United States Patent Application Publication	20250266022
Kind Code	A1
Publication Date	August 21, 2025
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Apparatus for Generating AI-Generated Music Based on Gait

Abstract

The present invention discloses an apparatus for producing AI-generated music based on gait, which includes a sensor assembly disposed on the user's foot, a pressure sensing device and an inertial sensing module used to collect the user's movement related data, a computing electronic device is coupled to the sensor assembly for receiving the user's movement-related data and the gait analysis module is used to analyze the movement-related data to obtain the user's gait parameters, and then extracting the rhythm parameters from the user's gait parameters by a rhythm parameter extraction module, and an AI music generation module is coupled to the computing electronic device for receiving the user's motion-related rhythm parameters, thereby converting the motion-related rhythm parameters into corresponding number of beats, high and low notes, light and heavy notes. A piece of music is created by an AI algorithm.

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Family ID: **1000008283566**

Appl. No.: **18/940873**

Filed: **November 08, 2024**

Foreign Application Priority Data

TW	113105631	Feb. 17, 2024

Publication Classification

Int. Cl.: **G10H1/00** (20060101)

U.S. Cl.:

Background/Summary

TECHNICAL FIELD

[0001] The present invention relates to an AI-generated music, more specifically, an apparatus to create an AI-generated music based on gait.

BACKGROUND

[0002] The information related to the people's movement gait can be detected and extracted through various electronic sensors, information and communication technologies. Previous technologies, such as US patent U.S. Pat. No. 5,765,300, have attempted to develop electronic tap dance shoes by pressure sensors to detect dancers' activities, and thereby sending corresponding MIDI (Musical Instrument Digital Interface) notes by wired or wireless means. For example, the patent provides a shoe-activated sound synthesizer device that converts shoe movement into audible sounds. A shoe includes at least one trigger disposed and capable of generating a trigger signal when the shoe is bent to a predetermined degree. The shoe flexes when it contacts with the floor. By contacting the floor via different parts of the shoe, the music is generated by the trigger elements contained within the different positions of the shoe under control manner. A sound synthesizer circuit is coupled to each trigger elements contained within the shoe. When a trigger signal is received from the shoe, the sound synthesizer circuit produces an audible sound through the speaker.

[0003] The pressure sensors may also be embedded in the floor or on surfaces of the floor to act as home game controllers or as tracking devices to track the user's movements and activities for fitness training purpose. The pressure sensors may transmit data packets to the receivers of a mobile device wirelessly.

[0004] Music and dance are enjoyable activities in modern society. Learning to dance is one of the most popular activities in the world. If using your favorite music to dance, the learning effect is particularly good, however, some dance moves are not easy to learn.

[0005] It is a complex process for achieving harmonious movements when a user's body moves during dancing or exercising, the dancer has to consider the coordination of action with time.

[0006] The connection between rhythm and people's daily life is getting closer and closer. For example, the people may exercise with the rhythm of the audio, the video games can be designed based on the rhythm of the audio, and the lights are set to flash with the rhythm of the audio, etc. In order to fetch the rhythm of audio, it is necessary to determine the rhythm point from the audio, typically. Therefore, what is required is to accurately determine the rhythm point of the audio in the related technical fields.

[0007] It is not easy to automatically generate a piece of music. In addition to melody generation, other elements such as multi-track accompaniment generation, lyric generation, orchestration and arrangement are also necessary to be considered. However, due to the rapid development of artificial intelligence technology, it has become possible to employ generative artificial intelligence technology (including machine learning models and deep learning models) to generate a piece of music from the rhythm of the user's movement gait.

SUMMARY OF THE INVENTION

[0008] Based on above, one aspect of the present invention is to provide an apparatus for generating music based on gait. The apparatus comprises a sensing assembly provided on a user's foot, the sensing assembly includes a pressure sensor and an inertial sensor configured to collect data related to the user's movement. A computing device is coupled to the sensing device, wherein the computing device includes a gait analysis device and a rhythm parameter extraction module,

wherein the gait analysis device is employed to analyze a movement data to obtain gait parameters, and the rhythm parameter extraction module extracting movement rhythm parameters from the gait parameters; an AI music generation module is coupled to the computing device, and is configured to receive the movement rhythm parameters and convert the movement rhythm parameters into corresponding beats, high and low sounds, light and heavy tones, and followed by composing melody with the beats, the high and low sounds, the light and heavy tones, thereby generating a music and outputting to the computing device.

