

DESCRIPTION**TITLE of Invention: ELECTRONIC DEVICE AND CONTROL METHOD
THEREOF****TECHNICAL FIELD**

[0001] The present invention relates to an electronic device and a control method thereof.

BACKGROUND ART

[0002] Recently, as coding education has become compulsory, smart toys incorporating various information technologies have attracted attention so that children can become familiar with software from childhood, and one of them is a coding robot.

[0003] However, in the conventional coding robot, since the coding robot is operated only by coding work, coding education should be preceded in order to operate the coding robot. Even if such coding education is preceded, there is a problem in that interest in the coding robot rapidly decreases as the coding robot does not operate if there is an error in the created coding or lack of coding skills.

[0004] Further, since the conventional coding robot can perform only simple motions in response to simple coding commands, there is a limitation that various interactions with a user of the coding robot are impossible.

[0005] Accordingly, the need for a coding robot capable of various motions according to various inputs such as user's emotions while operating easily is emerging.

DISCLOSURE OF THE INVENTION**TECHNICAL PROBLEM**

[0006] A problem to be solved by the present invention is to provide an electronic device and a control method thereof.

[0007] The problems to be solved by the present invention are not limited to the problems mentioned above, and other problems not mentioned will be clearly understood by those skilled in the art from the description below.

TECHNICAL SOLUTION

[0008] A control method of a coding robot according to an aspect of the present invention for solving the above problems includes the steps of acquiring, by the coding robot, information of a subject to be recognized, acquiring, by the coding robot, control data on the basis of the acquired information of the subject to be recognized, determining, by the coding robot, whether the control data matches preconfigured control information, performing, by the coding robot, a motion corresponding to the preconfigured control command if the control data matches the preconfigured control information, and analyzing the control data and matching same with one of preconfigured control commands, by the coding robot, if the control data does not match the preconfigured control information, in which the control data is at least one of emotion data and speech data of the subject to be recognized.

ADVANTAGEOUS EFFECTS

[0009] According to various embodiments of the present invention described above, the coding robot may determine the emotion or speech of the subject to be recognized and be

controlled based on a coding block corresponding to the determined emotion or speech.

[0010] The effects of the present invention are not limited to the effects mentioned above, and other effects not mentioned will be clearly understood by those skilled in the art from the description below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. 1 is an exemplary diagram for illustrating a coding robot according to an embodiment of the present invention.

[0012] FIG. 2 is a block diagram illustrating a configuration of the coding robot according to an embodiment of the present invention.

[0013] FIG. 3 is a flowchart for describing a control method of the coding robot according to an embodiment of the present invention.

[0014] FIGS. 4 and 5 are exemplary diagrams for describing a method of determining a recognized user's emotion according to an embodiment of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0015] A control method of a coding robot according to an aspect of the present invention for solving the above problems includes the steps of acquiring, by the coding robot, information of a subject to be recognized, acquiring, by the coding robot, control data on the basis of the acquired information of the subject to be recognized, determining, by the coding robot, whether the control data matches preconfigured control information, performing, by the coding

robot, a motion corresponding to a preconfigured control command if the control data matches the preconfigured control information, and analyzing the control data and matching same with one of preconfigured control commands, by the coding robot, if the control data does not match the preconfigured control information, in which the control data is at least one of emotion data and speech data of the subject to be recognized.

[0016] In this case, when the control data is the emotion data of the subject to be recognized, the step of acquiring the control data may include the steps of acquiring, by the coding robot, a photographed face image of the subject to be recognized, acquiring, by the coding robot, a model variable based on the face photographed face image, determining, by the coding robot, whether the subject to be recognized matches a face of a pre-registered user based on the acquired model variable, acquiring, by the coding robot, a feature value corresponding to the photographed face image based on the photographed face image, when the subject to be recognized matches the pre-registered user, determining, by the coding robot, a facial part including the eyes, nose, and mouth of when the subject to be recognized based on the acquired feature value, determining, by the coding robot, the emotion of the subject to be recognized based on the determined facial part, and acquiring, by the coding robot, the control data based on the determined emotion.

[0017] In this case, the step of performing the motion corresponding to the control command may include the steps of acquiring, by the coding robot, coordinate information on a two-dimensional vector space corresponding to the determined

emotion, acquiring a control command corresponding to the coordinate information on the vector space, and performing a motion corresponding to the control command.

[0018] In this case, the step of performing the motion corresponding to the control command may include the steps of acquiring, by the coding robot, emotion change information of the subject to be recognized based on the photographed face image of the subject to be recognized, acquiring, by the coding robot, first coordinate information corresponding to a first emotion and second coordinate information corresponding to a second emotion when the emotion of the subject to be recognized changes from the first emotion to the second emotion, and acquiring, by the coding robot, a movement command corresponding to a vector value corresponding to the first coordinate and the second coordinate as the control command.

[0019] In this case, when the control command is a control command for moving the coding robot, the control method may further include the steps of recognizing, by the coding robot, an object around the coding robot, acquiring, by the coding robot, control information corresponding to a pre-stored sign when the recognized object matches the pre-stored sign, recognizing, by the coding robot, a lane around the coding robot, and moving the coding robot along the recognized lane to correspond to the control information, in which the step of recognizing the lane may include the steps of acquiring two consecutive line segment information based on an image input to the coding robot, and acquiring a lane area based on the acquired line segment information, acquiring distance information between the acquired line segment and the coding

robot, and controlling the coding robot based on the lane area and the distance information.

[0020] In this case, when the control data is speech data of the subject to be recognized, the control method may further include the steps of generating, by the coding robot, a motion control block including a motion speed control command and a motion repetition number control command for the coding robot based on the speech data, acquiring, by the coding robot, at least one of the motion speed information and the motion repetition number information based on the speech data, and acquiring, by the coding robot, a control command corresponding to at least one of the motion speed and the motion repetition number of the coding robot based on at least one of the motion speed information and the motion repetition number information.

