

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

GUANGZHOU EKO TRADING DEVELOPMENT CO., LTD.

Petitioner,

v.

NINE STARS GROUP (U.S.A.) INC.,

Patent Owner.

Case No. IPR2025-01369

U.S. Patent No. 10,928,796

PETITION FOR *INTER PARTES* REVIEW

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LISTING OF EXHIBITS

Exhibit	Description
1001	U.S. Patent No. 10,928,796 B2 to Wang et al.
1002	File History of U.S. App. 16/315,625
1003	CN 105425665 A to Zheng et al.
1004	Certified translation of CN 105425665 A to Zheng et al. and associated translator's declaration
1005	Declaration of Miguel Gomez
1006	U.S. Patent No. 9,382,067 B2 to Gropper
1007	U.S. Patent No. 7,896,196 B2 to Wegelin et al.
1008	U.S. Patent No. 7,690,623 B2 to Parsons et al.
1009	CN 203740427U to Wang et al.
1010	Certified translation of CN 203740427U to Wang et al. and associated translator's declaration
1011	U.S. Patent No. 8,766,195 B2 to Tang et al.
1012	U.S. Patent No. 8,421,020 B2 to Chen et al.

I. INTRODUCTION

Petitioner Guangzhou EKO Trading Development Co., Ltd. (“EKO” or “Petitioner”)¹ respectfully requests IPR of claims 1-12 of U.S. Patent No. 10,928,796 B2 (“the ’796 patent”) assigned to Nine Stars Group (U.S.A.) Inc. (“Nine Stars” or “Patent Owner”).

The ’796 patent relates to a power-saving method for controlling an automatically opening trash bin. The bin uses an infrared sensor to detect an approaching user and drive open the bin cover. The infrared sensor is periodically turned off for purposes of saving power. The ’796 patent’s bin has three modes of operation: (1) a “sleep” state when the sensor is not powered, (2) a “working” state when the sensor is powered but not necessarily transmitting/detecting, and (3) a “standby” state where the sensor is transmitting/detecting. A timer wakes the bin from sleep. Upon waking, the bin enters the working state for a short period of time allowing the sensor to stabilize before transmitting/detecting in the standby state. When a user is detected, the trash bin’s cover is opened.

This type of power-saving, automatically opening bin was well known in the prior art. As explained in **Ground 1**, CN 105425665 A to Zheng et al. (“Zheng,”

¹ Guangzho EKO Trading Development Co., Ltd is also known as EKO Development Ltd.

Exs. 1003, 1004) exemplifies this. Zheng teaches the same type of power-saving trash bin control method the '796 patent requires. Zheng's bin employs an infrared transmitter/receiver to detect an approaching user and drive open the bin's cover. When no user is detected, the bin's microcontroller enters a dormancy state and power to the infrared receiver is cut off (Zheng's "sleep" state). The microcontroller will re-awaken after a set period of time, wait for another short set period (Zheng's "working" state), and then transmit/receive infrared signals again (Zheng's "standby" state). Because the infrared sensor is not powered all the time, Zheng's trash bin control method is able—just like the '796 patent—to save power.

Certain of the '796 patent's claims (7, 9, 10, 11, and 12) require location of an infrared sensor "on the front can edge of the trash can." While this would have been obvious in view of Zheng alone, **Ground 2** of the Petition explains why the example provided by CN 203740427U to Wang et al. ("Wang," Exs. 1009, 1010) would also have confirmed these claims' obviousness. Wang teaches the same type of automatically opening trash bin as Zheng. And Wang specifically discusses—and depicts in its figures—a bin with an infrared sensor mounted on the bin's top front.

II. MANDATORY NOTICES

A. Real Party-in-Interest

Petitioner Guangzho EKO Trading Development Co., Ltd. (also known as EKO Development Ltd.) and related corporate entities EKO North America Inc.

and EKO Group, Ltd. are the real parties-in-interest.

B. Related Matters

The '796 patent is currently at issue in *Nine Stars Group USA Inc. v. Guangzhou EKO Trading Development Co., Ltd.*, 5-24-cv-01843 (C.D. Cal.), which was filed on August 28, 2024. EKO North America Inc. and EKO USA LLC were served with the complaint on November 15, 2024.

C. Counsel, Service, and Fee Information

Petitioner designates the following counsel:

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Petitioner consents to service by electronic mail at the addresses listed in the table above. Petitioner's Power of Attorney is attached.

The USPTO is authorized to charge the filing fee and any other fees incurred by Petitioner to the deposit account of Orrick, Herrington, & Sutcliffe LLP: 15-0665.

III. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the '796 patent is available for IPR, and that Petitioner is not barred or estopped from requesting this IPR.

B. Identification of Challenge and Statement of Precise Relief Requested

Petitioner requests IPR of claims 1-12. This petition discusses claim construction, explains why the claims are unpatentable, provides details regarding where the various claim limitations are found in the prior art, and is supported (in part) by the accompanying Declaration of Miguel Gomez (Ex. 1005), an expert with extensive experience working with and designing electrical systems.

The '796 patent was filed July 17, 2017 as a PCT application. *See* Ex. 1001, Cover. The patent also makes a facial claim of priority back to an April 7, 2017 foreign filing. *Id.* For purposes of this Petition only, it is assumed that the '796 patent is entitled to the benefit of this April 2017 foreign filing date.

Petitioner relies on the following references: (1) Zheng (Ex. 1003) and (2) Wang (Ex. 1009). Zheng and Wang both published in Chinese. Thus, this Petition

is accompanied by certified translations and associated translator’s declarations of both references (Exs. 1004, 1010). Citations to Zheng and Wang throughout this Petition refer to these translations. Both Zheng and Wang are prior art. *See* Section VII.A-B.

Petitioner challenges the claims on the following grounds:

Ground 1: Claims 1-12 are obvious over Zheng; and

Ground 2: Claims 7, 8, 9, 10, 11, and 12 are obvious over Zheng and Wang.

The expert testimony accompanying the Petition is focused. The claims—and the prior art at issue—relate to straightforward, easily understandable subject matter: a trashcan control method. Both the patent and prior art can thus be understood without extensive expert testimony. Petitioner’s expert declaration simply serves to (1) confirm that the Petition interprets the prior art correctly and (2) summarize the background knowledge that would have been possessed by a POSITA regarding infrared sensors, watchdog timers, and sensor control loops. *See generally* Ex. 1005.

IV. THE ’796 PATENT

A. Overview

The ’796 patent explains that it “relates to a power-saving method for a standby circuit of an induction trash can.” Ex. 1001, 1:20-21. According to the patent, “[t]he power consumption of an induction trash can consists of two parts[.]” *Id.*, 1:26-27. This includes “standby power consumption (when lid is motionless)”

and “action power consumption (when lid moves).” *Id.*, 1:28-30. Because the trashcan spends most of its time closed, “the daily standby power consumption is much greater than the daily action power consumption.” *Id.*, 1:54-55.

