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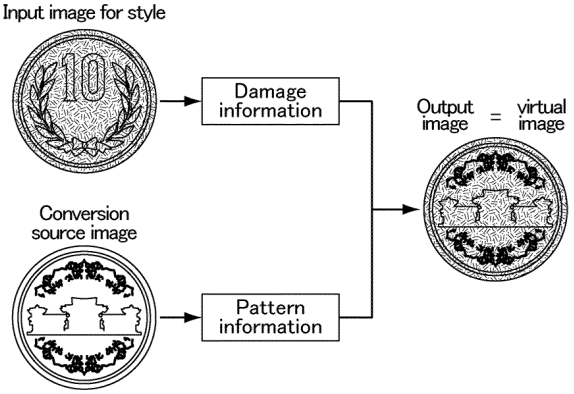
(54) **MONEY INFORMATION GENERATION DEVICE, MONEY PROCESSING SYSTEM, MONEY PROCESSING DEVICE, MONEY INFORMATION GENERATION SYSTEM, MONEY INFORMATION GENERATION METHOD, AND MONEY INFORMATION GENERATION PROGRAM**

(57) The money information generation device of the present disclosure includes a control unit configured to: generate, from money information of a first money, damage information relating to damage of the first money; generate, from money information of a second money, pattern information relating to a pattern of the second money; and generate, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

FIG.3



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to money information generation devices, money handling systems, money handling devices, money information generation systems, money information generation methods, and money information generation programs. The present disclosure specifically relates to a money information generation device, a money handling system, a money handling device, a money information generation system, a money information generation method, and a money information generation program capable of generating image information of a virtual money.

BACKGROUND ART

[0002] Money handling devices for handling moneys such as coins or notes (banknotes) utilize a plurality of types of sensors mounted on a money recognition unit to acquire features of moneys. Typically, based on comparison of the acquired features of the moneys with template information that serves as a reference of recognition, the types, authenticity, fitness, and the like of the moneys are recognized.

[0003] For example, Patent Literatures 1 and 2 disclose an image collation device that collates an image of a money and a plurality of template images corresponding to a variety of moneys to determine the authenticity of the money. In the case of determining the authenticity of coins, this device uses an averaged image obtained by synthesizing a plurality of images of coins of the same type as a template image in order to reduce variation due to individual differences of coins.

CITATION LIST

- Patent Literature

[0004]

Patent Literature 1: JP 4563740 B
Patent Literature 2: JP 4563741 B

SUMMARY OF INVENTION

- Technical Problem

[0005] The image collation devices disclosed in Patent Literatures 1 and 2 require obtaining a plurality of images for each denomination from coins circulating in the market in advance and generating a template image from the obtained images.

[0006] Also, in the case of determining not the authenticity but the fitness of moneys, a plurality of images is obtained for each denomination from soiled moneys circulating in the market in advance and template information is generated from the obtained images.

[0007] When a new series coin is introduced, money handling devices require immediate modification to recognize the new series coin. This causes a demand for immediate generation of template information of the new series coin and application thereof to the money handling devices in the market.

[0008] However, in the case of generating template information from real moneys, as in the case of the image collation devices of Patent Literatures 1 and 2, no template information corresponding to soiled moneys can be generated because only new, unused moneys (hereinafter, also referred to as new moneys) are present immediately after introduction of a new series money. This situation after introduction of a new series money prevents recognition of soiled moneys with a high degree of soiling.

[0009] Accordingly, even a situation where no real soiled money is available causes a demand for generation of money information (image information and template information) of such a soiled money, i.e., money information of a virtual money corresponding to the soiled money.

[0010] The opposite situation where only real soiled moneys are available may cause a demand for generation of template information from a new money.

[0011] The present disclosure has been made in view of the above current state of the art and aims to provide a money information generation device, a money handling system, a money handling device, a money information generation system, a money information generation method, and a money information generation program capable of generating coin information of a virtual money corresponding to a money having a desired damage condition even in a situation where no real one of such a money is available.

- Solution to Problem

[0012] In order to solve the above issue and achieve the above object, (1) a money information generation device according to a first aspect of the present disclosure includes a control unit configured to: generate, from money information of a first money, damage information relating to damage of the first money; generate, from money information of a second money, pattern information relating to a pattern of the second money; and generate, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

[0013] (2) In the money information generation device according to the above (1), the control unit may be configured to provide machine learning of a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information

of the virtual money look like a real one.

[0014] (3) In the money information generation device according to the above (1) or (2), the first money may be an unfit money and the second money may be a new money.

[0015] (4) In the money information generation device according to the above (1) or (2), the first money may be a new money, and the second money may be an unfit money.

[0016] (5) In the money information generation device according to any one of the above (1) to (4), a type of the first money may be different from a type of the second money.

[0017] (6) In the money information generation device according to any one of the above (1) to (5), a material of the first money may be the same as a material of the second money.

[0018] (7) In the money information generation device according to any one of the above (1) to (5), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material, and the control unit may be configured to: generate, from money information of the first region, pattern information relating to a pattern of the first region; and generate, from the damage information and the pattern information of the first region, money information of a virtual first region as a fusion of the damage information and the pattern information of the first region.

[0019] (8) In the money information generation device according to the above (7), the second material may be different from the material of the first money and may be the same as a material of a third money, and the control unit may be configured to: generate, from money information of the third money, damage information relating to damage of the third money; generate, from money information of the second region, pattern information relating to a pattern of the second region; and generate, from the damage information of the third money and the pattern information of the second region, money information of a virtual second region as a fusion of the damage information of the third money and the pattern information of the second region.

[0020] (9) The money information generation device according to any one of the above (1) to (5) may further include a storage unit, wherein the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material that is different from the material of the first money and is the same as a material of a third money, the storage unit may be configured to store a correlation between a feature of a third region and a feature of a fourth region generated from money information of a fourth money that includes the third region containing the first material and the fourth region containing the second material, and the control unit may be configured to generate the money information of the virtual money based on the correlation.

[0021] (10) In the money information generation device according to the above (9), the control unit may be configured to: generate, from pieces of money information of a plurality of first moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the first moneys; generate, from pieces of money information of a plurality of third moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the third moneys; generate, from the pieces of damage information relating to the first moneys and the pattern information, pieces of money information of a plurality of first virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the first moneys and the pattern information; generate, from the pieces of damage information relating to the third moneys and the pattern information, pieces of money information of a plurality of second virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the third moneys and the pattern information; calculate, from each of the pieces of money information of the first virtual moneys, a first feature of a region corresponding to the first region; calculate, from each of the pieces of money information of the second virtual moneys, a second feature of a region corresponding to the second region; determine a combination of an optimal first feature and an optimal second feature among a plurality of the first features and a plurality of the second features based on the correlation; and generate, from a piece of money information of a first virtual money and a piece of money information of a second virtual money respectively corresponding to the optimal first feature and the optimal second feature, money information of a third virtual money including the piece of money information of the first virtual money at a region corresponding to the first region and the piece of money information of the second virtual money at a region corresponding to the second region.

[0022] (11) In the money information generation device according to any one of the above (1) to (10), the damage information may be information relating to damage of a base of the first money.

[0023] (12) In the money information generation device according to any one of the above (1) to (11), a type of the first money may be the same as a type of the second money, and the control unit may be configured to: generate, from money information of a first side of the first money, damage information relating to damage of the first side; generate, from money information of a second side that is different from the first side of the second money, pattern information relating to a pattern of the second side; and generate, from the damage information of the first side and the pattern information of the second side, money information of a virtual second side as a fusion of the damage information of the first side and the pattern information of the second side.

[0024] (13) In the money information generation device according to any one of the above (1) to (12), the money

information may be image information.

[0025] (14) A money handling system according to a second aspect of the present disclosure includes the money information generation device according to any one of the above (1) to (13); and a money handling device including a storage unit configured to store template information based on the money information of the virtual money.

[0026] (15) A money handling device according to a third aspect of the present disclosure includes the money information generation device according to any one of the above (1) to (13); and a storage unit configured to store template information based on the money information of the virtual money.

[0027] (16) A money information generation system according to a fourth aspect of the present disclosure includes a damage information generation unit configured to generate, from money information of a first money, damage information relating to damage of the first money;

a pattern information generation unit configured to generate, from money information of a second money, pattern information relating to a pattern of the second money; and

a virtual money information generation unit configured to generate, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

[0028] (17) In the money information generation system according to the above (16), machine learning may be provided for a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like a real one.

[0029] (18) In the money information generation system according to the above (16) or (17), the first money may be an unfit money, and the second money may be a new money.

[0030] (19) In the money information generation system according to the above (16) or (17), the first money may be a new money, and the second money may be an unfit money.

[0031] (20) In the money information generation system according to any one of the above (16) to (19), a type of the first money may be different from a type of the second money.

[0032] (21) In the money information generation system according to any one of the above (16) to (20), a material of the first money may be the same as a material of the second money.

[0033] (22) In the money information generation system according to any one of the above (16) to (20), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material; the pattern information generation unit may be configured to generate, from money information of the first region, pattern information relating to a pattern of the first region; and the virtual money information generation unit may be configured to generate, from the damage information and the pattern information of the first region, money information of a virtual first region as a fusion of the damage information and the pattern information of the first region.

[0034] (23) In the money information generation system according to the above (22), the second material may be different from the material of the first money and may be the same as a material of a third money; the damage information generation unit may be configured to generate, from money information of the third money, damage information relating to damage of the third money; the pattern information generation unit may be configured to generate, from money information of the second region, pattern information relating to a pattern of the second region; and the virtual money information generation unit may be configured to generate, from the damage information of the third money and the pattern information of the second region, money information of a virtual second region as a fusion of the damage information of the third money and the pattern information of the second region.

[0035] (24) The money information generation system according to any one of the above (16) to (20) may further include a storage unit, wherein the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material that is different from the material of the first money and is the same as a material of a third money; the storage unit may be configured to store a correlation between a feature of a third region and a feature of a fourth region generated from money information of a fourth money that includes the third region containing the first material and the fourth region containing the second material; and the virtual money information generation unit may be configured to generate the money information of the virtual money based on the correlation.

[0036] (25) In the money information generation system according to the above (24), the damage information generation unit may be configured to generate, from pieces of money information of a plurality of first moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the first moneys and may be configured to generate, from pieces of money information of a plurality of third moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the third moneys; the virtual money information generation unit may be configured to generate, from the pieces of damage information relating

to the first moneys and the pattern information, pieces of money information of a plurality of first virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the first moneys and the pattern information, and may be configured to generate, from the pieces of damage information relating to the third moneys and the pattern information, pieces of money information of a plurality of second virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the third moneys and the pattern information; and the money information generation system may further include: a feature calculation unit configured to calculate, from each of the pieces of money information of the first virtual moneys, a first feature of a region corresponding to the first region, and configured to calculate, from each of the pieces of money information of the second virtual moneys, a second feature of a region corresponding to the second region; a combination determination unit configured to determine a combination of an optimal first feature and an optimal second feature among a plurality of the first features and a plurality of the second features based on the correlation; and a money information synthesis unit configured to generate, from a piece of money information of a first virtual money and a piece of money information of a second virtual money respectively corresponding to the optimal first feature and the optimal second feature, money information of a third virtual money including the piece of money information of the first virtual money at a region corresponding to the first region and the piece of money information of the second virtual money at a region corresponding to the second region.

[0037] (26) In the money information generation system according to any one of the above (16) to (25), the damage information may be information relating to damage of a base of the first money.

[0038] (27) In the money information generation system according to any one of the above (16) to (26), a type of the first money may be the same as a type of the second money; the damage information generation unit may be configured to generate, from money information of a first side of the first money, damage information relating to damage of the first side; the pattern information generation unit may be configured to generate, from money information of a second side that is different from the first side of the second money, pattern information relating to a pattern of the second side; and the virtual money information generation unit may be configured to generate, from the damage information of the first side and the pattern information of the second side, money information of a virtual second side as a fusion of the damage information of the first side and the pattern information of the second side.

[0039] (28) In the money information generation system according to any one of the above (16) to (27), the money information may be image information.

[0040] (29) A money information generation method according to a fifth aspect of the present disclosure includes generating, from money information of a first money, damage information relating to damage of the first money; generating, from money information of a second money, pattern information relating to a pattern of the second money; and generating, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

[0041] (30) The money information generation method according to the above (29) may further include providing machine learning of a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like a real one.

[0042] (31) In the money information generation method according to the above (29) or (30), the first money may be an unfit money, and the second money may be a new money.

[0043] (32) In the money information generation method according to the above (29) or (30), the first money may be a new money, and the second money may be an unfit money.

[0044] (33) In the money information generation method according to any one of the above (29) to (32), a type of the first money may be different from a type of the second money.

[0045] (34) In the money information generation method according to any one of the above (29) to (33), a material of the first money may be the same as a material of the second money.

[0046] (35) In the money information generation method according to any one of the above (29) to (33), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material; the step of generating pattern information may generate, from money information of the first region, pattern information relating to a pattern of the first region; and the step of generating money information may generate, from the damage information and the pattern information of the first region, money information of a virtual first region as a fusion of the damage information and the pattern information of the first region.

[0047] (36) In the money information generation method according to the above (35), the second material may be different from the material of the first money and may be the same as a material of a third money; the step of generating damage information may generate, from money information of the third money, damage information relating to damage of the third money; the step of generating pattern information may generate, from money information of the second region, pattern information relating to a pattern of the second region; and the step of generating money information may generate, from the damage information of the third money and the pattern

information of the second region, money information of a virtual second region as a fusion of the damage information of the third money and the pattern information of the second region.

[0048] (37) In the money information generation method according to any one of the above (29) to (33), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material that is different from the material of the first money and is the same as a material of a third money; and the step of generating money information may generate the money information of the virtual money based on a correlation between a feature of a third region and a feature of a fourth region generated from money information of a fourth money that includes the third region containing the first material and the fourth region containing the second material.

[0049] (38) In the money information generation method according to the above (37), the step of generating damage information may generate, from pieces of money information of a plurality of first moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the first moneys and may generate, from pieces of money information of a plurality of third moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the third moneys; the step of generating money information may generate, from the pieces of damage information relating to the first moneys and the pattern information, pieces of money information of a plurality of first virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the first moneys and the pattern information, and may generate, from the pieces of damage information relating to the third moneys and the pattern information, pieces of money information of a plurality of second virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the third moneys and the pattern information; and the money information generation method may further include: calculating, from each of the pieces of money information of the first virtual moneys, a first feature of a region corresponding to the first region; calculating, from each of the pieces of money information of the second virtual moneys, a second feature of a region corresponding to the second region; determining a combination of an optimal first feature and an optimal second feature among a plurality of the first features and a plurality of the second features based on the correlation; and generating, from a piece of money information of a first virtual money and a piece of money information of a second virtual money respectively corresponding to the optimal first feature and the optimal second feature, money information of a third virtual money including the piece of money information of the first virtual money at a region corresponding to the first region and the piece of money information of the second virtual money at a region corresponding to the second region.

[0050] (39) In the money information generation method according to any one of the above (29) to (38), the damage information may be information relating to damage of a base of the first money.

[0051] (40) In the money information generation method according to any one of the above (29) to (39), a type of the first money may be the same as a type of the second money; the step of generating damage information may generate, from money information of a first side of the first money, damage information relating to damage of the first side; the step of generating pattern information may generate, from money information of a second side that is different from the first side of the second money, pattern information relating to a pattern of the second side; and the step of generating money information may generate, from the damage information of the first side and the pattern information of the second side, money information of a virtual second side as a fusion of the damage information of the first side and the pattern information of the second side.

[0052] (41) In the money information generation method according to any one of the above (29) to (40), the money information may be image information.

[0053] (42) A money information generation program according to a sixth aspect of the present disclosure causes a computer to function as: a means for generating, from money information of a first money, damage information relating to damage of the first money; a means for generating, from money information of a second money, pattern information relating to a pattern of the second money; and a means for generating, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

[0054] (43) In the money information generation program according to the above (42), the computer may be further caused to function as a means for providing machine learning of a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like a real one.

[0055] (44) In the money information generation program according to the above (42) or (43), the first money may be an unfit money, and the second money may be a new money.