[0009] A music gait interaction module is configurated on the computing device to generate dynamic patterns in conjunction with rhythms of the music generated by the AI music generation module for interacting with the user. The AI music generation module and the music gait interaction module are computer software or instructions which are executable by the computer.

[0010] In one embodiment, the pressure sensor includes a plurality of pressure sensors to respectively detect pressure distributions of a toe area and a heel area of the foot. The inertial sensor includes an accelerometer and a gyroscope to sense the user's foot movements. wherein the inertial sensor further includes a GPS sensor.

[0011] In another one embodiment, the sensor assembly includes a microprocessor to collect and analyze signals detected by the pressure sensor, the inertial sensor, the GPS sensor, and to convert the signals into corresponding foot pressure distributions, an acceleration information and a GPS information; a memory coupled to the microprocessor to store the foot pressure distributions, the acceleration information and the GPS information; a wireless transceiver coupled to the microprocessor for wirelessly transmitting the foot pressure distributions, the acceleration information and the GPS information to an external device.

[0012] In one embodiment, the gait parameters include number of kicks, stride width, step length, cadence, standing time, forward, backward, jumping and movement trajectories of the user.

[0013] In one embodiment, the movement rhythm parameters include rhythm, speed, jump height, strength, stride length, and foot rotation range and frequency.

[0014] In one aspect, the AI music generation module is set up in a cloud server or the computing device. The cloud server is a generative AI server. In one aspect, the wireless transceiver includes a Bluetooth or WiFi device.

[0015] According to another aspect of the present invention, the present invention discloses a method of generating music based on gait. The present invention provides a pressure sensor and an inertial sensor configured to collect data related to the user's movement. Then, a gait analysis device is employed to analyze a movement data to obtain gait parameters, and a rhythm parameter extraction module is employed to extract movement rhythm parameters; an AI music generation module is configured to receive the movement rhythm parameters and convert the movement rhythm parameters into corresponding beats, high and low sounds, light and heavy tones, and followed by composing melody with the beats, the high and low sounds, the light and heavy tones, thereby generating a music and outputting to the computing device.

[0016] In the present disclosed method, the gait parameters include number of kicks, stride width, step length, cadence, standing time, forward, backward, jumping and movement trajectories of the user. The movement rhythm parameters include rhythm, speed, jump height, strength, stride length, and foot rotation range and frequency.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** shows the system of the gait-based AI-generated music apparatus of the present invention.

[0018] FIG. **2** shows the schematic diagram of sensors and circuits according to the present

invention.
[0019] FIG. **3** shows the functional block diagram of the sensors according to the embodiment of the present invention.
[0020] FIG. **4** shows the diagram of the sensing assembly and the external computing device according to the present invention.
[0021] FIG. **5** shows the functional block diagram corresponding to FIG. **1**.
DETAILED DESCRIPTION
[0022] Some preferred embodiments of the present invention will now be described in greater detail. However, it should be recognized that the preferred embodiments of the present invention are provided for illustration rather than limiting the present invention. In addition, the present invention can be practiced in a wide range of other embodiments besides those explicitly described, and the scope of the present invention is not expressly limited except as specified in the accompanying claims.
[0023] The present invention disclosed an apparatus to generate AI music based on gaits. The present invention employs AI algorithms to generate music based on information related to the user's movement and gait. For example, in a badminton match, contestants have many gait-related parameters (or gait parameters) such as jumping, advancing, retreating, and so on. The rhythm, speed, jump height, strength, stride can be extracted from these gait-related parameters. These parameters are corresponding to the beats, high sounds, low sounds, light and heavy sounds, these data may be used to compose a music. The subsequent step is to compose the music by adding melody into the information using the AI algorithm to create the AI music related to movement.
[0024] Based on the above, please refer to FIG. **1**, which shows a system **100** for implementing the aforementioned gait-based AI-generated music. The system **100** includes a sensor assembly **102**, a computing device **104** and a cloud server **106**. The sensor assembly **102** is communicatively connected to the external computing device **104**, and the external computing device **104** receives data collected by the sensor assembly **102**. The computing device **104** communicatively connects to the cloud server **106** through the Internet. According to embodiments of the present invention, the cloud server **106** may be a general network server or a generative AI server.
[0025] According to an embodiment of the present invention, the sensor assembly **102** has a wireless transceiver configured to wirelessly transmit data related to the movement of the user **108** collected by the sensor assembly **102** to the receiver of the external computing device **104**. As discussed in greater detail below, the sensor assembly **102** may be worn on the user **108**, such as in the shoe or on the foot (feet) of the user **108**, and the sensor assembly **102** includes a plurality of pressure sensor and inertial sensor module, and transceiver. According to one embodiment of the present invention, the pressure sensors and/or wireless transceivers may be separated or integrated together. According to embodiments of the present invention, the sensor assembly **102** can be worn on both feet of the user. The signals (including the data related to the movement of the user **108**) generated by the sensor assembly **102** are transmitted to the computing device **104** by the wireless transceiver (not shown), the computing device **104** includes, for example, a smartphone, laptop, tablet, or personal computer.
[0026] According to an embodiment of the present invention, the aforementioned gait data of the user **108**, for example, jumping, forward, backward data are received and analyzed by the computing device **104** through wireless transmission, and followed by obtaining the gait parameters and followed by uploading the data to the cloud server **106** via the internet for subsequent analysis and music generation. The system **100** also includes an application program installed on the computing device **104** to receive and process the data from the sensor assembly **102**, the computing device **104**, and the cloud server **106**. The application can be executed based on Android, Windows or iOS platforms, and it may also upload data to the cloud server **106** for storage and/or further computing processing. The system **100** continuously collects movement data of the user **108** through the computing device **104** which executes algorithms for gait analysis, and