The patent goes on to “provide a standby power-saving method” that aims to “greatly reduce the standby current of the induction trash can, extend battery life, achieve an excellent power saving effect, reduce the use cost for the users, and decrease pollution caused by used batteries.” *Id.*, 1:62-67. The patent’s trashcan includes, among other components, “an active infrared sensor 1,” “a microcontroller 2,” and “motor 4.” *Id.*, 5:20-25; Fig. 1. The trashcan’s “microcontroller has a sleep function and a watchdog timer.” *Id.*, 2:7-9. The trashcan’s “active infrared sensor” operates to detect an “obstacle” (like a user’s hand) in the sensor’s “induction area.” *Id.*, 2:12-14, 22-24. If an “obstacle” is detected, the trashcan’s lid will be “driven ... to open” by the motor. *Id.*, 2:22-30. If no “obstacle” is detected, the microcontroller “will enter a sleep state.” *Id.*, 2:14-18. “After it has slept for a preset time, the watchdog timer disposed in the microcontroller will wake up the microcontroller” allowing it to “reenter” a “working state.” *Id.*, 2:18-22. To save power, “the microcontroller will cut off the power supply of the active infrared sensor when the microcontroller enters the sleep state.” *Id.*, 2:31-35. And “[w]hen the microcontroller is woken by the watchdog timer ..., the microcontroller will first restore the power supply of the active infrared sensor and delay for a preset time for

the active infrared sensor to enter a stable working state” before emitting and detecting “an infrared pulse signal.” *Id.*, 2:35-42. The patent explains that because “the active infrared sensor” is only “in the working state intermittently,” the trashcan’s battery life is significantly extended. *Id.*, 4:1-26, 4:49-51.

This operation—including the “working,” “standby,” and “sleep” states—is also shown in Figure 2 of the ’796 patent:

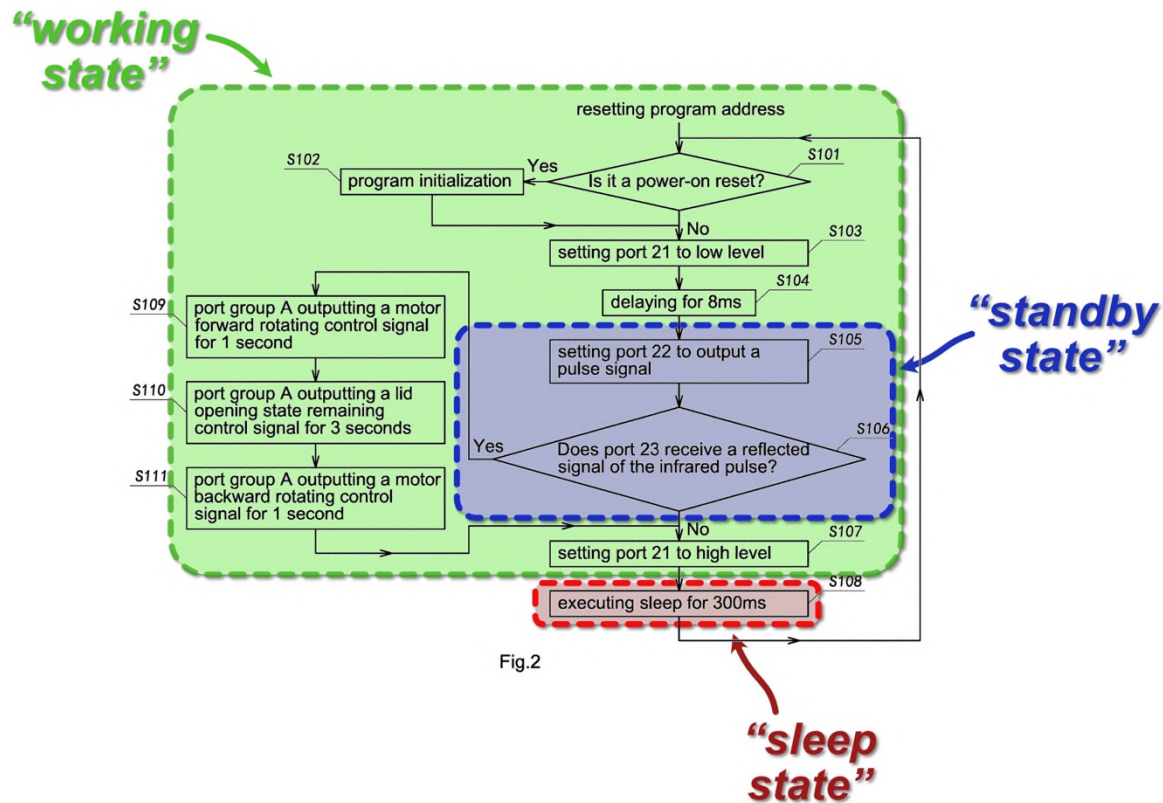


Fig.2

Id., Fig. 2 (annotated). The “working” state includes the power-on procedure, including sensor delay step S104. *See id.* The “standby” state includes the steps S105 and S106 where infrared signals are output and received for purposes of

opening the bin lid. *See id.* The “sleep” state includes step S108 where power for the sensor is cut off. *See id.*

B. Prosecution History

Again, the application underlying the ’796 patent was first filed as a PCT application on July 17, 2017. *See* Ex. 1001, Cover. Prosecution before the USPTO began on January 6, 2019. *See id.*; *see also* Ex. 1002, pp. 12-18.² Pending claims 6-17 were all rejected as anticipated by U.S. Pub. 2011/0220648 (“Yang”) in a May 18, 2020 office action. *Id.*, pp. 121-129.

The applicant responded with an amendment. Independent claim 6 was amended to specify that in the “standby state,” the “microcontroller controls the active infrared sensor to emit the infrared pulse signal” while in the “sleep state, the microcontroller cuts of a power of the active infrared sensor.” *Id.*, p. 166. A limitation requiring waking “from the sleep state to the working state” was also added. *Id.* Applicant then noted that while Yang includes a “nap mode,” it is “ONLY configured to set the microprocessor between a normal mode (working mode) and a sleep mode.” *Id.*, p. 170. The claimed third mode of operation was purportedly missing. *Id.*, pp. 170-171. For instance, in Yang, when the “sleep timer has elapsed, a pulsed light signal can be emitted by the light emitter.” *Id.*, pp. 171-

² Page citations in this section refer to the numbers added by Petitioner.

172. “Yang ... fails to ... initially power the active infrared sensor while no infrared pulse signal is generated yet.” *Id.*, p. 172.

After this response, the claims were allowed without further rejection. *See id.*, pp. 181-187. Here, the examiner explained that “[t]he prior art of record does not teach or suggest” a trashcan “microcontroller having three different power states (standby state, sleep state, and working state)....” *Id.*, p. 186.

V. CLAIM CONSTRUCTION

The Board applies the same *Phillips* claim construction standard used by district courts. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*).

Independent claim 1 requires that the claimed “**microcontroller**” have a “**sleep state**,” “**working state**,” and “**standby state**.” Petitioner submits that a POSITA would have understood these terms to mean the following:

- “**sleep state**”: the state in which the microcontroller cuts off power to the active infrared sensor;
- “**working state**”: the state in which the microcontroller is not sleeping and supplies power to the active infrared sensor; and
- “**standby state**”: the state in which the microcontroller causes the active infrared sensor to emit a signal for detection.

