United States Patent Application Publication	20250255272
Kind Code	A1
Publication Date	August 14, 2025
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AUTOMATIC PET FOOD DISPENSER

Abstract

Systems and methods for automated pet food dispensing are described. One apparatus includes a receptacle configured to hold a sealed container containing wet pet food. The apparatus may include an electrically-operated plunger configured to interface with the receptacle. A processing system may be connected to the electrically-operated plunger. In one aspect, the processing system is configured to initiate a pet feeding event by actuating the plunger to interface with the receptacle, puncture the sealed container, and dispense the wet pet food into the food bowl. The processing system may maintain a time history to determine one or more future pet feeding events.

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Appl. No.: **19/169764**

Filed: **April 03, 2025**

Related U.S. Application Data

parent US continuation 17841425 20220615 parent-grant-document US 12290053 child US 19169764
us-provisional-application US 63210835 20210615

Publication Classification

Int. Cl.: **A01K5/02** (20060101); **B65G1/02** (20060101)

U.S. Cl.:

CPC **A01K5/0291** (20130101); **A01K5/0216** (20130101); **A01K5/0283** (20130101); **B65G1/026** (20130101);

Background/Summary

RELATED APPLICATIONS [0001] This application is a continuation of U.S. patent application Ser. No. 17/841,425, filed Jun. 15, 2022, which claims the benefit under 35 U.S.C. § 119 (c) of U.S. Provisional Patent Application No. 63/210,835, filed Jun. 15, 2021, the disclosures of which are incorporated, in their entirety, by this reference.

BACKGROUND

[0002] The present disclosure relates to systems and methods for implementing an automatic pet food dispenser that dispenses wet pet food from cartridges or containers.

[0003] Wet pet food is objectively better for pet (e.g., dog or cat) health, but feeding a pet wet pet food can be labor-intensive. Most contemporary automatic feeders require at least some (oftentimes, a high) degree of manual involvement. Some contemporary systems require either feeding dry pet food or manually scooping wet pet food into a timed chamber with a small carry capacity. As soon as wet pet food is removed from its sealed aluminum can or container, the shelf life of the wet pet food is reduced, and bacterial growth increases at a rapid rate. This means there are only a limited number of meals these machines can carry. Dry pet food solutions are typically not suited to a pet's digestive nature. Long-term problems associated with dry pet food can include poor pet health and disease (e.g., diabetes, kidney failure, etc.).

SUMMARY

[0004] Aspects of the invention are directed to systems and methods for implementing an automated pet food dispenser that dispenses wet pet food substance (e.g., wet cat or dog food) from individual pouches, or containers. In one aspect, the automated pet food dispenser holds up to a week of pet food with substantially no reduction in the shelf life of the food. A load cell or other weighing mechanism may be used to measure a weight of a dispensed quantity of wet pet food, and a processing system may be used to regulate a quantity of food dispensed based on the weight measurement. One aspect includes a refrigeration unit that maintains the wet pet food at a temperature that is lower than an ambient temperature.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] Non-limiting and non-exhaustive embodiments of the present disclosure are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various figures unless otherwise specified.

[0006] FIGS. **1**A and **1**B are block diagrams depicting an operation of an embodiment of an automated pet food dispenser.

[0007] FIG. **2** is a schematic diagram depicting an embodiment of an automated pet food dispenser.

[0008] FIG. **3** is a schematic diagram depicting a view of an embodiment of an automated pet food dispenser.

[0009] FIG. **4** is a schematic diagram depicting an interface between a plunger and a receptacle.

[0010] FIG. **5** is a schematic diagram depicting a view of a food receptacle and a weighing apparatus.

[0011] FIG. **6** is a schematic diagram depicting an embodiment of an automated pet food dispenser.

[0012] FIG. **7** is a schematic diagram depicting an embodiment of an automated pet food dispenser.

[0013] FIG. **8** is a schematic diagram depicting an embodiment of an automated pet food dispenser.
[0014] FIG. **9** is a block diagram depicting an embodiment of a processing system used for implementing certain processing functions of an automated pet food dispenser.
[0015] FIG. **10** is a flow diagram depicting a method to automatically dispense a given quantity of pet food.
[0016] FIG. **11** is a schematic diagram depicting an embodiment of an automated pet food dispenser.
[0017] FIGS. **12**A and **12**B are schematic diagrams depicting an internal structure of an embodiment of an automated pet food dispenser.
[0018] FIG. **13** is a schematic diagram depicting an internal structure of an embodiment of an automated pet food dispenser.
[0019] FIG. **14** is a schematic diagram depicting a cross-sectional view of a portion of an automated pet food dispenser.
[0020] FIG. **15** is a schematic diagram depicting a cross-sectional view of a bowl tray assembly.
[0021] FIG. **16** is a schematic diagram depicting a view of an embodiment of an automated pet food dispenser.
[0022] FIG. **17** is a schematic diagram depicting a portion of an embodiment of an automated pet food dispenser.
[0023] FIG. **18** is a schematic diagram depicting an internal structure of an embodiment of an automated pet food dispenser.

DETAILED DESCRIPTION

[0024] In the following description, reference is made to the accompanying drawings that form a part thereof, and in which is shown by way of illustration specific exemplary embodiments in which the disclosure may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the concepts disclosed herein, and it is to be understood that modifications to the various disclosed embodiments may be made, and other embodiments may be utilized, without departing from the scope of the present disclosure. The following detailed description is, therefore, not to be taken in a limiting sense.
[0025] Reference throughout this specification to “one embodiment,” an embodiment,” “one example,” or “an example” means that a particular feature, structure, or characteristic described in connection with the embodiment or example is included in at least one embodiment of the present disclosure. Thus, appearances of the phrases “in one embodiment,” “an embodiment,” “one example,” or “an example” in various places throughout this specification are not necessarily all referring to the same embodiment or example. Furthermore, the particular features, structures, databases, or characteristics may be combined in any suitable combinations and/or sub-combinations in one or more embodiments or examples. In addition, it should be appreciated that the figures provided herewith are for explanation purposes to persons ordinarily skilled in the art and that the drawings are not necessarily drawn to scale.
[0026] Embodiments in accordance with the present disclosure may be embodied as an apparatus, method, or computer program product. Accordingly, the present disclosure may take the form of an entirely hardware-comprised embodiment, an entirely software-comprised embodiment (including firmware, resident software, micro-code, etc.), or an embodiment combining software and hardware aspects that may all generally be referred to herein as a “circuit,” “module,” or “system.” Furthermore, embodiments of the present disclosure may take the form of a computer program product embodied in any tangible medium of expression having computer-usable program code embodied in the medium.
[0027] Any combination of one or more computer-usable or computer-readable media may be utilized. For example, a computer-readable medium may include one or more of a portable computer diskette, a hard disk, a random-access memory (RAM) device, a read-only memory (ROM) device, an erasable programmable read-only memory (EPROM or Flash memory) device, a

portable compact disc read-only memory (CDROM), an optical storage device, a magnetic storage device, and any other storage medium now known or hereafter discovered. Computer program code for carrying out operations of the present disclosure may be written in any combination of one or more programming languages. Such code may be compiled from source code to computer-readable assembly language or machine code suitable for the device or computer on which the code can be executed.

