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(71) Applicant: **E.G.O. Elektro-Gerätebau GmbH**
75038 Oberderdingen (DE)

(72) Inventors:
• **TRAVE, Anna**
08520 Franqueses del Vallès (ES)

• **BERNER, Jonathan**
75433 Maulbronn (DE)
• **GADEA, Jordi**
08130 Santa Perpètua de Mogoda (ES)

(74) Representative: **Laqua, Bernd Christian Kurt**
Wuesthoff & Wuesthoff
Patentanwälte und Rechtsanwalt PartG mbB
Schweigerstraße 2
81541 München (DE)

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(54) **METHOD AND APPARATUS FOR REDUCING DETACHMENT OF MICROFIBRES FROM GARMENT IN A WASHING MACHINE**

(57) The present disclosure relates to a method for reducing detachment of microfibres from garment in a washing cycle of a washing machine (100). The method comprises receiving (312) a fabric type user input specifying a type of fabric of the garment placed in the washing machine, determining (332) a type of fabric of the garment in the washing machine, calculating (352) a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle, and if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres. The present disclosure further relates to a washing system, a mobile terminal, and a washing machine, each configured to perform the method.

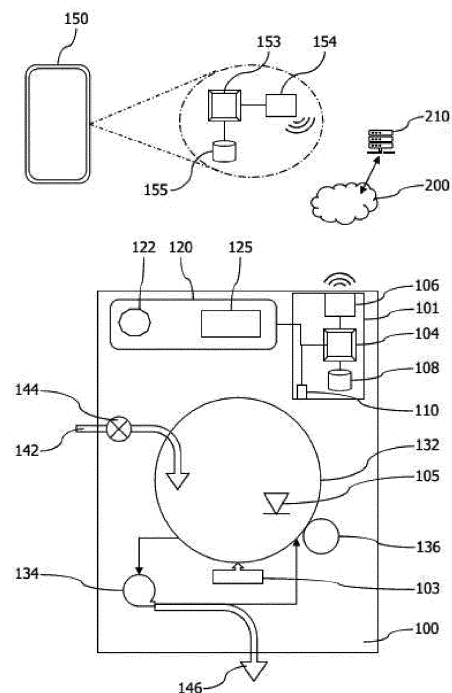


Figure 1

Description

[0001] The present disclosure generally relates to a method for reducing detachment of microfibres from garment in a washing cycle of a washing machine. Particularly, the present disclosure relates to a method for reducing detachment of microfibres from garment by determining a risk level of microfibre detachment based on a fabric type input by a user and a determined type of fabric. Moreover, the present disclosure further relates to a mobile terminal and a washing machine configured to perform such method.

[0002] Recently, the detachment of microfibres from garment during a washing cycle became of interest to research, since the microfibres are washed out with the wastewater and, hence, are introduced to the environment. Specifically, if the garment contains synthetic fibres, the microfibres are of non-organic material, which form microplastics. Particularly, microplastic can be a particle smaller than 5mm.

[0003] A conventional washing machine may be equipped with a filter to reduce the number of such microfibres in the wastewater. However, the user has to replace the filter regularly. If the replacement of the filter is postponed or forgotten, the amount of microfibres in the wastewater may increase or the washing machine has to be programmed to not run a washing cycle until a new filter has been installed.

[0004] This, however, is cumbersome for the user or may lead to non-acceptance of such devices, e.g., if a filter change has to be performed before a washing cycle can be started.

[0005] It is therefore an object of the present disclosure to provide a method and apparatus for reducing microfibres during washing cycles.

[0006] This object is solved by the present invention as defined in the independent claims. Preferred embodiments are defined by the dependent claims.

[0007] According to a first aspect of the present disclosure, a method for reducing detachment of microfibres from garment in a washing cycle of a washing machine comprises receiving a fabric type user input specifying a type of fabric of the garment placed in the washing machine, determining a type of fabric of the garment in the washing machine, and calculating a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle.

[0008] The method further comprises, if the risk level is determined to be high, outputting information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres. The dedicated washing cycle can be employed to reduce the amount of detached microfibres.

[0009] As a mere example, it can be determined that the risk level is above a first threshold, which indicates that there is a high risk of microfibre detachment. Alternatively, the distinction between a low and high risk level can be made by use of a lookup table. For instance, the lookup table may include risk values or risk value groups, each mapped to a risk type, such as a low risk or a high risk. Thus, when looking up a particular input risk level in the lookup table, a result/an output may indicate a low or high risk of microfibre detachment, for example.

[0010] Specifically, the user input can include entering or selecting, by a user, a particular fabric type, such as nylon, polyester, wool, linen, Elastane, elastomer, cotton, acrylic, or the like. As a mere example, the user may select the particular fabric type from a predefined list. It is to be understood that the user input can include entering or selecting a plurality of fabric types, such as if garment of different fabric types are placed in a drum of the washing machine for the next washing cycle.

[0011] Alternatively or additionally, the user input can include entering or selecting, by a user, a fabric group, such as organic or non-organic garment, or any other predefined fabric group, including numbers or characters (1, 2, 3, etc.; A, B, C, etc.), which can be interpreted as garment including one or more fabric types.

[0012] Likewise alternatively or additionally, the user input can include entering or selecting, by a user, a washing cycle type, such as cold washing, coloured washing, hot washing, delicates, etc.

[0013] The user input can be understood as the intention of the user to initiate a particular washing cycle corresponding to the received fabric type. However, the user selection may lead to an increased detachment of microfibres, although not intended by the user. It is very likely that users do not know how to reduce microfibre detachment during a washing cycle. Thus, the user input is checked against the determined type of fabric and the risk (level) of an unsuitable washing cycle is calculated. Based on this risk level, the washing cycle may be changed, i.e. the user input may be overruled.

[0014] This allows reduction of microfibre detachment, i.e. the amount of microfibres washed out with the wastewater. Such microfibres from garment can be fibre particles/portions with a small size down to 25 μm and even fibre particles/portions with a size down to 1.2 μm . Since the washing cycle is optimised for a minimum microfibre emission, the method further allows a prolonged life of any microfibre filter or other filter mechanisms employed during the washing cycle. For instance, the disclosed method may allow 50% to 70% prolonged life of the filter as it will not be clogged as soon as in case of regular washing cycles.

[0015] As a mere example, the risk level may be determined as low or high, or may correspond to a certain value from 0 to 10 or from 0 to 100, such as 0, 2, 5, 10, 20, 50, 80, 100 etc., wherein 0 means (almost) no risk, and 10 / 100 means a very high risk of microfibre emission (leading to a large amount of microfibre emission). The distinction between a low and high

risk level can be made by the first threshold or the use of the lookup table. For instance, if the risk level is above the threshold, there is a high risk of microfibre detachment, i.e. it is quite likely that the amount of detached microfibres will be high. The first threshold value may depend on the kind of risk level determination. For example, if the risk level is determined on the basis of a scale from 0 to 100, the first threshold may be set between 25 and 75, preferably between 40 and 60. Such risk level determination can be achieved alternatively by a correspondingly predefined lookup table.

[0016] In an implementation variant, the method can further comprise receiving a hardness user input specifying a water hardness of the water provided to the washing machine. The calculating of the risk level can then include calculating a risk contribution due to the specified water hardness. A risk contribution can influence the overall risk (level) that microfibres can be detached from the garment during the washing cycle.

[0017] The risk contribution can increase or decrease the risk level. In the particular example of water hardness, it has been found that a higher water hardness value decreases the amount or number of microfibres generated during a washing cycle. Thus, a high water hardness value (hard water) may contribute to the risk level only a small amount (e.g., 0, 20 or 30 points on the 0..100 scale). Alternatively, the risk level may even be reduced using a negative risk contribution value. A medium hardness of the water may contribute to the risk level an amount of, for example, 40, 50 or 60 points on the 0..100 scale, and a small water hardness value (soft water) may contribute to the risk level with a larger amount (e.g., 90 or 100 points on the 0..100 scale). It is to be understood that the risk contribution can likewise be on a 0..10 scale, for example, wherein hard water can be represented by a value of, e.g., 2, medium water (hardness) can be represented by a value of, e.g., 5, and soft water can be represented by a value of, e.g., 10.

[0018] In a further implementation variant, the method can further comprise receiving a detergent user input specifying a detergent type used in the washing machine for the washing cycle. The calculating of the risk level can then include calculating a risk contribution influencing the risk level due to the specified detergent. As a mere example, the detergent type can identify a heavy duty detergent (HDD), a light duty detergent (LDD), a non-biodegradable detergent, or a biodegradable detergent. For instance, it has been found that a light duty detergent decreases the amount or number of microfibres generated during a washing cycle, while using no detergent as well as using an HDD increases microfibre emission. Thus, an input indicating LDD may contribute to the risk level only a small amount (e.g., 0, 20 or 50 points on the 0..100 scale; or 5 on the 0..10 scale), while an input indicating HDD or no detergent may contribute to the risk level with a larger amount (e.g., 90 or 100 points on the 0..100 scale; or 10 on a 0..10 scale). Alternatively, in case of LDD the risk level may even be reduced.

[0019] In yet a further implementation variant, the method can further comprise determining a load weight of the garment placed in the washing machine. In this case, the calculating of the risk level includes calculating a risk contribution influencing the risk level due to the determined load weight. For instance, it has been found that a low load increases microfibre emission. A low load means, for example, equal to or less than 25% (quarter load) of the maximum load of the washing machine. This can, for example, correspond to 0 to 2 kg of garment. Thus, a low load weight value may contribute to the risk level a large amount (e.g., 80, 90 or even 100 points on the 0..100 scale), while a medium load (25% to 50%; half load) contributes to the risk level a smaller amount (e.g., 40 or 50 points on the 0..100 scale), and a high load weight (50% to 100%; full load) contributes to the risk level the smallest amount or zero (e.g., 0, 5, or 10 points).

