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MOTION GENERATION DEVICE FOR GENERATING MOTION BASED ON INPUT INFORMATION INCLUDING TEXT AND OPERATION METHOD THEREOF

Abstract

Disclosed is a motion generation device for generating motion based on input information including a text and an operation method thereof, and the motion generation device may include a memory configured to store at least one instruction; and at least one processor configured to execute the at least one instruction stored in the memory, wherein the at least one processor is configured to: obtain the input information including the text representing a movement of a character, extract feature information from the obtained input information, generate motion data for the movement of the character using the extracted feature information, obtain correction motion data by post-processing the generated motion data, and generate motion animation of the character based on the obtained correction motion data.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] The present application is a continuation of International Patent Application No. PCT/KR2023/018352, filed on Nov. 15, 2023, which is based upon and claims the benefit of priority to Korean Patent Application No. 10-2023-0135540 filed on Oct. 12, 2023. The disclosures of the above-listed applications are hereby incorporated by reference herein in their entirety.

BACKGROUND

1. Technical Field

[0002] The present disclosure relates to a motion generation device, and more particularly, to a motion generation device for generating motion based on input information including a text and an operation method thereof.

2. Description of Related Art

[0003] Recently, with the advancement of technology, techniques are being used to extract features from texts, by considering the content of the text or the context of the text, estimate the motion of characters such as avatars, or generate the motion of characters that perform actions included in the text.

[0004] However, there may be cases where it is difficult to explain all the motions of the character to be generated with only the input of text. In addition, even if the motion of the character generated based on the input of text is different from the intended one and a new character motion is generated by inputting the modified text again, there is still a problem in which the motion of the character that is different from the intention is generated.

SUMMARY

[0005] A user may want to generate motion animation of a character performing an imagined motion by inputting text or additionally inputting text and control elements other than text. At this time, the control elements may be elements that can provide information about the motion of the character to be generated.

[0006] In addition, in the case that the motion data generated by the input text or text and control elements is analyzed and it is determined that the motion data includes unnatural motions that should be filtered out, unnatural motions based on a physics engine, or unnatural motions according to a trained artificial intelligence model, correction motion data can be generated through post-processing to remove or improve the motions.

[0007] A motion animation of a character can be generated through correction motion data, and at this time, an editing function can be provided to select a character for which a motion animation is to be generated or to select motion data to be applied to the character.

[0008] Technical problems of the inventive concept are not limited to the technical problems mentioned above, and other technical problems not mentioned will be clearly understood by those skilled in the art from the following description.

[0009] In an aspect of the present disclosure, a motion generation device may include a memory configured to store at least one instruction; and at least one processor configured to execute the at least one instruction stored in the memory, wherein the at least one processor is configured to: obtain the input information including the text representing a movement of a character, extract feature information from the obtained input information, generate motion data for the movement of the character using the extracted feature information, obtain correction motion data by post-processing the generated motion data, and generate motion animation of the character based on the obtained correction motion data.

[0010] In another aspect of the present disclosure, a method of operating a motion generation device for generating motion based on input information including text may include obtaining the input information including the text representing a movement of a character, extracting feature information from the obtained input information, generating motion data for the movement of the character using the extracted feature information, obtaining correction motion data by post-processing the generated motion data, and generating motion animation of the character based on the obtained correction motion data.

[0011] In addition, a computer-readable recording medium recording a computer program for implementing the present disclosure may be further provided.

Description

BRIEF DESCRIPTION OF THE FIGURES

[0012] FIG. 1 is a block diagram illustrating a configuration of a motion generation device according to one embodiment of the present disclosure.

[0013] FIG. 2 is a flowchart for describing an operation of the motion generative device according to one embodiment of the present disclosure.

[0014] FIG. 3 is a diagram for describing an operation of the motion generative device according to one embodiment of the present disclosure.

[0015] FIG. 4 is a diagram for describing an operation of the input information preprocessing module according to one embodiment of the present disclosure.

[0016] FIG. 5 is a diagram for describing an operation of the motion generation module according to one embodiment of the present disclosure.

[0017] FIG. 6 is a diagram for describing an operation of the motion post-processing module according to one embodiment of the present disclosure.

[0018] FIG. 7 is a diagram for describing an operation of the filtering-based unnatural motion improvement module according to one embodiment of the present disclosure.

[0019] FIG. 8 is a diagram for describing an operation of the artificial intelligence model-based unnatural motion improvement module according to one embodiment of the present disclosure.

[0020] FIG. 9 is a diagram for describing an operation of the unnatural motion improvement module based on a physics engine according to one embodiment of the present disclosure.

[0021] FIG. 10 is a diagram for describing an operation of the motion rendering module according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0022] In the drawings, the same reference numeral refers to the same element. This disclosure does not describe all elements of embodiments, and general contents in the technical field to which the present disclosure belongs or repeated contents of the embodiments will be omitted. The terms, such as “unit, module, member, and block” may be embodied as hardware or software, and a plurality of “units, modules, members, and blocks” may be implemented as one element, or a unit, a module, a member, or a block may include a plurality of elements.

[0023] Furthermore, when a certain part “includes” a certain element, other elements are not

excluded unless explicitly described otherwise, and other elements may in fact be included.

[0024] The terms “first,” “second,” and the like are just to distinguish an element from any other element, and elements are not limited by the terms.

[0025] The singular form of the elements may be understood into the plural form unless otherwise specifically stated in the context.

[0026] Identification codes in each operation are used not for describing the order of the operations but for convenience of description, and the operations may be implemented differently from the order described unless there is a specific order explicitly described in the context.

[0027] The operating principle and embodiments of the present disclosure are described below with reference to the attached drawings.

[0028] In this specification, the term ‘device according to the present disclosure’ includes all of various devices that can perform computational processing and provide results to the user. For example, the device may include all of a computer, a server device, and a portable terminal, or may be in the form of one of them.