extracts gait parameters from the user movement data.
[0027] Please refer to FIG. **2**, the sensor assembly **102** includes a plurality of pressure sensors and inertial sensing modules. The multiple pressure sensors and the inertial sensing modules may be integrated together or separated. For convenience of illustration, FIG. **2** only shows that the pressure sensors and inertial sensing modules are integrated in the sensor assembly **102** in the insole **210**. Other sensor assembly **102** may be used without departing from the scope of the present invention. For example, the sensor assembly **102** is integrated in the shoes or shoe soles, these examples also fall within the scope of the present invention. Referring to FIG. **2**, the pressure sensors (not shown) can be provided in in the area **215** near toe, the area **219** aside the arch, and the heel area **220**. The area **215** near toe refers to the toe area and the forefoot area. Each of the areas has multiple pressure sensors (not shown) and different pressure sensor density. Individual pressure sensors are electrically connected to the inertial sensing module **216** using wires **222**. In one embodiment, the pressure sensor is a capacitive pressure sensor, different number of capacitive pressure sensors and corresponding wiring **224** form a flexible pressure sensing device, which is disposed on different parts of the insole **210** to sense the foot pressure distribution in different areas of the user's foot (for example, the area **215**, the area **219**, and the area **220**). Alternatively, the pressure sensor may also be a resistive pressure sensor. The inertial sensing module **216** includes wireless transceivers (such as Bluetooth chips), and other electronic components (such as inertial measurement units, GPS sensors), these elements are all formed into the arch pad of the insole **210**. In one embodiment, the inertial sensing module **216** may be a sensing module integrated by a printed circuit board, the sensing module has connection terminals electrically connected to the plurality of pressure sensing devices.
[0028] In another embodiment of the present invention, the sensor assembly **102** provides user movement data/information. The inertial sensing module **216** in the sensor assembly **102** may include (1) a wearable wireless real-time motion sensing device or an IMU (inertial measurement unit), (2) a wearable wireless instant multi-zone plantar pressure/six-dimensional motion capturing device.
[0029] According to the embodiment of the present invention, the inertial sensing module **216** includes at least an accelerometer, a gyroscope, a GPS sensor and other devices. The accelerometer and gyroscope are sensors based on Micro-Electro-Mechanical Systems (MEMS) technology, and both of them can be integrated into a single device with six degrees of freedom.
[0030] The sensor assembly **102** may be a multi-zone plantar pressure/six-axes motion detection device. When the user exercise, the sensor assembly **102** records the user's foot pressure (by the multiple pressure sensors) and motion with six degrees of freedom (through the inertial sensing module **216**). In some embodiments, the foot pressure/six axes motion detection device has a variable recording interval, the sampling circuit obtains the pressure point data of each foot and fetches the foot pressure distribution at each sampling interval by the sensors located the area **215**, area **219** and the heel area **220**.
[0031] The sensor assembly **102** may include an inertial sensing module **216**, which serves as a six-axes motion detection device (or called six-axes inertial measurement device), the devices detect motion changes based on Micro-Electro-Mechanical Systems (MEMS) sensors. The six-axes motion detection device determines accelerations Ax, Ay, Az in three dimensions, and the pitch, the yaw and the roll of rotational movements. For example, it generates 600 action data points per second by sampling at 100 Hz by the sampling circuit. The foot motion data is captured for each sampling interval. Utilizing six-axes motion detection device with a multi-zone pressure sensing device (multiple pressure sensors disposed on the insole), the present invention allows to dynamically track the spatial and temporal gait during walking/exercise.
[0032] FIG. **3** shows a functional block diagram of the sensor assembly **102**, which includes an inertial sensing module **216** capable of data transmission/reception through a wireless transceiver (TX/RX) **232**. Although FIG. **2** shows that the wireless transceiver (TX/RX) **232** is integrated into