See Ex. 1005, ¶¶ 67-89.

Construction of these terms—like any claim term—must begin with the language of the claim itself. *See Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004) (“[C]laim construction analysis must begin, and remain centered on, the claim language itself[.]”). Per claim 1, and just as required by the above construction, in “the sleep state, the microcontroller cuts off a power to the active infrared sensor.” Ex. 1001, 8:23-24. The “working state” is the inverse: it is state into which the “microcontroller” “wak[es] up” when exiting the “sleep state.” *Id.*, 8:34-38. Further, the “microcontroller” “remain[s]” in this “working state” if the “active infrared sensor” receives a “reflection output signal.” *Id.*, 8:25-27. In other words, the “working state” is the state when the microcontroller is not sleeping and performs various operations, such as powering the infrared sensor and opening/closing the trash can cover. Finally, claim 1 explains that the “standby state” is simply the state in which the “microcontroller” “controls the active infrared sensor to emit the infrared pulse signal.” *Id.*, 8:21-23. The “working state” and “standby state” overlap: the “microcontroller” enters the “working state” after waking from the “sleep state.” And per the claim, it must “remain[]” in this state when a “reflection output signal is received” for purposes of opening / closing the “trash can” cover. The “standby state” is a sub-set of this: it is the period when the “microcontroller” causes the “active infrared sensor” to not only be powered on but also emit a signal for purposes of detection.

The '796 patent's specification uses the terms the same way. In particular, the specification explains that in the "sleep state," "[t]he microcontroller will cut off the power supply of the active infrared sensor." *Id.*, 2:33-35. Because of this, no sensor "output signal" is received by the microcontroller. *Id.*, 3:46-48. Next, after being "woken up by the watchdog timer" from the sleep state, "the microcontroller will first restore the power supply of the active infrared sensor" allowing it to "enter a stable working state." *Id.*, 2:35-42; *see also id.*, 2:47-51 (similarly noting that "[a]fter a preset time of sleeping, the watchdog timer disposed in the microcontroller will wake up the microcontroller and turn it back into the working state"). So, the sleep state is the state where the microcontroller has cut off the power supply to the active infrared sensor. The working state is simply the state in which the microcontroller wakes from sleep and power is restored by the microcontroller to the sensor. The trash can "remain[s] in the working state" through the rest of its operation. *Id.*, 2:24-30; *see also id.*, 5:63-6:5. And like the claims, the specification explains that "[w]hen the induction trash can circuit is in a standby state, the microcontroller controls the active infrared sensor to emit an infrared pulse signal to the induction area." *Id.*, 2:12-14; *see also id.*, 3:42-44 (similar). So once again, the "standby state" refers to the state in which the microcontroller is awake and the sensor is not only powered but the microcontroller causes the sensor to emit a signal.

The applicant characterized the claims the same way during prosecution. Once again, in the “sleep state,” “the microcontroller cuts off a power of the active infrared sensor.” Ex. 1002, p. 171. The “working state” is the “normal mode” in which the trash can’s microcontroller operates when not sleeping. *Id.*, p. 170 And in “standby state,” “the microcontroller controls the active infrared sensor to emit the infrared pulse signal.” *Id.*

The applicant also contrasted the claimed control method’s three states with prior art methods that—at least according to applicant—simply switched between two states. In particular, rather than “three modes” as the ’796 patent’s claims require, the prior art purportedly included only “two modes”: a “working mode” when “the light emitter ... will emit the light signal” and a “nap mode” when “the light emitter ... will not emit the light signal.” *Id.*, pp. 169-170. Put another way, applicant explained that unlike the claims, “conventional trash cans ... are ONLY configured to set the microprocessor between a normal mode (working mode) and a sleep mode.” *Id.* “[T]he signal receiver module is activated in the normal mode for detection and is deactivated in the sleep mode for energy saving.” *Id.* According to the applicant, “[n]one of the cited arts include three different states of the microcontroller as claimed in the instant invention.” *Id.* There was no state in which the microcontroller “initially power[s] the active infrared sensor while no infrared pulse signal is generated yet.” *Id.*, p. 172. This serves to further emphasize the

impact the claimed microcontroller states have on sensor operation: (1) in the sleep state the sensor is not powered, (2) in the working state the sensor is powered but not necessarily transmitting/receiving, and (3) in the standby state the sensor is powered and transmitting/receiving.

Petitioner submits that the remainder of the '796 patent's claim terms do not require further construction and can be afforded their plain and ordinary meaning. *See* Ex. 1005, ¶ 90.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA in the field of the '796 patent would have had a degree in electrical engineering or an equivalent field, along with 2 years of electronic product design experience. Ex. 1005, ¶ 46. This POSITA would have been aware of and generally knowledgeable about the types of materials (including microcontrollers, sensors, circuits, and timers) employed in typical electronic products. *See id.*

VII. OVERVIEW OF THE PRIOR ART

A. Zheng

Zheng published March 23, 2016. *See* Ex. 1004, Cover. This predates the '796 patent's own April 2017 filing by more than a year making Zheng prior art under AIA 35 U.S.C. § 102(a)(1).

Zheng relates to a “smart environmentally-friendly trash bin control method and apparatus.” *Id.*, [0001]. According to Zheng, many existing trash bins require “users” to “open[] the upper cover” of the bin by “treading on a pedal or manually

opening the upper cover.” *Id.*, [0002]. This, however, “may be inconvenient.” *Id.*, [0003]. To address this concern, Zheng discloses a bin with an “upper cover” that “can be automatically opened when a person carrying garbage walks up to the smart environmentally-friendly trash bin....” *Id.*, [0004].

To accomplish this, Zheng’s “trash bin” includes a “microcontroller unit,” “an infrared transmitting tube” and an “infrared receiving tube” that are “connected to the microcontroller unit,” a “motor,” and an openable “upper cover.” *Id.*, [0036]-[0037]. The “infrared transmitting tube” and “infrared receiving tube” are “located close to each other” and “arranged on” the “trash bin” to “face the same direction” to allow for detection of “a reflected infrared signal.” *Id.*, [0103].

Zheng then goes on to discuss a control method that automatically opens the trash bin only when “[a] person or object passes by” the bin and “keeps blocking the” transmitted “infrared signal” for a period time. *Id.*, [0043]. This is meant to ensure appropriate bin opening while avoiding “interference ... from a transparent plastic bag, ambient light, and a remote object.” *Id.*, [0072], [0075]. The control method is also designed to “reduce[]” “energy consumption.” *Id.*, [0066], [0113] (similarly noting that Zheng’s method “sav[es] ... power”).

Before opening the bin cover, reflected infrared signals must be detected during two periods of operation (*i.e.*, a “first preset time” and a “second preset time”). During the first period, Zheng’s microcontroller causes the “infrared

transmitting tube to transmit an infrared signal of a first pulse waveform once” “every first preset time.” *Id.*, [0051]. “[T]he first preset time is 200 milliseconds.” *Id.*, [0052]. According to Zheng, the “time required by the infrared transmitting tube to transmit the infrared signal of the first pulse waveform once is $T = \dots 0.526$ milliseconds.” *Id.* This is Zheng’s “Step S101.” *Id.*, [0051].

