traits based on the one or more personality frameworks(for example, Big Five, HEXACO, Myers-Briggs Type Indicator (MBTI), Enneagram, DiSC, etc.)may not just be limited to AGENT_C 116c.The same can be applied to other virtual agents of the plurality of virtual agents 116, such as, but not limited to, AGENT_A 116a, AGENT_B 116b, and AGENT_D 116d.

[0061] Similarly, AGENT_A 116a may simulate qualities like planning, project management, and analytical thinking. Furthermore, operational workflows assigned to AGENT_A 116a may include task decomposition, scheduling, resource allocation, and dependency management. Furthermore, AGENT_A 116a may integrate with other web-based services such as project management tools (Asana, Trello) and calendars (Google Calendar) through the workflow automation application offered by the workflow automation application server 130. Furthermore, AGENT_A 116a may be configured to deploy machine learning algorithms for predictive analytics in project management (e.g., estimating task completion times) and implement algorithms like Critical Path Method (CPM) and Gantt charts for task scheduling. As a consequence, in several embodiments, the plurality of virtual agents 116 may be implemented in tiers, with lower tiers offering commonly needed skills-based agents, mid more premium tiers allowing for adding the skills needed to create custom agents. The plurality of virtual agents 116 may be deployed to automate several other organizational and operational workflows related tasks as will be discussed in the following discussion.

[0062] FIG. 4B illustrates an implementation of at least one virtual agent (for example, AGENT_D 116d), of the plurality of virtual agents 116, as a subject matter expert agent, in accordance with an embodiment of the present disclosure. In several embodiments, the at least one virtual agent 116dmay act as a scraper agent. Alternately, in several embodiments, the at least one virtual agent 116d may deploy or implement a dedicated scraper agent 412 and gather data and information from several web-based and local database repositories to generate a structured, semi-structured, or an unstructured expert-data repository related to a specific subject matter (for example, costing, marketing, human resource management, etc.). As illustrated in FIG. 4B, one or more of the at least one virtual agent 116d and the dedicated scraper agent 412 may communicate with a plurality of web-based databases 414 through the communication network 104.

[0063] The plurality of web-based databases 414 may include databases related to business and market research (for example, prices of products across several retailers, data on competitors, customer reviews, and industry trends, contact information in online directories, monitoring inventory levels, product information, and customer sentiment), finance(stock prices, market trends, and financial news, data on companies, industries, and economic indicators, market conditions and potential risks), academic research (data for research studies and analysis, public opinion on various topics, social media trends and user behavior), and other applications including property listings, pricing, and market data, job listings from different websites, news articles from various sources, data for investigative reporting, and websites and social media, etc.

[0064] Furthermore, the one or more of the at least one virtual agent 116d and the dedicated scraper agent 412 may communicate with a plurality of local databases 416. The plurality of local databases 416 may include databases related to the enterprise server 126, the HRIS server 122, the communications server 134, and other several databases maintained by the organization. The one or more of the at least one virtual agent 116d and the dedicated scraper agent 412 may gather data and information from the plurality of web-based databases 414 and the plurality of local databases 416 to generate an expert-data repository 418. The expert-data repository 418 may store the gathered and extracted data in the structured, the semi-structured or an unstructured form, for example by implementing a data lake. The expert-data repository 418 would then be leveraged by the at least one virtual agent 116d to act as a subject matter expert and communicate with other virtual agents or human agents during processes like brainstorming, project reviews, collaborative problem solving, cross-functional team meetings, quality circles, strategy planning sessions, role-playing and simulations, customer journey mapping, retrospective meetings, lead generation, ideation, market research, hiring optimization, organization restructuring, focus groups, “what-if” scenarios, and the like. In that regard, the at least one virtual agent 116d may act as a subject matter expert in one or more fields such as market research, finance, sales, engineering, testing and evaluation, taxation, excise, and the like.

[0065] Referring to FIG. 3, at Step 306, the processor 110 generates the plurality of employee digital twins 120 of the plurality of respective employees by leveraging the employee-specific data. As discussed above, the plurality of employee digital twins 120 are digital representations of the plurality of respective employees that capture their skills, knowledge, experience, behaviors, and preferences. The plurality of employee digital twins 120 essentially are virtual profiles that reflect individual working styles and contributions of the plurality of respective employees. For building the plurality of employee digital twins 120, the processor 110 may source data from the enterprise server 126, the HRIS server 122, and the communications server 134. Other sources of data may include targeted surveys. The data collected may be integrated and analyzed, by the processor 110, for example using machine learning tools, to identify patterns, relationships, and insights into the behavior of the plurality of employees. Based on the results of the analysis, the plurality of employee digital twins 120 may be generated.

[0066] The generation of the plurality of employee digital twins 120 has several benefits. For example, the plurality of employee digital twins 120 may be used for understanding skill gaps to create customized training programs. The plurality of employee digital twins 120 could be used to create virtual simulations of work situations. This allows employees to practice and refine their skills in a safe, controlled environment before encountering real-world challenges. By analyzing historical data and employee behavior patterns, the plurality of employee digital twins 120 could potentially predict future performance. This allows managers to identify high-potential employees and those needing additional support. The plurality of employee digital twins 120 could provide employees with immediate feedback on their work performance, allowing for course correction and continuous improvement. The feedback coming from a digital twin may be more amenable to an employee as it may be provided discreetly without any other individual noticing especially if the feedback is critical or negative. The plurality of employee digital twins 120 can empower employees by providing them with insights into their strengths and weaknesses, guiding their career development goals.

[0067] It is to be noted that while accessing the employee-specific data, compliance with data privacy and protection legislation like General Data Protection Regulation (GDPR) and California Consumer Privacy Act (CCPA) be ensured. Systems and practices may be coded in the machine-readable instructions to ensure compliance at all stages of the working of the embodiments disclosed in the present disclosure. Identification and documentation may be performed for a legal basis for processing personal data, such as consent, contract performance, legal obligation, vital interests, public task, or legitimate interests. Data minimization should further be implemented to ensure only data that is necessary for the specified purpose is collected and excessive data collection is avoided. Furthermore, processor 110 may create prompts to obtain explicit, informed consent from users where required. Moreover, documentation with clear and accessible information about how their data will be used may be provided to the users. Furthermore, the processor 110 executing machine-readable instructions may implement mechanisms or individuals to access, rectify, delete, or restrict the processing of their data.