[0028] Embodiments may also be implemented in cloud computing environments. In this description and the following claims, "cloud computing" may be defined as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned via virtualization and released with minimal management effort or service provider interaction and then scaled accordingly. A cloud model can be composed of various characteristics (e.g., on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service), service models (e.g., Software as a Service ("SaaS"), Platform as a Service ("PaaS"), and Infrastructure as a Service ("IaaS")), and deployment models (e.g., private cloud, community cloud, public cloud, and hybrid cloud).

[0029] The flow diagrams and block diagrams in the attached figures illustrate the architecture, functionality, and operation of possible implementations of systems, methods, and computer program products according to various embodiments of the present disclosure. In this regard, each block in the flow diagrams or block diagrams may represent a module, segment, or portion of code, which includes one or more executable instructions for implementing the specified logical function(s). It is also noted that each block of the block diagrams and/or flow diagrams, and combinations of blocks in the block diagrams and/or flow diagrams, may be implemented by special purpose hardware-based systems that perform the specified functions or acts, or combinations of special purpose hardware and computer instructions. These computer program instructions may also be stored in a computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instruction means which implement the function/act specified in the flow diagram and/or block diagram block or blocks.

[0030] Aspects of the invention described herein address challenges associated with manual feeding of wet pet food. One aspect includes placing one or more cartridges of wet pet food into an automatic pet food dispenser that is controlled by a processing system. The processing system may control the automatic pet food dispenser to automatically dispense wet pet food at a specific time or time intervals via a timer, or upon user command. User commands may be received via a built-in user interface, or via a connected device (e.g., a mobile phone or a tablet). An advantage of such an automatic pet food dispenser that dispenses wet pet food via one or more wet pet food storage cartridges includes increased shelf life of the wet pet food, reduced bacterial growth, and increased meal capacity for the pet (e.g., a cat or a dog).

[0031] FIG. **1**A is a block diagram depicting an operation of an embodiment of an automated pet food dispenser **100**. As depicted, automated pet food dispenser **100** includes processing system **102**, actuator **104**, plunger **106**, support **108**, receptacle **110**, pet food container **112**, food bowl **114**, computing system **116**, and load cell **118**.

[0032] In one aspect, support **108** is substantially rigidly mechanically connected to actuator **104** and receptacle **110**. Receptacle **110** may be configured to receive and store pet food container **112**. Pet food container **112** may be filled with wet pet food. In an aspect, a pet food container such as pet food container **112** may also be referred to as a "cartridge." Pet food container **112** may also be substantially sealed to appropriately preserve the contained wet pet food for a specified amount of time. In one aspect, the wet pet food can be preserved for a period of 4 months to 3 years, depending on factors such as sealing of pet food container **112**, and environmental factors such as

ambient temperature and humidity.
[0033] In one aspect, processing system **102** is configured to control actuator **104** and extend or retract plunger **106**. Plunger **106** may be extended by actuator **104** to apply a pressure or force on pet food container **112**. As a result of this force, the sealed pet food container **112** (or cartridge) may rupture or puncture and dispense a part of or the entire contents of pet food container **112** into food bowl **114**. A pet may be able to consume the dispensed wet pet food from food bowl **114**. Food bowl **114** may be a pet food bowl. As depicted in FIG. **1**A, plunger **106** is in a fully-retracted position.
[0034] In one aspect, actuator **104** is a linear actuator (e.g., a lead screw linear actuator) In other aspects, actuator **104** may be a pneumatic actuator, a hydraulic actuator, or a rigid chain-based actuator.
[0035] In one aspect, load cell **118** measures an amount of dispensed wet pet food in food bowl **114**. Processing system **102** may be configured to receive a measurement of the amount of dispensed wet pet food from load cell **118**. If the measured dispensed amount of wet pet food is greater than or equal to a predetermined amount, then processing system **102** may command actuator **104** to retract plunger **106**. In this way, a known quantity of wet pet food is dispensed from pet food container **112**. This enables a user to control an amount of wet pet food dispensed for a particular meal. In one aspect, meals are customizable and can be configured by a pet owner (i.e., a user). A typical meal might weigh 2-3 oz of wet pet food for an average cat. A feeding frequency of 2-4 meals per day may be programmed into processing system **102**, depending on a size or weight of the pet. For dogs, a daily amount of 3 oz of wet pet food may be dispensed by automated pet food dispenser **100** for each 3-3.5 pounds of body weight of a dog.
[0036] Processing system **102** may be configured to determine how much food remains in pet food container **112** based on how much plunger **106** is extended. When plunger **106** is extended to a certain length (e.g., 6 inches), processing system **102** may determine that a bottom of plunger **106** may be close to a bottom end of receptacle **110**. This, in turn, indicates that pet food container **112** is substantially empty. Processing system **102** may then completely command actuator **104** to completely withdraw plunger **106** from receptacle **110**. Processing system **102** may also issue one or more user alerts for a user via a user interface, informing the user that pet food container **112** is substantially empty.
[0037] In one aspect, processing system **102** is configured to dispense a predetermined quantity of wet pet food at a given time of day, or dispense predetermined quantities of wet pet food at regular time intervals or at different preset times of day (e.g., 100 grams of wet pet food every eight hours). To achieve these functional aspects, processing system **102** may be appropriately programmed by a user via a user interface. User-programmable functions associated with processing system **102** may include a quantity of wet pet food to be dispensed at a particular meal, one or more feeding times, a feeding time interval, and so on. To implement these functions, processing system **102** may be a microcontroller, a digital signal processor (DSP), a field-programmable gate array (FPGA), a general processing system, a personal computing system, a mobile phone, a tablet, a laptop computer, a desktop computer, or any other similar processing system. As presented herein, processing system **102** generally includes a processor, a memory, and one or more communication interfaces.
[0038] In one aspect, one or more user-programmable functions may be input by a user on computing system **116**, and then transmitted to processing system **102** via wireless communication link **120**. Computing system may be any computing device such as a desktop computer, a laptop computer, a mobile phone, a tablet, or any other computing device. Wireless communication link **120** may be implemented as a communication link compliant with a Bluetooth® standard protocol, a communication link compliant with a Wi-Fi™ standard protocol, a communication link compliant with a Zigbee standard protocol, an ultrasonic communication link, or as a communication link compliant with any other wireless communication protocol. In one aspect,

computing system **116** may run an application software that allows a user to configure, control, and monitor aspects of automated pet food dispenser **100**.

[0039] FIG. **1**B is a block diagram depicting an operation of automated pet food dispenser **100**. FIG. **1**B depicts automated food dispenser as including processing system **102**, actuator **104**, plunger **106**, support **108**, receptacle **110**, pet food container **112**, food bowl **114**, computing system **116**, and load cell **118**.

[0040] As depicted in FIG. **1**B, plunger **106** is shown to be extended by actuator **104**, to be in an extended position. As plunger **106** is extended by actuator **104** upon command from processing system **102**, plunger **106** exerts a force on pet food container **112**. Pet food container **112** is also physically constrained at a bottom end by receptacle **110**. This constraint may be due to a design of receptacle **110**, or due to an insert placed into receptacle **110**. Due to the forces exerted by plunger **106** and receptacle **110**, pet food container **112** may rupture. In one aspect, pet food container **112** may be designed to rupture at a bottom end so that the wet pet food contained within pet food container **112** is dispensed (or extruded) out into food bowl **114** as dispensed pet food **122**. In one aspect, load cell **118** measures a quantity (e.g., a weight) of dispensed pet food **122**. If the weight of dispensed pet food **122** is greater than or equal to a predetermined quantity as programmed into processing system **102**, processing system **102** may command actuator **104** to stop extending plunger **106** further, and possibly retract plunger **106** back to a fully-retracted state as shown in FIG. **1**A. A pet may now feed from food bowl **114**. Since a predetermined quantity of food has been dispensed, underfeeding or overfeeding of the pet may be avoided.

