US 20250265395A1

(19) **United States**

(12) **Patent Application Publication**

Iordache

(10) **Pub. No.: US 2025/0265395 A1**

(43) **Pub. Date: Aug. 21, 2025**

(54) **SYSTEM AND METHOD FOR RESOURCE SHARING IN AN ELECTRONIC DESIGN AUTOMATION CLOUD ARCHITECTURE**

(71) Applicant: **Microchip Technology Incorporated**, Chandler, AZ (US)

(72) Inventor: **Florinel Iordache**, Bucharest (RO)

(73) Assignee: **Microchip Technology Incorporated**, Chandler, AZ (US)

(21) Appl. No.: **19/057,261**

(22) Filed: **Feb. 19, 2025**

Related U.S. Application Data

(60) Provisional application No. 63/555,225, filed on Feb. 19, 2024.

Publication Classification

(51) **Int. Cl.**

G06F 30/27 (2020.01)

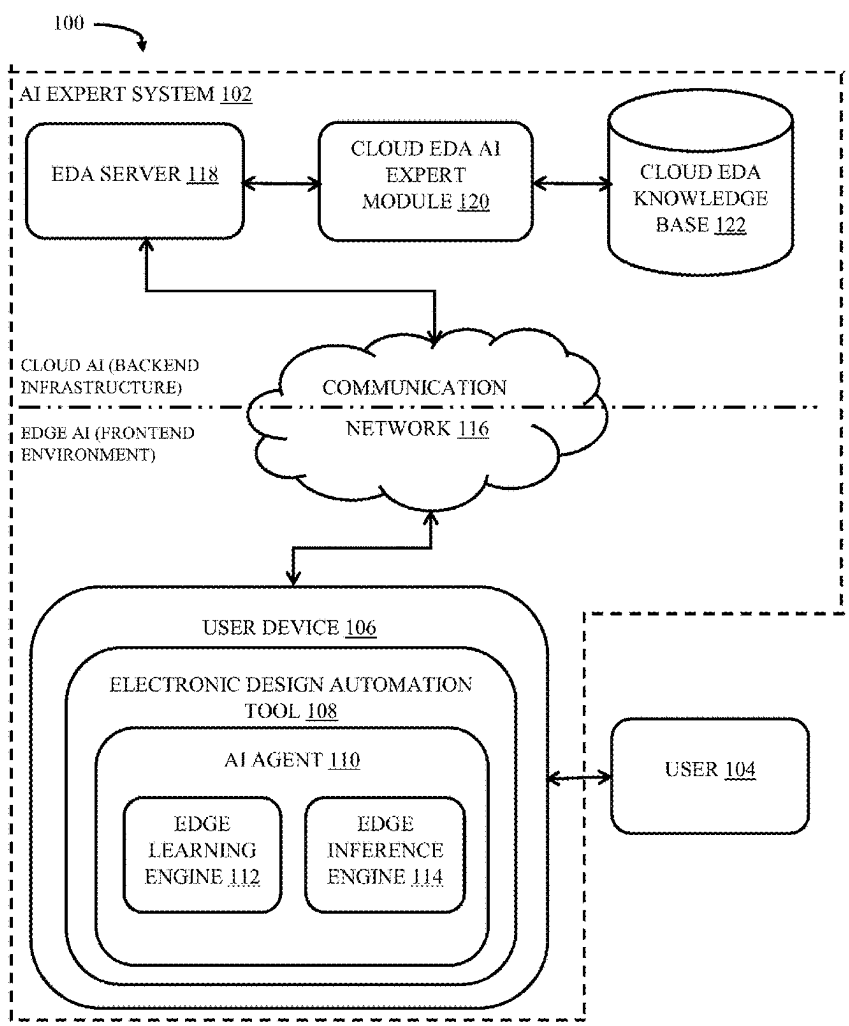
G06F 30/392 (2020.01)

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

CPC *G06F 30/27* (2020.01); *G06F 30/392* (2020.01)

(57) **ABSTRACT**

A cloud-based computer system for electronic design automation (EDA) is provided. The cloud-based computer system may include one or more processors, and a memory storing instructions executable by the one or more processors. The instructions, when executed, may cause the system to provide a cloud EDA artificial intelligence (AI) expert module to learn and evolve in an electronic designing field using a new set of electronic design methodologies data, store a new set of refined electronic design methodologies data, and update an AI agent associated with an EDA tool executed on a user device. The AI agent may receive a set of EDA-related knowledge data associated with a user activity on the EDA tool, transmit the received data to a cloud EDA AI expert module for processing, and receive the new set of refined electronic design methodologies data to enhance user assistance in the electronic design process.



