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(54) INTELLIGENT WATERLESS DIGITAL PRINTING INTEGRATED MACHINE BASED ON INTERNET OF THINGS

(57) The disclosure relates to an intelligent waterless digital printing integrated machine based on an Internet of Things, which includes a processing unit for performing heat treatment and performing local cooling treatment on a target fabric; an information acquisition unit for performing a hydrophilic test on a surface of the target fabric and detecting a contact angle between a test droplet and the target fabric; an analysis and processing unit for determining a heat treatment duration of a preheating treatment device when the target fabric does not meet a hydrophilic requirement, determining whether to turn on a water spray cooling device and determining an operation mode of the water spray cooling device according to an area of the target fabric; a digital printing unit for digital printing; a printing control unit for determining a parameter adjustment mode of the digital printing unit according to texture parameters of the target fabric.

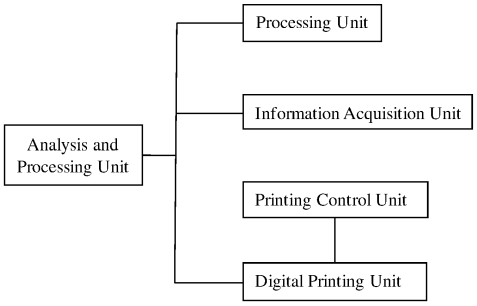

FIG. 1

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Description

TECHNICAL FIELD

[0001] The disclosure relates to the field of digital printing, in particular to an intelligent waterless digital printing integrated machine based on Internet of Things.

BACKGROUND ART

[0002] Digital printing is that a pattern is input into a computer in a digital form and is edited and processed by a computer printing color-separation pattern-designing system, and then a computer controls a micro-piezoelectric ink jet mouth to directly spray a special dye solution on a textile so as to form a required pattern. In a conventional process, the ink may flush along fibers after the ink is jet printed on fabric due to characteristics of ordinary fabric, which blurs a jet printed pattern. Therefore, sizing is required on the fabric before printing to solve a problem of color flushing of a digital jet printed pattern, and washing is required to remove the sizing after printing. This washing process causes a lot of waste water with residual dye solutions, and if heating is added, more energy is wasted. Additionally, soaping is required after washing, which is time-consuming, material-consuming, water-wasting and energy-wasting.

[0003] A digital printing machine and a digital printing system are disclosed in Chinese patent publication No. CN102173201B, which include a machine frame, a printing head, a mobile platform, and at least two working tables installed on the mobile platform for installing an object to be printed, at least one mobile-platform transmission device connected with the mobile platform for driving the movable platform to move, and a printing-head transmission device connected with the printing head for driving the printing head to move. The mobile-platform transmission device and the printing-head transmission device are installed on the machine frame. It can be seen that the above technical scheme has a problem that operation parameters of the system cannot be determined according to texture characteristics and fabric properties of an actual fabric, resulting in poor printing effect.

SUMMARY

[0004] Therefore, an intelligent waterless digital printing integrated machine based on an Internet of Things is provided in the disclosure, which is used to solve a problem in related art that operation parameters of a system cannot be determined according to texture characteristics and fabric properties of an actual fabric, resulting in poor printing effect.

[0005] In order to achieve above purposes, an intelligent waterless digital printing integrated machine based on the Internet of Things is provided in the disclosure, which includes:

a processing unit including a preheating device for heat treatment of a target fabric and a water spray cooling device for performing local cooling treatment on the target fabric;

an information acquisition unit including a dripping device for performing a hydrophilic test on a surface to be printed of the target fabric and a visual detection device for detecting a contact angle between a test droplet and the target fabric;

an analysis and processing unit respectively connected with the processing unit and the information acquisition unit, and configured for determining whether the target fabric meets a hydrophilic requirement according to the contact angle, determining a heat treatment duration of the preheating treatment device according to the contact angle when the target fabric does not meet the hydrophilic requirement, re-detecting a contact angle of a pattern printing region of the target fabric after the heat treatment is completed so as to determine whether to turn on the water spray cooling device, and determining an operation mode of the water spray cooling device according to an area of a non-printing region of the target fabric;

a digital printing unit connected with the analysis and processing unit and configured for performing digital ink-jet printing on the target fabric; and

a printing control unit connected with the digital printing unit and configured for determining a parameter adjustment mode of the digital printing unit according to texture parameters of the target fabric.

[0006] The parameter adjustment mode includes adjusting an ink-jet pressure of the digital printing unit and/or adjusting an ink-jet distance of the digital printing unit. The texture parameters of the target fabric are determined according to a yarn diameter of a fabric surface to be printed and a yarn density of the fabric surface to be printed of the target fabric.

[0007] Further, the analysis and processing unit is configured to determine whether the target fabric meets the hydrophilic requirement according to the contact angle; and

determine that the target fabric does not meet the hydrophilic requirements if the contact angle of the target fabric is greater than a reference value of a hydrophilic contact angle.