[0056] (45) In the money information generation program according to the above (42) or (43), the first money may be a new money, and the second money may be an unfit money.

[0057] (46) In the money information generation program according to any one of the above (42) to (45), a type of the first money may be different from a type of the second money.

[0058] (47) In the money information generation pro-

gram according to any one of the above (42) to (46), a material of the first money may be the same as a material of the second money.

[0059] (48) In the money information generation program according to any one of the above (42) to (46), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material; the means for generating pattern information may generate, from money information of the first region, pattern information relating to a pattern of the first region; and the means for generating money information may be configured to generate, from the damage information and the pattern information of the first region, money information of a virtual first region as a fusion of the damage information and the pattern information of the first region.

[0060] (49) In the money information generation program according to the above (48), the second material may be different from the material of the first money and may be the same as a material of a third money; the means for generating damage information may be configured to generate, from money information of the third money, damage information relating to damage of the third money; the means for generating pattern information may be configured to generate, from money information of the second region, pattern information relating to a pattern of the second region; and the means for generating money information may be configured to generate, from the damage information of the third money and the pattern information of the second region, money information of a virtual second region as a fusion of the damage information of the third money and the pattern information of the second region.

[0061] (50) In the money information generation program according to any one of the above (42) to (46), the second money may include a first region containing a first material that is the same as a material of the first money and a second region containing a second material that is different from the material of the first money and is the same as a material of a third money; and the means for generating money information may be configured to generate the money information of the virtual money based on a correlation between a feature of a third region and a feature of a fourth region generated from money information of a fourth money that includes the third region containing the first material and the fourth region containing the second material.

[0062] (51) In the money information generation program according to the above (50), the means for generating damage information may be configured to generate, from pieces of money information of a plurality of first moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the first moneys and may be configured to generate, from pieces of money information of a plurality of third moneys containing the same material and having different damage conditions, a plurality of pieces of damage information relating to the third moneys; the means for generating money information may be configured to generate, from the pieces of damage information relating to the first moneys and the pattern information, pieces of money information of a plurality of first virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the first moneys and the pattern information, and may be configured to generate, from the pieces of damage information relating to the third moneys and the pattern information, pieces of money information of a plurality of second virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the third moneys and the pattern information; and the money information generation program may further cause the computer to function as a means for calculating, from each of the pieces of money information of the first virtual moneys, a first feature of a region corresponding to the first region, and calculating, from each of the pieces of money information of the second virtual moneys, a second feature of a region corresponding to the second region; a means for determining a combination of an optimal first feature and an optimal second feature among a plurality of the first features and a plurality of the second features based on the correlation; and a means for generating, from a piece of money information of a first virtual money and a piece of money information of a second virtual money respectively corresponding to the optimal first feature and the optimal second feature, money information of a third virtual money including the piece of money information of the first virtual money at a region corresponding to the first region and the piece of money information of the second virtual money at a region corresponding to the second region.

[0063] (52) In the money information generation program according to any one of the above (42) to (51), the damage information may be information relating to damage of a base of the first money.

[0064] (53) In the money information generation program according to any one of the above (42) to (52), a type of the first money may be the same as a type of the second money; the means for generating damage information may be configured to generate, from money information of a first side of the first money, damage information relating to damage of the first side; the means for generating pattern information may be configured to generate, from money information of a second side that is different from the first side of the second money, pattern information relating to a pattern of the second side; and the means for generating money information may be configured to generate, from the damage information of the first side and the pattern information of the second side, money information of a virtual second side as a fusion of the damage information of the first side and the pattern information of the second side.

[0065] (54) In the money information generation program according to any one of the above (42) to (53), the money information may be image information.

[0066] (55) A money information generation device ac-

cording to a seventh aspect of the present disclosure includes a control unit configured to: generate, from money information of a first money, counterfeit information relating to counterfeit of the first money; generate, from money information of a second money, pattern information relating to a pattern of the second money; and generate, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

[0067] (56) In the money information generation device according to the above (55), the control unit may be configured to provide machine learning of a machine-learning algorithm relating to generation of the counterfeit information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like an actually existing counterfeit money.

[0068] (57) In the money information generation device according to the above (55) or (56), the first money may be a counterfeit money and the second money may be a genuine money.

[0069] (58) In the money information generation device according to any one of the above (55) to (57), a type of the first money may be different from a type of the second money.

[0070] (59) In the money information generation device according to any one of the above (55) to (58), the money information may be image information.

[0071] (60) A money handling system according to an eighth aspect of the present disclosure includes the money information generation device according to any one of the above (55) to (59); and a money handling device including a storage unit configured to store template information based on the money information of the virtual money.

[0072] (61) A money handling device according to a ninth aspect of the present disclosure includes the money information generation device according to any one of the above (55) to (59); and a storage unit configured to store template information based on the money information of the virtual money.

[0073] (62) A money information generation system according to a tenth aspect of the present disclosure includes: a counterfeit information generation unit configured to generate, from money information of a first money, counterfeit information relating to counterfeit of the first money; a pattern information generation unit configured to generate, from money information of a second money, pattern information relating to a pattern of the second money; and a virtual money information generation unit configured to generate, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

[0074] (63) In the money information generation system according to the above (62), machine learning may be provided for a machine-learning algorithm relating to generation of the counterfeit information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like an actually existing counterfeit money.

[0075] (64) In the money information generation system according to the above (62) or (63), the first money may be a counterfeit money and the second money may be a genuine money.

[0076] (65) In the money information generation system according to any one of the above (62) to (64), a type of the first money may be different from a type of the second money.

[0077] (66) In the money information generation system according to any one of the above (62) to (65), the money information may be image information.

[0078] (67) A money information generation method according to an eleventh aspect of the present disclosure includes generating, from money information of a first money, counterfeit information relating to counterfeit of the first money; generating, from money information of a second money, pattern information relating to a pattern of the second money; and generating, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

[0079] (68) The money information generation method according to the above (67) may further include providing machine learning of a machine-learning algorithm relating to generation of the counterfeit information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like an actually existing counterfeit money.

[0080] (69) In the money information generation method according to the above (67) or (68), the first money may be a counterfeit money and the second money may be a genuine money.

[0081] (70) In the money information generation method according to any one of the above (67) to (69), a type of the first money may be different from a type of the second money.

[0082] (71) In the money information generation method according to any one of the above (67) to (70), the money information may be image information.

[0083] (72) A money information generation program according to a twelfth aspect of the present disclosure causes a computer to function as: a means for generating, from money information of a first money, counterfeit information relating to counterfeit of the first money; a means for generating, from money information of a second money, pattern information relating to a pattern of the second money; and a means for generating, from the counterfeit information and the pattern information, mon-

ey information of a virtual money as a fusion of the counterfeit information and the pattern information.

[0084] (73) In the money information generation program according to the above (72), the computer may be further caused to function as a means for providing machine learning of a machine-learning algorithm relating to generation of the counterfeit information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like an actually existing counterfeit money.

[0085] (74) In the money information generation program according to the above (72) or (73), the first money may be a counterfeit money and the second money may be a genuine money.

[0086] (75) In the money information generation program according to any one of the above (72) to (74), a type of the first money may be different from a type of the second money.

[0087] (76) In the money information generation program according to any one of the above (72) to (75), the money information may be image information.

- Advantageous Effects of Invention

[0088] The money information generation devices, the money handling systems, the money handling devices, the money information generation systems, the money information generation methods, and the money information generation programs of the present disclosure can generate coin information of a virtual money corresponding to a money having a desired damage condition even in a situation where no real one of such a money is available.

BRIEF DESCRIPTION OF DRAWINGS

[0089]

FIG. 1 is a block diagram of the structure of a money information generation device according to Embodiment 1.

FIG. 2 is a flowchart of an example of steps of processing executed by the money information generation device according to Embodiment 1.

FIG. 3 is a schematic diagram of the outline of a method for generating money information in Embodiment 2.

FIG. 4 is a block diagram of a structure of a money information generation device according to Embodiment 2, illustrating the structure during machine learning.

FIG. 5 is a block diagram of a structure of the money information generation device according to Embodiment 2, illustrating the structure after machine learning.

FIG. 6 is a flowchart of an example of steps of processing executed by the money information generation device according to Embodiment 2 during machine learning.

FIG. 7 is a flowchart of an example of steps of processing executed by the money information generation device according to Embodiment 2 after machine learning.

FIG. 8 is a block diagram of an example of the overall structure of a money handling system including the money information generation device according to Embodiment 2.

FIG. 9 is a block diagram of another example of the overall structure of a money handling system including the money information generation device according to Embodiment 2.

FIG. 10 is a block diagram of the overall structure of a money handling device including the money information generation device according to Embodiment 2.

FIG. 11 is a block diagram of a structure of a money information generation device according to Embodiment 3, illustrating the structure after machine learning.

FIG. 12 is a schematic diagram of an example of a specific processing executed by the money information generation device according to Embodiment 3.

FIG. 13 is a flowchart of an example of steps of processing executed by the money information generation device according to Embodiment 3 after machine learning.

FIG. 14 is a block diagram of the structure of a money information generation device according to Modified Embodiment 1.

FIG. 15 is a flowchart of an example of steps of processing executed by the money information generation device according to Modified Embodiment 1.

FIG. 16 is a block diagram of a structure of a money information generation device according to Modified Embodiment 2, illustrating the structure during machine learning.

FIG. 17 is a block diagram of a structure of the money information generation device according to Modified Embodiment 2, illustrating the structure after machine learning.

DESCRIPTION OF EMBODIMENTS

[0090] The following describes embodiments of the money information generation device, the money information generation system, the money information generation method, and the money information generation program according to the present disclosure with reference to the drawings.

[0091] The term "money" herein encompasses both coins and sheets such as banknotes. Various sheets such as notes (banknotes), checks, vouchers, bills, business forms, documents of value, and card-like media are applicable as sheets to be used in the disclosure.

[0092] The term "money information" means predetermined information relating to a money. Specific examples thereof include images (image data) of the money and template information obtainable from the coin. In the following embodiments, examples are described where the moneys used are coins and the money information used is image information of the moneys (hereinafter, also referred to simply as images).

[0093] Examples of types of moneys damaged and factors for recognizing moneys as being damaged include the following.

[0094] Coins: "soiling", " corrosion (deterioration)", "mechanical damage (e.g., scratches, holes, wear)", "deformation", "defects (e.g., defects formed during manufacturing, marking errors, molding defects", etc.

[0095] Banknotes: "soiling", "scribbles," "losses (e.g., missing of corners, holes, other partial losses)", "tear or crack", "fold", "fatigue", "attachment of tape", etc.

[0096] As described above for the types and factors, the term "damage" herein collectively refers to any change of a money from its normal state, and may be used in the expression "have damage" and others, for example. Moneys without damage and moneys having damage are also respectively referred to as normal moneys and damaged moneys or fit moneys and unfit moneys; for coins, also respectively referred to as normal coins and damaged coins or fit coins and unfit coins; and for banknotes, also respectively referred to as normal notes and damaged notes or fit notes and unfit notes.

[0097] Recognizing (or determining) whether a money has damage, whether a money meets the standards, and/or whether a money is suitable for circulation are/is referred to as fitness recognition (or fitness determination).

(Embodiment 1)

<Structure of money information generation device>

[0098] With reference to FIG. 1, the following describes the structure of a money information generation device 10a of the present embodiment. The money information generation device 10a has functions equivalent to those of a typical personal computer and includes a control unit (processing unit) 20a as shown in FIG. 1.

[0099] As shown in FIG. 1, the control unit 20a has functions of a damage information generation unit 21a, a pattern information generation unit 22a, and a virtual money information generation unit 23a.

[0100] The control unit 20a includes, for example, software programs for achieving a variety of processing, a central processing unit (CPU) that executes the software programs, and a variety of hardware devices controlled by the CPU. The software programs and data for running the control unit 20a may be stored in a storage unit.

[0101] The units of the control unit 20a shown in FIG. 1 are embodied by causing the CPU of the control unit 20a to execute a money information generation program according to the present embodiment. The money information generation program according to the present embodiment may be preinstalled in the money information generation device 10a, or may be provided to a user as an application program that can run on a general-purpose OS, the application program being stored in a computer-readable recording medium or being provided via a network.

[0102] The storage unit includes a storage device such as a hard disk device or a non-volatile memory, and may store a learned model that executes processing relating to generation of damage information, a learned model that executes processing relating to generation of pattern information, and a learned model that executes processing relating to generation of money information of a virtual money.

[0103] The damage information generation unit 21a generates (extracts), from an image (input image for style) of a first coin input to the money information generation device 10a, damage information relating to damage of the first coin.

[0104] The input image for style (image of the first coin) may be an image of the first coin having a desired damage condition, i.e., a damage condition that the coin is desired to have, and may have any pattern (design, marking). The input image for style may be an image of a coin in circulation having a certain degree of damage (e.g., a damaged coin) or may be an image of a coin without damage (e.g., a new coin).

[0105] The pattern information generation unit 22a generates (extracts), from an image (conversion source image) of a second coin input to the money information generation device 10a, pattern information (pattern characteristics) relating to the pattern of the second coin.

[0106] The conversion source image (image of the second coin) may be an image of the second coin that is desired to have the damage condition of the input image for style, and may have any damage condition. The conversion source image (image of the second coin) may be an image of a coin without damage (e.g., new coin) or may be an image of a coin in circulation having a certain degree of damage (e.g., damaged coin).

[0107] The damage information generated by the damage information generation unit 21a may be information relating to damage of a base of the first coin. In other words, the damage information generation unit 21a may generate (extract) information relating to damage of the base of the first coin from an image (input image for style) of the first coin.

[0108] For coins, the term "base" herein commonly refers to the portion excluding the marking of a coin. In other words, a coin commonly includes a base and a marking.

[0109] The virtual money information generation unit 23a generates, from the damage information generated by the damage information generation unit 21a and the pattern information generated by the pattern information generation unit 22a, an image (image information) of a

virtual coin as a fusion (synthesis) of the damage information and the pattern information. This results in generation of an image of a coin (not an actually existing one but a virtual one) having a damage condition at a degree similar to that of the first coin and having the pattern of the second coin. In other words, even when no second coin having a damage condition at a degree similar to that of the first coin is available, template information relating to the second coin can be generated based on the image of a virtual coin generated as described above.

[0110] The term "damage information (information relating to damage)" may refer to information relating to the presence of damage or may refer to information relating to the absence of damage. In the former case, the information may be used to deteriorate the marking or base of the coin.

[0111] The term "damage condition" is a term indicating the degree of damage and encompasses not only the cases where damage is present but also the cases where damage is absent.

[0112] In other words, in the present embodiment, the first coin may be a coin having damage while the second coin may be a coin having no or little damage and the second coin may be damaged, as a virtual coin, to a degree similar to that of the first coin (the damage condition may be worsened). Alternatively, the first coin may be a coin having no or little damage while the second coin may be a coin having damage and the second coin may not be damaged, as a virtual coin, to a degree similar to that of the first coin (the damage condition may be lessened).

[0113] For coins, the term "pattern information (information relating to the pattern)" may refer to information relating to the marking of a coin (e.g., 3D information). The term "marking" herein may refer to something that may change when a coin is damaged or may be something that does not change even when a coin is damaged. Specific examples of the pattern information include information relating to a portion where the way the light hits changes in accordance with the degree of damage, information relating to a portion where the edge information changes in accordance with the degree of damage, and information relating to a portion where the material is changed by damage.

[0114] Also, in the present embodiment, an image (image information) may be used as money information. This enables generation of an image of a virtual money corresponding to a second money (real one) having a desired damage condition and enables visual check of the quality of the image.

[0115] The damage information generation unit 21a, the pattern information generation unit 22a, and the virtual money information generation unit 23a each may be constructed of a learned model, for example, a learned model utilizing a convolutional neural network (CNN). In this case, the CNN of the virtual money information generation unit 23a may be coupled with the respective CNNs of the damage information generation unit 21a and the pattern information generation unit 22a.

[0116] The learned models of the damage information generation unit 21a, the pattern information generation unit 22a, and the virtual money information generation unit 23a each may function as an inference program including learned parameters (coefficients) obtained as a result of learning with a data set.

[0117] Each learned model may be provided with additional learning. In other words, each learned model may be provided with a data set different from that of the previous learning and undergo further learning, generating new learned parameters. The learned models incorporated with these new learned parameters may be used.

