Examination Guide in the Artificial Intelligence Field (KIPO)

Korean Intellectual Property Office

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Part I- Examination Guide in the Artificial Intelligence Field

(Drafted・Amended by Artificial Intelligence/Big Data Examination Division)

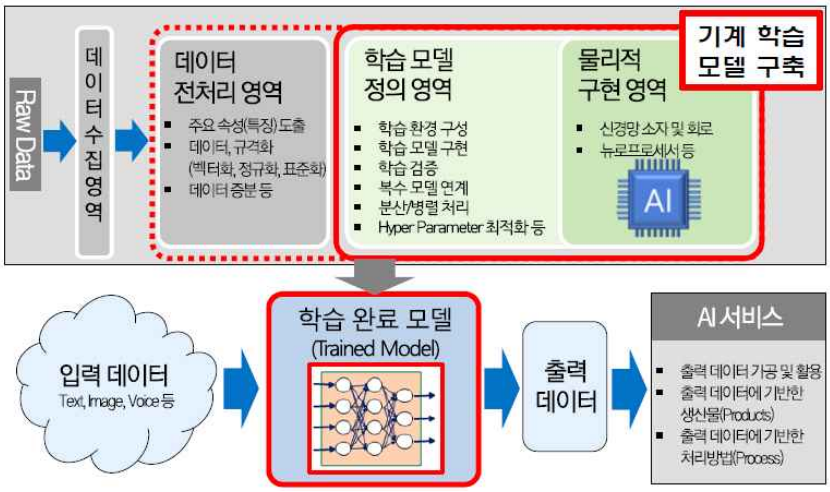
AI Field Examination Guide, legislated in December 2020

1. Introduction

This chapter explains an examination guide for applications of inventions requiring machine learning based artificial intelligence(AI) technologies (hereinafter referred to as AI related inventions) for the implementation of an invention.

Matters that are not explained in this chapter follow patents・utility models or computer related invention examination guidelines.

※ Overview of AI related inventions used in this examination guide



[Note]
Examples contained in this chapter are processed and edited in brief expressions with respect to a claim or claims, a description of the invention, drawing(s), etc. to explain cases of patentability assessment.

1.1 Explanation of Terminologies Used in Examination Cases

Main terminologies used in this guide have meanings as follows:

• **Artificial Neural Network (ANN)**

☞ The artificial neural network (ANN) is a type of a machine learning model based on a structure of the network where multiple layers of connected neurons are connected by synapses (weights), by simulating the transmission of human nerve cells or neurons. The representative structure of the ANN is a multi-layered perceptron formed into a plurality of hidden layers between one input layer and the output layer.

• **Convolutional Neural Networks (CNNs)**

☞ The convolutional neural networks (CNNs) are a type of deep neural networks (DNNs) formed with one or more convolutional layer(s), pooling layer(s), fully connected layer(s). The structure of the CNN is proper to the learning of 2 dimensional data (2D data) and it can be trained through backpropagation algorithm. The CNNs is one among the most representative models of the DNN that is broadly used in various application fields, such as object classification within an image, object detection, etc.

• **Recurrent Neural Networks (RNNs)**

☞ As a deep learning model to learn data, which changes over time, like time-series data, it refers to an artificial neural network formed by connecting the network at and after the reference point. As a representative model for solving the problem of loss of slope value caused by back-file data where the DNN is connected at each point, the long-short term memory recurrent neural networks (LSTM-RNNs) can be referred to.

• **Overfitting**

☞ It means the variance of learning results only based on sample data is set too high. Under the condition, learning results based on existing sample data show 100% accuracy, but it rapidly decreases if non-trained data are entered.

2. Description Requirements

2.1 Description of Invention

2.1.1 Enablement requirement

Enablement requirement in an AI-related invention shall be basically determined in accordance with 『Requirement for Written Description, Chapter 3, Part II』, Patents · Utility Models Examination Guidelines.

A description should be stated clearly and in detail for a person skilled in the art to implement the subject matter defined by a claim based on common general knowledge at the time of the filing of the application and matters described in the specification and drawing(s).

Matters regarding AI technologies applied in a claimed invention need to be specifically described to make a person skilled in the art clearly understand a specific means, a technical problem, a solving means, etc., and thereby easily carry out the AI related invention.

Specific means for implementing an AI related invention contain training data, data preprocessing method, learning model, loss function, etc.

If a person skilled in the art clearly understands a certain means for implementing an AI related invention in view of common general knowledge at the time of the filing of the application, even if a description of the invention or drawing(s) do not expressly describe said means, it should not be determined that the claimed invention cannot be easily implemented for this reason.

2.1.2 Examples of Violations of Enablement Requirement

(1) Where a description of the invention describing technical steps or functions corresponding to those recited in a claim in an abstract manner does not disclose how the steps or functions can be implemented or performed by hardware or software, and a person skilled in the art cannot clearly understand even in view of common general knowledge at the time of the filing of the application and thus cannot easily carry out the claimed invention

(Ex) Claims relate to generating a learning completed model (inference mode) for disease prediction by means of a multiple of an ensemble of artificial neural networks (ANN), but a description of the invention does not specify said multiple of ANN used in an ensemble of said learning completed model for disease prediction and does not specifically provide for 'means' or 'process' for generating said learning completed model for disease prediction by using an ensemble of said ANN, and a person skilled in the art cannot clearly understand said means or process even in view of common general knowledge at the time of the filing of the application and thus cannot easily carry out the claimed invention. In this case, the description is deemed not to satisfy the enablement requirement.

(2) A description of the invention is deemed not to satisfy the enablement requirement if it does not specifically provide for a correlation between input data and output data of a trained model as a certain means for implementing an AI related invention.

Specific provision of a correlation between input data and output data of a trained model means ① training data are specified, ② a correlation for solving a technical problem of the claimed invention between characteristics of training data exists, ③ a learning model to train by using training data or a training method is specifically described, ④ a trained model is generated for solving a technical problem of the claimed invention by means of such training data and training method.

If a person skilled in the art presumes or understands such a correlation on the basis of mode(s) described in a description of the invention, as taking common general knowledge at the time of the filing of the application into account, the enablement requirement is deemed to be satisfied.

(Ex) Claims relate to automatically controlling a house's temperature by

using a machine learning model applying training data of weather data(temperature, humidity, etc.) and environment data(fine dust information, etc.). A description of the invention specifically provides for a correlation between weather data and information for automatically controlling a house's temperature by using a machine learning model, but environment data are only recited as input data and a correlation between environment data and output data(information for automatically controlling a house's temperature) is not specifically described in the description. In this case, the description is deemed not to satisfy the enablement requirement.

If a person skilled in the art presumes or understands such a correlation on the basis of mode(s) described in a description of the invention, as taking common general knowledge at the time of the filing of the application into account, the enablement requirement is deemed to be satisfied.

(3) Where hardware or software which implements the function of the invention claimed in a description is explained only with 「functional block diagrams」 or general 「flow charts」 in a description of the invention, the explanation is not sufficient to understand how hardware or software is implemented, and a person skilled in the art cannot clearly understand even in view of common general knowledge at the time of the filing of the application and thus cannot easily carry out the claimed invention

2.1.3 Notes

(1) If the subject matter defined by a claim has a characteristics in application of machine learning, a technical problem can be solved by relying on a general machine learning method[1] and working effect can be identified,

1) As a general machine learning method, 'convolutional neural network(CNN)' in the field of patterns, such character, voice, etc., and 'recurrent neural network(RNN)', etc. in the field of automatic translation and natural language processing are widely used. Also, mean squared error(MSE), cross entropy, etc. are generally as a loss function of machine learning, and 'back-propagation' of errors, stochastic gradient descent(SGD), AdaGrad, AdaDelta, etc. are usually used to obtain optimal model parameters.

even if a learning model to train by using training data or a training method is not specifically provided for and a general machine learning method is only described, the enablement requirement is deemed to be satisfied.

(2) Some machine learning based AI related inventions have a characteristics in data preprocessing for changing collected raw data into training one. In this case, if a description of the invention does not describe (i) how data preprocessing steps or functions are carried out or realized for changing collected raw data into training one, generating, adding or deleting such raw data, (ii) a correlation between collected raw data and training data, the enablement requirement is not deemed to be satisfied.

If a person skilled in the art clearly understands a subject matter regarding such data preprocessing on the basis of mode(s) described in a description of the invention, as taking common general knowledge at the time of the filing of the application into account, the enablement requirement is deemed to be satisfied.

(3) If a reinforcement learning based AI related invention does not specifically provide for a reinforcement learning method including a correlation between agent, environment, state, action and reward, the enablement requirement is not deemed to be satisfied.

If a person skilled in the art clearly understands a subject matter of reinforcement learning related invention on the basis of mode(s) described in a description of the invention, as taking common general knowledge at the time of the filing of the application into account, the enablement requirement is deemed to be satisfied.

(4) If a subject matter of chemical substance invention or medical use invention applying AI technology is substance itself (medicines included), examination shall be carried out in accordance with examination guidelines regarding substance invention in the chemical field or medical use invention.

(※ Refer to 『2.3.2 Handling of Special Cases, Chapter 3 Description of

Invention, Part II』 or 『Chapter 2 Description Requirements, Medical Field Examination Guidelines』 of patents · utility models examination guidelines)

2.2 Claims

2.2.1 To be supported by a description of the invention

2.2.1.1 Description Requirements

In an AI related invention, it shall be determined of whether a claim or claims are supported by a description of the invention in accordance with description requirements of 『Claims, Chapter 4, Part II』 of patents · utility models examination guidelines.

『To be supported by a description of the invention』 among description requirements of a claim or claims is to be explained here, mainly focusing on examination of AI related inventions.

2.2.1.2 Cases not to be supported by a description of the invention

Cases where the subject matter defined by a claim is not supported by a description of the invention are as follows:

(1) Matters corresponding to the ones described in a claim or claims are neither directly described in a description of the invention nor implied

(2) Matters described in a claim or claims relate to ‘means’ or ‘step’ for carrying out certain functions, but specific features corresponding to such means or step are not described in a description of the invention

(3) Matters provided for in a description of the invention cannot be expanded to the scope of the claimed invention or generalized in view of common general knowledge at the time of the filing of the application

2.2.2 Description of the claimed invention in a clear and concise manner

2.2.2.1 Description Requirements of Claim(s)

Description requirements of claim(s) in an AI-related invention shall be basically determined in accordance with 『Description Requirements of Claim(s),

Chapter 4, Part 2』, patents · utility models examination guidelines. Matters necessary in assessment and examination of an AI-related invention shall be described here, especially from the point of view of『clear and concise description of an invention』among description requirements of claim(s),

2.2.2.2 Categories of AI related inventions

An AI related invention shall be described in a claim or claims as 「method invention」 or 「product invention」.

(1) Method invention

An AI related invention can be claimed as a method by specifying a series of processes or operations connected in a time sequence, namely steps.

(2) Product Invention

Since an AI related invention can be expressed in a multiple of functions enabling an invention, an invention shall be disclosed in the claim as a product(apparatus) invention specified with function(s).

Also, an AI related invention can be categorized into『a computer program readable medium』,『a computer program recorded in a medium』and『a recording medium having data structure』.

① Claim drawn to a computer program readable medium

An AI related invention can be claimed as a computer readable medium having program code recorded thereon to install, execute or distribute the said program.

(Ex) A computer-readable medium having a program recorded thereon, wherein the program makes the computer execute procedure A, procedure B, procedure C, …

(Ex) A computer-readable medium having a program recorded thereon; wherein the program makes the computer operate as means A, means B, means C, …

(Ex) A computer-readable medium having a program recorded thereon; wherein the program makes the computer implement function A, function B, function C, …

② Claim drawn to a 「computer program recorded in a medium」 to accomplish a specific task when combined with hardware <the application filed on and after July 1, 2014>

(Ex) Computer program recorded in a medium to make a computer execute procedure A, procedure B, procedure C, …

※ Meanwhile, ‘computer program not recorded in a medium’ is not allowed as it claims a computer program per se.

(Ex) A computer program executing procedure A, procedure B, procedure C, ... in the computer

③ Claim drawn to a 「recording medium having data structure」

A recording medium having data structure, namely, a 'computer-readable recording medium' where a processing performed by a computer is specified by recorded data structure or 'a computer-readable recording medium having data structure' can be described as a product invention in a claim or claims.

(Ex) A computer-readable recording medium having recorded data structure presenting structure A, structure B, structure C, ··· operated on a computer

2.2.2.3 Examples of indefinite claims

(1) Where an invention cannot be specified as it is unclear of who implements said invention

If a subject matter realizes 「the computation or processing of unique information in accordance with the purpose of use」, but who implements

the invention (hardware) cannot be clearly identified based on a description, a claim or claims is determined not to be clearly defined.