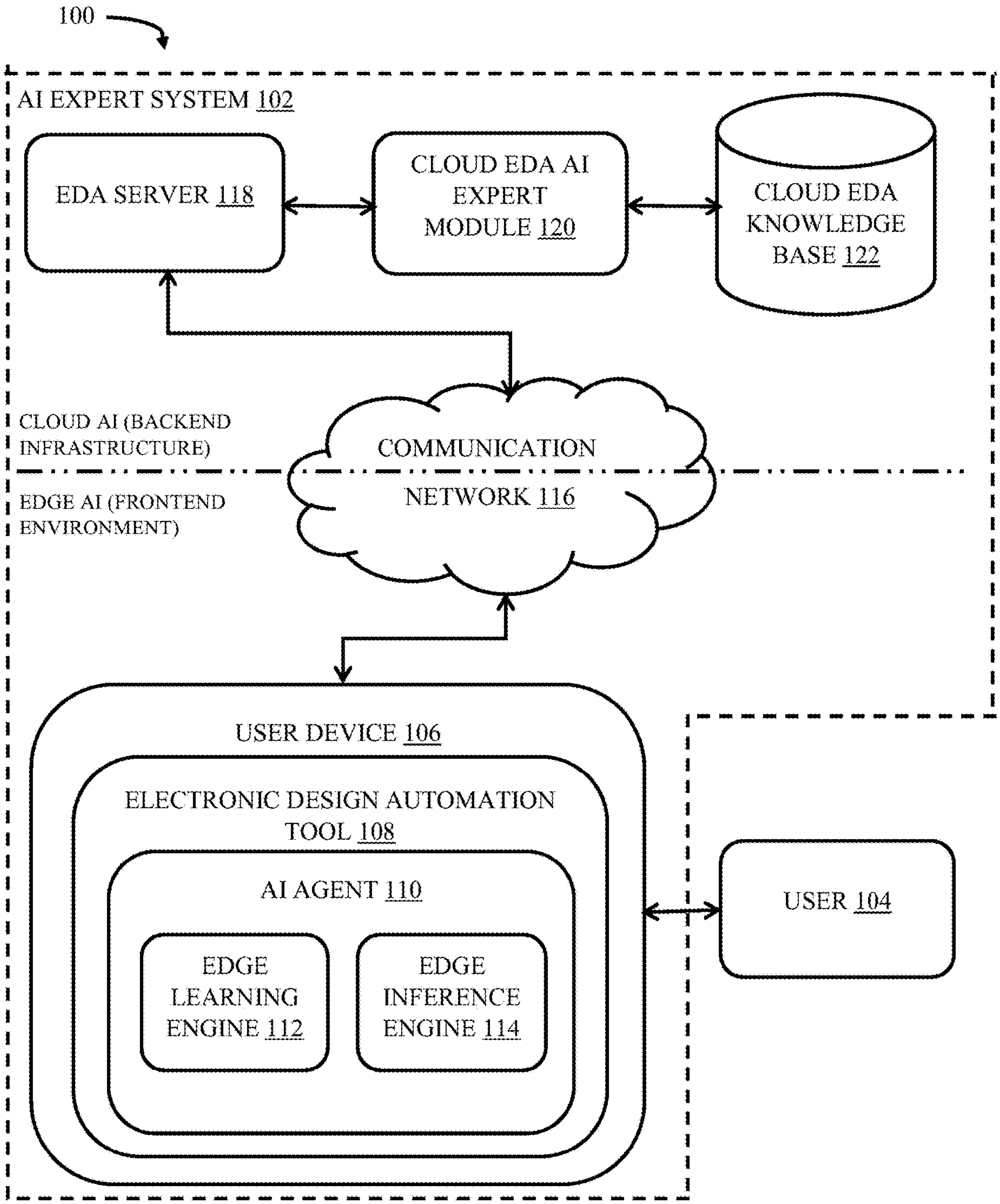

100
AI EXPERT SYSTEM 102
EDA SERVER 118
CLOUD EDA AI EXPERT MODULE 120
CLOUD EDA KNOWLEDGE BASE 122
CLOUD AI (BACKEND INFRASTRUCTURE)
COMMUNICATION NETWORK 116
EDGE AI (FRONTEND ENVIRONMENT)
USER DEVICE 106
ELECTRONIC DESIGN AUTOMATION TOOL 108
AI AGENT 110
EDGE LEARNING ENGINE 112
EDGE INFERENCE ENGINE 114
USER 104