the inertial sensing module **216**, the person having ordinary skill in the art realizes that the separated wireless transceiver (TX/RX) **232** can also be used for the purpose of data transmission/reception. In the example of FIG. **3**, the inertial sensing module **216** may include a wireless transceiver (TX/RX) **232** for transmitting data to and/or receiving data from one or more remote systems. In one embodiment, the low-power wireless transceiver **232** may be a Bluetooth, WiFi, RF, Zigbee, narrow band IoT (NB-IOT) networking devices, other medium/long-range wireless transceivers may also be utilized. The inertial sensing module **216** is electrically connected to the pressure sensors (pressure sensing devices **238**) provided on the insole via connection terminals. The inertial sensing module **216** also includes one or more microprocessors **234**, a memory **235**, an integrated inertial sensor **216-1** (including an accelerometer, a gyroscope (G-sensor)), and a GPS sensor **216-2** and a power supply device **237**. The power supply device **237** provides power to the pressure sensing device **238**, and other devices (e.g., microprocessor **234**, memory **235**, composite sensor **216-1**, GPS sensor **216-2** etc.) of the sensor assembly **102**. In a preferred embodiment, the power supply device **237** includes a rechargeable solid-state battery, an inductive coil for coupling with an external wireless charging system to wirelessly charge the battery, and a USB charging interface. It should be note that the sensor assembly **102** provides a computer program/algorithm to collect and store user's body movement data, for example, the user's foot pressure distribution, the impact force, the user's movement trajectory (forward, backward, jump), speed, distance, acceleration, angular orientation and angular orientation change data, etc., and these programs/algorithms can be stored and/or executed.

[0033] The wireless transceiver **232** connects to at least one pressure sensors, and the inertial sensors **216-1**, GPS sensors **216-2**, which detect and provide various data parameters. These data and information include user physiological data including user's foot pressure distribution, impact, the movement trajectory, speed, distance, GPS, acceleration, angular orientation data, and angular orientation changes (from the gyroscope sensor) data parameters which may be stored in memory or transmitted to remote computing electronics or servers via wireless transceiver **232**.

[0034] The inertial sensing module **216** may also be configured to communicate with an external computing device **104**, which may include, for example, a smartphone, a laptop, a tablet, or a computer.

[0035] From a system perspective, as shown in FIG. **4**, the user **108** employs two sensor assemblies **102** for each foot (one for each foot), for example, the sensing modules (**102***a*, **102***b*) are provided on the left and the right insoles respectively.

[0036] FIG. **4** shows a system block diagram of sensing modules (**102***a*, **102***b*) which communicate with the external computing electronic device **104**. The sensing modules (**102***a*, **102***b*) are provided on the feet of the user **108**. For example, each one of the left and right insoles include an inertial sensing module (**216***a*, **216***b*) formed in the arch portion of the insole, and is electrically connected to the pressure sensing device (**238***a*, **238***b*) to receive and analyze the user's foot pressure distribution data, and transmit the above data to the wireless transceiver (**232***a*, **232***b*) located in the sensing module, the remote computing device or server. Each one of the inertial sensing modules (**216***a*, **216***b*) include a processing device (one or more microprocessors), memory, additional sensors, and a power supply device (refer to FIG. **2**).

[0037] The external computing device **104** could be any electronic device that can transmit, process, and store data. In one embodiment, external computing device **104** is a portable computing device including a social networking device, a gaming device, a cell phone, a smartphone, a personal digital assistant, a digital audio/video player, a laptop, a tablet, a video game controller, or any other portable device having computing core.