[0021] In this case, the step of acquiring the control command corresponding to at least one of the motion speed and the motion repetition number of the coding robot may include the steps of acquiring, by the coding robot, the motion speed or the motion repetition number of the coding robot based on the motion speed information or the motion repetition number information corresponding to the preconfigured control information as the control command, when the speech data matches the preconfigured control information, generating, by the coding robot, syllable interval information based on the speech data and generating the motion speed information corresponding to the syllable interval information, when the speech data does not match the preconfigured control information, generating, by the coding robot, signal strength information based on the speech data and generating the

motion repetition number information corresponding to the signal strength information, when the speech data does not match the preconfigured control information, and acquiring the motion speed or the motion repetition number information of the coding robot as the control command based on the generated motion speed information or the motion repetition number.

[0022] Other specific details of the present invention are included in the detailed description and drawings.

[0023] Advantages and features of the present invention, and methods of achieving them, will become clear with reference to the embodiments described below in detail in conjunction with the accompanying drawings. However, the present invention is not limited to the embodiments disclosed below, but may be implemented in various different forms. These embodiments are provided only to make the disclosure of the present invention complete, and to fully inform those skilled in the art of the scope of the present invention to which the present invention belongs, and the present invention is only defined by the scope of the claims.

[0024] Terminology used in this specification is for describing the embodiments and is not intended to limit the present invention. In this specification, singular forms also include plural forms unless specifically stated otherwise in a phrase. As used in the specification, "comprises" and/or "comprising" does not exclude the presence or addition of one or more other elements other than the recited element. Throughout the specification, the same reference numeral refers to the same component, and the term "and/or" includes each and every combination of one or more

of the recited elements. Although "first", "second", etc. are used to describe various components, these components are not limited by these terms, of course. These terms are only used to distinguish one component from another. Accordingly, it goes without saying that a first component mentioned below may also be a second component within the technical spirit of the present invention.

[0025] Unless otherwise defined, all terms (including technical and scientific terms) used in this specification may be used with meanings commonly understood by those skilled in the art to which the present invention belongs. In addition, terms defined in commonly used dictionaries are not interpreted ideally or excessively unless explicitly specifically defined.

[0026] The term "unit" or "module" used in the specification refers to software or a hardware component such as, FPGA or ASIC, and the "unit" or "module" performs a certain role. However, the "unit" or "module" is not meant to be limited to software or hardware. The "unit" or "module" may be configured to reside in an addressable storage medium and may be configured to reproduce one or more processors. Thus, as an example, the "unit" or "module" includes components such as software components, object-oriented software components, class components, and task components, processes, functions, attributes, procedures, subroutines, and segments of program code, drivers, firmware, microcode, circuits, data, database, data structures, tables, arrays, and variables. Functions provided within components and "units" or "modules" may be combined into a smaller number of components and "units" or "modules" or further separated into additional components and

"units" or "modules".

[0027] The spatially relative terms "below", "beneath", "lower", "above", "upper", etc. may be used to easily describe a correlation between one component and other components as illustrated in the drawings. The spatially relative terms should be understood as including different directions of components in use or operation in addition to the directions illustrated in the drawings. For example, when reversing a component illustrated in the drawing, a component described as "below" or "beneath" another component may be placed "above" the other component. Thus, the exemplary term "below" may include directions of both below and above. A component may also be oriented in other directions, and thus spatially relative terms may be interpreted according to orientation.

[0028] In this specification, a computer refers to all types of hardware devices including at least one processor, and may be understood as a meaning that includes a software configuration operating on a corresponding hardware device according to an embodiment. For example, a computer may be understood as a meaning that includes a smartphone, a tablet PC, a desktop computer, a laptop computer, and user clients and applications running on each device, but is not limited thereto.

[0029] Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0030] Although each step described in this specification is described as being performed by a computer, the subject of each step is not limited thereto, and at least a part of each

step may be performed in different devices according to an embodiment.

[0031] FIG. 1 is an exemplary diagram for illustrating a coding robot according to an embodiment of the present invention.

[0032] A coding robot 100 according to the present invention may operate by a coding language programmed in a computer language or a programmed coding block. In this case, coding is a process of programming a sequential and logical flow using a computer language such as C language, and a coding block may mean a block including a completed coding command to execute a specific instruction. That is, the coding robot 100 may operate according to the command transmitted by written coding or selected coding blocks.

[0033] The coding robot 100 according to the present invention may include a camera, a microphone, a memory, a processor, and a driving unit.

[0034] FIG. 2 is a block diagram illustrating a configuration of the coding robot according to an embodiment of the present invention in detail.

[0035] Specifically, the coding robot 100 may further include a communication unit 140, a memory 150, and a sensing unit 160, in addition to an input unit 110, an output unit 120, and a processor 130.

[0036] The input unit 110 may include a camera 111, a microphone 112, a touch panel 113, etc. to acquire various external inputs.

[0037] The camera 111 is a configuration for acquiring image data around the coding robot 100. The camera 111 may capture a still image and a moving image. For example, the camera

111 may include one or more image sensors, lenses, image signal processors (ISPs), or flashes (e.g., LED or xenon lamp, etc.), and may be configured with a plurality of cameras 111. In this case, in order to prevent unnecessary power consumption, the camera 111 may be activated only when a specific condition is satisfied. For example, the camera 111 may be activated only when a user is detected around the coding robot 100. Alternatively, when the coding robot 100 is part of an IoT system, the camera 111 may be activated when a front door is opened or in a case where a condition in which an indoor light is turned on. However, it is not limited to the embodiment described above, and the camera 111 may always be activated when power is applied to the robot. When the camera 111 is always activated, the camera 111 may store an image or perform image processing only when a specific condition is satisfied. The specific condition may be a condition for a case where the user is detected around the coding robot 100, or when a front door is opened or a condition in which an indoor light is turned on when the coding robot 100 is part of the IoT system.