[0020] Alternatively, the risk level depending on the load weight can be determined by the use of a lookup table. For instance, the lookup table may include risk values or risk value groups, each mapped to a risk type, such as a low risk or a high risk. In addition, the lookup table can include load weight values or load weight value groups, each mapped to a load range, such as quarter load, half load or full load, or such as 0-500g, 500-1000g, 1000-1500g, etc. (up to the maximum load capacity of the washing machine). Thus, when inputting/sending a particular input risk level (with or without risk contribution(s)) and the determined load weight to the lookup table, an output may indicate a low or high risk of microfibre detachment.

[0021] In another implementation variant, the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight can be weighted. Specifically, a weighting, such as a factoring, can be applied to the risk contribution(s).

[0022] As a mere example, the weight of each of the risk contributions can be between 0.1 and 0.3, preferably 0.2, on the 0..100 scale, or between 1 and 3, preferably 2, on the 0..10 scale when continuing in the 0..100 scale. In any case, the total risk is a weighted sum of risk contribution(s) plus the risk level.

[0023] Alternatively, the risk level based on the fabric type and the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight can be weighted. Specifically, a weighting, such as a factoring, can be applied to the risk level as well as the risk contribution(s).

[0024] This can include weighting the risk level higher than the risk contribution. In other words, the type of fabric has a greater influence on the resulting total risk than the other influences, such as water hardness, detergent or load.

[0025] As a mere example, the weight of the risk level (based on the fabric type) can be between 0.4 and 0.8, preferably 0.6, on the 0..100 scale, or between 4 and 8, preferably 6, on the 0..10 scale (when continuing in the 0..100 scale), and the weight of each of the risk contributions can be between 0.1 and 0.3, preferably 0.2 on the 0..100 scale, or between 1 and 3, preferably 2, on the 0..10 scale. Thus, the total risk is a weighted sum of the individual risk level and risk contributions.

Furthermore, if the risk level and/or risk contribution(s) are determined with a 0..10 scale, the weighting factor can be employed to bring the resulting risk level value to a 0..100 scale, the latter being compared against the threshold or used as input to the lookup table.

[0026] It is to be understood that, if no weighting is implemented, the above-mentioned values of the risk level and/or the risk contributions may be set smaller. For instance, each of the specified values may be reduced by a factor corresponding to the respectively mentioned weight.

[0027] In another implementation variant, the determining of the type of fabric of the garment includes determining a water absorption of the garment. The water absorption of the garment can be determined, for example, by controlling the washing machine to open a water inlet to water/wet the garment.

[0028] As a mere example, the load of garment can be weighed or virtually determined when the garment is dry. Then, the water inlet is opened and the garment is wetted. This allows weighing or virtually determining the load of the wet garment. Based on the difference between dry and wet load, a fabric type can be calculated. This can include using another lookup table including a mapping between load difference(s) and garment types. It is to be understood that a combined lookup table can be used.

[0029] Alternatively or additionally, the water inlet can be opened for a predefined period, for which a water level in the empty washing machine (specifically in the drum of the washing machine without garment) is known. Depending on the fibre of the garment, a certain amount of water is absorbed, so that the water level may differ depending on the type of fabric in the washing machine.

[0030] Also alternatively or additionally, the water absorption of the garment can be determined by sensing a weight of the load in the drum of the washing machine.

[0031] Opening the water inlet and determining the load of garment may be performed several times after one another. This allows determination and analysis of a water absorption over time and in particular steps.

[0032] In an implementation variant, the determining of the type of fabric of the garment can include controlling the washing machine to operate a drum of the washing machine. This allows moving the garment, so that the entire garment is wet and absorbs water. Thus, the type of fabric can be determined more accurately.

[0033] In another implementation variant, the determining of the type of fabric of the garment can include detecting and analysing a power required by a motor to rotate the drum. Particularly, the more power the motor operating the drum requires, the heavier the garment is.

[0034] As a mere example, the required motor power can also be analysed in combination with the watering of the garment.

[0035] In a further implementation variant, the risk level depending on the type of fabric of the garment (depending on the type of garment) may be set as low, medium or high, or may be set to a certain value, such as 20, 50, 80, 100 etc., wherein 0 means (almost) no risk, and 100 means a very high risk of microfibre emission (leading to a large amount of microfibre emission).

[0036] As a mere example, if it is determined that the fabric type is cotton (or a majority of the garment appears to be cotton), a small risk level value is set, e.g., 0, 2, 5, or 10 points on the 0..100 scale, or 0, or 2 on the 0..10 scale. In case of synthetic fabric, a higher risk level value is set, for example 10, 15 or even 20 points on the 0..100 scale, or 5, 6 or even 10 on the 0..10 scale. A medium risk level value may be set between the above-mentioned values for low and high risks.

[0037] It is to be understood that if no weighting/factoring is implemented, all these values can be set higher, such as double or triple times the given values.

[0038] In another implementation variant, the method can further comprise, if the risk level is determined to be low, outputting information indicating to perform a washing cycle according to the type of fabric specified in the fabric type user input. For example, it can be determined that the risk level is below the first threshold (or the output of the lookup table indicates a small risk value), which indicates that there is a low risk of microfibre detachment. Specifically, the user input can be understood as the intention of the user to initiate a particular washing cycle corresponding to the received fabric type. If the risk level is determined to be low, information can be output that indicates to perform this particular washing cycle.

[0039] In yet another implementation variant, the method can further comprise, if the risk level is determined to be medium, outputting information indicating to perform a modified washing cycle that is a washing cycle according to the type of fabric specified in the fabric type user input with one or more washing parameters being modified. Thus, the user's desire to wash the garment in accordance with a particular washing cycle can be partially fulfilled, but certain washing parameters are adapted to minimise microfibre emission.

[0040] For instance, the risk level may be compared to a second threshold (being below the first threshold). Thus, if the risk level (value) is between the first second threshold and the second threshold, the risk level is determined to be medium. If the risk level (value) is below the second threshold, the risk level is determined to be low.

[0041] Alternatively, the distinction between a low, medium and high risk level can be made by use of a lookup table. For instance, the lookup table may include risk values or risk value groups, each mapped to a risk type, such as a low risk, a medium risk or a high risk. Thus, when inputting/sending a particular input risk level value (with or without risk

contribution(s)) to the lookup table, an output may indicate a low, medium or high risk of microfibre detachment.

[0042] As a mere example, the one or more modified washing parameters can include an adapted water temperature and/or an adapted spin speed of the drum of the washing machine. Alternatively or additionally, the one or more modified washing parameters that are adapted may further include a water level, a duration of the washing cycle, and/or a number of agitation and/or rinsing sub-cycles.

[0043] In a further implementation variant, the water temperature can be adapted by setting a maximum water temperature to 40°C, and/or the spin speed can be adapted by setting a maximum speed to 800 rpm.

[0044] In a further implementation variant, the method can further comprise outputting a user message to the user that a microfibre filter of the washing machine requires cleaning or replacement. The outputting of the user message can include a visual indication and/or a sound output and/or a message transmission (e.g., via telecommunication means, such as a text message on a mobile telephone and/or an application executed on the mobile telephone presenting the information to the user).

[0045] For instance, the outputting of the user message can be based on a change of power consumption by a pump motor driving a water pump of the washing machine. With increasing clogging of the filter, the power consumption of the pump motor, for example, will decrease. Thus, if the power (e.g., a current of an electric pump motor) changes (e.g., compared to a predefined threshold value), it can be assumed that the microfibre filter becomes less effective and should be replaced. Thus, a power change, including a power change over time, can trigger said outputting of the information.

[0046] In another implementation variant, outputting information indicating to perform a washing cycle, a modified washing cycle or a dedicated washing cycle comprises outputting a corresponding user message and/or transmitting a corresponding signal to the washing machine to perform the respective washing cycle. In other words, outputting information indicating to perform a washing cycle generally means that a signal and/or data is output that can be interpreted by a receiving device. Depending on the type of receiving device, a message can be output to the user (e.g., in case of a receiving device having a display and/or audio output means).

[0047] Alternatively or additionally, if the receiving device is the washing machine, the washing machine can perform the indicated washing cycle. As a mere example, washing cycle parameters and/or an identifier of the selected washing cycle may be indicated to the washing machine with the output information, i.e. may be transmitted in a signal associated with the indicating to perform the washing cycle. It is to be understood that the washing machine may likewise output a message to a user that the washing cycle will be or is performed, if the washing machine is equipped with associated output means.

[0048] In a further implementation variant, the dedicated washing cycle reducing detachment of microfibres can include one or more of the parameters:

- an initial water filling range of 20 to 25 Litre,
- an agitation speed range during an initial water filling of 30 rpm to 35 rpm,
- a water temperature of maximum 40°C (e.g., for washing the garment),
- an agitation speed range during a secondary water filling of 50 rpm to 55 rpm, preferably for 2 to 6 minutes (i.e., an agitation duration is 2 to 6 minutes), more preferably for 4 to 6 minutes,
- an agitation speed range during heating the water of 50 rpm to 55 rpm, preferably for 4 to 8 minutes,
- a spinning speed between 200 rpm to 600 rpm, preferably 400 rpm (e.g., during a draining phase),
- a secondary or subsequent water filling range of 20 to 25 Litre,
- an agitation speed range during washing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes (e.g., during a first or subsequent washing period),
- an agitation speed range during rinsing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes, and
- a spinning speed between 400 rpm to 800 rpm.

