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FISH PROCESSING SYSTEMS AND METHODS

Abstract

A fish processing system includes a measurement sensor configured to measure a distance across a head of a fish as the fish moves along a conveyor. A drive mechanism provides movement of a blade across a transport path of the fish along the conveyor in response to the determined distance to accurately sever the head of the fish based on the size of the fish. The system may also include a detection sensor for closing a wall of a trough to reject fish with heads that are not properly removed by the blade as well as an adjustment cylinder to vary a position of a conveyor relative to a fish processing subsystem to avoid jamming. Related methods for severing a portion of each fish in a series of transported fish based on the size of each fish are also provided.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S) [0001] This application claims the benefit of U.S. Provisional Patent Application No. 63/384,209 filed Nov. 17, 2022, all of which is incorporated herein by reference in its entirety.

BACKGROUND
Technical Field
[0002] This disclosure generally relates to systems and methods for processing fish, and more particularly to systems and methods for severing the head of a fish from its body and positioning the fish in alignment with a gutting machine in a reliable and consistent manner.
Description of the Related Art
[0003] In some fish products, the head is removed at the gills, leaving a hard cartilage structure on the head end of the fish called the collar. The viscera, including the gonads (roe or milt) are removed, the kidney membrane is cut and the kidney is removed with water sprays and brushes. In the salmon industry, this product is called a head and gut product and is a valuable commodity. An initial step of preparing such head and gut product is the removal or severing of the head from the body of the fish. Various devices for severing the head of the fish are known, including systems which feature a guillotine knife operated with a pneumatic cylinder which is actuated with compressed air to plunge through fish transported beneath the knife.
[0004] While known systems have been generally effective in fish head removal, the systems may suffer from various deficiencies and shortcomings, such as, for example, inadvertent damage to the fish resulting from mistiming of guillotine knife devices, and the systems being complex and expensive to produce and operate. In addition, known systems are not particularly suited for processing fish of different sizes, which can lead to jamming in the processing machinery and an overall reduction in the efficiency of the operation. Thus, it would be advantageous to have a fish processing system and method that overcomes the shortcomings of the prior art.
BRIEF SUMMARY
[0005] The systems and methods of processing fish described herein provide for the efficient removal of fish heads in a particularly reliable and robust form factor and include cutting and alignment systems and methods for processing fish of different sizes.
[0006] For example, the systems and methods described herein may include a system with a blade that is decoupled from movement of a conveyor belt transporting the fish and a measurement sensor, which may be a laser measurement sensor, that measures a height of the fish across the head from the belly to the back of the fish to generate an approximate of a size of each fish. The blade then performs the cut with irregular timing at a selected location along each fish in accordance with the determined size of each fish to increase cut accuracy and reduce the likelihood of jamming.
[0007] The systems and methods may also include a trough with a detection sensor that is configured to detect whether a head of the fish was successfully removed by the blade. If not, the detection sensor activates an actuator mechanically coupled to a moveable sidewall of the trough to a closed position to prevent the fish from entering the trough. Further, the systems and devices may include an adjustment cylinder associated with a conveyor for adjusting a position of the fish relative to a fish processing subsystem to align the fish with an inlet of the fish processing subsystem. As a result, the concepts of the disclosure enable more precise fish processing methods that reduce the likelihood of jamming, among other benefits.

[0008] The above examples are non-limiting and additional features and advantages will be described in greater detail herein.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS
[0009] FIG. **1**A is a top plan view of an embodiment of a fish processing system according to the present disclosure.
[0010] FIG. **1**B is a side elevational view of a cutting subsystem and a trough of the fish processing system of FIG. **1**A.
[0011] FIG. **2** is a schematic side elevational of the cutting subsystem of FIG. **1**B.
[0012] FIG. **3**A is a schematic plan view of a measurement sensor of the cutting subsystem of FIG. **1**B.
[0013] FIG. **3**B is a schematic elevational view of the measurement sensor of the cutting subsystem of FIG. **1**B.
[0014] FIG. **4**A is a schematic plan view of a measurement and cutting process of the cutting subsystem of FIG. **1**B.
[0015] FIG. **4**B is an isometric view of the trough of FIG. **1**B in an open position.
[0016] FIG. **5**A is a side elevational view of a detection sensor triggering an actuator associated with the trough of FIG. **1**B to manipulate the trough to a closed position.
[0017] FIG. **5**B is an isometric view of the trough of FIG. **5**A in the closed position.
[0018] FIG. **6**A is a side elevational view of the trough and a gutting subsystem of the fish processing system of FIG. **1**A with an adjustment cylinder for changing a position of a portion of the trough relative to the gutting subsystem.
[0019] FIG. **6**B is a front elevational view of the trough of FIG. **6**A at an entry to the gutting subsystem.
[0020] FIG. **6**C is a detail view of the adjustable portion of the trough of FIG. **6**A.
[0021] FIG. **7** is a block diagram of a controller suitable for executing an embodiment of a fish processing system that performs at least some techniques described in the present disclosure, as well as various devices and/or computing systems connected thereto.
DETAILED DESCRIPTION
[0022] The systems and methods of processing fish described herein provide for the efficient removal of fish heads in a particularly reliable and robust form factor and include cutting and alignment systems and methods for processing fish of different sizes, among other features and advantages. Although the present disclosure will describe embodiments for fish processing, it is to be appreciated that the concepts of the disclosure are applicable in various other industries and processes, such as at least with respect to any process that involves removing or severing a portion of an object, and particularly, but not exclusively, removing a portion of a food product. Accordingly, the disclosure is not limited solely to fish processing.
[0023] Beginning with FIG. **1**A, illustrated therein is a fish processing system **100** that includes a cutting subsystem **102**, a trough **104**, and a gutting subsystem **106**. Each of the cutting subsystem **102**, trough **104**, and gutting subsystem **106** may also be referred to herein as a fish processing subsystem or more generally as a subsystem. The trough **104** is in communication with an outlet **108** of the cutting subsystem **102** and an inlet **110** of the gutting subsystem **106**. Fish **112** are conveyed along a transport path through the fish processing system **100** that begins with the cutting subsystem **102**. The cutting subsystem **102** removes a head of the fish **112** and the de-headed fish are provided to the trough **104**. Then, the trough **104** conveys the de-headed fish **112** to the gutting subsystem **106** for further processing, such as to remove internal matter in the de-headed fish **112**.
[0024] FIG. **1**B is a side elevational view of the cutting subsystem **102** and the trough **104** of the

fish processing system **100**. As will be explained in greater detail below, the cutting subsystem **102** includes a first sensor **114** that may be a distance sensor or a measurement sensor upstream of a cutting location **116** where the head of the fish **112** is removed. Accordingly, the first sensor **114** may also be referred to herein as a distance sensor **114** or a measurement sensor **114**. The cutting subsystem **102** also includes a second sensor **118** that may be a detection sensor or a contact sensor configured to determine whether the head of the fish **112** remains on the fish **112** after the cutting operation. Accordingly, the second sensor **118** may also be referred to herein as a detection sensor **118** or a contact sensor **118**. The trough **104** includes a moveable sidewall **120** that is coupled to an actuator **122** configured to move the sidewall **120** between an open and closed position in response to the determination of whether the head remains on the fish **112** via the second or detection sensor **118**.