(2) Where the subject matter defined by a claim is indefinite

Where the end of the claim is described either as「Program Product」or as 「Program Achievements」or as「Program Results」, etc., as it is hard to specify as any of the followings between 「Program」, 「Computer Readable Medium」, 「Programs-Combined Computer System」, the subject matter of an invention is hard to be clearly understood.

(3) Where the category of an invention for which a patent is sought is unclear

Where the end of the claim is described either as 「program signals」 or as 「program signal sequence」, etc., as the invention cannot be specified as 「product」 or as 「method」, the category of the invention is indefinite.

2.2.2.4 Notes

(1) If it is not clearly identified of who implements the invention (hardware) even if the claims as a whole are considered, attentions should be given in that claims do not, in principle, define「certain means or method in cooperation between hardware and software to realize the computation or processing of unique information in accordance with the purpose of use」(refer to 『3.1.2 specific method of assessment, 3.1 requirements for subject matter eligibility, AI field examination guide』) and claims are not clearly described(refer to『2.2.2.3 examples of indefinite claims, 2.2.2 description of the claimed invention in a clear and concise manner, AI field examination guide』).

If a single office action is sufficient to overcome other reasons of refusal simultaneously, the examiner does not have to issue several office actions to promote convenience of handling the application and to carry out examinations quickly and accurately. For example, if an office action regarding violation of description requirement of claims is sufficient to overcome the reason of refusal regarding patent eligibility at the same time,

the office action regarding patent eligibility does not have to be issued, and vice versa.

3. Patentability Requirements

It explains 「requirements for subject matter eligibility」 and 「novelty and inventive step」 which are particularly important in assessing and examining patent applications for AI related inventions.

3.1 Requirements for Subject Matter Eligibility

3.1.1 Basics

Since an AI related invention refers to a computer-implemented invention using computer, etc. on the basis of 'information processing by software', criteria on patent eligibility of an AI related invention, in principle, are the same with the one of a computer·software related invention.

To be qualified as a "statutory subject matter" prescribed under the Patent Act, an AI related invention shall be "a creation of technical ideas utilizing a law of nature." Where information processing by software is specifically implemented by means of hardware in an AI related invention, an information processing device(apparatus) working in cooperation with software, working process, a computer readable medium having recorded a program, a computer program stored in the computer readable medium are directed to an invention as a creation of technical ideas utilizing a law of nature. However, a computer program is just related to a command to execute, and as a computer program itself is not a creation of technical ideas utilizing a law of nature, it cannot be an invention.

3.1.2 Specific Method of Assessment

A specific method of assessing whether a subject matter of the claimed invention constitutes a statutory invention prescribed under the Patent Act is as follows:

(1) A claimed invention shall be understood based on a description of the

claims.

(2) It should be reviewed whether the claimed invention is directed to 「a creation of technical ideas utilizing a law of nature」 in accordance with 「Patent Eligibility of an Invention, Paragraph 4, Chapter 1, Part III」 of patents· utility models examination guidelines.

① As it should be determined whether an invention is utilizing a law of nature based on the claim as a whole, even if a law of nature is used in some parts of the claim, where it is determined the claim as a whole does not use a law of nature, it shall not be deemed to be directed to a statutory invention prescribed under the Patent Act.

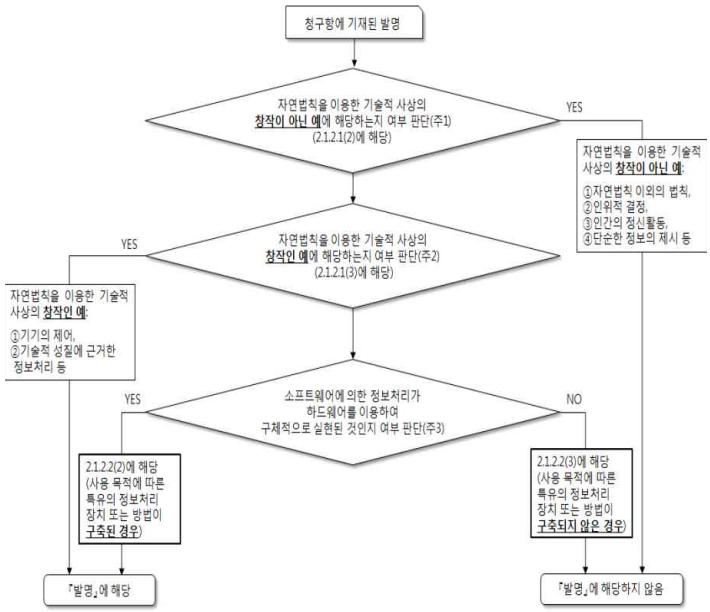
② Where the invention does not utilize a law of nature, but applies (i) any laws other than a law of nature, (ii) artificial determination, or belongs to (iii) mental activity of a human being or uses it, or (iv) suggests simple information, it is not directed to an invention, as it is not technical ideas utilizing a law of nature (Refer to Supreme Court 2001Hu3149, 2002Hu277, 2009Hu436, Patent Court 2000Heo5438, 2001Heo3453, 2006Heo8910).

③ Where the invention specifically (i) controls a device or implements necessary controlling process, or (ii) implements information processing based on the technical nature of the subject, it is directed to an invention, as it is technical ideas using the law of nature.

(3) Where the claimed invention is not directed to any one of the ②, ③ of the above mentioned paragraph (2), it should be reviewed whether the invention belongs to 「the case where information processing by software is specifically implemented by means of hardware」(Refer to Supreme Court 2001Hu3149, 2007Hu265, 2007Hu494, Patent Court 2005Heo11094, 2006Heo1742).

① Where information processing by software is specifically implemented, in other words, where 「a specific means or process in cooperation with software and hardware implements computing or processing of specific information in accordance with the purpose of use, and thereby specific information processing apparatus(device) or its working process is disclosed in the claim, it belongs to an invention, as it is a creation of technical ideas utilizing a law of nature.

② Meanwhile, where information processing by software is not specifically implemented by means of hardware, it does not belong to an invention, as it is not a creation of technical ideas utilizing a law of nature.



<Fig.> Flowchart of Assessment Process of Patent Eligibility of a Computer·Software-related Invention

(Note1) Where the claimed invention either uses (i) any laws other than a law of nature, (ii) artificial determination, or belongs to (iii) mental activity of a human being or uses it or (iv) suggests simple information, it does not belong to an invention, as it is not directed to a creation of technical ideas utilizing a law of nature.

(Note2) Where the claimed invention (i) specifically controls an apparatus or implements a necessary process for controlling, or (ii) specifically implements information processing based on the technical nature of the subject, it does belong to an invention, as it is a creation of technical ideas utilizing a law of nature.
(Note3) It shall be assessed whether the claimed invention discloses a specific information processing apparatus(device) or its working process in accordance with the purpose of use to determine that said invention is directed to the case where information processing by software is specifically implemented by means of hardware.

3.1.3 Specific cases for assessment

3.1.3.1 Case assessment in compliance with 『Patent eligibility, Section 4, Chapter 1, Part III』 of Patents · Utility Models Examination Guidelines

(1) **Cases where the invention is not the technical ideas using the law of nature**

The claimed invention does not constitute "a creation of technical ideas utilizing a law of nature" in the following cases:

① Laws other than the law of nature

(Ex: economic law, mathematical formula, etc.)

② Artificial decision

(Example1) A method for creating a password by combining characters, numbers, symbols, etc.
(Example2) [Claim] A method for forming the phonetic alphabet for foreign languages comprising: altering the shape of the throat and the sound of a person's throat that is formed in the pronunciation of such characters according to the pronunciation change and the shape of the lips

☞ As it is necessary to make a promise in the language society that a particular shape of symbol determined in the invention is defined by a specific writing method of the pronunciation of a foreign language and to comply with it to have meaning as a writing method, and said invention is just an artificial decision irrespective of the law of nature, the invention disclosed in the claim does not fall under invention defined by the Patent Act(Refer to Patent Court 2001Heo3453).

③ A human being's mental activity or offline activities

(Ex) [Claim] A method for comprehensively managing household waste recycling comprising: distributing a bar code sticker with a waster's personal information and a calendar marked for said thrown garbage by the competent authority to said each waster; discharging the waste accurately separated by the prescribed regulations by placing it in a regulated garbage bag, but should attach a bar code sticker with a waster's personal information; collecting said discharged garbage on a daily basis and carrying it to the loading dock to classify it into waste to be recycled or to be landfilled or to be incinerated by a garbage collector; comprehensively managing household wastes, based on statistics on data accumulated for each process that instructs said waster to correct it, by reading bar codes attached to the front of garbage bag that is misclassified

☞ Even though said invention includes hardware and software, namely reading bar-code by comprehensively utilizing bar-code sticker, calendar, garbage bag, computer, etc., it cannot be said that the law of nature is used, as said invention is just mental activity of a human being utilizing said means as just tools, and as each step of said invention is processed off line, not on line, said invention does not fall under invention(Refer to Supreme Court 2001Hu3149, Patent Court 2000Heo5438).

(Ex) [Claim] A method for travel management utilizing a computer to link a computer reservation system to a database, travelers and travel

management system comprising: filing and sending a travel request to a travel management system; obtaining approval for said traveler's requested travel plan at said travel management system; writing a cost report through said travel management system based on said traveler's requested travel plan; obtaining approval for said cost report through said travel management system; receiving a completed travel reservation at said travel management system from said traveler's computer based on said traveler's approved travel plan

☞ Even though a hardware means, namely a travel management system, is involved, it is ambiguous of a specific cooperative means between software and hardware and its cooperative relationship, such as how much the actions of a human being as an authorized person for said approval and a system's actions are correlated in the approval process. As the claim as a whole does not specifically define how said specific cooperative means in said travel management system is implemented for the purpose of achieving a specific purpose, but general functions of either a computer or the Internet system are simply utilized, said invention is not the creation of technical ideas using the law of nature, but just comprising the action of a human being utilizing general functions of a computer or the Internet system(Refer to Patent Court 2006Heo8910)

④ Mere Presentation of Information

The case where the technical feature of the claimed invention is the contents of information that is simply presented, in other words, the main purpose of invention is to present information does not fall under invention.

(Example1) Manual for how to operate an apparatus or how to use chemical substances
(Example2) CD that is unique to recorded music
(Example3) Video data captured by a digital camera
(Example4) An athletic program written with a writing device
(Example5) Computer program list

However, if the information presented has novel technical features, the apparatus(means) used for presenting the information and the presenting process shall be deemed to fall under invention.

(Ex) A plastic card with information, such as characters, figures and symbols, embossed thereon

☞ The process of embossing information on a plastic card shall be deemed to have technical features, so that it shall fall under invention.

(2) Creation of Technical Ideas Utilizing a Law of Nature

The claimed invention constitutes “a creation of technical ideas utilizing a law of nature” in the following cases:

① Control of an apparatus (rice cooker, washing machine, engine, hard disk drive, chemical reactor, etc.) or performing a processing necessary for the control

(Ex) Controlling an 「apparatus」 to implement an action in accordance with the purpose of use

(Ex)Controlling a control object device, etc. based on the structure, element, configuration, working, function, feature, etc. of the 「control object device」 and/or 「peripheral devices related to the control object devic e」

(Ex) Controlling comprehensively the whole system comprised of technically related a multiple number of devices

② Information processing based on the physical or technical properties, such as electric property, chemical property, biological property, etc., of an object (rotation rate of engine, rolling temperature, a physical or chemical correlation of substances, a correlation between genetic sequence of organisms and phenotypic expression, etc.)

(Ex) To carry out computing or processing based on technical properties to obtain information(ex: numerical value, image, etc.) presenting the technical properties of an object at issue

(Ex) To carry out information processing using technical correlation between an object's condition and its corresponding phenomenon

3.1.3.2 Where 「information processing by software is specifically implemented by means of hardware」

(1) Basic Concept

If information processing by software is concretely realized using hardware resources in an AI related invention, since information processing device(machine) operating in cooperation with software, working method, computer-readable medium having recorded a program and a computer program stored in a medium are creations of technical ideas utilizing a law of nature, they constitute statutory inventions prescribed under the Patent Act.

'Information processing by software is concretely realized using hardware resources' means the ability of software to read to a computer to compute or process specific information according to its intended use in specific ways or stages in which the software and hardware cooperates, thereby establishing a unique information processing device (machine) or operation method according to its intended use. Further, a specific information processing device(apparatus) or its working process in accordance with the purpose of use is the creation of technical ideas utilizing the law of nature, and thereby falls under invention.