After transmitting this single infrared signal with a “first pulse waveform” in Step S101 Zheng’s microcontroller uses the “infrared receiving tube” to detect reflected infrared signal “blocked by a person or an object.” *Id.*, [0053]-[0054]. If no signal is detected, Zheng will not transmit another “first pulse waveform” until the expiration of the “first preset time” 200 milliseconds later. *See id.*, [0051]-[0054]. If, however, a reflected signal is “receive[d]” by the “infrared receiving tube[,]” “the receiving tube may automatically output a low-level pulse....” *Id.*, [0054]. This is Zheng’s “Step S102.” *Id.*, [0053]; *see also id.*, [0105]-[0107].

When the “infrared receiving tube” indicates receipt of a reflection signal in Step S102, Zheng’s microcontroller proceeds to its second period of operation. Here, the microcontroller “control[s], every second preset time, the infrared transmitting tube to transmit an infrared signal of a second pulse waveform once” and then “continuously transmit” this signal “for a first preset number of times.” *Id.*, [0058]. According to Zheng, “the second preset time is 25 milliseconds, and the first preset number of times is 20.” *Id.*, [0059]. This takes a total of “500 milliseconds.”

Id. Once again, Zheng explains that each “waveform” lasts “ $T = \dots 0.526$ milliseconds.” *Id.*, [0060]. In other words, during this “second preset time” period, Zheng emits a “second pulse waveform” once every 25 milliseconds. It repeats this 20 times, leading to a second period spanning a total of 500 milliseconds. *Id.*, [0059]-[0060]. This is Zheng’s “Step S103.” *Id.*, [0058].

Next, Zheng’s microcontroller monitors the “infrared receiving tube” to determine if it “continuously ... detect[s]” reflected signals “for a second preset number of times.” *Id.*, [0061]. This “preset number of times” can be “5.” *Id.*, [0062]. If five consecutive reflections are not detected, Zheng enters a standby state and “continu[es]” back to the beginning of its control process to transmit another “first pulse waveform” 200 milliseconds later. *Id.*, [0074]-[0075]. If five consecutive reflections are detected, the “motor” is “control[led] ... to start to act ... to open an upper cover of an environmentally-friendly trash bin.” *Id.*, [0061]. The motor is then reversed to close the cover. *Id.*, [0104]. Requiring five consecutive detections distinguishes between a user actually “walk[ing] up to the trash bin to throw garbage” from “interference.” This is Zheng’s “Step S104.” *Id.*; *see also id.*, [0111]-[0112].

Steps S101-S104 are shown in Figure 1 of Zheng below:

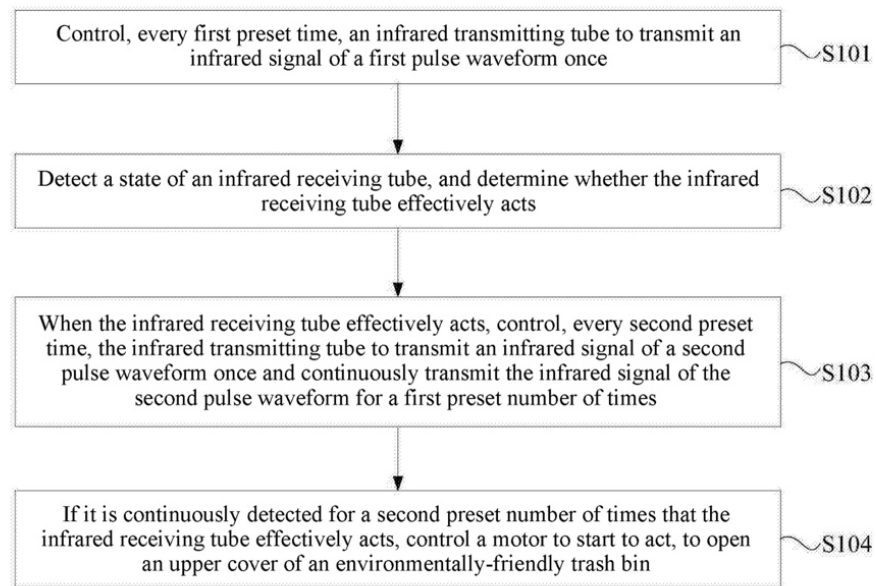


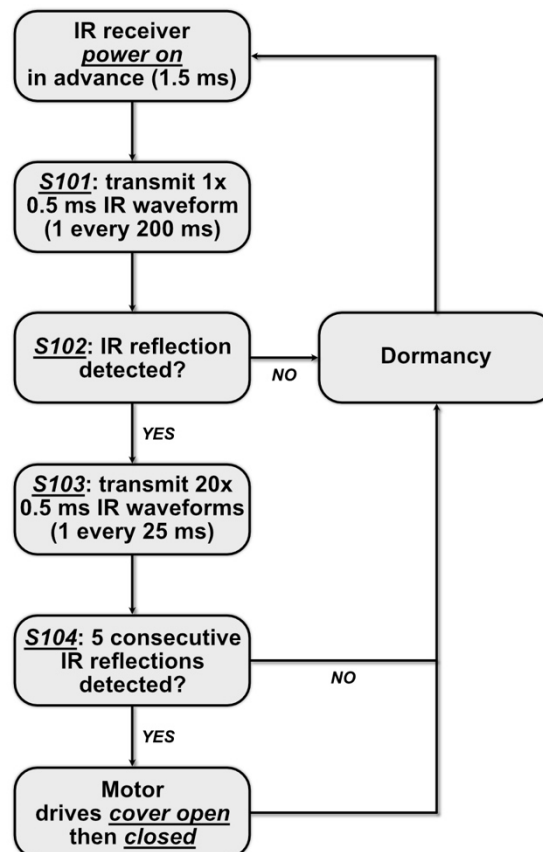
FIG. 1

Id., Fig. 1; *see also id.*, [0063] (similarly explaining the procedure for detecting reflected infrared signals and controlling the bin motor with the microcontroller); [0095]-[0100] (same).

Zheng also discusses a series of other “optional[.]” steps that can also be performed along with steps S101-S104. In particular, “each time” “before” Zheng’s microcontroller performs “step S101[.]” “the infrared receiving tube” is initially “powered on in advance of a third preset time.” *Id.*, [0065]. This “third preset time” can be “2T” or “1.502 milliseconds[.]” *Id.*, [0066]. After the “third preset time,” the IR receiving tube can be “maintain[ed] ... powered on for” a “fourth preset time” for purposes of emitting/detecting infrared signals. *Id.*, [0065]. This “fourth preset time” during which signals are emitted/detected can be “4T” or “2.104

milliseconds.” *Id.*, [0066]. Zheng explains that when not powered on, the infrared sensor is “turned off” allowing “energy consumption” to “be reduced.” *Id.*; *see also id.*, [0101]-[0102]. In other words, the infrared sensor starts powered off before S101, is powered up for 1.5 ms before use, and then powers off when not needed. *See generally id.* Finally, Zheng explains its system includes a “dormancy mode” that is “automatically enter[ed]” by the “microcontroller unit” “when the infrared transmitting tube and the infrared receiving tube do not work” for purposes of “saving more power.” *Id.*, [0113].