[0029] Here, the computer may include, for example, a notebook, a desktop, a laptop, a tablet PC, a slate PC, and the like mounted with a web browser.

[0030] The server device is a server that communicates with an external device to process information, and may include an application server, a computing server, a database server, a file server, a mail server, a proxy server, and a web server.

[0031] A portable terminal is a wireless communication device that ensures portability and mobility, and may include all kinds of handheld-based wireless communication devices such as PCS (Personal Communication System), GSM (Global System for Mobile communications), PDC (Personal Digital Cellular), PHS (Personal Handyphone System), PDA (Personal Digital Assistant), IMT (International Mobile Telecommunication)-2000, CDMA (Code Division Multiple Access)-2000, W-CDMA (W-Code Division Multiple Access), WiBro (Wireless Broadband Internet) terminal, a smart phone, and the like, and a wearable device such as at least one of a watch, a ring, bracelets, anklets, a necklace, glasses, contact lenses, or a head-mounted device (HMD).

[0032] The function related to artificial intelligence according to the present disclosure operates through a processor and a memory. The processor may be composed of one or more processors. At this time, the one or more processors may be a general-purpose processor such as a CPU, an AP, a DSP (Digital Signal Processor), a graphics-only processor such as a GPU, a VPU (Vision Processing Unit), or an artificial intelligence-only processor such as an NPU. The one or more processors control input data to be processed according to a predefined operation rule or artificial intelligence model stored in the memory. Alternatively, in the case that the one or more processors are artificial intelligence-only processors, the artificial intelligence-only processor may be designed as a hardware structure specialized for processing a specific artificial intelligence model.

[0033] The predefined operation rule or artificial intelligence model may be created through learning. Here, being created through learning means that a basic artificial intelligence model is trained by using a plurality of learning data by a learning algorithm, thereby creating a predefined operation rule or artificial intelligence model set to perform a desired feature (or, purpose). Such learning may be performed on the device itself in which the artificial intelligence according to the present disclosure is performed, or may be performed through a separate server and/or system. Examples of learning algorithms include supervised learning, unsupervised learning, semi-supervised learning, or reinforcement learning, but are not limited to the examples described above.

[0034] FIG. 1 is a block diagram illustrating a configuration of a motion generation device according to one embodiment of the present disclosure.

[0035] In one embodiment, a motion generation device **100** may be a device that receives input information including a text representing a movement of a character and generates motion animation of the character based on the input information. In one embodiment, the motion

generation device **100** may be used to generate motion animation of a character by inputting a text or text and additional control elements (e.g., audio, image, video, pose, emotion, style, etc.) related to the movement of the character for the movement of the character to be generated.

[0036] In this case, the character may be an object that may have a movement, such as a person, an animal, a character in a novel or a cartoon, an avatar, a character in a game, and the like, and is not limited thereto. The motion animation may mean a video or at least one image that may represent the character or the movement of the character.

[0037] Referring to FIG. 1, in one embodiment, the motion generative device **100** may include a display **110**, a memory **120**, the at least one processor **130**, an input/output interface **140**, and a communication interface **150**. However, the components illustrated in FIG. 1 are not essential for implementing the motion generative device **100** according to the present disclosure. In one embodiment, the motion generative device **100** described in this specification may have more or fewer components than the components listed above. The display **110**, the memory **120**, and the at least one processor **130**, the input/output interface **140**, and the communication interface **150** may be electrically and/or physically connected to each other, respectively.

[0038] In one embodiment, the display **110** may display information processed or generated by the motion generative device **100**. The display **110** may display an input interface provided by the motion generation device **100**.

[0039] In one embodiment, the display **110** may display execution screen information of an application program driven by the motion generation device **100**, or UI (User Interface) or GUI (Graphical User Interface) information according to such execution screen information.

[0040] In one embodiment, the at least one processor **130** may control the display **110** to display a UI or GUI, thereby providing an input interface to a user using the motion generation device **100**. The user may provide a text indicating a movement of a character, a control element related to a movement of a character, or post-processing information to the motion generation device **100** through the input interface displayed on the display **110**.

[0041] In one embodiment, the at least one processor **130** may control the display **110** to display motion data generated based on input information or motion animation of a character. In one embodiment, the at least one processor **130** may provide the generated motion data or the motion animation of the character to a user through the display **110**. The user may input post-processing information or terminate the generation of the motion animation of the character through the motion data or the motion animation of the character displayed on the display **110**.

[0042] However, the present disclosure is not limited thereto, and the motion generation device **100** may not include the display **110**. The motion generation device **100** may also generate the motion animation based on the input information obtained through the input/output interface **140** or the communication interface **150** described below.

[0043] In one embodiment, the memory **120** may store data supporting various functions of the motion generation device **100** and a program for the operation of the at least one processor **130**, may store input/output data (e.g., sentences, music files, still images, video images, etc.), may store a plurality of application programs or applications driven by the device, at least one data for the operation of the device, and at least one instruction.

[0044] In one embodiment, the memory **120** may include an input information preprocessing module **121**, a motion generation module **122**, a motion post-processing module **123**, and a motion rendering module **124** for performing an operation of generating motion based on input information including text. A 'module' included in the memory **120** may mean a unit that processes a function or operation performed by the at least one processor **130**. The 'module' included in the memory **120** may be implemented as software such as instructions, algorithms, or program codes. At least some of these applications may be downloaded from an external server via wireless communication.

[0045] In one embodiment, each of the input information preprocessing module **121**, the motion

generation module **122**, the motion postprocessing module **123**, and the motion rendering module **124** may include an artificial intelligence model that has been pre-trained to perform each operation. The artificial intelligence model may include a plurality of neural network layers. Each of the plurality of neural network layers has a plurality of weight values, and performs a neural network operation through an operation between the operation result of the previous layer and the plurality of weights. The plurality of weights of the plurality of neural network layers may be optimized by the learning result of the artificial intelligence model. For example, the plurality of weights may be updated so that the loss value or cost value acquired from the artificial intelligence model is reduced or minimized during the learning process. The artificial neural network may include a deep neural network (DNN), for example, a convolutional neural network (CNN), a deep neural network (DNN), a recurrent neural network (RNN), a restricted boltzmann machine (RBM), a deep belief network (DBN), a bidirectional recurrent deep neural network (BRDNN), a transformer, deep Q-networks, or a boosting algorithm, but is not limited to the examples described above.