[0008] Further, the analysis and processing unit is configured to calculate difference △ R between the contact angle R of the target fabric and the reference value R0 of the hydrophilic contact angle under a first hydrophilic adjustment condition, and determine the heat treatment duration of the preheating processing device according to △R.

[0009] The difference △R has a positive correlation with the heat treatment duration of the preheating treatment device.

[0010] The first hydrophilic adjustment condition is that

the contact angle of the target fabric is greater than the reference value of the hydrophilic contact angle.

[0011] Further, the analysis and processing unit is configured to re-control the information acquisition unit to perform a hydrophilic test on the surface to be printed of the target fabric upon the heat treatment of the preheating treatment device is completed, and detect a contact angle between a test droplet and the pattern printing region of the target fabric; and determine a water spray cooling temperature of the water spray cooling device according to contact angle difference between the contact angle and the reference value of the hydrophilic contact angle, if the contact angle is smaller than the reference value of the hydrophilic contact angle.

[0012] The contact angle difference has a positive correlation with the water spray cooling temperature of the water spray cooling device.

[0013] Further, the analysis and processing unit is configured to determine the operation mode of the water spray cooling device according to the area of the non-printing region of the target fabric under a slight cold spraying condition.

[0014] The analysis and processing unit is configured to determine that the water spray cooling device performs overall cooling on the non-printing region if the area of the non-printing region of the target fabric is in a first non-printing area state; and

the analysis and processing unit is configured to determine that the water spray cooling device performs partial cooling on the non-printing region if the area of the non-printing region of the target fabric is in a second non-printing area state.

[0015] The slight cold spraying condition is that the water spray cooling temperature is determined to be that numerical values in the first non-printing area state are all smaller than those in the second non-printing area state, and the non-printing region is a region in a selected printing region that does not need ink-jet printing; and the selected printing region is a smallest rectangular region containing the pattern printing region on the surface to be printed of the target fabric.

[0016] Further, the partial cooling indicates that the analysis and processing unit controls the water spray cooling device to take a contact profile between the non-printing region and the pattern printing region as a cooling region, and the water spray cooling device performs cooling treatment on the cooling area of the target fabric.

[0017] The analysis and processing unit correspondingly determines a spray diameter of the water spray cooling device according to the area of the non-printing region, and the area of the non-printing region has a positive correlation with the spray diameter of the water spray cooling device.

[0018] The analysis and processing unit is provided with a minimum spray diameter and a maximum spray diameter.

[0019] Further, the printing control unit is configured to determine the parameter adjustment mode of the digital printing unit according to the texture parameters of the target fabric.

[0020] The printing control unit determines to adjust the ink jet pressure of the digital printing unit if the texture parameters of the target fabric are in a first preset texture parameter range; and

the printing control unit determines to adjust the ink jet distance of the digital printing unit if the texture parameters of the target fabric are in a second preset texture parameter range.

[0021] Values in the first preset texture parameter range are all smaller than those in the second preset texture parameter range.

[0022] Further, the texture parameter K of the target fabric is determined by following formula:

$$K=\begin{vmatrix} D/D0 & B/B0 \\ \alpha 2 & \alpha 1 \end{vmatrix}$$

where D is the yarn diameter of the fabric to be printed, D0 is a reference yarn diameter, B is the yarn density of the fabric to be printed, B0 is a reference yarn density, $\alpha 1$ is a line-width weight coefficient, and $\alpha 2$ is a density weight coefficient, where $0<\alpha 2<\alpha 1$, $0<D0$, and $B<B0$.

[0023] Further, the printing control unit adjusts the ink-jet pressure of the digital printing unit according to first texture parameter difference $\triangle K1$ between the texture parameter K of the target fabric and the preset texture parameter K0.

[0024] K0 is greater than any value within the first preset texture parameter range.

[0025] Further, the printing control unit correspondingly adjusts the inkjet distance of the digital printing unit according to second texture parameter difference $\triangle K2$ between the texture parameter K of the target fabric and the preset texture parameter K0.

[0026] Compared with the related art, the disclosure has beneficial effects that the contact angle between the test droplet and the target fabric is detected by the information acquisition unit, so that ink-jet absorption capacity can be indicated and the heat treatment duration of the preheating treatment device can be correspondingly set to increase the ink-jet absorption capacity of the target fabric. When the heat treatment is completed and the contact angle between the test droplet and the pattern printing region of the target fabric is smaller than the reference value of the hydrophilic contact angle, the water spray cooling temperature of the water spray cooling device is determined according to the contact angle difference between the contact angle and the reference value of the hydrophilic contact angle, so that a problem of poor ink jet printing effect caused by ink jet flushing during digital printing can be avoided and the operation parameters of the digital printing unit are correspondingly set according to the texture parameters of the target fabric, so that the operation parameters are more in line with an actual working scene. Compared with the related

art, in this disclosure, the operation parameters of the integrated machine are adjusted by actually detecting a texture state and fabric properties of the target fabric, and the target fabric can be processed, so that printing quality of the disclosure can be improved, and printing efficiency of the disclosure is further improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027]

FIG. 1 is a unit connection diagram of an intelligent waterless digital printing integrated machine based on an Internet of Things according to the disclosure;
FIG. 2 is a schematic diagram of a target fabric according to the present disclosure;
FIG. 3 is an enlarged schematic view of a cooling region according to the present disclosure; and
FIG. 4 is a schematic diagram of a selected printing region according to the present disclosure;

[0028] Reference numbers are as follows: 1. Pattern Printing Region; 2. Surface To Be Printed; 3. Contact Contour; 4. Selected Printing Region.