FIG. 1

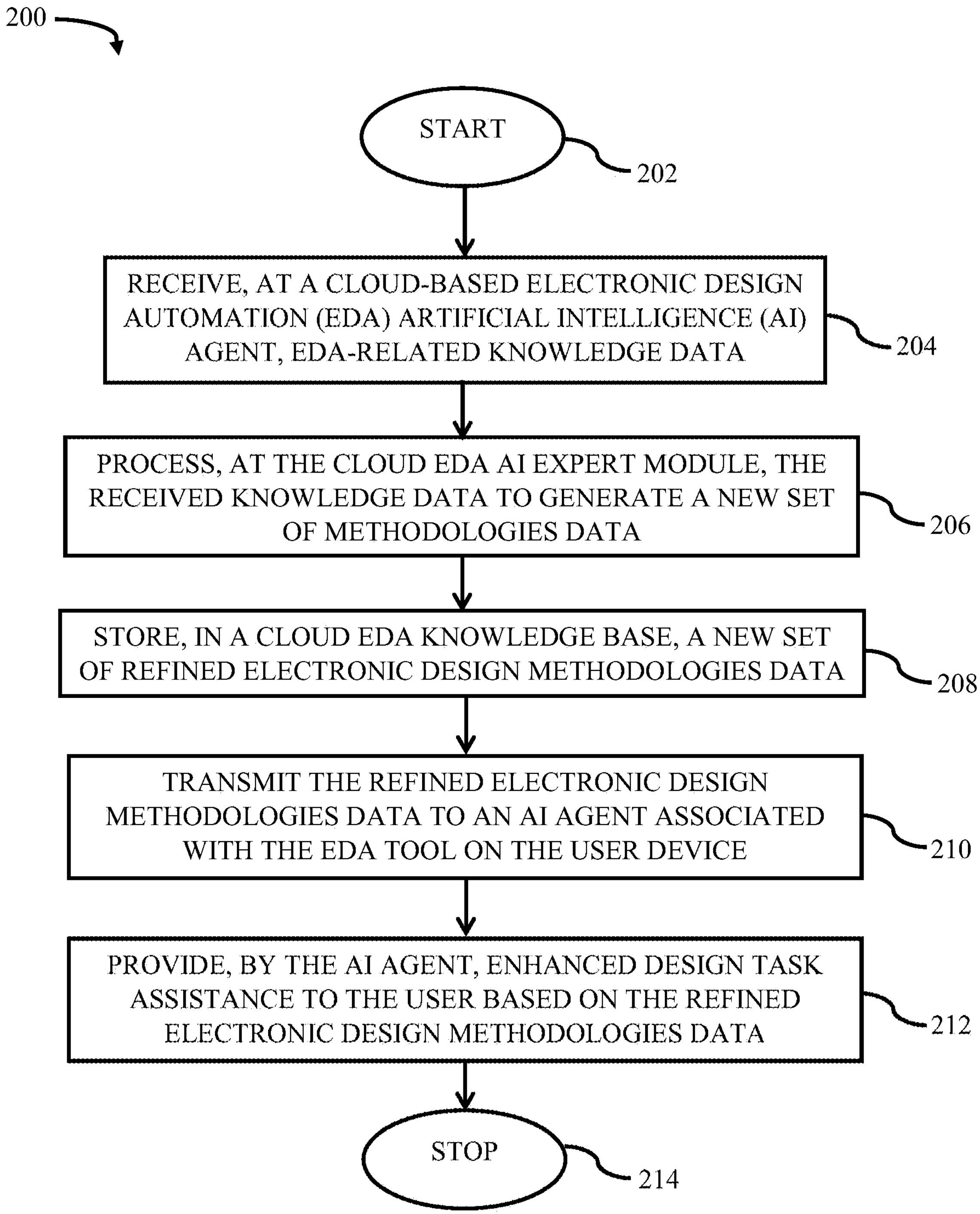

200
START
202
RECEIVE, AT A CLOUD-BASED ELECTRONIC DESIGN AUTOMATION (EDA) ARTIFICIAL INTELLIGENCE (AI) AGENT, EDA-RELATED KNOWLEDGE DATA
204
PROCESS, AT THE CLOUD EDA AI EXPERT MODULE, THE RECEIVED KNOWLEDGE DATA TO GENERATE A NEW SET OF METHODOLOGIES DATA
206
STORE, IN A CLOUD EDA KNOWLEDGE BASE, A NEW SET OF REFINED ELECTRONIC DESIGN METHODOLOGIES DATA
208
TRANSMIT THE REFINED ELECTRONIC DESIGN METHODOLOGIES DATA TO AN AI AGENT ASSOCIATED WITH THE EDA TOOL ON THE USER DEVICE
210
PROVIDE, BY THE AI AGENT, ENHANCED DESIGN TASK ASSISTANCE TO THE USER BASED ON THE REFINED ELECTRONIC DESIGN METHODOLOGIES DATA
212
STOP
214