[0046] Each of the modules **121**, **122**, **123**, and **124** may include an artificial intelligence model optimized through transfer learning and fine tuning of a pre-trained model to perform the corresponding operation.

[0047] The memory **120** may include at least one type of storage medium among a flash memory type, a hard disk type, a Solid State Disk (SSD) type, a Silicon Disk Drive (SDD) type, a multimedia card micro type, a card type memory (e.g., an SD or XD memory, etc.), a random access memory (RAM), a static random access memory (SRAM), a read-only memory (ROM), an electrically erasable programmable read-only memory (EEPROM), a programmable read-only memory (PROM), a magnetic memory, a magnetic disk, and an optical disk. In addition, the memory may be a database that is separate from the motion generation device **100** but connected by wire or wirelessly.

[0048] In one embodiment, the at least one processor **130** may be a general-purpose processor such as a CPU, an AP, a Digital Signal Processor (DSP), a graphics-only processor such as a GPU, a Vision Processing Unit (VPU), or an artificial intelligence-only processor such as an NPU. The at least one processor controls processing of patient-related information according to instructions stored in a memory or an artificial intelligence model. Alternatively, in the case that the at least one processor is an artificial intelligence-dedicated processor, the artificial intelligence-dedicated processor may be designed with a hardware structure specialized for processing a specific artificial intelligence model.

[0049] In one embodiment, the at least one processor **130** may control overall operations of the motion generation device **100**. In one embodiment, the at least one processor **130** may control operations of the motion generation device **100** by executing at least one or more instructions stored in a memory **120**. In one embodiment, the at least one processor **130** may perform an operation of generating a motion based on input information including text by executing at least one of the instructions or program codes of the input information preprocessing module **121**, the motion generation module **122**, the motion post-processing module **123**, or the motion rendering module **124** included in the memory **120**.

[0050] In one embodiment, the input/output interface **140** is for receiving information from a user or an external source, or providing information to an external source. When input information is input through the input/output interface **140**, the at least one processor **130** may control the motion generation device **100** to generate a motion based on the input information. In addition, the motion generation device **100** may provide the generated motion to a peripheral electronic device through the input/output interface **140**.

[0051] In one embodiment, the input/output interface **140** may be displayed through the display **110**. In addition, the input/output interface **140** may include a device such as a mouse, a keyboard, and the like. In one embodiment, the user may input input information including text using a

keyboard, and the like, and may receive generated motions through the display.

[0052] In addition, the input/output interface **140** may include a voice input interface such as a microphone. In one embodiment, the user may input control elements using a microphone, and the like.

[0053] In one embodiment, the communication interface **150** may perform data communication between an external server or other electronic devices in the vicinity and the motion generation device **100**.

[0054] In one embodiment, the communication interface **150** may include one or more components that enable communication with an external server or other electronic devices in the vicinity, and may include at least one of a wireless communication module, a short-range communication module, and a location information module, for example.

[0055] The wireless communication module may include a wireless communication module that supports various wireless communication methods such as a WiFi module, a WiBro (Wireless broadband) module, GSM (Global System for Mobile Communication), CDMA (Code Division Multiple Access), WCDMA (Wideband Code Division Multiple Access), UMTS (Universal Mobile Telecommunications System), TDMA (Time Division Multiple Access), LTE (Long Term Evolution), 4G, 5G, and 6G.

[0056] The wireless communication module may include a wireless communication interface including an antenna and a transmitter for transmitting a data signal. In addition, the wireless communication module may further include a data signal conversion module that modulates a digital control signal output from the at least one processor **130** through the wireless communication interface into an analog wireless signal under the control of the at least one processor **130**.

[0057] The wireless communication module may include a wireless communication interface including an antenna and a receiver for receiving a data signal. In addition, the wireless communication module may further include a data signal conversion module for demodulating an analog wireless signal received through a wireless communication interface into a digital control signal.

[0058] The short-range communication module is for short-range communication, and may support short-range communication using at least one of Bluetooth™, RFID (Radio Frequency Identification), Infrared Data Association (IrDA), UWB (Ultra Wideband), ZigBee, NFC (Near Field Communication), Wi-Fi (Wireless-Fidelity), Wi-Fi Direct, and Wireless USB (Wireless Universal Serial Bus) technologies.

[0059] In one embodiment, the motion generation device **100** may communicate with an external server or a peripheral electronic device through the communication interface **150**. In one embodiment, the external server may include an application server, a computing server, a database server, a file server, a game server, a mail server, a proxy server, and a web server.

[0060] In one embodiment, the external server or the peripheral electronic device may include a model including a method for generating motion based on input information including text described in the present disclosure. The motion generative device **100** may receive a model including a method for generating motion based on input information including text from the external server or the peripheral electronic device through an input/output interface **140**.

[0061] Hereinafter, for convenience of explanation, an operation for generating motion based on input information including text description is described as being performed in the motion generative device **100**.

[0062] FIG. **2** is a flowchart for describing an operation of the motion generative device according to one embodiment of the present disclosure. FIG. **3** is a diagram for describing an operation of the motion generative device according to one embodiment of the present disclosure.

[0063] Referring to FIGS. **2** and **3**, in one embodiment, the operating method of the motion generative device **100** may include a step **S100** of obtaining input information including a text **300**

indicating movement of a character. In one embodiment, the at least one processor **130** may obtain input information including the text **300** in the step of obtaining input information (step **S100**).