DETAILED DESCRIPTION

[0029] Preferred embodiments of the present disclosure will be described below with reference to the accompanying drawings. It should be understood by those skilled in the art that these embodiments are only used to explain technical principles of the present disclosure, and are not intended to limit the protection scope of the present disclosure.

[0030] It should be noted that in description of the present disclosure, terms such as "upper", "lower", "left", "right", "inner" and "outer" which indicate a directional or positional relationship are based on the directional or positional relationship shown in the drawings, and are merely for convenience of description, rather than indicate or imply that the device or element described must have a specific orientation, be configured and operated in a specific orientation, and thus cannot be understood as a limitation on the present disclosure.

[0031] In addition, it should be noted that in the description of the present disclosure, unless otherwise specified and limited, the terms "installing", "coupling" and "connecting" should be understood in a broad sense, for example, it can be "fixedly connecting", or "detachably connecting" or "integrally connecting", or it can be "mechanically connecting" or "electrically connecting", or it can be "directly connecting" or "indirectly connecting through an intermediate medium", or it can be "communicating within two elements". For those skilled in the art, specific meanings of the above terms in the present disclosure can be understood according to specific situations.

[0032] Referring to FIG. 1, which is a unit connection diagram of an intelligent waterless digital printing integrated machine based on an Internet of Things according to the disclosure, the intelligent waterless digital printing integrated machine based on the Internet of Things includes:

a processing unit including a preheating device for heat treatment of a target fabric and a water spray cooling device for performing local cooling treatment on the target fabric;
an information acquisition unit including a dripping device for performing a hydrophilic test on a surface to be printed of the target fabric and a visual detection device for detecting a contact angle between a test droplet and the target fabric;
an analysis and processing unit respectively connected with the processing unit and the information acquisition unit, and configured for determining whether the target fabric meets a hydrophilic requirement according to the contact angle between the test droplet and the target fabric, determining a heat treatment duration of the preheating treatment device according to the contact angle when the target fabric does not meet the hydrophilic requirement, re-detecting a contact angle between the test droplet and a pattern printing region of the target fabric after the heat treatment is completed so as to determine whether to turn on the water spray cooling device, and determining an operation mode of the water spray cooling device according to an area of a non-printing region of the target fabric;
a digital printing unit connected with the analysis and processing unit and configured for performing digital ink-jet printing on the target fabric; and
a printing control unit connected with the digital printing unit and configured for correspondingly determining a parameter adjustment mode of the digital printing unit according to texture parameters of the target fabric.

[0033] The parameter adjustment mode includes adjusting an ink-jet pressure of the digital printing unit and/or adjusting an ink-jet distance of the digital printing unit. The texture parameters of the target fabric are determined according to a yarn diameter of a fabric surface to be printed and a yarn density of the fabric surface to be printed of the target fabric.

[0034] The yarn density is a number of yarns per unit area of the target fabric.

[0035] Specifically, the information acquisition unit performs the hydrophilic test on the surface to be printed of the target fabric and controls the visual detection device to detect the contact angle between the test droplet and the target fabric, and the analysis and processing unit determines whether the target fabric meets the hydrophilic requirement according to the contact angle.

[0036] It is determined that the target fabric meets the hydrophilic requirements if the contact angle of the target

fabric is smaller than or equal to a reference value of a hydrophilic contact angle; and

[0037] It is determined that the target fabric does not meet the hydrophilic requirements if the contact angle of the target fabric is greater than the reference value of the hydrophilic contact angle.

[0038] The hydrophilic test involves the information acquisition unit controlling the dripping device to titrate a test droplet with preset quality on the surface to be printed of the target fabric and controlling the visual detection device to detect the contact angle between the test droplet and the target fabric.

[0039] As an implementable scheme, the information acquisition unit can use an integrated optical contact-angle measuring device with an automatic dripping function and a visual recognition function to realize hydrophilicity detection for the target fabric. In a process of printing and inkjet, ink needs to be absorbed into the fabric fibers, and the contact angle of the fabric surface may affect distribution and permeability of ink molecules on a fabric surface. If the contact angle on the fabric surface is large, it is difficult for the ink molecules to permeate into the fabric fibers, and a bead structure may be formed on the surface, which cannot be effectively absorbed. If the contact angle on the fabric surface is small, the ink molecules can permeate into the fabric fibers more easily, be absorbed and fixed on the fabric. The test droplet can be of pure water or liquid with same properties as the inkjet, which needs to be measured for the test fabric.