FIG. 2

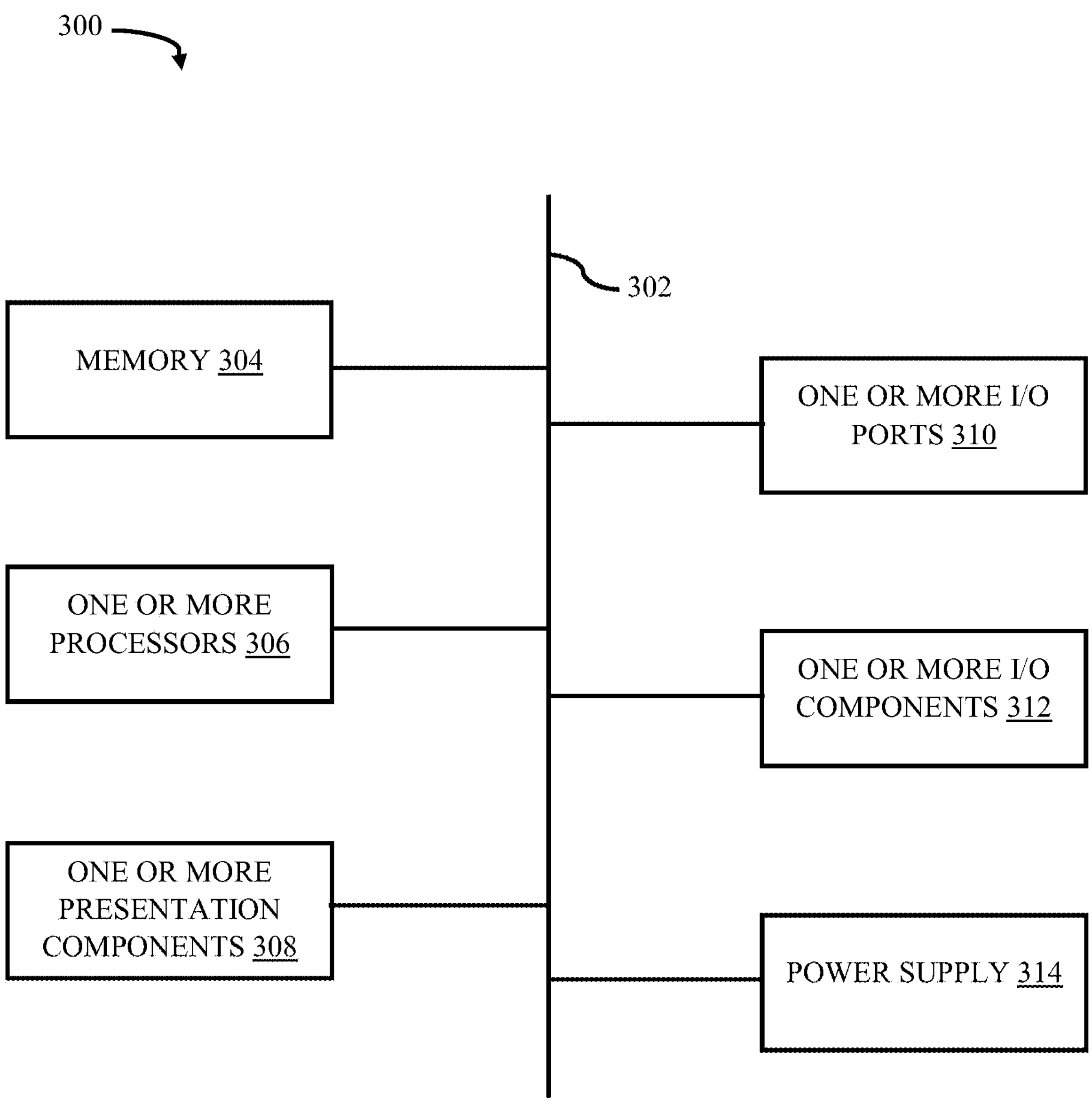

300
302
MEMORY 304
ONE OR MORE PROCESSORS 306
ONE OR MORE PRESENTATION COMPONENTS 308
ONE OR MORE I/O PORTS 310
ONE OR MORE I/O COMPONENTS 312
POWER SUPPLY 314

FIG. 3

SYSTEM AND METHOD FOR RESOURCE SHARING IN AN ELECTRONIC DESIGN AUTOMATION CLOUD ARCHITECTURE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application No. 63/555,225, entitled: System and Method for Resource Sharing in an Electronic Design Automation Cloud Architecture, filed on Feb. 19, 2024, the contents of which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] The present disclosure relates generally to electronic design automation (EDA) systems, and more specifically to a system and method for resource sharing in an EDA cloud architecture that incorporates an artificial intelligence (AI) expert system.