(2) The case where 「information processing by software is specifically implemented by means of hardware」

(Ex) Title of the Invention

A PREFERENCE PREDICTION APPARATUS

What is claimed is:

[Claim] A preference prediction apparatus comprising:

a similar user information receiving unit that receives a list of similar users for a user from a server that stores content usage information collected for content and homogeneous content;

a preference prediction unit that predicts the user's preference for content by using preference information form users listed in a list of similar users as input to machine learning algorithms and learning the feature set of contents contained in preference information by machine learning algorithms

☞ A computing or processing of unique information is specifically implemented to predict a user's preference for contents by inputting users' preference information contained in a list of similar users to machine learning algorithm of a preference prediction apparatus and by learning a feature set of contents contained in users' preference information through machine learning algorithms of a preference prediction apparatus for achieving the purpose of the invention to accurately predict users' preference for contents. Accordingly, the invention disclosed in the claim does fall under invention as the creation of technical idea using the law of nature, as information processing by software is specifically implemented by means of hardware.

(3) The case shall not be deemed to be directed to 「information processing by software is concretely realized using hardware resources」

(Ex) [Claim] A computer to calculate the minimum value of formula y=F(x) in the range of a<x<b.

☞ It cannot be said that the information processing to calculate the minimum value of formula y=F(x) is concretely implemented by the fact that the computer is used "to get the minimum value of formula y=F(x) in the rage of a<x<b." This is because information processing to calculate the minimum value of formula y=F(x) and the computer

cannot be said to be cooperatively working by only saying “a computer to calculate the minimum value…” Consequently, the claimed invention does not constitute “a creation of technical ideas utilizing a law of nature,” which means that it does not constitute “a statutory subject matter,” since the information processing by software is not concretely implemented by using hardware resources.

(Ex) [Claim] A computer comprising an input means to input document data, a processing means to process the inputted document data and an output means to output the processed document data; wherein said computer prepares a summary of the inputted document by using said processing means.

☞ It can be said that there exists a flow of information processing of document data on a computer in the order of input means, processing means and output means. However, since the said information processing to prepare a summary of the inputted document and the said processing means cannot be said to be cooperatively working, it cannot be said that the information processing is concretely implemented. Consequently, the claimed invention does not constitute “a creation of technical ideas utilizing a law of nature,” since the information processing by software is not concretely implemented by using hardware resources.

3.1.4 Notes

(1) As assessment is conducted based on the subject matter defined by a claim, even if a description of the invention or drawing(s) makes sure that information processing by software is concretely realized using hardware resources, if a claim or claims does not define that information processing by software is concretely realized using hardware resources, said subject matter does not constitute a statutory invention prescribed under the Patent Act.

(2) Even though the claim describes hardwares, such as 「computer」, 「process」, 「memory」, but 「specific means or processes where

software and hardware cooperate each other so as to conduct computing or processing of specific information in accordance with the purpose of use」 are not described(ex: where it is hard to clearly understand what hardware is used to specifically implement information processing by software algorithm [Refer to Patent Court 2011Heo9078]), the examiner shall keep in mind that the claimed invention might not belong to the 「creation of technical ideas using the law of nature」.

Meanwhile, where the claim specifically describes a computation or processing of specific information in accordance with the purpose of use, even if only a general 「computer」, not 「specific information processing apparatus(device) in accordance with the purpose of use」as a hardware, is described, said computing or processing of specific information is considered to be implemented in accordance with the purpose of use, as taking into account the technology level at the time of filing the patent application.

(3) When determining whether the invention disclosed in the claim is the creation of a technical idea using the natural law, it shall be determined after interpreting the meaning of a matter (the term) to specify the invention disclosed in the claim, regardless of the category of invention (the invention of the method or the invention of the thing) disclosed in the claim.

(4) When a claimed invention refers to “program listings” so that it is deemed to be a mere presentation of information, it is not the “creation of technical ideas using the law of nature.”

(5) An AI-related invention shall be determined of whether it is directed to the 「creation of technical ideas using the law of nature」 depending on whether the claim describes a 「specific process of means where software and hardware cooperate each other so as to implement the computing or processing of specific information in accordance with the purpose of use」 to repeatedly arrive at the same effect without the intervention of mental activity of a human being.

3.2 Novelty and inventive step

3.2.1 Basics

Novelty and inventive step of an AI related invention shall be basically determined in accordance with 『Novelty, Chapter 2, Part III and Inventive step, Chapter 3, Part III』 of patents · utility models examination guidelines. Matters necessary in determination and examination unique to an AI related invention as assessing novelty and inventive step are as follows:

(1) Novelty and inventive step shall be determined based on a subject matter of the claimed invention: it is significant to understand a subject matter as a combined one, rather than separately understand each feature composing said subject matter if features are organically combined together.

(2) Sameness between a subject matter of the claimed invention and the one of cited invention shall be determined by extracting common and different features from corresponding ones between the claimed invention and cited invention, as taking certain means(training data, data preprocessing, learning model, loss function, etc.) for implementing an AI related invention into account. If there is a difference between subject matters of the claimed invention and cited invention in technical features, the both inventions are not the same, but in the other case, the both inventions are the same. Sameness in this case includes substantial sameness.

(3) Inventive step shall be assessed as taking into account ① identifying a subject matter of the claimed invention ② specifying cited invention from the viewpoint of a person skilled in the art on the premise that said cited invention is in the same art field and shares same technical problem with the claimed invention, ③ selecting 「the closest prior art」 to a subject matter of the claimed invention, comparing the both and clarifying commonality and differences, ④ determining whether it is easy for a person skilled in the art to arrive at a subject matter of the claimed invention from 「the closest prior art」 despite such differences in view of other cited inventions, common general knowledge at the time of the filing of the application, experiences,

etc.

(4) A person skilled in the art refers to a hypothetical person who has common general knowledge in the art to which the claimed invention pertains and the ability to use ordinary technical means for research and development(including experiment, analysis, and manufacture); who has the ability to exercise ordinary creativity including design change; and who is abl to comprehend all technical matters regarding the state of the art in the field to which a claimed invention pertains at the time of filing based on his/her own knowledge.

(5) It is a general trial in the AI technology field to simply combine method, means, etc. used in a certain field or apply them to a specific field to achieve prescribed purpose. Therefore, as it falls into the category of ordinary creativity of a person skilled in the art to simply combine technologies used in several fields or apply them to a specific field, if there is no technical difficulty in combination and application (i.e., technical obstacles), inventive step shall not be acknowledged without any outstanding issues, for example, unexpected technical effect, etc.

(6) Such effects as ‘can rapidly process’, ‘can process a large amount of data’, ‘can reduce errors’, ‘can accurately predict’, etc. caused by an AI related invention are often naturally followed by implementation of an AI related invention. Inventive step of a subject matter of the claimed invention shall be determined in consideration that such effects may not be outstanding effect from the viewpoint of a person skilled in the art.

3.2.2 Examples of exercising ordinary creative activity expected of a person having ordinary skill in the art

(1) Simple addition of AI technology disclosed before the filing of the application

If a claim or claims simply describes '~ using AI technology', but a technical feature for implementing said AI related invention(data preprocessing, learning model, etc.) is not specified, it is treated as a simple addition of AI technology as a certain means for solving a problem. Thus, it may fall into the category of ordinary creativity of a person skilled in the art.

(Ex) In a method for providing stock price information utilizing an AI chart that is displayed in a different colors according to AI algorithm, which determines the rise/fall of stock price, as said 'criteria on rise/fall of stock price' and 'displayed in different colors according to AI algorithm' adopted by said 'AI algorithm' are just well known art widely utilized in stock investment or chart analysis area, displaying in different colors according to AI algorithm determining the rise/fall of stock price is within the scope of general creation by a skilled person in the art. Accordingly, it is considered to be a simple implementation of well known art by utilizing AI technology without specifying specific information processing obtained by a trained model to solve a problem by the invention disclosed in the claim. Therefore, the invention of the claim does not have an inventive step (Refer to Patent Court 2013Heo1788).

(2) Simple systemization of works performed by a human being or business methods with disclosed artificial intelligence technologies

Some claimed inventions do not specifically recite how works carried out by a human being or business methods are systemized by means of technical features of artificial intelligence (preprocessing of training data, learning model, etc.) in a certain field, but simply describe that it is implemented with artificial intelligence technology. In the meantime, the cited invention describes how works that are carried out by a human being or business methods are systemized by means of a computer, etc. in such field. In this case, it falls into the category of ordinary creativity of a person skilled in the art to simply systemize works that are carried out by a human being or business methods

with artificial intelligence technology disclosed before the filing of the application instead of a computer, etc.

[Claim] Artificial intelligence (AI) based credit rating system that determines credit rating of loan applicants through an artificial neural network (ANN) on the basis of financial transactions record of loan applicants as input data

[Cited invention] A method of determining the current credit rating of loan applicants by a credit rating system on the basis of financial transactions record

☞ The claimed invention does not specifically recite how the method of determining credit rating of loan applicants is systemized through an artificial neural network(ANN), and the cited invention discloses a business method of determining the current credit rating based on financial transactions record of loan applicants. In this case, it falls into the category of ordinary creativity of a person skilled in the art to simply systemize an ANN disclosed before the filing of the application in replace of a computer, etc. to systemize the method of determining credit rating of loan applicants.

(3) Simple design change resulted from certain application of artificial intelligence technology

As the claimed invention refers to the technical ideas of the cited invention as it is, if difference in a certain means between the claimed invention and the cited one for solving a technical problem is resulted from simple change of a learning model of artificial intelligence disclosed, and any superior effect to predictable one from the cited invention is not recognized, it falls into the category of ordinary creativity of a person skilled in the art unless there are special circumstances.
However as such difference brings different outcomes from the claimed invention, and such effect is recognized as superior one beyond predictable

from the viewpoint of a person skilled in the art, an inventive step is acknowledged.

[Claim] An automatic classification method of documents, comprising steps of receiving a camera captured document image by a computer; inferring a document area by using a convolutional neural network (CNN); classifying documents by title contained in said document area by using a convolutional neural network (CNN)

[Cited invention] A method of automatically classifying documents, comprising steps of reading a document by a computer through a scanner; identifying a document area only; extracting characteristics from said document area by using a recurrent neural network (RNN)

☞ The claimed invention and the cited one are identical in the art field and training data as the both inventions automatically classify documents from document image. The claimed invention selects a convolutional neural network (CNN) as a training model, while the cited one does a recurrent neural network (RNN) as a training model. In this regard, the both inventions are different in the training model. The claimed invention, however, does not specifically provide for a convolutional neural network (CNN), and it falls into the category of simple design change from the viewpoint of a person skilled in the art to replace a recurrent neural network (RNN) with a convolutional neural network (CNN), and the claimed invention does not bring superior effect to predictable one from the cited invention. Therefore, as it is determined that the claimed invention can be easily implemented by a person skilled in the art from the cited invention, an inventive step is not acknowledged.

[Claim] A power prediction system, composed of a data collection unit for collecting weather data and power usage data around a power facility; and a prediction unit for predicting power usage of said power facility through weather data and power usage data collected by said data collection unit

[Cited invention] A prediction system of future power demand by using multiple regression analysis on the basis of a correlation between weather data and power demand data

☞ The claimed invention and the cited one are identical in the art field and input data as the both inventions predict power usage on the basis of weather data and power usage data. The claimed invention applies an artificial neural network (ANN) as a training model, while the cited one applies multiple regression analysis as the same. In this regard, the both inventions are different in the training model. The claimed invention, however, does not specifically provide for an artificial neural network (ANN), and it falls into the category of simple design change from the viewpoint of a person skilled in the art to replace multiple regression analysis with an artificial neural network (ANN) in power usage prediction field, and the claimed invention does not bring superior effect to predictable one from the cited invention. Therefore, as it is determined that the claimed invention can be easily implemented by a person skilled in the art from the cited invention, an inventive step is not acknowledged.

(4) Simple addition of well-known·general means or replacement by equivalent

(Ex) An image data input method to an artificial intelligence training model, comprising binarizing camera image data in an artificial intelligence-based road surface recognition system; and inputting said binarized image data to an artificial intelligence learning model

☞ Where a difference in features between the claimed invention and the cited one is shown in ‘data preprocessing of binarizing camera image data’, as the feature of binarizing color image data is only well-known·

general means for reducing computational quantity, it falls into the category of ordinary creativity of a person skilled in the art.

3.2.3 Notes

3.2.3.1 Subject matter having a characteristics in a technical feature for implementing an artificial intelligence related invention

Where a claim specifically provides for data pre-processing, machine learning method, training completed model, etc. among technical features for implementing an artificial intelligence related invention, and said technical features bring superior effect to predictable one from the cited invention, it does not fall into the category of ordinary creativity of a person skilled in the art.

