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HIDE SORTING SYSTEMS AND METHODS

Abstract

Methods and systems for sorting hides are provided. In particular, one or more embodiments comprise a tanning control system that enhances the traceability of hides by capturing and utilizing data related to the unloading, tanning, sorting, and packaging of hides. Furthermore, one or more embodiments enable the tanning control system to improve efficiency by sorting hides based, at least in part, on data generated during prior tanning processes. Additionally, one or more embodiments facilitate the tanning control system in customizing the sorting and packaging of hides based, at least in part, on one or more hide characteristics and/or customer specifications.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation of U.S. application Ser. No. 18/244,670, filed Sep. 11, 2023, now issued as U.S. Pat. No. 12,264,372, which is a continuation of U.S. application Ser. No. 17/468,579, filed Sep. 7, 2021, now issued as U.S. Pat. No. 11,753,690, which is a continuation of U.S. application Ser. No. 17/002,706, filed Aug. 25, 2020, now issued as U.S. Pat. No. 11,111,551, which is a continuation of U.S. application Ser. No. 16/216,872, filed Dec. 11, 2018, now issued as U.S. Pat. No. 10,752,967, which is a continuation of U.S. application Ser. No. 15/390,704, filed Dec. 26, 2016, now issued as U.S. Pat. No. 10,151,005, which is a continuation of U.S. application Ser. No. 14/724,547, filed May 28, 2015, now issued as U.S. Pat. No. 9,530,162, which claims priority to and the benefit of U.S. Provisional Application No. 62/003,998, filed May 28, 2014. This application is related to U.S. application Ser. No. 14/714,006, filed May 15, 2015, now issued as U.S. Pat. No. 9,951,394, U.S. application Ser. No. 14/724,643, filed May 28, 2015, now issued as U.S. Pat. No. 10,480,040, and U.S. application Ser. No. 16/687,657, filed Nov. 18, 2019, now issued as U.S. Pat. No. 11,248,273. The entire contents of the foregoing applications and issued patents are hereby incorporated by reference in their entirety.

BACKGROUND
1. Technical Field
[0002] One or more embodiments relate generally to processing hides. More specifically, one or more embodiments relate to systems and methods of sorting hides.
2. Background and Relevant Art
[0003] In general, tanning is the process of transforming raw animal hides into leather hides. Typically, tanning is performed at a tanning facility that receives raw animal hides from slaughterhouses or other facilities that skin animals. Upon receiving the raw animal hides, the tanning facility usually subjects the hides to various tanning processes. For example, most often the tanning facility uses a mechanical and chemical tanning process, such as chrome tanning or vegetable tanning, to convert the raw animal hides into leather hides. Once transformed into leather, the tanning facility may subject the leather hides to further processing, such as wringing, grading, splitting, and shaving, before providing the hides to customers that generate finished leather products from the hides. However, while conventional tanning processes are useful in making leather hides, such processes suffer from several disadvantages.
[0004] One disadvantage of conventional tanning processes is a lack of traceability of information relating to the various activities performed within the tanning facility. Conventional tanning processes often fail to record information related to such activities. For example, conventional

tanning processes lack the ability to record process information for a particular hide or a particular batch of hides (e.g., the identification of particular machinery used in the tanning process and/or the identification of a chemical recipe used). Moreover, most conventional tanning processes cannot identify and track a batch of hides, an individual hide, and/or a package of hides with which to associate process information. Thus, by failing to record process information, conventional tanning processes do not facilitate traceability of hides throughout the various tanning facility activities. As a result, process malfunctions that result in poor quality hides are often difficult to troubleshoot due to the lack of traceability, and therefore, conventional tanning processes often produce inconsistent hides, which can lead to customer dissatisfaction, lost profit, and increased processing expense.

[0005] Another disadvantage is that conventional tanning processes typically package leather hides without regard to information generated during the tanning process. Oftentimes, conventional tanning processes package leather hides based only on information gathered during the packaging process (e.g., an assigned grade of a hide). Accordingly, conventional packaging processes typically fail to utilize prior hide measurements, batch characteristics, or other information that may be available or determined during the various states of the tanning process. Consequently, conventional tanning processes are inefficient as they frequently involve manual sorting and/or packaging of leather hides based on incomplete information about the hides.

[0006] Yet another disadvantage is that conventional tanning processes typically package leather hides using a single packaging process, regardless of the characteristics of each particular hide. For example, the packaging process usually involves folding each individual leather hide in the same way. Thus, most conventional tanning processes do not have the ability to customize the packaging process according to customer specifications. Furthermore, conventional packaging processes often involve using manual labor to consistently sort, fold, and package the leather hides according to a single standard. Consequently, in many cases, conventional tanning processes are inflexible, slow, and expensive.

[0007] Accordingly, there are a number of considerations to be made in sorting, folding, stacking, and packaging hides.

SUMMARY

[0008] Embodiments disclosed herein provide benefits and/or solve one or more of the foregoing or other problems in the art with systems and methods for improving the processing of hides. More specifically, one or more embodiments improve the sorting of hides. In addition, one or more embodiments provide systems and methods that enhance the traceability of hides throughout the packaging process, and thereby increase the efficiency of sorting hides into packages to improve the flexibility, speed, and cost associated with sorting and packaging hides.

[0009] For example, one or more embodiments provide systems and methods that record information related to the various activities performed within a tanning facility. More specifically, the systems and methods disclosed herein can provide a tanning control system that stores identifications of particular machinery used to unload, chemically tan, and package hides. Further, in one or more embodiments, a tanning control system can generate and assign unique identifiers to batches of hides, individual hides, and packages of hides. Accordingly, in one or more embodiments, a tanning control system can associate the identifications of particular machinery with the unique identifiers of hides to provide enhanced traceability of hides throughout the various tanning processes. Thus, the systems and methods described herein can assist in improving the consistency of hides, thereby promoting greater customer satisfaction.

[0010] Additional example embodiments can provide systems and methods that package hides based, at least in part, on information generated during prior tanning processes. In particular, the systems and methods disclosed herein can provide a tanning control system that utilizes information from the unloading or chemical tanning processes to sort hides into packages. More specifically, in one or more embodiments, a tanning control system can sort hides based on unique batch identifiers generated and associated with the hides prior to the chemical tanning process.

Furthermore, in one or more embodiments, a tanning control system can use prior hide measurements, batch characteristics, or other information from prior tanning processes to determine the manner in which to sort, fold, stack, and package hides. Accordingly, example systems and methods described herein can increase the efficiency of sorting and packaging hides by leveraging information obtained from prior tanning processes that is associated with a batch of hides or with an individual hide.

[0011] As a further example, one or more embodiments provide systems and methods that sort and package hides based on one or more characteristics associated with a particular hide. More specifically, the systems and methods disclosed herein can provide a hide sorting system that sorts, folds, stacks, and packages hides according to multiple customer specifications. For instance, in one or more embodiments, a hide sorting system can sort, fold, stack, and package a first type of hide according to a first customer specification and a second type of hide according to a second customer specification. Furthermore, in one or more embodiments, a hide sorting system can automate the packaging of hides by performing the sorting, folding, and stacking without the need for manual labor to handle the hides. Accordingly, one or more embodiments can improve the flexibility, speed, and cost of sorting and packaging hides, thereby providing added value to customers.

[0012] Additional features and advantages of exemplary embodiments will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of such exemplary embodiments. The features and advantages of such embodiments may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features will become more fully apparent from the following description, or may be learned by the practice of such exemplary embodiments as set forth hereinafter.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] In order to describe the manner in which the above recited and other advantages and features can be obtained, a more particular description will be rendered by reference to specific embodiments thereof that are illustrated in the appended drawings. It should be noted that the figures are not drawn to scale, and that elements of similar structure or function are generally represented by like reference numerals for illustrative purposes throughout the figures. In the following drawings, bracketed text and blocks with dashed borders (e.g., large dashes, small dashes, dot-dashes, dots, etc.) may be used to illustrate optional features or operations that add additional features to one or more embodiments. Such notation, however, should not be taken to mean that these are the only options or optional operations, and/or that blocks with solid borders are not optional in certain embodiments. Understanding that these drawings depict only typical embodiments and are not therefore to be considered to be limiting, such embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0014] FIG. **1** illustrates a schematic diagram of a system for processing raw animal hides into leather in accordance with one or more embodiments;

[0015] FIG. **2** illustrates a detailed schematic diagram of a hide sorting system of FIG. **1** in accordance with one or more embodiments;

[0016] FIGS. **3**A-**3**B illustrate a sequence-flow diagram of interactions between a measuring system, a classifying system, a tanning control system, and a routing manager of FIG. **2** in accordance with one or more embodiments;

[0017] FIG. **4** illustrates exemplary portions of a tanning system database in accordance with one

or more embodiments;

[0018] FIG. **5** illustrates additional exemplary portions of a tanning system database in accordance with one or more embodiments;

[0019] FIG. **6** illustrates a perspective view of a hide sorting system in accordance with one or more embodiments;

[0020] FIG. **7** illustrates a flowchart of a series of acts in a method of sorting hides in accordance with one or more embodiments; and

[0021] FIG. **8** illustrates a schematic block diagram of an exemplary computing device in accordance with one or more embodiments.