[0064] In one embodiment, the text **300** may represent the movement of a character. In FIG. **3**, the text **300** is illustrated as “a main is running.” The text **300** illustrated in FIG. **3** may include information about the movement of a male character, “a man is running.” In one embodiment, the text **300** may include information about the subject of the movement and the content of the movement. However, the present disclosure is not limited thereto, and the text **300** may include information about the movement of various characters.

[0065] In one embodiment, the input information may further include a control element **310** related to the movement of the character. In one embodiment, the control element **310** may include at least one of audio, emotion, style of movement, image, pose, or video related to the movement of the character.

[0066] In one embodiment, the audio included in the control element **310** may be the character's voice, or may include background music indicating a mood, and the like. In one embodiment, the emotion included in the control element **310** may include an emotional state that may affect the character's movement (e.g., happy, depressed, confident). In one embodiment, the movement style included in the control element **310** may include a style of the character's movement (e.g., exaggerated behavior, girlish feeling, etc.). In one embodiment, the image included in the control element **310** may include an image of a specific pose or an image indicating a specific mood. In one embodiment, the pose included in the control element **310** may include a keyframe pose that needs to be taken in the middle of the character's movement (e.g., a clapping pose at 1 second, a sitting pose on a chair at 3 seconds, etc.). In one embodiment, the video included in the control element **310** may include a moving image that represents a reference person or animal's behavior (e.g., a video of an Olympic gymnast competing).

[0067] In one embodiment, the operating method of the motion generation device **100** may include a step **S200** of extracting feature information of the obtained input information. In one embodiment, the at least one processor **130** may extract feature information of the input information by executing commands or program codes of the input information preprocessing module **121** in the step **S200** of extracting feature information of the input information.

[0068] In one embodiment, the input information preprocessing module **121** may be configured with commands or program codes related to an operation or function of converting the provided input information into a form for generating motion data using the motion generation module **122** described below. In one embodiment, the input information preprocessing module **121** may be configured with commands or program codes for performing a preprocessing operation, such as removing noise included in the input information, before extracting feature information using the input information. Hereinafter, the input information preprocessing module **121** will be described later with reference to FIG. **4**.

[0069] In one embodiment, the operating method of the motion generation device **100** may include a step **S300** of generating motion data for the movement of the character by using the extracted feature information. In one embodiment, the at least one processor **130** may generate motion data for the movement of the character by executing instructions or program codes of the motion generation module **122** in the step **S300** of generating the motion data.

[0070] In one embodiment, the motion generation module **122** may be configured with instructions or program codes for an operation or function of generating motion data for the movement of the character by using the extracted feature information. In one embodiment, the motion generation module **122** may be configured with instructions or program codes for an operation or function of converting the feature information into motion feature for generating motion data. In one embodiment, the motion generation module **122** may be configured with instructions or program codes for an operation or function of generating motion data including information about the position of the character or information about the angle of the joint of the character by using the

converted motion feature. Hereinafter, the motion generation module **122** will be described below in FIG. 5.

[0071] In one embodiment, the operation method of the motion generative device **100** may include a step **S400** of post-processing the generated motion data to obtain correction motion data. In one embodiment, the at least one processor **130** may execute instructions or program codes of the motion post-processing module **123** in the step **S400** of obtaining correction motion data, thereby post-processing the generated motion data to obtain correction motion data.

[0072] In one embodiment, the motion post-processing module **123** may be configured with instructions or program codes related to an operation or function of post-processing the generated motion data to obtain correction motion data. In one embodiment, the motion post-processing module **123** may determine the degree of post-processing of the generated motion data by analyzing the generated motion data and using post-processing information including the degree of post-processing of the acquired motion data, and may post-process the motion data according to the determined degree of post-processing to obtain correction motion data. In one embodiment, the motion generation device **100** may provide the user with a function to edit the character motion animation during the process of generating the motion animation of the character through the motion post-processing module **123**. Hereinafter, the editing function may be performed through post-processing of motion data.

[0073] In one embodiment, the motion post-processing module **123** may include at least one of a filtering-based unnatural motion improvement module, an artificial intelligence-based unnatural motion improvement module, or a physics engine-based unnatural motion improvement module. Hereinafter, the motion post-processing module **123** will be described below with reference to FIGS. 6 to 9.

[0074] In one embodiment, the operation method of the motion generative device **100** may include a step **S500** of generating the motion animation of the character based on the post-processed motion data. In the step **S500** of generating the motion animation of the character, the post-processed motion data may be rendered to generate the motion animation.

[0075] In one embodiment, the at least one processor **130** may generate motion animation of the character by rendering the post-processed motion data by executing commands or program codes of the motion rendering module **124** in the step **S500** of generating motion animation of the character.

[0076] In one embodiment, the motion rendering module **124** may be configured with commands or program codes regarding an operation or function of rendering correction motion data to the character using the post-processed motion data to generate motion animation of the character. However, the present disclosure is not limited thereto, and in the case that it is determined that the motion data generated using the motion generation module **122** does not require post-processing, the motion rendering module **124** may be configured with commands or program codes regarding an operation or function of rendering motion data to the character using the motion data to generate motion animation of the character. Hereinafter, the motion rendering module **124** will be described below with reference to FIG. 10.

[0077] In one embodiment, the at least one processor **130** may re-perform at least one of the following operations: extracting feature information of input information through the input information preprocessing module **121**, obtaining correction motion data through the motion postprocessing module **123**, or generating motion animation through the motion rendering module **124**, based on the result of the generated motion animation. The at least one processor **130** may change a coefficient used when performing at least one of the following operations: extracting feature information of input information through the input information preprocessing module **121**, obtaining correction motion data through the motion postprocessing module **123**, or generating motion animation through the motion rendering module **124**, based on the result of the generated motion animation, and repeat the operations so that an appropriate motion animation is generated.

[0078] FIG. 4 is a diagram for describing an operation of the input information preprocessing module according to one embodiment of the present disclosure.