3.2.3.1.1 Subject matter having a characteristics in data pre-processing

Where a subject matter of the claimed invention specifically provides for ‘data pre-processing’, and said technical feature brings superior effect to predictable one from the cited invention, it does not fall into the category of ordinary creativity of a person skilled in the art.

Specifically providing for ‘data pre-processing’, as mentioned above, means a feature deriving a main characteristic from input data and a feature producing certain standardized (vectoring, normalizing, standardizing) training data, etc. are specifically described.

If a machine learning related invention simply provides for ‘carrying out data pre-processing’, as it is only simple addition of artificial intelligence technology disclosed before the filing of the application, it falls into the category of ordinary creativity of a person skilled in the art.

[Claim] An artificial intelligence based security assurance system, comprising receiving CCTV footage; applying a feature vector of 'motion tracking' as training data; and recognizing an image object by using a CNN training model

[Preconditions] Technology of performing a function of 'motion tracking' analysis based on an image collected by CCTV is presumed not to be disclosed.

[Cited invention] An artificial intelligence based video system, comprising applying CCTV footage as training data; and identifying an image object by using an ANN training model

☞ The claimed invention and the cited one are identical in the art field and a training model (CNN is just one kind of ANN). Data pre-processing of 'motion tracking' in CCTV footage is added to the claimed invention, and thereby improving accuracy for object recognition enough to figure out the motion of the object in video image. As this is determined to be superior effect to predictable one from the cited invention, an inventive step is acknowledged.

[Claim] A system error prediction device, comprising analyzing an event syntax as a regular expression formula for system log data to predict a system error; classifying said event; performing data pre-processing for filtering duplicative events in accordance with a correlation between events; inputting the outcome to an ANN for error prediction; and learning and inferring

[Cited invention] A system error prediction device, comprising analyzing system log data by event; classifying said data; inputting said classified system log data to an ANN for error prediction; and learning and inferring

☞ Where a difference in features between the claimed invention and the cited one is shown in ‘data preprocessing of input data for system error prediction’ and performance improvement in accuracy, reproduction, etc. is expected in learning/inferring outcome by an ANN, it does not fall into the category of ordinary creativity of a person skilled in the art.

3.2.3.1.2 Subject matter having a characteristics in a learning model itself

If a subject matter of the claimed invention specifically provides for ‘a learning model’, and it brings superior effect to predictable one from the cited invention in view of creation speed of said learning model by machine learning, accuracy of prediction in accordance with said created learning model, etc., it does not fall into the category of ordinary creativity of a person skilled in the art.

Specifically providing for ‘a learning model’, as mentioned above, means a feature of a learning environment, verification of a learning model, connection between several learning models, distributed or paralleled processing, a feature of implementing hyper parameter optimization algorithms, etc. are specifically described.

If a machine learning related invention simply provides for ‘carrying out data pre-processing’, as it is only simple addition of artificial intelligence technology disclosed before the filing of the application, it falls into the category of ordinary creativity of a person skilled in the art.

[Claim] A method of optimizing neural network parameter implemented by a neural network computational apparatus, comprising shaping existing parameters of a neural network into size parameters with a single value per channel and sign parameters by using a sign parameter transformer and a size parameter transformer that make up a parameter optimizer unit; generating optimized parameters by pruning said size parameters that are converted as above by using a parameter pruning unit that makes up said parameter optimizer unit;

wherein said parameter pruning unit comprises setting a reference value by multiplying the average value of said size parameters by input and output

channels with a constant by layer reflecting the distribution of size by channel; and omitting said channel's convolution operation by making a size parameter value that is less than the set reference value as 0.

[Cited invention] A neural network acceleration process carried out by a neural network computing apparatus, comprising computing sizes of parameters regarding a connection between a multiple of artificial neurons; setting parameters of said multiple of connections to 0 where sizes of said parameters are less than threshold value; and maintaining parameters of said connection where sizes of said parameters are not less than said threshold value.

☞ The claimed invention and the cited one are identical in a problem to be solved as the both inventions are related to pruning technology for parameters optimization of a deep neural network (DNN). As the claimed invention, however, sets threshold value as the average one of size parameters by input and output channels multiplied by a constant by layer reflecting size distribution by channel, the both inventions are different in threshold value. Also, the claimed invention contributes to the effect of improving computing speed within limited hardware resources, and this is determined to be superior effect to predictable one from the cited invention. Therefore, an inventive step is acknowledged.

3.2.3.2 Subject matter having a characteristics in applications of learning outcomes of artificial intelligence related inventions (output data)

Where a claim specifically provides for applications of learning outcomes of artificial intelligence related inventions (output data), etc., and subsequent effect resulted from the technical features is superior to the one from the cited invention, it does not fall into the category of ordinary creativity of a person skilled in the art.

‘Specifically providing for applications of learning outcomes of artificial intelligence related inventions (output data)’, as mentioned above, means a feature of using outcomes from a learning model (output data), products based

on said outcomes, process based on said outcomes, etc. are specifically described.

If said claim simply relates to 'application of learning outcomes only, as it is only simple design change in accordance with certain application of technology, it falls into the category of ordinary creativity of a person skilled in the art.

[Claim] An automatic repair costs estimation system for an accident vehicle, composed of an input unit for receiving several camera captured images for an accident vehicle; a learning model output unit for detecting at least one part corresponding to a damaged part by inputting said several images to a CNN layer and outputting a damage level of said detected each part; a final projected costs calculation unit for calculating costs by repair type from said output damage level, deriving estimates of changes in user insurance rates, on presumption that costs by said repair type are insurance covered, by referring to an accidents record of a user and providing to a user's terminal with final estimation costs by repair type reflecting prediction of insurance rate changes to costs by repair type; and a repair costs providing unit for transmitting said output damage level and said final estimation costs receiving from said user's terminal to a server of a maintenance plant

[Cited invention] An insurance company's server for outputting a damaged part and a damaged level by part by inputting a car accident video filmed by a customer of an auto-insurance company to a deep learning model

☞ The claimed invention and the cited one are identical in training data and learning model as the both inventions relate to detecting a damaged part by inputting a car accident video to a deep learning model and outputting a damage level. A subject matter of the claimed invention, however, is different from the one of the cited invention in that it relates to a feature providing final estimation costs by repair type to a user's terminal by reflecting prediction of insurance rate changes on account of an accidents record of a user to costs by repair type that are calculated

from a damage level (output data) and transmitting said final estimation costs receiving from said user's terminal to a server of a maintenance plant. A subject matter of the claimed invention brings superior effect to predictable one from the cited invention in that it allows a user to anticipate increases in insurance premiums depending on the type of repair chosen, and thereby promoting convenience of a user. Therefore, an inventive step is acknowledged.

3.2.3.3 Subject matter applied in various industries

An artificial intelligence related invention including a learning completed model may bring different outcomes or effects depending on the industry applied. Where outstanding problems of a certain industry are relieved due to an artificial intelligence related invention or technical difficulties are overcome or superior effect is brought about depending on the industry applied, attention should be given in that novelty and inventive step should not be denied as there is no difference in technical features between the claimed invention and the cited one.

A person skilled in the art should be able to easily identify from an objective evidence or a specific embodiment, etc. described in a description whether superior effect is brought about depending on the industry applied.

3.2.3.4 Subject matter having a characteristics in training data

An artificial intelligence related invention may achieve different performance and output of a learning model depending on training data. If a subject matter of the claimed invention has a characteristics in training data, it is difficult to acknowledge an inventive step only based on a difference in training data between the claimed invention and the cited one, but it is preferable to determine novelty and inventive step on account of whether unique information processing of training data chosen by the claimed invention is specifically described or superior effect is achieved by a difference in training data.

[Claim] An emotion recognition device from a user's conversation, composed of a voice data collection unit for collecting a user's conversation through a mobile device; a characteristics extraction unit for extracting rhythmic data (pitch, size, accent) and speech language data and non-verbal data (sighs, laughter, etc.) from said voice data; and a deep learning training unit for learning a user's emotion using a LSTM model by applying data extracted from said characteristics extraction unit as learning data

[Preconditions] Technology for extracting rhythmic data (pitch, size, accent) and non-verbal data (sighs, laughter, etc.) from voice data as characteristics is presumed not to be disclosed before the filing of the application.

[Cited invention] An apparatus for extracting emotional words only from sentence(s) or document(s) disclosed by a user on SNS and determining a user's emotion through LSTM model by applying said emotional words as learning data

☞ The claimed invention and the cited one are identical in the art field in that the both inventions extract a user's emotional information from input information and use LSTM model as a learning model alike. The claimed invention and the cited one show a difference in a technical feature in that the claimed invention applies rhythmic data and non-verbal data, a characteristics unique to a user's voice data, as training data, while the cited invention applies emotional word text recognized from a text message as learning data. Further, as the claimed invention causes the effect of improving emotion recognition by learning the characteristics of voice data and said effect is determined to be superior to predictable one from the cited invention, an inventive step is acknowledged.

[Claim] An automatic identification apparatus for tomato's marketability, composed of an input unit for receiving a tomato's video clip; a maturity

discriminator for outputting classification value of a tomato's maturity respectively by inputting a tomato's hue, chroma and shape information extracted from said tomato's video clip to a deep learning model; and a marketability evaluation unit for finally classifying marketability of a tomato by putting each of said maturity classification values together

[Cited invention 1] A classification apparatus of strawberries' maturity by inputting hue and chroma data of strawberries computed from strawberries captured images to deep learning models and combining each of output values

[Cited invention 2] A classification method of tomatoes' marketability by a computer, comprising extracting shape information from tomato's video clip based on tomato's edge and classifying marketability by grade of flatness, dimorphism and deformity

☞ The claimed invention and cited invention 1 are identical in the art field and the learning model in that the both inventions determine produces' qualities by using deep learning models from image data of produces. As the claimed invention applies hue, chroma and shape data as training data and cited invention 1 does hue and chroma data as the same, the both inventions are different in whether shape image is used as training data, but cited invention 2 discloses a feature of classifying tomatoes' marketability by using shape data. Also it is determined that a person skilled in the art may easily arrive at combination between features of claims 1 and 2 through claim 1 in view of technology level as filed and there is no outstanding difference in the effects. Therefore, as the claimed invention can be easily implemented by a person skilled in the art in combination between cited inventions 1 and 2, it is determined that an inventive step is not acknowledged.

4. Examination cases

Examination cases regarding machine learning based AI related inventions are explained in this Chapter. A machine learning based AI related invention refers to a computer · software related invention having a characteristics in implementing certain functions through AI training and is categorized into an AI learning modeling invention and an AI application invention.

An AI learning modeling invention is the one having a characteristics in generating a learned model based on training data(raw data collected for training) and a learning model(training method, such as training algorithm and/or data pre-processing, included). For example, an acceleration method of computation by a learning model, data regularization method, learning model creation method, etc. can be referred to.

An AI application invention is the one having a characteristics in performing a certain function by applying training data and/or trained model to resolve a problem of a subject matter of the claimed invention in several technical fields (determined by 「device(hardware)」 implementing steps in accordance with the purpose of use). For example, AI autonomous robot, AI medical device or BM invention relying on AI can be referred to.

[Note]

Examination cases introduced in this Chapter are processed and edited in a concise manner regarding a claim or claims, a description, drawing(s), etc. to explain cases for assessment of patentability requirements. Also well-known/general art and cited invention applied to cases for assessment of inventive step are processed and edited for explaining cases for assessment thereof, and they may be different from the ones applied in actual inventive step assessment.

○ **Cases 1-5**

Title of the Invention	Patentability Requirements		Determination
1. An automatic control system of a house's temperature based on machine learning	§42(3)(1)		X
	§42(4)(1)		X
2. An urban traffic speed prediction system	§29(2)		O
3. A control method of a robot vacuum cleaner	§29(2)	[Claim 1]	X
		[Claim 2]	O
4. A real-time welding quality inspection device	§29(2)		X
5. A bone age reader based on machine learning algorithm	§29(2)	[Claim 1]	X
		[Claim 2]	O

1. Case 1

TITLE OF THE INVENTION

An automatic control system of a house's temperature based on machine learning

[Embodiment requirement]

1. The description of the invention just recites training data, but does not specifically define the correlation between input data and output data of a trained model, and it may be hard for a person skilled in the art to assume (understand) the correlation through an embodiment described in the description of the invention or in view of common general technical knowledge as of the filing. It is determined, thus, the embodiment requirement is not satisfied.