[0038] The microphone 112 is a configuration for acquiring sounds around the coding robot 100. The microphone 112 may generate electrical speech information by receiving an external acoustic signal, and the coding robot 100 may be provided with a plurality of microphones 112. The coding robot 100 may estimate a direction of a sound source generating a sound signal using a difference in arrival time of the sound signal input to each of the plurality of microphones. The microphone 112 may use various noise cancellation algorithms for removing noise generated in a

process of receiving the external sound signal. As in the case of the camera 111, the microphone 112 may be activated only when a certain condition is satisfied to prevent unnecessary power consumption. That is, the microphone 112 may be activated only when the user is detected around the coding robot 100. Alternatively, when the coding robot 100 is part of an IoT system, the microphone 112 may be activated when the front door is opened or in a case where a condition in which the indoor light is turned on. However, it is not limited to the embodiment described above, and as in the case of the camera 111, the microphone 112 may be always activated.

[0039] The touch panel 113 is a configuration capable of receiving various user inputs. The touch panel 113 may receive user data through user manipulation. The touch panel may also be activated under the condition described to prevent unnecessary power consumption. Alternatively, the touch panel 113 may be activated only when a user's touch is detected. The touch panel 113 may be configured by being combined with a display to be described later.

[0040] Of course, the input unit 110 may be of various configurations for receiving input of various user data, in addition to the camera 111, the microphone 112, and the touch panel 113 described above.

[0041] The output unit 112 may be configured with a driving unit 121, an audio output unit 122, and a display 123.

[0042] The driving unit 121 is a configuration for outputting various motions in response to user data acquired through the input unit 110. When the coding robot 100 according to an embodiment of the present invention is a humanoid coding robot 100, the driving unit 121 may include a

motor or actuator capable of driving at least one joint part corresponding to a human joint. As another embodiment, when the coding robot 100 according to an embodiment of the present invention is a wheeled robot, the driving unit 121 may include a motor or an actuator capable of driving wheels.

[0043] The audio output unit 122 is a configuration for outputting various audio signals in response to user data acquired through the input unit 110. The audio output unit 122 may output various notification sounds or speech messages as well as various audio data on which various processing tasks such as decoding, amplification, and noise filtering have been performed by an audio processing unit (not illustrated). In particular, the audio output unit 122 may be implemented as a speaker, but this is merely an example, and may be implemented as an output terminal capable of outputting audio data.

[0044] The display 123 is a configuration for outputting images in various reactions to user data acquired through the input unit 110. As an embodiment, the display 123 may output an avatar image for expressing emotion. That is, when the coding robot 100 intends to output emotion of joy in response to user data acquired through the input unit 110, the emotion of joy may be output through the avatar image displayed on the display 123. Meanwhile, the display 123 for providing various images may be implemented with various types of display panels. For example, the display panel may be implemented with various display technologies such as liquid crystal display (LCD), organic light emitting diode (OLED), active-matrix organic light-emitting diode (AM-OLED,) liquid crystal on silicon (LCoS), or digital light processing (DLP).

In addition, the display 123 may be coupled to at least one of a front area, side area, and rear area of the coding robot 100 in the form of a flexible display.

[0045] The communication unit 140 may communicate with an external device. In particular, the communication unit 140 may include various communication chips for performing wireless communication, such as a WiFi chip 141, a Bluetooth chip 142, an NFC chip 143, and a wireless communication chip 144 or circuits. In this case, the WiFi chip 141, the Bluetooth chip 142, and the NFC chip 143 each perform communication using a LAN method, a WiFi method, a bluetooth method, and an NFC method. In the case of using the WiFi chip 141 or the Bluetooth chip 142, various types of information may be transmitted and received by first transmitting and receiving various connection information such as an SSID and a session key, and then connecting communication using the same. The wireless communication chip 144 refers to a chip that performs communication according to various communication standards such as 3rd generation (3G), 3rd generation partnership project (3GPP), and long term evolution (LTE). Meanwhile, the communication unit 140 may perform communication in a wired communication method including at least one of universal serial bus (USB), high definition multimedia interface (HDMI), recommended standard 232 (RS-232), power line communication, or plain old telephone service (POTS), of course. In particular, the communication unit may communicate with external devices to transmit and receive various data for determining a user state. Alternatively, when the user state analysis is performed in an external server, the communication unit 140

may transmit collected learning data to the external server and receive an analysis result of the learning data.

[0046] A memory 150 may store commands or data for controlling at least one component of the coding robot 100, for example. According to one embodiment, the memory 150 may store software and/or programs. The program may include, for example, kernel, middleware, application programming interface (API), and/or application program (or "application"). At least part of the kernel, middleware or API may be referred to as an operating system (OS). The kernel may, for example, control or manage system resources used to execute operations or functions implemented in other programs. In addition, the kernel may provide an interface capable of controlling or managing system resources when accessing individual components of the coding robot 100 in middleware, API, or application programs.

[0047] The middleware, for example, may perform an intermediary role so that the API or the application program can communicate with the kernel to exchange data. In addition, the middleware may process one or more task requests received from the application program according to priority. For example, the middleware may assign a priority for using system resources of the coding robot 100 to at least one of the application programs and may process the one or more task requests. The API is an interface for the application program to control functions provided by the kernel or middleware, and may include, for example, at least one interface or function (e.g., instructions) for file control, window control, image processing, or text control.