[0038] The external computing device **104** includes a computing core **342**, a user interface **343**, an internet interface **344**, a wireless communication transceiver **345**, and a storage device **346**. The user interface **343** includes one or more input devices (for example, keyboard, touch screen, voice input device, etc.), one or more audio output devices (for example, speakers, headphone jack, etc.),

and/or one or more visual output devices (such as video graphics displays, touch screens, etc.). The internet interface **344** includes one or more networking devices (for example, wireless local area network (WLAN) devices, wired LAN devices, wireless wide area network (WWAN) devices, etc.). The storage **346** includes flash memory, one or more hard drives, one or more solid state (SS) storage devices, and/or cloud storage.

[0039] The computing core **342** includes a processor **342***a* and other computing core components **342***b* which include one or more video graphics processing unit, memory controllers, main memory (RAM), input/output (I/O) device interface modules, input/output (I/O) interfaces, input/output (I/O) controllers, peripheral device interfaces, USB interface modules, network interface modules, memory interface modules and peripheral device interface module.

[0040] The wireless communication transceiver **345** of the computing device **104** and the wireless transceivers (**232***a*, **232***b*) of the sensing modules (**102***a*, **102***b*) are the similar transceiver types, for example, Bluetooth, WLAN, Wifi, etc., the wireless transceivers (**232***a*, **232***b*) communicate directly with the wireless communication transceiver **345** to share collected data through their respective sensing modules (**102***a*, **102***b*) and/or receive instructions from external computing devices **104**. Alternatively, the wireless transceivers (**232***a*, **232***b*) communicate with one another for collecting data. The wireless transceivers (**232***a*, **232***b*) transmit the collect data to the wireless communication transceiver **345** of the external computing device **104**.

[0041] According to an embodiment of the present invention, referring to FIGS. **1**-**4**, when the user **108** steps on the pressure sensor, the pressure sensing device (**238***a*, **238***b*) is activated. When the user moves, jumps or runs, the inertial measurement module (**216***a*, **216***b*) is activated as well. Both the pressure sensing devices (**238***a*, **238***b*) and the inertial measurement modules (**216***a*, **216***b*) send electrical signals to the external computing device **104**. The microprocessor **234** of the sensor assembly **102** can be used to detect and analyze user's feet data during exercise, user's feet data includes, for example, the pressure wave curve (the curve of pressure changing with time), acceleration curve (the curve of Ax, Ay, Az changing with time) or angular curve (the curve of angular velocity (ωx, ωy, ωz) changes with time), followed by converting these continuous pressure waves and acceleration curves into discrete pulse signals.

[0042] According to an embodiment of the present invention, the gyroscope in the inertial measurement module (**216***a*, **216***b*) can sequentially integrate the acceleration Ax, Ay and Az along the X, Y and Z axes to obtain velocities along axes Vx, Vy and Vz. Similarly, the gyroscopes sequentially integrate the angular velocities ωx, ωy and ωz rotating around the X, Y and Z axes to obtain the pitch angle (θ), roll angle (γ) and yaw angle (ψ).

[0043] During typical body movements, such as walking, dancing, or ball games, people alternate their left and right feet during walking. In order to generate a musical scale from these alternating footsteps, each signal pulse sent from the wireless transceiver (**232***a*, **232***b*) of the sensing module (**102***a*, **102***b*) is sequentially numbered by the processor.

[0044] The present invention analyzes the user's gait-related information by the pressure wave curve (pressure changes with time) detected by the pressure sensing device (**238***a*, **238***b*). For example, the length of stride time of the user **108** can be measured by the time difference between consecutive heel strikes of the same foot of the user **108**, while the user's swing time (i.e., the length of time the foot swings in the air) can be measured by the time difference between toe off and heel strike of the same foot. The standing time (i.e., the length of time the foot is in contact with the floor) of the user **108** can be measured by the time difference between heel strike and toe off. These data may also be cooperated with the data received by the inertial sensing module (**216***a*, **216***b*) measurement units and the GPS sensor **236** to enable measurement of step length or distance and other gait characteristics.