[0025] FIG. **2** is a schematic diagram of the cutting subsystem **102**. The cutting subsystem **102** includes a structural frame **124** to support various conveying and processing elements in a relatively compact form factor. The frame **124** supports at least a portion of a conveyor system **126** which is configured to convey fish **112** received on a conveyor device **128** thereof across a cutting location **116** during operation. The conveyor device **128** may include, for example, belts, chains, or movable beds as well as associated drive mechanisms, gears, wheels, sprockets, and the like for transporting the fish **112** across the cutting location **116**. In the embodiment shown in FIG. **2**, for example, the conveyor device **128** includes roller chains **130** routed over a plurality of corresponding sprockets (not shown) which are arranged to carry fish **112** in a feed direction through the cutting subsystem **102** (i.e., from left to right in the orientation of FIG. **2**). Locating features **132** such as, for example, upstanding pegs or other protrusions are coupled to the roller chains for positioning the fish **112** at regular intervals and in consistent positions for subsequent processing operations.

[0026] For example, first locating features **132***a* may be coupled to a primary roller chain and are spaced to engage a first portion of each fish **112**, such as, for example, the top of each fish **112**. Second locating features **132***b* are coupled to a secondary roller chain and spaced to engage a second portion of each fish **112**, such as, for example, a head of each fish **112**. The secondary roller chain and corresponding locating features **132***b* may be configured to disengage the fish **112** prior to or upon reaching the cutting location **116** so as not to interfere with a cutting operation of the head of the fish **112** described herein. Collectively, the roller chains **130** and locating features **132** may locate the fish **112** at generally regular and consistent intervals to be cut in a repeatable manner as the roller chains **130** transport the fish **112** toward the cutting location **116**. In an embodiment, the fish **112** may be arranged on the roller chains **130** and locating features **132** at irregular intervals, including irregular intervals that arise as a result of differences in the sizes of the fish to be processed.

[0027] The conveyor system **126** may further include a supplemental belt **134** and tension devices **136** to assist in transporting fish **112** across the cutting location **116**. More particularly, the supplemental belt **134** may be provided to move in unison with the primary roller chain with tension devices **136** biasing the supplemental belt **134** and fish **112** in a downward direction. This arrangement may ensure that the fish **112** remain firmly positioned for subsequent processing activities.

[0028] The cutting subsystem **102** may further include a drive device **144** that may be, for example, an electric rotary drive motor. In an embodiment, the drive device **144** may instead be a pneumatic cylinder, linear actuator, or hydraulic drive device, among other possibilities. The disclosure also contemplates one or more such drive devices operating in combination. The drive device **144** is structured to intermittingly move a blade **146** between a standby position shown in FIG. **2**, and a cutting position where the blade **146** is driven vertically downward and through the head of the fish **112** (i.e., the blade **146** extends beyond the head of the fish **112** in the cutting position) to sequentially sever a head or other portion from each of the fish **112** conveyed across the cutting location **116**. In a non-limiting example where the drive device **144** is a motor, the drive device **144** may include a drive wheel **152**. In an embodiment, at least the drive device **144** is in electronic communication with a controller **156** that provides instructions to activate the drive device **144** to perform the cutting operation at irregular intervals corresponding to a determined size of each fish **112**. For example, the controller **156** may communicate with measurement sensor **114** to determine the size of an individual fish **112** as the fish **112** moves towards the cutting location **16**. Then, after a distance across the fish **112** is measured by the measurement sensor **114** and a cut location on the fish **112** and timing of the cut are determined, the controller **156** may send instructions, signals, and/or data to the drive device **144** to intermittently set the drive wheel **152** into rotary motion to plunge the blade **146** toward the cutting position **116** to sever the head or other portion from the fish **112** at irregular intervals based on the determined size of the fish **112**. The drive wheel **152** may also continue to rotate to retract the blade **146** back toward the standby position based on such instructions, signals, and/or data. Once the blade **146** returns to the standby position, the controller **156** inactivates the drive device **144** to again hold the blade **146** stationary while controller **156** determines, via the measurement sensor **114**, a size of the next successive fish **112** approaching the cutting location **116**. The cutting operation is then repeated at irregular intervals based on the determined size of each fish **112**. The above operations may be similar with a different type of drive device **144**, although other drive devices **144** may omit the wheel **152** in some embodiments. As a result, the cutting subsystem **102** performs cuts at irregular intervals corresponding to a detected or measured size of each fish **112**, as further described below.

[0029] FIG. **3**A is a schematic plan view of the measurement sensor **114** of the cutting subsystem **102** and FIG. **3**B is a schematic elevational view of the measurement sensor **114** of the cutting subsystem **102**. With reference to FIG. **3**A and FIG. **3**B, the measurement sensor **114** may be located upstream of the cutting location **116** relative to a movement direction of the conveyor device **128** and/or transport path through the cutting subsystem **102**. The measurement sensor **114** is operable to measure a dimension **158** across each fish **112**, which may be a horizontal distance across the fish **112** or a height of the fish **112** across the head from a belly to a back of the fish **112**. The dimension **158** of the fish **112** across the head can then be used to generate an approximate size of each fish based on a correlation table or other information and/or data stored in the controller **156**. Such correlation table may include values or ranges of values corresponding to the dimension **158** as well as approximate fish characteristics, such as size, length, weight, or others, that correspond to a given value or range of values for the dimension **158** (i.e., where the dimension **158** is 5 inches, the fish is 28 inches long, weighs between 5-10 pounds, etc.).

[0030] The measurement sensor **114** may be a laser measuring device that measures the dimension **158** across the fish **112** as the fish **112** is moved along the transport path by the conveyor device **128**. In an embodiment, the measurement sensor **114** is a proximity sensor that detects whether a fish **112** is present on the conveyor device **128** in a field of view of the sensor **114** over a certain period of time. For a given rate of movement of the conveyor device **128** in such an embodiment, the amount of time that the fish **112** is within the field of view of the measurement sensor **114** can be utilized to determine the dimension **158**, such as at least via the controller **156**. For example, if the conveyor device **128** is operable to move the fish **112** at a rate of one foot per second, and the proximity sensor **114** determines that the fish **112** is present for 0.5 seconds, then the dimension **158** is 6 inches. Other variations and configurations are possible.