[0048] In addition, the memory 150 may include at least one

of a built-in memory and an external memory. The built-in memory may include, for example, at least one of volatile memory (e.g., DRAM, SRAM, or SDRAM, etc.), non-volatile memory (e.g., one time programmable ROM (OTPROM)), PROM, EPROM, EEPROM, mask ROM, flash ROM, flash memory, hard drive, or solid state drive (SSD). The external memory may include a flash drive, for example, compact flash (CF), secure digital (SD), Micro-SD, Mini-SD, extreme digital (xD), multi-media card (MMC) or memory stick. The external memory may be functionally or physically connected to the coding robot 100 through various interfaces.

[0049] The sensing unit 160 is a configuration for acquiring surrounding information of the coding robot 100. As described above, the sensing unit 160 may be configured with various sensors, and may acquire information sensed by the sensors as user data. The sensing unit 160 may include various sensors such as an infrared sensor, a pressure sensor, an illuminance sensor, a humidity sensor, and a gyro sensor. For example, when the sensing unit 160 includes the infrared sensor, data on the presence or absence of the user may be acquired as user data, or data on the user's body temperature may be acquired through the infrared sensor. Alternatively, when the sensing unit 160 includes the pressure sensor, data on physical contact with the user may be acquired as user data. Alternatively, when the coding robot 100 includes the illuminance sensor or the humidity sensor, information on humidity and illuminance related to the user's surrounding environment may be acquired as user data.

[0050] The processor 130 may control overall operations of the coding robot 100 using various programs stored in the

memory 150.

[0051] The processor 130 may be configured with a RAM 131, a ROM 132, a graphics processing unit 133, a main CPU 134, and first to nth interfaces 135-1 to 135-n, and a bus 136. In this case, the RAM 131, the ROM 132, the graphic processing unit 133, the main CPU 134, and the the first through nth interfaces 135-1 to 135-n may be connected to each other through the bus 136.

[0052] The RAM 131 stores OS and application programs. Specifically, when the coding robot 100 is booted, the OS is loaded into the RAM 131, and various application data selected by the user can be loaded into the RAM 131.

[0053] An instruction set for system booting is stored in the ROM 132. When a turn-on command is input and power is supplied, the main CPU 134 copies the OS stored in the memory 150 to the RAM 131 according to the instruction stored in the ROM 132, and executes the OS to boot the system. When booting is completed, the main CPU 134 copies various application programs stored in the memory 150 to the RAM 131 and executes the copied application programs in the RAM 131 to perform various operations.

[0054] The graphic processing unit 133 uses an arithmetic unit (not illustrated) and a rendering unit (not illustrated) to create a screen including various objects such as graphical user interface (GUI) items, images, and text. Here, the arithmetic unit may be a configuration that makes an arithmetic operation on attribute values such as coordinate values for each object to be displayed, shape, size, color, etc. according to a layout of the screen by using a control command received from the input unit 140. The rendering unit

may be a configuration that generates screens of various layouts including the object based on the attribute values obtained by being subjected to the arithmetic operation by the arithmetic unit. The screen created by the rendering unit may be displayed within a display area of the display 130.

[0055] The main CPU 134 accesses the memory 150 and performs booting using the OS stored in the memory 150. Also, the main CPU 134 performs various operations using various programs, contents, data, etc. stored in the memory 150.

[0056] The first to nth interfaces 135-1 to 135-n are connected to various components described above. One of the first to nth interfaces 135-1 to 135-n may be a network interface connected to an external device through a network.

[0057] Hereinafter, various embodiments according to the present invention will be described using FIGS. 3 to 5.

[0058] FIG. 3 is a flowchart for describing a control method of the coding robot according to an embodiment of the present invention.

[0059] In step S110, the coding robot 100 may acquire information of a subject to be recognized.

[0060] As an embodiment, the information of subject to be recognized may be acquired by the input unit 110 or detection unit 160 described above.

[0061] In step S120, the coding robot 100 may acquire control data based on the acquired information of the subject to be recognized.

[0062] In step S130, the coding robot 100 may determine whether the control data matches preconfigured control information.

[0063] As an embodiment, the coding robot 100 may previously store control information matched with the control data in the memory 150. For example, when the control data is angry emotion, the memory 150 may store motion information of the coding robot 100 corresponding to the angry emotion as a control command.

[0064] In step S140, the coding robot 100 may perform a motion corresponding to a preconfigured control command when the control data matches the preconfigured control information.

[0065] In step S150, when the control data does not match the preconfigured control information, the coding robot 100 may analyze the control data to match the same with one of preconfigured control commands.

[0066] That is, even when there is no control command matched to the control data acquired based on the information of the subject to be recognized, the coding robot 100 may analyze the control data to match the same with one of the preconfigured control commands.

[0067] Meanwhile, in the present invention, control data may mean at least one of emotion data and speech data of the subject to be recognized.

[0068] Meanwhile, according to various embodiments of the present invention, when the control data is emotion data of the subject to be recognized, the coding robot 100 may acquire the control data through various methods.

[0069] Specifically, the coding robot 100 may acquire a photographed face image of the subject to be recognized. Thereafter, the coding robot 100 may acquire a model variable based on the photographed face image. Thereafter, the coding

robot 100 may determine whether the subject to be recognized matches a face of a pre-registered user based on the acquired model variable. Thereafter, when the subject to be recognized matches the pre-registered user, the coding robot 100 may acquire a feature value corresponding to the photographed face image based on the photographed face image. Thereafter, the coding robot 100 may determine a facial part including the eyes, nose, and mouth of the subject to be recognized based on the acquired feature value. Thereafter, the coding robot 100 may determine emotion of the subject to be recognized based on the determined facial part.