DETAILED DESCRIPTION

[0022] One or more embodiments include a tanning control system that enhances the traceability of hides throughout the packaging process. For example, a tanning control system can control various systems in a manner that enhances traceability, on an individual hide level, by capturing information related to one or more processes of a hide sorting system. For instance, a tanning control system can generate a unique hide identifier for each hide and associate the hide identifier with data corresponding to one or more processes of a hide sorting system (e.g., unique identifiers for a particular sammying machine, weight scale, conveyor systems, grading machine, folding device, and pallet used to package the hide). Thus, by capturing and tracking information related to the activities performed in a tanning facility, example embodiments of a tanning control system can facilitate troubleshooting defects and other problems associated with processing hides, and thereby provide improved consistency in producing hides.

[0023] Furthermore, one or more embodiments of a tanning control system can facilitate the packaging of hides based, at least in part, on information generated from processes that occur prior to hides arriving at a hide sorting system. In particular, in one or more embodiments a tanning control system can cause a hide sorting system to sort a hide based, at least in part, on a batch identifier that the tanning control system generates during a process of unloading and/or chemically tanning the hide. More specifically, for example, a tanning control system can sort a hide based on batch characteristics (e.g., a batch hide type) associated with a batch identifier of the hide. Furthermore, in one or more embodiments a tanning control system can sort a hide based on any combination of a batch identifier associated with the hide, one or more measurements of the hide obtained by a measuring system of a hide sorting system, or a grade of the hide obtained by a classifying system of a hide sorting system. Accordingly, one or more embodiments improve the efficiency of sorting and packaging hides by utilizing relevant information generated from prior activities performed during a tanning process, as well as information obtained during a packaging process (e.g., at a hide sorting system).

[0024] In addition, one or more embodiments include a tanning control system that packages hides based on one or more characteristics of each hide and one or more customer specifications. More specifically, for instance, a tanning control system can determine one or more characteristics of a hide and, based on those characteristics, the tanning control system can identify a particular customer specification to use to sort, fold, stack, and package the hide. For example, a customer specification can include a sorting specification (i.e. an indication of acceptable hide characteristics, as requested by the customer), a folding specification (i.e. an indication of how to fold the hides, as requested by the customer), a stacking specification (i.e. an indication of how to stack the hides, as requested by the customer), and a packaging specification (i.e. an indication of how to package the hides, as requested by the customer). Thus, in one or more embodiments, a tanning control system can sort, fold, stack, and package a first type of hide according to a first customer specification and a second type of hide according to a second customer specification. Moreover, one or more embodiments can automate the packaging of hides according to customer specifications without the use of human intervention. Thus, one or more embodiments improve the flexibility of packaging hides and also reduce the time and cost needed to package hides in

accordance with multiple different customer specifications.

[0025] For example, FIG. **1** is a schematic diagram illustrating a tannery system **100** (or simply "system **100**") for processing raw animal hides into leather in accordance with some embodiments. An overview of system **100** will be described next in relation to FIG. **1**. Thereafter, a more detailed description of the components and processes of system **100** will be described in relation to the remaining figures.

[0026] As illustrated by FIG. **1**, the system **100** can include a tanning facility **102**. As illustrated in FIG. **1**, tanning facility **102** can include a tanning system **104**, a hide sorting system **106**, and/or a customized processing system **108**. Moreover, as FIG. **1** illustrates, the system **100** can include a hide supply system **110** and/or a leather finishing system **112**. As explained in greater detail below, each component **104-108** of the tanning facility **102**, as well as components **110** and **112**, can be managed and/or controlled by one or more computing devices.

[0027] In general, and as FIG. **1** illustrates, system **100** can include a hide supply system **110** that provides raw animal hides obtained from the slaughter of certain animals. For example, the hide supply system **110** provides raw animal hides to tanning system **104** of tanning facility **102**. Tanning system **104** employs various tanning systems, processes, machinery, and apparatuses to transform the raw animal hides into leather. After the tanning system **104** transforms the hides into leather, a hide sorting system **106** then sorts and stacks the hides. After the hides are sorted and stacked by hide sorting system **106**, a customized processing system **108** can provide further processing (e.g., rewetting, trimming, splitting, folding, etc.) according to additional customized specifications (e.g., a customer order or requirements in a customer specification). Following processing by customized processing system **108**, a leather finishing system **112** produces finished leather from the hides.

[0028] In one or more embodiments of system **100**, hide supply system **110** can be a slaughterhouse. For example, hide supply system **110** can be a slaughterhouse for hooved livestock (e.g., cattle, sheep, pigs, goats, etc.) or a slaughterhouse for exotic animals (e.g., deer, bison, buffalo, ostrich, kangaroo, crocodile, alligator, snake, eel, and stingray). Alternatively, in one or more embodiments of system **100**, hide supply system **110** can be a knackery (i.e. a facility where animals are not slaughtered for human consumption). Additionally, in one or more embodiments of system **100**, hide supply system **110** can be part of, and physically located within, tanning facility **102**.

[0029] Regardless of whether hide supply system **110** is a slaughterhouse, knackery, or a system within tanning facility **102**, hide supply system **110** produces raw animal hides that can be tanned into leather by tanning facility **102**. In one or more embodiments, hide supply system **110** obtains raw animal hides by skinning animals as part of the slaughtering process. Further, in one or more embodiments, hide supply system **110** can perform curing of the raw animal hides either by treating the raw animal hides with salt (e.g., by wet-salting or brine-curing the hides) or preserving the raw animal hides at a cold temperature (e.g., by packing the hides with ice). Moreover, in one or more embodiments, hide supply system **110** can pack the raw animal hides, whether cured or uncured, into transport containers, which are then loaded onto a transport vehicle (e.g., a semi-trailer truck) for delivery to tanning facility **102**.

[0030] Additionally, in one or more embodiments hide supply system **110** can use one or more computing devices to generate and store hide supplier information to associate with hides that the hide supply system **110** provides. For example, hide supply system **110** can mark or otherwise associate a container of hides with various types of hide supplier information. In one or more embodiments, hide supply system **110** can generate a hide supplier information file to associate with a container of hides, provide access to the hide supplier information file to the tanning facility **102**, and tag the transport container (e.g., with a computer readable code, such as a barcode or QR code) so that the tanning facility **102** can access the hide supplier information file upon receiving the container of hides (e.g., scanning the barcode or QR code to access the hide supplier

information over a network).

[0031] The hide supplier information can include various types of information. For example, the hide supplier information may include a plant identifier (e.g., a slaughterhouse name and/or location), transport vehicle identifiers (e.g., semi-trailer truck vehicle identification numbers or VINs), transport container identifiers (e.g., unique numerical identifiers), and a date of slaughter for the raw animal hides. In addition, the hide supplier information can include information related to hide characteristics, such as hide type, packaged hide weight, pre-packed hide weight, source of hides (e.g., cattle ranch location) and any other hide characteristic. Accordingly, in one or more embodiments, hide supply system **110** can then use one or more computing devices to provide the hide supplier information to tanning facility **102** in order to facilitate greater traceability of hides and enable tanning facility **102** to further refine its tanning processes.

[0032] Alternatively or additionally, in one or more embodiments hide supply system **110** can provide hide supplier information in documentation that accompanies the transport vehicle and/or transport containers received by tanning facility **102**. For example, in one or more embodiments hide supply system **110** can mark transport containers of raw animal hides with hide supplier information labels which can be read or input into one or more computing devices of tanning facility **102** (e.g., a tanning system database of a tanning control system as discussed in greater detail below). Accordingly, the input of hide supplier information from hide supply system **110** into one or more computing devices of tanning facility **102** enables traceability of hides from their origin. Thus, this level of traceability assists tanning facility **102** in troubleshooting problems or reducing inefficiencies in tanning processes that may be due to issues associated with a particular hide supply system **110**.

[0033] As further illustrated by FIG. **1**, one or more embodiments of system **100** include a tanning system **104** that can receive raw animal hides from hide supply system **110**. For example, in one or more embodiments, tanning system **104** can receive raw animal hides in transport containers shipped from hide supply system **110** to tanning facility **102** using a transport vehicle. Further, after receiving raw animal hides, tanning system **104** can transform the raw animal hides into leather. As an example, in one or more embodiments, tanning system **104** uses various systems, processes, machinery, and apparatuses to transform raw animal hides into wet-blue leather hides. As an alternative example, in one or more embodiments, tanning system **104** uses various systems, processes, machinery, and apparatuses to transform raw animal hides into wet-white leather hides.

[0034] Moreover, in one or more embodiments, tanning system **104** can generate and store tannery process information related to batches of raw animal hides and associate or incorporate hide supplier information into the tannery process information to provide improved traceability. Also, as discussed in greater detail below, tanning system **104** can use one or more computing devices to manage and control the various systems, processes, machinery, and apparatuses used to convert the raw animal hides into leather.

[0035] As FIG. **1** illustrates, one or more embodiments of tanning facility **102** include a hide sorting system **106**. More specifically, in one or more embodiments hide sorting system **106** receives hides produced by the tanning processes of tanning system **104**. For example, hide sorting system **106** can receive hides that are automatically transported from tanning system **104** to hide sorting system **106** (e.g., via a conveyor system). As an alternative example, hide sorting system **106** can receive hides that are manually transported from tanning system **104** to hide sorting system **106** (e.g., via rolling carts).