[0031] In some embodiments, and as best shown in FIG. **3**B, the dimension **158** and/or the determined size of the fish **112** is also used to determine a sever or cut location **160** on each fish **112**. The sever location **160** can be selected and may depend, at least in part, on the size and configuration of the blade **146** of the cutting subsystem **102** (FIG. **2**), among other factors. Further, the sever location **160** is preferably in the body of the fish **112** behind the gills or the gill plate (i.e., toward the tail of the fish **112** from the gills or the gill plate). In some embodiments, the fish **112** are arranged on the conveyor device **128** in a manner that approximately aligns the sever location

160 on the fish **112** with the cutting location **116** of the blade **146**. In such embodiments, the sever location **160** may correspond to a timing of the cut with the blade **146** (FIG. **2**) such that a center of the blade **146** plunges through the sever location **160** to increase cut accuracy. The sever location **160** may preferably be located proximate to a center of the dimension **158**, or at a location that is between 55% and 75% of the dimension **158** measured from the belly of the fish **112** (i.e., 5% to 25% beyond the center of the dimension **158** relative to the belly of the fish **112** or between 25% and 45% of the dimension **158** measured from the back of the fish **112**) that generally corresponds to an area in the body of the fish **112** that is closer to a center of the gills than to the back of the fish **112**. In an embodiment, the sever location **160** is approximately 30% (i.e., between 25% and 35%) of the dimension **158** measured from either the belly or the back of the fish **112**. The determination of the sever location **160** may be performed by the controller **156** based on instructions, signals, and/or data from the measurement sensor **114**, with the controller **156** also providing instructions to operate the blade **146** at intermittent intervals to sever each fish **112** at the sever location **160**.

[0032] In an embodiment, and as shown in FIG. **3**B, the measurement sensor **114** is coupled to the support frame **124** and is positioned above the fish **112** with a line of sight **162** directed downward and toward the fish **112** on the conveyor device **128**. The location of the measurement sensor **114** may also be referred to as a measurement location in the system **100**, with the measurement location generally being upstream from the cutting location **116**, unless otherwise indicated. The measurement sensor **114** may also be positioned in other locations, such as least in a gap in the conveyor device **128** below the fish **112** or as part of a separate structure from the structural frame **124** in some embodiments. As such, the measurement sensor **114** may be operable to measure a horizontal distance across the fish **112** from a position vertically above the fish **112** in at least some embodiments.

[0033] In an embodiment, the fish **112** may have a different arrangement relative to the cutting location **116** and the dimension **158** may be measured at least partially across the gills of the fish **112**. The gills or gill plate of the fish **112** may not be a desirable sever location because the gill plate and therefore the head may not be fully severed by the blade **116**, among other challenges. In such an embodiment, the determined approximate size of the fish **112** can be used to determine the sever location **160** in the body of the fish **112**. For example, if the determined length of the fish **112** is 28 inches and the gills of the fish **112** are aligned with the cutting location **116**, the sever location **160** can be approximated to be 1 to 2 inches behind the gills, or another selected location, based on the determined size of the fish **112**. The fish **112** may be adjusted to such a location manually or by conveyor device **128**, and/or the position of the cutting location **116** of the blade **146** can be adjusted to align the sever location **160** with the cutting location **116** in some embodiments.

[0034] FIG. **4**A and FIG. **4**B are schematic views of a successful cutting operation of the cutting subsystem **102** and subsequent operation of the second sensor **118** and the trough **104**. In operation, and beginning with FIG. **4**A, the conveyor device **128** moves fish **112** along the transport path through the cutting subsystem **102** (i.e., from left to right in the orientation of FIG. **4**A). The first sensor **114** or measurement sensor **114** determines the size of each fish **112** and approximates the sever location **160** (FIG. **3**B), as described above. The blade **146** (FIG. **2**) is intermittently operated to cut each fish **112** at the sever location **160** (FIG. **3**B) based on, or in accordance with, the readings from the measurement sensor **114**. During the cutting operation, the head is removed from each fish **112**, as shown in FIG. **4**A. The severed heads may be collected for disposal, sale, or further processing.

[0035] Following the cutting operation, the conveyor device **128** conveys the severed fish **112** toward the second sensor **118** or detection sensor **118**. Where the head is successfully removed according to the above process, the fish **112** does not contact, interface with, or otherwise trigger the detection sensor **118**. As a result, and turning to FIG. **4**B, the actuator **122** maintains a retracted position shown in FIG. **4**B in which the movable sidewall **120** of the trough **104** is held in an open position below and aligned with the outlet **108** of the cutting subsystem **102** for receiving the severed fish **112**. In other words, the trough **104** is maintained in the open position in response to a successful cutting operation of the type described above with reference to FIG. **4**A in some embodiments. The severed fish **112** is received in the trough **104** and conveyed along the trough **104** for further processing, as described herein.

[0036] FIG. **5**A and FIG. **5**B illustrate operation of the system **100** in response to an unsuccessful cutting operation where at least a portion (i.e., the head or another portion of the head) of the fish **112** improperly remains on the body of the fish **112**. Specifically, FIG. **5**A is a side elevational view of the second sensor **118** or detection sensor **118** triggering the actuator **122** to manipulate the trough **104** to a closed position. FIG. **5**B is an isometric view of the trough **104** in the closed position.

[0037] Beginning with FIG. **5**A, the cutting operation described above may not always be successful in removing the entirety of a desired portion of the fish **112**, such as the head (or some other portion) of the fish **112**. Such improper cuts can occur because of errors in the alignment of the fish **112** with the cutting location **116** and errors with the operation of the blade **146** (FIG. **2**) and the system for driving the blade, among other factors. If the head of the fish **112** is not completely removed, the intact fish **112** can jam the system **100**, which increases downtime and reduces efficiency. Accordingly, if an improper cut occurs that fails to sever the entire head or other desired portion of the fish **112**, the detection sensor **118** triggers the actuator **122** to manipulate the trough **104** to a closed position.