[0041] Automated pet feeder **100** may be used on a daily basis for automatically dispensing a known quantity of wet pet food to a pet. For example, when a pet owner goes to work, the pet owner (user) may program processing system to dispense predetermined amounts of pet food at predetermined times while the pet owner is away. In one aspect, food bowl **114** is removable for cleaning and sanitizing, and may be replaced with a similar food bowl. In one aspect, food bowl **114** is attached to load cell **118** via a magnetic coupling. In one aspect, load cell **118** may be replaced by a similar weight-measuring device.

[0042] FIG. **2** is a schematic diagram depicting an embodiment of an automated pet food dispenser **200**. As depicted, automated pet food dispenser **200** includes user interface **202**, processing system **204**, linear actuator **206**, supporting structure **208**, plunger **210**, receptacle **212**, receptacle support **214**, support **216**, food bowl **218**, and load cell **220**.

[0043] In one aspect, user interface **202** allows a user (e.g., a pet owner) to interact with automated food dispenser **200**. User interface **202** may include any combination of input/output devices such as push buttons, video display screens, LCD screens, touch screens, switches, incandescent bulbs, LED bulbs, haptic feedback devices, and so on. In one aspect, a user programs data such as a feeding schedule (e.g., a feeding time or a feeding time interval), and a quantity of wet pet food to be dispensed, via user interface **202**. In one aspect, user input/output components associated with user interface **202** may be integrated onto a printed circuit board (PCB).

[0044] In one aspect, processing system **204** is similar to processing system **102**, and may perform functions similar to processing system **102**. Processing system **204** may receive one or more user commands and data entered via user interface **202** or via a computing system such as computing system **116**, and may use these commands and data to appropriately schedule a pet feeding routine, while dispensing a predetermined amount of pet food.

[0045] Supporting structure **208** may provide a substantially rigid support structure for automated pet food dispenser **200**. Specifically, supporting structure **208** may provide a substantially rigid support for linear actuator **206**, receptacle **212**, processing system **204**, user interface **202**, and other components of automated pet food dispenser **200**. Supporting structure **208** may be similar to support **108**.

[0046] Linear actuator **206** may be similar to actuator **104**, and may receive one or more instructions or commands from processing system **204** to extend or retract plunger **210**. Linear

actuator **206** may be any of a lead screw linear actuator, a pneumatic actuator, a hydraulic actuator, or a rigid chain-based actuator. Receptacle support **214** may provide a substantially rigid support to a lower end of receptacle **212**.

[0047] In one aspect, support **216** supports user interface **202**, processing system **204**, linear actuator **206**, supporting structure **208**, plunger **210**, and receptacle **212**. Food bowl **218** may be similar to food bowl **114**. Food bowl **218** may rest on load cell **220** that may be similar to load cell **118**.

[0048] In one aspect, a pet food container similar to pet food container **112** may be inserted or placed into receptacle **212**. At a designated pet feeding time, processing system **204** may command linear actuator **208** to extend plunger **210** into receptacle **212**. Plunger **210** may exert a force on the pet food container within receptacle **212**. In one aspect, motion of the pet food container within receptacle **212** is constrained by an insert. The insert may prevent motion of the pet food container while linear actuator **206** applies a force to the pet food container via plunger **210**. The force exerted by plunger **210** may cause the pet food container to rupture, and the contents of the pet food container may be dispensed into food bowl **218** through an opening at the bottom of receptacle **212**.

[0049] In one aspect, a quantity of pet food dispensed may be measured by load cell **220**. Measurements from load cell **220** may be received by processing system **204**. Processing system **204** may command linear actuator **206** to stop extending plunger **210** when a quantity of food in food bowl **218** as measured by load cell **220** is greater than or equal to a predetermined amount. Processing system **204** retract plunger **210** so that plunger **210** is completely outside of receptacle **212**.

[0050] In one aspect, electrical portions of automated pet food dispenser **200** (e.g., processing system **204** and user interface **202**) may be collectively referred to as “electronics.” The electronics serve several roles in automated pet food dispenser **200**. The electronics may provide connectivity, either to a local device (e.g., computing device **116** that may be a smartphone), or to the cloud. This connectivity may be accomplished via wireless communication link **120** (e.g., a communication link compliant with Wi-Fi™ or Bluetooth® standard protocol). In one aspect, wireless communication link **120** allows a user to remotely set feed times, check feed status, view how much food has been consumed, or other perform useful functions associated with automated pet food dispenser **200**. The electronics also monitor the scale (e.g., load cell **118** or **220**) under the food bowl (e.g., food bowl **114** or **218**), provide power and control to the actuator (e.g., actuator **104** or linear actuator **206**), check for user inputs, and other routine functions. The electronics tell the actuator (e.g., actuator **104** or linear actuator **206**) to dispense food at the set times or when otherwise commanded to by the user, and monitor how much food is dispensed.

[0051] FIG. **3** is a schematic diagram depicting a view **300** of an embodiment of an automated pet food dispenser. As depicted, view **300** includes cover **302**, cover door **304**, receptacle **306**, and food bowl **308**. In one aspect, an automated pet food dispenser (e.g., automated pet food dispenser **200**) may be housed in cover **302**. Cover door **304** may be opened to gain access to receptacle **306**. Via cover door **304**, a user may be able to refill receptacle **306** with a new pet food container, or remove an empty pet food container from a previous feeding. Cover **302** may include an opening or orifice at a bottom end (not shown), through which wet pet food may be dispensed from receptacle **306** into food bowl **308**. Cover **302** may also include one or more inserts to provide a substantially rigid support for receptacle **306**. Cover **302** may also house other components of an automated pet food dispenser such as actuator **104**, plunger **106**, and processing system **102**.

[0052] FIG. **4** is a schematic diagram depicting an interface **400** between a plunger **406** and a receptacle **408**. As depicted, actuator **402** (similar to actuator **104**) may be substantially rigidly supported by support **404**, that is substantially rigidly connected to supporting structure **412**. Receptacle **408** (similar to receptacle **110**) may be substantially rigidly supported by support **410**, that is substantially rigidly connected to supporting structure **412**. Supporting structure **402** may be