Furthermore, users may be provided with the ability to withdraw consent and object to data processing.

[0068] Other measures that may be built into the machine-readable instructions include data anonymization, algorithmic transparency and fairness, regular and automated audits and assessments, documentation and record keeping, and monitoring by one or more virtual agents deployed as legal experts. Furthermore, for automation of compliance with GDPR and CCPA, several tools may be deployed at various stages. Automated data discovery tools can scan and map out where personal data is stored across all systems. Examples include BigID, OneTrust, and Informatica. A data inventory may be maintained of data assets that include details about data sources, types of data collected, purposes of processing, and data flows. Consent Management Platforms (CMPs) may be implemented to automate the collection and management of user consent. Tools like TrustArc, Cookiebot, and Quantcast can help manage consent for cookies and other data processing activities. Furthermore, dynamic consent forms may be implemented that dynamically update based on user interactions, ensuring that users are always providing informed consent for specific use cases.

[0069] Furthermore, the processor 110 executing the machine-readable instructions may further implement self-service portals where users can submit and manage their data access, deletion, and portability requests. The self-service portals may be configured to automate identity verification and track request statuses. Tools may be used to automate the workflows for handling data subject requests. Solutions like OneTrust, TrustArc, and DataGrail can help automate these processes. The processor 110 may further implement data-minimization tools that automatically enforce data minimization principles, ensuring only necessary data is collected and retained. Furthermore, automated data retention policies may be utilized that automatically apply and enforce data retention policies, deleting data that is no longer needed after a certain period. Furthermore, the processor 110 may deploy security solutions that continuously monitor for vulnerabilities, unauthorized access, and data breaches. Tools like Splunk, SIEM systems, and automated patch management tools may be integrated into the business logic. Furthermore, the processor 110 may integrate incident response platforms that automate the detection, reporting, and management of data breaches. These systems can help ensure timely notification to authorities and affected individuals.

[0070] For visualization purposes, the processor 110 executing the machine-readable instructions may further generate dashboards that provide real-time insights into compliance status across the organization. These dashboards may be configured to include metrics on data subject requests, consents, and security incidents. Furthermore, the processor 110 may employ tools that automatically audit the systems for compliance with GDPR and CCPA. These tools can generate reports and highlight areas that need attention. To mitigate third-party risks, the processor 110 may deploy tools that automate the assessment of third-party vendors for compliance with GDPR and CCPA requirements. Platforms like OneTrust Vendorpedia can help manage third-party risk. Furthermore, the processor 110 may implement systems that automate the creation, management, and monitoring of data processing agreements and contracts with vendors. Some of the examples of contract management tools include DocuSign CLM, SAP Ariba, Icertis, Concord, PandaDoc, Agiloft, ContractWorks, and the like.

[0071] For the specific reasons concerning the use of AI in the embodiments discussed in this specification, the processor 110 may further deploy tools that provide transparency and explainability for AI models. Solutions like IBM Watson OpenScale and Fiddler can help ensure that AI decisions are understandable and fair. Furthermore, for bias mitigation, automated tools to detect and mitigate biases in AI models may also be implemented. These tools can continuously monitor and adjust models to ensure compliance with fairness requirements. For the employees and other human agents and personnel related to the organization, e-learning platforms may be used to provide ongoing training and awareness programs for employees. These platforms can track completion rates and ensure that all staff are up-to-date on compliance requirements. Furthermore, the processor 110 executing the machine-readable instructions may ensure that the compliance tools and processes are regularly updated to reflect changes in the regulatory landscape. Automated compliance tools may be further configured to receive updates to stay current with new laws and guidelines. Furthermore, the processor 110 may implement feedback mechanisms to continuously improve compliance strategies based on user and stakeholder feedback

[0072] At Step 308, the processor 110 generates at least one workplace digital twin 118 representing the workplace environment. As discussed above, there may be several steps involved in the generation of the at least one workplace digital twin 118.For example, when executing the machine-readable instructions, the processor 110 may identify goals intended to be achieved from the at least one workplace digital twin 118. Such goals may include improving efficiency, identifying bottlenecks, or testing process changes. The next step may include the processor 110 performing data collection. The data may be collected from IT system logs, transaction data, and employee interviews stored on the enterprise server 126, the HRIS server 122, and the communications server 134. The processor 110 may then perform mining and visualization. Process mining techniques may be used to analyze collected data to identify patterns, variations, and bottlenecks in the processes. Furthermore, the findings may be translated into visual representations such as flowcharts and process maps. Furthermore, the processor 110 may build a model representing the workplace environment using simulation software, low-code platforms, spreadsheets/databases, etc. The processor 110 may further integrate the model with IT systems for real-time monitoring and upgradation. Furthermore, the algorithm of the model may be adapted for testing and validation of performance by comparing the model with real processes and outcomes.

[0073] The at least one workplace digital twin 118 offers several advantages. The at least one workplace digital twin 118 can analyze real-time data on how a business operates. This allows the identification of bottlenecks, optimization of processes, and enabling of data-driven decisions to improve efficiency and productivity. The ability to simulate different scenarios within the at least one workplace digital twin 118 is a powerful tool for innovation. New ideas, products, or processes can be tested in a safe virtual environment. This helps identify potential risks and challenges before real-world implementation, leading to more successful innovation with minimized risks The at least one workplace digital twin 118 can be used to understand how customers interact with the products and services. This data can then be used to improve the customer experience and develop new offerings that better meet their needs.