[0049] It is to be understood that the present disclosure explicitly covers all possible combinations of one or more of the above parameters to implement the dedicated washing cycle. Thus, the present disclosure is neither restricted to the number of parameters in the above list nor to the order of the parameters in the list.

[0050] Furthermore, the dedicated washing cycle can include one or more washing cycle subcategories, each category consisting of one or more of the above parameters. For instance, the dedicated washing cycle can be categorised into washing, draining, rinsing and/or final spin. Thus, different phases of a washing cycle can be determined and set in accordance with one or more of the parameters to achieve the dedicated washing cycle.

[0051] According to a second aspect of the present disclosure, a washing system comprises one or more processors, and one or more memories configured to store processor-executable instructions that when executed by the one or more processors configure the washing system to perform the method according to the first aspect or one of its implementation variants. Particularly, the washing system can perform the method of the first aspect, the method according to one of the implementation variants of the first aspect, the method according to an example of the first aspect, or any combination thereof.

[0052] In an implementation variant, the washing system can comprise a mobile terminal and/or a washing machine.

The one or more processors may be installed in the mobile terminal, in the washing machine or may be distributed over the mobile terminal and the washing machine. Thus, the washing system can perform the method of the first aspect, one of its implementation variants and/or examples, or combinations thereof solely on the mobile terminal, solely on the washing machine, or on the mobile terminal and the washing machine interacting with each other (e.g., in a distributed manner). For instance, some method steps may be performed by the mobile terminal, while other method steps are performed by the washing machine.

[0053] According to a third aspect of the present disclosure, a mobile terminal comprises a processor, and a memory configured to store processor-executable instructions that when executed by the processor configure the mobile terminal to perform the method according to the first aspect or one of its implementation variants. Particularly, the mobile terminal can perform the method of the first aspect, the method according to one of the implementation variants of the first aspect, the method according to an example of the first aspect, or any combination thereof.

[0054] As a mere example, the mobile terminal may execute a program (an application) configured to perform the method of the first aspect or one of its implementation variants. An execution screen of such program may be displayed on a display screen of the mobile terminal to request for user input, to indicate a risk level, to indicate a washing cycle, to indicate modification of a washing cycle, etc.

[0055] In an implementation variant, the mobile terminal can further comprise a communication unit configured to communicate with a washing machine. Such communication unit may operate on any wireless or wired communication protocol. As a mere example, the mobile terminal and the washing machine may communicate with one another via Bluetooth, Wi-Fi (WLAN), near field communication, or the like.

[0056] Alternatively or additionally, the communication unit may operate on a telecommunication standard data transfer protocol based on, for example, GSM, 3G, LTE, 5G, or the like. In this case, the communication unit may indicate any information and/or data to a server, and the washing machine is equipped with a corresponding communication unit to receive information and/or data from the server.

[0057] It is to be understood that a bi-directional communication is possible between the mobile terminal and the washing machine, either directly or via a server. This allows transmitting status information from the washing machine to the mobile terminal. As a mere example, the washing machine may be configured to determine a type of fabric of the garment in the washing machine and send information and/or data to the mobile terminal allowing the mobile terminal to determine the type of fabric of the garment in the washing machine.

[0058] According to a fourth aspect of the present disclosure, a washing machine comprises a washing drum, a controller, a user input unit configured to receive a user input, and a memory configured to store computer-executable instructions that when executed by the controller configure the washing machine to perform the method of the first aspect or one of its implementation variants. Particularly, the washing machine can perform the method of the first aspect, the method according to one of the implementation variants of the first aspect, the method according to an example of the first aspect, or any combination thereof.

[0059] As a mere example, the washing machine may comprise a user interface, such as a display and a user input device, e.g., buttons and/or a touchscreen. This allows the washing machine to receive user input, particularly the fabric type user input, and to output information to the user visually and/or audibly.

[0060] In an implementation variant, the washing machine can further comprise a load sensor configured to weigh the load of the drum, and/or a water level sensor configured to detect a water level in the drum. These sensors alone or in combination can be employed to determine a type of fabric of garment in the washing drum. As a mere example, the water level sensor can be used to determine a water absorption of the garment in the washing drum, which allows determination of the type of fabric of the garment in the washing drum.

[0061] In a further implementation variant, the controller can be configured to calculate a load of the garment in the drum by determining a current and/or torque of a motor driving the drum. For instance, the heavier the garment (dry vs. wet) the more power is required to move the drum. Thus, the controller can implement a virtual load sensor, i.e., avoiding installation of an actual/physical load sensor.

[0062] According to a fifth aspect, a computer program product is provided. The computer program product comprises program code portions for performing the method of the first aspect when the computer program product is executed on one or more computing devices (e.g., a processor or a distributed set of processors). The computer program product may be stored on a computer readable recording medium, such as a semiconductor memory, DVD, CD-ROM, and so on.

[0063] According to a sixth aspect of the present disclosure, a washing machine control unit configured to control components of a washing machine to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibrils comprises a processor, a component interface configured to be connected with at least one component of the washing machine and to transmit a control signal to the at least one component, and a memory configured to store processor-executable instructions. The processor, when executing the processor-executable instructions stored in the memory, is configured to receive a user input to apply the dedicated washing cycle specifically adapted to reduce detachment of microfibrils, and configure the component interface to transmit control signals to the at least one component to perform the dedicated washing cycle.

[0064] The at least one component can include a washing drum, a water inlet (valve), a pump configured to convey water inside of the washing machine and/or to a waste water outlet, a motor driving the washing drum, a heater heating the water in the washing machine, and a detergent supply configured to release detergent into the water inside of the washing machine.

[0065] In an implementation variant, the memory can be further configured to store additional processor-executable instructions that when executed by the processor configure the component interface to transmit control signals to the at least one component to perform the dedicated washing cycle in accordance with washing parameters including:

- a water temperature of maximum 40°C,
- an agitation speed range during heating the water of 50 rpm to 55 rpm, preferably for 4 to 8 minutes,
- an agitation speed range during washing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes,
- an agitation speed range during rinsing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes, and
- a spinning speed between 400 rpm to 800 rpm.

[0066] It is to be understood that the present disclosure explicitly covers all possible combinations of one or more of the above washing parameters to implement the dedicated washing cycle. Thus, the present disclosure is neither restricted to the number of parameters in the above list nor to the order of the parameters in the list.

[0067] In an implementation variant, the memory can be further configured to store additional processor-executable instructions that when executed by the processor configure the component interface to transmit control signals to the at least one component to perform the dedicated washing cycle in accordance with further washing parameters including:

- an initial water filling range of 20 L to 25 L,
- a secondary or subsequent water filling range of 20 to 25 Litre,
- an agitation speed range during the initial water filling of 30 rpm to 35 rpm,
- a spinning speed between 200 rpm to 600 rpm, preferably 400 rpm (e.g., during draining phase), and
- an agitation speed range during an intermediate water filling of 50 rpm to 55 rpm, preferably for 2 to 6 minutes, more preferably for 4 to 6 minutes, the intermediate water filling taking place after the initial water filling and before the rinsing.

[0068] It is to be understood that the present disclosure explicitly covers all possible combinations of one or more of the above washing parameters (of both implementation variants) to implement the dedicated washing cycle. Thus, the present disclosure is neither restricted to the number of parameters in the above list nor to the order of the parameters in the list.

[0069] Furthermore, the dedicated washing cycle can include one or more washing cycle subcategories, each category consisting of one or more of the above parameters. For instance, the dedicated washing cycle can be categorised into washing, draining, rinsing and/or final spin. Thus, different phases of a washing cycle can be determined and set in accordance with one or more of the parameters to achieve the dedicated washing cycle.

[0070] According to a seventh aspect of the present disclosure, a washing machine comprises a washing machine control unit of the sixth aspect or one of its implementation variants.

[0071] The present disclosure is not restricted to the aspects and variants in the described form and order. Specifically, the description of aspects and variants is not to be understood as a specific limiting grouping of features. It is to be understood that the present disclosure also covers combinations of the aspects and variants. Thus, each variant or optional feature can be combined with any other aspect, variant, optional feature or even combinations thereof.

[0072] In the following, the present disclosure will further be described with reference to exemplary implementations illustrated in the figures, in which:

Figure 1 schematically illustrates a washing machine and user terminal;

Figure 2 schematically illustrates an exemplary method for reducing detachment of microfibrils from garment in a washing cycle; and

Figure 3 schematically illustrates another exemplary method for reducing detachment of microfibrils from garment in a washing cycle.

[0073] In the following description, for purposes of explanation and not limitation, specific details are set forth in order to provide a thorough understanding of the present disclosure. It will be apparent to one skilled in the art that the present disclosure may be practiced in other implementations that depart from these specific details.

[0074] Figure 1 schematically illustrates a washing machine 100 and a user terminal 150, that can together form a washing system. Such washing system may consist only of a washing machine 100, which has functionality integrated

therein that is described in the present disclosure with respect to the user terminal 150.

[0075] The washing machine 100 comprises a washing drum 132, into which garment can be placed for a washing cycle. Through a water inlet 142, such as a hose or other source, the drum 132 or a sump (not explicitly illustrated), in which the drum 132 is installed, can be filled with water. The water inlet 142 may be controllable via an inlet valve 144. A water level sensor 105 may detect a water level in the drum 132 or sump. A load sensor 103 may be provided that is configured to weigh a load of the drum 132. Thus, the weight of garment loaded into the drum 132 can be weighed.