[0045] According to the embodiment of the present invention, the heel strike pressure signal corresponds to the foot pressure distribution signal sensed by the pressure sensor in the heel area **220** in FIG. **2**, and the pressure signal of the toe off the ground (toe off) corresponds to the foot

pressure signal sensed by the pressure sensor disposed near the toe area **215** in FIG. **2**.
[0046] According to aforementioned, the information, for example, the number of kicks, stride length, step length, step frequency, and standing time can be obtained by analyzing the pressure wave curve (pressure changes with time) of the user's **108** feet. Further information such as user's forward, backward, jumping, motion trajectory is obtained by the accelerometer, GPS sensor of the inertial sensing module (**216***a*, **216***b*). In addition, the rotation movement is detected by the gyroscope (**216***a*, **216***b*).
[0047] Referring to FIG. **5**, it shows a functional block diagram corresponding to the system of FIG. **1**, the external computing electronic device **104** receives the motion data of the user **108**, that is, the time dependent pulse signals of pressure and acceleration. The data is processed by the gait analysis module **340** to generate various gait parameters. For example, the processor **342** of the external computing electronic device **104** cooperates with the computing or algorithm in the gait analysis module **340** to process the pulses of pressure, acceleration and angular velocity from the sensor modules (**102***a*, **102***b*). The external computing device **104** analyzes the time dependent pressure, acceleration and angular velocity on the left and right feet of the user **108** by the gait analysis algorithm set in the gait analysis module **340** using the collected movement-related data of the user. The pulse signal, the collected GPS data are analyzed to obtain the user's **108** gait parameter information, for example, the number of kicks, stride length, step frequency, standing time, jumping, forward, backward, foot rotation and movement trajectory, followed by outputting these data. Subsequently, these output gait-related parameters are extracted by a rhythm parameter extraction module **350** to extract rhythm, speed, jump height, force, step spoke, and foot rotation range, frequency and other related motion rhythm parameters. These motion rhythm parameters can be transmitted to the AI music generation module **360** of the cloud server **106** via the internet, thereby converting the rhythm, speed, jump height, force, stride, and rotation range, frequency, etc. into related motion rhythms. The motion rhythms are then converted into the corresponding beat number, high and low notes, light and heavy notes, etc., and the AI algorithm is used to compose the melody using above data to generate a piece of music and store the generated music in the memory. Therefore, an AI music related to movement can be created. The AI music related to movement is output by the speakers.
[0048] According to an embodiment of the present invention, the user may interact with the music generated by the AI music generation module **360** by the music gait interaction interface displayed on the external computing device **104**. For example, the music gait interactive module **370** is an application program (APP), which is installed into a group online game device with interesting rehabilitation functions, and the rehabilitation levels can be divided by game difficulty and scoring mechanisms. The aforementioned group online game device may include a mobile phone dancing machine application (APP), for example, the APP generates and displays dynamic patterns in accordance with the rhythm of the music generated by the AI music generation module **360** for interacting with the user for training purpose. For example, the method may train the users to perform rehabilitation according to the gait rhythm (generated by a mobile phone dance machine).
[0049] According to the embodiment of the present invention, the aforementioned AI music generation module **360** may include Amper Music, AVIA, Ecrett Music, Soundraw, Boomy, MuseNet, Amadeous2/3xo4n42k7 or other similar AI music generators, which can make music with machine learning.
[0050] According to an alternative embodiment of the present invention, the system of FIG. **5** may include multiple wireless signals generated by the physical movements of multiple individuals (multiple users), the multiple signals are generated from the feet of the multiple users. The corresponding pressure, acceleration and GPS data detected by the sensors. In one embodiment, the multiple users may be members of a dance group or competitors in a sporting event.
[0051] In the preferred embodiment, the multi-person system has a group of people, each member of which is equipped with a corresponding sensor assembly, each sensor assembly has a wireless

transceiver. Each corresponding sensor and wireless transceiver may communicate with the wireless transceiver **345** of the computing device **104**.

[0052] As will be understood by persons skilled in the art, the foregoing preferred embodiment of the present invention illustrates the present invention rather than limiting the present invention. Having described the invention in connection with a preferred embodiment, modifications will be suggested to those skilled in the art. Thus, the invention is not to be limited to this embodiment, but rather the invention is intended to cover various modifications and similar arrangements included within the spirit and scope of the appended claims, the scope of which should be accorded the broadest interpretation, thereby encompassing all such modifications and similar structures. While the preferred embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made without departing from the spirit and scope of the invention.