[0074] It is to be noted here that the processor 110 may further leverage machine learning algorithms like decision trees, logistic regression, random forest, gradient boosting, K-Nearest Neighbors, Support Vector Machines (SVM), and clustering algorithms on the data received from the HRIS server 122, the enterprise server 126, and communications server 134 to generate the plurality of employee digital twins 120 and the at least one workplace digital twin 118. The processor 110 may further leverage one or more of the multiagent framework 147, the first LLM 139, and the second LLM 143 for the generation of the plurality of employee digital twins 120 and the at least one workplace digital twin 118.

[0075] Furthermore, it is envisaged, that in several embodiments, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118may be designed to evolve as they interact with an environment including each other, other business systems and data sources such as CRM, ERP, and manufacturing software, and human agents such as employees at different hierarchical levels. In that regard, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may deploy some rapidly evolving techniques. Such techniques may include reinforcement learning that allows algorithms to learn through trial and error. The plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may interact with the environment, receive rewards or penalties for their actions, and adjust their behavior accordingly. Another technique includes evolutionary algorithms which is inspired by natural selection. In the scenario of evolutionary algorithms, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may create a population of solutions, evaluate their fitness, and select the best ones to breed, producing new generations of improved solutions.

[0076] Another technique known as transfer learning would enable the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 to leverage knowledge gained from one task to improve performance on another, related task. This can accelerate learning in new environments. Other techniques may involve meta-learning, imitation learning, hierarchical reinforcement learning, lifelong learning, etc., and other similar techniques that may be developed in the foreseeable future for continuous and autonomous evolution of the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 are envisaged to be within the scope of the disclosure.

[0077] Furthermore, since there would be several instances when the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 would be interacting with the human agents and documents and files created by or in assistance with the human agents, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may be provided with several additional capabilities such as state-of-the-art Natural Language Processing (NLP) techniques and sentiment analysis techniques. The NLP and sentiment analysis may be performed using labeled training data, deployment of state-of-the-art algorithms such as Naive Bayes, Support Vector Machines (SVM), Random Forest, and Deep Learning models (RNNs, CNNs, Transformers such as BERT (Bidirectional Encoder Representations from Transformers) and GPT (Generative Pre-trained Transformer)), and feature engineering (extracting relevant features from text (e.g., word counts, n-grams, sentiment lexicons)). Pre-defined dictionaries (e.g., AFINN, VADER, SentiWordNet) may be used to assign sentiment scores to words and aggregate them to determine the overall sentiment. Furthermore, advanced models such as LSTM, GRU, or transformers (e.g., BERT, RoBERTa) may be used for more accurate sentiment analysis. In addition to the integration of Transformer-based models, LLMs, and other machine learning algorithms, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 may be provided with multi-lingual capabilities.

[0078] FIG. 4C illustrates a logical representation 425 of the plurality of employee digital twins 120, in accordance with an embodiment of the present disclosure. The plurality of employee digital twins 120 (for example, ALEX_T 120a, SANDRA_T 120b, JASON_T 120c, and JANET_T120d) have therewith associated a plurality of respective employee personality profiles 427 (for example, ALEX_P 427a, SANDRA_P 427b, JASON_P 427c, and JANET_P 427d). The plurality of employee digital twins 120 have been given the same name as the associated employees while the plurality of respective employee personality profiles 427 have been named by appending _P to the names of associated employees' names. The plurality of employee personality profiles 427 may be generated by leveraging employee-specific data from the HRIS server 122, and the communications server 134.

[0079] In that regard, for generating the plurality of employee personality profiles 427, the processor 110 while executing machine-readable instructions may analyze patterns in employee behavior, such as communication style, task orientation, and problem-solving approaches. Furthermore, the processor 110 may identify correlations between performance and personality traits, such as conscientiousness and achievement orientation. The processor 110 may further examine collaboration patterns and team dynamics to infer personality traits like extraversion and agreeableness. The processor 110 may also study career paths to identify potential personality traits linked to leadership, innovation, or stability. The plurality of employee personality profiles 427 may be built on the one or more personality frameworks (for example, Big Five, HEXACO, Myers-Briggs Type Indicator (MBTI), Enneagram, DiSC, etc.). The processor 110 may further deploy techniques like factor analysis, cluster analysis, or machine learning algorithms to identify underlying personality dimensions. Furthermore, NLP and sentiment analysis may also be deployed to analyze textual data (e.g., performance reviews, and emails) to extract personality-related keywords and phrases.

[0080] Furthermore, the plurality of employee personality profiles 427 may be used by the processor 110 to generate a plurality of employee anti-personality profiles 429 (for example, ALEX_AP 429a, SANDRA_P 429b, JASON_P 429c, and JANET_P 429d) by reversing values of parameters used in the selected one or more personality frameworks. Furthermore, the processor 110 may then generate a plurality of anti-employee digital twins 431 (for example, ALEX_AT 413a, SANDRA_AT431b, JASON_AT431c, and JANET_AT431d). The plurality of anti-employee digital twins 431 may help in offering alternative perspectives and support in areas where a user may need improvement. This feature can help balance skillsets and viewpoints.

[0081] It is to be noted here that biases can creep into AI-based virtual agents, employee digital twins, and workplace digital twins at various stages of development and use. Several steps can be deployed to ensure that such biases can be mitigated as much as possible within the constraints of the technology available. For example, AI models can be trained on diverse datasets that represent the variety of people and experiences within an organization. This helps mitigate bias based on factors like gender, race, age, or disability. Cleaning of training data to identify and remove biases that might be present. This could involve manually reviewing data or using bias detection algorithms. Human experts may be involved in the data collection and training process to identify potential biases and ensure the data accurately reflects the organization and the operational workflows. When designing the AI models, fairness metrics may be incorporated to assess potential biases in the outputs. These metrics could track factors like decision fairness or outcome fairness across different demographics. Another approach is to build explainable models, allowing an understanding of how the AI arrives at its decisions. This helps identify and address any biases embedded in the logic of the model.