[0040] The reference value of hydrophilic contact angle is related to historical data of waterless digital printing. That is, a user can record contact angles of the fabric that meet printing needs of the user in historical printing preparation data, and count and calculate an average value of all of the contact angles, so as to determine the reference value of hydrophilic contact angle.

[0041] Specifically, the analysis and processing unit is configured to calculate difference $\triangle R$ between the contact angle R of the target fabric and the reference value R0 of the hydrophilic contact angle under a first hydrophilic adjustment condition, and determine the heat treatment duration of the preheating processing device according to $\triangle R$, and it is set that $\triangle R = R-R0$.

[0042] The difference $\triangle R$ has a positive correlation with the heat treatment duration of the preheating treatment device, and the analysis and processing unit is provided with a maximum heat treatment duration. If it is determined that the heat treatment duration is greater than the maximum heat treatment duration, the analysis and processing unit sets the heat treatment duration as the maximum heat treatment duration.

[0043] The first hydrophilic adjustment condition is that the contact angle of the target fabric is greater than the reference value of the hydrophilic contact angle.

[0044] Specifically, the difference $\triangle R$ reflects difference between hydrophilicity of the target fabric and hydrophilicity required by the user, and the preheating treatment device is correspondingly controlled to perform heat treatment on the target fabric according to the difference $\triangle R$. The preheating treatment device can use a hot press to change a fiber structure of the fabric by using high temperature and high pressure of the hot press, thereby improving hydrophilicity of the fabric.

[0045] Specifically, the analysis and processing unit is configured to re-control the information acquisition unit to perform a hydrophilic test on the surface to be printed of the target fabric upon the heat treatment of the preheating treatment device is completed, and detect a contact angle between a test droplet and the pattern printing region of the target fabric; and determine a water spray cooling temperature of the water spray cooling device according to contact angle difference between the contact angle and the reference value of the hydrophilic contact angle, if the contact angle is smaller than the reference value of the hydrophilic contact angle.

[0046] The contact angle difference has a positive correlation with the water spray cooling temperature of the water spray cooling device.

[0047] Specifically, the analysis and processing unit is configured to determine the operation mode of the water spray cooling device according to the area of the non-printing region of the target fabric under a slight cold spraying condition.

[0048] The analysis and processing unit is configured to determine that the water spray cooling device performs overall cooling on the non-printing region if the area of the non-printing region of the target fabric is in a first non-printing area state; and

the analysis and processing unit is configured to determine that the water spray cooling device performs partial cooling on the non-printing region if the area of the non-printing region of the target fabric is in a second non-printing area state.

[0049] The slight cold spraying condition is that the water spray cooling temperature is determined to be that numerical values in the first non-printing area state are all smaller than those in the second non-printing area state, and the non-printing region is a region in the selected printing region that does not need ink-jet printing; and the selected printing region is a smallest rectangular region containing the pattern printing region on the surface to be printed of the target fabric.

[0050] Specifically, because overall hydrophilicity of the target fabric after heat treatment is improved, flushing of printing ink can be easily caused in the printing process, which results in a problem of poor final printing effect. In this technical scheme, the water spray cooling device is configured to cool a non-printing region in a peripheral contour of the pattern printing region to reduce its hydrophilicity, thereby avoiding the flushing of the printing ink and further improving the printing effect of the disclosure. A value of the non-printing area state is related to flushing ability of the printing ink for the target fabric, that is, the user can set the value of the non-printing area state according to a maximum flushing area

recorded correspondingly to a printing ink with a same material in historical production data and printing precision requirements of the user, and it should be ensured that the value of the first non-printing area state should be less than the maximum flushing area.

[0051] Specifically, the partial cooling indicates that the analysis and processing unit controls the water spray cooling device to take a contact profile between the non-printing region and the pattern printing region as a cooling region, and the water spray cooling device performs cooling treatment on the cooling area of the target fabric.

[0052] The analysis and processing unit correspondingly determines a spray diameter of the water spray cooling device according to the area of the non-printing region, and the area of the non-printing region has a positive correlation with the spray diameter of the water spray cooling device.

[0053] The analysis and processing unit is provided with a minimum spray diameter and a maximum spray diameter.

[0054] Specifically, the analysis and processing unit correspondingly determines the spray diameter of the water spray cooling device according to the area of the non-printing region, in which it only requires that cooling effect is realized for a contact region between the non-printing region and the pattern printing region, which further improves a printing speed.

[0055] Specifically, the printing control unit is configured to determine the parameter adjustment mode of the digital printing unit according to the texture parameters of the target fabric.

[0056] The printing control unit determines to adjust the ink jet pressure of the digital printing unit if the texture parameters of the target fabric are in a first preset texture parameter range; and

the printing control unit determines to adjust the ink jet distance of the digital printing unit if the texture parameters of the target fabric are in a second preset texture parameter range.

[0057] Values in the first preset texture parameter range are all smaller than those in the second preset texture parameter range.