[0118] For the first coin used for an input image for style and the second coin used for a conversion source image, the first coin (money) may be a damaged coin (damaged money) while the second coin (money) may be a new coin (new money). In this case, an image of a virtual coin corresponding to a damaged second coin can be generated even in a situation where a new series second coin is introduced and only new second coins are present.

[0119] Conversely, the first coin (money) may be a new coin (new money) and the second coin (money) may be a damaged coin (damaged money). In this case, an image of a virtual coin corresponding to a new second coin can be generated even in a situation where only damaged second coins are present.

[0120] The type, i.e., the denomination, of the first coin (money) may be different from the type, i.e., the denomination, of the second coin (money). Even in this case, an image of a virtual coin corresponding to the second coin having a desired damage condition can be generated.

[0121] The material of the first coin (money) may be the same as the material of the second coin (money) (including the cases where they are substantially the same as each other). This can make a generated image of a virtual coin look more like a real one. This is because moneys of the same material are damaged in a similar manner even when they are different in type. The materials of the first and second coins may be the coin materials of the surfaces of the respective coins.

[0122] Also, banknotes are commonly damaged in different manners depending on their materials. For example, a paper banknote and a polymer sheet banknote (polymer banknote) are soiled in different manners.

[0123] The color of the first coin (money) may be similar to the color of the second coin (money). This can also make a generated image of a virtual coin look more like a real one. This is because moneys of similar colors are damaged in a similar way even when they are different in type.

[0124] The type, i.e., the denomination, of the first coin (money) may be the same as the type, i.e., the denomination, of the second coin (money). In this case, the damage information generation unit 21a may generate damage information of a first side (e.g., front side) of the first

coin (e.g., 10 yen coin) from an image of the first side. The pattern information generation unit 22a may generate, from an image of a second side (e.g., back side), which is different from the first side, among the images of the second coin (e.g., a 10 yen coin different from the first coin), pattern information of the second side. The virtual money information generation unit 23a may generate, from the damage information of the first side generated by the damage information generation unit 21a and the pattern information of the second side generated by the pattern information generation unit 22a, an image of a virtual second side as a fusion of the damage information and the pattern information. This enables generation of an image of a virtual second side that looks more like a real one. This is because moneys of the same type are damaged in a similar manner even on different sides.

[0125] The following describes processing applicable to the case where the second coin, in particular a surface thereof, has a plurality of regions formed from different materials. This coin may be a bicolor coin. A specific example thereof may be a new series 500 yen coin to be issued in the first half of fiscal 2021.

[0126] In the case where the second coin (e.g., a new series 500 yen coin), in particular a surface thereof, includes a first region (e.g., a ring portion) formed from a first material that is the same as the material (e.g., nickel brass) of the first coin (e.g., a current 500 yen coin), the pattern information generation unit 22a may generate, from an image of the first region of the second coin, pattern information of the first region. The virtual money information generation unit 23a may generate, from the damage information generated by the damage information generation unit 21a and the pattern information of the first region generated by the pattern information generation unit 22a, an image of a virtual first region as a fusion of the damage information and the pattern information. This enables generation of an image of a virtual first region corresponding to the first region (e.g., ring portion) formed from the first material that is the same as the material of the first coin and having a desired damage condition even when the second coin is a bicolor coin.

[0127] In the case where the second coin (e.g., a new series 500 yen coin), in particular a surface thereof, includes a second region (e.g., a central portion) formed from a second material that is different from the material of the first coin (e.g., a current 500 yen coin) but is the same as the material (e.g., cupronickel) of a third coin (e.g., an old series 500 yen coin), the damage information generation unit 21a may generate, from an image of the third coin, damage information of the third coin. The pattern information generation unit 22a may generate, from an image of the second region of the second coin, pattern information of the second region. The virtual money information generation unit 23a may generate, from the damage information of the third coin generated by the damage information generation unit 21a and the pattern information of the second region generated by the pattern information generation unit 22a, an image of a virtual second region as a fusion of the damage information and the pattern information. This enables generation of an image of not only the first region (e.g., a ring portion) but also a virtual second region corresponding to the second region (e.g., a central portion) formed from the second material that is the same as the material of the third coin and having a desired damage condition.

[0128] In this case, the control unit 20a may be provided with a money information synthesis unit that synthesizes an image of a virtual first region (e.g., a ring portion) and an image of a virtual second region (e.g., a central portion) to generate an image of the whole coin.

<Steps for generating money information>

[0129] With reference to FIG. 2, the following describes the steps of processing executed by the money information generation device 10a.

[0130] As shown in FIG. 2, first, the damage information generation unit 21a generates damage information of a first coin from an image (input image for style) of the first coin input to the money information generation device 10a (Step S1).

[0131] The pattern information generation unit 22a generates pattern information of a second coin from an image (conversion source image) of the second coin input to the money information generation device 10a (Step S2).

[0132] Steps S1 and S2 may be executed in the order of Steps S1 and S2 as shown in FIG. 2, or may be executed in the order of Steps S2 and S1, or may be executed in parallel.

[0133] Next, the virtual money information generation unit 23a generates, from the damage information generated in Step S1 and the pattern information generated in Step S2, an image of a virtual coin as a fusion of the damage information and the pattern information (Step S3).

[0134] Thereby, the processing is completed.

[0135] The aforementioned Steps S1 to S3 may be executed on predetermined samples to generate images of a plurality of virtual coins having different damage conditions and having the same pattern as the second coin.

(Embodiment 2)

<Summary of the present embodiment>

[0136] First, the outline of a method for generating money information in Embodiment 2 is described. As shown in FIG. 3, in the present embodiment, an input image for style and a conversion source image are first prepared respectively as an image of a first coin and an image of a second coin.

[0137] The input image for style (image of the first coin) is an image of the first coin having a desired damage condition, i.e., a damage condition that the coin is desired to have, and has any pattern (design, marking). The input

image for style is commonly an image of a coin in circulation having a certain degree of damage (e.g., a damaged coin), but may be an image of a coin without damage (e.g., a new coin).

[0138] The conversion source image (image of the second coin) is an image of the second coin that is desired to have the damage condition of the input image for style, and has any damage condition. The conversion source image (image of the second coin) is commonly an image of a coin without damage (e.g., new coin), but may be an image of a coin in circulation having a certain degree of damage (e.g., damaged coin).

[0139] Next, the input image for style is used to generate (extract) damage information, which is information relating to damage of the first coin, while the conversion source image is used to generate (extract) pattern information, which is information relating to the pattern of the second coin.

[0140] Then, the damage information and the pattern information are used to generate an image of a virtual coin as a fusion of the damage information and the pattern information. This results in generation of an image of a coin (not an actually existing one but a virtual one) having a damage condition at a degree similar to that of the first coin and having the pattern of the second coin. In other words, even when no second coin having a damage condition at a degree similar to that of the first coin is available, template information relating to the second coin can be generated based on the image of a virtual coin generated as described above.

[0141] The term "damage information (information relating to damage)" may refer to information relating to the presence of damage or may refer to information relating to the absence of damage. In the former case, the information may be used to deteriorate the marking or base of the coin.

[0142] The term "damage condition" is a term indicating the degree of damage and encompasses not only the cases where damage is present but also the cases where damage is absent.

[0143] In other words, in the present embodiment, the first coin may be a coin having damage while the second coin may be a coin having no or little damage and the second coin may be damaged, as a virtual coin, to a degree similar to that of the first coin (the damage condition may be worsened). Alternatively, the first coin may be a coin having no or little damage while the second coin may be a coin having damage and the second coin may not be damaged, as a virtual coin, to a degree similar to that of the first coin (the damage condition may be lessened).

[0144] For coins, the term "pattern information (information relating to the pattern)" may refer to information relating to the marking of a coin (e.g., 3D information). The term "marking" herein may refer to something that may change when a coin is damaged or may be something that does not change even when a coin is damaged. Specific examples of the pattern information include information relating to a portion where the way the light hits changes in accordance with the degree of damage, information relating to a portion where the edge information changes in accordance with the degree of damage, and information relating to a portion where the material is changed by damage.

[0145] In the present embodiment, to make an image of a virtual money look like a real one, machine learning (e.g., deep learning) may be performed using a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money. This can provide a more realistic image of a virtual coin. In other words, an image of a virtual coin generated can be made closer to an image of a real second money having a desired damage condition.

[0146] Also, in the present embodiment, an image (image information) may be used as money information to generate an image of a virtual money corresponding to a second money (real one) having a desired damage condition and enables visual check of the quality of the image.

<Structure of money information generation device>

[0147] With reference to FIG. 4 and FIG. 5, the following then describes the structure of a money information generation device 10A of the present embodiment. The money information generation device 10A has functions equivalent to a typical personal computer and includes a control unit (processing unit) 20 as shown in FIG. 4 and FIG. 5 and a storage unit (not shown in FIG. 4 and FIG. 5).

[0148] As shown in FIG. 4, the control unit 20 has functions of a damage information generation unit 21, a pattern information generation unit 22, a virtual money information generation unit 23, and a learning unit 24 during machine learning, and has functions of the damage information generation unit 21, the pattern information generation unit 22, the virtual money information generation unit 23, and a template generation unit 25 after machine learning (e.g., at practical use).

[0149] The control unit 20 includes, for example, software programs for achieving a variety of processing, a CPU that executes the software programs, and a variety of hardware devices controlled by the CPU. The software programs and data for running the control unit 20 are stored in the storage unit.

[0150] The units of the control unit 20 shown in FIG. 4 and FIG. 5 are embodied by causing the CPU of the control unit 20 to execute a money information generation program according to the present embodiment. The money information generation program according to the present embodiment may be preinstalled in the money information generation device 10a, or may be provided to a user as an application program that can run on a general-purpose OS, the application program being

stored in a computer-readable recording medium or being provided via a network.

[0151] The storage unit includes a storage device such as a hard disk device or a non-volatile memory, and stores a learned model that executes processing relating to generation of the damage information, a learned model that executes processing relating to generation of the pattern information, and a learned model that executes processing relating to generation of the money information of a virtual money.

[0152] The damage information generation unit 21 generates (extracts), from an image (input image for style) of a first coin input to the money information generation device 10A, damage information relating to damage of the first coin.

[0153] The pattern information generation unit 22 generates (extracts), from an image (conversion source image) of a second coin input to the money information generation device 10A, pattern information (pattern characteristics) relating to the pattern of the second coin.

[0154] The damage information generated by the damage information generation unit 21 may be information relating to damage of a base of the first coin. In other words, the damage information generation unit 21 may generate (extract) information relating to damage of the base of the first coin from an image (input image for style) of the first coin.

[0155] For coins, the term "base" herein commonly refers to the portion excluding the marking of a coin. In other words, a coin commonly includes a base and a marking.

[0156] The virtual money information generation unit 23 generates, from the damage information generated by the damage information generation unit 21 and the pattern information generated by the pattern information generation unit 22, an image (image information) of a virtual coin as a fusion (synthesis) of the damage information and the pattern information. This results in generation of an image of a coin (not an actually existing one but a virtual one) having a damage condition at a degree similar to that of the first coin and having the pattern of the second coin.

[0157] The damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23 are each constructed of a learned model, for example, a learned model utilizing a convolutional neural network (CNN). The CNN of the virtual money information generation unit 23 is coupled with the respective CNNs of the damage information generation unit 21 and the pattern information generation unit 22.

[0158] To make an image of a virtual coin generated by the virtual money information generation unit 23 look like a real one, the learning unit 24 provides machine learning of a machine-learning algorithm relating to generation of damage information by the damage information generation unit 21, a machine-learning algorithm relating to generation of pattern information by the pattern information generation unit 22, and a machine-learning algorithm relating to generation of money information of a virtual money by the virtual money information generation unit 23. This machine-learning results in learned models of the damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23. Each machine-learning algorithm may utilize a CNN like the aforementioned learned models.

[0159] The learning unit 24 also includes a machine-learning algorithm (e.g., one utilizing a CNN) and executes machine learning based on an image of a virtual coin (output image) generated by the virtual money information generation unit 23 and an image of a real coin (training data). In other words, an image of a virtual coin and an image of a real coin are used in learning so as to more accurately determine whether an image of a virtual coin generated by the virtual money information generation unit 23 is a virtual one or a real one (an actually existing one). The learning unit 24 then provides an error between the output from the learning unit 24 and a desired output (correct answer) as a teaching signal to the respective machine-learning algorithms relating to the learning unit 24, the damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23, which gradually changes the coupling coefficients of the respective CNNs and finally enables a correct output.

[0160] The learned models of the damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23 each function as an inference program including learned parameters (coefficients) obtained as a result of learning with a data set.

[0161] Each learned model may be provided with additional learning. In other words, each learned model may be provided with a data set different from that of the previous learning and undergo further learning, generating new learned parameters. The learned models incorporated with these new learned parameters may be used.

[0162] The template generation unit 25 generates template information from images of a plurality of virtual coins having different damage conditions and having the same pattern as the second coin generated using the machine-learned damage information generation unit 21, pattern information generation unit 22, and virtual money information generation unit 23.

[0163] For the first coin used for an input image for style and the second coin used for a conversion source image, the first coin (money) may be a damaged coin (damaged money) while the second coin (money) may be a new coin (new money). In this case, an image of a virtual coin corresponding to a damaged second coin can be generated even in a situation where a new series second coin is introduced and only new second coins are present.

[0164] Conversely, the first coin (money) may be a new coin (new money) and the second coin (money) may be

a damaged coin (damaged money). In this case, an image of a virtual coin corresponding to a new second coin can be generated even in a situation where only damaged second coins are present.

[0165] The type, i.e., the denomination, of the first coin (money) may be different from the type, i.e., the denomination, of the second coin (money). Even in this case, an image of a virtual coin corresponding to the second coin having a desired damage condition can be generated.

[0166] The material of the first coin (money) may be the same as the material of the second coin (money) (including the cases where they are substantially the same as each other). This can make a generated image of a virtual coin look more like a real one. This is because moneys of the same material are damaged in a similar manner even when they are different in type. The materials of the first and second coins may refer to the coin materials of the surfaces of the respective coins.

[0167] Also, banknotes are commonly damaged in different manners depending on their materials. For example, a paper banknote and a polymer sheet banknote (polymer banknote) are soiled in different manners.

[0168] The color of the first coin (money) may be similar to the color of the second coin (money). This can also make a generated image of a virtual coin look more like a real one. This is because moneys of similar colors are damaged in a similar way even when they are different in type.

[0169] As shown in FIG. 3, the type, i.e., the denomination, of the first coin (money) may be the same as the type, i.e., the denomination, of the second coin (money). In this case, the damage information generation unit 21 generates damage information of a first side (e.g., front side) of the first coin (e.g., 10 yen coin) from an image of the first side. The pattern information generation unit 22 generates, from an image of a second side (e.g., back side), which is different from the first side, among the images of the second coin (e.g., a 10 yen coin different from the first coin), pattern information of the second side. The virtual money information generation unit 23 generates, from the damage information of the first side generated by the damage information generation unit 21 and the pattern information of the second side generated by the pattern information generation unit 22, an image of a virtual second side as a fusion of the damage information and the pattern information. This enables generation of an image of a virtual second side that looks more like a real one. This is because moneys of the same type are damaged in a similar manner even on different sides.

[0170] The following describes processing applicable to the case where the second coin, in particular a surface thereof, has a plurality of regions formed from different materials. This coin may be a bicolor coin. A specific example thereof may be a new series 500 yen coin to be issued in the first half of fiscal 2021.

[0171] In the case where the second coin (e.g., a new series 500 yen coin), in particular a surface thereof, includes a first region (e.g., a ring portion) formed from a first material that is the same as the material (e.g., nickel brass) of the first coin (e.g., a current 500 yen coin), the pattern information generation unit 22 generates, from an image of the first region of the second coin, pattern information of the first region. The virtual money information generation unit 23 generates, from the damage information generated by the damage information generation unit 21 and the pattern information of the first region generated by the pattern information generation unit 22, an image of a virtual first region as a fusion of the damage information and the pattern information. This enables generation of an image of a virtual first region corresponding to the first region (e.g., ring portion) formed from the first material that is the same as the material of the first coin and having a desired damage condition even when the second coin is a bicolor coin.