[0036] Further, in one or more embodiments hide sorting system **106** grades the hides received from tanning system **104**. For example, hide sorting system **106** can grade the hides using computer vision and machine learning techniques that assign a grade to each hide. Alternatively, hide sorting system **106** can grade the hides manually using a human operator to inspect each hide and assign a grade to each hide.

[0037] The grading system used by hide sorting system **106** can be a national hide grading

standard, an international hide grading standard, an industry-wide hide grading standard, or a proprietary hide grading standard. For example, a proprietary hide grading standard can assign an "AA" grade to hides that include a single butt brand, light healed scratches through the prime, isolated light open scratches at the margins, and are suitable for full grain aniline or semi-aniline leather applications; an "AS" grade to hides that include two butt brands or butt and center brands, light healed scratches through the prime, isolated light open scratches at the margins, and are suitable for full grain aniline or semi-aniline leather applications; a "B" grade to hides that include up to two brands, including both butt and rib brands, with medium healed scratches and open scratches through the prime, and are suitable for pigmented or lightly tanned leather applications; and a "C" grade to hides that include multiple brands, minimal open scratches, multiple healed scratches throughout the hides, and are suitable for corrected grain leather applications.

[0038] As an alternative example, a proprietary hide grading standard can assign an "A" grade to hides that are free from parasite damage, contain butt brands, have light open and healed scratches throughout the prime, and are suitable for full grain aniline or semi-aniline leather applications; a "B" grade to hides that have healed parasite damage at the margins, butt brands, medium healed and open scratches in the prime, and are suitable for pigmented or lightly tanned leather applications; a "C" grade to hides that have heavy parasite damage, multiple brands, open scratches through the prime, and are suitable for corrected grain leather; and a "Reject" grade to hides that are misshapen, damaged, or have gross processing defects, but nevertheless are suitable for heavily embossed leathers.

[0039] In one or more embodiments, hide sorting system **106** sorts, folds, stacks, and packs each hide in response to, at least in part, a grade being assigned to each hide. For example, hide sorting system **106** can include a plurality of stacking sites, such that hides of the same grade can be sorted, folded, stacked, and packed at the same stacking site. Additionally, in one or more embodiments, hide sorting system **106** can perform rewetting, sammying (i.e. wringing), shaving, trimming, and/or splitting of the hides prior to sorting, folding, and stacking each hide at a particular stacking site.

[0040] Moreover, in one or more embodiments, the hide sorting system **106** can tag, mark, or otherwise label each hide with a unique hide identifier that can be stored by one or more computing devices of tanning facility **102** for purposes of improved traceability and quality assurance. Furthermore, the hide sorting system **106** can associate the unique hide identifier for each hide with the assigned grade for each hide, as well as other tannery process information that the tanning facility **102** can generate and store using one or more computing devices. In one or more embodiments, the tanning facility **102** can assign a unique hide identifier before a grade is assigned to a particular hide, or alternatively, the hide sorting system **106** can assign a grade to a hide before a unique hide identifier is assigned to a particular hide. Thus, the association of a unique hide identifier to a grade of a hide can occur once the hide sorting system **106** determines both items of information.

[0041] As further illustrated by FIG. **1**, tanning facility **102** can include a customized processing system **108**. In one or more embodiments, customized processing system **108** receives hides that the hide sorting system **106** has previously graded. For example, customized processing system **108** can receive hides that are automatically transported (e.g., via a conveyor system) from hide sorting system **106**, or alternatively, customized processing system **108** can receive hides that are manually transported (e.g., via rolling carts) from hide sorting system **106**.

[0042] Moreover, in one or more embodiments, customized processing system **108** performs further processing on hides. As an example, customized processing system **108** can rewet and/or wring (i.e. sammy) hides to a moisture level according to customer requirements (e.g., as indicated by a customer order or customer specification). As a further example, customized processing system **108** can trim and/or shave the hides to a particular size, split the hides to a specified thickness, and/or fold the hides in a certain manner. Thus, customized processing system **108** can

perform one or more processes, including for example, trimming, shaving, splitting, and folding, and the one or more processes can be tailored according to customer requirements (e.g., as indicated by a customer order or customer specification). Furthermore, in one or more embodiments, customized processing system **108** can pack the hides for shipment or storage purposes.

[0043] FIG. **1** further illustrates that system **100** can include a leather finishing system **112**. In one or more embodiments, leather finishing system **112** receives hides from tanning facility **102** and transforms those hides into finished leather using a variety of processes. For example, leather finishing system **112** can perform any number of leather finishing processes, including retanning, coloring, fatliquoring, setting out, drying, conditioning, staking, dry milling, buffing, finishing, and/or plating. Once leather finishing system **112** converts the hides into finished leather, leather product manufacturers can use the finished leather to make leather products for end consumers.

[0044] FIG. **2** illustrates a detailed schematic diagram of a system **200** that, in accordance with one or more embodiments, shows a hide sorting system **106** of a tanning facility **102** of FIG. **1**. FIG. **2** further illustrates that in one or more embodiments system **200** includes tanning system **104** and customized processing system **108** of FIG. **1**. Moreover, as shown by FIG. **2**, the system **200** includes a tanning control system **202**. In addition, FIG. **2** shows that hide sorting system **106** includes a measuring system **204**, a routing manager **206**, a routing system **208**, a classifying system **210**, a routing system **212**, and a stacking system **214**.

[0045] Furthermore, in one or more embodiments, tanning system **104**, hide sorting system **106**, and customized processing system **108** can include one or more computing devices, as described herein. Likewise, in one or more embodiments, tanning control system **202**, measuring system **204**, routing manager **206**, routing system **208**, classifying system **210**, routing system **212**, and stacking system **214** can also include one or more computing devices, as described in further detail below.

[0046] As shown in FIG. **2**, one or more embodiments of the hide sorting system **106** include a measuring system **204** that can measure one or more characteristics of each hide processed by hide sorting system **106**. In particular, measuring system **204** can measure one or more characteristics of each hide received from tanning system **104** and provide data representing the one or more measured characteristics to tanning control system **202**. Accordingly, tanning control system **202** can determine the sorting of each hide based, at least in part, on one or more characteristics of each hide, as measured and provided by measuring system **204**.

[0047] Measuring system **204** can measure a variety of hide characteristics that include, but are not limited to, weight, thickness, length, width, surface area, presence of butt brands or scratches, etc. To illustrate, measuring system **204** can include one or more measuring devices communicatively connected to tanning control system **202**. For example, measuring system **204** can include a weight scale that determines a weight for each hide received from tanning system **104**. In particular, the weight scale can include one or more load cells supporting a conveyor, such that the one or more load cells detect a weight for each hide as the hide passes along the conveyor.

[0048] As another example, measuring system **204** can include a conveyor coupled with one or more sensors (e.g., roller sensors) that determine a thickness, length, and/or width for each hide received from tanning system **104**. More specifically, one or more sensors can determine a thickness of each hide by detecting an amount that each hide displaces the one or more sensors when moved along the conveyor. Further, one or more sensors can determine a length of each hide by, for example, determining the speed of the conveyor and detecting an amount of time that the one or more sensors are displaced as the hide moves along the conveyor. Additionally or alternatively, measuring system **204** can detect a number of revolutions of roller sensors to determine a length of each hide as the hide passes through the roller sensors. Moreover, measuring system **204** can determine a width for each hide by arranging one or more sensors across a conveyor and detecting which of the one or more sensors come in contact with each hide as they pass through the conveyor. Furthermore, by determining the length and width of each leather hide,

measuring system **204** can also then determine the surface area of each hide.

[0049] As a further example, measuring system **204** can include a machine vision device (e.g., camera, scanner, photo cell, etc. coupled to a computing device) that determines the length, width, and/or surface area of each hide. In particular, a machine vision device can capture an image of each hide and determine the length, width, and/or surface area based on the captured image. Moreover, a machine vision device can detect the presence of butt brands and/or scratches on each hide by analyzing an image of one or more sides of each hide.

[0050] Additionally, in one or more embodiments measuring system **204** can include a marking device that marks each hide with a unique hide identifier. For example, measuring system **204** can generate a unique hide identifier for a hide, direct a marking device to mark the hide with the unique hide identifier, and then communicate the unique hide identifier to tanning control system **202**. Alternatively, measuring system **204** can receive a unique hide identifier of a hide generated by tanning control system **202** and, in turn, direct a marking device to mark the hide with the unique hide identifier.

[0051] Moreover, measuring system **204** can also include a wringing (i.e. sammying) machine that wrings each hide to a particular moisture level. For example, a wringing machine can wring each hide to a static predetermined moisture level. Alternatively, a wringing machine can wring each hide to a moisture level received from tanning control system **202**. More specifically, tanning control system **202** can determine a moisture level based on a batch identifier associated with each hide and/or one or more other characteristics of the hide and provide that moisture level to a wringing machine to ensure each hide has a correct moisture level.

[0052] Furthermore, measuring system **204** can include a trimming machine and/or a shaving machine that trims and/or shaves each hide to particular dimensions. For example, a trimming machine can modify the length and/or width of hides (e.g., by removing uneven edges or excess material from each hide). Likewise, a shaving machine can modify the thickness of hides (e.g., by cutting the top and/or bottom surfaces of each hide). The trimming machine and shaving machine can operate according to either predetermined settings or one or more settings specified by tanning control system **202** and provided to measuring system **204** (e.g., based on customer specifications).