[0070] In one embodiment, the coding robot 100 may recognize a user of the coding robot based on libraries such as OpenCV, Tensorflow, and Dlib, and determine the emotion of the subject to be recognized.

[0071] In this case, OpenCV is a programming library for real-time computer vision, Robomi can handle cameras and process camera images, TensorFlow is an open-source software library for dataflow programming for a variety of tasks and symbolic math library, also is used for a machine learning application such as neural network, and can be used for face recognition and object recognition, and Dlib is a universal cross-platform software library written in the programming language C++, and the coding robot 100 may perform emotion recognition using a facial landmark (regions such as eyes, nose, mouth, etc.) recognition function in Dlib.

[0072] Specifically, the coding robot 100 may perform face recognition based on the various libraries described above. To this end, the coding robot 100 may include pre-created coding blocks.

[0073] Specifically, a face storage block can store the recognized face as an image file using OpenCV.

[0074] In addition, the face model generation block can generate a model variable using the Tensorflow library based on a stored face photograph. The generated model variable may be used in the face recognition block.

[0075] In addition, the face recognition block can calculate how much the face matches the registered face by using the model variable.

[0076] In addition, a face emotion recognition block uses Dlib to represent vertices of the face as dots, as illustrated in FIG. 4. Emotion can be inferred by calculating the size of the eyes, the angle of the eyebrows, and the size of the mouth using position values of these points. In addition, since the face emotion recognition model can calculate the positions of the eyes, nose, and mouth, it is of course possible to overwrite the image at the positions of the eyes, nose, and mouth.

[0077] According to an embodiment, the coding robot 100 may determine a facial expression of the subject to be recognized by utilizing the following code.

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[0078] [Algorithm 1]
[0079] def detect_face_elem(o_frame):
[0080]     global detector
[0081]     global predictor
[0082]     [82]
[0083]     if detector is None or predictor is None:
[0084]         if "dlib" not in sys.modules:
[0085]             import dlib
[0086]             detector = dlib.get_frontal_face_detector()
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[0087] predictor                                     =
dlib.shape_predictor('shape_predictor_68_face_landmarks.dat')
[0088]
[0089] frame = copy.deepcopy(o_frame)
[0090] gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
[0091]
[0092] line_brow_x = []
[0093] line_brow_y = []
[0094]
[0095] faces = detector(gray)
[0096] for face in faces:
[0097]
[0098]     #200107
[0099]     x1 = face.left()
[00100]     y1 = face.top()
[00101]     x2 = face.right()
[00102]     y2 = face.bottom()
[00103]     cv2.rectangle(frame, (x1, y1), (x2, y2), (0, 255, 0),
1)
[00104]
[00105]
[00106] landmarks = predictor(gray, face)
[00107]
[00108] ## "Jaw"
[00109] for n in range(0, 17):
[00110]     x = landmarks.part(n).x
[00111]     y = landmarks.part(n).y
[00112]     cv2.circle(frame, (x, y), 1, (19, 199, 109), -1)
[00113] ## "Nose"
[00114] for n in range(27, 35):

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[00115] x = landmarks.part(n).x
[00116] y = landmarks.part(n).y
[00117] cv2.circle(frame, (x, y), 1, (180, 42, 220), -1)
[00118] #cv2.putText(frame, str(n), (x, y),
cv2.FONT_HERSHEY_SIMPLEX, 0.35, (0, 255, 255), 2, 4)
[00119] #31-34, 27-33
[00120]
[00121] ## "Left Eye"
[00122] for n in range(42, 48):
[00123] x = landmarks.part(n).x
[00124] y = landmarks.part(n).y
[00125] cv2.circle(frame, (x, y), 1, (163, 38, 32), -1)
[00126]
[00127] ## "Right Eye"
[00128] for n in range(36, 42):
[00129] x = landmarks.part(n).x
[00130] y = landmarks.part(n).y
[00131] cv2.circle(frame, (x, y), 1, (158, 163, 32), -1)
[00132] #cv2.putText(frame, str(n), (x, y),
cv2.FONT_HERSHEY_SIMPLEX, 0.4, (0, 0, 255), 2, 4)
[00133]
[00134] ## "Left Eyebrow"
[00135] for n in range(22, 27):
[00136] x = landmarks.part(n).x
[00137] y = landmarks.part(n).y
[00138] cv2.circle(frame, (x, y), 1, (168, 100, 168), -1)
[00139]
[00140] ## "Right Eyebrow"
[00141] for n in range(17, 22):
[00142] x = landmarks.part(n).x

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[00143] y = landmarks.part(n).y
[00144] cv2.circle(frame, (x, y), 1, (230, 159, 23), -1)
[00145]
[00146] ## "Mouth"
[00147] for n in range(48, 68):
[00148] x = landmarks.part(n).x
[00149] y = landmarks.part(n).y
[00150] cv2.circle(frame, (x, y), 1, (79, 76, 240), -1)
[00151] #cv2.putText(frame, str(n), (x, y),
cv2.FONT_HERSHEY_SIMPLEX, 0.35, (0, 0, 255), 2, 4)
[00152]
[00153] face_width = x2 - x1
[00154] face_height = y2 - y1
[00155]
[00156] # analyzing positional relationship of n random
points based on facial expression recognition
[00157] mouth_width = (landmarks.part(54).x -
landmarks.part(48).x) / face_width # extent to which mouth is
opened
[00158] mouth_height = (landmarks.part(66).y -
landmarks.part(62).y) / face_width # extent to which mouth is
opened
[00159]
[00160] # calc center pos
[00161] face_x = face_width / 2 + x1
[00162] face_y = face_height / 2 + y1
[00163] face_pos = [face_x, face_y, face_width, face_height,
x1, y1]
[00164]
[00165] mouth_x = (landmarks.part(54).x -