This collective operation—including steps S101-S104 and the power on/off and dormancy steps—is summarized in the demonstrative figure below:



Ex. 1005, ¶¶ 99-121.

B. Wang

Wang indicates on its face that it published July 30, 2014. *See* Wang, Cover. This is more than two years before the '796 patent's own 2017 effective filing date. Given this date of publication, Wang is prior art to the '796 patent under AIA § 102(a)(1).

Wang explains that it relates generally to the field of “[i]ntelligent [a]utomatic” trashcans. Wang, [0002]. Wang’s “trash can” employs a “sensing opening-closing apparatus” that “detect[s]” when a “hand approaches the sensing trash can” and automatically opens/closes the can. *Id.*, [0018]-[0023]. The “sensing opening-closing apparatus” includes, among other things, “a sensor 20...” *Id.*, [0018]; *see also* Abstract, [004]. This “sensor 20 is disposed on a front side of the middle body seat 12” of Wang’s trashcan body. *Id.*, [0019].

VIII. GROUND 1: OBVIOUSNESS IN VIEW OF ZHENG

Zheng teaches the same type of power-saving trash bin control method the '796 patent's claims require. Rather than keeping its infrared sensor powered on at all times, the Zheng powers its sensor off when not in use (a “sleep state”). After a preset sleep time, Zheng powers the sensor on, waits for another preset time (a “working state”), and then causes an infrared signal to be generated for purposes of detecting an approaching user (a “standby state”).

A. **Claim-By-Claim Analysis**

1. *Claim 1*

[1-p] “1. A power-saving method for an induction trash can circuit, comprising the steps of:”

To the extent this preamble language is limiting, it is taught by Zheng. Zheng explains that it relates to a “smart environmentally-friendly trash bin control method and apparatus.” Zheng, Abstract; *see also id.*, [0001]. The method is designed to “reduce energy consumption” and “sav[e] ... power.” *Id.*, [0059], [0066], [0113]. Thus, Zheng teaches a **“power-saving method.”**

Next, Zheng’s method also causes the trash bin to transmit—and then detect—“infrared” signals to determine if a “person walks up to the smart environmentally-friendly trash bin” to throw away garbage. *Id.*, [0063]. Detection of a reflected infrared signal results in the bin being “automatically controlled.” *Id.* Because it employs an infrared sensor to automatically control bin opening, Zheng’s trash bin is an **“induction trash can.”** This is how the ’796 patent uses the term: to refer to a trashcan with an infrared sensor that allows the trashcan to automatically open/close. *See, e.g.*, Ex. 1001, 2:4-6 (“The induction trash can circuit comprises an active infrared sensor, a microcontroller, a driving circuit, a motor to open and close the lid”); *see also* Abstract, 3:33-35 (similar). Finally, Zheng explains that its method is performed by a “microcontroller unit” that is “connected to” an “infrared

transmitting tube[,]” “infrared receiving tube[,]” and “motor.” Zheng, [0037]. Thus, Zheng employs a “*circuit.*” *See also* Ex. 1005, ¶¶ 130-137.

[1-1] “controlling an active infrared sensor to emit an infrared pulse signal to an induction area by a microcontroller in a standby state;”

This is all taught by Zheng. Zheng’s “trash bin” includes a “microcontroller unit” that is connected to—and “control[s]”—“an infrared transmitting tube” and an “infrared receiving tube.” Zheng, [0036]-[0042], [0050]-[0063] (discussing control performed by system). The “infrared transmitting tube” operates to “transmit an infrared signal.” *Id.*, [0043]. The “infrared receiving tube ... receive[s]” a “reflected” version of this “infrared signal” if “a person or object” approaches the trash bin. *Id.* The “infrared transmitting tube and the infrared receiving tube” are both “arranged” on the “trash bin” to “face the same direction ... and are located close to each other.” *Id.*, [0103]. This is what allows a “reflected” infrared signal to be “received by the infrared receiving tube.” *Id.*

While Zheng does not use the term “sensor,” a POSITA would nonetheless have understood that this is what its infrared transmitting and infrared receiving tubes are. At the time the ’796 patent was filed, “infrared sensor[s]” had “been widely used in” a variety of household “sanitary apparatus.” Ex. 1011, 1:27-31. Further, it was “common” for such sensors to include an “infrared transmitting tube and ... infrared receiving tube ... welded directly on” a “traditional circuit board....” *Id.*, 2:25-29. The below figure provides an example:

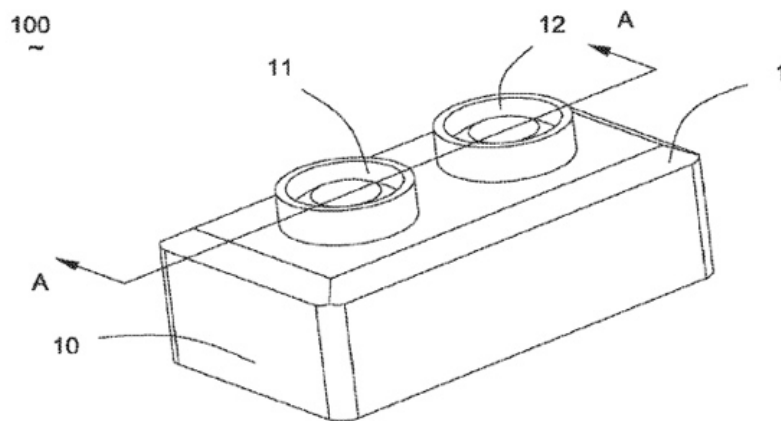


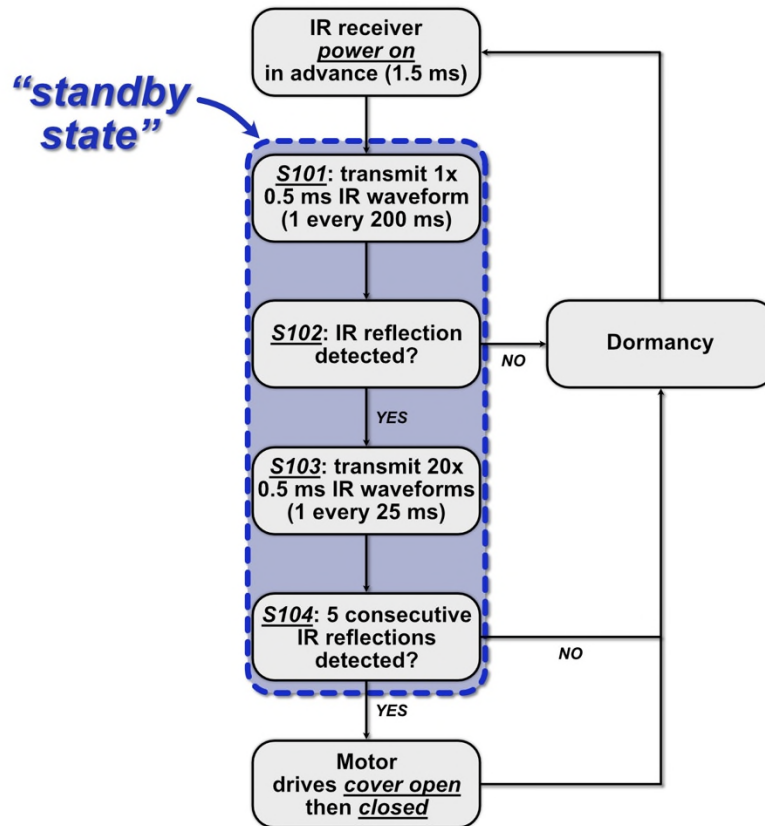
FIG. 1A

Id., Fig. 1A. As shown, the “sensor 100” includes a “housing 1” that contains both a “transmitter device 4” (the transmitting tube) and a “receiver device 5” (the receiving tube). *Id.*, 4:40-57. Transmitted “infrared light rays” exit the housing through a “circular aperture[]” 11, while reflected rays re-enter the housing through another aperture 12. *Id.*, 4:59-5:28; *see also* Ex. 1012, 2:61-3:4 (similarly discussing an “infrared sensing device 100” that includes both an “infrared emitting tube 4” and an “infrared receiving tube 5” located within a “housing 3”). A POSITA would have understood Zheng to be no different: its infrared transmitting tube and infrared sensing tube would be located in a single housing and together constitute an infrared sensing device or sensor. *See* Ex. 1005, ¶¶ 139-151.

In sum, Zheng includes a “**microcontroller**” (its microcontroller unit) that operates to “**control**” (perform Zheng’s control method) an “**active infrared sensor**” (the combination of the infrared transmitting tube and co-located receiving tube that

detects an approaching person/object). This “**active infrared sensor**” includes an “**induction area**” (the area from which the infrared receiving tube—which faces in the same direction as the transmitting tube—detects a reflected infrared signal).

Zheng also teaches that its “**microcontroller**” operates in a “**standby state.**” As explained above, the claimed “**standby state**” is the state in which the microcontroller causes the active infrared sensor to emit a signal for detection. See *supra* Section V. According to Zheng, its microcontroller unit causes the “infrared receiving tube” to “transmit” one “first pulse waveform” during a “first preset time” as part of “Step S101.” *Id.*, [0051]. The microcontroller unit also causes the “infrared receiving tube” to “continuously transmit” an “infrared signal of [a] second pulse waveform” 20 times during a “second preset time” as part of “Step S103.” *Id.*, [0058]-[0059]; see also *id.*, Abstract, [0006]-[0010], [0038]-[0043]. These periods of infrared transmission—and the surrounding periods where reflected infrared signal is detected by the infrared receiving tube—are the claimed “**standby state.**” This is shown in the demonstrative figure below:



Ex. 1005, ¶¶ 152-157.

[1-2] “setting a microcontroller into a sleep state if no reflection output signal is received from the active infrared sensor, wherein in the standby state, the microcontroller controls the active infrared sensor to emit the infrared pulse signal, wherein in the sleep state, the microcontroller cuts off a power of the active infrared sensor; or”

This is also taught by Zheng. As noted above, the claimed “**sleep state**” is the state in which the microcontroller cuts off power to the active infrared sensor. See *supra* Section V. According to Zheng, its “infrared receiving tube” is not “turned on all the time.” Zheng, [0066]. Instead, it is “controlled to be periodically turned on, and is turned off after being turned on for a period of time.” *Id.* Zheng’s “microcontroller unit” “automatically enters a dormancy mode when the infrared

transmitting tube and the infrared receiving tube do not work” (*i.e.*, when not powered) for purposes of “saving more power.” *Id.*, [0113].

More specifically, Zheng explains that “each time” “before” Zheng’s microcontroller performs “step S101” (the first step in which an infrared signal is transmitted for detection purposes), “the infrared receiving tube” is initially “powered on in advance of a third preset time.” *Id.*, [0065]. This “third preset time” can be “2T” or “1.502 milliseconds[.]” *Id.*, [0066]. Thus, before emitting a signal in step S101, Zheng performs 1.502 millisecond power up step.

After the 1.5 millisecond power up step, the receiving tube is “maintain[ed] ... powered on for” “2.104 milliseconds” for purposes of transmitting an infrared signal in step S101 and detecting a reflected version of the infrared signal during step S102. *Id.*, [0065]-[0066]. Only a single “first pulse waveform” is transmitted by the infrared transmitting tube during the initial “first preset time” of step S101 after the infrared receiving tube is powered on. *Id.*, [0051]-[0052].

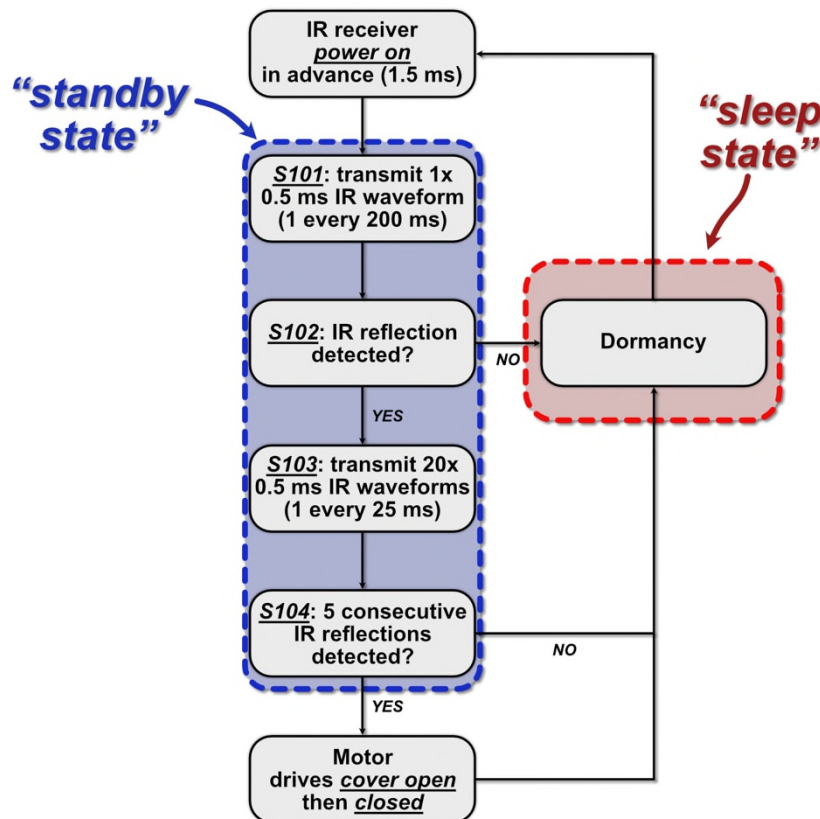
Zheng then goes on to teach two alternate paths its system can follow. If a reflected infrared signal is detected at step S102, Zheng proceeds to step S103 where it “control, every second preset time, the infrared transmitting tube to transmit an infrared signal of a second pulse waveform once” and then “continuously transmit” this signal once every 25 milliseconds 20 times. *Id.*, [0058]-[0059]. Zheng only discusses performance of its power on procedure in advance of step S101. *See id.*,

[0064]-[0066]. No separate power on procedure occurs before any other step. Thus, a POSITA would have understood (or at least considered it obvious) that Zheng's infrared sensor would remain powered as Zheng proceeds through steps S101, S102, S103, and S104. See Ex. 1005, ¶¶ 160-170.