[0058] Specifically, reference values of the preset texture parameters are related to a material of the target fabric. The user can select a same target fabric and same printing operation parameters to check whether final printing effect meets the user's requirements at the ink jet pressure or ink jet distance, and record, by combining technical experience of the skilled in the art, a texture parameter range of the target fabric with poor ink jet printing and dyeing effect as the first preset texture parameter range, and record, by combining technical experience of the skilled in the art, a texture parameter range of the target fabric with ink jet splash as the second preset texture parameter range.

[0059] Specifically, the texture parameter K of the target fabric is determined by following formula:

$$K=\begin{vmatrix} D/D0 & B/B0 \\ \alpha 2 & \alpha 1 \end{vmatrix}$$

where D is the yarn diameter of the fabric to be printed, D0 is a reference yarn diameter, B is the yarn density of the fabric to be printed, B0 is a reference yarn density, $\alpha 1$ is a line-width weight coefficient, and $\alpha 2$ is a density weight coefficient, where $0<\alpha 2<\alpha 1$, $0<D0$, and $B<B0$. The line-width weight coefficient and density weight coefficient are determined according to the yarn diameter of the fabric to be printed in actual production and influence degree of the yarn density of the fabric to be printed on the printing effect, values of $\alpha 1$ and $\alpha 2$ can be set as $\alpha 1 = 0.6$ and $\alpha 2 = 0.4$.

[0060] Specifically, the printing control unit correspondingly adjusts the ink-jet pressure of the digital printing unit according to first texture parameter difference $\triangle K1$ between the texture parameter K of the target fabric and the preset texture parameter K0, and the adjusted ink jet pressure is F, it is set that $F = F0\times\zeta$, where ζ is a pressure conversion coefficient, and $1<\zeta$.

[0061] It is set $\triangle K1 = K0-K$, where K0 is greater than any value within the first preset texture parameter range.

[0062] Specifically, the printing control unit correspondingly adjusts the inkjet distance of the digital printing unit according to second texture parameter difference $\Delta K2$ between the texture parameter K of the target fabric and the preset texture parameter K0, and the adjusted ink jet distance is L, and it is set that $L = L0\times\varepsilon$, where ε is a distance conversion coefficient, and $\varepsilon\geq 1$.

it is set that when $\triangle K2 = K-K0$ and $K0 = K$, a value of ε is 1.

[0063] Embodiment: referring to FIGS. 2 to 4, in this embodiment, the area of the non-printing region in the selected printing region 4 is in the second non-printing area state. The analysis and processing unit determines that the water spray cooling device performs partial cooling on the non-printing region, and the analysis and processing unit controls the water spray cooling device to take a contact profile 3 between the non-printing region and the pattern printing region 1 as the cooling region, and the water spray cooling device moves and cools the target fabric according to the cooling region.

[0064] To this end, technical schemes of the present disclosure has been described in connection with preferred embodiments shown in the drawings, but it is easy for those skilled in the art to understand that the protection scope of the present disclosure is obviously not limited to these specific embodiments. Equivalent changes or substitutions can be made to relevant technical features by those skilled in the art without deviating from the principle of the disclosure, and technical schemes after these changes or substitutions falls within the protection scope of the disclosure.

[0065] The above is only specific embodiments of the present disclosure, and is not intended to limit this disclosure, and modifications and variations can be made in this disclosure for those skilled in the art. Any modification, equivalent substitution, improvement, etc. made

within the spirit and principle of this disclosure shall be encompassed within the protection scope of this disclosure.

Claims

1. An intelligent waterless digital printing integrated machine based on the Internet of Things, comprising:

   a processing unit comprising a preheating device for heat treatment of a target fabric and a water spray cooling device for performing local cooling treatment on the target fabric;
   an information acquisition unit comprising a dripping device for performing a hydrophilic test on a surface to be printed of the target fabric and a visual detection device for detecting a contact angle between a test droplet and the target fabric;
   an analysis and processing unit respectively connected with the processing unit and the information acquisition unit, and configured for determining whether the target fabric meets a hydrophilic requirement according to the contact angle, determining a heat treatment duration of the preheating treatment device according to the contact angle when the target fabric does not meet the hydrophilic requirement, re-detecting a contact angle of a pattern printing region of the target fabric after the heat treatment is completed so as to determine whether to turn on the water spray cooling device, and determining an operation mode of the water spray cooling device according to an area of a non-printing region of the target fabric;
   a digital printing unit connected with the analysis and processing unit and configured for performing digital ink-jet printing on the target fabric; and
   a printing control unit connected with the digital printing unit and configured for determining a parameter adjustment mode of the digital printing unit according to texture parameters of the target fabric;
   wherein the parameter adjustment mode comprises adjusting an ink-jet pressure of the digital printing unit and/or adjusting an ink-jet distance of the digital printing unit; and the texture parameters of the target fabric are determined according to a yarn diameter of a fabric surface to be printed and a yarn density of the fabric surface to be printed of the target fabric.

2. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 1, wherein the analysis and processing unit is configured to determine whether the target fabric meets the hydrophilic requirement according to the contact angle; and
   determine that the target fabric does not meet the hydrophilic requirements if the contact angle of the target fabric is greater than a reference value of a hydrophilic contact angle.

3. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 2, wherein the analysis and processing unit is configured to calculate difference $\triangle R$ between the contact angle R of the target fabric and the reference value R0 of the hydrophilic contact angle under a first hydrophilic adjustment condition, and determine the heat treatment duration of the preheating processing device according to $\triangle R$;

   the difference $\triangle R$ has a positive correlation with the heat treatment duration of the preheating treatment device; and
   wherein the first hydrophilic adjustment condition is that the contact angle of the target fabric is greater than the reference value of the hydrophilic contact angle.

4. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 3, wherein the analysis and processing unit is configured to re-control the information acquisition unit to perform a hydrophilic test on the surface to be printed of the target fabric upon the heat treatment of the preheating treatment device is completed, and detect a contact angle between a test droplet and the pattern printing region of the target fabric; and determine a water spray cooling temperature of the water spray cooling device according to contact angle difference between the contact angle and the reference value of the hydrophilic contact angle, if the contact angle is smaller than the reference value of the hydrophilic contact angle; and
   the contact angle difference has a positive correlation with the water spray cooling temperature of the water spray cooling device.

5. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 4, wherein the analysis and processing unit is configured to determine the operation mode of the water spray cooling device according to the area of the non-printing region of the target fabric under a slight cold spraying condition, wherein

   the analysis and processing unit is configured to determine that the water spray cooling device performs overall cooling on the non-printing region if the area of the non-printing region of the target fabric is in a first non-printing area state; and

the analysis and processing unit is configured to determine that the water spray cooling device performs partial cooling on the non-printing region if the area of the non-printing region of the target fabric is in a second non-printing area state; and
wherein the slight cold spraying condition is that the water spray cooling temperature is determined to be that numerical values in the first non-printing area state are all smaller than those in the second non-printing area state, and the non-printing region is a region in a selected printing region that does not need ink-jet printing; and the selected printing region is a smallest rectangular region containing the pattern printing region on the surface to be printed of the target fabric.

6. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 5, wherein the partial cooling indicates that the analysis and processing unit controls the water spray cooling device to take a contact profile between the non-printing region and the pattern printing region as a cooling region, and the water spray cooling device performs cooling treatment on the cooling area of the target fabric;

the analysis and processing unit correspondingly determines a spray diameter of the water spray cooling device according to the area of the non-printing region, and the area of the non-printing region has a positive correlation with the spray diameter of the water spray cooling device; and
wherein the analysis and processing unit is provided with a minimum spray diameter and a maximum spray diameter.

7. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 6, wherein the printing control unit is configured to determine the parameter adjustment mode of the digital printing unit according to the texture parameters of the target fabric;

the printing control unit determines to adjust the ink jet pressure of the digital printing unit if the texture parameters of the target fabric are in a first preset texture parameter range; and
the printing control unit determines to adjust the ink jet distance of the digital printing unit if the texture parameters of the target fabric are in a second preset texture parameter range; and
wherein values in the first preset texture parameter range are all smaller than those in the second preset texture parameter range.

8. The intelligent waterless digital printing machine based on the Internet of Things according to claim 7, wherein the texture parameter K of the target fabric is determined by following formula:

$$K=\begin{vmatrix} D/D0 & B/B0 \\ \alpha 2 & \alpha 1 \end{vmatrix}$$

where D is the yarn diameter of the fabric to be printed, D0 is a reference yarn diameter, B is the yarn density of the fabric to be printed, B0 is a reference yarn density, $\alpha 1$ is a line-width weight coefficient, and $\alpha 2$ is a density weight coefficient, where $0<\alpha 2<\alpha 1$, $0<D0$, and $B<B0$.

9. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 8, wherein the printing control unit adjusts the ink-jet pressure of the digital printing unit according to first texture parameter difference $\Delta K1$ between the texture parameter K of the target fabric and the preset texture parameter K0; and
wherein K0 is greater than any value within the first preset texture parameter range.

10. The intelligent waterless digital printing integrated machine based on the Internet of Things according to claim 8, wherein the printing control unit correspondingly adjusts the ink jet distance of the digital printing unit according to second texture parameter difference $\triangle K2$ between the texture parameter K of the target fabric and the preset texture parameter K0.