[0079] Referring to FIG. 1, FIG. 3, and FIG. 4, in one embodiment, the input information preprocessing module **121** may include a text feature extraction model **400**, a feature extraction model **410** for each control element, and a feature fusion preprocessing model **420**.

[0080] In one embodiment, the text feature extraction model **400** may extract a text feature by identifying the character included in the acquired text **300**, the feature of the character's behavior, the intention by which the corresponding text **300** is generated, and the like. In one embodiment, when the text **300** is given as an input to the text feature extraction model **400**, the text feature may be generated as an output.

[0081] In one embodiment, the feature extraction model **410** for each control element may extract information included in the obtained control element **310**. In one embodiment, the feature extraction model **410** for each control element may extract corresponding information according to the types of elements included in the control element **310**. In one embodiment, in the case that the control element **310** includes music, the feature extraction model **410** for each control element may extract information such as the mood of the music, the intensity of the music, and the speed of the music as the feature. In one embodiment, in the case that the control element **310** is given as an input to the feature extraction model **410** for each control element, the feature **440** for each control element may be generated as an output.

[0082] In one embodiment, the text and the each control element features may be referred to as feature information. The input information preprocessing module **121** may extract feature information based on input information including the text **300**.

[0083] In one embodiment, the feature fusion preprocessing model **420** may generate a synthetic feature **430** by fusing the text feature extracted from the text feature extraction model **400** and the feature for each control element extracted from the feature extraction model **410** for each control element. In one embodiment, the synthetic feature **430** may include information about the character included in the text feature, the feature of the character's behavior, the intention for which the corresponding text **300** is generated, and the control element included in the feature for each control element.

[0084] In one embodiment, the text feature extraction model **400** may include an artificial intelligence model that has been trained in advance to infer text features by identifying the character included in the acquired text **300**, the feature of the character's behavior, the intention for which the corresponding text **300** is generated, and the like. In one embodiment, the feature extraction model **410** for each control element may include an artificial intelligence model that has been pre-trained to infer the feature **440** for each control element according to the acquired control element **310**. In one embodiment, the feature fusion preprocessing model **420** may include an artificial intelligence model that has been pre-trained to infer the synthetic feature **430** by fusing of the text and the each control element features.

[0085] In one embodiment, the text feature extraction model **400** may include a Seq2Seq model, BERT (Bidirectional Encoder Representations from Transformers), CNN, RNN, Attention mechanism, and the like, but is not limited thereto. In one embodiment, the feature extraction model **410** for each control element may include a 2D CNN, a 3D CNN, an Optical Flow-based model, and the like, but is not limited thereto. In one embodiment, the feature fusion preprocessing model **420** may include, but is not limited to, an Attention mechanism, a Multi-modal model (e.g., Early Fusion, Late Fusion), and the like.

[0086] FIG. 5 is a diagram for describing an operation of the motion generation module according to one embodiment of the present disclosure. Referring to FIGS. 1, 3, and 5, in one embodiment, the motion generation module **122** may include a motion feature mapping model **500** and a motion feature-based motion generation model **510**.

[0087] In one embodiment, the motion feature mapping model **500** may map generated feature

information into the motion feature for generating motion data. In one embodiment, the motion feature mapping model **500** may convert the synthetic feature **430** into the motion feature for generating motion data. In one embodiment, the motion feature mapping model **500** may use the control feature **440** in the process of converting the synthetic feature **430** into the motion feature. In the process of mapping the synthetic feature **430** into the motion feature according to the control feature **440**, the mapped motion feature may be changed.

[0088] In one embodiment, the motion feature-based motion generation model **510** may generate motion data **520** using the motion feature mapped through the motion feature mapping model **500**. In one embodiment, the motion data **520** may include information about the position of the character, the positions of multiple joints included in the character, the angles between the multiple joints, and the like. In one embodiment, the motion data **520** may include not only the motion information of the character in 2D, but also the motion information of the character in 3D. In one embodiment, the motion data **520** may include the motion information of the character across multiple frames.

[0089] In one embodiment, the motion feature mapping model **500** may include an artificial intelligence model that is pre-trained to map the generated synthetic feature **430** or the synthetic feature **430** and the control feature **440** to the motion feature for generating the motion data **520**. In one embodiment, the motion feature-based motion generation model **510** may include an artificial intelligence model that is pre-trained to infer the motion data **520** using the motion feature mapped through the motion feature mapping model **500**. In one embodiment, the motion feature mapping model **500** and the motion feature-based motion generation model **510** may include an artificial intelligence model that is pre-trained together to infer the motion data **520** based on the synthetic feature **430** or the synthetic feature **430** and the control feature **440**.

[0090] In one embodiment, in the step **S300** of generating the motion data **520**, the motion data **520** may be generated from the feature information using an artificial intelligence model trained to infer the motion data **520** about the movement of a character from feature information extracted from the text **300** and the control element **310**.

[0091] In one embodiment, the motion feature mapping model **500** and the motion feature-based motion generation model **510** may include Seq2Seq, CNN, RNN, LSTM (Long Short-Term Memory), or Transformer. In one embodiment, the motion feature mapping model **500** may be trained in advance to convert the synthetic feature **430** generated as an encoder or the synthetic feature **430** and the control feature **440** into the motion feature. The motion feature-based motion generation model **510** may be pre-trained to infer motion data **520** using the converted motion feature as a generative model. However, this is merely an example, and the motion feature mapping model **500** and the motion feature-based motion generation model **510** are not limited to either one.

[0092] In one embodiment, the input information preprocessing module **121** and the motion generation module **122** may include an artificial intelligence model pre-trained to infer motion data of a corresponding character when text is provided by a training data set of text representing the movement of a character and motion data of a character corresponding to the text. In one embodiment, the input information preprocessing module **121** may extract the input text as feature information necessary to generate the corresponding motion data according to the pre-trained content. The motion generation module **122** may also infer the motion data **520** based on the extracted feature information.