[0038] In more detail, the detection sensor **118** may be provided in the form of a contact sensor with an arm **164** that is adjacent to, but spaced from, the conveyor device **128**. When a fish **112** that improperly includes the head is conveyed along the transport path by the conveyor device **128**, the head of the fish **112** contacts the detection sensor **118** and causes the arm **164** to rotate or otherwise move away from the conveyor device **128**. Such movement of the arm **164** beyond a threshold value (which may be an amount of rotation, such at least 5 degrees, or a distance, such as at least 0.25 inches) triggers the sensor **118** to send instructions, signals, and/or data to the controller **156** (FIG. **2**) to activate the actuator **122** and push the movable sidewall **120** toward the outlet **108** of the cutting subsystem **102**. Such movement of the moveable sidewall **120** closes the trough **104** and prevents fish at the outlet **108** of the cutting subsystem **102** from entering the trough **104**. Rather, the rejected fish **112** slide down an outer face of the movable sidewall **120** to be collected for additional processing. In an embodiment, the detection sensor **118** is coupled to the structural frame **124** and operable to detect whether the portion (such as the head or some other portion) has been properly removed from the fish **112** at a detection location **166** downstream of the cutting location **116** (FIG. **4**A) relative to the path of travel of the conveyor device **128**. The detection location **166** is located between the cutting location **116** and the outlet **108** of the cutting subsystem **102** in a particularly advantageous embodiment, although other configurations are contemplated herein, such as the detection sensor **118** being located at the outlet **108**, or at any entry to the trough **104**. In further embodiments, the detection sensor **118** may be a proximity sensor of the type described above, a time of flight sensor, or some other type of sensor, instead of a contact sensor.

[0039] FIG. **5**B provides additional detail of the trough **104** in the closed position. The moveable sidewall **120** may be coupled to the structural frame **124** or some other aspect of the trough **104** with a hinge **168**, which may be a piano hinge or some other type of hinge in some embodiments. Further, the actuator **122** may be a linear actuator that is electrically or hydraulically driven, among other possibilities. The actuator **122** has a rod **170** that is coupled the moveable sidewall **120** and operable to slide into and out of a housing **172** of the actuator **122**. The drive components of the actuator **122** for moving the rod **170** may likewise be accommodated in the housing **172**. The actuator **122** is in communication with the controller **156** (FIG. **2**) such that the actuator **122** can receive instructions, signals, and/or data from the controller **156** to move the rod **170** into and out of the housing **172** in response to the operation of the detection sensor **118** above. In FIG. **5**B, the actuator **122** is in an extended position corresponding to the closed position of the trough **104** in which the rod **170** is extend from the housing **172** to rotate the sidewall **120** toward the outlet **108** of the cutting subsystem **102** about the hinge **168** and close the trough **104**. In the context of FIG. **5**A and FIG. **5**B, the trough **104** being "closed" refers to the sidewall **120** being in a position where a suitable fish **112** for processing in the system **100** is not able to enter the trough **104**. As a result, "closed" may mean that the sidewall **120** is adjacent to, in contact with, or positioned in close proximity to the conveyor device **128** at the outlet **108** of the cutting subsystem **102**, or the sidewall **120** may be spaced from the conveyor device **128** at the outlet **108** of the cutting subsystem **102** by less than 1 inch, 1 inch, 2 inches, 3 inches, or 4 or more inches depending on the size of the fish **112**. Thus, "closed" should be construed broadly and may include embodiments where there is a space between the sidewall **120** and the conveyor device **128** at the outlet **108** of the cutting subsystem **102**.

[0040] Once the fish **112** with the improperly removed portion traverses the outer face of the sidewall **120** and is collected for further processing, the detection sensor **118** (FIG. **5**A) returns to its normal operating position, which triggers the controller **156** (FIG. **2**) to send instructions, signals, and/or data to the actuator **122** to retract the rod **170** into the housing **172** and return the trough **104** to the open position shown in FIG. **4**A and FIG. **4**B. Such movement of the sidewall **120** and operation of the actuator **122** occurs simultaneously with continuous operation of the system **100** and cutting subsystem **102**. In other words, the detection sensor **118** is triggered to activate the actuator **122** in response to a single fish **112** that improperly retains the head or some portion, with the next successive fish **112** that is properly cut not triggering the sensor **118** and the actuator **122** returning the trough **104** to the open position. As a result, the system **100** enables selective removal and collection of improperly processed fish **112** without downtime or otherwise negatively impacting continuous operation of the system **100**.

[0041] FIG. **6**A is a side elevational view of the trough **104** and the gutting subsystem **106**. FIG. **6**B is a front elevational view of the trough **104** at an entry to the gutting subsystem **106**. FIG. **6**C is a schematic detail view of an adjustable portion of the trough **104**.

[0042] Beginning with FIG. **6**A, and with reference back to FIG. **1**A, the trough **104** may define a path of travel from the outlet **108** of the cutting subsystem **102** to an entry or inlet **174** of the gutting subsystem **106** where the path of travel is curved, straight, angled, or any combination thereof. Further, the trough **104** may be provided in the form factor of a channel with a bottom wall and opposing sidewalls coupled to the bottom wall. The channel is open at the top to receive the fish **112**, as best shown in FIG. **4**B. In an embodiment, the bottom wall of the trough **104** may be a further conveyor device **176**. The fish **112** with the head or other portion removed are conveyed along the trough **104** by the further conveyor device **176**.

[0043] In an embodiment, the trough **104** is not directly coupled to the gutting subsystem **106** proximate the inlet **174** of the gutting subsystem **106**. Rather, the end of the trough **104** is freestanding with respect to the gutting subsystem **106** and otherwise supported by the structural frame **124** associated with the trough **104**. An end **178** of the trough **104** proximate the inlet **174** of the gutting subsystem **106** may be supported with respect to the structural frame **124** by an adjustment cylinder **180**. As will be described in further detail below, the adjustment cylinder **180** is structured to adjust a height of at least a portion of the trough **104** proximate the end **178** to change a position of the trough **104** and the fish **112** relative to the inlet **174** of the gutting subsystem **106**. In a further embodiment, the adjustment cylinder **180** interfaces with a plate or other structure under the fish **112** at the bottom of the trough **104** to change a position of the fish **112**. In yet a further embodiment, the trough **104** is static and fixed in place, and the adjustment cylinder **180** is coupled to the gutting subsystem **106** and configured to adjust a position (i.e., height) of the gutting subsystem **106** relative to the trough **104**.

[0044] Turning to FIG. **6**B, the adjustment cylinder **180** may be a linear actuator of the type described herein with a cylinder **182** for slidably receiving an adjustment rod **184**. The cylinder **182** is coupled to the structural frame **124** supporting the trough **104** and the adjustment rod **184** is coupled to the end **178** of the trough **104**. In operation, the adjustment rod **184** is extended from, or retracted into, the cylinder **182** based on operation of hydraulics, an electric motor, or other drive mechanism in the cylinder **182**. The movement of the adjustment rod **184** changes a position of the end **178** of the trough **104** relative to the gutting subsystem **106**, as well as a position of the fish **112** relative to the inlet **174** of the gutting subsystem **106**. In an embodiment, the adjustment cylinder **180** is in communication with the controller **156** (FIG. **2**) and changes a position of the trough **104** based on the determined size of the fish **112** in order to align the fish **112** with the inlet **174** of the gutting subsystem **106** based on the size of the fish **112** and reduce the likelihood of jamming and other improper operation of the gutting subsystem **106**.