[0076] The drum 132 can be moved, particularly, rotated. This can be achieved by a drive motor 136 mechanically coupled with the drum 132. Thus, driving the motor 136 is equivalent to driving or rotating the drum 132.

[0077] A pump 134 may be provided to circulate water from the drum 132 or sump and back. For instance, a filter (not explicitly illustrated) may be arranged in a duct connected to the pump 134, so that particles in the water can be filtered out. Through a water outlet 146 waste water can be removed from the drum 132 or sump. As illustrated in Figure 1, the water outlet 146 may be connected to an outlet of the pump 134, so that the pump can further be configured to pump out waste water from the drum 132 or sump. It is to be understood that the water outlet 146 may likewise be equipped with a valve (not explicitly illustrated), if necessary.

[0078] The washing machine 100 further comprises a controller 104, a user input unit 120 configured to receive a user input, and a memory 108 configured to store computer-executable instructions. These instructions may be loaded and executed by the controller 104 to perform a washing cycle, as it will be explained in more detail with respect to Figure 2 or 3.

[0079] The controller 104 can be part of a washing machine control unit 101 configured to control components of the washing machine 100, such as the drum 132 (e.g., via the motor 136), the pump 134, the water inlet 142 and/or valve 144, and the water outlet 146. The washing machine control unit 101 can comprise a component interface 110 configured to be coupled with at least one of the components 132, 134, 136, 142, 144, 146 of the washing machine 100 and to transmit a control signal to the at least one component. For the sake of clarity of the drawing, a signal line connecting the component interface 100 with the at least one component 132, 134, 136, 142, 144, 146 has been omitted.

[0080] The washing machine 100, such as the washing machine control unit 101, can further comprise a communication unit 106. The communication unit 106 allows wireless and/or wired communication with another device. As a mere example, the communication unit 106 can be configured to transmit and receive signals and data via a network 200. Furthermore, a server 210 may be connected to the network 200, so that a data communication can be achieved between the washing machine 100 and the server 210 via the communication unit 106.

[0081] Furthermore, the washing machine 100 further comprises a user input unit 120. Figure 1 illustrates only a knob or button 122 representing one possibility for a user input device. It is to be understood that more than the one button 122 can be provided in the user input unit 120. This includes one or more keys, soft buttons and the like as well as a touchscreen.

[0082] The washing machine 100 can further comprise a user output unit 125. The user output unit can include indication devices, such as one or more lights, a display, a speaker, a buzzer or the like. Such indication device may be employed to provide information to a user visually and/or audibly. The user output unit 125 can be combined with the user input unit 120 or can be spatially integrated therein. As a mere example, a touchscreen may be employed that combines the functionality of a user input unit 120 and user output unit 125.

[0083] The user input unit 120 and/or user output unit 125 can be connected to the washing machine control unit 101, such as to the processor 104. Thus, the processor 104 can be configured to receive a user input from the user input unit 120 and can further be configured to output or indicate information to the user via the user output unit 125. As a mere example, a user input can be a fabric type selection of the user, while a user output can be information of a washing cycle, such as a beginning or other status of the washing cycle.

[0084] Furthermore, the washing machine control unit 101, such as the processor 104, can be connected to a sensor of the washing machine 100, such as a load sensor 103 and/or a water level sensor 105. Thus, the washing machine control unit 101 can receive signals indicating a weight of the drum 132 and/or a water level in the drum 132 or sump, and can process the received signals to control the at least one component 132, 134, 136, 142, 144, 146 of the washing machine 100 based on the received signals and/or processed signals.

[0085] Furthermore, the controller 104 can be configured to calculate a load of the garment in the drum 132 by determining a current and/or torque of the motor 136 driving the drum 132. For instance, the heavier the garment (dry vs. wet), the more power is required to move the drum 132. Thus, the controller 104 can implement a virtual load sensor, i.e., avoiding installation of an actual/physical load sensor 103. In addition, the controller 104 can further fill water into the drum 132 (e.g., by opening the valve 144), so that the garment absorbs water. By knowing the amount of water added to the washing machine 100, the weight of the garment can be determined by the controller 104 in a virtual manner.

[0086] Figure 1 further illustrates a mobile terminal 150, such as a handheld device, a mobile telephone, a tablet, a laptop or the like. The mobile terminal 150 may be configured to communicate with the washing machine 100 and control at least one function of the washing machine 100. Some details of the mobile terminal 150 are illustrated highlighted between dashed-dotted lines. The mobile terminal 150, for example, includes a processor 153 and a memory 155 configured to store processor-executable instructions. These instructions can be executed by the processor 153 and configure the processor 153 and, hence, the mobile terminal 150, to perform a particular operation relating to the washing machine 100,

which will be explained in more detail with respect to Figure 2 or 3.

[0087] Moreover, the mobile terminal 150 can include a communication unit 154 configured to communicate with a washing machine 100. The communication unit 154 allows a wireless and/or wired communication with another device. As a mere example, the communication unit 154 can be configured to transmit and receive signals and data via a network 200. For instance, a data communication can be achieved between the mobile terminal 150 and the server 210 via the network 200. If the washing machine 100 is also connected to the network 200, particularly the server 210, a data communication can be achieved between the washing machine 100 and mobile terminal 150 via associated communication units 106, 154. It is to be understood that a direct communication between mobile terminal 150 and washing machine 100 can likewise be achieved via communication units 154 and 106.

[0088] Figure 2 schematically illustrates a flow diagram of a method for reducing detachment of microfibrils from garment in a dedicated washing cycle of a washing machine 100. This dedicated washing cycle is the result of a Spanish funding project called "Fiberclean project". The method may be performed by the processor 153 of the mobile terminal 150 and/or the controller 104 of the washing machine 100. For instance, the processor-executable instructions or computer-executable instructions stored in the respective memory 155, 108 may configure the mobile terminal 150 and/or the washing machine 100 to perform the method or at least some of the method steps, so that interoperability between the mobile terminal 150 and the washing machine 100 is achieved.

[0089] In a first step 312, a fabric type user input is received that specifies a type of fabric of a garment placed in the washing machine 100, particularly placed in the drum 132. The fabric type may be input by a user via a user input unit of the mobile terminal 150 (not explicitly illustrated) or via the user input unit 120 of the washing machine 100, depending on which device performs the method.

[0090] The user may directly input one or more fabric types of the garment placed into the drum 132. Alternatively, a list of possible fabric types is presented to the user, from which the user can select one or more.

[0091] In optional receiving steps 314 and 316, a hardness user input and a detergent user input can be received, respectively. The hardness user input specifies a water hardness of the water provided to the washing machine. For instance, the user may have the corresponding information from a water supplier or the like and enters the information via a user input unit. The hardness user input can be a water hardness value. The water hardness may not change often, so that this optional receiving step 314 may be performed only once, at long-term intervals (e.g., every year or second year) or not at all. The detergent user input specifies a detergent type used in the washing machine for the (next) washing cycle. The detergent user input may refer to HDD, LDD, biodegradable detergent, non-biodegradable detergent, or the like. The user input steps 314 and 316 may be performed at the user input unit of the mobile terminal 150 and/or via the user input unit 120 of the washing machine 100.

[0092] The method continues with calculating a risk contribution in step 353, and optionally in steps 356 and 358. For instance, a risk contribution due to the fabric type user input can be calculated in step 353. If input by the user in steps 314 and/or 316, a risk contribution due to the specified water hardness can be calculated in step 354 and/or a risk contribution due to the specified detergent can be calculated in step 356. Thus, a risk contribution for each user input value is calculated.

[0093] For instance, a risk contribution can be any value of a particular range, such as a certain value from 0 to 10 or from 0 to 100. As a mere example, a risk contribution value can be 0, 2, 5, 10 (or any value therebetween) or 0, 10, 20, 50, 80, 100 (or any value therebetween), wherein 0 means (almost) no risk, and 10 / 100 means a very high risk of detachment of microfibrils.

[0094] Furthermore, in step 359, the risk contribution(s) can be weighted. Moreover, the weighted risk contribution(s) can be summed up, i.e. a weighted sum is calculated. For instance, the risk contribution due to the fabric type user input may receive a higher weight, as it has larger impact on the actual amount of detached microfibrils. As a mere example, the risk contribution due to fabric type user input may be weighted to form 60% of the weighted sum, while the risk contributions due to the specified water hardness and the specified detergent may each be weighted to form 20% of the weighted sum.

[0095] Returning to Figure 2, the method further includes determining a type of fabric in step 332. The fabric type of the garment in the washing machine 100 is determined by the washing machine 100. This fabric type is processed either by the controller 104 of the washing machine 100 or it is transmitted via communication units 106 and 154 to the mobile terminal 150, where it is processed by processor 153. Alternatively or additionally, sensor information is provided by the washing machine 100 to the mobile terminal 150, so that the mobile terminal 150 can determine the fabric type of the garment based on the sensor information.

[0096] The fabric type can be determined by the washing machine 100 by different means. For example, the determining of the type of fabric can include controlling the washing machine to open a water inlet 142 in step 362. A water absorption of the garment can then be determined and allows conclusions on the type of fabric depending on the amount of water absorbed by the garment. The determining of the type of fabric can further include controlling the washing machine to operate the drum 132 in step 364.