[0082] During deployment and use, the performance of the AI systems can be continuously monitored for signs of bias. This could involve analyzing outputs or gathering user feedback. Human review processes may be implemented for critical decisions made by AI-based systems. This allows humans to identify and correct for biases before they impact real-world outcomes. Furthermore, employees may be educated about potential biases in AI systems and how to identify and report them. This fosters a culture of awareness and helps mitigate bias throughout the organization. Other factors may include awareness of inherent biases in the algorithms used, regular review processes, and practicing a fair amount of transparency within the organization. By following these strategies, proactive steps can be taken to reduce bias in AI-based virtual agents, employee digital twins, and workplace digital twins. This ensures these systems operate fairly and ethically, benefiting the employees and the organization as a whole.

[0083] Furthermore, to address ethical concerns, Explainable AI (XAI) techniques may be integrated with the plurality of virtual agents 116, the plurality of employee digital twins 120, the plurality of anti-employee digital twins 431, and the at least one workplace digital twin 118 making their decision-making process more transparent to human agents. Some common methods used in XAI include feature importance (identifying which inputs had the most impact on the output), Local Interpretable Model-agnostic Explanations (LIME) (creating simplified models to explain individual predictions), partial dependence plots (visualizing how features influence the output), counterfactual explanations (showing how input data would need to change to produce a different output).

[0084] At Step 310, the processor 110 enables exchange of information amongst a plurality of disparate groupings including one or more of the plurality of employee devices 102, the plurality of virtual agents 116, the plurality of employee digital twins 120, and the at least one workplace digital twin 118 for simulating business outcomes. In several embodiments, the exchange of information may be enabled amongst the plurality of employees and the plurality of employee digital twins 120 through the plurality of employee devices 102. In several embodiments, the exchange of information may be enabled amongst the plurality of employees and the plurality of virtual agents 116 through the plurality of employee devices 102. In several embodiments, the exchange of information may be enabled amongst the plurality of employees and the at least one workplace twin 118 through the plurality of employee devices 102. In several embodiments, the exchange of information may be enabled amongst the plurality of employee digital twins 120 and the plurality of virtual agents 116. In several embodiments, the exchange of information may be enabled amongst the plurality of employee digital twins 120 and the at least one workplace twin 118. Many such combinations of different groups may be enabled without departing from the scope of the disclosure.

[0085] In several embodiments, the plurality of anti-employee digital twins 431 may also be involved in such groupings. For example, in several embodiments, the exchange of information may be enabled amongst the plurality of employees and the plurality of anti-employee digital twins 431 through the plurality of employee devices 102.In several embodiments, the exchange of information may be enabled amongst the plurality of ant-employee digital twins 431 and the plurality of virtual agents 116. In several embodiments, the exchange of information may be enabled amongst the plurality of anti-employee digital twins 431 and the at least one workplace twin 118.The exchange of information amongst other combinations of two, three or four groups of different kind of agents and entities are envisaged to be within the scope of the present disclosure. For example, in several embodiments, the exchange of information may be enabled amongst the plurality of employee devices 102, the plurality of employee digital twins 120, and the plurality of anti-employee digital twins 431.In several embodiments, the exchange of information may be enabled amongst the plurality of ant-employee digital twins 431, the at least one workplace digital twin 118, and the plurality of virtual agents 116. In several embodiments, the exchange of information may be enabled amongst the plurality of anti-employee digital twins 431, the plurality of employee devices 102, and the at least one workplace twin 118.

[0086] The exchange of information may be performed in several manners. For example, the plurality of employees may utilize the plurality of client applications 103a, 103b, 103c, and 103d installed with the plurality of respective employee devices 102 (for example, 102a, 102b, 102c, and 102d). In several embodiments, the plurality of client applications 103a, 103b, 103c, and 103d may be represented as dashboard applications with features supporting audiovisual interaction and text-based interactions with the plurality of virtual agents 116, the plurality of employee digital twins 120 and the at least one workplace digital twin 118. In several embodiments, each one of the plurality of virtual agents 116, the plurality of employee digital twins 120,the plurality of anti-employee digital twins 431, and the at least one workplace digital twin 118 may manifest as one or more combinations of aninstant messaging chatbot, a voice-based chatbot, or a visual 3-Dimensional avatar through the plurality of client applications 103a, 103b, 103c, and 103d.

[0087] To implement text messaging capabilities, the processor 110 may implement WebSocket for real-time text communication in web applications. Furthermore, the processor 110 may deploy tools such as Firebase Realtime Database, Pusher, or Socket.io for real-time chat implementation. Furthermore, the processor 110 may leverage rich text editors such as Quill, TinyMCE, or Draft.js for web applications and use libraries like Trix Editor or RichEditorView for mobile applications. Furthermore, databases like Firebase Firestore, MongoDB, or PostgreSQL may be used to store chat messages. The processor 110 may implement efficient querying and indexing to handle large volumes of text data. For audio interaction support, the processor 110 may use APIs like Web Audio API for web applications, and for mobile apps, the processor 110 may use platform-specific libraries such as AVFoundation for iOS and MediaRecorder for Android. Furthermore, desktop applications can utilize libraries like PortAudio or use built-in system APIs. The processor 110 may further integrate libraries for audio processing and manipulation, such as SoX or FFMPEG, and implement noise reduction, echo cancellation, and other audio enhancements if necessary. For streaming, the processor 110 may use protocols like WebRTC for real-time audio communication and third-party services such as Twilio, Agora, or Jitsi for the implementation of real-time audio features.

[0088] For video interaction support, the processor 110 may utilize HTML5 <video> element or WebRTC for web applications, platform-specific APIs for mobile apps, such as AVFoundation for iOS and MediaRecorder for Android, and libraries like OpenCV or VLC's libVLC for desktop applications. The processor 110 may further integrate video processing libraries such as OpenCV for tasks like face detection, object tracking, and video manipulation. For streaming, the processor 110 may use WebRTC for real-time video communication or third-party services such as Twilio Video, Agora, and Jitsi. The video files can be stored using cloud storage services like AWS S3, Google Cloud Storage, or Azure Blob Storage and Content Delivery Networks (CDNs) can be used to ensure efficient delivery of video content.