[Insufficient description of the invention]

2. The description of the invention does neither describe a specific feature corresponding to the claim nor be extended to the whole scope of claims nor be generalized in view of common general technical knowledge. It is determined, thus, the claim is not be supported by the description of the invention.

<Premise>

1. It is premised that there is no correlation between data on a building's temperature control and fine dust concentration amongst outside environmental information.

Claim 1:

An automatic temperature control system for a house based on a machine learning algorithm comprising:

a storing unit for storing historical records of daily weather information and information on temperature control for a house;

a learning model generation unit for generating a machine learning model using at least one or more daily weather information among the stored

temperature, humidity, wind speed, cloud amount, fine mist concentration and the temperature control information for a house as training data;

a collection unit for collecting at least one or more current weather information among temperature, humidity, wind amount, fine dust concentration information from a server of Korea Meteorological Administration; and

an output unit for outputting information on the automatic temperature control of a house that is predicted from the current weather information input in the said collection unit, by using the machine learning model generated in accordance with the said learning model generation unit.

Overview of the description

The purpose is to automatically control a house's temperature by using the correlation between weather information and a house's temperature.

The present disclosure gives rise to the effect of reducing a house's energy consumption cost, comprising using a house's temperature control information and daily weather information collected from a server of Korea Meteorological Administration and outputting a house's automatic temperature control information by using a machine learning model.

Daily weather information, such as temperature, humidity, wind speed, wind amount, fine dust concentration information, etc., collected from a server of Korea Meteorological Administration is contained.

According to the house's autonomous temperature control system described in the present disclosure, the storing unit stores historial records of daily weather information and a house's temperature control information and the learning model generation unit generates a machine learning model using a house's temperature control information and daily weather information stored in the said storing unit as a training dataset.

The machine learning model of the present disclosure may use an artificial neural network (ANN) as a disclosed machine learning model. The collection unit collects current weather information from a server of Korea Meteorological Administration and the output unit outputs a house's automatic temperature control information predicted from the current weather information input in the said collection unit, by using a learning model in accordance with the said

learning model generation unit.

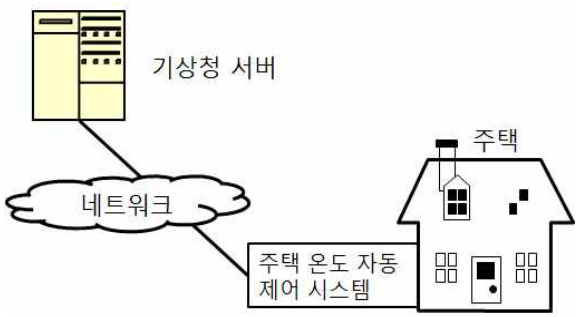
According to an embodiment, the house's automatic temperature control system compares temperature data amongst the current weather information collected from a server of Korea Meteorological Administration with temperature data amongst historical records of daily weather information, but outputs a house's temperature control information predicted from the current weather information data based on the machine learning model.

<*Hereinafter omitted*>

According to a specific embodiment, the house's automatic temperature control system compares humidity data amongst the current weather information collected from a server of Korea Meteorological Administration with humidity data amongst historical records of daily weather information, but outputs a house's temperature control information predicted from the current humidity data based on the machine learning model.

<*Hereinafter omitted*>

[Figure]



Conclusion

1. It is determined that the description of the invention would have been described clearly or in detail so as for a person skilled in the art to easily embody the invention of claim 1 in view of common general technical

knowledge as of the filing.

2. It is determined that the invention of claim 1 is not be supported by the description of the invention.

Reason for the determination (Article 42(3)(i))

The description of the invention describes the correlation between some input data, such as temperature and humidity information, and output data of a trained model, such as information on a house's automatic temperature control, but does not describe the correlation between other input data, such as wind speed, wind amount and fine dust concentration information, and output data of the trained model.

Also, the description of the invention describes an embodiment regarding some input data, such as temperature and humidity information, but does not describe an embodiment regarding other input data, such as wind speed, wind amount, fine dust concentration information.

If the correlation between input data and output data of the trained model is not specifically described, it cannot be considered that the description of the invention is clearly and in detail described so as for a person skilled in the art to easily implement information processing by using a technical correlation, provided, however, that if a person skilled in the art can assume (understand) the correlation through an embodiment as described in the description of the invention or in view of common general technical knowledge as of the filing, it is not the case.

Since a person skilled in the art can assume (understand) the correlation through an embodiment as described in the description of the invention or in view of common general technical knowledge as of the filing, even if the description of the invention does not specifically describe the correlation between weather information, such as temperature, humidity, wind speed and wind amount, amongst training data, and a house's temperature control information, there is no difficulty in working the invention.

Since the description of the invention does not, however, specifically describe the correlation between fine dust concentration data and a house's automatic temperature control information, it is not obvious to a person skilled in the art

that there is the correlation between fine dust data and a house's automatic temperature control information in view of common general technical knowledge as of the filing.

Also, since the description of the invention does not suggest an embodiment (experimental case) for automatically controlling a house's temperature to get a person skilled in the art to obtain proper temperature control information from the trained model only based on fine dust concentration information, it is not considered that the description of the invention satisfies the embodiment requirement.

Accordingly, it is determined that the description of the invention is not clearly and in detail described so as for a person skilled in the art to easily carry out the invention in view of common general technical knowledge and based on the specification and brief description of the drawing(s).

Proposal for amendment

If an amendment together with a written argument does not support the「correlation between fine dust concentration data and a building's temperature control data or the effect of reducing energy consumption cost by automatically controlling a house' temperature through machine learning based on fine dust concentration information」, the objection cannot be overcome.

If「an embodiment for supporting the effect of reducing energy consumption cost by automatically controlling a house' temperature through machine learning based on fine dust concentration information」is added to the amendment, attention should be paid that it can be considered as addition of a new matter.

For a reference, the patent applicant can consider a measure for overcoming the objection by deleting find dust concentration information amongst weather information that is used in a machine learning model from an amendment.

Reason for the determination (Article 42(4)(i))

The invention of claim 1 describes a learning model generation unit for generating a machine learning model using weather information (temperature, humidity, wind speed, wind amount and fine dust concentration information) and a house's temperature control information as learning data as a characteristic

feature.

The description of the invention, however, does only describe a learning model generation unit using temperature and humidity information as learning data as a specific feature corresponding to the said learning model generation unit, but does not describe the learning model generation unit using fine dust concentration information as training data. Further, it is not obvious to a person skilled in the art even as considering common general technical knowledge as of the filing.

Accordingly, the description of the invention does describe neither a specific feature corresponding to the invention of claim 1 nor be extended to the whole scope of claims (weather information including fine dust information) nor be generalized in view of common general technical knowledge.

It is determined, thus, the invention of claim 1 cannot be supported by the description of the invention.

2. Case 2

TITLE OF THE INVENTION

An urban traffic speed prediction system

1. The invention of claim 1 is identical with the cited invention 1 in the technology field and the trained data. Since, however, there is a difference in the trained model, but the invention of claim 1 involves an advantageous effect over the cited invention 1, it is determined that the invention of claim 1 involves an inventive step.

Claim 1:

An urban traffic speed prediction system comprising:

an information extraction unit for extracting historical records with respect to geographic information, weather information, construction information and the changes in traffic volume by time of day;

a learning model unit for implementing an artificial neural network (ANN) training algorithm to find out the functional relationship between the road pattern and an average speed by section after a road pattern is generated in accordance with the extracted historical records;

a traffic prediction unit (TPU) for predicting average speed by section by using the local ANN corresponding to the member cluster of an input pattern vector for prediction;

wherein the said learning model unit comprises an input pattern vector generation unit for generating an input pattern vector by combining the extracted historical records and detection information for the road concerned; a data partitioning unit for estimating a lattice-structured cluster by clustering data with similar patterns by applying clustering to the dataset of the input pattern vector and generating the estimated cluster boundary; an ANN learning unit for separately implementing an ANN learning to the input pattern vector within each of the said estimated cluster generated in the data partitioning unit; and

a model structure database (DB) for storing the estimated cluster boundary that is generated in the said data partitioning unit and the said learned ANN in the input pattern vector within each of the said estimated

clusters in the said ANN learning unit.

OVERVIEW OF THE DESCRIPTION

Problem to be solved

The purpose is to provide an urban traffic speed prediction system that additionally considers environment variables affecting traffic congestion and detection variables of an intelligent traffic system (ITS) to exactly predict road traffic speed.

Means for solving the problem

The invention of claim 1 comprises an information extraction unit for extracting historical records with respect to geographic information, weather information, construction information and the changes in traffic volume by time of day that are provided by an intelligent traffic system (ITS), a geographic information system and a weather information system, a learning model unit for implementing an artificial neural network (ANN) training algorithm to find out the functional relationship between the road pattern and an average speed by section after a road pattern is generated in accordance with the extracted historical records after generating an input pattern vector by standardizing data values in accordance with historical records extracted from the information extraction unit and a traffic prediction unit for predicting an average speed by section by using a local ANN corresponding to the member cluster of an input pattern vector for prediction through the same pre-processing with the said learning model unit.

The learning model unit comprises an input pattern vector generation unit for generating an input pattern vector by combining with detection information of the road concerned through standardization of data values in accordance with historical records extracted from the information extraction unit, a data partitioning unit for estimating a lattice-structured cluster by clustering data with similar patterns by applying clustering to the data set of the input pattern vector and generating the estimated cluster boundary, an ANN learning unit for separately implementing an ANN learning to the input pattern vector within

each of the said estimated cluster generated in the data partitioning unit and a model structure database (DB) for storing the estimated cluster boundary that is generated in the said data partitioning unit and the said learned ANN in the input pattern vector within each of the said estimated clusters in the said ANN learning unit.

Training data are clustered by time for each road and by similarity characteristic for each road. In this case, if each ANN training is implemented for data as a whole and the result is used for prediction, high-quality predictive performance may not be expected. This is because the different characteristics of each cluster are standardized, with they being treated as mean square errors. Of course, even if the pattern of cluster of data sets may be closely reflected by adjusting the parameters, it may cause an over-fitting problem.

Accordingly, the present disclosure implements ANN learning separately to an input pattern vector within each of the generated cluster. The range of the generated cluster and the trained ANN are each stored in a model structure database (DB).

As the next step, traffic speed by section is predicted by utilizing a local ANN corresponding to the member cluster of an input pattern vector for prediction that is identified through the same pre-processing with the said pre-processing. In the prediction process, an input pattern vector for prediction is generated through the same pre-processing for new data and the member cluster of the said generated input pattern vector for prediction is identified. And then an average speed by section is predicted by using a local ANN corresponding to the member cluster of the said identified member cluster.

A specific training method for predicting an average speed by section based on a local ANN is described hereafter.

[Figures]

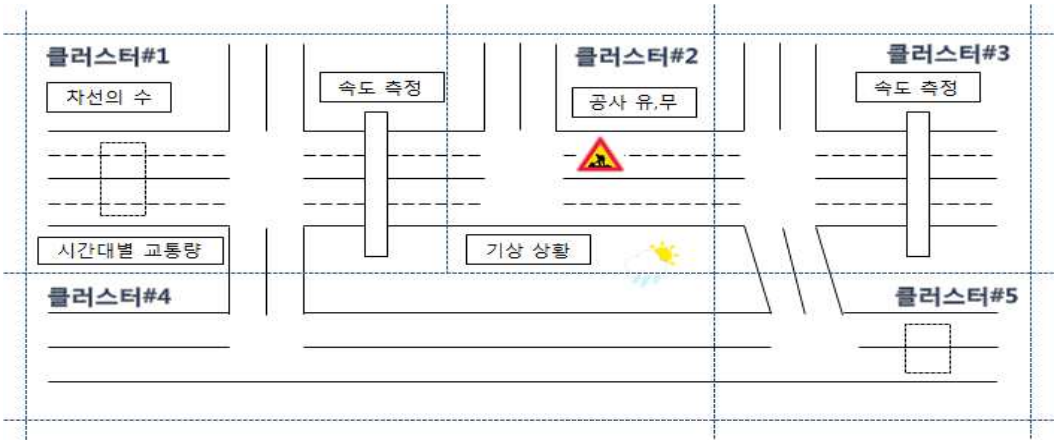


FIG. 1: Concept of clustering in accordance with an embodiment

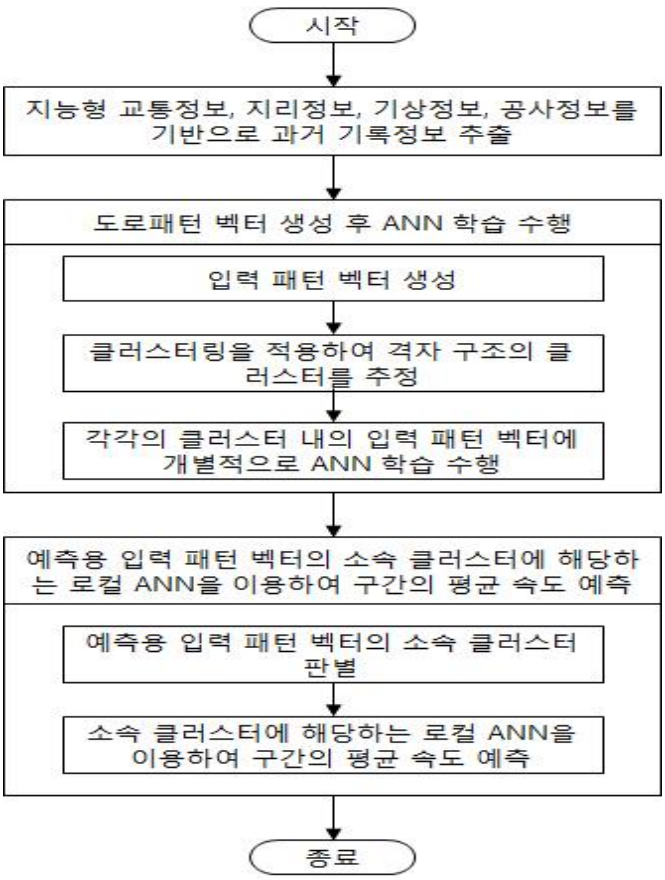


FIG. 2: Operation method of an urban traffic speed prediction system

Common general technical knowledge as of the filing

An artificial neuron network (ANN) and multi-layer perceptron (MLP) are substantially the same each other, only different in the expression of the terms.