[0172] In the case where the second coin (e.g., a new series 500 yen coin), in particular a surface thereof, includes a second region (e.g., a central portion) formed from a second material that is different from the material (e.g., nickel brass) of the first coin (e.g., a current 500 yen coin) but is the same as the material (e.g., cupronickel) of a third coin (e.g., an old series 500 yen coin), the damage information generation unit 21 generates, from an image of the third coin, damage information of the third coin. The pattern information generation unit 22 generates, from an image of the second region of the second coin, pattern information of the second region. The virtual money information generation unit 23 generates, from the damage information of the third coin generated by the damage information generation unit 21 and the pattern information of the second region generated by the pattern information generation unit 22, an image of a virtual second region as a fusion of the damage information and the pattern information. This enables generation of an image of not only the first region (e.g., a ring portion) but also a virtual second region corresponding to the second region (e.g., a central portion) formed from the second material that is the same as the material of the third coin and having a desired damage condition.

[0173] In this case, the control unit 20 may be provided with a money information synthesis unit that synthesizes an image of a virtual first region (e.g., a ring portion) and an image of a virtual second region (e.g., a central portion) to generate an image of the whole coin, and the template generation unit 25 may generate template information from an image generated by the money information synthesis unit.

<Steps for generating money information>

[0174] With reference to FIG. 6 and FIG. 7, the following describes the steps of processing executed by the money information generation device 10A.

[0175] As shown in FIG. 6, during machine learning, the damage information generation unit 21 first generates damage information of a first coin from an image (input

image for style) of the first coin input to the money information generation device 10A (Step S11).

[0176] The pattern information generation unit 22 generates pattern information of a second coin from an image (conversion source image) of the second coin input to the money information generation device 10A (Step S12).

[0177] Steps S11 and S12 may be executed in the order of Steps S11 and S12 as shown in FIG. 6, or may be executed in the order of Steps S12 and S11, or may be executed in parallel.

[0178] Next, the virtual money information generation unit 23 generates, from the damage information generated in Step S11 and the pattern information generated in Step S12, an image of a virtual coin as a fusion of the damage information and the pattern information (Step S13).

[0179] Next, the learning unit 24 provides machine learning of the respective machine-learning algorithms relating to the damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23. At this time, each machine-learning algorithm relating to the learning unit 24 itself also learns based on the image of the virtual coin generated in Step S13 and the image of the real coin (training data) (Step S14).

[0180] The aforementioned Steps S11 to S14 are executed for a predetermined data set, whereby the processing relating to machine learning is completed.

[0181] As shown in FIG. 7, after machine learning, the damage information generation unit 21 first generates damage information of a first coin from an image (input image for style) of the first coin input to the money information generation device 10A (Step S21).

[0182] The pattern information generation unit 22 generates pattern information of a second coin from an image (conversion source image) of the second coin input to the money information generation device 10A (Step S22).

[0183] Steps S21 and S22 may be executed in the order of Steps S21 and S22 as shown in FIG. 7, or may be executed in the order of Steps S22 and S21, or may be executed in parallel.

[0184] Next, the virtual money information generation unit 23 generates, from the damage information generated in Step S21 and the pattern information generated in Step S22, an image of a virtual coin as a fusion of the damage information and the pattern information (Step S23).

[0185] The aforementioned Steps S21 to S23 are executed on predetermined samples to generate images of a plurality of virtual coins having different damage conditions and having the same pattern as the second coin.

[0186] The template generation unit 25 then generates template information from the images of the virtual coins generated (Step S24). Thereby, the processing is completed.

<Overall structure of money handling system or money handling device including money information generation device>

[0187] With reference to FIG. 8 to FIG. 10, the following describes the overall structures of a money handling system and money handling device each including the money information generation device of Embodiment 2. As shown in FIG. 8, a money handling system 200 of the present embodiment is constructed for business branches of financial institutions such as banks, and includes the money information generation device 10A and a money handling device 100 communicably connected to the money information generation device 10A.

[0188] The money handling device 100 may be a teller machine that executes a variety of processing including deposit and withdrawal. The money handling device 100 includes a storage unit 110 that includes a storage device such as a hard disk device or a non-volatile memory. The storage unit 110 stores template information 111 generated by the money information generation device 10A, and the money handling device 100, in particular a built-in money recognition unit (not shown), can execute processing of recognizing a money to be handled, in particular processing of recognizing the fitness, using the template information 111 stored in the storage unit 110.

[0189] As shown in FIG. 9, the money information generation device 10A of the money handling system 200 may be provided in the cloud and a plurality of money handling devices 100 in the market may be communicably connected to the money information generation device 10A in the cloud. In this case, for example, money information (an image of a money) acquired by one or more money handling devices 100 may be sent from the coin handling device(s) 100 to the money information generation device 10A in the cloud. The money information generation device 10A in the cloud may use this money information to execute machine learning and template generation as described above, and then may send the resulting template information to one or more money handling devices 100. The money handling device(s) 100 then may use this template information to execute processing of recognizing a money. The template information generated in the cloud may be used in the money handling device(s) 100 that has provided the money information (the image of the money) used to generate the template information, or may be shared by other money handling devices 100 in addition to the former money handling device 100.

[0190] The money handling system 200 may include the money information generation device 10a instead of the money information generation device 10A. The money handling device 100 may acquire, from the money information generation device 10a, images of a plurality of virtual coins generated by the money information generation device 10a. In this case, the money handling device 100 may generate template information based on the images of the virtual coins acquired and store it in

the storage unit 110.

[0191] As shown in FIG. 10, the aforementioned money handling device 100 may incorporate the money information generation device 10A. Also in this case, the template information 111 stored in the storage unit 110 of the money handling device 100 (money recognition device) may be used to execute processing of recognizing a money to be handled, in particular processing of recognizing the fitness.

[0192] The money handling device 100 shown in FIG. 10 may include the money information generation device 10a instead of the money information generation device 10A. The money handling device 100 may acquire, from the money information generation device 10a, images of a plurality of virtual coins generated by the money information generation device 10a. In this case, the money handling device 100 may generate template information based on the acquired images of the virtual coins and store it in the storage unit 110.

(Embodiment 3)

[0193] The present embodiment is substantially the same as Embodiments 1 and 2 except for difference in the method of generating virtual first and second regions in the case where the second coin (in particular, a surface thereof) includes a plurality of regions formed from a plurality of materials. Thus, the contents overlapping those in the above embodiments are not elaborated upon here.

[0194] In other words, in the present embodiment, the case mainly considered is such that the second coin (e.g., a new series 500 yen coin), in particular a surface thereof, includes a first region (e.g., a ring portion) formed from a first material that is the same as the material (e.g., nickel brass) of the first coin (e.g., a current 500 yen coin) and a second region (e.g., a central portion) formed from a second material that is different from the material of the first coin but is the same as the material (e.g., cupronickel) of the third coin (e.g., an old series 500 yen coin).

[0195] In this case, as described in Embodiments 1 and 2, a virtual image can be generated using images of the first and third coins for each of the first and second regions. Still, the first and second regions are formed from different materials and are therefore unclear whether these regions change over time in the same manner. For example, the manner of soiling of the second region relative to the manner of soiling of the first region is unclear, and vice versa. This makes it difficult to generate a virtual image that takes into consideration the difference in change of damage over time.

[0196] Accordingly, in the present embodiment, a plurality of fourth coins (e.g., commemorative coins) is prepared each including a third region (e.g., a ring portion) formed from the first material and a fourth region (e.g., a central portion) formed from the second material. In other words, the third region of the fourth coin is formed from the same material as the first money and the first region of the second money, while the fourth region of the fourth coin is formed from the same material as the third money and the second region of the second money. Then, from each of these images of the fourth coins, the feature of the third region and the feature of the fourth region are calculated and the correlation between the calculated features (e.g., a relational formula indicating the relationship between the calculated features) is created. Based on this correlation, an image of a virtual second coin is generated. This correlation reflects changes of damage over time in the case where the material of the third region, i.e., the first coin, and the material of the fourth region, i.e., the third coin, are present in a single coin. This therefore enables generation of a virtual image that reflects the difference in change of damage over time. The fourth coins may have different damage conditions. The present embodiment is particularly applicable to a situation where the fourth coin is not available in large quantities. Embodiments 1 and 2 are applicable to a situation where no fourth coin is available. The following more specifically describes the present embodiment.

<Structure of money information generation device>

[0197] With reference to FIG. 11, the following first describes the structure of a money information generation device 10B of the present embodiment. The structure during machine learning is the same as in Embodiment 2 and therefore the description thereof is not elaborated upon here. As shown in FIG. 11, after machine learning, the control unit 20 of the money information generation device 10B has functions of the damage information generation unit 21, the pattern information generation unit 22, the virtual money information generation unit 23, and the template generation unit 25, as well as functions of a feature calculation unit 26, a combination determination unit 27, and a money information synthesis unit 28. In addition, the storage unit (shown in FIG. 11 with the reference sign 30) of the money information generation device 10B stores a correlation 31, such as a relational formula, created from the features of the third regions and the features of the fourth regions of the fourth coins. The relational formula used may be a subspace, for example.

[0198] In the present embodiment, the damage information generation unit 21 generates a plurality of pieces of damage information relating to the first coin from images of a plurality of the first coins (e.g., current 500 yen coins) formed from the same material and having different damage conditions. The damage information generation unit 21 also generates a plurality of pieces of damage information relating to the third coin from images of a plurality of the third coins (e.g., old series 500 yen coins) formed from the same material and having different damage conditions. The third coin is a coin formed from a material different from that of the first coin. The first coins may be of the same type (denomination) or may be of different types (denominations). Similarly, the third coins may be of the same type (denomination) or may be of different types (denominations).

[0199] As in Embodiment 2, the pattern information generation unit 22 generates pattern information of the second coin (e.g., a new series 500 yen coin) from an image of the second coin.

[0200] The virtual money information generation unit 23 generates, from the pieces of the damage information relating to the first coin and the pattern information, images of a plurality of first virtual coins (the entire coins or only regions corresponding to the first region) each as a fusion of a respective piece of the damage information relating to the first coin and the pattern information. This results in generation of images of a plurality of coins (not actually existing ones but virtual ones) each having a damage condition at a degree similar to that of a respective first coin and having the pattern of the second coin. The virtual money information generation unit 23 also generates, from the pieces of the damage information relating to the third coin and the pattern information, images of a plurality of second virtual coins (the entire coins or only regions corresponding to the second region) each as a fusion of a respective piece of the damage information relating to the third coin and the pattern information. This results in generation of images of a plurality of coins (not actually existing ones but virtual ones) each having a damage condition at a degree similar to that of a respective third coin and having the pattern of the second coin.

[0201] The feature calculation unit 26 calculates a first feature of a region corresponding to the first region (e.g., a ring portion) from each of the images of the first virtual coins generated by the virtual money information generation unit 23. The feature calculation unit 26 also calculates a second feature of a region corresponding to the second region (e.g., a central portion) from each of the images of the second virtual coins generated by the virtual money information generation unit 23.

[0202] The aforementioned features (the first and second features, the feature of the third region, and the feature of the fourth region) each may be, but are not limited to, the average of the luminances (pixel values), for example. Alternatively, the variance of the luminances (pixel values) or the average and variance of the edge intensities may be used.

[0203] The combination determination unit 27 determines optimal combinations of a first feature and a second feature respectively among the first features relating to the first virtual coins and the second features relating to the second virtual coins based on the correlation 31 (e.g., relational formula). For example, a combination having the smallest distance from the relational formula (subspace) may be determined.

[0204] The money information synthesis unit 28 synthesizes, from the image of the first virtual coin and the image of the second virtual coin respectively corresponding to the optimal first feature and the optimal second feature determined by the combination determination unit 27, an image of the first virtual coin at a region corresponding to the first region (e.g., an image of a ring portion) and an image of the second virtual coin at a region corresponding to the second region (e.g., an image of a central portion), and generates an image of a third virtual coin containing both images. The money information synthesis unit 28 generates an image of the third virtual coin from an image of the first virtual coin and an image of the second virtual coin for the respective combinations determined by the combination determination unit 27.

[0205] The template generation unit 25 then generates template information from the images of the third virtual coins generated by the money information synthesis unit 28.

[0206] With reference to FIG. 12, the following describes an example of a more specific processing in the present embodiment. In this example, as shown in FIG. 12, images of a plurality of commemorative coins as fourth coins having different damage conditions are first prepared. These commemorative coins are bicolor coins each including a ring portion formed from the same material as the current 500 yen coin and a central portion formed from the same material as the old series 500 yen coin. The denominations and designs of the commemorative coins are not limited and may be the same as or different from each other. Then, one side of a commemorative coin is separated into four regions (white regions in the figure): the marking portion, the base portion, the central portion (inner), and the ring portion (outer). The correlation 31 is created in the form of a 4-dimensional subspace where the feature is the average of the luminances (pixel values) of the respective regions (learning with the commemorative coins).

[0207] Next, images for style of a plurality of current 500 yen coins having different damage conditions and images for style of a plurality of old series 500 yens coins having different damage conditions are prepared and the damage information generation unit 21 generates a plurality of pieces of damage information relating to the current 500 yen coins and a plurality of pieces of damage information relating to the old series 500 yen coins.

[0208] Also, a conversion source image of a new series 500 yen coin is prepared and the pattern information generation unit 22 generates pattern information of the new series 500 yen coin.

[0209] The virtual money information generation unit 23 then generates images of a plurality of first virtual coins (first output images) each having a damage condition at a degree similar to that of a respective current 500 yen coin and having the pattern of the new series 500 yen coin, and generates images of a plurality of second virtual coins (second output images) each having a damage condition at a degree similar to that of a respective old series 500 yen coin and having the pattern of the new series 500 yen coin.

[0210] Then, the feature calculation unit 26 calculates the averages of the luminances (pixel values) for the markings and bases of the ring portions of the images of the first virtual coins and calculates the averages of the

luminances (pixel values) of the markings and bases of the central portions of the images of the second virtual coins.

[0211] Then, based on the correlation 31, the combination determination unit 27 determines optimal combinations of an image of a first virtual coin and an image of a second virtual coin each having the optimal averages of the luminances. Specifically, between the images of the first virtual coins and the images of the second virtual coins, optimal combinations are determined in each of which the averages of the luminances each have the smallest distance from the 4-dimensional subspace. This results in one-toone correspondences between the images of the first virtual coins and the images of the second virtual coins.

[0212] The money information synthesis unit 28 then synthesizes an image of the ring portion of the first virtual coin and an image of the central portion of the second virtual coin of a respective combination to generate an image (inner-outer synthesized image) of a third virtual coin.

<Steps for generating money information>

[0213] With reference to FIG. 13, the following describes the steps of processing executed by the money information generation device 10B. The processing during machine learning is the same as in Embodiment 2 and therefore the description thereof is not elaborated upon here.

[0214] In the present embodiment, as shown in FIG. 13, after machine learning, the damage information generation unit 21 first generates, from images (input images for style) of a plurality of the first coins input to the money information generation device 10B, a plurality of pieces of damage information of the first coins, and generates, from images (input images for style) of a plurality of the third coins input to the money information generation device 10B, a plurality of pieces of damage information of the third coins (Step S31).

[0215] The pattern information generation unit 22 generates, from an image (conversion source image) of the second coin input to the money information generation device 10B, pattern information of the second coin (Step S32).

[0216] Steps S31 and S32 may be executed in the order of Steps S31 and S32 as shown in FIG. 13, or may be executed in the order of Steps S32 and S31, or may be executed in parallel.

[0217] Next, the virtual money information generation unit 23 generates, from the pieces of the damage information relating to the first coins generated in Step S31 and the pattern information generated in Step S32, images of a plurality of first virtual coins each as a fusion of a respective piece of the damage information and the pattern information, and generates, from the pieces of the damage information relating to the third coins generated in Step S31 and the pattern information generated in Step S32, images of a plurality of second virtual coins each as a fusion of a respective piece of the damage information and the pattern information (Step S33).

[0218] Next, the feature calculation unit 26 calculates a first feature of a region corresponding to the first region (e.g., a ring portion) from each of the images of the first virtual coins generated in Step S33, and calculates a second feature of a region corresponding to the second region (e.g., a central portion) from each of the images of the second virtual coins generated in Step S33 (Step S34).