SUMMARY

[0003] According to an aspect of one or more examples, there is provided a cloud-based computer system for electronic design automation (EDA). The cloud-based computer system may include one or more processors, and a memory storing instructions executable by the one or more processors. The instructions, when executed, may cause the system to provide a cloud EDA artificial intelligence (AI) expert module to learn and evolve in an electronic designing field using a new set of electronic design methodologies data, store, in a cloud EDA knowledge base, a new set of refined electronic design methodologies data generated by the cloud EDA AI expert module, and update an AI agent associated with an EDA tool executed on a user device. The AI agent may receive, from the user device, a set of EDA-related knowledge data associated with a user activity on the EDA tool, transmit the received data to the cloud EDA AI expert module for processing, and receive, from the cloud EDA AI expert module, the new set of refined electronic design methodologies data to enhance user assistance in the electronic design process.

[0004] The cloud EDA AI expert module may include a deep neural network architecture that uses one or more deep learning algorithms to learn and evolve in the electronic designing field. The new set of refined electronic design methodologies data may include multiple schematics, chip designs, and printed circuit board (PCB) layout techniques. The AI agent may include a neural network that applies one or more reinforcement learning algorithms to assist the user in the designing process. The AI agent may detect electrical issues during the designing process. The AI agent may provide suggestions to the user to resolve the detected electrical issues. The AI agent may offer suggestions to the user for electrical improvements during the designing process. The EDA tool may be web-based. The EDA tool may be desktop-based.

[0005] According to an aspect of one or more examples, there is provided a computer-implemented method for resource sharing in an electronic design automation (EDA) cloud architecture. The method may include receiving, at a cloud-based EDA artificial intelligence (AI) expert module, EDA-related knowledge data from a user device, the knowledge data being associated with user activity on an EDA tool, processing, at the cloud EDA AI expert module, the received knowledge data to generate a new set of methodologies data, storing, in a cloud EDA knowledge base, a new set of refined electronic design methodologies data, wherein the refined data is generated based on aggregated updates and analysis results from the cloud EDA AI expert module, transmitting the refined electronic design methodologies data to an AI agent associated with the EDA tool on the user device, and providing, by the AI agent, enhanced design task assistance to the user based on the refined electronic design methodologies data received from the cloud EDA AI expert module.

[0006] The cloud EDA AI expert module may include a deep neural network architecture applying deep learning algorithms. The refined data may include schematics, chip designs, and printed circuit board (PCB) layout techniques. The AI agent may employ reinforcement learning algorithms. The AI agent may detect electrical issues. The AI agent may provide suggestions for resolving the detected electrical issues. The AI agent may provide guidance for refining the design. The EDA tool may be web-based. The EDA tool may be desktop-based.

[0007] According to an aspect of one or more examples, there is provided a non-transitory computer-readable medium encoding instructions that, when executed by one or more processors of a computing device, cause the computing device to perform a method. The method may include receiving, at the computing device, a set of electronic design automation (EDA)-related knowledge data associated with user activity on an EDA tool, processing, at the computing device, the received knowledge data to generate an updated set of electronic design methodologies data, transmitting the updated set of electronic design methodologies data to a cloud-based EDA artificial intelligence (AI) expert module for refinement, receiving, from the cloud-based EDA AI expert module, a new set of refined electronic design methodologies data, storing, at the computing device, the received refined electronic design methodologies data along with historical electronic design methodologies data, analyzing, at the computing device, a user interaction with the EDA tool in relation to the refined electronic design methodologies data, and providing, at the computing device, design assistance to the user based on the analysis.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** shows an electronic design automation (EDA) cloud system architecture using an artificial intelligence (AI) expert system according to one or more examples.

[0009] FIG. **2** shows a flowchart of a computer-implemented method for resource sharing in an electronic design automation (EDA) cloud architecture according to one or more examples.

[0010] FIG. **3** shows a block diagram of a computing device according to one or more examples.

DETAILED DESCRIPTION OF VARIOUS EXAMPLES

[0011] Reference will now be made in detail to the following various examples, which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The following examples may be exemplified in various forms without being limited to the examples set forth herein.

[0012] Electronic Design Automation (EDA) tools have schematic and circuit design functionalities along with manual circuit simulation capabilities. These tools have evolved to incorporate features, such as automatic on-the-fly simulation during schematic modifications and on-the-fly validation while creating schematic diagrams. Moreover, some EDA tools use static artificial intelligence (AI) and machine learning (ML) algorithms to facilitate chip design modeling and simulation processes. Despite the advancements in EDA tools, there persists a challenge in knowledge sharing related to electronic design among multiple users. Therefore, there exists a need for a system and method that may facilitate resource sharing in an EDA cloud architecture.