Claims

1. An apparatus for generating music based on gait comprising: a sensing assembly provided on a user's foot, said sensing assembly including a pressure sensor and an inertial sensor configured to collect pressure, acceleration, and rotation data related to said user's movement; a computing device coupled to said sensing assembly, wherein said computing device includes a gait analysis module and a rhythm parameter extraction module, wherein said gait analysis module is employed to analyze said pressure, acceleration, and rotation data to obtain gait parameters, and said rhythm parameter extraction module extracting rhythm parameters from said gait parameters; an AI music generation module coupled to said computing device to receive and convert said rhythm parameters into corresponding beats, high and low sounds, light and heavy tones, and followed by composing melody with said beats, said high and low sounds, said light and heavy tones, thereby generating a music and outputting to said computing device.

2. The apparatus of claim 1, further comprising a music gait interaction module configurated on said computing device to generate dynamic patterns with rhythms of said music generated by said AI music generation module for interacting with said user.

3. The apparatus of claim 1, wherein said pressure sensor includes a plurality of pressure sensors to respectively detect pressure distributions of a toe area and a heel area.

4. The apparatus of claim 1, wherein said inertial sensor includes an accelerometer and a gyroscope to sense said user's foot movements.

5. The apparatus of claim 4, wherein said inertial sensor includes a GPS sensor.

6. The apparatus of claim 4, wherein said sensor assembly includes a microprocessor to collect and analyze signals detected by said pressure sensor, said inertial sensor, a GPS sensor, and to convert said signals into corresponding foot pressure distributions, an acceleration information and a GPS information; a memory coupled to said microprocessor to store said foot pressure distributions, said acceleration information and said GPS information; a wireless transceiver coupled to said microprocessor for wirelessly transmitting said foot pressure distributions, said acceleration information and said GPS information to an external device.

7. The apparatus of claim 6, wherein said wireless transceiver includes a Bluetooth or WiFi device.

8. The apparatus of claim 1, wherein said gait parameters include number of kicks, stride width, step length, cadence, standing time, forward, backward, jumping and movement trajectories of said user.

9. The apparatus of claim 1, wherein said rhythm parameters include rhythm, speed, jump height, strength, stride length, and foot rotation range and frequency.

10. The apparatus of claim 1, wherein said AI music generation module is set up in a cloud server or said computing device.

11. The apparatus of claim 10, wherein said cloud server is a generative AI server.

12. An apparatus for generating music based on gait comprising: a sensing assembly provided on a

user's foot, said sensing assembly including a pressure sensor and an inertial sensor configured to collect data related to said user's movement; a computing device coupled to said sensing assembly, wherein said computing device includes a gait analysis module and a rhythm parameter extraction module, wherein said gait analysis module is employed to analyze said pressure, acceleration, and rotation data to obtain gait parameters, and said rhythm parameter extraction module extracting rhythm parameters from said gait parameters; an AI music generation module coupled to said computing device to receive and convert said rhythm parameters into corresponding beats, high and low sounds, light and heavy tones, and followed by composing melody with said beats, said high and low sounds, said light and heavy tones, thereby generating a music and outputting to said computing device; wherein said gait parameters include number of kicks, stride width, step length, cadence, standing time, forward, backward, jumping and movement trajectories of said user; wherein said rhythm parameters include rhythm, speed, jump height, strength, stride length, and foot rotation range and frequency.

13. The apparatus of claim 12, further comprising a music gait interaction module configurated on said computing device to generate dynamic patterns in conjunction with rhythms of said music generated by said AI music generation module for interacting with said user.

14. The apparatus of claim 12, wherein said pressure sensor includes a plurality of pressure sensors to respectively detect pressure distributions of a toe area and a heel area.

15. The apparatus of claim 12, wherein said inertial sensor includes an accelerometer and a gyroscope to sense said user's foot movements.

16. The apparatus of claim 15, wherein said inertial sensor includes a GPS sensor.

17. The apparatus of claim 15, wherein said sensor assembly includes a microprocessor to collect and analyze signals detected by said pressure sensor, said inertial sensor, a GPS sensor, and to convert said signals into corresponding foot pressure distributions, an acceleration information and a GPS information; a memory coupled to said microprocessor to store said foot pressure distributions, said acceleration information and said GPS information; a wireless transceiver coupled to said microprocessor for wirelessly transmitting said foot pressure distributions, said acceleration information and said GPS information to an external device.

18. The apparatus of claim 17, wherein said wireless transceiver includes a Bluetooth or WiFi device.

19. The apparatus of claim 12, wherein said AI music generation module is set up in a cloud server or said computing device.

20. The apparatus of claim 19, wherein said cloud server is a generative AI server.