[0219] Next, the combination determination unit 27 determines optimal combinations of a first feature and a second feature based on the correlation 31 (Step S35).

[0220] Next, the money information synthesis unit 28 synthesizes, from the image of the first virtual coin and the image of the second virtual coin respectively corresponding to the optimal first feature and the optimal second feature determined in Step S35, an image of the first virtual coin at a region corresponding to the first region and an image of the second virtual coin at a region corresponding to the second region, and generates an image of a third virtual coin (Step S36). This step S36 is executed for each of the combinations determined in Step S35.

[0221] The template generation unit 25 then generates template information from the images of the third virtual coins generated in Step S36 (Step S37). Thereby, the processing is completed.

[0222] In the present Embodiment, the images of the third virtual coins may be generated by the following processing.

[0223] In this case, as in the case shown in FIG. 11, a 4-dimensional subspace is first created as the correlation 31 (learning with the commemorative coins), and a plurality of pieces of damage information relating to the current 500 yen coin and a plurality of pieces of damage information relating to the old series 500 yen coin are generated. Also, the pattern information generation unit 22 generates pattern information of the new series 500 yen coin.

[0224] Then, the feature calculation unit 26 calculates the averages of the luminances (pixel values) for the markings and bases of the ring portions of the images of the current 500 yen coins and calculates the averages of the luminances (pixel values) of the markings and bases of the central portions of the images of the old series 500 yen coins.

[0225] Next, between the images of the current 500 yen coins and the images of the old series 500 yen coins, the combination determination unit 27 determines combinations in each of which the averages of the luminances each have the smallest distance from the correlation 31 (4-dimensional subspace).

[0226] The virtual money information generation unit 23 then generates, from the damage information of the current 500 yen coin and the damage information of the old series 500 yen coin relating to a respective optimal

combination and the pattern information of the new series 500 yen coin, an image (output image) of a virtual coin that has a damage condition at a degree similar to that of the current 500 yen coin for the ring portion and a damage condition at a degree similar to that of the old series 500 yen coin for the central portion, and that has the pattern of the new series 500 yen coin.

[0227] As described above, in the aforementioned embodiments, the damage information of the first coin is generated from the image of the first coin, the pattern information of the second coin is generated from the image of the second coin, and the image of the virtual coin as a fusion of the damage information and the pattern information is generated from the damage information and the pattern information. Thus, based on the images of the real first and second coins, the image of the virtual coin having a damage condition at a degree similar to that of the first coin and having the pattern of the second coin can be generated. Therefore, even in a situation where no real second coin having a desired damage condition is available, an image of a virtual coin corresponding thereto can be generated.

[0228] In the case of a second coin having a plurality of regions formed from a plurality of respective materials, the following method may be used instead of the method described in the aforementioned embodiments. Specifically, a plurality of fourth coins (e.g., commemorative coins) formed from the same materials as the second coin may be used as images (input images for style) of the first coins to directly generate images of virtual coins each having a damage condition at a degree similar to that of a respective fourth coin and having the pattern of the second coin (e.g., a new series 500 yen coin). This method is particularly applicable to the situation where the fourth coin is available in large quantities.

[0229] Described in the above embodiments is the case of generating the damage information of the first coin from the image (input image for style) of the first coin. Alternatively, counterfeit information, which is information relating to counterfeit of the first coin, may be generated from the image (input image for style) of the first coin.

[0230] Specifically, for example, as shown in FIG. 14, a control unit 20c of a money information generation device 10c has a function of a counterfeit information generation unit 29c instead of the damage information generation unit 21a of Embodiment 1.

[0231] The counterfeit information generation unit 29c generates (extracts), from an image (input image for style) of a first money, counterfeit information relating to counterfeit of the first money, specifically a feature relating to counterfeit, for example. In other words, the first money may be a counterfeit money.

[0232] In this case, the input image for style (image of the first money) may be an image of the first money having any counterfeit characteristic and may have any pattern (design, marking). The conversion source image (image of a second money) may be an image of the second money to which the counterfeit characteristic of the input image for style is to be given, and may be one having no counterfeit characteristic. In other words, the second money may be not a counterfeit money but a genuine money.

[0233] The type, i.e., the denomination, of the first money may be different from the type, i.e., the denomination, of the second money. Even in this case, an image of a virtual money corresponding to the second coin having a desired counterfeit characteristic can be generated.

[0234] The virtual money information generation unit 23a generates, from the counterfeit information generated by the counterfeit information generation unit 29c and the pattern information generated by the pattern information generation unit 22a, an image (image information) of a virtual money as a fusion (synthesis) of the counterfeit information and the pattern information. This results in generation of an image of a money (not an actually existing one but a virtual one) having a counterfeit characteristic similar to that of the first money and having the pattern of the second money.

[0235] The counterfeit information generation unit 29c may also be constructed of a learned model, for example, a learned model utilizing a CNN. The CNN of the virtual money information generation unit 23c may be coupled with the respective CNNs of the counterfeit information generation unit 29c and the pattern information generation unit 22c.

[0236] The learned models of the counterfeit information generation unit 29c, the pattern information generation unit 22a, and the virtual money information generation unit 23a each may function as an inference program including learned parameters (coefficients) obtained as a result of learning with a data set.

[0237] Each learned model may be provided with additional learning. In other words, each learned model may be provided with a data set different from that of the previous learning and undergo further learning, generating new learned parameters. The learned models incorporated with these new learned parameters may be used.

[0238] With reference to FIG. 15, the following describes the steps of processing executed by the money information generation device 10c.

[0239] As shown in FIG. 15, first, the counterfeit information generation unit 29c generates counterfeit information of a first coin from an image (input image for style) of the first coin input to the money information generation device 10c (Step S41).

[0240] The pattern information generation unit 22a generates pattern information of a second coin from an image (conversion source image) of the second coin input to the money information generation device 10c (Step S42).

[0241] Steps S41 and S42 may be executed in the order of Steps S41 and S42 as shown in FIG. 15, or may be executed in the order of Steps S42 and S41, or may be executed in parallel.

[0242] Next, the virtual money information generation

unit 23a generates, from the counterfeit information generated in Step S41 and the pattern information generated in Step S42, an image of a virtual coin as a fusion of the counterfeit information and the pattern information (Step S43). Thereby, the processing is completed.

[0243] The aforementioned Steps S41 to S43 may be executed on predetermined samples to generate images of a plurality of virtual coins counterfeited by different techniques and having the same pattern as the second coin.

[0244] An example of generating counterfeit information may be a money information generation device 10C shown in FIG. 16 and FIG. 17, for example. In this case, during machine learning and after machine learning, the control unit 20 of the money information generation device 10C has a function of a counterfeit information generation unit 29 instead of the damage information generation unit 21 of Embodiment 2.

[0245] The counterfeit information generation unit 29 generates (extracts), from an image (input image for style) of a first money, counterfeit information relating to counterfeit of the first money, specifically a feature relating to counterfeit, for example. In other words, the first money is a counterfeit money.

[0246] In this case, the input image for style (image of the first money) is an image of the first money having any counterfeit characteristic and may have any pattern (design, marking). The conversion source image (image of a second money) is an image of the second money to which the counterfeit characteristic of the input image for style is to be given, and is one having no counterfeit characteristic. In other words, the second money is not a counterfeit money but a genuine money.

[0247] The type, i.e., the denomination, of the first money may be different from the type, i.e., the denomination, of the second money. Even in this case, an image of a virtual money corresponding to the second coin having a desired counterfeit characteristic can be generated.

[0248] The virtual money information generation unit 23 generates, from the counterfeit information generated by the counterfeit information generation unit 29 and the pattern information generated by the pattern information generation unit 22, an image (image information) of a virtual money as a fusion (synthesis) of the counterfeit information and the pattern information. This results in generation of an image of a money (not an actually existing one but a virtual one) having a counterfeit characteristic similar to that of the first money and having the pattern of the second money.

[0249] The counterfeit information generation unit 29 is also constructed of a learned model, for example, a learned model utilizing a CNN. The CNN of the virtual money information generation unit 23 is coupled with the respective CNNs of the counterfeit information generation unit 29 and the pattern information generation unit 22.

[0250] The learned models of the counterfeit information generation unit 29, the pattern information generation unit 22, and the virtual money information generation unit 23 each function as an inference program including learned parameters (coefficients) obtained as a result of learning with a data set.

[0251] Each learned model may be provided with additional learning. In other words, each learned model may be provided with a data set different from that of the previous learning and undergo further learning, generating new learned parameters. The learned models incorporated with these new learned parameters may be used.

[0252] To make an image of a virtual money generated by the virtual money information generation unit 23 look like an actually existing counterfeit money, the learning unit 24 provides machine learning of a machine-learning algorithm relating to generation of counterfeit information by the counterfeit information generation unit 29, a machine-learning algorithm relating to generation of pattern information by the pattern information generation unit 22, and a machine-learning algorithm relating to generation of money information of a virtual money by the virtual money information generation unit 23. This machine-learning results in learned models of the counterfeit information generation unit 29, the pattern information generation unit 22, and the virtual money information generation unit 23. Each machine-learning algorithm may utilize a CNN like the aforementioned learned models.

[0253] The learning unit 24 includes a machine-learning algorithm (e.g., one utilizing a CNN), and executes machine learning based on an image of a virtual money (output image) generated by the virtual money information generation unit 23 and an image of an actually existing counterfeit money (training data). In other words, an image of a virtual coin and an image of a real coin are used in learning so as to more accurately determine whether an image of a virtual money generated by the virtual money information generation unit 23 is a virtual one or an actually existing one. The learning unit 24 then provides an error between the output from the learning unit 24 and a desired output (correct answer) as a teaching signal to the respective machine-learning algorithms relating to the learning unit 24, the counterfeit information generation unit 29, the pattern information generation unit 22, and the virtual money information generation unit 23, which gradually changes the coupling coefficients of the respective CNNs and finally enables a correct output.

[0254] The template generation unit 25 generates template information from images of a plurality of virtual moneys having different features relating to counterfeit and having the same pattern as the second coin generated using the machine-learned counterfeit information generation unit 29, pattern information generation unit 22, and virtual money information generation unit 23.

[0255] In the money handling system or money handling device (both not shown) including the money information generation device 10C, like the money handling system 100 or the money handling device 200 of Embodiment 2, the money handling device, in particular the built-in coin recognition device, can execute processing of recognizing a coin to be handled, in particular process-

ing of recognizing the authenticity, using the template information stored in the storage unit.

[0256] This money handling system or money handling device may include the money information generation device 10c instead of the money information generation device 10C. Images of a plurality of virtual coins generated by the money information generation device 10c may be acquired from the money information generation device 10c. In this case, the money handling system or money handling device may generate template information based on the images of the virtual coins acquired and store it in the storage unit.

[0257] Described in the above embodiments and modified embodiments is the case where the learned models and the machine-learning algorithms are each based on a CNN. Alternatively, the learned models and the machine-learning algorithms may be any of those utilized in machine learning (e.g., deep learning), and may be those utilizing a deep neural network (DNN) or ResNet (deep residual network) other than the CNNs.

[0258] Described in the above embodiments and modified embodiments is the case where each money information generation device is configured as a single device. Alternatively, the device may be embodied as a distributed handling system in which the functions of the money information generation device are distributed to a plurality of devices as appropriate. For example, during machine learning, the functions of the damage information generation unit 21, the pattern information generation unit 22, and the virtual money information generation unit 23 and the function of the learning unit 24 may be distributed to different devices. After machine learning, the functions of the pattern information generation unit 22 and the virtual money information generation unit 23 and the function of the template generation unit 25 may be distributed to different devices.

[0259] Hereinabove, embodiments of the disclosure have been described with reference to the drawings. The present disclosure is not limited to the above embodiments. The structures of the embodiments may be combined or modified as appropriate within the range not departing from the gist of the disclosure.

INDUSTRIAL APPLICABILITY

[0260] As described above, the present disclosure relates to a technique useful for generating coin information of a virtual money corresponding to a money having a desired damage condition even in a situation where no real one of such a money is available.

Claims

1. A money information generation device comprising a control unit configured to:

generate, from money information of a first money, damage information relating to damage of the first money;
generate, from money information of a second money, pattern information relating to a pattern of the second money; and
generate, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

2. The money information generation device according to claim 1,
wherein the control unit is configured to provide machine learning of a machine-learning algorithm relating to generation of the damage information, a machine-learning algorithm relating to generation of the pattern information, and a machine-learning algorithm relating to generation of the money information of the virtual money so as to make the money information of the virtual money look like a real one.

3. The money information generation device according to claim 1 or 2,

wherein the first money is an unfit money, and the second money is a new money.

4. The money information generation device according to claim 1 or 2,

wherein the first money is a new money, and the second money is an unfit money.

5. The money information generation device according to any one of claims 1 to 4,
wherein a type of the first money is different from a type of the second money.

6. The money information generation device according to any one of claims 1 to 5,
wherein a material of the first money is the same as a material of the second money.

7. The money information generation device according to any one of claims 1 to 5,

wherein the second money includes a first region comprising a first material that is the same as a material of the first money and a second region comprising a second material, and
the control unit is configured to:

generate, from money information of the first region, pattern information relating to a pattern of the first region; and
generate, from the damage information and the pattern information of the first region, money information of a virtual first region as

a fusion of the damage information and the pattern information of the first region.

8. The money information generation device according to claim 7,

wherein the second material is different from the material of the first money and is the same as a material of a third money, and
the control unit is configured to:

generate, from money information of the third money, damage information relating to damage of the third money;
generate, from money information of the second region, pattern information relating to a pattern of the second region; and
generate, from the damage information of the third money and the pattern information of the second region, money information of a virtual second region as a fusion of the damage information of the third money and the pattern information of the second region.

9. The money information generation device according to any one of claims 1 to 5, further comprising a storage unit,

wherein the second money includes a first region comprising a first material that is the same as a material of the first money and a second region comprising a second material that is different from the material of the first money and is the same as a material of a third money,
the storage unit is configured to store a correlation between a feature of a third region and a feature of a fourth region generated from money information of a fourth money that includes the third region comprising the first material and the fourth region comprising the second material, and
the control unit is configured to generate the money information of the virtual money based on the correlation.

10. The money information generation device according to claim 9,
wherein the control unit is configured to:

generate, from pieces of money information of a plurality of first moneys comprising the same material and having different damage conditions, a plurality of pieces of damage information relating to the first moneys;
generate, from pieces of money information of a plurality of third moneys comprising the same material and having different damage conditions, a plurality of pieces of damage information relating to the third moneys;
generate, from the pieces of damage information relating to the first moneys and the pattern information, pieces of money information of a plurality of first virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the first moneys and the pattern information;
generate, from the pieces of damage information relating to the third moneys and the pattern information, pieces of money information of a plurality of second virtual moneys each as a fusion of a respective one of the pieces of damage information relating to the third moneys and the pattern information;
calculate, from each of the pieces of money information of the first virtual moneys, a first feature of a region corresponding to the first region;
calculate, from each of the pieces of money information of the second virtual moneys, a second feature of a region corresponding to the second region;
determine a combination of an optimal first feature and an optimal second feature among a plurality of the first features and a plurality of the second features based on the correlation; and
generate, from a piece of money information of a first virtual money and a piece of money information of a second virtual money respectively corresponding to the optimal first feature and the optimal second feature, money information of a third virtual money including the piece of money information of the first virtual money at a region corresponding to the first region and the piece of money information of the second virtual money at a region corresponding to the second region.

11. The money information generation device according to any one of claims 1 to 10,
wherein the damage information is information relating to damage of a base of the first money.

12. The money information generation device according to any one of claims 1 to 11,

wherein a type of the first money is the same as a type of the second money,
the control unit is configured to:

generate, from money information of a first side of the first money, damage information relating to damage of the first side;
generate, from money information of a second side that is different from the first side of the second money, pattern information relating to a pattern of the second side; and

generate, from the damage information of the first side and the pattern information of the second side, money information of a virtual second side as a fusion of the damage information of the first side and the pattern information of the second side.

13. The money information generation device according to any one of claims 1 to 12, wherein the money information is image information.