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landmarks.part(48).x) / 2 + landmarks.part(48).x
[00166] mouth_y          =          (landmarks.part(66).y          -
landmarks.part(62).y) / 2 + landmarks.part(62).y
[00167] mouth_pos = [mouth_x, mouth_y, landmarks.part(54).x -
landmarks.part(48).x,          landmarks.part(66).y          -
landmarks.part(62).y,          landmarks.part(48).x,
landmarks.part(50).y]
[00168]
[00169] nose_x          =          (landmarks.part(34).x          -
landmarks.part(31).x) / 2 + landmarks.part(31).x
[00170] nose_y          =          (landmarks.part(33).y          -
landmarks.part(27).y) / 2 + landmarks.part(27).y
[00171] nose_pos = [mouth_x, mouth_y, landmarks.part(34).x -
landmarks.part(31).x,          landmarks.part(33).y          -
landmarks.part(27).y,          landmarks.part(31).x,
landmarks.part(27).y]
[00172]
[00173] eye_x1          =          (landmarks.part(39).x          -
landmarks.part(36).x) / 2 + landmarks.part(36).x
[00174] eye_y1          =          (landmarks.part(41).y          -
landmarks.part(37).y) / 2 + landmarks.part(37).y
[00175] eye_pos1 = [eye_x1, eye_y1, landmarks.part(39).x -
landmarks.part(36).x,          landmarks.part(41).y          -
landmarks.part(37).y,          landmarks.part(36).x,
landmarks.part(37).y]
[00176]
[00177] eye_x2          =          (landmarks.part(45).x          -
landmarks.part(42).x) / 2 + landmarks.part(42).x
[00178] eye_y2          =          (landmarks.part(47).y          -
landmarks.part(43).y) / 2 + landmarks.part(43).y

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[00179] eye_pos2 = [eye_x2, eye_y2, landmarks.part(45).x -
landmarks.part(42).x, landmarks.part(47).y -
landmarks.part(43).y, landmarks.part(42).x,
landmarks.part(43).y]
[00180]
[00181] # analyzing degree of straightening eyebrows and
degree of frowning with 10 features on the eyebrows
[00182] brow_sum = 0 # sum of heights
[00183] frown_sum = 0 # sum of distances between eyebrows
[00184] for j in range(17, 21):
[00185] brow_sum += (landmarks.part(j).y - y1) +
(landmarks.part(j + 5).y - y1)
[00186] frown_sum += landmarks.part(j + 5).x -
landmarks.part(j).x
[00187] line_brow_x.append(landmarks.part(j).x)
[00188] line_brow_y.append(landmarks.part(j).y)
[00189]
[00190] temp_x = np.array(line_brow_x)
[00191] temp_y = np.array(line_brow_y)
[00192] z1 = np.polyfit(temp_x, temp_y, 1) # primary straight
line synthesis
[00193] brow_k = -round(z1[0], 3) # inclination of sum curve
and inclination of actual eyebrows are opposite
[00194]
[00195] eye_sum = (landmarks.part(41).y -
landmarks.part(37).y + landmarks.part(40).y -
landmarks.part(38).y +
[00196] landmarks.part(47).y - landmarks.part(43).y +
landmarks.part(46).y - landmarks.part(44).y)
[00197] eye_height = (eye_sum / 4) / face_width

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[00198]

[00199] return frame, face_pos, eye_pos1, eye_pos2, nose_pos, mouth_pos, mouth_width, mouth_height, eye_height, brow_k

[00200] return frame, [], [], [], [], [], -1, -1, -1, -1

[00201]

[00202] In addition to the various coding blocks described above, the coding robot 100 may include various coding blocks. For example, an object recognition block stores coding commands capable of recognizing about 32 objects, and may operate based on Tensorflow. Alternatively, a sign recognition block may be configured with a coding block for a user to directly learn signs and a block for recognizing signs based on learned data. Alternatively, a lane recognition block is a coding block for preventing deviation by recognizing two consecutive lines on the screen, measuring a distance between the line and a vehicle, and moving the vehicle to the middle of the lane if the vehicle is leaning to one side. Alternatively, a number recognition block for recognizing numbers from 0 to 9 and a letter recognition block for recognizing English alphabets may be applied according to various embodiments of the present invention.

[00203] Thereafter, the coding robot 100 may acquire control data based on the determined emotion.

[00204] Meanwhile, the coding robot 100 may be controlled according to a control command corresponding to the emotion determined by the embodiment described above.

[00205] As an embodiment, the coding robot 100 may acquire coordinate information on a two-dimensional vector space corresponding to the determined emotion. Thereafter, the coding robot 100 may acquire a control command corresponding

to the coordinate information on the vector space.

[00206] For example, the two-dimensional vector space may be the 2D space illustrated in FIG. 5. In this case, it goes without saying that the two-dimensional space can be displayed on J. Russell's circular emotion model. The horizontal axis of J. Russell's circular emotion model indicates whether the emotion is positive or negative, and the vertical axis indicates activity. That is, the emotion of the subject to be recognized determined by the coding robot 100 may be acquired as one coordinate information on J. Russell's circular emotion model illustrated in FIG. 5.

[00207] The coding robot 100 may store a control command corresponding to each coordinate information on J. Russell's circular emotion model. According to one embodiment, if the acquired coordinate information exists in a first quadrant, the coding robot 100 may perform a first control command, if it exists in a second quadrant, the coding robot 100 may perform a second control command, if it exists in a third quadrant, the coding robot 100 may perform a third control command, and if it exists in a fourth quadrant, the coding robot 100 may perform a fourth control command.