[0045] FIG. **6**C is a schematic detail view showing a change in position or height of the fish **112** relative to the inlet **174** of the gutting subsystem **106**. The trough **104** may have a movable or adjustable portion corresponding to an area proximate the end **178** of the trough **104**. As noted above, the adjustable portion of the trough **104** may be freestanding with respect to the gutting subsystem **106**, with the adjustment cylinder **180** changing a position of the adjustable portion of the trough **104**, and thus a position of the fish **112** in the trough **104**, relative to the inlet **174** of the gutting subsystem **106**. Such change in position is represented in FIG. **6**C with dashed outlines of the fish **112**. For example, fish **112** with different dimensions **158** (FIG. **3**B) may benefit from being moved upward and/or downward relative to the inlet **174** of the gutting subsystem **106** to improve processing accuracy and efficiency, and reduce the likelihood of jamming. Such movement of the trough **104** and the fish **112** therefore increases processing accuracy and efficiency, with proper alignment of the fish **112** relative to the gutting subsystem **106** reducing the likelihood of jamming from inaccurate feeding of the fish **112** into the gutting subsystem **106**.

[0046] FIG. **7** shows the controller **156** represented in black diagram or schematic form. As further described below, the controller **156** may be suitable for executing or otherwise performing at least some embodiments or techniques described herein with respect to the fish processing system **100**. The physical or hardware aspects of the controller **156** may be located internal to a housing coupled to the structural frame **124** (FIG. **2**), or may be located external to the fish processing system **100** and in communication with certain aspects of the system **100**. For example, and with reference to FIG. **1**A-**6**C, the controller **156** may be in communication, either wired or wirelessly according to the any of the communication protocols described herein, with at least the first sensor **114** (measurement sensor), the second sensor **118** (detection sensor), the trough **104**, the drive motor **138** for the blade **146**, the conveyor devices **128**, **176** and drive mechanisms associated therewith, the actuator **122**, the adjustment cylinder **180**, and other aspects of the system **100** and/or other external devices.

[0047] The controller **156** includes a processor **186**, for example a microprocessor, digital signal processor, programmable gate array (PGA) or application specific integrated circuit (ASIC). The controller **156** includes one or more non-transitory storage mediums **188**, for example read only memory (ROM), random access memory (RAM), Flash memory, or other physical computer- or processor-readable storage media in communication with the processor **186**. The non-transitory storage mediums **188** may store instructions and/or data used by the processor **186** and the controller **156** generally, for example an operating system (OS) and/or applications. The instructions as executed by the processor **186** may execute logic to perform the functionality of the various implementations or techniques of the devices and systems described herein, including, but not limited to, receiving signals from the one or more sensors **114**, **118**, and determining, based on the signals, a size of the fish **112**, when to activate the drive motor **138** to perform a cutting operation based on the determined size of the fish **112**, whether to instruct the actuator **122** to move the sidewall **120**, and whether to instruct the adjustment cylinder **180** to adjust the trough **104**, among others.

[0048] The controller **156** may include, or be in communication with, the one or more sensors, such as at least the first or measurement sensor **114** and the second or detection sensor **118**. As described herein, the sensors **114**, **118** send signals, instructions, and/or data to the processor **156** based on detected conditions, such as a size of the fish **112** in the field of view of the measurement sensor **114** and whether a head or other portion remains on the fish **112** and activates the detection sensor **118**. In some embodiments, the controller **156** may include, or be in communication with, a status indicator or other such devices. The status indicator may be one or more LEDs or some other lighting element, a speaker, and/or a buzzer, among others. In at least some embodiments, each individual lighting element may be position—and hue-addressable, such as to control the color and state of each element independently of or in conjunction with the other lighting elements. The speaker may be a buzzer configured to emit sound as well as haptic signals or vibrations. In some embodiments, the controller **156** may include a separate speaker for emitting sound and a haptic device for emitting vibration, such as to change the strength, volume, or other characteristics of either of these signals relative to a buzzer. The status indicator may be operable, in some embodiments, to provide a signal to an operator or other user of the rejection of a fish **112**, or some other characteristic of the system **100**.

[0049] The controller **156** may also include a user interface (UI) **190** to allow a user to operate or otherwise provide input to the controller **156** and/or the system **100** described herein, such as with respect to the processing speed of the system **100**, activation or deactivation of selected subsystems, or others. In some embodiments, the user interface **190** is configured to display information to the user, such as an operator or other user of the system regarding the operational state or other characteristics of the system **100**. Additionally, the user interface **190** may include a number of user actuatable controls, such as, for example, a number of switches or keys operable to turn certain aspects ON and OFF and/or to set various operating parameters of the system **100**, the one or more sensors **114**, **118**, the status indicator, the drive motor **138**, the actuators **122**, **180**, operation and control of test and/or maintenance modes, among others. The switches and keys or the user interface **190** may include, for example, toggle switches, a keypad or keyboard, rocker switches or other physical actuators.

[0050] In some embodiments, the user interface **190** may include a display, for instance a touch panel display. The touch panel display (e.g., LCD or LED with touch sensitive overlay) may provide both an input and an output interface for the user. The touch panel display may present a graphical user interface, with various user selectable icons, menus, check boxes, dialog boxes, and other components and elements selectable by the end user to set operational states or conditions of the system **100**. The user interface **190** may also include one or more auditory transducers, for example one or more speakers and/or microphones. Such may allow audible alert notifications or signals to be provided to the user as a result of manual interaction with the user interface **190**. Such may additionally, or alternatively, allow the user to provide audible commands or instructions. The user interface **190** may include additional components and/or different components than those illustrated or described, and/or may omit some components.

[0051] The controller **156** includes a communications sub-system **192** that may include one or more communications modules or components which facilitate communications with the aspects of the system **100** described above, as well as with one or more other devices **194**, such as a personal computing device, mobile device, server, or a remote computing system associated with the controller **156** that monitors the operational characteristics of the system **100**. The communications sub-system **192** may provide wireless or wired communications to one or more such devices and may include wireless receivers, wireless transmitters and/or wireless transceivers to provide wireless signal paths to the various aspects, remote components, and/or systems of the one or more paired devices. The communications sub-system **192** may, for example, include components enabling short range (e.g., via Bluetooth®, BLE (“Bluetooth® low energy”), near field communication (NFC), or radio frequency identification (RFID) components and protocols) or longer range wireless communications (e.g., over a wireless LAN, Low-Power-Wide-Area Network (LPWAN), satellite, or cellular network) and may include one or more modems or one or more

Ethernet or other types of communications cards or components for doing so. The communications sub-system **192** may also include one or more bridges or routers suitable to handle network traffic including switched packet type communications protocols (TCP/IP), Ethernet or other networking protocols.