14. A money handling system comprising:

the money information generation device according to any one of claims 1 to 13; and
a money handling device comprising a storage unit configured to store template information based on the money information of the virtual money.

15. A money handling device comprising:

the money information generation device according to any one of claims 1 to 13; and
a storage unit configured to store template information based on the money information of the virtual money.

16. A money information generation system comprising:

a damage information generation unit configured to generate, from money information of a first money, damage information relating to damage of the first money;
a pattern information generation unit configured to generate, from money information of a second money, pattern information relating to a pattern of the second money; and
a virtual money information generation unit configured to generate, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

17. A money information generation method comprising:

generating, from money information of a first money, damage information relating to damage of the first money;
generating, from money information of a second money, pattern information relating to a pattern of the second money; and
generating, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

18. A money information generation program causing a computer to function as:

a means for generating, from money information of a first money, damage information relating to damage of the first money;
a means for generating, from money information of a second money, pattern information relating to a pattern of the second money; and
a means for generating, from the damage information and the pattern information, money information of a virtual money as a fusion of the damage information and the pattern information.

19. A money information generation device comprising a control unit configured to:

generate, from money information of a first money, counterfeit information relating to counterfeit of the first money;
generate, from money information of a second money, pattern information relating to a pattern of the second money; and
generate, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

20. A money handling system comprising:

the money information generation device according to claim 19; and
a money handling device comprising a storage unit configured to store template information based on the money information of the virtual money.

21. A money handling device comprising:

the money information generation device according to claim 19; and
a storage unit configured to store template information based on the money information of the virtual money.

22. A money information generation system comprising:

a counterfeit information generation unit configured to generate, from money information of a first money, counterfeit information relating to counterfeit of the first money;
a pattern information generation unit configured to generate, from money information of a second money, pattern information relating to a pattern of the second money; and
a virtual money information generation unit configured to generate, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the

counterfeit information and the pattern information.

23. A money information generation method comprising:

generating, from money information of a first money, counterfeit information relating to counterfeit of the first money;
generating, from money information of a second money, pattern information relating to a pattern of the second money; and
generating, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

24. A money information generation program causing a computer to function as:

a means for generating, from money information of a first money, counterfeit information relating to counterfeit of the first money;
a means for generating, from money information of a second money, pattern information relating to a pattern of the second money; and
a means for generating, from the counterfeit information and the pattern information, money information of a virtual money as a fusion of the counterfeit information and the pattern information.

FIG.1

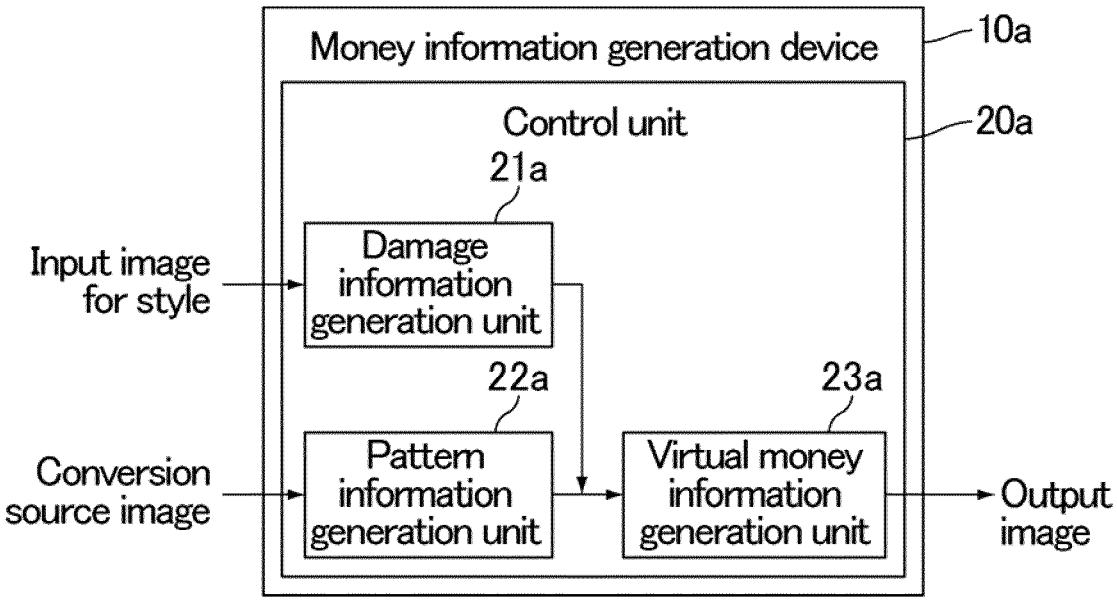

Money information generation device
10a
Control unit
20a
21a
Damage information generation unit
Input image for style
22a
23a
Pattern information generation unit
Virtual money information generation unit
Conversion source image
Output image

FIG.2

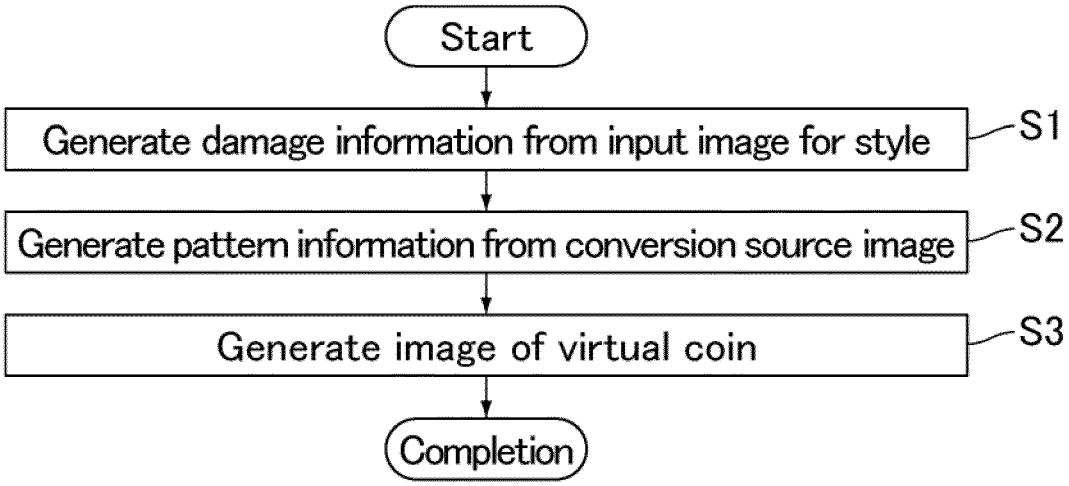

Start
Generate damage information from input image for style
S1
Generate pattern information from conversion source image
S2
Generate image of virtual coin
S3
Completion

FIG.3

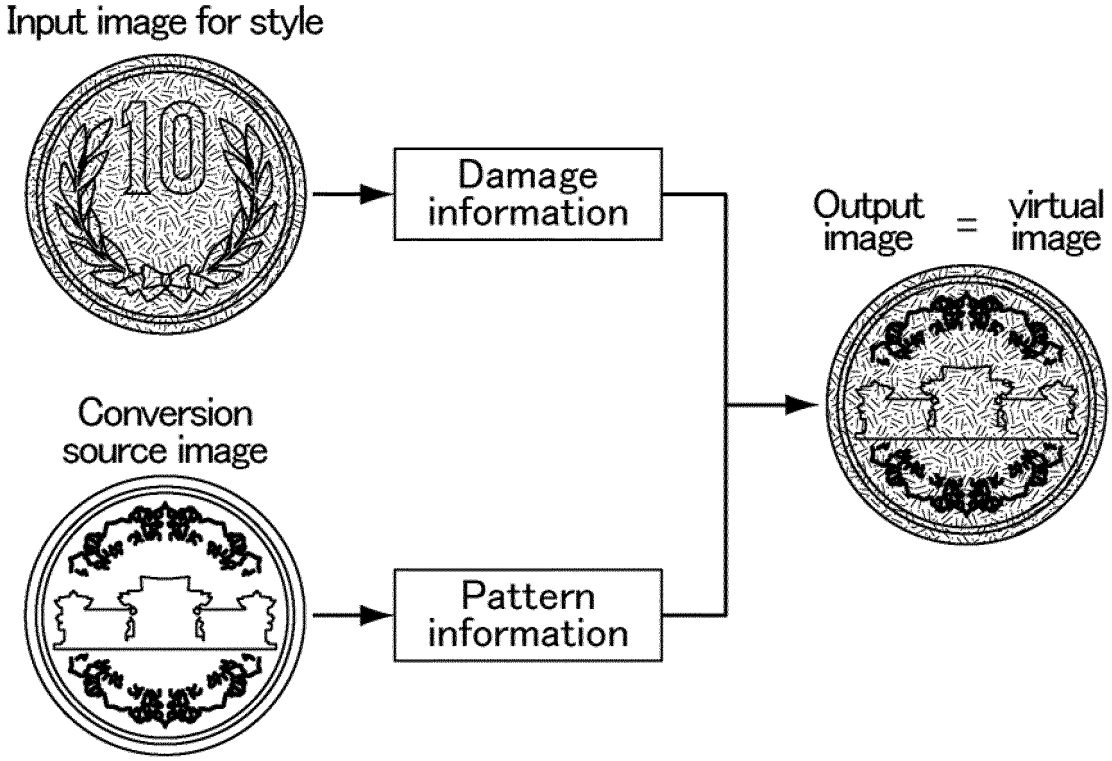

Input image for style
Damage information
Output image
=
virtual image
Conversion source image
Pattern information

FIG.4

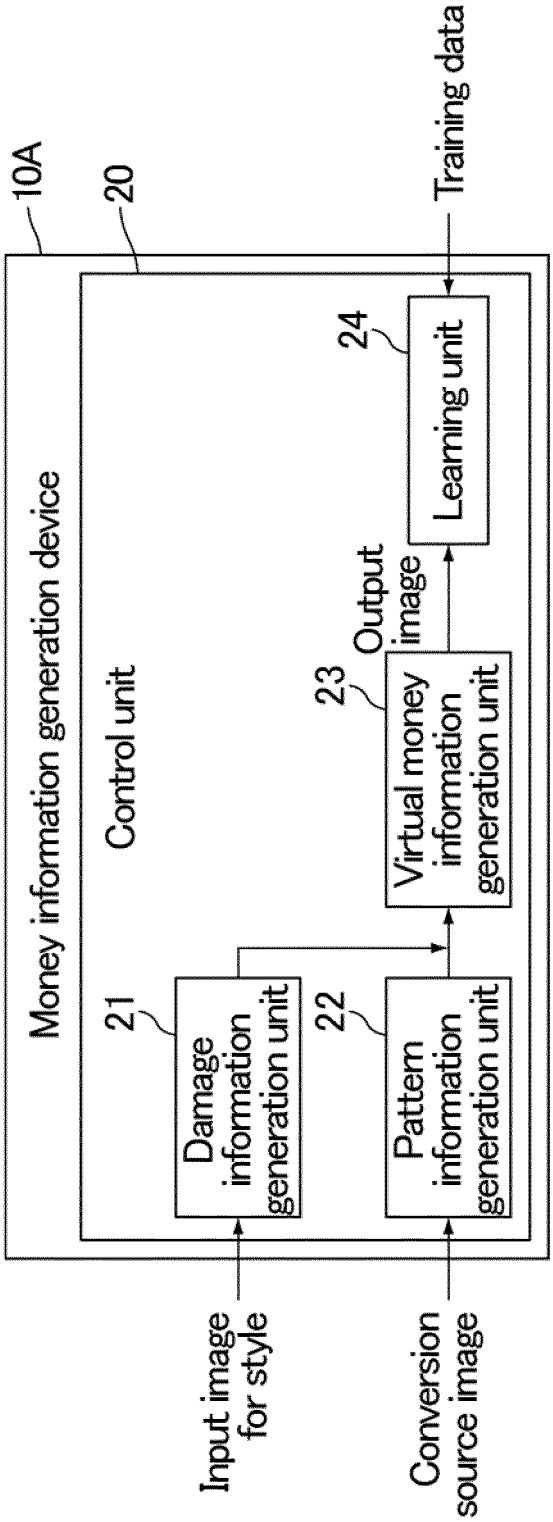

10A
20
Training data
Money information generation device
Control unit
24
Learning unit
Output image
23
Virtual money information generation unit
21
Damage information generation unit
22
Pattern information generation unit
Input image for style
Conversion source image

FIG.5

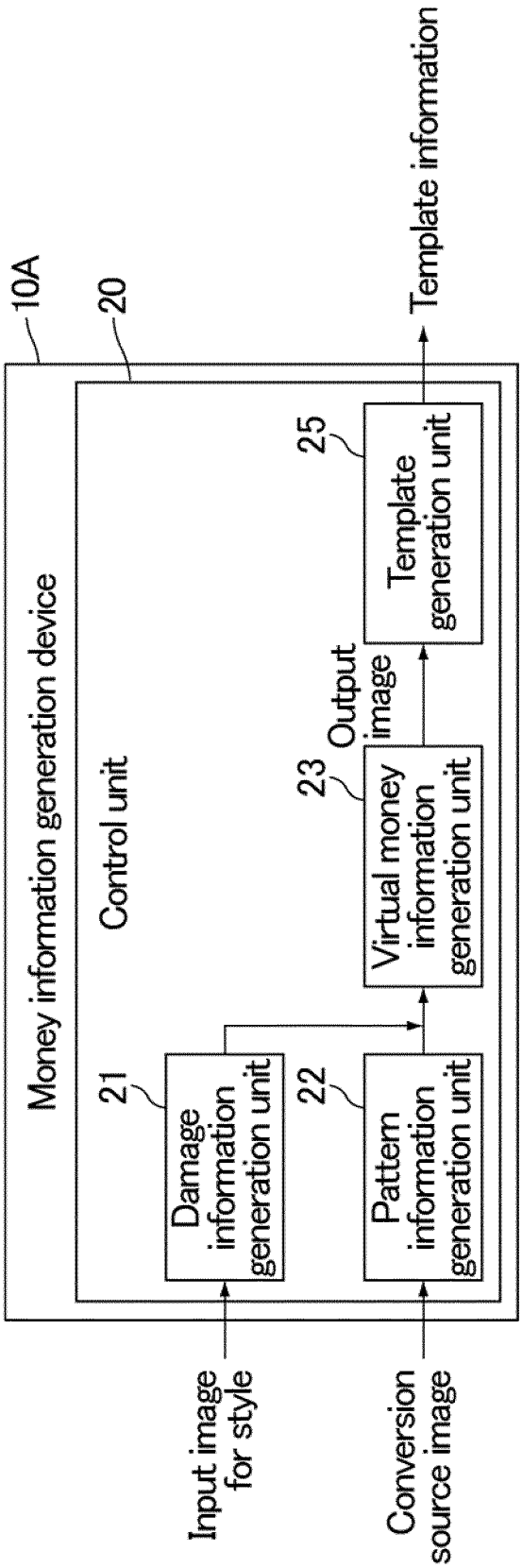

10A
Money information generation device
20
Control unit
21
Damage information generation unit
22
Pattern information generation unit
23
Virtual money information generation unit
Output image
25
Template generation unit
Template information
Input image for style
Conversion source image