[0097] As a mere example, the load of garment can be weighed or virtually determined when the garment is dry. Then, the water inlet 142 is opened, for example, until the water level sensor 105 outputs a corresponding signal indicating the

water level in the drum 132. This allows weighing or virtually determining the load of the wet garment. Based on the difference between dry and wet load, the controller 104 can calculate a fabric type. This can include using a lookup table including a mapping between load difference(s) and garment types. The opening of the water inlet 142 may be repeated one or more times, in order to achieve more precise results for the fabric type determination.

[0098] The virtual determination of the load of the garment can include measuring a power consumption or torque of the motor 136, i.e. moving the garment in the drum 132. The measured power consumption or torque of the motor 136 varies depending on the amount of water absorption by the garment fabric. Thus, the processor 104 can determine (calculate or use a lookup table) the fabric type in dependence on the weight of the dry garment and the wet garment (including several repetitions of adding more water to the garment and measuring the power consumption or torque of the motor 136).

[0099] Alternatively or additionally, an amount of water filled into the drum 132 can be opposed to a water level in the drum 132 sensed by the water level sensor 105. Specifically, compared to filling the same amount of water in an empty drum 132 may lead to a different water level depending on the type of fabric of the garment. The difference between the water level of an empty drum 132 and the sensed water level indicated by sensor 105 allows determination of the fabric type, for example, based on empirical values.

[0100] Any signal from the sensor 105 or weight values determined by the controller 104 may be transmitted to the mobile terminal 150 (as the sensor information), so that the mobile terminal can perform the associated determination of the fabric type.

[0101] In order to let the garment absorb the water, the determining of the type of fabric of the garment (step 332) can include controlling the washing machine 100, particularly operating the drum 132. For instance, the drum 132 may be moved back and forth. This movement may include only a few degrees forward and backward or one or more full rotations in a forward or backward direction. Alternatively, the drum 132 is rotated in the same direction with a predefined rotational speed, such as 30 to 35 rpm.

[0102] Alternatively or additionally, the load sensor 103 can provide a corresponding signal indicating a weight of the drum 132. This weight allows conclusions on the water absorption of the garment based on empirical values. Likewise, any signal from the load sensor 103 may be transmitted to the mobile terminal 150 (as the sensor information), to allow the mobile terminal 152 determine the fabric type.

[0103] The load weight of the garment can be determined in step 334, for example, when the garment is placed into the drum 132 and/or during a washing cycle. Alternatively or additionally, the load weight of the garment can also be determined during controlling the washing machine in steps 362 and 364, i.e. letting the garment absorb water.

[0104] The method continues with step 352 calculating a risk level based on the (risk contribution due to) fabric type user input and the determined type of fabric. Specifically, the risk level indicates a risk that microfibres can be detached from the garment during the washing cycle. In more detail, the risk level is calculated to determine whether the fabric type user input may lead to fibre shedding, i.e. the emission of microfibres from the garment. Thus, the fabric type user input and the type of fabric determined by the information received from the washing machine 100 are compared.

[0105] As a mere example, if in step 332 it is determined that a majority of the garment consists of cotton, the risk of detachment of microfibres is very low. In this case (i.e., cotton is determined to be placed in the drum 132), the method could be stopped, as there is no risk of microfibre detachment. In other words, the risk level is calculated to be 0. On the other hand, a factor may be applied to the determined type of fabric (step 332) which results in a low risk level. Thus, the factor for calculating the risk level can be smaller than 1, for example can be 0, 0.1, 0.5, 0.8, or the like.

[0106] Likewise, if in step 332 it is determined that a majority of the garment consists of synthetic fabric, the risk of microfibre detachment is rather high. If a synthetic fibre is determined to be present in the drum 132 in step 332, the calculated risk contribution(s) (see step 355, 356, 358) may also be taken into account. As a mere example, the calculated risk contribution(s) can be multiplied with a factor depending on whether the risk contribution(s) increases or decreases the resulting risk level. For instance, the calculated risk contribution should be increased when calculating the risk level. In this case, the factor can be larger than 1, such as 1.2, 1.5, 2, 5 or the like.

[0107] It is to be understood that the step 353 (calculating a risk contribution) can be omitted, if only the fabric type user input of step 312 is performed and the optional steps 314 and 316 are omitted. In other words, the type of fabric (from the user input and from the determination by the washing machine 100 or mobile terminal 150) may be used to directly calculate a risk level. This further allows avoiding a weighting of any risk level or risk contribution.

[0108] Furthermore, the determined load weight of the garment (from step 334) can be taken into account when calculating the risk level in step 352. Specifically, like a risk contribution, a weighted risk contribution or in form of a factor, the risk contributions from step 353 (and optionally 356, 358) or from step 359 can be further modified based on the determined load weight of the garment. The smaller the load weight is, the higher the risk of microfibre emission is. Thus, for a small load weight, the resulting risk level has to be increased compared to the risk contribution(s).

[0109] As a mere example, the risk contribution from step 353 (and optionally 356, 358) or from step 359 as well as the calculated risk level from step 352 could be a value between 0 and 100. The below (lookup) table indicates an influence on the risk level based on the determined load weight:

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Load	0	10	20	30	40	50	60	70	80	90	100
Quarter load (0%-25%)											
Half load (25%-50%)											
Full load (50%-100%)											

wherein a white field means a low risk, a light grey field means a medium risk and a dark grey field means a high risk of microfibre detachment.

[0110] It is to be understood that the above table does not include a risk level for non-synthetic fibres, since this is low (a white field) for all values 0 to 100.

[0111] Furthermore, the above table may be further divided, for example, by sub-grouping the load. For instance, sub-groups in steps of, for example, 200g, 500g or 1000g can be employed to divide the load groups into finer groups. This can be derived from the below (lookup) table forming only one possible example:

Load	Load (g)	0	10	20	30	40	50	60	70	80	90	100
Quarter load (0%-25%)	0											
	500											
	1000											
	1500											
Half load (25%-50%)	2000											
	2500											
	3000											
	3500											
Full load (50%-100%)	4000											
	4500											
	5000											
	5500											
	6000											
	6500											
	7000											

[0112] Thus, the smaller the load weight is, the higher the risk for microfibre detachment is, so that only for small risk contributions based on the user input (see step 312-316 and 353-359 in Figure 2) there is a medium risk for microfibre detachment. Likewise, only in case of a full load and small risk contributions based on the user input, the risk level may be low (white fields). Otherwise, there is a medium risk level or even high risk level, particularly for a quarter load and half load.

[0113] It is to be understood that the above risk level calculation may be performed in any manner, taking into account the type of fabric determined by the washing machine and/or taking into account the load weight determined by the washing machine.

[0114] As a mere example, the user input (steps 312, 314, 316) may be handled by values of a 0..10 scale, so that each of the risk contributions calculated in step 353, 356, 358 results in a value between 0 and 10. These values may be multiplied by 10 and/or may be summed up, or a weighted sum may be calculated from the risk contributions, so that the resulting risk level is in a 0..100 scale. A specific example would be using in step 359 a factor of 1 to 3, preferably 2, for calculating the risk contributions regarding water hardness (step 314, 356) and regarding detergent (step 316, 358), and using a factor of 4 to 8, preferably 6, for calculating the risk contribution of the fabric type user input (steps 312, 353). In step 352, the risk level, calculated as a weighted sum, will be any value between 0 and 100 (e.g., using a 0..10 scale and factors of: 2, 2, and 6). This risk level can then be applied to one of the above (lookup) tables, where the resulting risk level is classified in dependence on the determined load (from step 334).

[0115] The resulting risk level can be low or high, or optionally can have a medium value. If the risk level is low, in step 372 information is output that indicates to perform a washing cycle according to the type of fabric specified by the fabric type user input. On the other hand, if the risk level is high, in step 376 information is output that indicates to perform a dedicated

washing cycle reducing detachment of microfibres. In other words, the dedicated washing cycle is employed and overrules any washing cycle identified by the fabric type user input.

[0116] As illustrated in Figure 2, the risk level can also be medium and, if so, in step 374 information is output that indicates to perform a modified washing cycle. The modified washing cycle is based on or according to the type of fabric specified in the fabric type user input, where one or more washing parameters are modified. For example, the one or more modified washing parameters can include an adapted water temperature and/or an adapted spin speed of the drum of the washing machine. The spin speed is particularly relevant at the end of a rinsing phase of the washing cycle.

[0117] As a mere example, the water temperature can be adapted by setting a maximum water temperature to 40°C, or a maximum of 30°C. The spin speed can be adapted by setting a maximum spin speed between 400 rpm and 800 rpm. Spinning the garment with 400 rpm, 800 rpm, or another particular value therebetween, reduces the amount of microfibres shedded from the garment.

[0118] The outputting of information in step 372, 374 or 376 can comprise outputting a corresponding user message (e.g., via a display of the mobile terminal 150 and/or the user output unit 125 of the washing machine 100) and/or transmitting a corresponding signal to the washing machine 100 and/or transmitting a corresponding signal to a washing machine component 132, 134, 136, 142, 144, 146 and to perform the respective washing cycle. For instance, if the method is performed by the mobile terminal 150, in case of step 374, a signal indicating the modified washing cycle can be transmitted to the washing machine 100. This signal can include the modified washing parameter(s). In case of steps 372 and 376, a signal is transmitted indicating the washing cycle specific to the fabric type or the dedicated washing cycle, respectively. Such signal can include an identification of the respective washing cycle and/or can include all washing parameters for the particular washing cycle.