[0052] The controller **156** further includes a power interface manager **196** that manages supply of power from a power source **198** to the various components of the controller **156** and/or aspects of the system **100** described above. The power interface manager **196** is coupled to the processor **186** and the power source **198**. Alternatively, in some implementations, the power interface manager **196** can be integrated in the processor **186**.

[0053] The power source **198** may include an external power supply, or a rechargeable or replaceable battery power supply, among others. The power interface manager **196** may include power converters, rectifiers, buses, gates, circuitry, etc. in some embodiments. In particular, the power interface manager **196** can control, limit, and/or restrict the supply of power from the power source **198** based on the various operational states of the system **100** and/or aspects of the system **100**.

[0054] In some embodiments or implementations, the instructions and/or data stored on the non-transitory storage mediums **188** that may be used by the processor **186** and the controller **156** generally, such as, for example, ROM, RAM and/or Flash memory, includes or provides an application program interface ("API") that provides programmatic access to one or more functions of the controller **322**. For example, such an API may provide a programmatic interface to control one or more operational characteristics of the system **100**. Such control may be invoked by one of the other programs, other remote device or system, or some other module. In this manner, the API may facilitate the development of third-party software, such as various different user interfaces and control systems for other devices, plug-ins, and adapters, and the like to facilitate interactivity and customization of the operation and devices within the system **100**.

[0055] In an embodiment, components or modules of the controller **156** and other devices within the systems described herein are implemented using standard programming techniques. For example, the logic to perform the functionality of the various embodiments or techniques described herein may be implemented as a "native" executable running on the controller **156**, e.g., microprocessor **186**, along with one or more static or dynamic libraries. In other embodiments, various functions of the controller **156** may be implemented as instructions processed by a virtual machine that executes as one or more programs whose instructions are stored on non-transitory storage mediums **188**. In general, a range of programming languages known in the art may be employed for implementing such example embodiments, including representative implementations of various programming language paradigms, including but not limited to, object-oriented (e.g., Java, C++, C#, Visual Basic .NET, Smalltalk, and the like), functional (e.g., ML, Lisp, Scheme, and the like), procedural (e.g., C, Pascal, Ada, Modula, and the like), scripting (e.g., Perl, Ruby, Python, JavaScript, VBScript, and the like), or declarative (e.g., SQL, Prolog, and the like).

[0056] In a software or firmware implementation, instructions stored in a memory configure, when executed, one or more processors of the controller **156**, such as microprocessor **186**, to perform the functions of the controller **156**. The instructions cause the microprocessor **186** or some other processor, such as an I/O controller/processor, to process and act on information received from the one or more sensors **114**, **118**, drive motor **138**, actuators **122**, **180**, other devices **194**, and other aspects of the system **100** to provide the functionality and techniques described herein.

[0057] The embodiments or implementations described above may also use well-known or other synchronous or asynchronous client-server computing techniques. However, the various components may be implemented using more monolithic programming techniques as well, for example, as an executable running on a single microprocessor, or alternatively decomposed using a variety of structuring techniques known in the art, including but not limited to, multiprogramming, multithreading, client-server, or peer-to-peer (e.g., Bluetooth®, NFC or RFID wireless technology, mesh networks, etc.), running on one or more computer systems each having one or more central processing units (CPUs) or other processors. Some embodiments may execute concurrently and asynchronously, and communicate using message passing techniques.

[0058] In addition, programming interfaces to the data stored on and functionality provided by the controller **156**, can be available by standard mechanisms such as through C, C++, C#, and Java APIs; libraries for accessing files, databases, or other data repositories; scripting languages; or Web servers, FTP servers, or other types of servers providing access to stored data. The data stored and utilized by the controller **156** and overall system **100** may be implemented as one or more database systems, file systems, or any other technique for storing such information, or any combination of the above, including implementations using distributed computing techniques.

[0059] Different configurations and locations of programs and data are contemplated for use with techniques described herein. A variety of distributed computing techniques are appropriate for implementing the components of the illustrated embodiments in a distributed manner including but not limited to TCP/IP sockets, RPC, RMI, HTTP, and Web Services (XML-RPC, JAX-RPC, SOAP, and the like). Other variations are possible. Other functionality could also be provided by each component/module, or existing functionality could be distributed amongst the components/modules within the controller **156** and/or system **100** in different ways, yet still achieve the functions of the controller **156**.

[0060] Furthermore, in some embodiments or implementations, some or all of the components of the controller **156** may be implemented or provided in other manners, such as at least partially in firmware and/or hardware, including, but not limited to, one or more application-specific integrated circuits ("ASICs"), standard integrated circuits, controllers (e.g., by executing appropriate instructions, and including microcontrollers and/or embedded controllers), field-programmable gate arrays ("FPGAs"), complex programmable logic devices ("CPLDs"), and the like. Some or all of the system components and/or data structures may also be stored as contents (e.g., as executable or other machine-readable software instructions or structured data) on a computer-readable medium (e.g., as a hard disk; a memory; a computer network, cellular wireless network or other data transmission medium; or a portable media article to be read by an appropriate drive or via an appropriate connection, such as a DVD or flash memory device) so as to enable or configure the computer-readable medium and/or one or more associated computing systems or devices to execute or otherwise use, or provide the contents to perform, at least some of the described techniques.

[0061] In at least some embodiments, the non-transitory storage medium **188** stores instructions, that when executed the processor **186**, cause the controller **156** to determine the dimension **158** across the fish **112**, such as across the head of the fish **112**, based on instructions, signals, and/or other data from the measurement sensor **114**, as described herein. The non-transitory storage medium **188** may store further instructions that are executed by the processor **186** to determine, based on instructions, signals, and/or data from the detection sensor **118**, whether to activate the actuator **122** to move the movable sidewall **120** of the trough **104**. The non-transitory storage medium **188** may also store instructions that are executed by the processor **186** to intermittently activate the drive motor **138** to perform a cutting operation with the blade **146** based on, or in accordance with, the dimension **158** across the fish **112**. In other words, the controller **156** is operable to instruct the drive motor **138** and other aspects of the system **100** to activate the blade **146** at irregular intervals based on the detected size of the fish **112** with the measurement sensor **114**.

[0062] In yet further embodiments, the non-transitory storage medium **188** stores instructions that are executed by the processor **186** to activate or deactivate conveyor devices **128**, **176** and/or adjust a speed of the conveyor devices **128**, **176**. The non-transitory storage medium **188** may also store instructions for adjusting or otherwise manipulating the adjustment cylinder **180** to change a position of the trough **104** relative to the gutting subsystem **106**. Other operational aspects of the system **100** may be similarly executed or performed by the controller **156**, such as at least activation or deactivation of the entire system **100**, select subsystems or other aspects of the system **100**, as well as operational characteristics of various components.