FIG.6

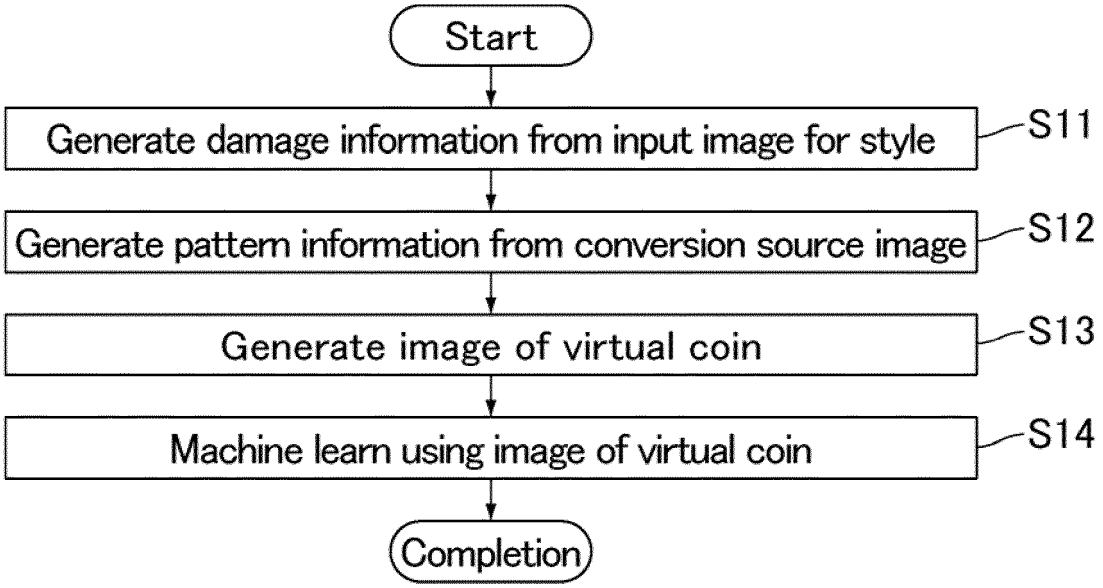

Start
Generate damage information from input image for style
S11
Generate pattern information from conversion source image
S12
Generate image of virtual coin
S13
Machine learn using image of virtual coin
S14
Completion

FIG.7

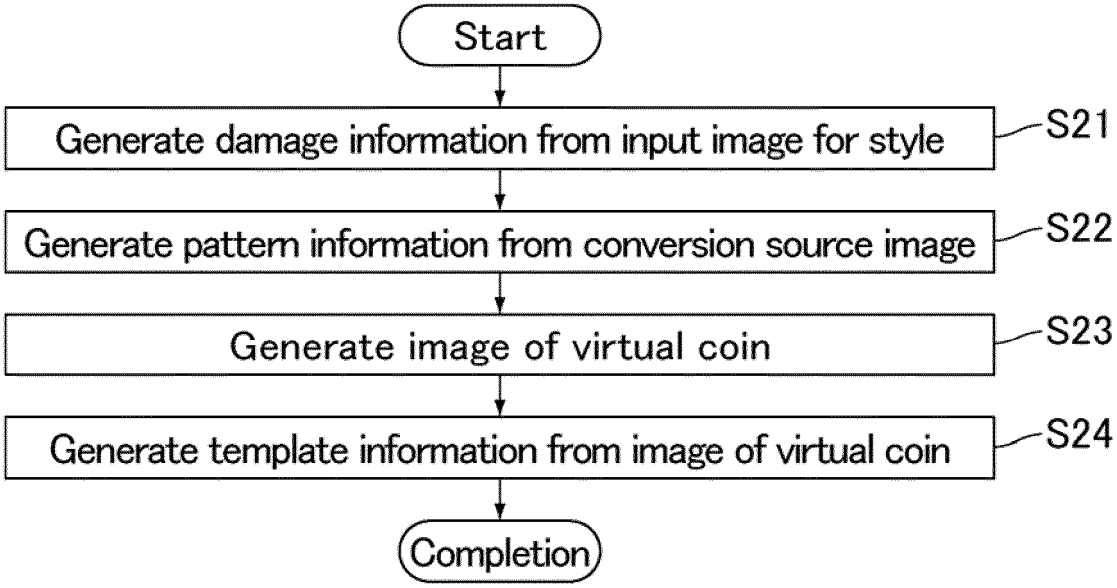

Start
Generate damage information from input image for style
S21
Generate pattern information from conversion source image
S22
Generate image of virtual coin
S23
Generate template information from image of virtual coin
S24
Completion

FIG.8

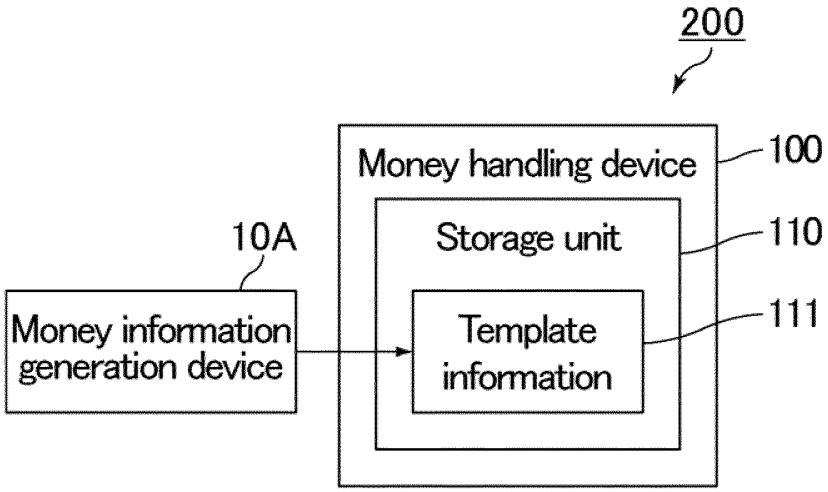

200
Money handling device
100
Storage unit
110
10A
Money information generation device
Template information
111

FIG.9

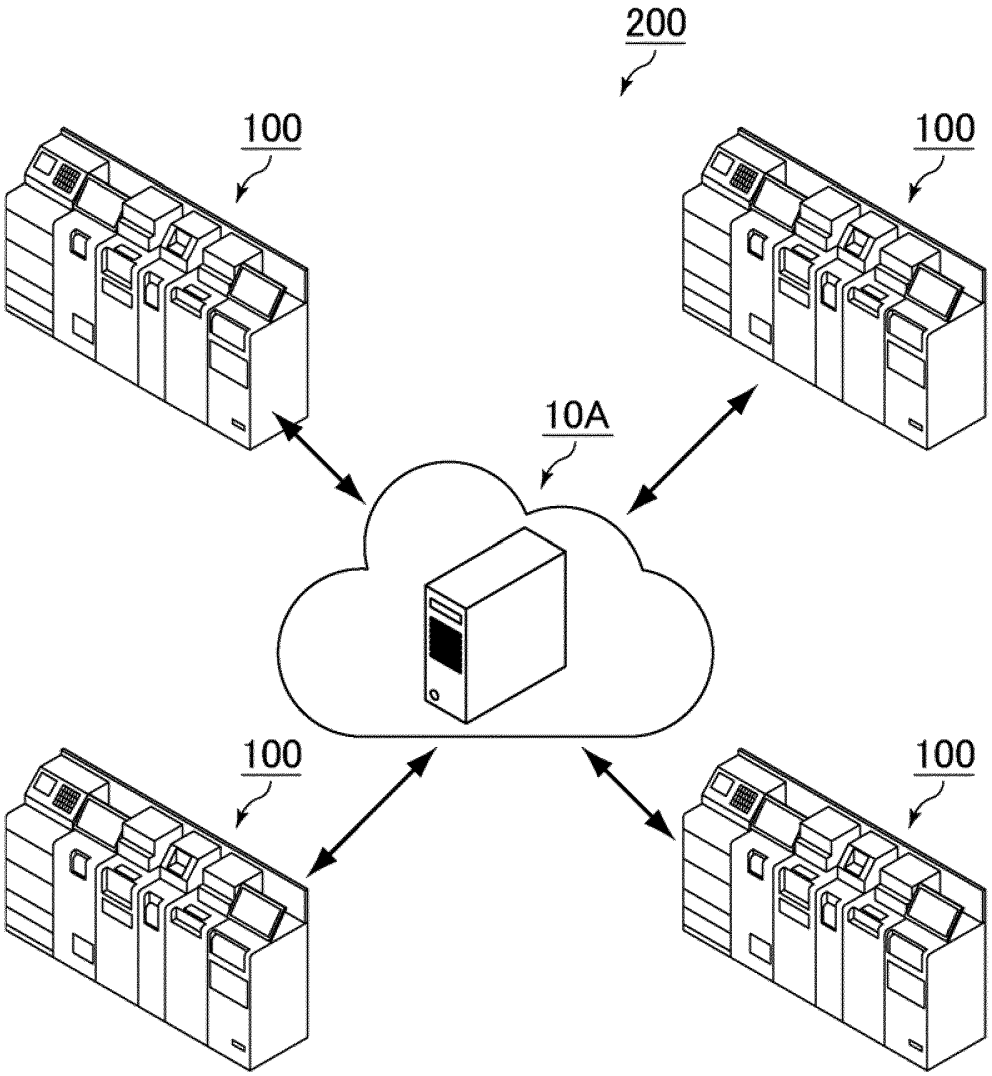

200
100
100
10A
100
100

FIG.10

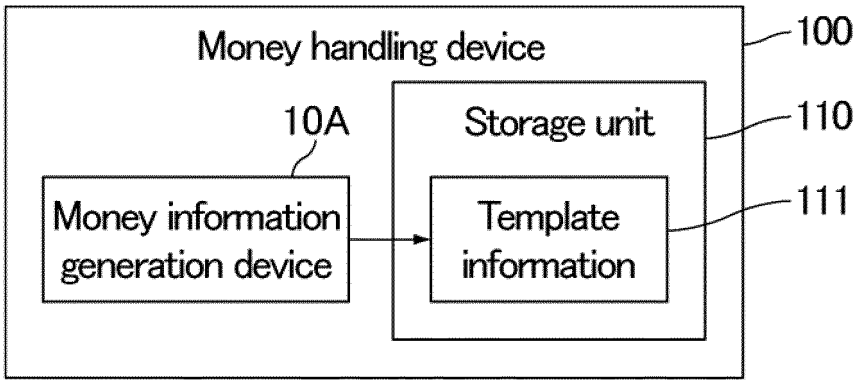

Money handling device
100
10A
Storage unit
110
Money information generation device
Template information
111

FIG.11

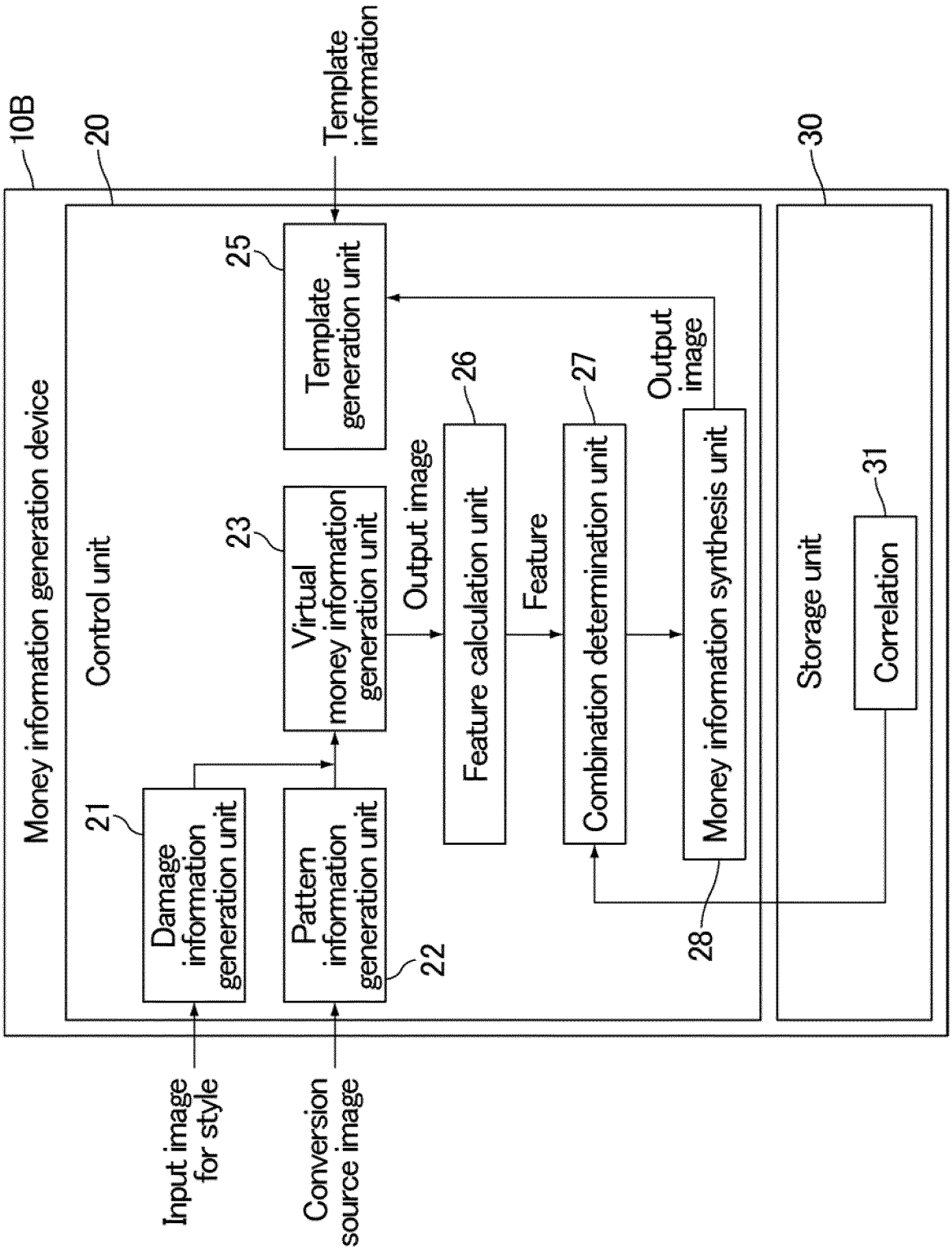

10B
Money information generation device
20
Control unit
Template information
25
Template generation unit
23
Virtual money information generation unit
Output image
26
Feature calculation unit
Feature
27
Combination determination unit
Output image
Money information synthesis unit
28
30
Storage unit
31
Correlation
21
Damage information generation unit
Pattern information generation unit
22
Input image for style
Conversion source image

FIG.12

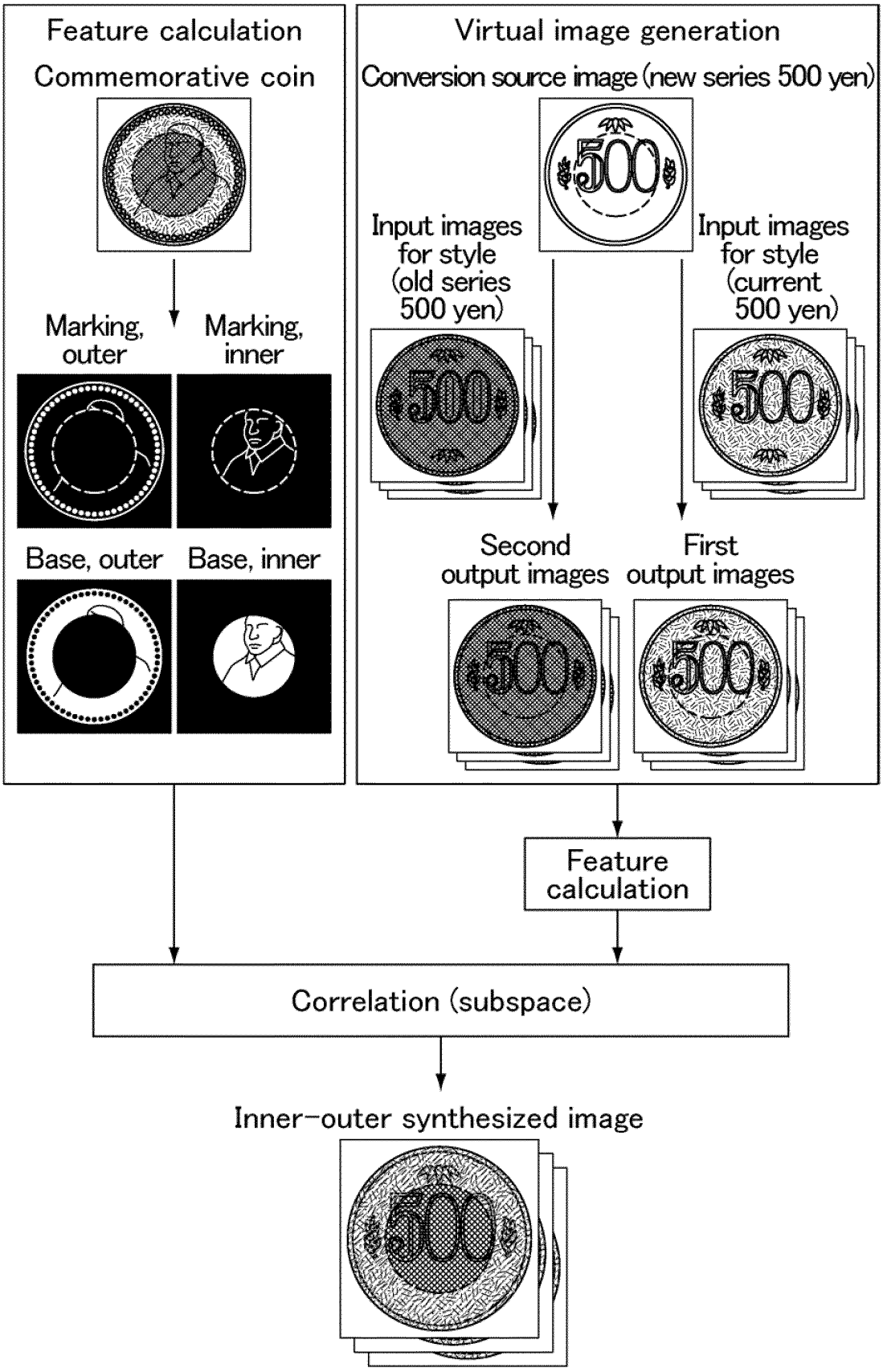

Feature calculation
Commemorative coin
Marking, outer
Marking, inner
Base, outer
Base, inner
Virtual image generation
Conversion source image (new series 500 yen)
Input images for style (old series 500 yen)
Input images for style (current 500 yen)
Second output images
First output images
Feature calculation
Correlation (subspace)
Inner-outer synthesized image