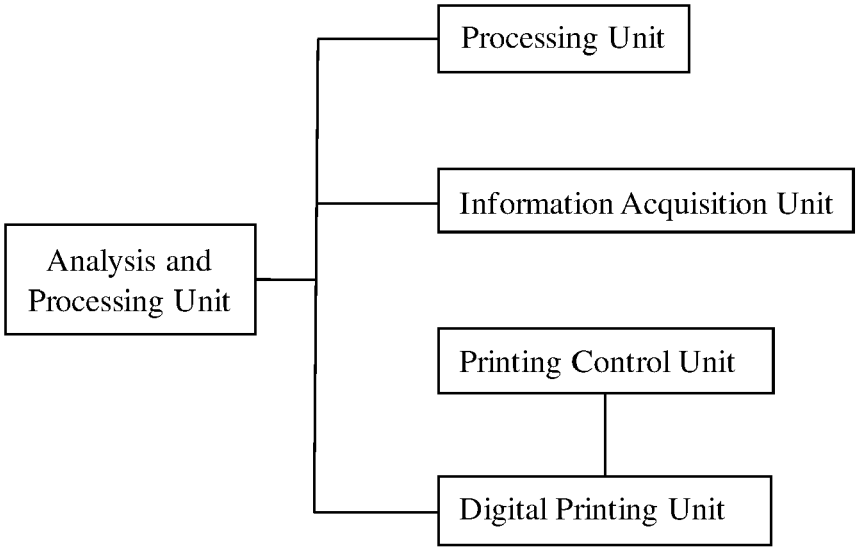
Processing Unit
Information Acquisition Unit
Analysis and Processing Unit
Printing Control Unit
Digital Printing Unit