[0089] FIG. 4Dillustrates an implementation 450 of a client application 103a as a dashboard for an employee named Alex on an employee device 102a, in accordance with an embodiment of the present disclosure. The dashboard includes several segments indicating several performance parameters and personality traits specific to Alex. For example, the dashboard includes a personality traits segment 452, a CliftonStrenghts segment 454, a CVI segment 456, a preferences segment 458, a 3-Dimensional (3D) virtualization 460 of AGENT_C 116c, and a messaging space 462 to allow instant messaging between the AGENT_C 116c and the employee Alex. The 3D virtualization 460 of AGENT_C 116c allows the employee ALEX to have a more relatable conversation between AGENT_C 116c and themselves. Moreover, the 3D virtualization 460 allows audiovisual interactions between the employee ALEX and AGENT_C 116c. It is well known in the art that employees are more receptive to audiovisual interactions in combination with text-based interactions when compared with text-based interactions alone.

[0090] The messaging space 462 allows text messages to be exchanged between AGENT_C 116c and the employee ALEX. It is to be noted here that messages and responses of AGENT_C 116c may be personalized to suit the performance parameters and personality traits specific to ALEX through implementations of machine learning algorithms, multi-agent framework 147, the first LLM 139, and the second LLM 143.In that regard, AGENT_C 116c may also utilize an employee personality profile (ALEX_P) 427a corresponding to ALEX to personalize a text message shared with ALEX. Furthermore, AGENT_C 116c may deploy NLP and sentiment analysis on responses presented by ALEX to further personalize subsequent text messages exchanged with ALEX. The personalized text message with NLP and sentiment analysis deployed reads as “Alex, your innovative approach is spot on. To strengthen the proposal, add detailed budget justifications and a clear timeline. Let's discuss AI integration for customer feedback in our next meeting.” The message depicted in FIG. 4D without personalization may have come about as "Your project proposal is good, but it needs more details in the budget section and a stronger risk management plan", which given the personality traits and other parameters corresponding to ALEX would not have inspired a positive or a wholehearted response from ALEX. Another virtual agent AGENT_B 116b may be utilized as a communications-assist agent for assisting communication between two employees of the organization.

[0091] FIG. 4E illustrates an implementation 475 of the virtual agent AGENT_B 116b acting as the communications-assist agent during an exchange of messages between two employees SANDRA and JASON of the organization, in accordance with an embodiment of the present disclosure. SANDRA and JASON are communicating with each other through their respective client applications 103b and 103c, respectively in a messaging space 477. AGENT_B 116b has access to respective employee personality profiles (JASON_P) 427c and (SANDRA_P) 427b of JASON and SANDRA, and the messaging space 477. The respective employee personality profiles 427c and 427b allow AGENT_B 116b to provide personalized suggested responses 479 to SANDRA and JASON on their respective client applications 103b and 103c. The suggested responses 479 are tailored to suit the personality of amessage receiver employee in correlation to the respective employee personality profile (for example, SANDRA_P 427b for SANDRA) of the message receiver employee. In this manner, a message sender employee (for example, JASON) would be able to communicate effectively and efficiently with the message receiver employee and enhance engagement of both the employees JASON and SANDRA. In addition to the plurality of employee personality profiles 427, by further leveraging NLP libraries such as SpaCy, NLTK, Hugging Face Transformers, language models such as GPT-3, BERT, T5, spell checkers such as PySpellChecker, Hunspell, LanguageTool, and APIs such as Google Cloud Natural Language API, Microsoft Azure Text Analytics, Grammarly API,AGENT_B 116b may also further be able to provide options of autofill and autocorrect in the suggested responses 479.

[0092] It is further to be noted that similar dashboards may be created for other aspects, with different employees in different positions. For example, managerial-level employees may have a dedicated dashboard with access controls where they may be able to simulate business outcomes of planned operational workflows by interacting with the plurality of employee digital twins 120, the plurality of anti-employee digital twins 431, and the at least one workplace digital twin 118. Furthermore, the managers may be able to communicate critical feedback to their team members through the plurality of virtual agents 120 and the plurality of employee digital twins 120 enabling the employees to be more amenable to receiving feedback and taking corrective actions if necessary.

[0093] Furthermore, in several embodiments, the processor 110 may be enabled by the machine-readable instructions to receive personality traits input from one or more employees through one or more of the plurality of employee devices 102 and use the received personality traitsto either generate a new personality profile of a virtual agent and modify an existing profile of a virtual agent. In that regard, in several embodiments, fields may be provided in the plurality of client applications 103a, 103b, 103c, and 103d, where an employee can enter the personality traits in accordance with the one or more personality frameworks. The entered personality traits may then be used by the processor 110 to generate a new personality profile of a virtual agent (of the plurality of virtual agents 116) and modify an existing profile of a virtual agent (of the plurality of virtual agents 116).

[0094] In addition to the earlier example, with AGENT_C 116c acting as a central agent, employees as human agents may also be enabled to assign tasks to one or more virtual agents of the plurality of virtual agents 116. For example, the plurality of employee devices 102 through the plurality client applications 103a, 103b, 103c, and 103d may be configured to assign tasks to the plurality of virtual agents 116. In that regard, the processor 110 would then be enabled by the machine-readable instructions to receive task assignments from one or more of the plurality of employee devices 102 and assign the task to one or more virtual agents of the plurality of virtual agents 116.

[0095] The implementation of the plurality of virtual agents 116, the plurality of employee digital twins 120, the plurality of anti-employee digital twins 431, and the at least one workplace digital twin 118 offer several advantages. For example, vast amounts of data may be processed to identify patterns and trends that human agents might miss. Forecast of future trends and outcomes based on historical data is made possible, enabling proactive decision-making. Potential risks and opportunities can be identified, helping businesses mitigate threats and capitalize on new avenues. Repetitive tasks can be automated, freeing up human resources for more strategic work. Business processes can be analyzed to identify inefficiencies and suggest improvements. Information can be processed and decisions can be made much faster than humans. Customer data may be analyzed to offer personalized products, services, and recommendations. Operations can be streamlined and costs reduced by optimizing resource allocation. Fraudulent activities can be identified much in advance, preventing financial losses. Inventory management and logistics can be optimized, reducing costs. New product ideas can be generated and product design optimized. Market trends can be analyzed to identify new opportunities. Therefore, the organization can be provided with a competitive advantage by enabling the organization to outpace competitors.