[0013] FIG. **1** shows an electronic design automation (EDA) cloud system architecture **100** according to one or more examples. The EDA cloud system architecture **100** may include an artificial intelligence (AI) expert system **102** and a user **104**. The EDA cloud system architecture **100** may be any environment which facilitates interaction of the user **104** with the AI expert system **102**. The user **104** may be any person or individual who access the AI expert system **102** to perform a designing process. In one or more examples, the user **104** may be an expert electronic computer-aided design (ECAD) user, a senior ECAD user, an intermediate ECAD user, a junior ECAD user, or a novice ECAD user, without limitation.

[0014] The EDA cloud system architecture **100** may include the AI expert system **102**. The AI expert system **102** may include a cloud AI, which may correspond to a backend infrastructure, and an EDGE AI, which may correspond to a frontend environment. The AI expert system **102** may include a user device **106** in the frontend environment. However, those skilled in the art would appreciate that the AI expert system **102** may include a greater number of user devices. In various examples, the user device **106** may be a portable user device. The portable user device may be a laptop, smartphone, tablet, or smart watch, without limitation. In various examples, the user device **106** may be a fixed user device. The fixed user device may be a desktop, workstation, smart TV, or mainframe computer, without limitation. The user device **106** may be any type of device that has ability to communicate with other devices using an active internet connection.

[0015] The AI expert system **102** may include an EDA tool **108** in the frontend environment. The EDA tool **108** may be accessed on the user device **106** by the user **104**. In various examples, the EDA tool **108** may be a web-based EDA application. In various examples, the EDA tool **108** may be a desktop-based EDA application.

[0016] The EDA cloud AI system **102** may include an AI agent **110** in the frontend environment. The AI agent **110** in the EDA tool **108** may be used by the user **104** using the user device **106**. The AI agent **110** may receive a set of EDA related knowledge data associated with a user activity on the EDA tool **108**. The AI agent **110** may include a neural network that uses one or more reinforcement learning algorithms to assist the user **104** in the designing process. The AI agent **110** may detect one or more electrical issues in the designing process. The AI agent **110** may provide one or more suggestions to the user **104** to fix the one or more electrical issues during the designing process. The AI agent **110** may provide the one or more suggestions to the user **104** for one or more electrical enhancements during the designing process.

[0017] The AI agent **110** may include an edge learning engine **112** that may process the set of EDA related knowledge data to detect a new set of electronic design methodologies data. The new set of electronic design methodologies data may correspond to relevant knowledge in an electronic designing field. Moreover, the AI agent **110** may include an edge inference engine **114** that processes a new set of refined electronic design methodologies data along with a historical set of electronic design methodologies data. The edge inference engine **114** may evaluate a user interaction with the EDA tool **108** and a processed set of electronic design methodologies data. The AI agent **110**, by the means of the edge inference engine **114**, may assist the user **104** in the designing process based on the evaluation.

[0018] The EDA cloud AI system **102** may include a communication network **116**. The communication network **116** may provide a medium for the frontend environment to connect with the backend infrastructure. In various examples, the communication network **116** may be an internet connection, a wireless mobile network, a wired network with a finite bandwidth, or a combination of the wireless and the wired network, without limitation. In another example, the communication network **116** may be an optical fiber high bandwidth network that enables a high data rate with negligible connection drops. The communication network **116** may include a set of channels. Each channel of the set of channels may support a finite bandwidth. In addition, the finite bandwidth of each channel of the set of channels may be based on capacity of the communication network **116**.

[0019] The EDA cloud AI system **102** may include an EDA server **118** in the backend infrastructure. However, those skilled in the art would appreciate that the EDA cloud AI system **102** may include a greater number of EDA servers. The EDA server **118** may learn, generate, store, receive, and transmit electronic data, such as executable instructions for knowledge sharing in the EDA cloud system architecture **100**. For example, the EDA server **118** may receive data from the user device **106** based on the user activity and the user interaction. In turn, the EDA server **118** may transmit data (e.g., based on the user activity and the user interaction) to the EDA tool **108** in the frontend environment of the EDA cloud system architecture **100**.

[0020] The EDA cloud AI system **102** may include a cloud EDA AI expert module **120** that may provide intelligence behind the EDA cloud AI system **102**, and a cloud EDA knowledge base **122** that may provide a database storage for the new set of refined electronic design methodologies data accumulated by the EDA cloud AI system **102**, in the backend infrastructure. The cloud EDA AI expert module **120** may learn and evolve in the electronic designing field using the new set of electronic design methodologies data detected by the AI agent **110**. The cloud EDA AI expert module **120** may include a deep neural network architecture that uses one or more deep learning algorithms to learn and evolve in the electronic designing field. The cloud EDA knowledge base **122** may store the new set of refined electronic design methodologies data. The new set of refined electronic design methodologies data may include a plurality of schematics, a plurality of chip designs, and a plurality of printed circuit board (PCB) layout design techniques. The AI agent **110** may be updated with the new set of refined electronic design methodologies data from the cloud EDA AI expert module **120**. The edge learning engine **112** may send the new set of electronic design methodologies data to the cloud EDA AI expert module **120**, via EDA server **118**, subsequently to be stored in the cloud EDA knowledge base **122**. The cloud EDA AI expert module **120** may filter, learn and process the new set of electronic design methodologies data to achieve the new set of refined electronic design methodologies data. The cloud EDA knowledge base **122** may be updated with the new set of refined electronic design methodologies data detected by the cloud EDA AI expert module **120**.