[00208] As an embodiment, the first to fourth control commands may be commands related to movement of the coding robot 100.

[00209] Meanwhile, according to another embodiment of the present invention, the coding robot 100 may acquire emotion change information of the subject to be recognized based on a photographed face image of the subject to be recognized.

[00210] Thereafter, the coding robot 100 may acquire first coordinate information corresponding to a first emotion and

second coordinate information corresponding to a second emotion when the emotion of the subject to be recognized changes from the first emotion to the second emotion.

[00211] Thereafter, the coding robot 100 may acquire a movement command corresponding to a vector value corresponding to the first coordinate and the second coordinate as a control command.

[00212] For example, as illustrated in FIG. 5, when the emotion of the subject to be recognized changes from a first coordinates 510 to a second coordinates 520, the coding robot 100 may move in a vector direction having the first coordinates 510 as a starting point and the second coordinates 520 as an ending point.

[00213] According to one embodiment, an initial movement speed of the coding robot 100 may be proportional to the distance from the origin to the first coordinates 510, and the movement acceleration of the coding robot 100 may be proportional to the distance from the first coordinates 510 to the second coordinates 520. For example, when the first coordinates 510 are (a, b) and the second coordinates are (c, d), the initial movement speed V and the movement acceleration A can be expressed as the following equation.

[00214] [Equation 1]

$$V=k\sqrt{a^2+b^2}$$

[00215]

$$A=l\sqrt{(a-c)^2+(b-d)^2}$$

[00216] In this case, k and l may be arbitrary positive constants.

[00217] Meanwhile, according to another embodiment of the present invention, when the control data is speech data of the subject to be recognized, the coding robot 100 may acquire the control data through various methods.

[00218] Specifically, the coding robot 100 may generate a motion control block including a motion speed control command and a motion repetition number control command for the coding robot based on speech data.

[00219] Thereafter, the coding robot 100 may acquire at least one of motion speed information and motion repetition number information based on the speech data.

[00220] Thereafter, the coding robot 100 may acquire a control command corresponding to at least one of the motion speed and the motion repetition number of the coding robot based on at least one of the motion speed information and the motion repetition number information.

[00221] In this case, when the speech data matches the preconfigured control information, the coding robot 100 may acquire the motion speed or the number of motion repetitions of the coding robot as the control command based on the motion speed information or the motion repetition number information corresponding to the preconfigured control information.

[00222] For example, if the speech data is "moving right quickly" and there is a pre-stored control command corresponding thereto (e.g., moving to the right by a speed of 3 steps), the coding robot 100 may be controlled according to the pre-stored control command.

[00223] However, when the speech data does not match the preconfigured control information, the coding robot 100 may generate syllable interval information based on the speech data, and generate motion speed information corresponding to the syllable interval information.

[00224] For example, when the speech data is "move right quickly" and there is no preconfigured control information corresponding to "quickly", the coding robot 100 may generate syllable interval information based on speech data, generate motion speed information corresponding to the syllable interval information, and generate a movement speed control command sentence corresponding to the generated motion speed information.

[00225] Specifically, if the motion speed information is not retrieved from speech data, the coding robot 100 may generate syllable interval information based on the speech data, generate motion speed information corresponding to the syllable interval information, and generate the movement speed control command corresponding to the generated motion speed information.

[00226] Specifically, the coding robot 100 may calculate a first time difference between an end time of one syllable among the syllables included in the speech data speech data and a start time of a syllable following the one syllable, and generate an average time difference of a plurality of first time differences as the syllable interval information.

[00227] Thereafter, the coding robot 100 may generate motion speed information by calculating a time difference ratio of an average time difference represented by the syllable interval information to a reference time difference and

applying the time difference ratio to a basic movement speed.

[00228] For example, when an average time difference is "12 msec", a reference time difference is "10 msec", and a basic movement speed is "1x speed", the coding robot 100 may generate the motion speed information as "1.2x speed" by calculating the time difference ratio as "120%" and applying the time difference ratio "120%" to the basic movement speed "1x speed".

[00229] On the other hand, when the speech data does not match the preconfigured control information, the coding robot 100 may generate signal strength information based on the speech data and generates motion repetition number information corresponding to the signal strength information.

[00230] Specifically, when the speech data does not include the motion repetition number information, the coding robot 100 may generate the signal strength information based on a speech signal, generate the motion repetition number information corresponding to the signal strength information, and generate the motion repetition number control command sentence corresponding to the generated motion repetition number information.

[00231] For example, if the motion repetition number information is not retrieved from speech data, the coding robot 100 may generate the signal strength information based on the speech signal, generate the motion repetition number information corresponding to the signal strength information, and generate the motion repetition number control command sentence corresponding to the generated motion repetition number information.

[00232] Specifically, the coding robot 100 may generate a

maximum signal strength among signal strengths over time of the speech signal as signal strength information.

[00233] Thereafter, the coding robot 100 may generate the motion repetition number information by calculating a signal strength ratio of the maximum signal strength indicated by the signal strength information to the reference signal strength and applying the signal strength ratio to a basic motion repetition number.

[00234] For example, when the maximum signal strength is "200DB", the reference signal strength is "100DB", and the basic motion repetition number is "one time", the coding robot 100 may generate the basic motion repetition number as "two times" by calculating the signal strength ratio as "200%" and applying the signal strength ratio "200%" to the basic motion repetition number "one time". In this case, the motion repetition number information may be rounded off and generated as a natural number.

[00235] Based on the generated motion speed information or the motion repetition number, the motion speed or motion repetition number of the coding robot may be acquired as the control command.