[0093] FIG. **6** is a diagram for describing an operation of the motion post-processing module according to one embodiment of the present disclosure.

[0094] Referring to FIG. **1**, FIG. **3**, and FIG. **6**, in one embodiment, the motion post-processing module **123** may generate correction motion data through post-processing that removes unnatural motion included in the motion data **520** or changes it into natural motion. In one embodiment, FIG. **6** illustrates that the motion post-processing module **123** includes all of a filtering-based unnatural motion improvement module **600**, an artificial intelligence model-based unnatural motion

improvement module **610**, and a physics engine-based unnatural motion improvement module **620**, but the present disclosure is not limited thereto. The motion post-processing module **123** may include at least one of a filtering-based unnatural motion improvement module **600**, an artificial intelligence model-based unnatural motion improvement module **610**, or a physics engine-based unnatural motion improvement module **620**.

[0095] In addition, although FIG. **6** illustrates that the post-processing operation of the motion data **520** is sequentially performed by the filtering-based unnatural motion improvement module **600**, the artificial intelligence model-based unnatural motion improvement module **610**, and the physics engine-based unnatural motion improvement module **620** included in the motion post-processing module **123**, the present disclosure is not limited thereto. The filtering-based unnatural motion improvement module **600**, the artificial intelligence model-based unnatural motion improvement module **610**, and the physics engine-based unnatural motion improvement module **620** may operate in parallel with each other. In addition, the operation order of the filtering-based unnatural motion improvement module **600**, the artificial intelligence model-based unnatural motion improvement module **610**, and the physics engine-based unnatural motion improvement module **620** may be different from each other.

[0096] FIG. **7** is a diagram for describing an operation of the filtering-based unnatural motion improvement module according to one embodiment of the present disclosure. Hereinafter, the same configuration as described in FIG. **6** is assigned with the same reference numerals, and the repeated descriptions are omitted.

[0097] Referring to FIG. **1**, FIG. **3**, FIG. **6**, and FIG. **7**, in one embodiment, the filtering-based unnatural motion improvement module **600** may obtain correction motion data **790** by post-processing the generated motion data **520** to remove errors such as jittering phenomenon, phenomenon of feet not touching a floor or slipping, phenomenon of mesh overlapping due to different ratios of retargeted characters, and the like included in the motion data **520**. At this time, the motion data **520** may be referred to as an input motion sequence, and the correction motion sequence **790** may be referred to as a modified motion sequence.

[0098] In one embodiment, the filtering-based unnatural motion improvement module **600** may obtain post-processing information including the degree of post-processing of the motion data. The post-processing information may be generated by analyzing the generated motion data to reflect the degree of noise included in the motion data or whether the motion data includes specific conditions set in advance for example, conditions set to be filtered in the filtering-based unnatural motion improvement module **600**. In one embodiment, the post-processing information may be generated by analyzing the generated motion data or the correction motion data that has been post-processed previously or the character motion animation generated using the correction motion data. In one embodiment, the post-processing information is illustrated as user modification information **700** in FIG. **7**. In one embodiment, the post-processing information may be information generated by a user's input obtained through an input/output interface unit for example, a correction coefficient input module **710**. Hereinafter, for convenience of description, the post-processing information will be referred to as the user modification information **700**.

[0099] In one embodiment, the filtering-based unnatural motion improvement module **600** may obtain coefficients of a filtering algorithm for improving unnatural motion through the user modification information **700** obtained through the correction coefficient input module **710**. The filtering-based unnatural motion improvement module **600** may convert coefficients of a filtering algorithm obtained through the user modification information **700** into a form corresponding to each filtering algorithm through a correction coefficient transfiguration **720**.

[0100] In one embodiment, the filtering-based unnatural motion improvement module **600** may designate a joint among the skeleton joints of a character included in the motion data **520** that requires correction of an unnatural motion error through a joint group partial filtering **730** algorithm. In one embodiment, the filtering-based unnatural motion improvement module **600** may

remove data in which a shaking phenomenon occurs among the motion data **520** through a jittering error removal **740** algorithm. In one embodiment, the filtering-based unnatural motion improvement module **600** may smoothen the motion of the character included in the motion data **520** or add random motion information through a smoothing error removal **750** algorithm.

[0101] In one embodiment, the filtering-based unnatural motion improvement module **600** may remove a part of the character's sole included in the motion data **520** in the case that there is a difference between the coordinate information of the sole and the coordinate information of the floor through a foot contact error removal **760** algorithm. In one embodiment, the filtering-based unnatural motion improvement module **600** may remove a part of the character's motion included in the motion data **520** where the character slips on the floor through a foot sliding error removal **770** algorithm. In one embodiment, the filtering-based unnatural motion improvement module **600** may designate a joint among the skeleton joints of the character included in the motion data **520** that requires correction of an unnatural motion error through a joint ratio modification **780** algorithm.

[0102] Although FIG. 7 illustrates that the filtering-based unnatural motion improvement module **600** sequentially uses the joint group partial filtering **730** algorithm, the jittering error removal **740** algorithm, the smoothing error removal **750** algorithm, the foot contact error removal **740** algorithm, the foot sliding error removal **770** algorithm, and the joint ratio correction **780** algorithm, the present disclosure is not limited thereto. The filtering-based unnatural motion improvement module **600** may use at least one of the respective algorithms, and the order of use may vary.

[0103] FIG. 8 is a diagram for describing an operation of the artificial intelligence model-based unnatural motion improvement module according to one embodiment of the present disclosure. Hereinafter, the same configuration as that described in FIG. 7 is given the same drawing reference numerals, and redundant descriptions are omitted.

[0104] Referring to FIG. 1, FIG. 3, and FIG. 8, in one embodiment, the artificial intelligence model-based unnatural motion improvement module **610** may perform an operation of adjusting the parameter of the motion generation module **122** to generate motion data from which unnatural motions are removed based on the generated motion data **520** through the motion generation module **122**.