[0021] FIG. **2** shows a flowchart of a computer-implemented method **200** for resource sharing in an electronic design automation (EDA) cloud architecture according to one or more examples. The method **200** may start at operation **202**. At operation **204**, the method **200** may include receiving, at a cloud-based EDA artificial intelligence (AI) expert module, EDA-related knowledge data from a user device, the knowledge data being associated with user activity on an EDA tool. At operation **206**, the method **200** may include processing, at the cloud EDA AI expert module, the received knowledge data to generate a new set of methodologies data. At operation **208**, the method **200** may include storing, in a cloud EDA knowledge base, a new set of refined electronic methodologies data, wherein the refined data is generated based on aggregated updates and analysis results from the cloud EDA AI expert module. At operation **210**, the method **200** may include transmitting the refined electronic design methodologies data to an AI agent associated with the EDA tool on the user device. At operation **212**, the method **200** may include providing, by the AI agent, enhanced design task assistance to the user based on the refined electronic design methodologies data received from the cloud EDA AI expert module.

[0022] The method **200** may terminate at operation **214**. It may be noted that the method **200** is explained to have above stated process operations; however, those skilled in the art would appreciate that the method **200** may have more/less number of process operations which may enable all the above stated examples of the present disclosure.

[0023] FIG. **3** shows a block diagram of a computing device **300** according to one or more examples that may perform one or more of the processes described above. One will appreciate that one or more computing devices, such as the computing device **300**, may represent the computing devices described above (e.g., the user device **106**, the EDA server **118**). In one or more examples, the computing device **300** may be a mobile device (e.g., a mobile telephone, a smart phone, a PDA, a tablet, a laptop, a camera, a tracker, a watch, a wearable device). In some examples, the computing device **300** may be a non-mobile device (e.g., a desktop computer). Further, the computing device **300** may be a server device that includes cloud-based processing and storage capabilities.

[0024] As shown in FIG. **3**, the computing device may include a memory **304**, one or more processor(s) **306**, one or more presentation component(s) **308**, one or more I/O port(s) **310**, one or more I/O component(s) **312**, and a power supply **314**, which may be communicatively coupled by way of a bus **302**. While the computing device **300** is shown in FIG. **3**, the components illustrated in FIG. **3** are not limiting. Additional or alternative components may be used in other examples. Furthermore, in certain examples, the computing device **300** may include fewer components than those shown in FIG. **3**.

[0025] In various examples, the one or more processor(s) **306** may include hardware for executing instructions, such as those making up a computer program. As an example, to execute instructions, the processor(s) **306** may retrieve or fetch the instructions from an internal register, an internal cache, the memory **304**, the I/O component(s) **312**, or a storage device, and decode and execute them.

[0026] The computing device **300** may include the memory **304**, which is coupled to the processor(s) **306**. The memory **304** may be used for storing data, metadata, and programs for execution by the processor(s) **306**. The memory **304** may include one or more of volatile and non-volatile memories, such as Random-Access Memory ("RAM"), Read-Only Memory ("ROM"), a solid-state disk ("SSD"), Flash, Phase Change Memory ("PCM"), or other types of data storage. The memory **304** may be internal or distributed memory.

[0027] The computing device **300** may include the storage device for storing data or instructions. As an example, the storage device may include a non-transitory computer-readable medium. The storage device may include a hard disk drive ("HDD"), flash memory, a Universal Serial Bus (USB) drive, or a combination these or other storage devices.

[0028] The computing device **300** may include the one or more presentation component(s) **308** that may present data indications to a user or other device. The one or more presentation component(s) **308** may include a display device, speaker, printing component, vibrating component, without limitation. The one or more I/O ports **310** may allow the computing device **300** to be logically coupled to other devices, including the one or more I/O components **312**, some of which may be built in.

[0029] Various examples have been disclosed herein, in connection with the above description and the drawings. It will be understood that it would be unduly repetitious to literally describe and illustrate each combination and subcombination of these examples. Accordingly, all examples can be combined in any way or combination, and the present specification, including the drawings, shall be construed to constitute a complete written description of all combinations and subcombinations of these examples herein, and of the manner and process of making and using them, and shall support claims to any such combination or subcombination.