State of the art (Prior art, well-known art, etc.)

The cited invention relates to a traffic prediction method on the basis of multi-layer perceptron (MLP) for predicting congestion of the downtown areas of the city by relying on a neural network, as taking into account time-related factors affecting congestion, i.e., day information, time information, precipitation, share, traffic volume, incoming and outgoing traffic of the lanes, the number of intersections·crosswalks, bus stop information, construction information, etc., in heavy traffic downtown area and various factors depending on the environment of a road section.

The cited invention relates to a multi-layer perceptron structure. It selects various factors affecting traffic congestion as input variables for predicting an average speed by hour and do traffic volume as output variables. Input data, including at least one among day characteristic, time characteristic, traffic volume, share, construction area and precipitation, are collected and pre-processing is implemented on the basis of the collected data. Training and training completion conditions are determined for the pre-processed data. The pre-processing step is implemented for deleting unnecessary information and for standardizing input variables related to traffic volume before neural network algorithms are constructed. Initial synapses of multi-layer perceptron are randomly set and the final synapses are confirmed in accordance with back propagation algorithm and then used for training.

Conclusion

It can be determined, thus, the invention of claim 1 involves an inventive step over the cited invention.

REASON FOR THE DETERMINATION

Common feature

The invention of claim 1 and the cited invention substantially have the same purpose of predicting traffic information in downtown area on the basis of information related to conditions of roads. The both inventions substantially have the same training data including traffic volume information by time, geographic information, weather information and construction information used in the machine training for predicting traffic information.

Difference

The invention of claim 1 is different from the cited invention in a learning model (processing of training data and layout of artificial neural network system), especially in that it clusters data with similar patterns by applying clustering to training data and predicts an average speed by section by implementing a local ANN training separately to an input pattern vector within each of the clusters.

Determination for the difference

The cited invention discloses a prediction method of traffic volume by using a learning model based on multi-layer perceptron (MLP), but does not describe the feature of training a local artificial neural network (ANN) corresponding to each of the clusters or of clustering input pattern data.

It is determined that a person skilled in the art may not easily arrive at the feature of training a local ANN corresponding to each of the clusters by clustering input patter data that is disclosed in the invention of claim 1, starting from the features of standardizing input values and of implementing pre-processing for deleting unnecessary information, as specified in the cited invention.

In view of the working effect, it is recognized that the invention of claim 1 can more exactly predict an average speed of a certain section through a local ANN algorithm corresponding to the member cluster.

Therefore, since it is determined that a person skilled in the art may not easily arrive at the invention of claim 1 from the cited invention, it is concluded that the invention of claim 1 involves an inventive step over the cited invention.

3. Case 3

TITLE OF THE INVENTION

A control method of a robot vacuum cleaner

1. Where the claimed invention is identical with the cited invention in the technology field and the training data, but the difference in the learning models corresponds to a simple design modification by a person skilled in the art, it is determined that the claimed invention does not involve an inventive step
2. Where there is a difference in a specific feature besides training data and a learning model, and the claimed invention has an advantageous effect over the cited invention, it is determined that the claimed invention involves an inventive step

WHAT IS CLAIMED IS:

Claim 1:

A control method of a robot vacuum cleaner comprising:

a step in which the said robot vacuum cleaner drives each area and collects surrounding images;

a step in which the said collected surrounding images and an area identifier that is corresponding to the said collected surrounding images are set and training data thereof are generated;

a step in which a convolutional neural network (CNN) is trained by using the said training data;

a step in which cleaning motion of the said robot vacuum cleaner is activated;

a step in which the said robot vacuum cleaner acquires surrounding images at the present location;

a step in which an area identifier of the present location is assumed by reading surrounding images acquired at the said present location in the said

trained CNN; and

a step in which driving paths of the said robot vacuum cleaner are reset on the basis of the assumed area identifier of the said present location.

Claim 2:

The control method of a robot vacuum cleaner described in claim 1 further contains:

prior to the step where cleaning motion of the said robot vacuum cleaner is activated,

a step where a cleaning area where the said robot vacuum cleaner performs cleaning and a charging area where a battery charger of the said robot vacuum is located are designated by using the said area identifier.

The step where the said driving path is reset, as described in claim 1, further contains:

a step where the said robot vacuum cleaner measures the current battery remaining volume;

a step where if the said battery remaining volume are below the threshold, the driving path is reset to the said battery charging area; and

a step where if the said battery remaining volume exceeds the said threshold, the driving path is reset to get the said robot vacuum cleaner to move to the said battery charging area passing the said cleaning area on the basis of the said cleaning area and average battery consumption data by cleaning area.

OVERVIEW OF THE DESCRIPTION

Problem to be solved

The purpose is to provide a control method of a robot vacuum cleaner performing cleaning and the “return to charge” (RTC) by making the robot vacuum cleaner clearly figure out the present location through a computer vision technology and compute an efficient path for cleaning and the return path to a battery charger through the reset of the driving path based on the

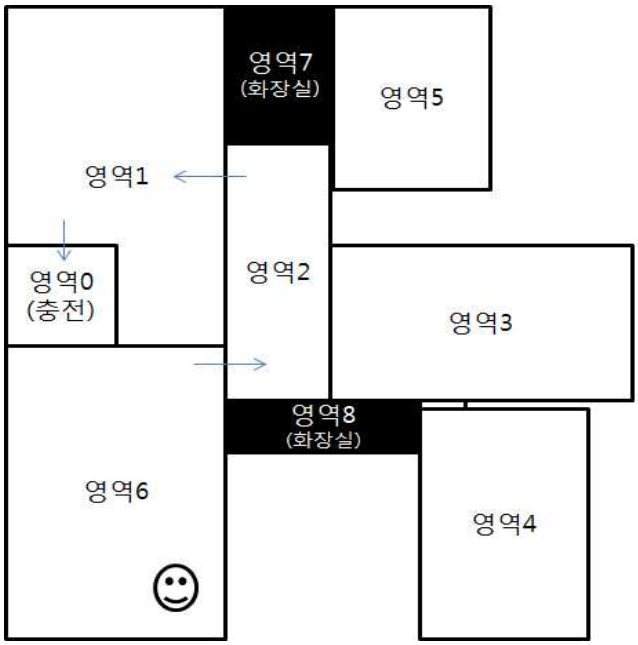
present location.

Means for solving the problem

In the learning step, a robot vacuum cleaner drives all the cleaning areas and collects surrounding images separately for each area. Training data, however, are collected by adding an area identifier to the collected images at each area. A convolutional neural network within the robot vacuum cleaner are trained by utilizing the collected training data. A specific training method of image data through the convolutional neural network is to be described hereafter. Also, a user can designate both a cleaning area where the said robot vacuum cleaner performs cleaning and a battery charging area where a battery charger of the said robot vacuum is located by using the said cleaning area identifier. A robot vacuum cleaner for which the training for the convolutional neural network is completed for recognizing a cleaning area is charged at the battery charger and waits for activation of the cleaning function based on the user's cleaning command or schedule. If the robot cleaner receives the user's cleaning command or the cleaning function is activated in accordance with schedule, it collects surrounding images at the present location. The robot vacuum cleaner computes a presumed identifier for a cleaning area by reading the input images in a deep-learning model. The robot cleaner resets the driving path by using the presumed cleaning area identifier as the starting point.

The step where the driving path is reset may include a feature for resetting the driving path to the said battery charging area if the battery remaining volume is below the threshold based on the measurement of the battery remaining volume. Also, if the battery remaining volume of the robot cleaner exceeds the threshold, a feature for resetting the driving path to get the robot cleaner to move to the said charging area passing the cleaning area, based on the cleaning area and average battery consumption data by cleaning area.

[Figure]



영역 식별자	청소대상	충전기
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2	1	0
3	1	0
4	1	0
5	1	0
6	1	0
7	0	0
8	0	0
9	1	0

현위치	6
배터리잔량	15%
청소이동경로	6, 2, 1, 0

Common general technical knowledge as of the filing

Selective application of artificial neural networks (ANNs), convolutional neural networks (CNNs) and recurrent neural networks (RNNs) is merely design modification for a person skilled in the art, as applying a machine learning model.

Cited invention

A driving control method of an automatically driving vacuum cleaner using an artificial neural network comprising:

a cell image collection step in which a certain area around a vacuum cleaner is divided into multiple cells and image information by the said cell is generated by collecting image data through photographing;

an intelligent neural network training step in which the image information for each cell of the above cells is divided into cleanable, non-cleaning areas and training data are generated by numbering each cell and an artificial neural network is trained by using the said generated training data;

a step in which the said vacuum cleaner photographs the present

location and inputs the image information to the said trained artificial neural network through the said artificial neural network training step;

a step in which the cell number of the present location is identified through the said trained artificial neural network; and

a vacuum cleaner driving step in which the vacuum cleaner drives along a certain path arranged by sequential listing of the cell numbers specified as the cleaning area, with the cell number of the above present location as the starting point.

Conclusion

1. It is determined that the invention of claim 1 does not involve an inventive step over the cited invention.
2. It is determined that the invention of claim 2 involves an inventive step over the cited invention.

REASON FOR THE DETERMINATION – INVENTION OF CLAIM 1

Common features

The invention of claim 1 and the cited invention have an identical purpose in that a robot vacuum cleaner identifies, by itself, an information of the present location through a machine learning model on the basis of visual information collection and is controlled for the driving on the basis of it.

Also, the invention of claim 1 and the cited invention are identical in a feature of generating training data for dividing areas by collecting the visual information (picture or image) of the said divided area after dividing surrounding areas of the vacuum cleaner into several areas and in a feature where training data are trained through a machine learning model on the basis of the artificial neural network, visual information of the present location is input to the said learned machine learning model, the information of the current area is derived, cleaning areas are recognized and the vacuum cleaner’s driving is set by using it.

Differences

The invention of claim 1 selects a convolutional neural network (CNN) as a learning model, whereas the cited invention does an artificial neural network (ANN) as the same. Accordingly, the both inventions are different in learning models.

Determination for the differences

The invention of claim 1 selects a convolutional neural network (CNN) as a learning model, whereas the cited invention does an artificial neural network (ANN) as the same. Accordingly, the both inventions are different in learning models. Even if the description of the invention is referred to, however, it does not specifically define a convolutional neural network (CNN) as described in claim 1. Further, in an image recognition technology field, it is a mere design modification for a person skilled in the art in accordance with a specific application to simply replace an artificial neural network (ANN) with a convolutional neural network (CNN).

Also, it cannot be considered that the invention of claim 1 has an advantageous working effect over the cited invention.

Therefore, since it is determined that the invention of claim 1 is easily embodied by a person skilled in the art from the cited invention, it is concluded, thus, that the invention of claim 1 does not involve an inventive step.

REASON FOR THE DETERMINATION – INVENTION OF CLAIM 2

Common features

Common features are already described in the aforementioned reason for the determination – Invention of claim 1.