[0105] In one embodiment, the artificial intelligence model-based unnatural motion improvement module **610** may convert the user correction information **700** obtained through the correction coefficient input unit **710** into a vector form that may be integrated through a correction coefficient vectorization **810** algorithm. In this case, the vector form that may be integrated may mean a vector form for integration into the converted motion data to generate motion data using the motion generation module **122**.

[0106] In one embodiment, the artificial intelligence model-based unnatural motion improvement module **610** may designate a skeleton joint of a character included in motion data **520** that requires error correction through a joint group designation **820** based on the user correction information **700**. In one embodiment, the artificial intelligence model-based unnatural motion improvement module **610** may mask a vector representing joint information of a skeleton joint that requires error correction through a joint vector masking **830**.

[0107] In one embodiment, the artificial intelligence model-based unnatural motion improvement module **610** may integrate the user correction information **700** converted into a vector form that may be integrated and masking a vector representing joint information of a skeleton joint that requires error correction through a correction coefficient integration **840**. Through this, the parameter of the motion generation module **122** may be adjusted to generate motion data from which unnatural motions are removed, which is provided to the motion generation module **122**. The motion generation module **122** may generate correction motion data **791** from which unnatural motions are removed, using the adjusted parameter and feature information.

[0108] FIG. 9 is a diagram for describing an operation of the unnatural motion improvement module based on a physics engine according to one embodiment of the present disclosure. Hereinafter, the same components as those described in FIG. 7 are given the same drawing reference numerals, and redundant descriptions are omitted.

[0109] Referring to FIG. 1, FIG. 3, and FIG. 8, in one embodiment, the unnatural motion improvement module **620** based on a physics engine utilizes a simulation technique based on a physics engine to the generated motion data **520** to remove unnatural motions included in the motion data **520**, and generates an animation that matches the additional control information to obtain correction motion data **792**.

[0110] In one embodiment, the physics engine-based unnatural motion improvement module **620** may include a module **621** that determines a correction coefficient that determines the degree of correction of the motion data **520** and a module **622** that post-processes motion data based on the physics engine.

[0111] In one embodiment, the physics engine-based unnatural motion improvement module **620** may obtain user correction information **900** determined according to the degree of unnatural motion included in the motion data **520** through the correction coefficient input unit **710**. At this time, the degree of unnatural motion included in the motion data **520** may include at least one of foot content correction information, foot sliding correction information, trajectory information, target point information, or avoidance area information. In one embodiment, the physics engine-based unnatural motion improvement module **620** may convert the correction coefficient transformation **720** algorithm into a vector form that may be integrated. In one embodiment, the physics engine-based unnatural motion improvement module **620** may obtain joint designation information **910** that designates a skeleton joint that requires error correction among the skeleton joints of the character included in the motion data **520** through the joint group designation input module **820**. In one embodiment, the physics engine-based unnatural motion improvement module **620** may mask a vector representing joint information of a skeleton joint that requires error correction through the joint vector masking **830**.

[0112] In one embodiment, the physics engine-based unnatural motion improvement module **620** may integrate the user correction information **900** converted into a vector form that may be integrated and masking a vector representing joint information of a skeleton joint that requires error correction through the correction coefficient integration **840**.

[0113] In one embodiment, the physics engine-based unnatural motion improvement module **620** may integrate masking of the vector that represents the user correction information **900** converted to a vector form and the joint information of the skeleton joint that is designated as requiring error correction through the correction coefficient integration **840**.

[0114] In one embodiment, the physics engine-based unnatural motion improvement module **620** may modify the motion data **520** by projecting (**960**) a physics-based motion control condition using the integrated correction coefficient through the motion generation module **122** and feedback. In one embodiment, the physics engine-based unnatural motion improvement module **620** may modify the motion data **520** so that the character moves and operates based on the integrated correction coefficient using a physics-based reinforcement learning control model **970**. In one embodiment, the physics engine-based unnatural motion improvement module **620** may generate correction motion data **792** in which unnatural motion is improved through the operation of the motion generation module **122**, the physics-based motion control condition projection **960**, and the physics-based reinforcement learning control model **970**.

[0115] FIG. 10 is a diagram for describing an operation of the motion rendering module according to one embodiment of the present disclosure.

[0116] Referring to FIG. 1, FIG. 3, and FIG. 10, in one embodiment, the motion rendering module **124** may generate the motion animation **320** of a character by rendering correction motion data **1000** to the character based on the correction motion data **1000**. In one embodiment, the motion

rendering module **124** may generate the motion animation **320** of the character corresponding to the correction motion data **1000** by re-targeting the correction motion data **1000** to the character to visualize the generated the correction motion data **1000**.

[0117] In one embodiment, the motion rendering module **124** may utilize a rendering selection signal **1010** in generating the motion animation **320** of the character. In one embodiment, the rendering selection signal **1010** may include information **1011** on motion data selection for selecting the correction motion data **1000** to be rendered among a plurality of correction motion data stored in a database. In one embodiment, the rendering selection signal **1010** may include information **1020** about selection of a character model for generating motion animation **320** using correction motion data **1000**. In one embodiment, the rendering selection signal **1010** may include information **1013** for playing or stopping the character motion animation **320** for visualization of the generated the character motion animation **320**.

[0118] In one embodiment, the rendering selection signal **1010** may be obtained through the input/output interface module **140** or may be acquired through the communication interface **150**.

[0119] In one embodiment, the motion rendering module **124** may load (**1020**) the generated correction motion data **1000**. At this time, the motion rendering module **124** may load the correction motion data **1000** from a database in which the generated correction motion data **1000** is stored.