[0053] Additionally, when measuring system **204** receives one or more hides from tanning system **104**, measuring system **204** can provide tanning control system **202** with a batch identifier associated with the one or more hides. For example, a human operator can input into measuring system **204** (e.g., via a user interface of a computing device) a batch identifier associated with one or more hides (e.g., by manually inputting the batch identifier, scanning a barcode on a rolling cart, etc.). In turn, measuring system **204** can provide the batch identifier to tanning control system **202**.

[0054] Alternatively, tanning control system **202** can determine a batch identifier associated with one or more hides being processed by measuring system **204** (e.g., by identifying a batch identifier associated with the most recently unloaded tanning drum which measuring system **204** has not yet begun processing). Accordingly, by determining a batch identifier associated with the one or more hides that measuring system **204** is processing, tanning control system **202** can then sort the one or more hides based, at least in part, on characteristics associated with the determined batch identifier (e.g., characteristics determined during prior tanning processes).

[0055] As FIG. **2** illustrates, once measuring system **204** determines one or more characteristics of a hide and/or a batch identifier associated with the hide, measuring system **204** can communicate that characteristic and/or the batch identifier to tanning control system **202**. In response, and as also shown by FIG. **2**, tanning control system **202** can communicate with routing manager **206** to direct routing system **208** to transport the hide from measuring system **204** to classifying system **210**. Alternatively, in one or more embodiments, routing system **208** can automatically transport the hide from measuring system **204** to classifying system **210**, without the need for direction or control signals from routing manager **206**.

[0056] Thus, in one or more embodiments, routing manager **206** can include a computing device

communicatively coupled to tanning control system **202** and routing system **208**. In particular, routing manager **206** can include a computing device, such as a programmable logic controller ("PLC"). Further, in one or more embodiments, routing system **208** can include a conveyor system (e.g., a belt conveyor) in communication with routing manager **208**.

[0057] FIG. **2** further illustrates that one or more embodiments include a classifying system **210** that classifies each hide processed by hide sorting system **106**. More specifically, classifying system **210** determines a classification for each hide received from measuring system **204** and then classifying system **210** provides the determined classification to tanning control system **202**. Accordingly, tanning control system **202** can direct the sorting of each hide based, at least in part, on the classification that classifying system **210** determines for each hide.

[0058] Classifying system **210** can determine and assign various classifications to each hide. In some embodiments, classifying system **210** determines and assigns a hide grade as the classification (e.g., a grade according to a national hide grading standard, international hide grading standard, industry-wide hide grading standard, or a proprietary hide grading standard, as discussed above). In other embodiments, classifying system **210** determines and assigns a category as the classification, wherein the category can distinguish between various hides (e.g., weight category, length category, width category, surface area category, thickness category, shape category, blemish category (scrape/brand), etc.).

[0059] Moreover, in one or more embodiments classifying system **210** can include a classifying device. For example, a classifying device can include a conveyor positioned to hold a hide and enable a human operator to view the hide to determine a classification (e.g., a grade) for the hide. Further, once the human operator determines the classification for a hide, the human operator can provide user input to classifying system that specifies the classification (e.g., by providing user input to a computing device of classifying system **210**, such as by pressing a button coupled to a PLC). In turn, classifying system **210** can provide an indication of the classification to tanning control system **202**. As another example, a classifying device can include a computer vision device (e.g., camera, scanner, photo cell, etc. coupled to a computing device) that determines a classification for a hide by capturing and analyzing an image of the hide. Thus, once the computer vision device determines a classification for a hide, the computer vision device can provide an indication of the classification to tanning control system **202** (e.g., via communication over a network).

[0060] As shown by FIG. **2**, once classifying system **210** provides a classification of a hide to tanning control system **202**, tanning control system **202** can respond by communicating with routing manager **206** to transport the hide from classifying system **210** to a particular stacking site of stacking system **214** via routing system **212**. Accordingly, in one or more embodiments, routing system **212** can include a conveyor system (e.g., a belt conveyor) in communication with routing manager **208**. Additionally, routing system **212** can include a folding table that facilitates the folding of pliable hides by a folding device, but prevents the pliable hides from falling to the ground and/or folding improperly.

[0061] Furthermore, in one or more embodiments stacking system **214** can include a plurality of stacking sites. In particular, each stacking site can include one or more pallets to stack hides on. Also, each stacking site can include a weight scale (e.g., load cells) that detects the weight of hides loaded onto a particular pallet. Thus, stacking system **214** can communicate to tanning control system **202** the load (i.e. weight) on a particular pallet and tanning control system **202** can then use this information in determining how to route hides to particular stacking sites (e.g., by determining whether particular stacking sites are empty, partially full, or full). Additionally, each stacking site of stacking system **214** can include a folding device that folds hides in a specified manner (e.g., as directed by tanning control system **202** according to a folding specification).

[0062] Moreover, in one or more embodiments stacking system **214** and/or each stacking site can communicate a stacking site status (e.g., "Empty", "Partially Full", or "Full/Inactive") to tanning

control system **202** for use in the hide sorting process. The stacking site status can be based on the weight and/or number of the hides at a particular stacking site. A stacking site with a status of "Empty" can receive any acceptable hide of any characteristics, classification, and associated batch identifier. In contrast, a stacking site with a status of "Partially Full" can receive any hide that is compatible with the characteristics of the hides already stacked at that site. Further, a stacking site with a status of "Full/Inactive" cannot receive any additional hides (i.e. until the full pallet is removed from the stacking site and replaced with an empty pallet using either manual labor or automated machinery). Thus, in one or more embodiments tanning control system **202** can consider the stacking site status of each stacking site when determining how to route a hide from classifying system **210** to a particular stacking site of stacking system **214** via routing system **212**.

[0063] As already discussed, in one or more embodiments, tanning control system **202** receives indications or measurements of one or more characteristics of a hide from measuring system **204**. Tanning control system **202** can also receive, from measuring system **204**, a batch identifier associated with a hide or, alternatively, tanning control system **202** can independently determine a batch identifier associated with a hide that measuring system **204** is processing. Further, tanning control system **202** can receive, from classifying system **210**, one or more classifications of the hide. Thus, in one or more embodiments tanning control system **202** can determine how to route a hide from classifying system **210** to a particular stacking site of stacking system **214** via routing system **212** (e.g., a conveyor system) based on any combination of one or more characteristics of the hide, the batch identifier associated with the hide, characteristics associated with the batch identifier of the hide, and/or the classification of the hide.

[0064] Moreover, as previously mentioned, in one or more embodiments tanning control system **202** generates a unique hide identifier for each hide that hide sorting system **106** processes. To improve the traceability of hide sorting processes, tanning control system **202** can store the unique hide identifier in a tanning system database. Further, upon receiving one or more characteristics of a hide from measuring system **204**, tanning control system **202** can associate the one or more characteristics with the unique hide identifier and store the one or more characteristics in the tanning system database. Similarly, upon receiving one or more classifications of a hide from classifying system **210**, tanning control system **202** can associate the one or more classifications with the unique hide identifier and store the one or more classifications in the tanning system database. Moreover, upon stacking a hide at a particular stacking site, tanning control system **202** can associate the unique hide identifier with a unique stack identifier of the stacking site and/or a unique pallet identifier of the pallet the hide is on, and such an association can also be stored in the tanning system database. Accordingly, by recording and associating such information, tanning control system **202** enhances the traceability of hides, thereby facilitating the troubleshooting of tanning processes, which in turn can lead to the improvement of those same processes.

[0065] In addition, in one or more embodiments tanning control system **202** can identify unique device identifiers for each component or device used to sort and package a particular hide. For example, tanning control system **202** can identify a unique device identifier for each component or device of measuring system **204**, routing system **208**, classifying system **210**, routing system **212**, and stacking system **214** used to process a particular hide. Further, tanning control system **202** can associate these unique device identifiers with the unique hide identifier of the particular hide and store this information in a tanning system database. Thus, identifying and storing device identifiers of devices used to process a particular hide facilitates improvements in tanning processes and troubleshooting of those processes.

[0066] Referring now to FIGS. **3**A-**3**B, which illustrate a sequence-flow diagram of interactions between the measuring system **204**, the classifying system **210**, the tanning control system **202**, and the routing manager **206** of FIG. **2**. The sequence-flow diagram of FIGS. **3**A-**3**B illustrates an example process flow of interactions between the measuring system **204**, the classifying system **210**, the tanning control system **202**, and the routing manager **206** of FIG. **2**. In particular, FIGS.

3A-**3**B illustrate that in one or more embodiments the tanning control system **202** controls and/or communicates with measuring system **204**, classifying system **210**, and routing manager **206** to sort a hide to a particular stacking site (e.g., on a pallet located at a stacking site of stacking system **214**).

[0067] As FIG. **3**A illustrates, step **302** includes receiving a hide. More specifically, measuring system **204** receives a hide from a tanning system (e.g., tanning system **104**). For example, measuring system **204** can receive a hide that is manually transported from a tanning drum of a tanning system (e.g., through the use of one or more human operators who manually carry the hide or use a rolling cart). As an alternative example, measuring system **204** can receive a hide that is automatically transported from a tanning drum of a tanning system (e.g., through the use of a conveyor system).