Difference

The invention of claim 2 is different from the cited invention in that it discloses a specific feature where the driving path of the robot vacuum cleaner is reset by taking the output data of the learned convolutional neural network

learning model as the landmark position and taking into account the current remaining battery volume data of the robot vacuum cleaner.

Determination for the difference

The cited invention discloses a feature of setting the driving path of a robot vacuum cleaner on the basis of the output data of a neural network learning model but does not disclose a feature of taking the output data of the learned convolutional neural network learning model as the landmark position and taking into account the current remaining battery volume data of the robot vacuum cleaner for resetting the driving path of the robot vacuum cleaner, as described in the invention of claim 2.

Also, it is determined that the invention of claim 2 has an advantageous effect over the cited invention in that a robot vacuum cleaner recognizes the present location through the learned convolutional neural network and resets the driving path on the basis of the current remaining battery volume, and thereby preventing a robot vacuum cleaner from returning to a battery charging area.

Therefore, since it is determined that the invention of claim 2 cannot be easily embodied by a person skilled in the art from the cited invention, it is concluded, thus, that the invention of claim 1 involves an inventive step.

4. Case 4

TITLE OF THE INVENTION

A real-time welding quality inspection device

The claimed invention and the cited inventions are identical in the technology field and the learning model, but the claimed invention and the cited invention 1 are different in the learning data. However, in the cited invention 2, the corresponding feature is disclosed, and there are no difficulty in the combination and no difference in the working effect.
In this case, it is determined that the claimed invention does not involve an inventive step.

Claim 1:

A real-time welding quality inspection device comprising:

an image signal acquisition unit in which a laser is irradiated on the surface of a welded bead by a welder and the reflected light from the surface of the said welded bead is acquired as an image signal;

a welding quality assessment unit where the weld bead geometry from the said acquired image signal is measured, characteristic data are extracted from the said weld bead geometry and welding defects are determined through a machine learning model;

wherein if it is determined that welding is normal without any defects, the said welding quality assessment unit outputs a position movement control signal to the welder to get it to move to the next point for the subsequent welding process; or otherwise

if it is determined that welding is abnormal with defects, the said welding quality assessment unit outputs a welding stop control signal to the welder;

the said characteristic data contain at least one among the width between the said welded bead's valley and hill, the valley angle of the said welded bead and the valley’s curvature of the said welded bead; and

the said machine learning model is trained with the said characteristic data and the welding defects assessment value corresponding to the said characteristic data as training data.

OVERVIEW OF THE DESCRIPTION

Problem to be solved

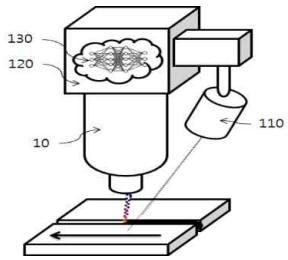
The purpose is to provide a real-time welding quality inspection device used for managing quality process of welding in such a way of uniformly conducting a welded bead quality inspection in real time and stopping welding process right away if any defects are detected.

Means for solving the problem

If a welder (10) implements welding, an image signal acquisition unit (110) irradiates a patterned laser on the surface of a welded bead and acquires the reflected light from the surface of the said welded bead as an image signal and transmits the acquired image signal to a welding quality assessment unit (120). The welding quality assessment unit (120) measures the welded bead geometry from the said acquired image signal for reading the bead quality and extracts characteristic data from the welded bead geometry, input the extracted characteristic data to a machine learning model within the welding quality assessment unit and carries out the quality assessment process through the machine learning model. If it is determined that welding is normal without any defects, the welding quality assessment unit (120) outputs a position movement control signal to the welder (10) to get the welder (10) to move to the next point for the subsequent welding process. In the meantime, if it is determined that welding is abnormal with defects, the said welding quality assessment unit (120) outputs a welding stop control signal to the welder (10).

Characteristic data input in the machine learning model (130) within the welding quality assessment unit contain at least one among the width between the said welded bead's valley and hill, the valley angle of the said welded bead and the valley’s curvature of the said welded bead, and the machine learning model within the welding quality assessment unit is trained with the said characteristic data and the welding defects assessment value corresponding to the said characteristic data as training data. The machine learning model (130) can use an artificial neural network and can also be implemented in a knife-edge scanning or support vector machine.

[Figure]



Cited invention 1

A measuring process of a welded bead using a welding carriage where a laser diode (LD) for irradiating laser beam, a laser vision system including a camera equipped on the surface of the said laser diode (LD) and a welding torch unit are each mounted, comprising:

a welding initiation step where the said welding torch unit starts welding processes;

a welded bead measuring step where the said laser vision system irradiates laser beam of the said laser diode (LD) on the welded bean on the surface of weld member and an weld bead image is acquired by capturing the laser beam reflected from the said welded bead with the said camera;

a welded bead abnormality assessment step where the said laser vision system derives a characteristic value from the said welded bead image, the said derived characteristic value is input in the trained artificial neural network by using a characteristic value of a normally welded bead image and an abnormal one and the said trained artificial neural network determines welding abnormality;

wherein a welding stopping step is contained for stopping the welding process of the said welding torch unit, if the said laser vision system detects weld defects in the said welded bead defects assessment step; and

the characteristic value derived from the said welded bead image is at least one among the shape and the color of a welded bead image.

Cited invention 2

Cited invention 2 relates to a welding quality assessment method based on a

welded part image in the welding process, suggesting a height difference between basic materials for welding, a valley depth of a welded bead, a hill height of a welded bead, the width between a welded bead's valley and hill, the valley angle of a welded bead, the valley's curvature of a welded bead, the width of a key hole, etc. as measurement data for concisely assessing the welding quality. A mock experiment for inspecting welding defects specifically suggests an experimental case comparing welding quality assessment values based on welding quality assessment data extracted from the welded bead image with really measured welding quality assessment values.

Conclusion

It is determined that the invention of claim 1 does not involve an inventive step over the combination between cited inventions 1 and 2.

REASON FOR THE DETERMINATION

Common features

The invention of claim 1 and cited invention 1 have the same purpose in that welding defects are determined in real time by using a machine learning model and welding process is stopped as defects are detected to improve quality of welding production process.

The invention of claim 1 and cited invention 2 are substantially identical in measuring data for determining welding defects.

Also, the invention of claim 1 and cited invention 1 are identical in that the welded bead feature is measured from a laser image signal reflected from the surface of the welded bead and the feature data are extracted and a machine learning model learns the feature data and welding defects assessment values corresponding to the feature data as learning data.

Difference

According to the invention of claim 1, learning data used in a machine learning model are data containing one or more amongst the width between a welded bead's valley and hill, the valley angle of a welded bead and the

valley’s curvature of a welded bead. Meanwhile, cited invention 1 limits learning data to shape or color of a welded bead image. In this sense, the both inventions are different in learning data.

Determination for the difference

Cited invention 1 limits learning data to shape or color of a welded bead image. In the meantime, according to the invention of claim 1, learning data refer to feature data containing one or more amongst the width between a welded bead's valley and hill, the valley angle of a welded bead and the valley’s curvature of a welded bead. In this sense, the both inventions are different from each other.

The invention of claim 1 and cited invention 2 in the same technological field, however, suggest a height difference between basic materials for welding, a valley depth of a welded bead, a hill height of a welded bead, the width between a welded bead's valley and hill, the valley angle of a welded bead, the valley’s curvature of a welded bead, the width of a key hole, etc. as measurement data for concisely assessing welding quality in a mock experiment for inspecting welding defects.

Also, it is determined that a person skilled in the art may neither face any difficulty in combining a feature of cited invention 2 to citied invention 1 through an implication of cited invention 1 in view of the technological level as of the filing nor is a noticeable difference in the working effect.

Accordingly, the invention of claim 1 can be implemented by a person skilled in the art through the combination of cited inventions 1 and 2. It is, thus, determined that the invention of claim 1 does not involve an inventive step.

5. Case 5

TITLE OF THE INVENTION

A bone age reader based on machine learning algorithm

1. The claimed invention and the cited inventions are identical in the technology field and the training data, but different in learning models between the claimed invention and cited invention 1. However, in the cited invention 2, the corresponding feature is disclosed, and there is no difference in the working effect. In this case, it is determined that the claimed invention does not involve an inventive step.
2. The claimed invention and the cited inventions are identical in the technological field and the training data, but a learning model of the claimed invention is different from the one of cited invention 1, and the difference is neither disclosed nor implicated in cited invention 2. Further, the working effect of the claimed invention is different from the one of the cited inventions. In this case, it is determined that the claimed invention involves an inventive step.

WHAT IS CLAIMED IS:

Claim 1:

A bone age reader comprising:

a bone image input unit for inputting a hand bone (手骨) image;

a region of interest (ROI) extraction unit for extracting a plurality of regions of interest from the input hand bone (手骨) image;

a bone grade classification unit for classifying a bone grade by applying a convolutional neural network (CNN) to an image of the said extracted regions of interest each; and

a bone age reading unit for reading a bone age by using the classified bone grade by the bone grade classification unit.

Claim 2:

A bone age reading method by a bone age reader comprising:

a step in which a bone image input unit inputs a hand bone (手骨) image;

a step in which a region of interest (ROI) extraction unit extracts a plurality of regions of primary interest from the input hand bone image;

a step in which the region of interest extraction unit extracts a plurality of regions of secondary interest from the said extracted region of primary interest;

a step in which a bone grade classification unit classifies a bone grade by applying a convolutional neural network (CNN) to the said extracted regions of secondary interest each;

a step in which a bone age reading unit reads the bone age by using the bone grade of the said classified region of secondary interest;

wherein the said region of secondary interest extraction step further comprising:

an extraction step for extracting a feature map through the convolutional neural network from the input region of primary interest; and

an extraction step for extracting the said plurality of regions of secondary interest from the said plurality of regions of primary interest based on a predictable score.

wherein the computation of the predictable score comprising:

a step in which a feature vector is generated by implementing the computation of each location by applying the sliding window method to the said feature map; and

a step in which a predictable score is computed for the location and the size of a candidate region and a candidate region on the regions of secondary interest by using the generated feature vector.

OVERVIEW OF THE DESCRIPTION

Description of the Related Art

Hand bone age reading helps to confirm whether a young child is normally developed by comparing a bone age with a physical age through reading his/her x-ray image and to predict how much more he or she can grow in the

future.

SUMMARY OF THE INVENTION

Problem to be solved

Correct and reliable bone age reading is implemented by using image processing based on a machine learning algorithm for a hand bone image.

Means for solving the problem

A bone age reader can output by reading a bone age through machine learning with an input image including a human being's hand bone (手骨). A bone age reader comprises a bone image input unit for inputting a hand bone (手骨) image; a region of interest (ROI) extraction unit for extracting a plurality of regions of interest from the input hand bone (手骨) image; a bone grade classification unit for classifying the bone grade by applying a convolutional neural network (CNN) to an image of the said extracted regions of interest each and a bone age reading unit for reading a bone age by using the classified bone grade by the bone grade classification unit.

A bone image input unit is input with an image including a human being's hand bones or inputs the human being's hand bones by capturing a human being's hand bones. A region of interest (ROI) extraction unit extracts a plurality of regions of interest from the input hand bones image.

The said region of interest includes the ones of the wrist, a thumb, a middle finger and a ring finger. Specifically the ROI of the wrist sets the two X coordinates closest to the center of the wrist to the left and right boundaries and extracts the region of interest in the wrist using the upper and lower boundary of the wrist and the left and right contours of the wrist; for example, the convex hull method may be utilized.

When it comes to the region of interest in the finger, the bone image using a feature point of a finger tip portion and a bone feature point between fingers is rotated; the upper and lower boundaries are set by using the feature point of the finger tip and the center point of the hand; the bone features on both sides of the finger are set to the left and right boundaries, and thereby the

regions of interest of a thumb, a middle finger and a ring finger are extracted.

According to an embodiment of the present disclosure, a bone age reading method by a bone age reader comprises a step where a bone image input unit inputs a hand bone (手骨) image; a step where a region of interest extraction unit extracts a plurality of regions of primary interest from the input hand bone image; a step where a region of interest extraction unit extracts a plurality of regions of secondary interest from the said extracted region of primary interest; a step where a bone grade classification unit classifies the bone grade by applying a convolutional neural network (CNN) to an image of the said extracted regions of secondary interest each and a step where a bone age reading unit reads the bone age by using the bone grade of the said classified regions of secondary interest.

According to an embodiment, a bone age reading device extracts, in the regions of primary interest (ROI) extraction step, regions of interest of the wrist, a thumb, a middle finger and a ring finger as the regions of primary interest from the input hand bone image.