similar to support **108** or supporting structure **208**.
[0053] In one aspect, piston **406** is similar to plunger **106**. Piston **406** may be configured to be substantially coaxial with receptacle **408**, so that piston **406** is contained within receptacle **408** when piston **406** is extended by actuator **402**.
[0054] FIG. **5** is a schematic diagram depicting a view **500** of a food receptacle and a weighing apparatus. As depicted, view **500** includes food bowl **504** (also referred to as a "food receptacle"), connecting wire(s) **502**, top shell **506**, load cell **508**, and base piece **510**. In one aspect, food bowl **504** may be similar to food bowl **114**. Top shell **506** may enclose load cell **508** and provide a support base for food bowl **504**. Load cell **508** may rest on base piece **510**. In one aspect, connecting wire(s) **502** communicate one or more electrical signals between processing system **102** and load cell **508**. These electrical signals may include initialization and calibration signals from processing system **102** to load cell **508**, and weight measurement signals from load cell **508** to processing system **102**.
[0055] FIG. **6** is a schematic diagram depicting an embodiment of an automated pet food dispenser **600**. As depicted, automated pet food dispenser **600** includes outer cover **602**, actuator **604**, insulation **606**, cooling unit **608**, support **610**, and food bowl **612**. Automated food dispenser **600** may be a modified version of automated food dispenser, to include refrigeration and insulation components (e.g., insulation **606** and cooling unit **608**). Actuator **604** may be similar to actuator **104** or to linear actuator **206**. Food bowl **612** may be similar to food bowl **114** or food bowl **218**. Support **610** may be similar to support **216**.
[0056] In one aspect, cooling unit **608** provides cooling or refrigeration functions to keep wet pet food in a pet food container (e.g., pet food container **112**) within a receptacle (e.g., receptacle **110**) at a lower temperature than an ambient temperature. Cooling unit **608** may also be referred to as a "refrigeration unit." To further help maintain the lower temperature, the receptacle may be surrounded or covered by insulation **606**. Maintaining the wet pet food at a lower temperature than the ambient temperature helps increase food shelf life, reduce bacterial growth rates, and keep the wet pet food fresh for a longer period of time.
[0057] In one aspect, cooling unit **608** may be any combination of a thermoelectric cooler, a heatsink, and a fan. The thermoelectric cooler may help reduce a temperature of the wet pet food to a temperature below the ambient temperature. The heatsink may be used to dissipate any heat generated by components such as cooling unit **608**, or processing system **102**. The fan may be used to circulate air within automated pet food dispenser **600** to maintain a substantially constant temperature within automated pet food dispenser **600**.
[0058] In one aspect, processing system **102** monitors a temperature of the wet pet food in pet food container **112**, and controls cooling unit **608** via a feedback control loop to maintain the wet pet food at a substantially constant temperature. Such a feedback control loop may be configured such that cooling unit **608** is switched on or off based on commands from processing system **102**. This, in turn, can allow automated pet food dispenser **600** to account for daily and seasonal temperature fluctuations in the ambient temperature while maintaining the temperature of the wet pet food in pet food container **112** at a substantially constant value.
[0059] FIG. **7** is a schematic diagram depicting an embodiment of an automated pet food dispenser **700**. Some aspects of automated pet food dispenser **700** include enclosing components such as processing system **102**, actuator **104**, plunger **106**, and receptacle **110** in cover **702**. A bottom end of cover **702** may be open to allow dispensing of wet pet food from automated pet food dispenser into bowl **704**.
[0060] FIG. **8** is a schematic diagram depicting an embodiment of an automated pet food dispenser **800**. Some aspects of automated pet food dispenser **800** include enclosing components such as processing system **102**, actuator **104**, plunger **106**, and receptacle **110** in cover **802**. A bottom end of cover **802** may be open to allow dispensing of wet pet food from automated pet food dispenser into bowl **806**. Support **804** may provide support for automated pet food dispenser **800** in a manner

similar to support **216**.
[0061] As depicted, each of cover **702** and **802** (also known as an “outer shell”) is a casing that is intended to provide environmental protection to the corresponding automated pet food dispenser. Each of cover **702** and **802** may also be designed to be cosmetically pleasing, and enhance a user experience. In one aspect, each of cover **702** and **802** provides structure and support for the internals (e.g., processing system **102**, actuator **104**, plunger **106**, and receptacle **110**), and have mounting features for securing the device to a stand or surface (e.g., support **216**). Each of cover **702** or **802** may also have cutouts to allow LEDs or other status indicating elements to show system status and alerts, button(s) to control the associated functions, and possibly a screen to show device status.
[0062] In one aspect, each of cover **702** and **802** includes a door (e.g., door **304**) which opens and allows the user to insert a food container into the device (e.g., a receptacle such as receptacle **110**). In one aspect, cover **802** also includes a stand (e.g., support **804**) that has a space for a food bowl (e.g., food bowl **806**), under which there are weight sensors (e.g., load cell **118** or **508**) to measure an amount of food currently in the bowl. In another aspect, a load cell may be integrated into a bottom of a food bowl, or bowl platform with integrated weight sensors may be used. In general, automated pet food dispenser **100** may include a shell (e.g., cover **302**, outer cover **602**, cover **702**, or cover **802**), electronics (e.g., processing system **204** and user interface **202**), structure (e.g., supporting structure **208**), actuator (e.g., actuator **104** or linear actuator **206**), food storage (e.g., pet food container **1 12** and receptacle **1 10**), and refrigeration (e.g., cooling unit **608**).
[0063] As depicted, automated pet food dispenser **100** includes a single pet food container **112** in a single receptacle **110**; however, multi-container automated pet food dispensers may also be implemented. In one design, this aspect takes the form of a carousel holding multiple pet food containers. This carousel can be rotated either manually or via an electrical motor to present different containers for dispensing. Food cartridges (e.g., pet food container **112**) may be inserted into the device and placed into a chamber where there are mechanical restraints to hold them in place during storage and dispensing.
[0064] In one aspect, a pet food container **112** may be implemented as a pouch containing wet pet food. The pouch may be constructed of a material such as plastic, which is designed to rupture when plunger **106** exerts a force on it. Pet food container **112** may also be constructed of a malleable metal such as aluminum. Such a container may be designed with one or more seams that rupture upon application of an external force by plunger **106**.
[0065] Advantages of automated pet food dispenser **100** include an ability to automatically dispense wet pet food via unique cartridges, increase shelf life of the wet pet food, reduce bacteria, and increase meal capacity. As presented, automated pet food dispenser **100** dispenses wet pet food substance from one or more custom-designed pouches. Automated pet food dispenser **100** can hold a week to a month's worth of wet cat or dog food, with years of shelf life. No manual handling or transfer of wet pet food substance is required by the owner or user.
[0066] One aspect of an automated pet food dispensing system may include: [0067] 1. Case (e.g., cover **302**, **602**, **702**, or **802**) [0068] 2. Base (e.g., support **610**) [0069] 3. Stem (e.g., supporting structure **208**) [0070] 4. Removable Carousel [0071] 5. Hinge (e.g., a hinged cover at a top end) [0072] 6. Plunger (e.g., plunger **106**) [0073] 7. Electrical Motor (e.g., an electrical motor to actuate/rotate the removable carousel) [0074] 8. Electrical motor (e.g., actuator **104**) [0075] 9. Power Supply (to power electronic components of the automated pet food dispenser) [0076] 10. Computer (e.g., processing system **102**) [0077] 11. Digital interface (e.g., user interface **202**) [0078] 12. Food cartridge (e.g., pet food container **112**) [0079] 13. Food bowl (e.g., food bowl **114**) [0080] Item 1 Case encapsulates and houses all mechanical and electrical components. Item 2 acts as the bottom weight to stabilize the machine. Item 3 stem connects to item 1 case at the top and item 2 base and the bottom to physically construct the automated pet food dispenser. Item 4 removable carousel is accessed by opening item 1 case via item 5 hinge vertically in a clam shell

type fashion, which can then be removed to reload food cartridges (item 12). Item 4 removable carousel also spins around as dictated by the computer (item 10) on a time based or user prompted command. Item 7 motor actuates the carousel motion prompted by said command and item 8 motor will work in conjunction with item 6 plunger to extrude item 12's (food cartridge) contents into the end receptacle (item 13, food bowl). Item 10's (processing system) logic and device interconnectivity via both Bluetooth® and Wi-Fi™ standard protocols will command the actuation of any mechanical or motorized functions. The digital interface (item 11) will also be user-operated to offer inputs that can control when item 10 will dispense wet pet food. Item 13 (food bowl) sits on item 2 (base) as a removable vessel for wet pet food and can be reattached via a magnet.