[0068] Moreover, measuring system **204** can receive a hide in a variety of other ways. For example, measuring system **204** can receive a hide by detecting the loading of the hide into a measuring device of measuring system **204**. As another example, measuring system **204** can include a conveyor system, and thus, receiving a hide can include detecting that a hide has been loaded onto the conveyor system. As a further example, measuring system **204** can include a wringing machine. Accordingly, receiving a hide at measuring system **204** can include detecting the loading of the hide into the wringing machine. Additionally or alternatively, receiving a hide at measuring system **204** can also include receiving user input from a human operator that indicates the loading of a hide into measuring system **204**.

[0069] As shown by FIG. **3**A, step **304** includes determining a characteristic of the hide. For example, one or more measuring devices of measuring system **204** determine one or more characteristics of the hide. As another example, measuring system **204** determines one or more characteristics of the hide by receiving user input that specifies the one or more characteristics (e.g., via user input into a user interface of a computing device coupled to measuring system **204**). Thus, by determining a characteristic of the hide, measuring system **204** can improve the quality and consistency of hides by obtaining more information about the hides processed and sorted by a hide sorting system, such as hide sorting system **106**.

[0070] As FIG. **3**A illustrates, step **306** includes providing the characteristic of the hide to tanning control system **202**. In particular, in one or more embodiments measuring system **204** provides a hide characteristic communication to tanning control system **202** (e.g., via a communication network). For example, measuring system **204** can provide a hide characteristic communication that includes a single hide characteristic as measured or determined by a device of measuring system **204**. Alternatively, measuring system **204** can provide a hide characteristic communication that includes multiple hide characteristics as measured or determined by one or more devices of measuring system **204**. As a result, measuring system **204** can assist tanning control system **202** in sorting the hide by providing detailed information concerning the characteristics and/or state of the hide.

[0071] As further shown by FIG. **3**A, step **308** includes determining a hide identifier for the hide. In particular, tanning control system **202** generates a unique hide identifier for the hide. For example, tanning control system **202** can generate a unique hide identifier using a random number generator. As another example, tanning control system **202** can generate a unique hide identifier using a timestamp and/or date stamp. As yet another example, tanning control system **202** can generate a unique hide identifier as a sequential number for each hide (e.g., 1, 2, 3, etc.).

[0072] Further, tanning control system **202** can generate the unique hide identifier according to a hide identifier format. For example, the hide identifier format can include one or more alphanumeric characters which indicate the identifier relates to an individual hide (e.g., the letter "H" for hide), followed by two numerical characters specifying the month of processing the hide (e.g., "05" for May), followed by two numerical characters specifying the date of processing the hide (e.g., "15" for the 15.sup.th day of May), and a sequential hide number. Moreover,

determining a hide identifier for the hide may also include concatenating or adding a batch identifier associated with the hide to a unique hide identifier generated by tanning control system **202**.

[0073] As FIG. **3**A illustrates, step **310** includes associating the characteristic of the hide with the hide identifier. More specifically, tanning control system **202** associates the characteristic of the hide with the hide identifier by storing the characteristic of the hide and the hide identifier in a tanning system database. Furthermore, tanning control system **202** can associate the characteristic of the hide with the hide identifier by linking the characteristic of the hide to the hide identifier in the tanning system database (e.g., creating a database relationship between a hide characteristic table and a unique hide identifier table). Associating such information in a tanning system database facilitates greater traceability of hides throughout the tanning processes and further assists in troubleshooting tanning processes.

[0074] As FIG. **3**A shows, in one or more embodiments, step **312** includes determining a batch identifier of the hide. For example, measuring system **204** can determine a batch identifier of the hide by receiving user input from a human operator that specifies the batch identifier of the hide. As another example, measuring system **204** can determine a batch identifier of the hide by receiving an indication of the batch identifier from the tanning drum that processed the hide. Furthermore, in one or more embodiments tanning control system **202** generates and associates batch identifiers with hides during the unloading and tanning processes of tanning system **104**.

[0075] Moreover, as FIG. **3**A illustrates, step **314** includes providing the batch identifier of the hide to tanning control system **202**. More specifically, in one or more embodiments measuring system **204** provides a batch identifier communication that indicates the batch identifier to tanning control system **202** (e.g., via a communication network). Furthermore, in one or more embodiments, measuring system **204** can combine the batch identifier communication and the hide characteristic communication discussed above into a single communication to tanning control system **202** (e.g., combining steps **306** and **314** into a single step). Thus, providing a batch identifier to tanning control system **202** enables tanning control system **202** to sort the hide based, at least in part, on the batch identifier of the hide and/or one or more characteristics associated with the batch identifier of the hide (e.g., batch hide type, plant identifier, etc.).

[0076] Alternatively, tanning control system **202** can determine the batch identifier of the hide without having measuring system **204** provide the batch identifier. More specifically, in one or more embodiments tanning control system **202** can track the batch identifiers of all batches processed by tanning system **104** and then determine a batch identifier of a batch that was most recently unloaded from a tanning drum but has not yet been processed by measuring system **204** (e.g., determining a batch identifier of a hide in a first-in-first-out ("FIFO") manner). For example, tanning control system **202** can utilize a tanning system database to identify a batch identifier of a tanning drum that was unloaded most recently and has not yet been processed by measuring system **204**.

[0077] As FIG. **3**A shows, step **316** includes associating the characteristics of the batch identifier with the hide identifier. In particular, tanning control system **202** associates the characteristics of the batch identifier with the hide identifier by storing the characteristics of the batch identifier and the hide identifier in a tanning system database. Furthermore, tanning control system **202** can associate the characteristics of the batch identifier with the hide identifier by linking the characteristics of the batch identifier to the hide identifier in the tanning system database (e.g., creating a database relationship between a batch characteristics table and a unique hide identifier table). Associating the characteristics of the batch identifier with the hide identifier enhances traceability by linking the hide sorting processes of hide sorting system **106** back to the tanning processes of tanning system **104**.

[0078] As further illustrated by FIG. **3**A, step **318** includes optionally providing the hide identifier to measuring system **204**. For example, tanning control system **202** can provide a marking

communication to a marking device of measuring system **204**, wherein the marking communication indicates the hide identifier. Furthermore, in one or more embodiments, the marking communication can include other information that a marking device may use to mark the hide. As an example, the marking communication can include one or more of the batch identifier associated with the hide, the batch hide type associated with the hide, the hide identifier of the hide, as well as one or more other characteristics associated with the batch identifier and/or the hide identifier. Additionally or alternatively, the marking communication can include an indication of a marking type (e.g., emboss, engrave, print, stamp, label, etc.) that indicates the type of mark that a marking device of measuring system **204** is to apply to the hide.

[0079] As FIG. **3**A shows, step **320** includes optionally marking the hide with the hide identifier. In particular, measuring system **204** can mark the hide according to the capabilities of one or more marking devices. For example, measuring system **204** can include an embossing machine that embosses the hide with the hide identifier. As another example, measuring system **204** can include an engraving machine that engraves the hide identifier into the hide. As a further example, measuring system **204** can include a printer (e.g., laser, ink, etc.) that prints the hide identifier on the hide. In one or more embodiments, measuring system **204** can include a stamping machine that stamps the hide with the hide identifier. Additionally or alternatively, measuring system **204** can include a labeling machine that applies a label of the hide identifier to the hide. Accordingly, marking the hide provides improved traceability of hides.

[0080] As FIG. **3**A further illustrates, step **322** includes providing a routing communication to routing manager **206**. More specifically, the routing communication indicates how to move the hide from the measuring system **204** to the classifying system **210** via routing system **208**. For example, some hide sorting systems can include multiple measuring systems and/or devices, as well as multiple routing systems and/or multiple classifying systems. Thus, the routing communication can include an identification of the particular measuring system that has the hide, an identification of the particular classifying system that is to receive the hide, and an identification of the routing system to use to transport the hide from the particular measuring system to the particular classifying system.

[0081] Consequently, in one or more embodiments, routing manager **206** can use such a routing communication to communicate with the appropriate routing system to move the hide as needed. As another example, other hide sorting systems may include only a single measuring system and a single classifying system connected via a single routing system (e.g., as shown by FIG. **2**). In such a case, the routing communication can include a control signal or trigger that causes the routing system to move a hide from the measuring system to the classifying system, without the need for any additional routing information. Regardless, as FIG. **3**B illustrates, after receiving the routing communication, step **324** includes moving the hide according to the routing communication.

[0082] As FIG. **3**B also shows, step **326** includes determining a grade of the hide. For example and as previously discussed, classifying system **210** can determine a grade of the hide by receiving user input from a human operator, wherein the user input specifies the grade. As another example and as discussed above, classifying system **210** can determine a grade of the hide using a computer vision device that captures and analyzes an image of the hide. More specifically, in one or more embodiments the computer vision device can determine a grade of the hide by counting a number of butt brands and/or scratches on the hide (i.e. the fewer butt brands and/or scratches, the higher the quality grade). Moreover, the computer vision device can determine a grade of the hide by determining the location of any butt brands and/or scratches (i.e. higher grades for hides with butt brands and/or scratches on the margins of the hide, lower grades for hides with butt brands and/or scratches on the interior of the hide).

[0083] Further, as FIG. **3**B illustrates, step **328** includes providing the grade of the hide to tanning control system **202**. In particular, in one or more embodiments classifying system **210** provides a hide grade communication to tanning control system **202** (e.g., via a communication network). For

example, classifying system **210** can provide a hide grade communication that includes a single hide grade as determined by classifying system **210**. Alternatively, classifying system **210** can provide a hide grade communication that includes multiple hide grades as determined by classifying system **204** (e.g., a quality grade, a size grade, a butt brand grade, and a scratch grade, etc.). As a result, classifying system **210** can assist tanning control system **202** in sorting the hide based, at least in part, on one or more grades of hide.