According to an embodiment, a bone age reader can extract a plurality of regions of secondary interest from each of the region of primary interest in the following ways: it can extract radius and ulna regions of interest from the region of interest of the wrist, a first distal phalanx, a first proximal phalanx and a first metacarpal from the region of interest of a thumb, a third distal phalanx, a third middle phalanx, a third proximal phalanx, a third metacarpal from the region of interest of a middle finger, a fifth distal phalanx, a fifth middle phalanx, a fifth proximal phalanx and a fifth metacarpal from the region of interest of a ring finger.

According to an embodiment, the bone age reader further contains CNN application on feature map extraction, the regions of secondary interest (ROI) training and the region of secondary interest (ROI) extraction in the regions of secondary interest (ROI) extraction step.

In the said CNN application on feature map extraction, a bone age reader extracts a feature map through the CNN from the input hand bone image of the region of primary interest. Here the CNN may apply various kinds of neural networks; for example, ZFNet may be applied.

The said region of secondary interest (ROI) training step uses the said region of primary interest by part as training data for extracting a plurality of regions of secondary interest from a plurality of regions of primary interest. Here the training data can rely on the upper left and lower right coordinates in the image of the region of primary interest by part.

The said regions of secondary interest (ROI) extraction step comprises applying the sliding window method to the said feature map that is extracted in the said CNN application on feature map extraction, generating a feature vector by implementing a computation for each location and extracting the said plurality of regions of secondary interest from the said plurality of regions of primary interest based on a predictable score that is calculated for a candidate region and the location and size of a candidate region in the region of secondary interest by using the generated feature vector.

According to an embodiment, a bone age reader sets an anchor box as taking each sliding window into account for its scale and aspect ratio relative to the center of the feature map; for example, the scale is 128, 256 and 512, and the aspect ratio is 1:1, 1:2, and 2:1 for each window, with nine anchor boxes available for each window.

The bone age reader calculates the location and size of the candidate region in the regions of secondary interest and the predictable score thereof through the two full connected layers of the feature vectors generated each. The bone age reader excludes overlapping candidate regions by setting the intersection width between regions and the intersection of union (IoU) between regions based on candidate regions with a high predictive score, for example, to 0.7 as a preset criterion.

The bone age reader sets the top N candidate regions based on the predictable score for the remaining candidate regions. The bone age reader extracts a certain size feature vector through the ROI pooling of the candidate region in the regions of secondary interest.

According to an embodiment, the bone age reader classifies a bone grade by setting up the convolution neural network (CNN).

Here the CNN can apply various kinds of neural networks; for example, the Alex net and the VGG net may be applied.

According to an embodiment, the bone age reading unit calculates Radius, Ulna and Short bones (RUS) scores by using the predicted bone grades of the four regions of interest based on TW3 techniques and translates them into bone ages.

[Figure]

FIG1: The concept of bone age reading in accordance with an embodiment

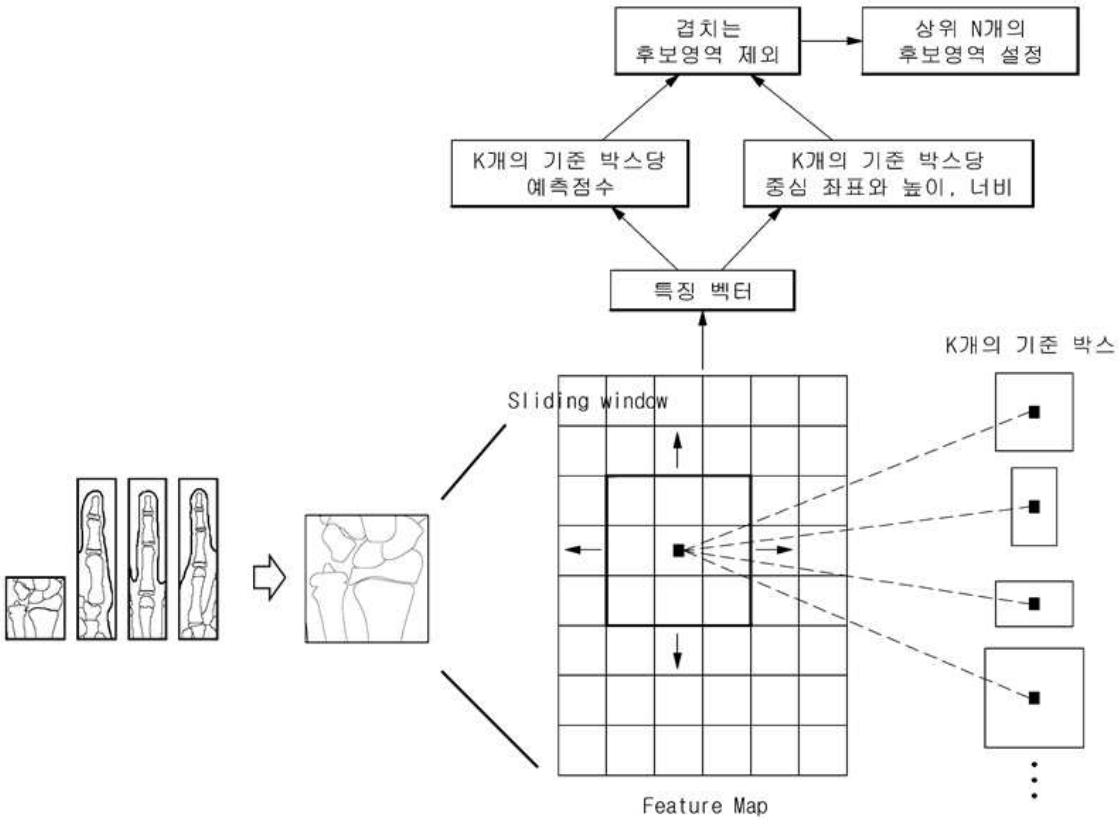


FIG2: The CNNs for extracting a feature vector on each location of an image by applying a sliding window method in accordance with an embodiment

Common general technical knowledge as of the filing

According to the Atlas matching method or the Tanner and Whitehouse 2 (TW2) method, a bone age can be evaluated by measuring the similarity between image data for a young child's left hand X-ray or bone image data by detailed parts of a finger and patterned images that are databased by age and gender.

Cited invention 1

The invention relates to an automated bone age measuring algorithm using a pattern recognizing technique. The algorithm disclosed in the invention comprises automatically classifying each part of finger bones on the X-ray image; extracting a standardized feature model from the classified bone image and measuring a bone age from the standardized feature model. According to an embodiment, a background and a hand area are divided through pre-processing in an x-ray image taken for the left hand of the subjects aged from 5 to 15 and the epiphyseal plate and finger bones are each extracted from an index finger, a middle finger and a ring finger by using a subordinate model segmentation algorithm.

In generating a feature model of the said three finger bones, an active shape model (ASM) algorithm is applied to improve accuracy in extraction of feature values used in age measurement. Several points of contours having morphological characteristic in finger bones and the epiphyseal plate are utilized for landmarks used in training the active shape model (ASM). If one finger model is generated, a feature vector composed of the length and ratio of each part of the pelvic and finger bone of this invention can be extracted.

Each finger age is diagnosed through a machine learning algorithm, including a support vector machine (SVM), etc., by using the said three feature vectors that are extracted from each of the three fingers to classify the bones ages. A conventional technology (E. Pietka method) shows 1.13 age error, while the present disclosure does 0.679 age diagnostic error. This proves a high

reliability of the present disclosure.

Cited invention 2

The invention suggests a system using image patterning based on the CNN for reading a medical image. An image input unit reads in an input image and a patterning module generates input images received from the image input unit into a plurality of pattern images. A CNN training unit learns the input image received from the image input unit and pattern images received from the patterning module based on the CNN, and if a CNN operation unit is transmitted with training information from the CNN training unit and with input images from the image input unit, a final classification unit receives image information from the CNN operation unit and classifies the objects in the image information by type. The present disclosure gives rise to the working effect as such: an image is input through various kinds of routes and massive image data with various kinds of features are generated by patterning and combining input images. Accordingly, image training data of high precision can be obtained.

Conclusion

1. It is determined that the invention of claim 1 does not involve an inventive step over the combination of cited inventions 1 and 2.
2. It is determined that the invention of claim 2 involves an inventive step over the combination of cited inventions 1 and 2.

REASONS FOR THE DETERMINATION – INVENTION OF CLAIM 1

Common features

The invention of claim 1 and cited invention 1 are substantially identical in that the regions of interest by part are extracted from hand bone image data and the bone age is read by using the bone grade data classified though image processing based on a machine learning algorithm by using the extracted image data of regions of interest by part.

The invention of claim 1 and cited invention 2 are substantially identical in

that characteristic image data are generated by patterning and combining input images and classified through the CNN in the image recognition technological field.

Difference

The invention of claim 1 classifies a bone age grade by applying the CNN to hand bone (手骨) image data. Meanwhile, cited invention 1 diagnoses a finger age through SVM. Accordingly, the both inventions show a difference in a learning model (data pre-processing method included).

Determination for the difference

The invention of claim 1 extracts the region of interest from hand bone image data and classifies the bone age grade by applying the CNN. Meanwhile, cited invention 1 diagnoses a finger age through the SVM by using each of the three feature vectors extracted from any interested three fingers. Accordingly, the both inventions show a difference in a learning model.

The invention of claim 1 does not specifically define the CNN learning model, but a person skilled in the art may easily derive the said difference from the learning model disclosed in cited invention 2. As said before, according to the learning model of cited invention 2, the CNN learns the input image received from an image input unit and pattern images received from a patterning module based on the CNN, the CNN operation unit is transmitted with training information from the CNN training unit and with input image from the image input unit, and then a final classification unit receives image information from the CNN operation unit and classifies the objects in the image information by type.

Also, it is determined that there is no difficulty in combining the feature of cited invention 2 to cited invention 1 through implication of cited invention 1 in view of the technological level as filed and no noticeable difference in the working effect.

Therefore, since the invention of claim 1 can be easily implemented by a person skilled in the art in combination of cited inventions 1 and 2, it is determined that the invention of claim 1 does not involve an inventive step.

REASONS FOR THE DETERMINATION – INVENTION OF CLAIM 2

Common feature

Common features are already described in the aforementioned reason for the determination- Invention of claim 1.

Difference

The invention of claim 2 extracts a plurality of regions of secondary interest by using the feature vector extracted from the region of primary interest and classifies a the bone age grade by applying the CNN. Meanwhile, cited invention 1 diagnoses a finger age through the SVM by using each of the three feature vectors extracted from the pre-set interested three fingers. Accordingly, the both inventions show a difference in a learning model.

Determination for the difference

The invention of claim 2 is characterized in that a feature vector is generated by implementing a calculation for each location by applying the sliding window method to the feature map of the region of primary interest of a hand bone image; a plurality of regions of secondary interest are generated on the basis of the predictable score calculated for a candidate area and the location and size of the candidate area of the regions of secondary interest by using the generated feature vector; and the bone grade is classified by applying the CNN to the image of each of the extracted regions of secondary interest.

Cited invention 1 discloses extracting a feature vector by using an active feature model algorithm to the pre-set three fingers and diagnosing finger age through the support vector machine (SVM) algorithm. Meanwhile, cited invention 2 discloses that the CNN training unit learns an input image and a pattern image received from a patterning module based on the CNN.

A person skilled in the art may derive a feature of classifying a bone grade by applying the CNN based on a hand image from cited inventions 1 and 2, but it is determined that the invention of claim 2, that is, the CNN is applied to the regions of secondary interest extracted from the region of primary interest and classifies the bone grade accordingly, cannot be derived from cited

inventions 1 and 2. Further, it cannot be considered that cited inventions 1 and 2 suggest or imply the specific feature.

Accordingly, the feature disclosed in the invention of claim 2, that is, a plurality of regions of secondary interest are extracted by using the feature vector extracted from the region of primary interest and the bone age grade is classified by applying the CNN, is different from cited invention 1 or 2.

From the viewpoint of the working effect, it is determined the invention of claim 2 gives rise to an advantageous effect over cited inventions 1 and 2 in that a feature vector is generated by implementing a calculation of each location of an image of the region of primary interest; the region of secondary interest is generated from a plurality of regions of primary interest based on the predicted score calculated for the location and the size of a candidate region and a candidate region in the regions of secondary interest by using the generated feature vector; the bone grade is classified by applying the CNN to the image of the region of secondary interest, and thereby more accurate and reliable bone age reading is enabled.

Therefore, since a person skilled in the art cannot easily arrive at the invention of claim 2 in view of the combination of cited inventions 1 and 2, it is determined that the invention of claim 2 involves an inventive step.