[0119] The transmission of this signal can take place via the communication unit(s) 154, 106, if the method is performed at the mobile terminal 150, and can take place via the component interface 110, if the method is performed by the washing machine 100.

[0120] Corresponding information on the washing cycle performed by the washing machine 100 and selected depending on the calculated total risk level (i.e., risk level and risk contribution(s)) can be output to the user in step 392. Optionally, a status of the respective washing cycle can be output during performing of the washing cycle.

[0121] In addition, in step 392 information can be output to the user that a microfibre filter of the washing machine 100 requires cleaning or replacement. This information output can be optional to the above-described information output to the user. As a mere example, the outputting of the information on the microfibre filter can be based on a power consumed by a pump motor (not explicitly illustrated) driving the water pump 134 of the washing machine 100. For instance, if the water pump 134 conveys the water in/from the drum 132 through the microfibre filter, the required power to convey the water will decrease with increasing clogging of the filter.

[0122] Figure 3 schematically illustrates another exemplary method for reducing detachment of microfibres from garment in a washing cycle. The majority of method steps of the method of Figure 3 are identical to those of the method of Figure 2. These method steps have been provided with the same reference numerals and their description will be omitted for sake of brevity of this disclosure.

[0123] Compared with the method of Figure 2, in the method of Figure 3 the risk level is calculated in step 352 solely based on the received fabric type user input (step 312) and the determined type of fabric (step 332). Thus, the method could function even without further user input and without determination of a load weight (step 334). Nevertheless, if such further user input and/or load weight determination takes place, a risk contribution(s) is/are calculated in step 354, 356 and/or 358 once the risk level is calculated.

[0124] In other words, the risk level may be amended based on further information. Specifically, in steps 354 to 358 particular risk contributions are calculated. For instance, a risk contribution due to the specified water hardness can be calculated in step 354, a risk contribution due to the specified detergent can be calculated in step 356 and/or a risk contribution due to a determined load weight can be calculated in step 358.

[0125] The load weight of the garment can be determined in step 334, for example, when the garment is placed into the drum 132. Alternatively or additionally, the load weight of the garment can also be determined during controlling the washing machine in steps 362 and 364, i.e. letting the garment absorb water.

[0126] The risk level as well as each risk contribution can be weighted (not explicitly illustrated in Figure 3), for example, to form a weighted sum of the risk level and each risk contribution, if any. Since the determined fabric type has the greatest influence on the amount of microfibres emitted during a washing cycle, the risk level can be weighted higher than the risk contribution(s).

[0127] The method of Figure 3 can be employed by the washing machine 100, where any user input is performed at the washing machine 100, particularly at the user input unit 120. In other words, since the user is at the washing machine 100 and not at a mobile terminal 150, which may be spatially away from the washing machine 100, the receiving and determining steps 312 to 334 can be performed any time and in any (timely) order. This further allows grouping the corresponding tasks by the washing machine, as no interaction with the mobile terminal 150 is necessary. For instance, the calculation of a risk level and calculation of the risk contribution can take place after the receiving and determining steps

312 to 334 are completed.

[0128] It is to be understood that, in another embodiment, the washing machine 100 can be used as a standard washing machine. Particularly, if the user is at the washing machine 100 and not at a mobile terminal 150, which may be spatially away from the washing machine 100, the washing machine 100 can be used in a usual manner. This includes operating the washing machine 100 also without determination of a risk level and/or risk contribution.

[0129] Irrespective of the performed method of either Figure 2 or Figure 3, the dedicated washing cycle for reducing detachment of microfibrils takes into account several washing parameters observed during testing, such as:

1. At a lower temperature, a greater detachment of fibres is observed, for example, fibres that are collected in a filtration system. Such detachment decreases as the washing temperature increases (25°C, 40°C and 60°C).
2. The variation of washing revolutions (33rpm, 52rpm and 57rpm) causes that, at less revolutions (33rpm) a greater detachment of fibres is observed. However, this detachment is not sequential to the increase in revolutions; In this way, the fibre detachment values obtained for revolutions of 53rpm and 57rpm reach an optimum.
3. By varying the spinning revolutions (600rpm, 1000rpm and 1200rpm) a greater detachment of fibres is obtained as its value increases. It should be noted that the variation found when modifying this parameter is less than the variations experienced with the rest of the parameters tested.
4. In the case of load variation (2kg, 4.5kg, 7.2kg), there is a greater detachment at a lower load.
5. By varying the time (50', 90' and 120') a sequential detachment is observed as this parameter is increased. The detachment is greater with a time of 50' and decreases with increasing time.
6. When varying the water level, there is a greater detachment in a control test carried out with 65L of water, followed by a test carried out with 80L and finally, it is a test with 60L that provides the minimum detachment.
7. In the case of detergent, there is great similarity between washing without using detergent and doing it using an HDD-type detergent. However, the test with LDD type detergent distances itself from these two towards a lower fibre shedding.
8. Regarding the water hardness in the washing, it has been proven that, by increasing the hardness, the number of microfibrils generated during washing decreases.
9. In the test of old age of the fabric, after analysing the 5th washing in control conditions for the same garment, it is observed that the level of microfibrils that are released is lower when increasing the number of washes of these garments.

[0130] Thus, the dedicated washing cycle can be performed in accordance with the below illustrated washing parameter ranges. The below table shows, for comparison, a "normal" 60 minute washing cycle, a dedicated washing cycle, and washing parameter ranges for the dedicated washing cycle.

		Daily 60' cycle	Dedicated washing cycle (FiberClean)	Washing parameter ranges
Washing	Filling	~24l	~20l	20l to 25l
	Agitation	33rpm / 3min	33rpm / 3min	30rpm to 35rpm
	Heating	60°C(*)	30°C	Cold to 40°C
	Agitation	53rpm / 20min	53rpm / 5min	50rpm to 55rpm for 4min to 8min
	Agitation	53rpm / 10min	53rpm / 3min	50rpm to 55rpm for 2 min to 4min
	Draining		400 rpm	200rpm to 600rpm)
	Filling	~20l	~20l	20l to 25l
Rinse	Agitation	53rpm / 1min	53rpm / 2min	50rpm to 55rpm for 2min to 4min
	Agitation	53rpm / 4min	53rpm / 4min	50rpm to 55rpm for 3min to 6min
	Spin	1400rpm / 15min	800rpm / 6min	Limited from 400rpm to 800rpm
Total duration		~70min	~45min	

[0131] It is believed that the advantages of the technique presented herein will be fully understood from the foregoing description, and it will be apparent that various changes may be made in the form, constructions and arrangement of the exemplary aspects thereof without departing from the scope of the disclosure or without sacrificing all of its advantageous effects. Because the technique presented herein can be varied in many ways, it will be recognized that the disclosure should be limited only by the scope of the claims that follow.

Claims

1. A method for reducing detachment of microfibrils from garment in a washing cycle of a washing machine (100), the method comprising:

receiving (312) a fabric type user input specifying a type of fabric of the garment placed in the washing machine; determining (332) a type of fabric of the garment in the washing machine; calculating (352) a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibrils can be detached from the garment during the washing cycle; and if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibrils.

2. The method of claim 1, further comprising:

receiving (314) a hardness user input specifying a water hardness of the water provided to the washing machine, wherein calculating the risk level includes calculating (354) a risk contribution influencing the risk level due to the specified water hardness.

3. The method of claim 1 or 2, further comprising:

receiving (316) a detergent user input specifying a detergent type used in the washing machine for the washing cycle, wherein calculating the risk level includes calculating (356) a risk contribution influencing the risk level due to the specified detergent.

4. The method of one of claims 1 to 3, further comprising:

determining (334) a load weight of the garment placed in the washing machine, wherein calculating the risk level includes calculating (358) a risk contribution influencing the risk level due to the determined load weight.

5. The method of one of claims 2 to 4, further comprising:

weighting (359) the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight, or weighting (359) the risk level based on the fabric type and the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight, wherein, preferably, the risk level is weighted higher than the risk contribution.

6. The method of one of claims 1 to 5, wherein determining the type of fabric of the garment includes determining a water absorption of the garment, wherein, preferably, determining of the water absorption of the garment includes controlling (362) the washing machine to open a water inlet (142) to water the garment.

7. The method of one of claims 1 to 6, further comprising:

if the risk level is determined to be low, outputting (372) information indicating to perform a washing cycle according to the type of fabric specified in the fabric type user input; and/or if the risk level is determined to be medium, outputting (374) information indicating to perform a modified washing cycle that is a washing cycle according to the type of fabric specified in the fabric type user input with one or more washing parameters being modified,

wherein, preferably, the one or more modified washing parameters can include an adapted water temperature and/or an adapted spin speed of the drum of the washing machine, and
 wherein, preferably, the water temperature is adapted by setting a maximum water temperature to 40°C, and/or
 wherein the spin speed is adapted by setting a maximum spin speed between 400 rpm and 800 rpm.

8. The method of one of claims 1 to 7, further comprising:

outputting (392) a user message to the user that a microfibre filter of the washing machine requires cleaning or replacement,

wherein, preferably, the outputting (392) of the user message is based on a change of power consumption by a pump motor driving a water pump (134) of the washing machine.

9. The method of one of claims 1 to 8, wherein indicating (372, 374, 376) to perform a washing cycle, a modified washing cycle or a dedicated washing cycle comprises outputting a corresponding user message and/or transmitting a corresponding signal to the washing machine to perform the respective washing cycle.