[0081] The automated pet food dispenser may be opened from the top, pivoting on a hinge. The user can place a food cartridge into, for example, each of 14 empty chambers on the carousel. The user may close the top case, plug in the power supply and interact with the digital interface (e.g., user interface **202**). The user can connect the digital interface to a phone application (e.g., an application running on computing system **116**) and Wi-Fi™ standard protocol, and determine the frequency and volume of food that will be extracted. Once these configurations are set, automated pet food dispenser **100** may have the actuator motor actuate the plunger and extract the wet pet food through a nozzle into the bowl. The actuator motor will then raise the plunger into its original state, freeing the carousel to then rotate to the next cartridge position to repeat the process. This process can occur as many times as there are full cartridges in the machine. Once the food has been consumed, the user can remove the food bowl to clean and keep the food bowl sanitary.

[0082] An orientation of the automated pet food dispenser can be reconfigured in a number of different ways and angles. The carousel can rotate 360 degrees as with the other elements to perform the same action. Extrusion of wet pet food can occur a number of ways depending on the design of pet food container **112** (e.g., a pet food cartridge, or “cartridge”). The cartridge can be reformed into a different shape, the motors and actuators can be reshaped or respecified or substituted by other mechanisms or motors.

[0083] A user would use automated pet food dispenser **100** to replace the existing process of opening a can of wet pet food and feeding their pet (e.g., a cat or a dog). Instead of opening a can of wet pet food and putting it into a bowl or plate for the pet to eat, the user would simply plug in the device, fill it with one or more pet food cartridges and set a timing function to give time-based feedings to the animal. This method of feeding wet pet food can be used for any animal that consumes a wet solid substance. It could even be used to dispense wet or solid substances that are non-edible or edible for humans and insects.

[0084] FIG. **9** is a block diagram depicting an embodiment of a processing system **900** used for implementing certain processing functions of an automated pet food dispenser. As depicted, processing system **900** includes communication manager **902**, memory **904**, actuator interface **906**, wireless interface **908**, processor **910**, user interface **912**, sensor interface **914**, timing module **916**, and data bus **918**.

[0085] In one aspect, processing system **900** may be similar to processing system **102** or processing system **204**. Communication manager **902** may be configured to manage communication between different internal components of processing system **102**. For example, communication manager may include components such as one or more direct memory access (DMA) controllers, input-output arbitrators, and so on. Communication manager **902** may also manage communication between processing system **900** and different external peripheral devices such as load cell **118**, and actuator **104**.

[0086] Data associated with processing operations and general functionality of automated pet food dispenser **100** may be stored in memory **904**. Memory **904** may store one or more instructions or instruction sets associated with running one or more programs or applications related to functioning of automated pet food dispenser **100**. These instruction sets may be related to controlling actuator **104**, and feedback control loop strategies that enable processing system **900** to command actuator

104 to stop extending plunger **106** when a quantity of dispensed pet food in food bowl **114** is greater than or equal to a predetermined amount. Memory **904** may also store data associated with an operation of automated pet food dispenser **100**. For example, memory **904** may include a numerical value associated with the predetermined threshold. Memory **904** may also store data associated with feeding intervals and feeding times. Memory **904** may also store measurements of wet pet food dispensed, as measured by load cell **118**. In one aspect, memory **904** may be implemented using any combination of random-access memory (RAM), read-only memory (ROM), hard disk drives, flash memory, nonvolatile memory, or any other memory components.
[0087] In one aspect, actuator interface **906** is configured to interface processing system **900** with an actuator such as actuator **104**. Actuator interface **906** may implement actuator-specific communication protocols, such as pulse-width modulation (PWM) and other actuator and/or motor-related command protocols.
[0088] Wireless interface **908** may be configured to implement communication protocols associated with one or more wireless communication links such as wireless communication link **120**. Examples of wireless communication links include communication links compliant with a Wi-Fi™, Bluetooth® or Zigbee standard protocol.
[0089] In one aspect, processor **910** is configured to implement one or more processing functions associated with an operation of automated pet food dispenser **100**. These processing functions may include one or more mathematical or logical functions. Examples of processing functions implemented on processor **910** include comparing an amount of dispensed pet food with the predetermined threshold value. Processor **910** may be implemented as a single-core processor, or as a multi-core processor. Processor **910** may also include one or more graphics processing unit (GPU) arrays.
[0090] In one aspect, user interface **912** may interface processing system **900** with user interface **202**. User interface **912** may include any combination of LED drivers, switch readers, push button readers, switch debounce logic for push button inputs, LCD touchscreen interfaces, and other input/output interfaces. User interface **912** might also implement communication protocols such as serial peripheral interface (SPI) or inter-integrated circuit (I2C) communication protocols to communicate with one or more multiplexers and/or demultiplexers that implement an appropriate input/output mapping between processing system **900** and any input/output devices.
[0091] Sensor interface **914** may be configured to read data from one or more sensors such as load cell **118**. Sensor interface **914** may also be connected to sensors such as ambient light sensors, temperature sensors, and so on. Communication protocols such as serial peripheral interface (SPI) or inter-integrated circuit (I2C) communication may be used to interface sensor interface **914** with the one or more sensors. Sensor interface **914** may also include one or more analog-to-digital converters (ADCs) that convert any directly-input analog signals to digital signals.
[0092] In one aspect, timing module **916** may be configured to keep a track of time. This time data may be used to schedule one or more feedings via automated pet food dispenser **100**. Timing module **916** may include one or more phase-locked loops to maintain a synchronous clock signal. Timing module **916** may also include a GPS module that outputs GPS time. The GPS time may be used by timing module **916** to keep a track of time.
[0093] Data bus **918** may connect the different internal components of processing system, and route data and instructions as needed between processor **910** and the other components of processing system **900**.
[0094] FIG. **10** is a flow diagram depicting a method **1000** to automatically dispense a given quantity of pet food.
[0095] Method **1000** may include receiving an initialization command to dispense pet food (i.e., wet pet food) at a specific time (**1002**). For example, processing system **102** may receive an initialization command from computing system **116**, to dispense wet pet food at a specific time.
[0096] Method **1000** may include checking a current time (**1004**). For example, processing system