[0063] The present disclosure also contemplates the techniques and other aspects above implemented as one or more methods for processing fish or other products. For example, and without limitation, a method may include transporting fish **112** through a measurement location corresponding to the measurement sensor **114** and the cutting location **116** with the conveyor device **128**. The method further includes measuring the dimension or distance **158** across the fish **112** with the measurement sensor **114** at the measurement location. The method may conclude with severing a portion of the fish **112** at the cutting location **116** with the blade **146** in accordance with the measured dimension or distance **158**. The blade **146** is driven by a drive mechanism, such as at least the drive device **144** described with reference to FIG. **2**, with the drive mechanism in communication with the measurement sensor **114**. The blade **146** is moved or otherwise operated in irregular intervals corresponding to the measured distance via the drive mechanism.

[0064] The method may further include transporting the fish **112** through the detection location **166** with the conveyor device **128** and determining with the detection sensor **118** at the detection location **166** whether the portion of the fish **112**, such as the head, was successfully severed at the cutting location **116**. The method may also include manipulating the movable sidewall **120** of the trough **104** with the trough **104** including the conveyor device **176**. The trough **104** and/or conveyor device **176** is in communication with the conveyor device **178** with the sidewall **120** being manipulated to a closed position in response to the detection sensor **118** determining the portion of the fish **112** was not severed from the fish **112** at the cutting location **116**. Similarly, the method may include manipulating the sidewall **120** to the open position to receive the fish **112** in the trough **104** in response to the detection sensor **118** and/or controller **156** determining the portion of the fish **112** was successfully severed at the cutting location **116**.

[0065] In an embodiment, the method includes transporting the fish **112** along the conveyor device **176** associated with the trough **104**, and aligning the fish **112** with the gutting subsystem **106**. The gutting subsystem **106** is in communication with the conveyor device **176** and the method includes adjusting a vertical position of the fish **112** relative to the gutting subsystem **106** with the adjustment cylinder **180**. Additional methods and processes are described and contemplated herein.

[0066] In view of the above, an embodiment of a fish processing system includes: a structural frame; a first conveyor device coupled to the structural frame configured to convey a fish received on the first conveyor device along a transport path including a measurement location and a cutting location; a measurement sensor coupled to the structural frame configured to measure a distance across a head of the fish conveyed by the first conveyor device at the measurement location; a blade movably coupled to the structural frame configured to move across the transport path of the fish conveyed by the first conveyor device at the cutting location; and a drive mechanism coupled to the structural frame and mechanically coupled to the blade, the drive mechanism in communication with the measurement sensor and configured to move the blade between a standby position and a cutting position in irregular intervals in accordance with the measured distance across the head of the fish to sever a portion from the fish conveyed across the cutting location based on the measured distance.

[0067] In an embodiment, the first conveyor device is configured to convey the fish across a detection location on the transport path, and the fish processing system further includes a detection sensor coupled to the structural frame configured to detect at the detection location whether the portion from the fish was successfully severed at the cutting location.

[0068] In an embodiment, the fish processing system further includes a second conveyor device in communication with an outlet of the first conveyor device, the second conveyor device including: a trough having a movable sidewall; and an actuator mechanically coupled to the movable sidewall and in communication with the detection sensor, the actuator configured to move the movable sidewall between an open position in which the fish is received in the trough in response to the detection sensor determining the portion from the fish was successfully severed at the cutting location, and a closed position in which the movable sidewall closes the trough to prevent the fish from entering the trough in response to the detection sensor determining the portion from the fish was not successfully severed at the cutting location.

[0069] In an embodiment, the fish processing system further includes: a second conveyor device in communication with an outlet of the first conveyor device; and a fish processing subsystem in communication with an outlet of the second conveyor device, and wherein the second conveyor device includes an adjustment cylinder proximate the outlet of the second conveyor device which is configured to change a position of the fish relative to the fish processing subsystem for alignment of the fish with an inlet of the fish processing subsystem.

[0070] In an embodiment, the adjustment cylinder is configured to change a vertical position of the fish relative to the fish processing subsystem.

[0071] In an embodiment, the measurement sensor is positioned vertically above the fish on the first conveyor device to measure a horizontal distance across the fish from a jaw of the fish to a back of the head of the fish.

[0072] In an embodiment, the drive mechanism is configured to move the blade between the standby position and the cutting position to sever the portion from the fish at a location on the fish that corresponds to approximately 30% of the measured distance across the fish. In an embodiment, a fish processing system includes: a first conveyor device configured to convey a fish along a transport path; a measurement sensor coupled to the conveyor device configured to measure a distance across the fish; a blade movable across the transport path; and a drive mechanism mechanically coupled to the blade and in communication with the measurement sensor, the drive mechanism configured to move the blade across the transport path in irregular intervals in accordance with the measured distance across the fish.

[0073] In an embodiment, the first processing subsystem further including a detection sensor coupled to the first conveyor device configured to detect whether a portion of the fish was successfully severed by the blade.

[0074] In an embodiment, the fish processing system further includes a second conveyor device in communication with the first processing subsystem, the second conveyor device including a trough with a sidewall movable between an open position and a closed position to selectively provide access to the trough.

[0075] In an embodiment, the second conveyor device further includes an actuator coupled to the sidewall of the trough and in communication with the movement sensor, the actuator configured to move the sidewall from the open position to the closed position in response to the detection sensor contacting the portion of the fish.

[0076] In an embodiment, the second conveyor device further includes an adjustment cylinder, the fish processing system further including a second processing subsystem in communication with the second conveyor device, the adjustment cylinder configured to change a position of the fish relative to the second processing subsystem.

[0077] In an embodiment, the fish processing system further includes: a second conveyor device in communication with the first processing subsystem, the second conveyor device including an adjustment cylinder; and a second processing subsystem in communication with the second conveyor device, and wherein the adjustment cylinder is configured to change a position of the fish relative to the second processing subsystem.

[0078] In an embodiment, a method of processing fish includes: transporting fish through a measurement location and a cutting location with a first conveyor device; measuring a distance across the fish with a measurement sensor at the measurement location; and severing a portion of the fish at the cutting location with a blade driven by a drive mechanism in communication with the measurement sensor, including moving the blade in irregular intervals in accordance with the measured distance with the drive mechanism.