[0120] In one embodiment, the motion rendering module **124** may parse (**1030**) the loaded correction motion data **1000**, analyze the correction motion data **1000**, and extract information necessary for generating the character motion animation **320**. At this time, the information necessary for generating the character motion animation **320** may include the position of the character in each frame, the position of the skeleton joint of the character, the angle of the skeleton joint of the character, and the like. At this time, the motion rendering module **124** may parse the selected correction motion data **1000** based on the information **1011** for selecting the motion data included in the rendering selection signal **1010**. However, the present disclosure is not limited thereto, and the motion rendering module **124** may also load the selected correction motion data **1000** from among the plurality of correction motion data included in the database based on the information **1011** for selecting the motion data included in the rendering selection signal **1010** in the step of loading **1020** the correction motion data **1000**.

[0121] In one embodiment, the motion rendering module **124** may retarget **1040** the parsed correction motion data by loading it to the selected character based on the selection information **1012** of the character model included in the rendering selection signal **1010**. The motion rendering module **124** may apply the parsed correction motion data by loading it to the skeleton joint of the selected character.

[0122] In one embodiment, the motion rendering module **124** may render (**1050**) the animation of the character to which correction motion data is retargeted based on the information **1013** included in the rendering selection signal **1010** for playing or stopping the character motion animation **320** and visualize it. In one embodiment, the motion rendering module **124** may render (**1050**) the animation of the character to which correction motion data is retargeted and generate the motion animation **320** of the character.

[0123] Meanwhile, the disclosed embodiments may be implemented in the form of a recording medium storing instructions executable by a computer. The instructions may be stored in the form of program codes and, when executed by a processor, may generate a program module to perform the operations of the disclosed embodiments. The recording medium may be implemented as a computer-readable recording medium.

[0124] The computer-readable recording medium includes all kinds of recording media storing instructions that may be deciphered by a computer. For example, there may be ROM (Read Only Memory), RAM (Random Access Memory), a magnetic tape, a magnetic disk, a flash memory, an optical data storage device, and the like.

[0125] The disclosed embodiments have been described with reference to the attached drawings as described above. Those skilled in the art to which the present disclosure pertains will understand that the present disclosure may be implemented in a different form from the disclosed embodiments without changing the technical idea or essential features of the present disclosure. The disclosed embodiments are exemplary and should not be construed as limiting.

[0126] According to the present disclosure, the motion generation device may input the control element that may provide additional information about the motion of the character to be generated in addition to the text, thereby generating motion animation of the character performing the intended motion.

[0127] In addition, the motion data generated in the process of generating motion animation of the character may be analyzed to filter out the unnatural motion, improve based on a physics engine, or improve using a trained artificial intelligence model. In addition, in the post-processing process, the degree of post-processing may be controlled by inputting different coefficients used in each post-processing motion.

[0128] In addition, a function for selecting a character for which motion animation is to be generated or selecting motion data to be applied may be provided, thereby allowing the user to generate motion animation of the desired character, thereby improving user convenience.

[0129] The effects of the present disclosure are not limited to the effects mentioned above, and other effects not mentioned may be clearly understood by a person skilled in the art from the description.

Claims

1. A motion generation device for generating motion based on input information including text, comprising: a memory configured to store at least one instruction; and at least one processor configured to execute the at least one instruction stored in the memory, wherein the at least one processor is configured to: obtain the input information including the text representing a movement of a character, extract feature information from the obtained input information, generate motion data for the movement of the character using the extracted feature information, obtain correction motion data by post-processing the generated motion data, and generate motion animation of the character based on the obtained correction motion data.
2. The device according to claim 1, wherein the at least one processor is configured to: generate the motion data from the feature information using an artificial intelligence model trained to infer the motion data for the movement of the character from the feature information extracted from the text.
3. The device according to claim 2, wherein, the input information further includes a control element related to the movement of the character, and the control element includes at least one of audio, emotion, style of the movement, image, pose, or video.
4. The device according to claim 3, wherein the at least one processor is configured to: generate the motion data from the feature information by using an artificial intelligence model trained to infer the motion data from the feature information extracted from the text and the control element.
5. The device according to claim 4, wherein the at least one processor is configured to: obtain the correction motion data by post-processing the motion data using a motion post-processing module, wherein the motion post-processing module includes at least one of a filtering-based unnatural motion improvement module, an artificial intelligence-based unnatural motion improvement module, or a physics engine-based unnatural motion improvement module.
6. The device according to claim 5, wherein the at least one processor is configured to: obtain post-processing information including a degree of post-processing of the motion data by analyzing the generated motion data, and obtain the correction motion data by post-processing the generated motion data using the obtained post-processing information.
7. A method of operating a motion generation device for generating motion based on input

information including text, comprising: obtaining the input information including the text representing a movement of a character; extracting feature information from the obtained input information; generating motion data for the movement of the character using the extracted feature information; obtaining correction motion data by post-processing the generated motion data; and generating motion animation of the character based on the obtained correction motion data.

8. The method according to claim 7, wherein generating the motion data includes: generating the motion data from the feature information using an artificial intelligence model trained to infer the motion data for the movement of the character from the feature information extracted from the text.

9. The method according to claim 8, wherein, the input information further includes a control element related to the movement of the character, and the control element includes at least one of audio, emotion, style of the movement, image, pose, or video.

10. The method according to claim 9, wherein generating the motion data includes: generating the motion data from the feature information by using an artificial intelligence model trained to infer the motion data from the feature information extracted from the text and the control element.

11. The method according to claim 10, wherein obtaining the correction motion data includes: obtaining the correction motion data by post-processing the motion data using a motion post-processing module, wherein the motion post-processing module includes at least one of a filtering-based unnatural motion improvement module, an artificial intelligence-based unnatural motion improvement module, or a physics engine-based unnatural motion improvement module.

12. The method according to claim 11, wherein obtaining the correction motion data includes: obtaining post-processing information including a degree of post-processing of the motion data by analyzing the generated motion data, and obtaining the correction motion data by post-processing the generated motion data using the obtained post-processing information.

13. A computer-readable recording medium storing a program for executing the method for operating the motion generation device of claim 7, coupled to a computer.