10. The method of one of claims 1 to 9, wherein the dedicated washing cycle reducing detachment of microfibres includes one or more of the parameters:

an initial water filling range of 20 L to 25 L,

a secondary or subsequent water filling range of 20 to 25 L,

a water temperature of maximum 40°C,

an agitation speed range during an initial water filling of 30 rpm to 35 rpm,

an agitation speed range during a secondary water filling of 50 rpm to 55 rpm, preferably for 2 to 4 minutes,

an agitation speed range during heating the water of 50 rpm to 55 rpm, preferably for 4 to 8 minutes,

an agitation speed range during washing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes,

an agitation speed range during rinsing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes, and

a spinning speed between 400 rpm to 800 rpm.

11. A washing system (100, 150), comprising:

one or more processors (104, 153); and

one or more memories (108, 155) configured to store processor-executable instructions that when executed by the one or more processors configure the washing system to perform the method of one of claims 1 to 10.

12. A mobile terminal (150), comprising:

a processor (153); and

a memory (155) configured to store processor-executable instructions,

wherein the processor, when executing the processor-executable instructions, is configured to:

receive a fabric type user input specifying a type of fabric of garment placed in the washing machine;

determine a type of fabric of the garment in the washing machine;

calculate a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle; and

if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres.

13. A washing machine (100), comprising:

a washing drum (132);

a controller (104);

a user input unit (120) configured to receive a user input; and

a memory (108) configured to store computer-executable instructions,

wherein the controller, when executing the computer-executable instructions, is configured to:

receive a fabric type user input specifying a type of fabric of garment placed in the washing drum;

determine a type of fabric of the garment in the washing drum;

calculate a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle; and if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres.

14. The washing machine of claim 13, further comprising:

a load sensor (103) configured to weigh a load of the drum (132); and/or
a water level sensor (105) configured to detect a water level in the drum (132).

15. A computer program product comprising program code portions for performing the method of any one of claims 1 to 10 when the computer program product is executed on one or more computing devices, wherein, preferably, the computer program product is stored on a computer readable recording medium.

Amended claims in accordance with Rule 137(2) EPC.

1. A method for reducing a risk of detachment of microfibres from garment in a washing cycle of a washing machine (100), the method comprising:

determining (332) a type of fabric of the garment in the washing machine,
characterised in that the method further comprises:

receiving (312) a fabric type user input specifying a type of fabric of the garment placed in the washing machine;

calculating (352) a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle; and
if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres.

2. The method of claim 1, further comprising:

receiving (314) a hardness user input specifying a water hardness of the water provided to the washing machine, wherein calculating the risk level includes calculating (354) a risk contribution influencing the risk level due to the specified water hardness.

3. The method of claim 1 or 2, further comprising:

receiving (316) a detergent user input specifying a detergent type used in the washing machine for the washing cycle,
wherein calculating the risk level includes calculating (356) a risk contribution influencing the risk level due to the specified detergent.

4. The method of one of claims 1 to 3, further comprising:

determining (334) a load weight of the garment placed in the washing machine,
wherein calculating the risk level includes calculating (358) a risk contribution influencing the risk level due to the determined load weight.

5. The method of one of claims 2 to 4, further comprising:

weighting (359) the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight, or
weighting (359) the risk level based on the fabric type and the risk contribution due to the water hardness and/or the specified detergent and/or the determined load weight, wherein, preferably, the risk level is weighted higher than the risk contribution.

6. The method of one of claims 1 to 5, wherein determining the type of fabric of the garment includes determining a water absorption of the garment,

wherein, preferably, determining of the water absorption of the garment includes controlling (362) the washing machine to open a water inlet (142) to water the garment.

7. The method of one of claims 1 to 6, further comprising:

if the risk level is determined to be low, outputting (372) information indicating to perform a washing cycle according to the type of fabric specified in the fabric type user input; and/or
if the risk level is determined to be medium, outputting (374) information indicating to perform a modified washing cycle that is a washing cycle according to the type of fabric specified in the fabric type user input with one or more washing parameters being modified,
wherein, preferably, the one or more modified washing parameters can include an adapted water temperature and/or an adapted spin speed of the drum of the washing machine, and
wherein, preferably, the water temperature is adapted by setting a maximum water temperature to 40°C, and/or wherein the spin speed is adapted by setting a maximum spin speed between 400 rpm and 800 rpm.

8. The method of one of claims 1 to 7, further comprising:

determining a change of power consumption by a pump motor driving a water pump (134) of the washing machine; and
outputting (392) a user message to the user that a microfibre filter of the washing machine requires cleaning or replacement, based on the change of power consumption by the pump motor driving the water pump (134) of the washing machine.

9. The method of one of claims 1 to 8, wherein indicating (372, 374, 376) to perform a dedicated washing cycle comprises outputting a corresponding user message and/or transmitting a corresponding signal to the washing machine to perform the respective washing cycle.

10. The method of one of claims 1 to 9, wherein the dedicated washing cycle reducing detachment of microfibres includes one or more of the parameters:

an initial water filling range of 20 L to 25 L,
a secondary or subsequent water filling range of 20 to 25 L,
a water temperature of maximum 40°C,
an agitation speed range during an initial water filling of 30 rpm to 35 rpm,
an agitation speed range during a secondary water filling of 50 rpm to 55 rpm, preferably for 2 to 4 minutes,
an agitation speed range during heating the water of 50 rpm to 55 rpm, preferably for 4 to 8 minutes,
an agitation speed range during washing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes,
an agitation speed range during rinsing of 50 rpm to 55 rpm, preferably for 2 to 4 minutes, and
a spinning speed between 400 rpm to 800 rpm.

11. A washing system (100, 150), comprising:

one or more processors (104, 153); and
one or more memories (108, 155) configured to store processor-executable instructions that when executed by the one or more processors configure the washing system to perform the method of one of claims 1 to 10.

12. A mobile terminal (150), comprising:

a processor (153);
a communication unit (154) configured to communicate with a washing machine (100); and
a memory (155) configured to store processor-executable instructions,
wherein the processor, when executing the processor-executable instructions, is configured to:

receive a fabric type user input specifying a type of fabric of garment placed in the washing machine;
receive from the washing machine a type of fabric of the garment in the washing machine, or receive sensor information from the washing machine to determine the type of fabric of the garment in the washing machine;
calculate a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle; and

if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres.

13. A washing machine (100), comprising:

a washing drum (132);
a controller (104);
a user input unit (120) configured to receive a user input; and
a memory (108) configured to store computer-executable instructions,

characterised in that the controller, when executing the computer-executable instructions, is configured to:

receive a fabric type user input specifying a type of fabric of garment placed in the washing drum;
determine a type of fabric of the garment in the washing drum;
calculate a risk level based on the fabric type user input and the determined type of fabric, the risk level indicating a risk that microfibres can be detached from the garment during the washing cycle; and
if the risk level is determined to be high, outputting (376) information indicating to perform a dedicated washing cycle specifically adapted to reduce detachment of microfibres.

14. The washing machine of claim 13, further comprising:

a load sensor (103) configured to weigh a load of the drum (132); and/or
a water level sensor (105) configured to detect a water level in the drum (132).

15. A computer program product comprising program code portions for performing the method of any one of claims 1 to 10 when the computer program product is executed on one or more computing devices, wherein, preferably, the computer program product is stored on a computer readable recording medium.