102 (or processing system **900**) may check a current time via timing module **916**.
[0097] Method **1000** may include determining whether the current time is approximately equal to a feeding time as received via the initialization command (**1006**). For example, processing system may compare the current time with the feeding time. If the current time is not approximately equal to the feeding time, method **1000** returns to **1004**.
[0098] If the current time is approximately equal to the feeding time, then method **1000** goes to **1008**, which may include enabling an actuator to move a plunger to dispense the wet pet food. For example, processing system **102** may command actuator **104** to move plunger **106** such that wet pet food contained in pet food container **112** is dispensed into food bowl **114**
[0099] Method **1000** may include measuring an amount of wet pet food dispensed (**1010**). For example, load cell **118** may measure a quantity (i.e., an amount, or a mass, or a weight) of wet pet food dispensed into food bowl **114**.
[0100] Method **1000** may include determining whether a required quantity of wet pet food has been dispensed (**1012**). For example, processing system **102** may receive a measurement of the amount of wet pet food dispensed in food bowl **114** from load cell **118**. Processing system **102** may compare this measurement with a predetermined value that may be received as a part of the initialization command received at **1002**.
[0101] If the quantity dispensed (i.e., the measurement) is less than the predetermined value, then method **1000** returns to **1008**. If the quantity dispensed is greater than or equal to the predetermined value, then method **1000** goes to **1014**, which may include disabling the actuator to stop dispensing food. For example, processing system **102** may command actuator **104** to stop extending plunger **106** so that no more wet pet food is dispensed from pet food container **112**. Processing system **102** may also command actuator **104** to retract plunger **106**.
[0102] FIG. **11** is a schematic diagram depicting an embodiment of an automated pet food dispenser **1100**. As depicted, automated pet food dispenser **1100** includes upper structure **1102**, outer housing **1104**, and drawer **1106**.
[0103] In one aspect, upper structure **1102** may be designed to function as a carrying handle. A user may transport automated pet food dispenser **1100** using upper structure **1102** as a carrying handle. Upper structure **1102** may also include one or more LED lamps that may function as status indicators for automated pet food dispenser **1100**. For example, the LED lamps may indicate if automated pet food dispenser **1100** has run out of food.
[0104] In one aspect, outer housing **1104** may serve as a protective covering for one or more internal elements of automated pet food dispenser **1100**. In one embodiment, outer housing **1104** is constructed of multiple connected pieces. In another embodiment, outer housing **1104** is constructed as a single, solid structure. Outer housing may also serve to provide cosmetic or aesthetic appeal to automated pet food dispenser **1100**.
[0105] Drawer **1106** may be configured to be a retractable drawer that can be used to support and store a food bowl such as food bowl **114** or **218**. Under normal storage, when no pet feeding is occurring, drawer **1106** may be retracted to be substantially flush with an outer surface of outer housing **1104**. In this position, the food bowl is concealed within automated pet food dispenser **1100**. During a feeding session, automated pet food dispenser may fill the food bowl with the requisite quantity of food. Drawer **1106** may then be extended outwards by a processing system (e.g., processing system **102**) to reveal the food bowl to the pet. After the pet consumes the food or after a specified amount of time, automated pet food dispenser **1100** (specifically, the processing system included in automated pet food dispenser **1100**) may retract drawer **1106**.
[0106] FIGS. **12**A and **12**B are schematic diagrams depicting an internal structure **1200** of an embodiment of an automated pet food dispenser. FIG. **12**A depicts an isometric view of internal structure **1200**, while FIG. **12**B depicts a side view of internal structure **1200**. Internal structure **1200** may be associated with an internal structure of automated pet food dispenser **1100** that may be revealed if outer housing **1104** is removed from automated pet food dispenser **1100**. As depicted,

internal structure **1200** includes user interface **1202**, linear actuator **1204**, support structure **1206**, cooling unit **1208**, plunger **1210**, receptacle **1212**, carousel **1214**, food bowl **1216**, base **1218**, and drawer **1220**. Internal structure **1200** may also include a processing system such as processing system **102** (not depicted in FIGS. **12**A and **12**B).

[0107] In one aspect, user interface **1202** is similar to user interface **202**. User interface **1202** may be configured to allow a user (e.g., a pet owner) to interact with automated food dispenser **1100**. User interface **1202** may include any combination of input/output devices such as push buttons, video display screens, LCD screens, touch screens, switches, incandescent bulbs, LED bulbs, haptic feedback devices, and so on. In one aspect, a user programs data such as a feeding schedule (e.g., a feeding time or a feeding time interval), and a quantity of wet pet food to be dispensed, via user interface **1202**. In one aspect, user input/output components associated with user interface **1202** may be integrated onto a printed circuit board (PCB). User interface **1202** may be configured to drive the one or more LEDs associated with upper structure **1102**.

[0108] Linear actuator **1204** may be similar to actuator **104** or linear actuator **206**. Linear actuator **1204** may receive one or more instructions or commands from a processing system such as processing system **102** to extend or retract plunger **1210**. Linear actuator **1204** may be any of a lead screw linear actuator, a pneumatic actuator, a hydraulic actuator, or a rigid chain-based actuator.

[0109] Support structure **1206** may be similar to support **108**. Support structure may provide a substantially rigid support to one or more internal components of automated pet food dispenser such user interface **1202**, linear actuator **1204**, cooling unit **1208**, plunger **1210**, receptacle **1212**, and carousel **1214**.

[0110] In one aspect, cooling unit **1208** may function in a similar manner as cooling unit **608**. In one aspect, cooling unit **1208** provides cooling or refrigeration functions to keep wet pet food in a pet food container (e.g., pet food container **112**) within a receptacle (e.g., receptacle **1212**) at a lower temperature than an ambient temperature. Cooling unit **1208** may also be referred to as a "refrigeration unit." Maintaining the wet pet food at a lower temperature than the ambient temperature helps increase food shelf life, reduce bacterial growth rates, and keep the wet pet food fresh for a longer period of time.

[0111] In one aspect, cooling unit **1208** may be any combination of thermoelectric cooler, a heatsink, and a fan. The thermoelectric cooler may help reduce a temperature of the wet pet food to a temperature below the ambient temperature. The heatsink may be used to dissipate any heat generated by components such as cooling unit **1208**, linear actuator **1204**, or processing system **102**. The fan may be used to circulate air within automated pet food dispenser **1100** to maintain a substantially constant temperature within automated pet food dispenser **1100** or within a portion of automated pet food dispenser **1100**.

[0112] In one aspect, processing system **102** monitors a temperature of the wet pet food in a pet food container such as pet food container **112**, and controls cooling unit **1208** via a feedback control loop to maintain the wet pet food at a substantially constant temperature. Such a feedback control loop may be configured such that cooling unit **1208** is switched on or off based on commands from processing system **102**. This, in turn, can allow automated pet food dispenser **1100** to account for daily and seasonal temperature fluctuations in the ambient temperature while maintaining the temperature of the wet pet food in pet food container **112** at a substantially constant value.

[0113] In one aspect, a pet food container similar to pet food container **112** may be inserted or placed into receptacle **1212**. In one aspect, receptacle **1212** may be referred to as a food container. At a designated pet feeding time, processing system **102** may command linear actuator **1204** to extend plunger **1210** into receptacle **1212**. Plunger **1210** may exert a force on the pet food container within receptacle **1212**. In one aspect, motion of the pet food container within receptacle **1212** is constrained by an insert. The insert may prevent motion of the pet food container while linear actuator **1204** applies a force to the pet food container via plunger **1210**. In another aspect,

receptacle **1212** is constructed to have a built-in physical restraint that prevents motion of the pet food container while linear actuator **1204** applies a force to the pet food container via plunger **1210**. The force exerted by plunger **1210** may cause the pet food container to rupture, and the contents of the pet food container may be dispensed into food bowl **1216** through an opening at the bottom of receptacle **1212**.

[0114] In one aspect, piston **1210** is similar to plunger **106**. Piston **1210** may be configured to be substantially coaxial with receptacle **1212**, so that piston **1210** is contained within receptacle **1212** when piston **1210** is extended by linear actuator **1204**.

[0115] In one aspect, a quantity of pet food dispensed may be measured by a load cell (not depicted in internal structure **1200**). Measurements from the load cell may be received by processing system **102**. Processing system **102** may command linear actuator **1204** to stop extending plunger **1210** when a quantity of food in food bowl **1216** as measured by the load cell is greater than or equal to a predetermined amount. Processing system **102** may also retract plunger **1210**.