[0030] It will be appreciated by persons skilled in the art that the examples described herein are not limited to what has been particularly shown and described herein above. In addition, unless mention was made above to the contrary, it is to be noted that all of the accompanying drawings are not to scale. A variety of modifications and variations are possible in light of the above teachings.

What is claimed is:

1. A cloud-based computer system for electronic design automation (EDA), comprising:

one or more processors; and

a memory storing instructions executable by the one or more processors, wherein the instructions, when executed, cause the system to:

provide a cloud EDA artificial intelligence (AI) expert module to learn and evolve in an electronic designing field using a new set of electronic design methodologies data;

store, in a cloud EDA knowledge base, a new set of refined electronic design methodologies data generated by the cloud EDA AI expert module; and

update an AI agent associated with an EDA tool executed on a user device, wherein the AI agent is to:

receive, from the user device, a set of EDA-related knowledge data associated with a user activity on the EDA tool;

transmit the received data to the cloud EDA AI expert module for processing; and

receive, from the cloud EDA AI expert module, the new set of refined electronic design methodologies data to enhance user assistance in the electronic design process.

2. The cloud-based computer system of claim **1**, wherein the cloud EDA AI expert module comprises a deep neural network architecture that uses one or more deep learning algorithms to learn and evolve in the electronic designing field.

3. The cloud-based computer system of claim **1**, wherein the new set of refined electronic design methodologies data comprises multiple schematics, chip designs, and printed circuit board (PCB) layout techniques.

4. The cloud-based computer system of claim **1**, wherein the AI agent comprises a neural network that applies one or more reinforcement learning algorithms to assist the user in the designing process.

5. The cloud-based computer system of claim **1**, wherein the AI agent is to detect electrical issues during the designing process.

6. The cloud-based computer system of claim **5**, wherein the AI agent is to provide suggestions to the user to resolve the detected electrical issues.

7. The cloud-based computer system of claim **1**, wherein the AI agent is to offer suggestions to the user for electrical improvements during the designing process.

8. The cloud-based computer system of claim **1**, wherein the EDA tool is web-based.

9. The cloud-based computer system of claim **1**, wherein the EDA tool is desktop-based.

10. A computer-implemented method for resource sharing in an electronic design automation (EDA) cloud architecture, comprising:

receiving, at a cloud-based EDA artificial intelligence (AI) expert module, EDA-related knowledge data from a user device, the knowledge data being associated with user activity on an EDA tool;

processing, at the cloud EDA AI expert module, the received knowledge data to generate a new set of methodologies data;

storing, in a cloud EDA knowledge base, a new set of refined electronic design methodologies data, wherein the refined data is generated based on aggregated updates and analysis results from the cloud EDA AI expert module;

transmitting the refined electronic design methodologies data to an AI agent associated with the EDA tool on the user device; and

providing, by the AI agent, enhanced design task assistance to the user based on the refined electronic design methodologies data received from the cloud EDA AI expert module.

11. The computer-implemented method of claim **10**, wherein the cloud EDA AI expert module comprises a deep neural network architecture applying deep learning algorithms.

12. The computer-implemented method of claim **10**, wherein the refined electronic design methodologies data comprises schematics, chip designs, and printed circuit board (PCB) layout techniques.

13. The computer-implemented method of claim **10**, wherein the AI agent is to employ reinforcement learning algorithms.

14. The computer-implemented method of claim **10**, wherein the AI agent is to detect electrical issues.

15. The computer-implemented method of claim **14**, wherein the AI agent is to provide suggestions for resolving the detected electrical issues.

16. The computer-implemented method of claim **10**, wherein the AI agent is to provide guidance for refining the design.

17. The computer-implemented method of claim **10**, wherein the EDA tool is web-based.

18. The computer-implemented method of claim **10**, wherein the EDA tool is desktop-based.

19. A non-transitory computer-readable medium storing instructions that, when executed by one or more processors of a computing device, cause the computing device to perform a method comprising:

receiving, at the computing device, a set of electronic design automation (EDA)-related knowledge data associated with user activity on an EDA tool;

processing, at the computing device, the received knowledge data to generate an updated set of electronic design methodologies data;

transmitting the updated set of electronic design methodologies data to a cloud-based EDA artificial intelligence (AI) expert module for refinement;

receiving, from the cloud-based EDA AI expert module, a new set of refined electronic design methodologies data;

storing, at the computing device, the received refined electronic design methodologies data along with historical electronic design methodologies data;

analyzing, at the computing device, a user interaction with the EDA tool in relation to the refined electronic design methodologies data; and

providing, at the computing device, design assistance to the user based on the analysis.

* * * * *