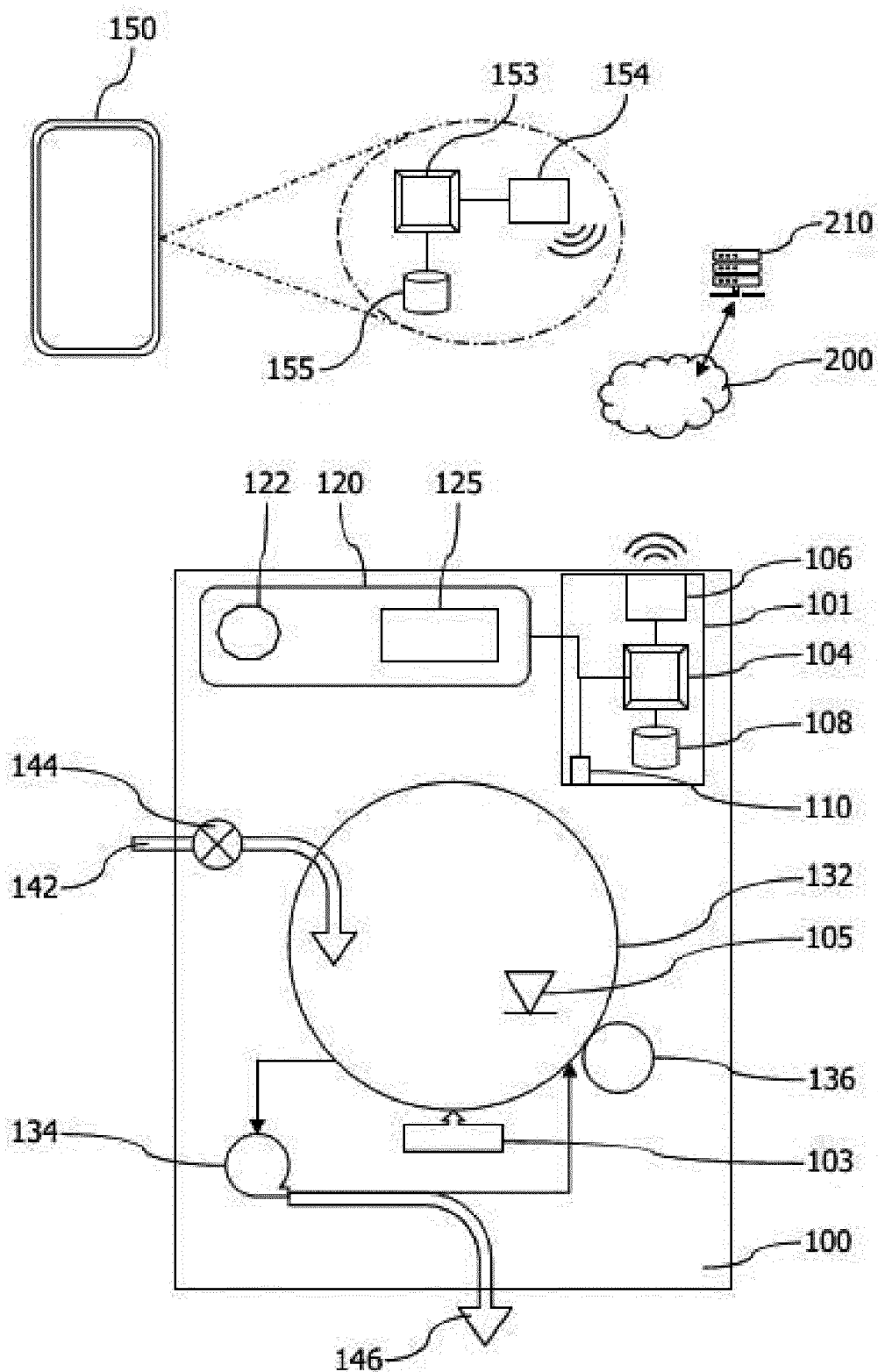
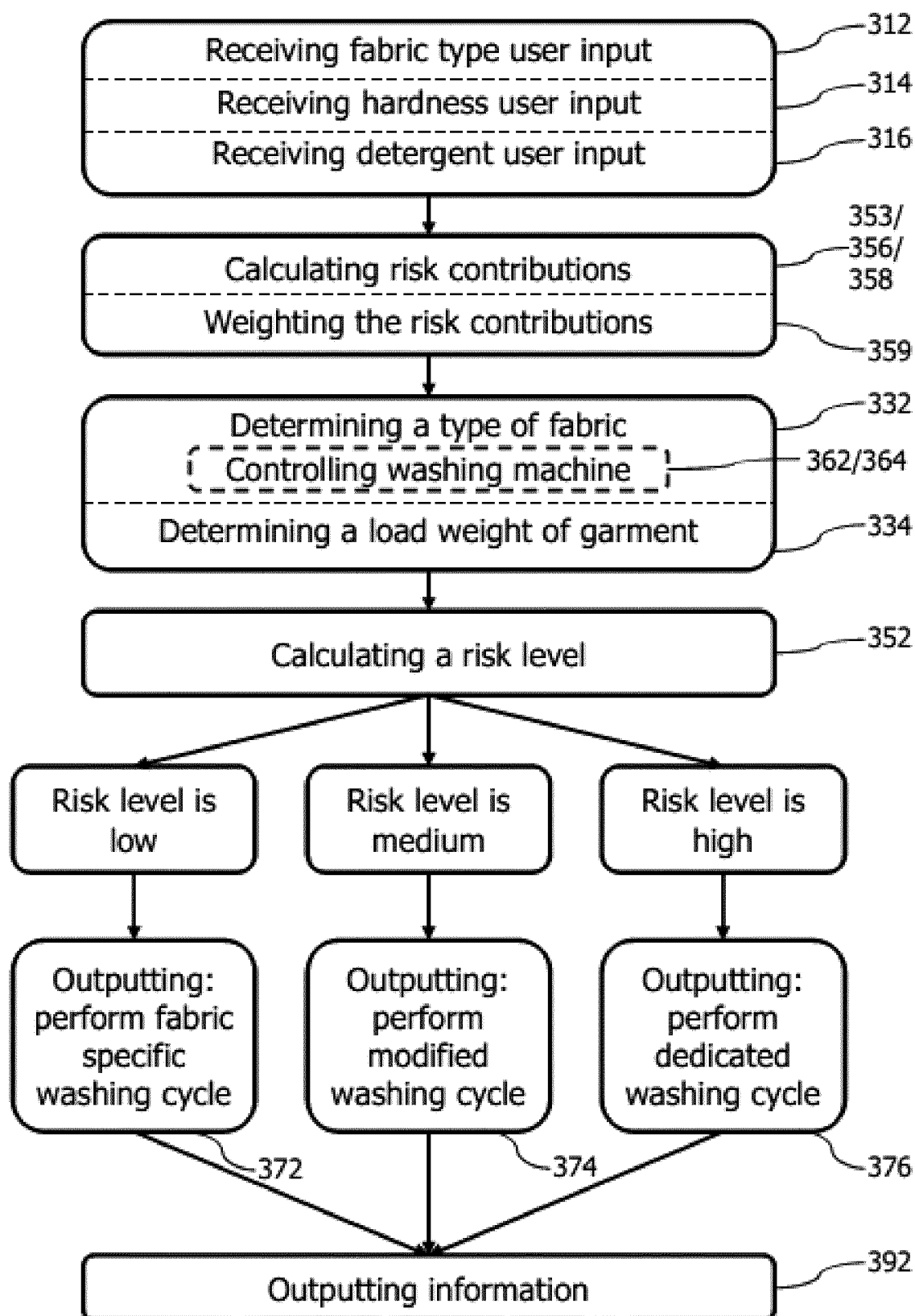
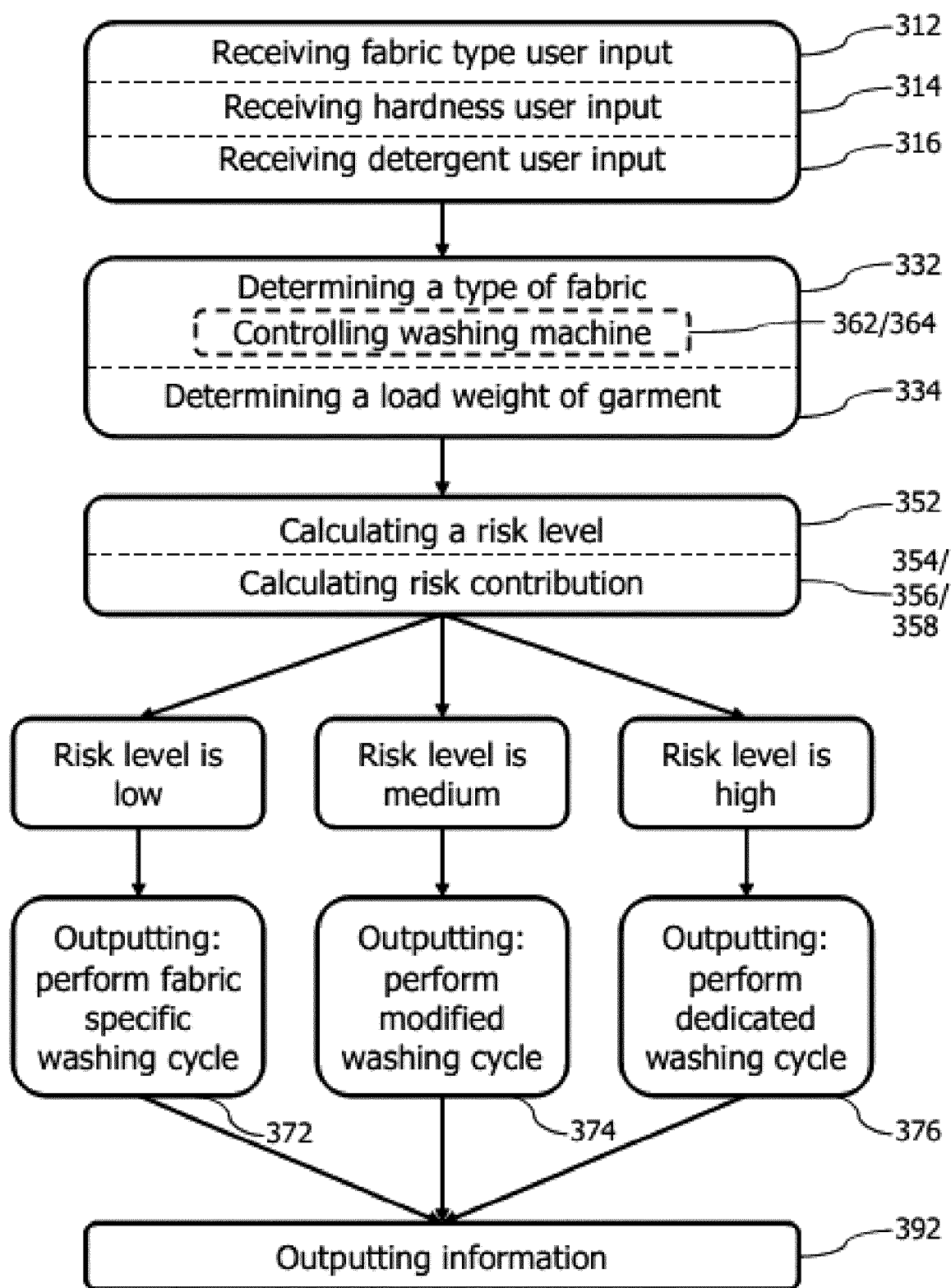


Figure 1

**Figure 2**

**Figure 3**



EUROPEAN SEARCH REPORT

Application Number

EP 23 38 2837

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		17 January 2024	Weidner, Maximilian
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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