[0084] As further shown by FIG. **3**B, step **330** includes associating the grade of the hide with the hide identifier. More specifically, tanning control system **202** associates the grade of the hide with the hide identifier by storing the grade of the hide and the hide identifier in a tanning system database. Moreover, tanning control system **202** can associate the grade of the hide with the hide identifier by linking the grade of the hide to the hide identifier in the tanning system database (e.g., creating a database relationship between a hide grade table and a unique hide identifier table). Associating the grade of the hide with the hide identifier facilitates greater traceability and enables the tanning control system **202** to sort and package the hide based, at least in part, on the grade.

[0085] As FIG. **3**B illustrates, step **332** includes sorting the hide. In particular, tanning control system **202** can sort the hide in a variety of ways. For example, tanning control system **202** can sort the hide by identifying a stacking site of stacking system **214**. In one or more embodiments, identifying a stacking site of stacking system **214** can include determining a stacking site status for each stacking site of stacking system **214**. Moreover, identifying a stacking site of stacking system **214** can include determining whether a stack at each of the one or more stacking sites is compatible with the hide. More specifically, determining whether a stack is compatible with the hide can include determining whether the relevant characteristics of the hides on the stack are the same or sufficiently similar to the relevant characteristics of the hide, such that the hide can be sorted to the stack.

[0086] For example, determining whether a stack is compatible with the hide can include determining that the classification of the hide is the same as the classification of the hides already on the stack. As another example, determining whether a stack is compatible can include determining that the hide type of the hide (e.g., as determined based on the batch hide type associated with the batch identifier of the hide) is the same as the hide type of the hides already on the stack. As a further example, determining whether a stack is compatible can include determining that prior tanning process characteristics (e.g., tannery process information, such as batch identifier, tanning recipe, chroming drum, plant identifier, etc.) associated with the hide are the same as prior tanning process characteristics associated with the hides already on the stack. Thus, tanning control system **202** can sort the hide according to a variety of criteria and hide characteristics, including but not limited to, classification (e.g., grade), weight, surface area, hide type, and batch identifier.

[0087] Moreover, tanning control system **202** can sort the hide by determining a pallet that is compatible with one or more characteristics of the hide. More specifically, determining a pallet that is compatible can include determining whether the relevant characteristics of the hides on the pallet are the same or sufficiently similar to the relevant characteristics of the hide, such that the hide can be sorted to the pallet. Thus, determining a pallet that is compatible can include analyzing the characteristics of the hides sorted to each active pallet at each stacking site of stacking system **214**. Moreover, determining a pallet that is compatible can include comparing and/or matching one or more characteristics of the hide with one or more characteristics of hides already on the pallet. Furthermore, identifying a pallet can also include determining a pallet status (e.g., similar to a stacking site status). In addition, determining a pallet that is compatible can include identifying a stacking site associated with the pallet.

[0088] Furthermore, while tanning control system **202** can sort the hide, in some situations two or more stacking sites (or pallets) may be compatible with the hide. For example, in such situations, tanning control system **202** can sort the hide by determining that two or more stacking sites (or pallets) are compatible and, in response to such a determination, routing the hide to the compatible

stacking site (or pallet) that is closest to full. As another example, tanning control system **202** can sort the hide by determining that two or more stacking sites (or pallets) are compatible and, in response to such a determination, routing the hide to the compatible stacking site (or pallet) that is closest to empty. Further, in one or more other embodiments, tanning control system **202** can sort the hide according to other rationales when one or more stacking sites (or pallets) are compatible with the hide (e.g., customer priority level, order urgency, etc.).

[0089] Moreover, in one or more embodiments, tanning control system **202** can sort the hide according to one or more customer specifications. More specifically, a customer specification can include one or more indications of characteristics of hides desired by a particular customer. For example, a customer specification can be generated from a customer order that specifies a desired hide classification (e.g., grade), hide type, weight, and/or surface area. Furthermore, tanning control system **202** can sort the hide according to one or more customer specifications by identifying a customer specification associated with one or more active stacking sites (or pallets) and comparing the characteristics of the hide to the desired characteristics specified by the customer specification associated with each of the one or more active stacking sites (or pallets). Thus, a customer specification can include a data file stored by tanning control system **202** in a data file format, such as Extensible Markup Language ("XML") or JavaScript Object Notation ("JSON"). Furthermore, as previously mentioned, a customer specification can include a sorting specification, a folding specification, a stacking specification, and a packing specification.

[0090] Thus, in one or more embodiments, sorting the hide according to step **332** can include determining a folding specification for the hide (i.e. an indication of how a folding device at a stacking site of stacking system **214** is to fold the hide). More specifically, determining a folding specification for the hide can include identifying a folding specification that is compatible with one or more relevant characteristics of the hide. For example, tanning control system **202** can determine a first hide type folding specification for a first hide having a first hide type (e.g., jumbo) and also determine a second hide type folding specification for a second hide having a second hide type (e.g., heifer). Moreover, tanning control system **202** can determine a folding specification for a hide based on any of the characteristics associated with the hide. Alternatively, tanning control system **202** can determine a folding specification based on a customer specification associated with the stack where the hide is to be sorted.

[0091] Once tanning control system **202** has determined which stacking site (or pallet) to stack the hide onto, tanning control system **202** can improve traceability by determining and storing a unique stacking site identifier (and/or pallet identifier) in association with the hide identifier of the hide. Alternatively, stacking system **214** (e.g., the particular stacking site for the hide) can confirm that the hide has been stacked on a particular stacking site, and then tanning control system **202** can associate the hide identifier with the stacking site identifier (and/or pallet identifier) in response to such a confirmation. Thus, tanning control system **202** can link such hide sorting information in a tanning system database, thereby increasing the traceability of the hide sorting system

[0092] As illustrated by FIG. **3**B, step **334** includes providing a routing communication to routing manager **206**. More specifically, the routing communication specifies how to move the hide from classifying system **210** to a particular stacking site of stacking system **214** via routing system **212**. For example, the routing communication can include an indication of a classifying system identifier and an indication of a stacking site identifier. As another example, the routing communication can include an indication of a classifying device identifier (e.g., computer vision device identifier) and an indication of a stacking site identifier. Additionally, one or more embodiments may include multiple routing systems between classifying systems and stacking sites, accordingly, the routing communication can also include an indication of the particular routing system to use to transport the hide to the particular stacking site (e.g., a routing system identifier, such as for a conveyor system).

[0093] As shown by FIG. **3**B, step **336** includes moving the hide according to the routing

communication. More specifically, routing manager **206** sends one or more control signals to routing system **212**, which directs routing system **212** to transport the hide from classifying system **210** to a particular stacking site of stacking system **214**. Moreover, routing manager **206** can direct routing system **212** to move the hide to a folding table proximate a particular stacking site of stacking system **214**. Further, routing manager **206** can direct routing system **212** to move the folding table with the hide onto a folding device located at a particular stacking site. Thus, once routing manager **206** has moved the hide to the particular stacking site, the stacking site can fold and stack the hide onto a pallet.

[0094] Turning to FIG. **4**, exemplary portions **400** of a tanning system database are illustrated in accordance with one or more embodiments. In one or more embodiments, tanning system database includes one or more databases (e.g., relational databases, non-relational databases, XML databases, JSON databases, SQL databases, NoSQL databases, cloud databases, etc.). Further, as illustrated by FIG. **4**, a tanning system database can capture, associate, and store information related to individual hides processed by a hide sorting system, such as hide sorting system **106** of FIG. **2**.

[0095] In particular, each column **402-414** shows the types of information that tanning control system **202** can capture, associate, and store with respect to individual hides shown by each row **416-428**. For example, tanning control system **202** can determine a batch identifier **402** for each hide. Further, tanning control system **202** can determine a hide type **404** for each hide based on the batch identifier of the hide by identifying the batch hide type associated with the batch identifier (e.g., as shown in FIG. **5**). Additionally, tanning control system **202** can generate, store, and associate a unique hide identifier **406** for each hide processed by hide sorting system **106**. Moreover, tanning control system **202** can store and associate one or more hide characteristics with each hide (e.g., hide characteristic **408** and hide classification **410**). The one or more hide characteristics can be received from one or more measuring systems and/or classifying systems (e.g., measuring system **204** and/or classifying system **210**). Additionally or alternatively, the one or more hide characteristics can be determined and obtained from prior tannery process information (e.g., information recorded and stored in a tanning system database during unloading and tanning processes, such as that shown by FIG. **5**).

[0096] Moreover, as FIG. **4** illustrates, once tanning control system **202** sorts a particular hide to a particular stacking site and pallet, tanning control system **202** can capture, store, and associate a unique hide identifier with a unique stacking site identifier **412** and/or a unique pallet identifier **414**. Accordingly, as shown by FIG. **4**, a tanning system database facilitates improved traceability by storing information related to the sorting of each hide.