[0116] Once a requisite quantity of pet food is dispensed into food bowl **1216**, processing system may command an electrical motor to extend drawer **1220** and reveal food bowl **1216** to a pet. This initiates a feeding routine. Drawer **1220** may be similar to drawer **1106**. Drawer **1120** may be alternatively referred to as a “tray.” In one aspect, the electrical motor actuates the extension of drawer **1220** along a linear path, using a rack-and-pinion mechanism.

[0117] Processing system **102** may be configured to keep a track of time elapsed since drawer **1220** is extended. Processing system **102** may also be configured to keep a track of a weight of wet pet food remaining in food bowl **1216** based on one or more weight measurements from the load cell. If the time elapsed is greater than or equal to a predetermined time limit or the weight of wet pet food remaining in food bowl **1216** is significantly less than the dispensed quantity (suggesting that all or most of the wet pet food has been consumed), then processing system **102** may retract drawer **1220** back into base **1218**. Base **1218** may provide a concealing enclosure for food bowl **1216**, as well as a bottom support for internal elements of automated pet food dispenser **1100**.

[0118] In one aspect, drawer **1220** may include one or more accelerometers and/or gyroscopes to measure vibration motion of drawer **1220** and food bowl **1216**. These vibration measurements may be transmitted to processing system **102**. Excessive vibrations may suggest that a pet is currently in a vicinity of automated pet food dispenser **1100**, and might be currently feeding. Processing system **102** may make a decision to keep drawer **1220** extended while vibration measurements are at relatively higher levels. A substantial reduction in vibration levels may suggest that the pet has finished feeding and has left a vicinity of automated pet food dispenser **1100**. Processing system **102** may command drawer **1220** to retract responsive to this reduction.

[0119] In one aspect, processing system **102** is configured to determine how rapidly food is being consumed from food bowl **1216**. This functionality may be accomplished by computing a rate of food consumption as a function of time, where load cell readings associated with the weight of the wet pet food in food bowl **1216** are sampled at discrete time intervals.

[0120] In one aspect, carousel **1214** is configured to hold multiple receptacles such as receptacle **1212**. For example, carousel **1214** may hold six receptacles. Carousel **1214** may also be configured to rotate about an axis of rotation that may be substantially parallel to an axis associated with linear actuator **1214** and plunger **1210**. A user may fill each of the multiple receptacles held by carousel **1214** with an individual pet food container that may be similar to pet food container **112**.

[0121] In one aspect, carousel **1214** is initially positioned such that a first receptacle is substantially coaxial with plunger **1210**. Processing system **102** may initiate a pet feeding routine from a pet food container contained in this first receptacle. Processing system **102** may be configured to determine how much food remains in the pet food container based on how much plunger **1210** is extended. When plunger **1210** is extended to a certain length (e.g., 6 inches), processing system **102** may determine that a bottom of plunger **1210** may be close to a bottom end of the first receptacle. This, in turn, indicates that the pet food container contained within the first receptacle is

substantially empty. Responsive to this determination, processing system **102** may retract plunger **1210** so that plunger **1210** is completely outside of the first receptacle. Processing system **102** may then command an electrical motor connected to carousel **1214** to rotate carousel **1214** about the axis of rotation so that a second receptacle filled with a pet food container is substantially coaxial with plunger **1210**. A subsequent feeding routine is then initiated from the second receptacle, till the pet food container contained in the second pet food receptacle is substantially empty. The second receptacle is then replaced by a third receptacle by rotating carousel **1214**, and so on, till the pet food containers in all receptacles have been used up. Processing system **102** may then issue one or more alerts to a user via user interface **1202**, or to computing system **116** via wireless communication link **120**.

[0122] Carousel **1214** allows extended periods of multiple unattended pet feeding sessions via the multiple receptacles. Carousel **1214** may be especially beneficial if a pet owner has to be out of the home for extended periods of time (e.g., a vacation).

[0123] FIG. **13** is a schematic diagram depicting an internal structure **1300** of an embodiment of automated pet food dispenser **1100**. As depicted, internal structure **1300** includes hot side plenum **1302**, cooling unit **1304**, thermal bulkhead **1306**, and cold side plenum **1308**.

[0124] In one aspect, cooling unit **1304** is similar to cooling unit **1208**. Thermal bulkhead **1306** may be configured to thermally isolate hot side plenum **1302** from cold side plenum **1308**. Hot side plenum **1302** may be a portion of an internal structure of automated pet food dispenser **1100** that is at a higher temperature relative to cold side plenum **1308**. Hot side plenum may include linear actuator **1204**, processing system **102**, user interface **1202**, cooling unit **1208**, and other components that may generate heat during operation. Thermal bulkhead **1306** may function to thermally isolate cold side plenum **1308** from the heat generated by these heat-generating components.

[0125] In one aspect, cold-side plenum **1308** is cooled by cooling unit **1304** to be at a temperature that is lower than an ambient temperature. Cold-side plenum **1308** may include components such as carousel **1214**, and receptacle **1212** that may further include a pet food container. Cold-side plenum **1308** may include a space around the multiple receptacles associated with carousel **1214**, whose temperatures are being controlled. Some aspects include one or more insulating features (e.g., insulation **606**) in outer housing **1104** or base **1218** to help regulate heat flow. Thermal bulkhead **1306** reduces an amount of heat transferred from hot side plenum **1302** to cold side plenum **1308**. This further helps maintain a temperature of one or more pet food containers stored in cold side plenum **1308** at a temperature below an ambient temperature. This further helps in maintaining pet food freshness, while reducing bacterial growth rates.

[0126] FIG. **14** is a schematic diagram depicting a cross-sectional view **1400** of a portion of automated pet food dispenser **1100**. As depicted, cross-sectional view includes linear actuator **1402**, plunger **1404**, receptacle **1406**, food bowl **1408**, load cell **1410**, and rack-and-pinion mechanism **1412**.

[0127] Linear actuator may be similar to linear actuator **1204**, plunger **1404** may be similar to plunger **1210**, receptacle **1406** may be similar to receptacle **1212**, food bowl **1408** may be similar to food bowl **1216**, and load cell **1410** may be similar to load cell **118**.

[0128] Cross-sectional view **1406** depicts how linear actuator **1402**, plunger **1404**, and receptacle **1406** are substantially coaxial. Cross-sectional view **1406** also depicts how plunger **1404** is designed to be contained within receptacle **1406**.

[0129] In one aspect, processing system **102** is configured to extend or retract drawer **1220** via an electrical motor that actuates rack-and-pinion mechanism **1412**. This extension or retraction may be associated with one or more pet feeding events. Load cell **1410** may be configured to measure a weight of dispensed wet pet food in food bowl **1408**.