If no reflected infrared signal is detected at step S102, however, Zheng's system will not proceed to step S103. Another "first pulse waveform" will be transmitted after the expiration of the "first preset time" (or 200 milliseconds). Zheng, [0051]-[0052]. In such circumstances, the receiving tube will not stay powered on (as Zheng does not proceed to step S103). Instead, per Zheng, the receiving tube—which, like all of Zheng's components, is controlled by Zheng's microcontroller—will be "turned off" allowing "energy consumption" to "be reduced." *Id.*, [0066]; see also *id.*, [0101]-[0102]. The tube will be turned back on again before step S101 is repeated in 200 milliseconds. See, e.g., *id.*, [0064] (explaining that the receiving tube is "powered on" "each time" "before step S101" is performed). See Ex. 1005, ¶¶ 171-174.

This teaches what this limitation requires. Zheng's "**microcontroller**" is set "**into a sleep state if no reflection output signal is received from the active infrared sensor**" (Zheng's microcontroller unit enters a dormancy—or sleep—mode if no infrared reflection is detected by the receiving tube in step S102). Next, "**in the standby state, the microcontroller controls the active infrared sensor to emit the**

infrared pulse signal” (Zheng’s microcontroller unit causes the infrared transmitting tube to transmit infrared signals during steps S101 and S103). And ***“in the sleep state, the microcontroller cuts off a power of the active infrared sensor”*** (if no reflected signal is detected at step S102, Zheng powers off the infrared receiving tube until it is necessary to repeat step S101—and the 1.5 millisecond power on step that precedes it—200 milliseconds later). This is shown below:



Ex. 1005, ¶¶ 175-179.

[1-3] “remaining the microcontroller in a working state if a reflection output signal is received from the active infrared sensor and controlling a driving circuit to drive a motor to rotate forward to open a lid of the induction trash can, delaying for a few seconds after the motor has driven the lid to open, controlling the driving

circuit to drive the motor to rotate backward to close the lid, and setting the microcontroller into the sleep state after the lid is closed; and”

This is all taught by Zheng. Zheng’s bin will maintain power to its infrared sensor—and not put the microcontroller into dormancy mode—if a reflected infrared signal is detected at step S102. If a user maintains their hand in front of the trash bin, the bin will then be opened after step S104.

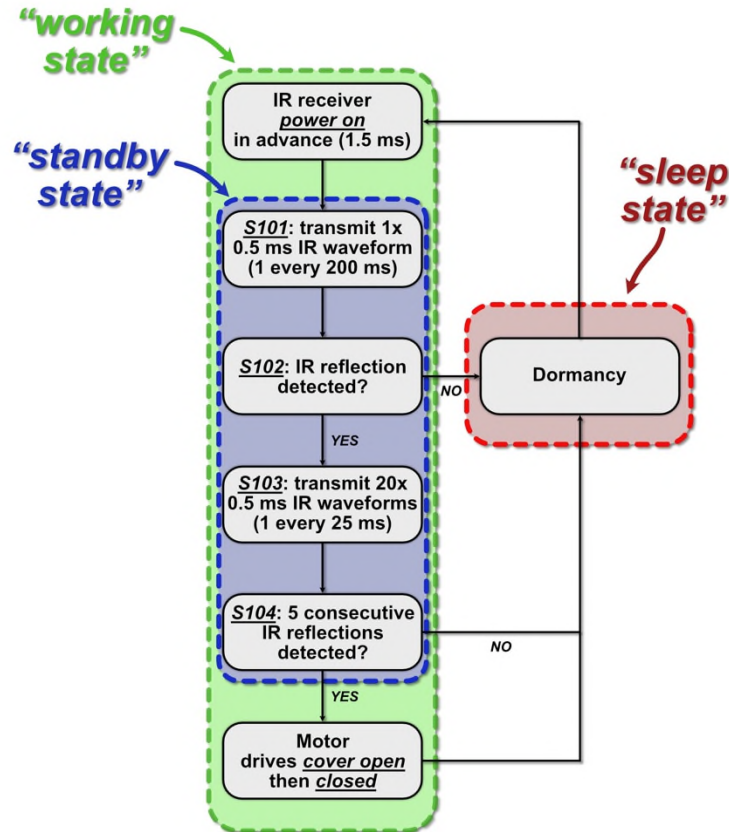
More particularly, according to Zheng, its microcontroller “periodically” supplies power to its “infrared receiving tube” during operation. Zheng, [0064]-[0066]. The receiving tube is powered on in advance of step S101. *See id.* The infrared transmitting tube transmits one “infrared signal of a first pulse waveform” during step S101. *Id.*, [0051]-[0052]. If a “reflected infrared signal” is detected during step S102, Zheng proceeds to step S103. *Id.*, [0053]-[0057]. During step S103, the infrared transmitting tube “continuously transmits” an “infrared signal of the second pulse waveform” every 25 milliseconds 20 times. *Id.*, [0058]-[0059]. Then, in step S104, if reflected infrared signals are “continuously detected” 5 times, the bin cover is “control[led] to start to act” for purposes of “open[ing] an upper cover of” the “environmentally-friendly trash bin.” *Id.*, [0061]-[0062]. If, however, no (or an insufficient quantity of) reflected signals are detected at step S104, Zheng will return back to the beginning of its process and “continu[e] to control, every ... first preset time, the infrared transmitting tube to transmit the first pulse waveform once” in step S101. *Id.*, [0073]-[0075]. Once again, Zheng states that it performs a

“power[] on” procedure in advance of step S101. *Id.*, [0064]-[0066]. No similar procedure occurs in advance of any other step. So, as explained, a POSITA would have understood that Zheng’s infrared sensor remains powered as it proceeds through steps S101 through S104. *See* Ex. 1005, ¶¶ 181-189.