[0096] Referring to FIG. 3, at Step 312, the processor 110 modifies or updates one or more of the at least one workplace digital twin 118, the plurality of virtual agents 116, and the plurality of employee digital twins 120 to optimize the operational workflows. The at least one workplace digital twin 118 may be modified by implementing physical assets with sensors that collect real-time data on performance, usage, and environmental conditions. This data can be fed directly into the at least one workplace digital twin 118, providing a continuous stream of updates. Furthermore, at least one workplace digital twin 118 may be connected with business systems, such as CRM, ERP, and manufacturing software. This allows for automatic updates on inventory levels, production processes, customer interactions, and other relevant data points. Furthermore, the at least one workplace digital twin 118 may further be modified manually through scheduled updates for information that changes less frequently, such as employee data, equipment maintenance records, or new product specifications. Authorized personnel may be allowed to manually input changes or corrections to the at least one workplace digital twin 118. This can be useful for capturing qualitative data or unforeseen events that may not be automatically tracked by sensors.

[0097] Furthermore, regular monitoring of the data flowing into the at least one workplace digital twin 118 may be implemented to ensure accuracy and consistency. Furthermore, data-cleaning processes to identify and fix errors or inconsistencies may also be implemented. It is also important to maintain a version history to track changes over time. This allows the organization to revert to previous versions if necessary and understand the impact of changes made to the model. The machine learning algorithms may be deployed to analyze data from the at least one workplace digital twin 118 and identify deviations from normal operating conditions. This can be helpful for predictive maintenance or identifying potential issues before they occur. Advanced machine learning models can automatically learn from data and update the at least one workplace digital twin 118 based on patterns or insights they discover.

[0098] On the other hand, the plurality of virtual agents 116 may be retrained using new data, allowing the plurality of virtual agents 116 to learn and improve their performance over time. This can be done periodically or triggered by specific events. Fine-tuning can be performed using data specific to relevant tasks for which one or more of the plurality of AI agents 116 may be intended. For traditional virtual agents built with code, updates involve modifying the underlying codebase. This can involve bug fixes, introducing new functionalities, or optimizing existing behaviors. Some virtual agents are designed with modular components. Updates can be made by replacing specific modules with improved versions without affecting the entire system. Reinforcement learning virtual agents learn through trial and error by receiving rewards for desired behaviors. The reward system itself can be updated to guide the plurality of virtual agent 116 towards new goals or behaviors. In some scenarios, a simulated environment may be deployed. The simulations themselves can be updated to reflect new scenarios or challenges, prompting the plurality of virtual agents116 to adapt and improve their decision-making.

[0099] The plurality of employee digital twins 120 may be modified through integration with the HRIS server 122 and the communications server 134. This allows for automatic updates whenever employee data in the HRIS changes, such as promotions, skills updates, or changes in contact information. Furthermore, employee activity may be tracked within the virtual workspace or company systems. This data can be used to update the plurality of employee digital twins 120 regarding the preferred working styles of the employees, most used tools, or areas of expertise. The plurality of employee digital twins 120 may also be modified through manual methods such as by allowing employees to update their digital twin profiles. This empowers them to keep their skills, certifications, and preferred work styles current. Managers can be given access to update the plurality of employee digital twins 120 under their supervision. This allows them to reflect changes in employee roles, responsibilities, or project assignments. A regular review process may be established to assess the accuracy and completeness of data. This might involve checking for inconsistencies or outdated information.

[00100] The embodiments described above may be embodied as a monolithic application or embodied as containerized microservices architecture using Docker® and orchestrated using Kubernetes. Combining containerization and microservices offers several advantages. Containers isolate microservices from the underlying operating system, allowing the microservices to run on any system with a container runtime. This makes applications easier to deploy across different environments, from development machines to production servers. Containers are lightweight and share the kernel of the host system, resulting in faster startup times and lower resource consumption compared to virtual machines. This efficiency allows the packing of more microservices onto a single server, maximizing resource utilization.

[00101] Since microservices are independent units, the microservices can be scaled up or down individually based on demand. Each microservice can be scaled independently based on its specific needs. If one part of the application experiences a surge in traffic, only that service may be scaled without affecting others. More instances of a microservice may be added to handle the increased load, distributing the workload across multiple machines. For resource-intensive microservices, the capabilities of individual instances may be enhanced by adding more CPU, memory, or storage.

[00102] By using container orchestration tools like Kubernetes, the scaling process can be automated for a highly responsive and elastic application. Microservices architecture promotes faster development cycles and easier deployments. Containers further streamline this process by providing a consistent environment for development, testing, and production. This agility allows developers to make changes and deliver new features quickly. If a single microservice crashes, it will not bring down the entire application. Containers isolate microservices from each other, preventing issues in one service from impacting others. This improves the overall stability and reliability of the application. Containers provide a familiar development environment for programmers. They can code, test, and deploy microservices using the same container image throughout the development lifecycle.

[00103] Kubernetes builds on the benefits of containerized microservices by providing a robust orchestration platform. Kubernetes automates deployments and scaling of containerized microservices. Several instances of a service can be defined to run based on resource usage or other metrics,ensuring the application scales seamlessly to meet fluctuating demands. Kubernetes ensures application uptime by automatically replacing failed or unresponsive container instances. This self-healing capability minimizes downtime and keeps theapplication running smoothly. Kubernetes provides built-in load balancing, distributing traffic efficiently across multiple instances of a microservice. This optimizes performance and prevents bottlenecks. Microservices can discover each other automatically within the Kubernetes cluster. This eliminates the need for manual configuration and simplifies communication between services. Kubernetes efficiently allocates resources between containerized microservices, preventing resource waste and ensuring optimal utilization. Kubernetes itself is portable and can run on various platforms, including public clouds, private clouds, and on-premises infrastructure. This flexibility helps avoid vendor lock-in and allows the movement of the application across environments as needed. Kubernetes integrates well with DevOps practices, enabling continuous integration and continuous delivery (CI/CD) pipelines. This automation streamlines the development and deployment process for microservices.