[00236] Meanwhile, according to another embodiment of the present invention, when the control command is a control command for moving the coding robot, the coding robot 100 may recognize objects around the coding robot. Thereafter, the coding robot 100 may acquire control information corresponding to the pre-stored sign when the recognized object matches the pre-stored sign. The coding robot 100 may recognize lanes around the coding robot. The coding robot 100 may move along the recognized lane and move in

correspondence with control information.

[00237] In this case, the coding robot 100 may acquire two consecutive line segment information based on an image input to the coding robot 100, and acquire a lane area based on the acquired line segment information.

[00238] Thereafter, the coding robot 100 may acquire distance information between the acquired line segments and the coding robot. Thereafter, the coding robot 100 may control the coding robot based on the lane area and the distance information.

[00239] To this end, it goes without saying that at least one of the object recognition block, the sign recognition block, the lane recognition block, the number recognition block, and the text recognition block described above can be used.

[00240] Meanwhile, the components of the present invention may be implemented as a program (or application) to be executed in combination with a computer, which is hardware, and stored in a medium. The components of the present invention may be implemented as software programming or software elements. Similarly, the embodiments may be implemented in a programming or scripting languages, such as C, C++, Java, an assembler, etc., including various algorithms implemented as combinations of data structures, processes, routines, or other programming constructions. Functional aspects may be implemented in an algorithm running on one or more processors.

[00241] Although the embodiments of the present invention have been described with reference to the accompanying drawings, those skilled in the art to which the present invention belongs will understand that the present invention

may be embodied in other specific forms without changing technical spirit or essential features of the present invention. Therefore, it should be understood that the embodiments described above are illustrative in all respects and not restrictive.

CLAIMS

1. A control method of a coding robot, the control method comprising the steps of:

acquiring, by the coding robot, information of a subject to be recognized;

acquiring, by the coding robot, control data on the basis of the acquired information of the subject to be recognized;

determining, by the coding robot, whether the control data matches preconfigured control information;

performing, by the coding robot, a motion corresponding to a preconfigured control command if the control data matches the preconfigured control information; and

analyzing the control data and matching same with one of preconfigured control commands, by the coding robot, if the control data does not match the preconfigured control information, wherein

the control data is at least one of emotion data and speech data of the subject to be recognized.

2. The control method of claim 1, wherein

when the control data is the emotion data of the subject to be recognized, the step of acquiring the control data includes the steps of:

acquiring, by the coding robot, a photographed face image of the subject to be recognized;

acquiring, by the coding robot, a model variable based on the face photographed face image;

determining, by the coding robot, whether the subject to be recognized matches a face of a pre-registered user based on the acquired model variable;

acquiring, by the coding robot, a feature value corresponding to the photographed face image based on the photographed face image, when the subject to be recognized matches the pre-registered user;

determining, by the coding robot, a facial part including the eyes, nose, and mouth of when the subject to be recognized based on the acquired feature value;

determining, by the coding robot, the emotion of the subject to be recognized based on the determined facial part, and

acquiring, by the coding robot, the control data based on the determined emotion.

3. The control method of claim 2, wherein the step of performing the motion corresponding to the control command includes the steps of:

acquiring, by the coding robot, coordinate information on a two-dimensional vector space corresponding to the determined emotion;

acquiring a control command corresponding to the coordinate information on the vector space; and

performing a motion corresponding to the control command.

4. The control method of claim 2, wherein the step of performing the motion corresponding to the control command includes the steps of:

acquiring, by the coding robot, emotion change information of the subject to be recognized based on the photographed face image of the subject to be recognized;

acquiring, by the coding robot, first coordinate information corresponding to a first emotion and second coordinate information corresponding to a second emotion when the emotion of the subject to be recognized changes from the first emotion to the second emotion; and

acquiring, by the coding robot, a movement command corresponding to a vector value corresponding to the first coordinate and the second coordinate as the control command.

5. The control method of claim 1, wherein

when the control command is a control command for moving the coding robot, the control method further includes the steps of:

recognizing, by the coding robot, an object around the coding robot,

acquiring, by the coding robot, control information corresponding to a pre-stored sign when the recognized object matches the pre-stored sign,

recognizing, by the coding robot, a lane around the coding robot; and

moving the coding robot along the recognized lane to correspond to the control information, and

the step of recognizing the lane may include the steps of:

acquiring two consecutive line segment information based on an image input to the coding robot, and

acquiring a lane area based on the acquired line segment information;

acquiring distance information between the acquired line segment and the coding robot; and

controlling the coding robot based on the lane area and the distance information.

6. The control method of claim 1, wherein

when the control data is speech data of the subject to be recognized, the control method further includes the steps of:

generating, by the coding robot, a motion control block including a motion speed control command and a motion repetition number control command for the coding robot based on the speech data;

acquiring, by the coding robot, at least one of the motion speed information and the motion repetition number information based on the speech data; and

acquiring, by the coding robot, a control command corresponding to at least one of the motion speed and the motion repetition number of the coding robot based on at least one of the motion speed information and the motion repetition number information.

7. The control method of claim 6, wherein

the step of acquiring the control command corresponding to at least one of the motion speed and the motion repetition number of the coding robot includes the steps of:

acquiring, by the coding robot, the motion speed or the motion repetition number of the coding robot based on the motion speed information or the motion repetition number information corresponding to the preconfigured control information as the control command, when the speech data matches the preconfigured control information;

generating, by the coding robot, syllable interval information based on the speech data and generating the motion speed information corresponding to the syllable interval information, when the speech data does not match the preconfigured control information;

generating, by the coding robot, signal strength information based on the speech data and generating the motion repetition number information corresponding to the signal strength information, when the speech data does not match the preconfigured control information; and

acquiring the motion speed or the motion repetition number information of the coding robot as the control command based on the generated motion speed information or the motion repetition number.