FIG. 1

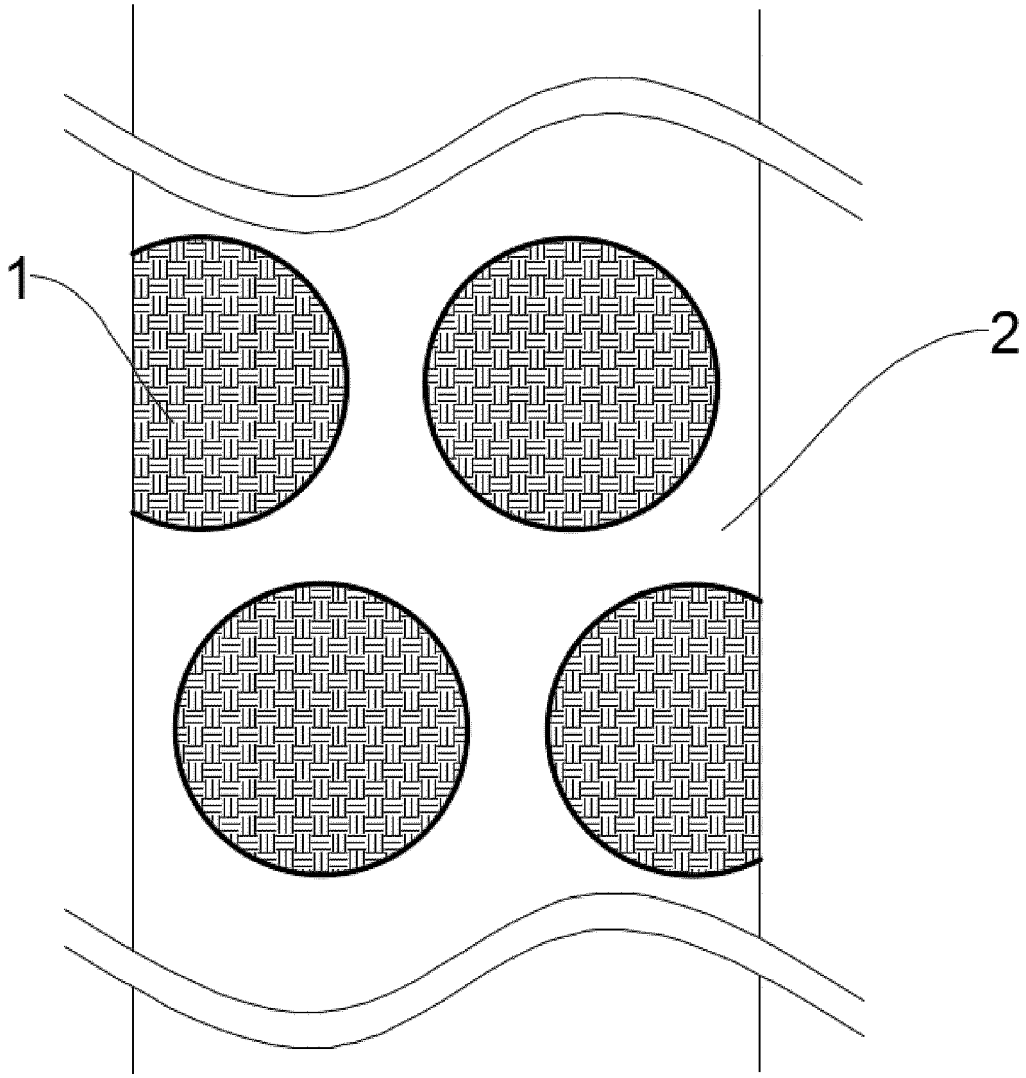

FIG. 2

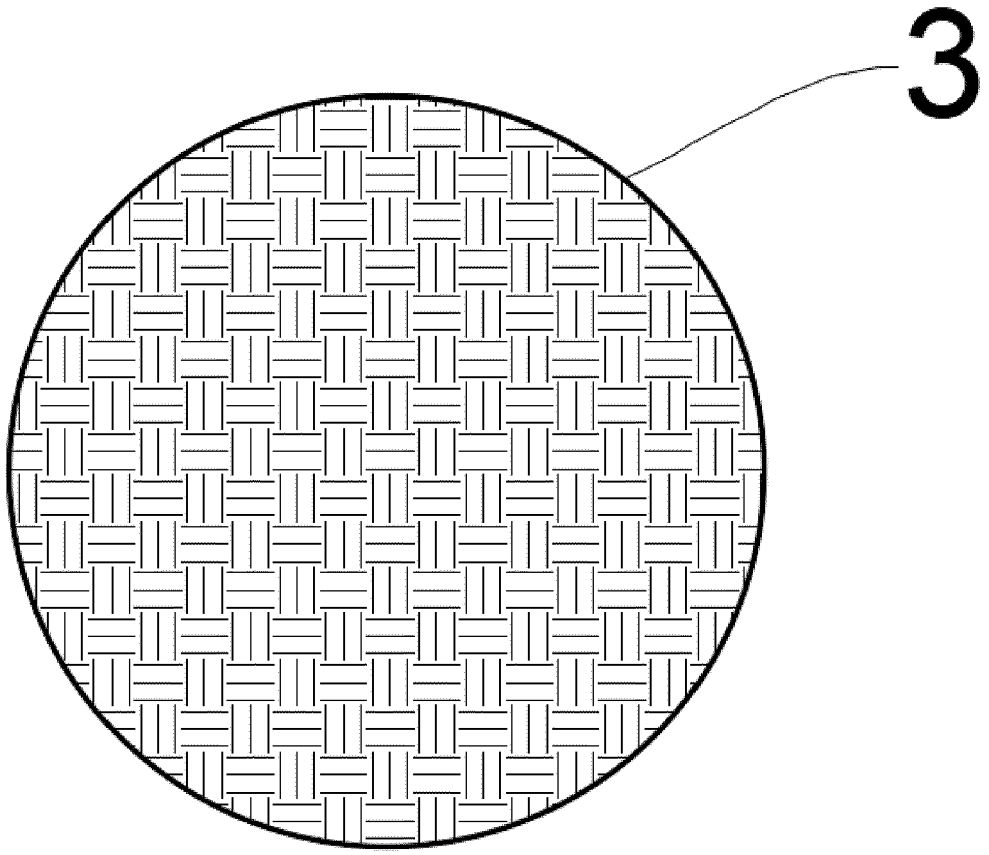

FIG. 3

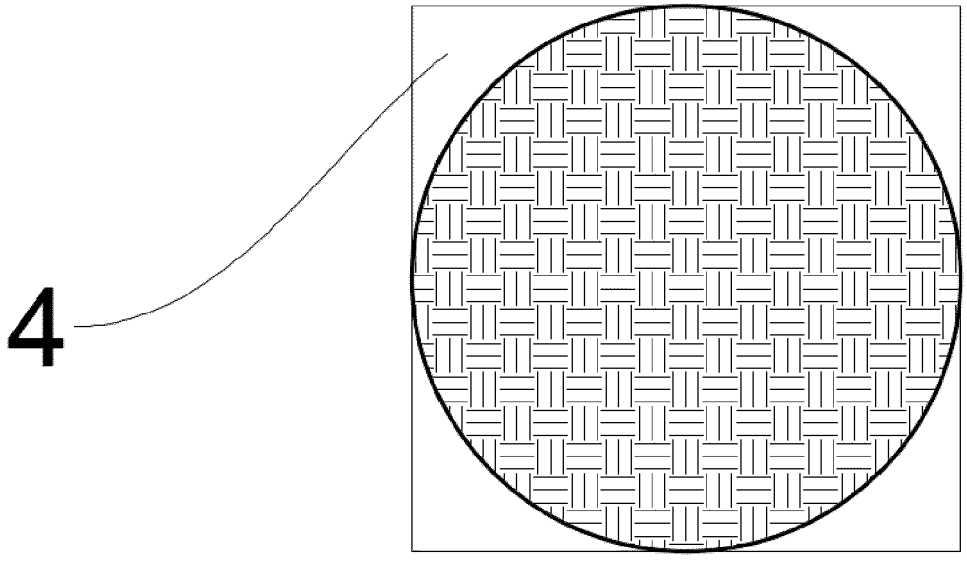

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 24 18 4051

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2021/170779 A1 (ASAKAWA YUTA [JP] ET AL) 10 June 2021 (2021-06-10) * the whole document *	1-10	INV. B41J3/407 B41J11/00 D06B11/00 D06P5/30
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TECHNICAL FIELDS SEARCHED (IPC)

B41J
D06Q
D06B
D06P
H04N
D01G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 November 2024	Dewaele, Karl

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