FIG.13

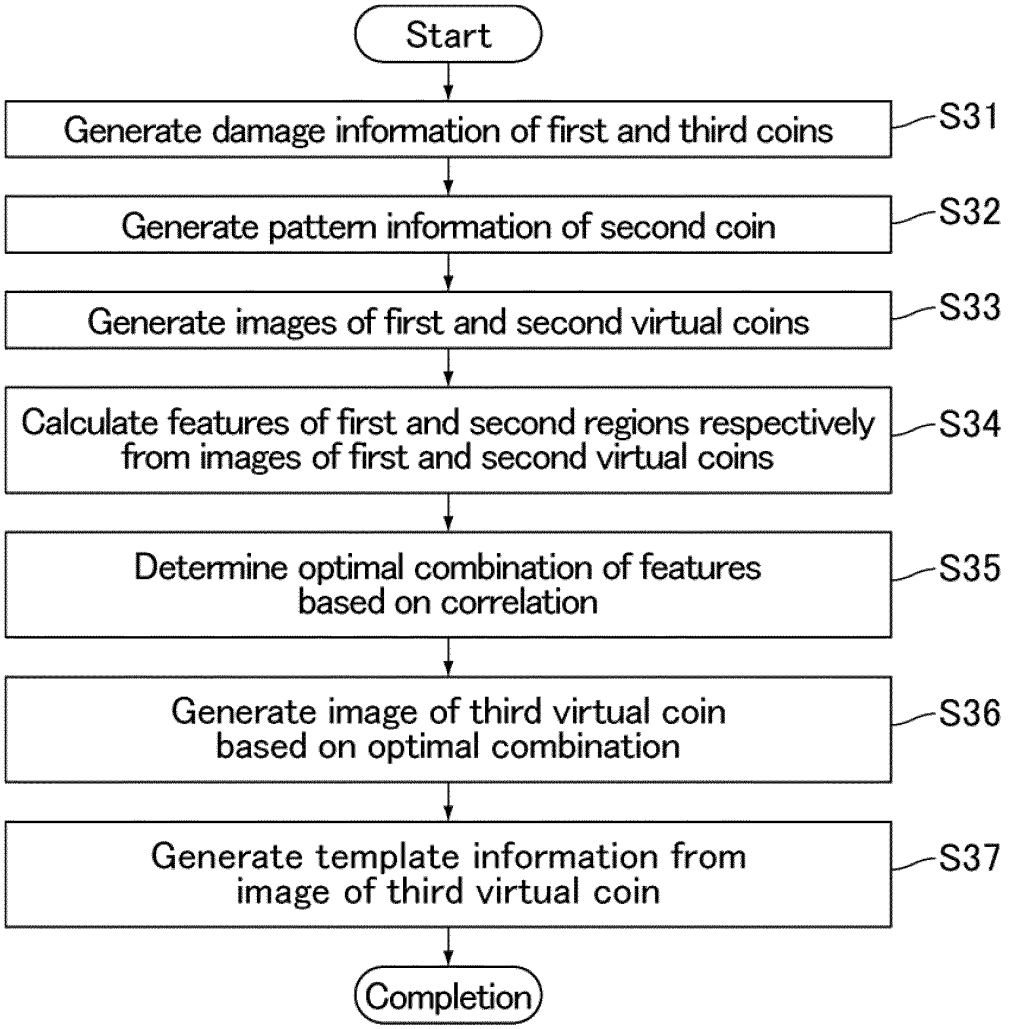

Start
Generate damage information of first and third coins
S31
Generate pattern information of second coin
S32
Generate images of first and second virtual coins
S33
Calculate features of first and second regions respectively from images of first and second virtual coins
S34
Determine optimal combination of features based on correlation
S35
Generate image of third virtual coin based on optimal combination
S36
Generate template information from image of third virtual coin
S37
Completion

FIG.14

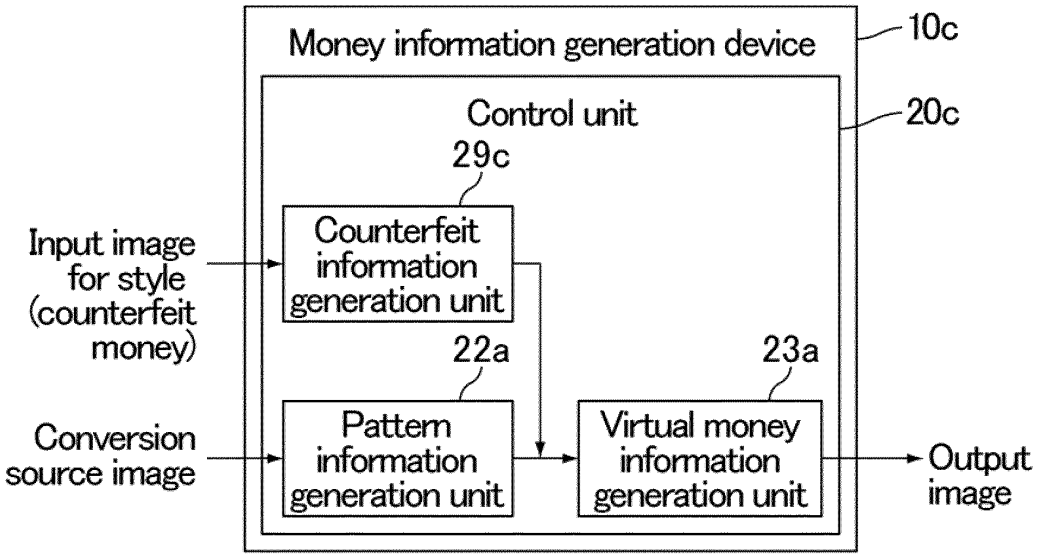

Money information generation device
10c
Control unit
20c
29c
Input image for style (counterfeit money)
Counterfeit information generation unit
22a
23a
Conversion source image
Pattern information generation unit
Virtual money information generation unit
Output image

FIG.15

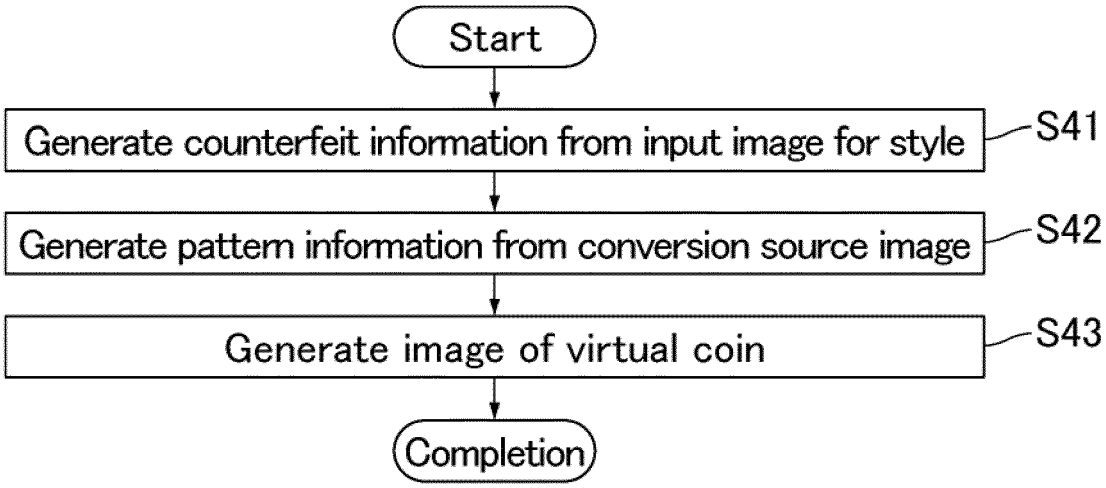

Start
Generate counterfeit information from input image for style
S41
Generate pattern information from conversion source image
S42
Generate image of virtual coin
S43
Completion

FIG.16

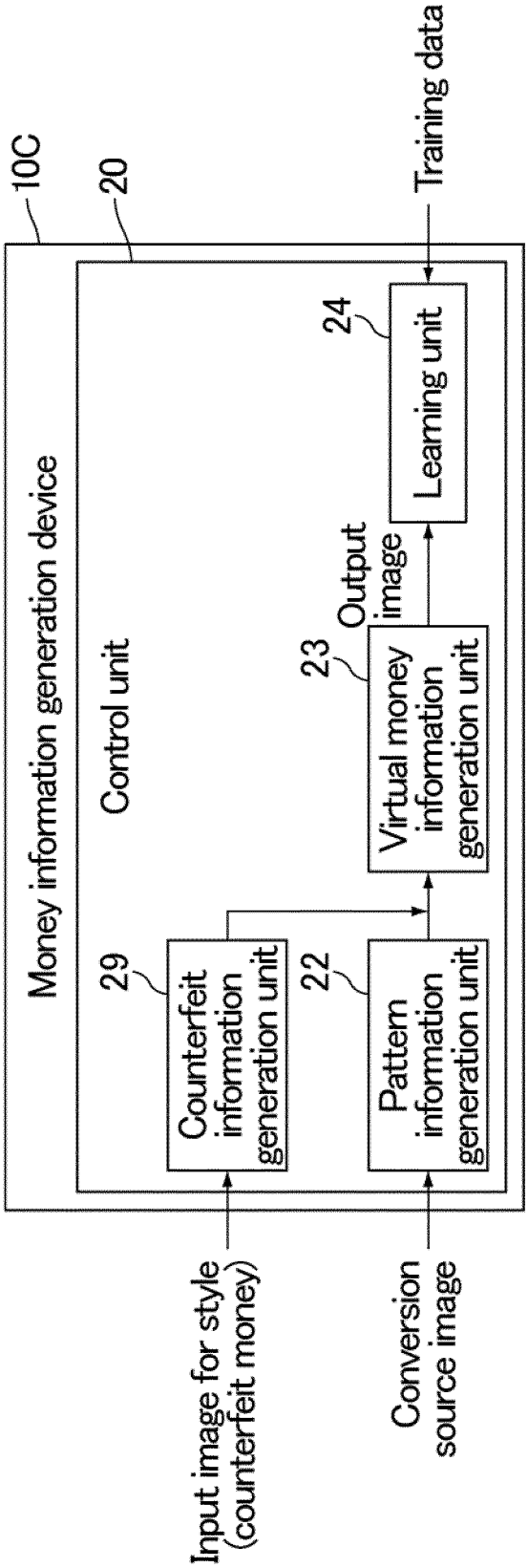
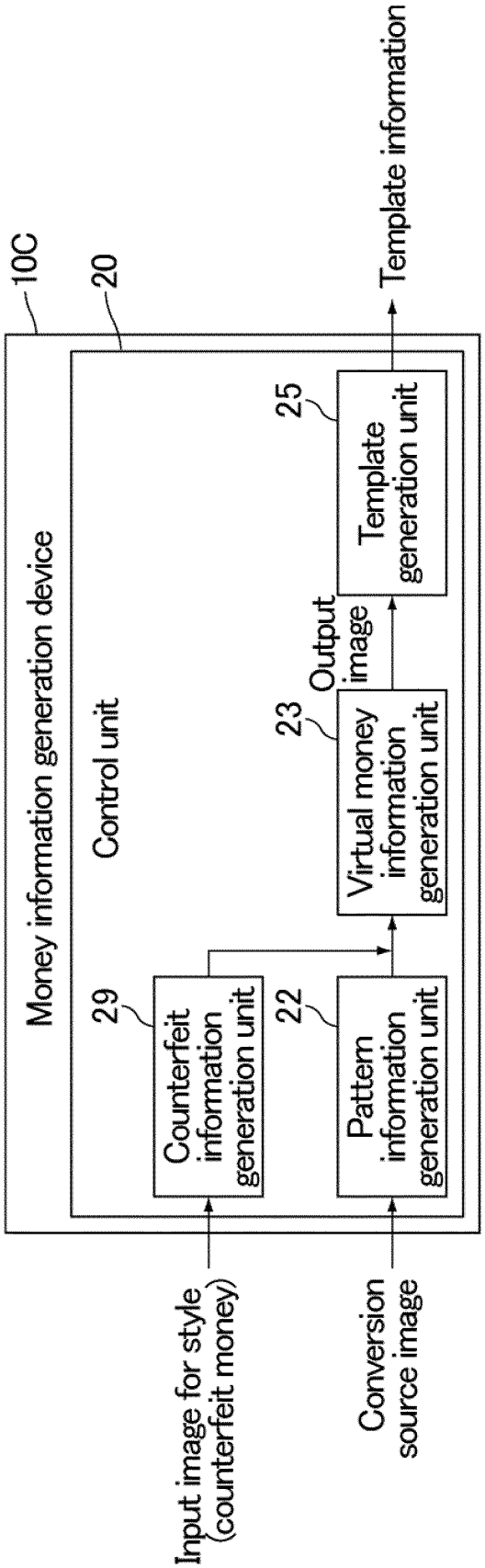

10C
20
Training data
Money information generation device
Control unit
24
Learning unit
Output image
23
Virtual money information generation unit
29
Counterfeit information generation unit
22
Pattern information generation unit
Input image for style (counterfeit money)
Conversion source image

FIG.17


10C
Money information generation device
20
Control unit
29
Counterfeit information generation unit
22
Pattern information generation unit
23
Virtual money information generation unit
Output image
25
Template generation unit
Template information
Input image for style (counterfeit money)
Conversion source image

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/011747

A. CLASSIFICATION OF SUBJECT MATTER
Int. Cl. G07D5/02(2006.01)i, G06T7/00(2017.01)i, G07D7/00(2016.01)i, G07D7/206(2016.01)i
FI: G07D7/00 J, G07D5/02, G07D7/206, G06T7/00 300D, G06T7/00 350B
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
Int. Cl. G06T7/00, G07D1/00-G07D13/00, G07F19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2010-026848 A (HITACHI-OMRON TERMINAL SOLUTIONS, CORP.) 04 February 2010, paragraphs [0022], [0036], [0084]	1, 3, 11, 13-18 2-3, 5-6, 11, 13-15
A		4, 7-10, 12
Y	JP 10-171993 A (OKI ELECTRIC INDUSTRY CO., LTD.) 26 June 1998, paragraph [0020]	2-3, 5-6, 11, 13-15
A	JP 9-204522 A (SANYO ELECTRIC CO., LTD.) 05 August 1997, entire text, all drawings	1-24
A	JP 2016-004332 A (OMRON CORP.) 12 January 2016, entire text, all drawings	1-24

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15.04.2021	18.05.2021

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/011747

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002-109598 A (FUJI ELECTRIC CO., LTD.) 12 April 2002, entire text, all drawings	19-24
A	JP 2004-246714 A (NIDEC COPAL CORP.) 02 September 2004, entire text, all drawings	19-24

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2021/011747

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