[0079] In an embodiment, the method further includes: transporting fish through a detection location with the first conveyor device; and determining with a detection sensor at the detection location whether the portion of the fish was successfully severed at the cutting location.
[0080] In an embodiment, the method further includes manipulating a movable sidewall of a trough of a second conveyor device in communication with the first conveyor device to a closed position in response to the detection sensor determining the portion of the fish was not severed from the fish at the cutting location.
[0081] In an embodiment, the method further includes manipulating a movable sidewall of a trough of a second conveyor device in communication with the first conveyor device to an open position to receive the fish in the trough in response to the detection sensor determining the portion of the fish was successfully severed from the fish at the cutting location.
[0082] In an embodiment, the method further includes: transporting the fish along the second conveyor device; and aligning the fish with a processing subsystem in communication with the second conveyor device, including adjusting a position of the fish relative to the processing system with an adjustment cylinder of the second conveyor device.
[0083] In an embodiment, the method further includes: transporting the fish along a second conveyor device in communication with the first conveyor device; and aligning the fish with a processing subsystem in communication with the second conveyor device, including adjusting a position of the fish relative to the processing system with an adjustment cylinder of the second conveyor device.
[0084] In an embodiment, a fish processing system includes: a structural frame; a conveyor device coupled to the structural frame configured to convey a fish received on the conveyor device along a transport path including a cutting location and a detection location; a blade movably coupled to the structural frame configured to move across the transport path of the fish conveyed by the conveyor device at the cutting location; a drive mechanism coupled to the structural frame and mechanically coupled to the blade, the drive mechanism configured to move the blade between a standby position and a cutting position to sever a portion from the fish conveyed across the cutting location; and a detection sensor coupled to the structural frame configured to detect at the detection location whether the portion from the fish was successfully severed at the cutting location.
[0085] In an embodiment, a fish processing system includes: a first processing subsystem configured to sever a first portion of a fish; a second processing subsystem configured to remove a second portion of the fish; and a conveyor device in communication with the first processing subsystem and the second processing subsystem, including a trough proximate an outlet of the first processing subsystem having a sidewall movable between an open position and a closed position to selectively provide access to the trough, and an actuator coupled to the sidewall of the trough configured to move the sidewall from the open position to the closed position.
[0086] In an embodiment, the conveyor device further includes an adjustment cylinder proximate an inlet of the second processing subsystem, the adjustment cylinder configured to change a position of the fish relative to the second processing subsystem.
[0087] In the foregoing description, certain specific details are set forth in order to provide a thorough understanding of various disclosed embodiments. However, one skilled in the relevant art will recognize that embodiments may be practiced without one or more of these specific details. In other instances, well-known structures and techniques associated with the technology may not be shown or described in detail to avoid unnecessarily obscuring descriptions of the embodiments. For instance, well known power transmission components may be provided, but are not shown and described in detail herein, to transmit power to and drive elements of the various fish processing systems described herein. Drive and control systems may also be provided to selectively control a speed with which components move and thus a rate at which fish are processed.
[0088] Unless the context requires otherwise, throughout the specification and claims which follow, the word “comprise” and variations thereof, such as, “comprises” and “comprising” are to be

construed in an open, inclusive sense, that is as "including, but not limited to."
[0089] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.
[0090] As used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the content clearly dictates otherwise. It should also be noted that the term "or" is generally employed in its sense including "and/or" unless the content clearly dictates otherwise.
[0091] Moreover, aspects and features of the various embodiments described above may be combined to provide further embodiments, and may be combined with other features of known fish processing machines and methods, such as, for example, those shown and described in U.S. Pat. Nos. 3,309,730; 5,520,576; 6,994,617, 8,512,106; 8,834,238; 8,986,077; 9,635,867 and 9,839,223. All of the above US patents are incorporated herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary, to employ systems, concepts and features of the various patents to provide yet further embodiments.
[0092] Furthermore, the various embodiments described above can be combined to provide further embodiments. These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled.

Claims

1-22. (canceled)
23. A method of processing fish, comprising: measuring a distance across the fish with a measurement sensor; and severing a portion of the fish with a blade, including moving the blade in irregular intervals in accordance with the measured distance.
24. The method of claim 23, further comprising: transporting the fish with a first conveyor device through a measurement location corresponding to the measurement sensor and a cutting location corresponding to the blade.
25. The method of claim 23, wherein the severing the portion of the fish includes moving the blade with a drive mechanism in communication with the measurement sensor.
26. The method of claim 25, wherein the moving the blade includes moving the blade in accordance with the measured distance.
27. The method of claim 23, further comprising: determining with a detection sensor whether the portion of the fish was successfully severed by the blade.
28. The method of claim 27, further comprising: manipulating a movable sidewall of a trough to a closed position in response to the detection sensor determining the portion of the fish was not severed from the fish by the blade.
29. The method of claim 27, further comprising: manipulating a movable sidewall of a trough to an open position to receive the fish in the trough in response to the detection sensor determining the portion of the fish was successfully severed from the fish by the blade.
30. The method of claim 29, further comprising: aligning the fish with a processing subsystem, including adjusting a position of the fish relative to the processing subsystem with an adjustment cylinder.
31. A method of processing fish, comprising: transporting the fish along a path; measuring a

dimension of the fish with a measurement sensor; and severing a portion of the fish with a blade, including moving the blade at irregular intervals in accordance with the measured dimension.
32. The method of claim 31, wherein the dimension is a distance across the fish.
33. The method of claim 31, further comprising: determining with a detection sensor whether the portion of the fish was successfully severed by the blade.
34. The method of claim 33, further comprising: manipulating a movable sidewall of a trough along the path to a closed position in response to the detection sensor determining the portion of the fish was not severed from the fish; or manipulating the movable sidewall of the trough to an open position to receive the fish in the trough in response to the detection sensor determining the portion of the fish was successfully severed from the fish.
35. The method of claim 31, wherein the moving the blade includes moving the blade toward a location on the fish that corresponds to approximately 30% of the measured dimension.
36. The method of claim 31, further comprising, after the severing the portion of the fish: aligning the severed fish with a fish processing subsystem, including adjusting a position of the severed fish with respect to the fish processing subsystem.
37. A method of processing fish, comprising: measuring a dimension of the fish with a measurement sensor; and moving a blade at different intervals in accordance with the measured dimension, including severing a portion of the fish with the blade.
38. The method of claim 37, wherein the dimension is a distance across the fish.
39. The method of claim 37, further comprising: determining with a detection sensor whether the portion of the fish was successfully severed by the blade.
40. The method of claim 39, further comprising, after the determining: advancing the fish further along a transport path in response to a determination that the portion of the fish was successfully severed; or preventing the fish from advancing further along the transport path in response to a determination that the portion of the fish was not severed.
41. The method of claim 37, further comprising, after the moving the blade: adjusting a position of the fish with respect to a fish processing subsystem by selectively actuating an adjustment cylinder.
42. The method of claim 37, wherein the moving the blade includes moving the blade toward a location on the fish that is less than half of the measured dimension of the fish.