[0097] Along similar lines, FIG. **5** illustrates additional exemplary portions **500** of a tanning system database in accordance with one or more embodiments. In particular, FIG. **5** illustrates exemplary portions **500** of a tanning system database that relate to information concerning prior tannery processes, such as the unloading and tanning processes performed by tanning system **104** of FIGS. **1-2**. More specifically, each column **502-518** shows the particular types of information that tanning control system **202** can capture, associate, and store with respect to batches of hides shown by each row **520-526**. Accordingly, tanning control system **202** can determine a batch identifier associated with a hide and then sort that hide based, at least in part, on the types of information shown in FIG. **5**. In doing so, one or more embodiments improve traceability by linking information generated during the hide sorting process with information generated during prior tannery processes. Moreover, one or more embodiments can improve hide sorting efficiency by leveraging information generated during prior tannery processes.

[0098] FIG. **6** illustrates a perspective view of a hide sorting system **600** in accordance with one or more embodiments. More specifically, FIG. **6** shows one embodiment of a hide sorting system **600**, such as hide sorting system **106** of FIG. **2**. As FIG. **6** shows, human operators can provide leather hides to a wringing machine **602**. After passing through the wringing machine **602**, a measuring

system **604** determines one or more characteristics of each hide. For example, measuring system **604** can include a weight scale that determines a weight of each hide and communicates that weight to a tanning control system. Alternatively, measuring system **604** can include any other measuring devices, as previously described.

[0099] Following processing by measuring system **604**, leather hides move along routing system **606** (i.e. a belt conveyor) to classifying system **608**. As FIG. **6** shows, classifying system **608** can include a conveyor elevated at an angle that enables a human operator to determine a classification (e.g., grade) for the hide. However, as previously discussed, in other embodiments classification system **608** can classify hides without the need for a human operator (e.g., by using a computer vision device).

[0100] Once a leather hide is classified by classifying system **608**, the hide moves onto a rotating conveyor system **610** (i.e. a rotating belt conveyor). If the hide was classified as defective, rotating conveyor system **610** can move the hide to reject stacking site **628**, which can include a folding device **630** and one or more reject pallets **632**. Alternatively, if the hide was not classified as defective, rotating conveyor system **610** can move the hide to routing system **612** (i.e. a belt conveyor) to be stacked at a particular stacking site selected from the plurality of stacking sites **614a-614b**.

[0101] As shown by FIG. **6**, each stacking site, such as stacking site **618**, in the plurality of stacking sites **614a-614b** can include a folding device **620**, and one or more pallets **622**. Furthermore, prior to a hide being folded and stacked onto a particular stacking site, routing system **612** can move the hide onto a folding table **616**, which can then move over the folding device of a particular stacking site. As previously mentioned, a folding table **616** can prevent a hide from falling through a folding device, and facilitates consistent and precise folding of each hide.

[0102] Additionally, as FIG. **6** illustrates, hide sorting system **600** can include a rail system **624-626** which runs adjacent to the plurality of stacking sites **614a-614b** and beneath routing system **612**. Accordingly, when a pallet of hides is full, the pallet can automatically move onto rail system **624-626** and then move down the rail system **624-626** to a common unloading point, such as the locations indicated by **624** or **626**. Moreover, when a full pallet is moved from a stacking site, it is replaced by an empty pallet at the stacking site. For example, stacks of empty pallets can be arranged at each stacking site, such that only the top pallet is loaded with hides, and an empty pallet is used when a full pallet is removed.

[0103] FIGS. **1-6**, the corresponding text, and the examples provide a number of different systems and devices for sorting hides. In addition to the foregoing, embodiments can also be described in terms of flowcharts comprising acts and steps in a method for accomplishing a particular result. For example, FIG. **7**, as described in further detail below, illustrates a flowchart of an exemplary method in accordance with one or more embodiments.

[0104] FIG. **7** illustrates a flowchart of one exemplary method **700** of sorting hides from the perspective of a hide sorting system **106** and/or a tanning control system **202**. The method **700** can include an act **702** of determining a characteristic of a hide. More specifically, act **702** can include determining a characteristic of a hide based on a batch identifier associated with a plurality of hides (i.e. a batch) that includes the hide. Further, act **702** can include determining a characteristic of a hide by determining a characteristic of a plurality of hides associated with the batch identifier (e.g., determining one or more batch characteristics). Additionally or alternatively, act **702** can include receiving a characteristic of a hide from a measuring system.

[0105] Moreover, method **700** can also include an act of identifying a batch identifier associated with a plurality of hides that includes the hide to be sorted. In particular, method **700** can include receiving, as user input, an identifier that identifies the plurality of hides and comparing the identifier to one or more batch identifiers stored in a tanning system database. Furthermore, method **700** can include determining, based on the comparison of the identifier to one or more batch identifiers, that the identifier does not match any batch identifiers and providing a notification to a

user. Consequently, in one or more embodiments, method **700** can include providing a prompt to a user to re-enter the identifier in order to find a match with one or more batch identifiers stored in a tanning system database. Additionally, method **700** can include receiving user input at a measuring system (e.g., measuring system **204**).

[0106] Furthermore, method **700** can also include an act of identifying a batch identifier by accessing a tanning system database. More specifically, method **700** can include identifying a batch identifier associated with a plurality of hides by selecting the batch identifier of the plurality of hides most recently unloaded from a chroming drum, as indicated by a tanning system database.

[0107] The method **700** may also include an act **704** of associating a hide identifier with the hide. In particular, act **704** can include generating a unique hide identifier for the hide. Furthermore, act **704** can include capturing the hide identifier in a tanning system database. Moreover, act **704** can include marking the hide with an indication of the hide identifier (e.g., by using a marking device). Additionally, act **704** can include associating a batch identifier with the hide identifier of the hide (e.g., linking the batch identifier and the hide identifier in a tanning system database, thereby creating a database relationship).

[0108] The method **700** may further include an act **706** of associating the characteristic of the hide with the hide identifier. More specifically, act **706** can include associating a characteristic of a plurality of hides (i.e. a batch) with the hide identifier by linking the characteristic to the hide identifier in a tanning system database. Additionally or alternatively, act **706** can include associating a characteristic of a hide with a hide identifier by linking a characteristic received from a measuring system with the hide identifier in a tanning system database.

[0109] FIG. **7** further illustrates that the method **700** can include an act **708** of determining a grade of the hide. In particular, act **708** can include determining a grade of the hide based on a grade received from a classifying device (e.g., as provided by a human operator (i.e. grader) or a computer vision device). Alternatively, act **708** can include determining a grade of the hide based on one or more characteristics associated with the batch identifier of the batch that includes the hide. Otherwise, act **708** can include determining a grade of the hide based on one or more characteristics received from a measuring device.

[0110] FIG. **7** also shows that the method **700** can include an act **710** of associating the grade of the hide with the hide identifier. More specifically, act **710** can include linking, in a tanning system database, the grade of the hide with the hide identifier (e.g., creating a database relationship between the grade of the hide and the hide identifier). Further, act **710** can include associating the grade of the hide with a batch identifier of the hide.

[0111] Method **700** can also include an act **712** of sorting the hide based on the grade of the hide and the characteristic of the hide. In particular, act **712** can include sorting the hide based on the grade of the hide and at least one characteristic selected from the one or more characteristics of the hide. Act **712** can also include determining whether one or more stacking sites are compatible with the hide. Thus, act **712** can include determining a stacking site status for each of one or more stacking sites. Further, act **712** can include sorting the hide based on one or more customer specifications.

[0112] Moreover, method **700** can include an act of stacking the hide. More specifically, method **700** can include an act of stacking the hide on a pallet, identifying a pallet identifier associated with the pallet, and associating the pallet identifier with the hide identifier. Furthermore, method **700** can include an act of generating a pallet identifier for the pallet and linking the pallet identifier with the hide identifier in a tanning system database. Additionally, method **700** can include an act of marking the pallet with the pallet identifier.

[0113] In one or more embodiments, method **700** can also include an act of identifying a customer specification and sorting the hide according to the identified customer specification. In particular, method **700** can include an act of identifying a customer specification based on the grade of the hide and at least one characteristic selected from the one or more characteristics of the hide.

Further, method **700** can include an act of folding and/or stacking the hide according to the identified customer specification.

[0114] Embodiments may comprise or use a special purpose or general-purpose computer including computer hardware, such as, for example, one or more processors and system memory, as discussed in greater detail below. Embodiments within the scope also include physical and other computer-readable media for carrying or storing computer-executable instructions and/or data structures. In certain particular embodiments, one or more of the processes described herein may be implemented at least in part as instructions embodied in a non-transitory computer-readable medium and executable by one or more computing devices (e.g., any of the media content access devices described herein). In general, a processor (e.g., a microprocessor, etc.) receives instructions, from a non-transitory computer-readable medium, (e.g., a memory, etc.), and executes those instructions, thereby performing one or more processes, including one or more of the processes described herein.

[0115] Computer-readable media can be any available media that can be accessed by a general purpose or special purpose computer system. Computer-readable media that store computer-executable instructions are non-transitory computer-readable storage media (devices). Computer-readable media that carry computer-executable instructions are transmission media. Thus, by way of example, and not limitation, one or more embodiments can comprise at least two distinctly different kinds of computer-readable media: non-transitory computer-readable storage media (devices) and transmission media.

[0116] Non-transitory computer-readable storage media (devices) includes RAM, ROM, EEPROM, CD-ROM, solid state drives (SSDs) (e.g., based on RAM), flash memory, phase-change memory (PCM), other types of memory, other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store desired program code means in the form of computer-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer.