[0130] FIG. **15** is a schematic diagram depicting a cross-sectional view of a bowl tray assembly **1500**. As depicted, bowl tray assembly **1500** includes load cell **1502**, food bowl **1504**, upper section

1506, lower section **1508**, electrical motor **1510**, and base **1512**.
[0131] Load cell **1502** may be similar to load cell **1410**, and food bowl **1504** may be similar to food bowl **1408**. Upper section **1506** and lower section **1508** may be configured to collectively enclose internal components such as load cell **1502** and electrical motor **1510** while forming an external structure for drawer **1220**. Electrical motor **1510** may be configured to drive rack-and-pinion mechanism **1412** under command of processing system **102**. Base **1512** may be similar to base **1218**.
[0132] FIG. **16** is a schematic diagram depicting a view **1600** of automated pet food dispenser **1100**. As depicted, view **1600** shows automated pet food dispenser **1100** in a partially disassembled state. As depicted view **1600** includes outer housing **1602**, support structure **1604** and base **1606**. Outer housing may be similar to outer housing **1104**, support structure **1604** may be similar to support structure **1206**, and base **1606** may be similar to base **1218**. In one aspect, outer housing **1602** may be removed from automated pet food dispenser **1100** along a vertical direction. Such a removal allows a user access to internal components of automated pet food dispenser **1100**. For example, a user may remove outer cover **1100** to remove empty pet food containers and/or refill one or more receptacles with new pet food containers. A service technician may remove outer cover **1100** to service or repair one or more components of automated pet food dispenser **1100**. For example, the service technician may plug in a diagnostic tool into processing system **102** to run fault detection and other diagnostic procedures.
[0133] FIG. **17** is a schematic diagram depicting a portion **1700** of automated pet food dispenser **1100**. As depicted, portion **1700** includes outer cover **1702**, food bowl **1704**, drawer **1706**, and base **1708**. Outer cover **1702** may be similar to outer cover **1104**, food bowl **1704** may be similar to food bowl **1216**, drawer **1706** may be similar to drawer **1220**, and base **1708** may be similar to base **1218**.
[0134] Drawer **1706** is depicted to be in an extended state. This extension may be initiated by processing system **102** during a feeding event. Processing system **102** may also extend drawer **1706** based on a user command. For example, a user may instruct processing system to extend drawer **1706** so that the user may remove food bowl **1704** for cleaning. This extension may be accomplished via rack-and-pinion mechanism **1412** and electrical motor **1510** via command from processing system **102**.
[0135] FIG. **18** is a schematic diagram depicting an internal structure **1800** of automated pet food dispenser **1100**. As depicted, internal structure **1800** includes electrical motor **1802**, rotating element **1804**, carousel **1806**, base **1808**, linear actuator **1810**, plunger **1812**, and receptacle **1814**.
[0136] In one aspect, carousel **1806** is similar to carousel **1214**, base **1808** is similar to base **1218**, linear actuator **1810** is similar to linear actuator **1204**, plunger **1812** is similar to plunger **1210**, and receptacle **1814** is similar to receptacle **1212**.
[0137] In one aspect, electrical motor **1802** is commanded by processing system **102** to rotate carousel **1806**. Such a rotation command may be initiated by processing system **102** to switch between a receptacle containing a substantially empty pet food container to a receptacle containing a new pet food container. In one aspect, electrical motor **1802** may rotate carousel **1806** using rotating element **1804**. In one aspect, rotating element **1804** is a Geneva wheel or a Geneva drive. Receptacle **1814** and other receptacles associated with carousel **1806** may be removable by a user for cleaning or replacement.
[0138] Embodiments of automated pet food dispenser such as automated pet food dispenser **100**, automated pet food dispenser **200**, and automated pet food dispenser **1100** may include any combination of the following features: [0139] The communication link between processing system **102** computing system **116** may also include a wired communication link such as USB, Ethernet, UART, or some other wired communication interface. [0140] Embodiments of automated pet food dispensers described herein may be powered by any combination of electrical power sourced from an electrical outlet or electrical power sourced from one or more batteries. [0141] Embodiments of

automated pet food dispensers described herein may include communications security and a programmable ID so that a particular dispenser can be selected using computing system **116** via wireless communication link **120**. This is beneficial for scenarios such multi-unit applications like pet hotels, animal hospitals, common carriers transporting multiple pets at a time, and so on. [0142] In one aspect, a user can fill pet food containers containing different kinds of wet pet food in different receptacles when initializing carousel **1214**. The user can then program processing system **102** (for example, via computing system **116** or via user interface **202**) to dispense a specific kind of food at a specific feeding time in the feeding schedule. [0143] Some aspects may include a user logging in to an application software running on computing system **116**. This application software may allow the user keep track of when a pet food container has been put in, its expiration date, and other parameters. The application software may warn the user when an expiration date associated with a pet food container is getting near. [0144] Parameters associated with scheduling feeding times and feeding amounts may include any combination of ambient temperature, previous patterns of consumption, detecting a pet's presence, an abundance or a scarcity of remaining food in the carousel, and so on.

[0145] Although the present disclosure is described in terms of certain example embodiments, other embodiments will be apparent to those of ordinary skill in the art, given the benefit of this disclosure, including embodiments that do not provide all of the benefits and features set forth herein, which are also within the scope of this disclosure. It is to be understood that other embodiments may be utilized, without departing from the scope of the present disclosure.

Claims

1. An apparatus comprising: a receptacle configured to hold a sealed container containing wet pet food; an electrically-actuated plunger configured to interface with the receptacle; and a processing system connected to the electrically-operated plunger, the processing system configured to initiate a pet feeding event by: electrically actuating the plunger to interface with the receptacle, puncture the sealed container, and dispense the wet pet food into the food bowl; and maintaining a time history to determine one or more future pet feeding events.

2. The apparatus of claim 1, further comprising: a rotating carousel configured to receive and store one or more sealed containers of wet pet food; and an electrical motor configured to rotate the carousel around an axis of rotation, wherein the processing system is connected to the electrical motor, wherein, prior to actuating the plunger, the processing system rotates the carousel via the electrical motor, and wherein the processing system stops the electrical motor when a selected sealed container is in a proximity of the plunger, and wherein the plunger is actuated after the electrical motor is stopped.

3. The apparatus of claim 1, further comprising a load cell physically coupled to the food bowl, wherein the load cell is configured to measure a weight of the wet pet food dispensed into the food bowl, and wherein the processing system is configured to deactivate the plunger when the weight of the wet pet food dispensed into the food bowl is greater than or equal to a predetermined threshold weight.

4. The apparatus of claim 1, wherein the electrically-actuated plunger is actuated by any of a lead screw linear actuator, a pneumatic actuator, a hydraulic actuator, or a rigid chain-based actuator.

5. The apparatus of claim 1, further comprising: a computing system; and a wireless communication link between the processing system and the computing system, wherein a user enters one or more user commands associated with one or more pet feeding events and a quantity of the wet pet food to be dispensed into the computing system, wherein the processing system is configured to receive the user commands from the computing system via the wireless communication link, and wherein the processing system schedules the pet feeding events and stores the quantity of the wet pet food to be dispensed as a predetermined threshold weight.

6. The apparatus of claim 5, wherein the wireless communication link is any of a Bluetooth communication link, a Wi-Fi communication link, or a ZigBee communication link.
7. The apparatus of claim 1, wherein the processing system initiates the pet feeding event upon receiving a user command.
8. The apparatus of claim 1, further comprising a refrigeration unit configured to maintain the wet pet food at a temperature that is lower than an ambient temperature.
9. The apparatus of claim 1, further comprising a user interface, wherein a user enters one or more user commands associated with one or more pet feeding events and a quantity of the wet pet food to be dispensed via the user interface, wherein the processing system is configured to receive the user commands via the user interface, and wherein the processing system schedules the pet feeding events and stores the quantity of the wet pet food to be dispensed as a predetermined threshold weight.
10. The apparatus of claim 9, wherein the user interface includes any combination of one or more push buttons, an LCD touchscreen, one or more switches, one or more rotary knobs, and one or more light emitting diodes.