[00104] FIGS 5 to 6C illustrate Kubernetes-based orchestration of the plurality of virtual agents 116 as containerized microservices, in accordance with an embodiment of the present disclosure. However, a person skilled in the art will appreciate that the same orchestration can be extended to the plurality of employee digital twins 120 and the at least one workplace twin 118 without departing from the scope of the present disclosure.

[00105] FIG. 5 illustrates a Kubernetes cluster 500 (hereinafter also referred to as "the cluster 500") for orchestration of the containerized plurality of virtual agent 116, in accordance with an embodiment of the present disclosure. The cluster 500 includes a master node 502 also referred to as a control plane. Furthermore, the cluster 500 includes a plurality of worker nodes 506a, 506b, and 506c. The plurality of worker nodes 506a, 506b, and 506c may be physical machines or a combination of physical and virtual machines. Furthermore, the plurality of worker nodes 506a, 506b, and 506c communicate with the master node 502 through aKubernetes API 504. In several embodiments, each worker node ofthe plurality of worker nodes 506a, 506b, and 506c may have its own Linux environment. Furthermore, each one of the plurality of worker nodes 506a, 506b, and 506c are configured to run one or more pods 508a, 508b, 508c, and 508d that are configured to host containers illustrated in FIGS 6A to 6C.

[00106] The master node 502 maintains the overall health and configuration of the cluster 500. Furthermore, the master node 500 keeps track of the plurality of worker nodes 506a, 506b, and 506c, the one or more pods 508a, 508b, 508c, and 508d (groups of containers), and other resources. The master node 502 plays a crucial role in scheduling tasks. The master node 502 determines where to runthe one or more pods 508a, 508b, 508c, and 508d on the plurality of worker nodes 506a, 506b, and 506c based on various factors like resource availability, pod requirements, and any specified constraints. The master node 502 constantly monitors the cluster 500 for issues. If a worker node fails or a pod becomes unhealthy, the master node 502 can take corrective actions. This might involve restarting the pod on another worker node or taking other steps to maintain application uptime. The master node 502 facilitates communication between microservices within the cluster 500. It maintains a registry of services and enables service discovery, allowing microservices to find each other and interact seamlessly. Furthermore, the Kubernetes API 504 serves as the main point of access for interacting with the cluster 500. Users, tools, and other components can interact with Kubernetes through the Kubernetes API 504 to deploy applications, manage resources, and monitor cluster health.

[00107] FIG. 6A illustrates an implementation 625 of a fourth pod 508d hosted on a first worker node 506a, in accordance with an embodiment of the present disclosure. The first worker node 506a includes an operating system 637 that communicates with a Docker daemon 635. The fourth pod 508d includes a fourth container 627 with a service space 629 including a virtual agent 116d. Furthermore, the fourth container 627 includes libraries 631 and dependencies 633 to run the virtual agent 116d. The Docker daemon 635 acts as an intermediary, facilitating communication and resource access between containers and the host kernel of the operating system 637.

[00108] FIG. 6B illustrates an implementation 650 of a first pod 508a and third pod 508c hosted on a second worker node 506b, in accordance with an embodiment of the present disclosure. The second worker node 506b includes the operating system 637 that communicates with a Docker daemon 668. The first pod 508a includes a first container 652 with a service space 656 including a virtual agent 116a. Furthermore, the first container 652 includes libraries 658 and dependencies 660 to run the virtual agent 116a. The third pod 508c includes a third container 654 with a service space 662 including a virtual agent 116c. Furthermore, the third container 654 includes libraries 664 and dependencies 666 to run the virtual agent 116c. The Docker daemon 668 acts as an intermediary, facilitating communication and resource access between containers and the host kernel of the operating system 637.

[00109] FIG. 6C illustrates an implementation 637 of a second pod 508b hosted on a third worker node 506c, in accordance with an embodiment of the present disclosure. The third worker node 506c includes the operating system 637 that communicates with a Docker daemon 685. The second pod 508b includes a second container 667 with a service space 679 including a virtual agent 116b. Furthermore, the second container 667 includes libraries 681 and dependencies 683 to run the virtual agent 116b. The Docker daemon 685 acts as an intermediary, facilitating communication and resource access between containers and the host kernel of the operating system 637.

[00110] Access to the server system 106 may be provided to the developers and clients alike through a well-documented service API for developers to integrate the application into their products. Furthermore, Software Development Kits (SDKs) and code samples may be provided to simplify integration. Furthermore, a dedicated platform may be created for developers to access documentation, forums, and support resources. In several instances, developer contests and hackathons may be offered to foster engagement. The service API may be divided into modular API components allowing each component to be developed, tested, and deployed independently. Furthermore, individual components can be scaled independently based on their workload. Examples of modular API components may include (1) authentication (for handling user authentication and authorization), (2) data validation (to validate incoming data to ensure the incoming data meets specific criteria), (3) error handling (to message error responses and provide informative messages), (4) database interactions (to interactwith underlying databases to retrieve or store data), and (5) business logic (to implement core business rules and calculations).

[00111] Furthermore, the service API may be provided in most widely accepted protocols such as REST (Representational State Transfer), SOAP (Simple Object Access Protocol), GraphQL, RPC (Remote Procedure Call), WebSocket, gRPC, MessagePack, etc. In addition, the service API can be designed to support a variety of data formats to accommodate different use cases and developer preferences. Such data formats may include JSON (JavaScript Object Notation), XML (Extensible Markup Language), CSV (Comma-Separated Values), YAML (YAML Ain't Markup Language), etc. An API gateway is a critical component of modern application architectures. The API gateway acts as a single entrypoint for clients, providing security, load balancing, caching, monitoring, and more. The API gateway can be secured through several techniques including authentication and authorization (API Keys, OAuth 2.0, OpenID Connect, JSON Web Tokens (JWT)), encryption (Secure Socket Layer (SSL)/Transport Layer Security (TLS), data encryption), input validation, security headers (HTTP Strict Transport Security (HSTS), Content Security Policy (CSP), X-Frame-Options), API key management, logging and monitoring, web application firewall, Intrusion Detection System (IDS), security audits, security testing, and incident response plans.