[0117] A "network" is defined as one or more data links that enable the transport of electronic data between computer systems and/or modules and/or other electronic devices. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a computer, the computer properly views the connection as a transmission medium. Transmission media can include a network and/or data links which can be used to carry desired program code means in the form of computer-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer. Combinations of the above should also be included within the scope of computer-readable media.

[0118] Further, upon reaching various computer system components, program code means in the form of computer-executable instructions or data structures can be transferred automatically from transmission media to non-transitory computer-readable storage media (devices) (or vice versa). For example, computer-executable instructions or data structures received over a network or data link can be buffered in RAM within a network interface module (e.g., a "NIC"), and then eventually transferred to computer system RAM and/or to less volatile computer storage media (devices) at a computer system. Thus, it should be understood that non-transitory computer-readable storage media (devices) can be included in computer system components that also (or even primarily) use transmission media.

[0119] Computer-executable instructions comprise, for example, instructions and data which, when executed at a processor, cause a general purpose computer, special purpose computer, or special purpose processing device to perform a certain function or group of functions. In some embodiments, computer-executable instructions are executed on a general purpose computer to turn the general purpose computer into a special purpose computer implementing elements of one or more embodiments. The computer executable instructions may be, for example, binaries,

intermediate format instructions, such as assembly language, or even source code. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the described features or acts described above. Rather, the described features and acts are disclosed as example forms of implementing the claims.

[0120] Those skilled in the art will appreciate that the one or more embodiments may be practiced in network computing environments with many types of computer system configurations, including, personal computers, desktop computers, laptop computers, message processors, hand-held devices, multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, mobile telephones, PDAs, tablets, pagers, routers, switches, and the like. One or more embodiments may also be practiced in distributed system environments where local and remote computer systems, which are linked (either by hardwired data links, wireless data links, or by a combination of hardwired and wireless data links) through a network, both perform tasks. In a distributed system environment, program modules may be located in both local and remote memory storage devices.

[0121] Embodiments can also be implemented in cloud computing environments. In this description and the following claims, "cloud computing" is defined as a model for enabling on-demand network access to a shared pool of configurable computing resources. For example, cloud computing can be employed in the marketplace to offer ubiquitous and convenient on-demand access to the shared pool of configurable computing resources. The shared pool of configurable computing resources can be rapidly provisioned via virtualization and released with low management effort or service provider interaction, and then scaled accordingly.

[0122] A cloud computing model can be composed of various characteristics such as, for example, on-demand self-service, broad network access, resource pooling, rapid elasticity, measured service, and so forth. A cloud computing model can also expose various service models, such as, for example, Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). A cloud computing model can also be deployed using different deployment models such as private cloud, community cloud, public cloud, hybrid cloud, and so forth. In this description and in the claims, a "cloud computing environment" is an environment in which cloud computing is employed.

[0123] FIG. **8** illustrates, in block diagram form, an exemplary computing device **800** that may be configured to perform one or more of the processes described above. The systems and components **102-112** of FIG. **1** and **202-214** of FIG. **2** can each comprise implementations of the data-computing device **800**. As shown by FIG. **8**, the computing device can comprise a processor **802**, memory **804**, a storage device **806**, an I/O interface **808**, and a communication interface **810**. While an exemplary computing device **800** is shown in FIG. **8**, the components illustrated in FIG. **8** are not intended to be limiting. Additional or alternative components may be used in other embodiments. Furthermore, in certain embodiments, a computing device **800** can include fewer components than those shown in FIG. **8**. Components of computing device **800** shown in FIG. **8** will now be described in additional detail.

[0124] In particular embodiments, processor(s) **802** includes hardware for executing instructions, such as those making up a computer program. As an example and not by way of limitation, to execute instructions, processor(s) **802** may retrieve (or fetch) the instructions from an internal register, an internal cache, memory **804**, or a storage device **806** and decode and execute them. In particular embodiments, processor(s) **802** may include one or more internal caches for data, instructions, or addresses. As an example and not by way of limitation, processor(s) **802** may include one or more instruction caches, one or more data caches, and one or more translation lookaside buffers (TLBs). Instructions in the instruction caches may be copies of instructions in memory **804** or storage device **806**.

[0125] The computing device **800** includes memory **804**, which is coupled to the processor(s) **802**.

The memory **804** may be used for storing data, metadata, and programs for execution by the processor(s). The memory **804** may include one or more of volatile and non-volatile memories, such as Random Access Memory (RAM), Read Only Memory (ROM), a solid state disk (SSD), flash, Phase Change Memory (PCM), or other types of data storage. The memory **804** may be internal or distributed memory.

[0126] The computing device **800** includes a storage device **806** for storing data or instructions. As an example and not by way of limitation, storage device **806** can comprise a non-transitory storage medium described above. The storage device **806** may include a hard disk drive (HDD), a floppy disk drive, flash memory, an optical disc, a magneto-optical disc, magnetic tape, or a Universal Serial Bus (USB) drive or a combination of two or more of these. Storage device **806** may include removable or non-removable (or fixed) media, where appropriate. Storage device **806** may be internal or external to the computing device **800**. In particular embodiments, storage device **806** is non-volatile, solid-state memory. In particular embodiments, storage device **806** includes read-only memory (ROM). Where appropriate, this ROM may be mask programmed ROM, programmable ROM (PROM), erasable PROM (EPROM), electrically erasable PROM (EEPROM), electrically alterable ROM (EAROM), or flash memory, or a combination of two or more of these.

[0127] The computing device **800** also includes one or more input or output (I/O) devices/interfaces **808**, which are provided to allow a user to provide input to, receive output from, and otherwise transfer data to and from the computing device **800**. These I/O devices/interfaces **808** may include a mouse, keypad or a keyboard, a touch screen, camera, optical scanner, network interface, modem, other known I/O devices or a combination of such I/O devices/interfaces **808**. The touch screen may be activated with a stylus or a finger.

[0128] The I/O devices/interfaces **808** may include one or more devices for presenting output to a user, including, but not limited to, a graphics engine, a display (e.g., a display screen), one or more output drivers (e.g., display drivers), one or more audio speakers, and one or more audio drivers. In certain embodiments, I/O devices/interfaces **808** is configured to provide graphical data to a display for presentation to a user. The graphical data may be representative of one or more graphical user interfaces and/or any other graphical content as may serve a particular implementation.

[0129] The computing device **800** can further include a communication interface **810**. The communication interface **810** can include hardware, software, or both. The communication interface **810** can provide one or more interfaces for communication (such as, for example, packet-based communication) between the computing device **800** and one or more other computing devices or one or more networks. As an example and not by way of limitation, communication interface **810** may include a network interface controller (NIC) or network adapter for communicating with an Ethernet or other wire-based network or a wireless NIC (WNIC) or wireless adapter for communicating with a wireless network, such as a WI-FI.

[0130] This disclosure contemplates any suitable network and any suitable communication interface **810**. As an example and not by way of limitation, computing device **800** may communicate with an ad hoc network, a personal area network (PAN), a local area network (LAN), a wide area network (WAN), a metropolitan area network (MAN), or one or more portions of the Internet, or a combination of two or more of these. One or more portions of one or more of these networks may be wired or wireless. As an example, computing device **800** may communicate with a wireless PAN (WPAN) (such as, for example, a BLUETOOTH WPAN), a WI-FI network, a WI-MAX network, a cellular telephone network (such as, for example, a Global System for Mobile Communications (GSM) network), or other suitable wireless network or a combination thereof. Computing device **800** may include any suitable communication interface **810** for any of these networks, where appropriate.

[0131] The computing device **800** can further include a bus **812**. The bus **812** can comprise hardware, software, or both that couples components of computing device **800** to each other. As an example and not by way of limitation, bus **812** may include an Accelerated Graphics Port (AGP) or

other graphics bus, an Enhanced Industry Standard Architecture (EISA) bus, a front-side bus (FSB), a HYPERTRANSPORT (HT) interconnect, an Industry Standard Architecture (ISA) bus, an INFINIBAND interconnect, a low-pin-count (LPC) bus, a memory bus, a Micro Channel Architecture (MCA) bus, a Peripheral Component Interconnect (PCI) bus, a PCI-Express (PCIe) bus, a serial advanced technology attachment (SATA) bus, a Video Electronics Standards Association local (VLB) bus, or another suitable bus or a combination thereof.

[0132] In the foregoing specification, various embodiments have been described with reference to specific exemplary embodiments thereof. Various embodiments and aspects are described with reference to details discussed herein, and the accompanying drawings illustrate the various embodiments. The description above and drawings are illustrative and are not to be construed as limiting. Numerous specific details are described to provide a thorough understanding of various embodiments.

[0133] One or more embodiments may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. For example, the methods described herein may be performed with less or more steps/acts or the steps/acts may be performed in differing orders. Additionally, the steps/acts described herein may be repeated or performed in parallel with one another or in parallel with different instances of the same or similar steps/acts. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes that come within the meaning and range of equivalency of the claims are to be embraced within their scope.

Claims

1. A method of hide sorting comprising: determining a characteristic of a hide; associating a hide identifier with the hide; associating the characteristic of the hide with the hide identifier; determining a grade of the hide; associating the grade of the hide with the hide identifier; and sorting the hide based on the grade of the hide and the characteristic of the hide.