[00112] Furthermore, the service API may be enabled with customizable API endpoints. Customizable API endpoints offer flexibility and adaptability to the application. Customizable API endpoints allow clients to tailor requests to their specific needs. Key components of customizable API endpoints include (1) endpoint structure (define a base endpoint URL, use path parameters to capture dynamic elements, and employ query parameters for optional filtering, sorting, and pagination), (2) parameter validation (ensure that incoming parameters adhere to expected data types and formats, and implement error handling for invalid inputs), (3) endpoint logic (develop the core logic to process requests and generate responses, and utilize parameter values to modify the API's behavior), (4) response formatting (choose a suitable data format (JSON, XML, etc.), and structure the response based on the requested parameters), and (5) security (protect the API using authentication and authorization mechanisms, and implement rate limiting to prevent abuse)

[00113] Furthermore, several measures may be taken to ensure cross-platform compatibility of the application implementing the aforementioned embodiments. These include (1) use of frameworks and libraries designed to be used with multiple platforms (frameworks such as Electron (for desktop apps), Xamarin, React Native, or Flutter (for mobile apps)), (2) adherence to platform guidelines and user experience standards to provide a native feel, (3) abstraction of platform specific code and use of conditional compilation or platform-specific modules to handle differences in functionality, (4) testing of the application (and microservices on all targeted platforms) and further automation of testing with cross-platform testing tools like Appium, BrowserStack, or Selenium, (5) implementing responsive design principles, flexible layouts, and scalable graphics to ensure the application adapts to different screen sizes and resolutions, (6) use of standardized data formats (e.g., JSON, XML), consistent handling of data across platforms, and cloud-based or centralized storage solutions for data synchronization (7) minimizing the use of platform-specific features unless absolutely necessary, ensuring there are equivalent functionalities on other platforms and/or providing fallbacks, (8) ensuring web applications comply with modern web standards (HTML5, CSS3, JavaScript ES6) and testing web applications across different browsers and devices to ensure compatibility, (9) keeping thorough documentation of any platform-specific considerations and how they are handled, and (10) implementing Continuous Integration (CI) and Continuous Deployment (CD) pipelines to automate the building, testing, and deployment processes across different platforms.

[00114] The processor 110 executing the machine-readable instructions may deploy several mechanisms for automating backup and disaster recovery. The processor 110 may identify which data and applications are critical to the operational workflow and classify data based on its importance and recovery requirements. Furthermore, the processor 110 may deploy several third-party back-up solutions based on the requirement. Popular options include AWS Backup, Azure Backup, Veeam, and Acronis. The processor 110 may further implement regular backups (daily, weekly, monthly) based on the criticality of the data. Several third-party tools and libraries may be used to automate the backup schedules to avoid manual intervention. Furthermore, in several embodiments, incremental or differential backups may be implemented to save time and storage space. These backups only capture changes since the last backup, reducing the amount of data to be stored. The machine-readable instructions may have built-in automated backup policies and retention rules. Furthermore, old backups may be deleted or archived according to the policies and retention rules to manage storage effectively. The processor 110 may further automate backup verification processes to ensure backups are not corrupted and can be restored successfully. Tools like BackupChecker and Bacula may be deployed.

[00115] For the automation of disaster recovery, a comprehensive Disaster Recovery Plan (DRP) may be developed that outlines the steps to take during a disaster. The DRP may include roles, responsibilities, and communication plans. A DR solution that meets RTO (Recovery Time Objective) and RPO (Recovery Point Objective) requirements may be selected. Options include AWS Disaster Recovery, Azure Site Recovery, and Zerto. The processor 110 may automate data replication to a secondary site or cloud environment. In that regard, the processor 110 may use tools that support real-time replication and automated failover, such as AWS CloudEndure, Azure Site Recovery, and Veeam. Furthermore, regular DR drills may be scheduled and automated to test the effectiveness of the DR plan, while ensuring that failover and failback processes work as expected. Furthermore, the processor 110 may implement monitoring tools that provide real-time alerts for backup failures and other critical events. Tools like Nagios, Zabbix, and Prometheus can help monitor the health of the backup and DR systems. Version control and configuration management tools like Git, Ansible, or Puppet may be used to automate the deployment and configuration of applications during disaster recovery.

[00116] In addition, backups may be stored in multiple locations, including geographically separated data centers, to protect against regional disasters. Furthermore, backups may be encrypted both in transit and at rest to protect sensitive data. The processor 110 may use tools that comply with security standards and regulations. Automated data integrity checks may be implemented to ensure that backups are consistent and complete. Furthermore, detailed documentation of the backup and DR processes may be maintained, including scripts, policies, and recovery procedures.

[00117] A person skilled in the art would appreciate that although several embodiments discussed in the aforementioned discussion have been implemented in an organizational setup, the embodiments as disclosed below may extend to other equivalent and non-equivalent scenarios as well, such as college campuses or cities. The embodiments allow users to run "what if" scenarios to evaluate life decisions, such as selecting the right college or career path, providing valuable insights for personal and professional development. Therefore, the several embodiments discussed above could be open to the public for personal uses (to create their environment, create their digital twin, and run “what if” scenarios to make life decisions).

[00118] Various embodiments of the disclosure, as discussed above, may be practiced with steps and/or operations in a different order, and/or with hardware elements in configurations, which are different than those which are disclosed. Therefore, although the disclosure has been described based on these exemplary embodiments, it is noted that certain modifications, variations, and alternative constructions may be apparent and well within the spirit and scope of the disclosure.