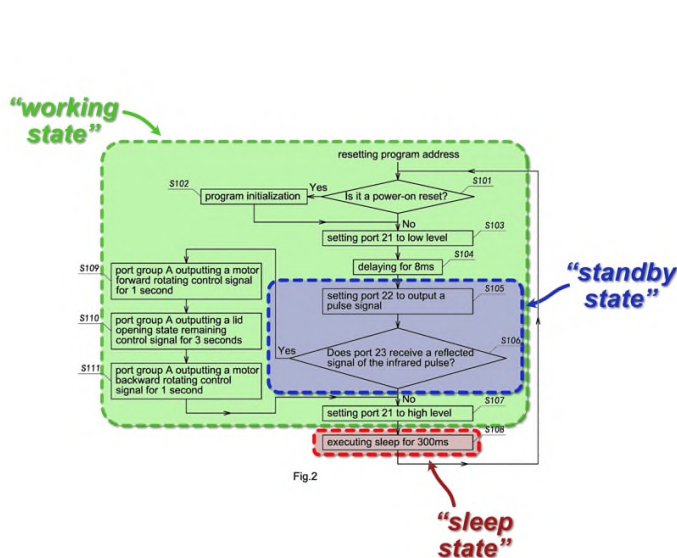
As explained above, the claimed **“working state”** is the state in which the microcontroller is not sleeping and supplies power to the active infrared sensor. *See supra* Section V. Zheng’s microcontroller operates to **“remain[] the microcontroller in a working state if a reflection output signal is received from the active infrared sensor”** (the microcontroller only performs a power off / power on procedure in advance of step S101, but will remain awake with the sensor powered if a reflected infrared signal is detected at step S102 or step S104 to allow the detection process to continue). Next, in this **“working state,”** the **“microcontroller”** **“control[s] a driving circuit to drive a motor to rotate forward to open a lid of the induction trash can.”** If reflected infrared signals are detected at step S104, the bin cover is driven open by a motor. *See* Ex. 1005, ¶¶ 190-193.

Zheng’s control method also includes the required three separate states: a **“working state,”** **“standby state,”** and **“sleep state.”** Per Zheng, its microcontroller controls the “infrared receiving tube to be powered on in advance” of a “third preset time” of “1.502 milliseconds.” Zheng, [0064]-[0066]. This “power[] on” step occurs “before step S101” where an infrared signal of a “first pulse waveform” is

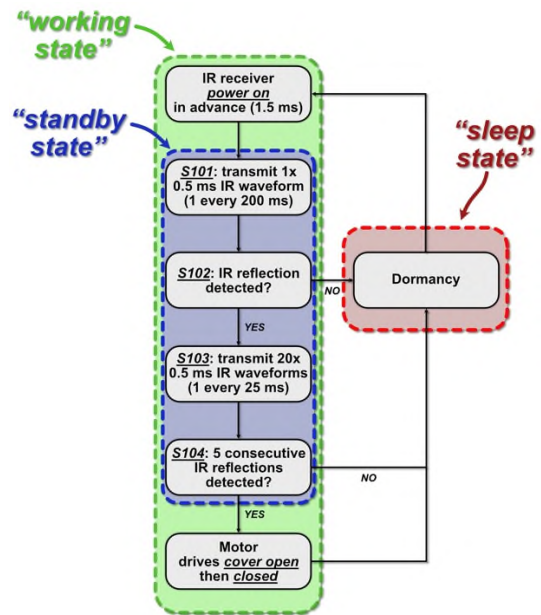
transmitted. *Id.* It follows that in Zheng, there is a period of time—the “third preset time” of “1.502 milliseconds”—where Zheng’s infrared sensor is powered but not yet transmitting an infrared signal. This is Zheng’s “**working state**.” Next, Zheng’s “**standby state**” includes the periods of time—steps S101-S104—where infrared signals are transmitted for detection. According to Zheng, it maintains power to its infrared sensor for at least 2.104 milliseconds seconds. *See id.* Zheng also provides that it takes 0.526 milliseconds to transmit the “first pulse waveform.” *Id.*, [0052]. Thus, the microcontroller is awake with the infrared sensor supplied with power for a longer period of time (the “**working state**”) than the sensor is caused to transmit and then detect an infrared signal (the “**standby state**”). Finally, Zheng’s “**sleep state**” includes the dormancy period when the infrared sensor is not powered. The three states are annotated in the demonstrative figure below:



Ex. 1005, ¶¶ 194-202. Further, as shown below, Zheng’s operation is indistinguishable from that of the ’796 patent. Both Zheng and the ’796 patent teach microcontrollers (with an associated infrared sensor) that wake from a “*sleep state*” into a “*working state.*” Infrared signals are emitted and detected during a “*standby*” state. And the microcontroller remains in the “*working state*” for purposes of opening/closing the bin cover if an approaching hand is detected:



'796 Patent



Zheng

Next, Zheng's method also *"delay[s] for a few seconds after the motor has driven the lid to open."* Zheng explains that its trash bin is opened in a way that "facilitates people to directly throw garbage into the trash bin." Zheng, [0004]; see also *id.*, [0043] (similarly noting that opening of the bin's cover allows one to "throw garbage into the trash bin"), [0063] (similar). According to Zheng, this makes use of the trash bin "convenient" and "ensure[s] cleanness and tidiness of an environment around the trash bin." *Id.* Given this, a POSITA would have understood—or at the very least considered it highly obvious—that Zheng would keep its trash bin cover open and delay closing for a few seconds to allow a person to "throw garbage into the trash bin" as Zheng intends. If Zheng's bin cover were instead to immediately snap closed after opening, it would be unnecessarily difficult to deposit trash. A quickly closing bin cover would interfere with the throwing out

process by either deflecting trash or impacting the user's hand while it is still in proximity of the bin. See Ex. 1005, ¶¶ 203-210. In contrast, keeping the cover open for a few seconds would ensure that users would be able to successfully deposit trash into the bin before the cover is closed. This would in turn make the bin more convenient to use and reduce mess around the bin. See *id.*, ¶¶ 209-210.

As this limitation next requires, Zheng ***“control[s] the driving circuit to drive the motor to rotate backward to close the lid.”*** Per Zheng, “[t]he motor rotates clockwise to open the upper cover, and rotates counterclockwise to close the upper cover.” *Id.*, [0104].

Finally, a POSITA would have understood that Zheng ***“set[s] the microcontroller into the sleep state after the lid is closed.”*** Zheng's system is intended to allow a trash bin cover to be repeatedly opened and closed. See, e.g., *id.*, [0043] (“[t]he smart environmentally-friendly trash bin can automatically open the upper cover when a person carrying garbage walks up to the smart environmentally-friendly trash bin”), [0063] (similarly noting that the bin is opened “when a person carrying garbage walks up” to the bin), [0114] (similar). To allow for this repeated opening and closing, after bin closing, Zheng restarts its control procedure from the beginning for purposes of detecting the next bin opening event: “after step S104,” Zheng “continu[es] to control, every ... first preset time, the infrared transmitting tube to transmit the first pulse waveform once.” *Id.*, [0073]-[0074]. Further, Zheng

explains that “each time” “before” it performs “step S101,” its microcontroller “control[s] the infrared receiving tube to be powered on.” Zheng, [0064]-[0066]; *see also* [0011] (similarly noting that “each time before” it “control[s] an infrared transmitting tube to transmit an infrared signal of a first waveform once” it “control[s] the infrared receiving tube to be powered on in advance of a third preset time”), [0102] (similar). In other words, Zheng always starts its control procedure by powering on its infrared receiving tube. It follows that Zheng’s infrared sensor must be powered off—with the microcontroller in its dormancy mode (*see id.*, [0113] (explaining that the microcontroller enters the “dormancy mode” when the infrared sensor is powered off))—after the bin is closed. If the microcontroller did not enter dormancy and power off the sensor after lid closing, it would not be necessary to power on the infrared sensor in advance of step S101 as Zheng teaches. *See* Ex. 1005, ¶¶ 212-217.

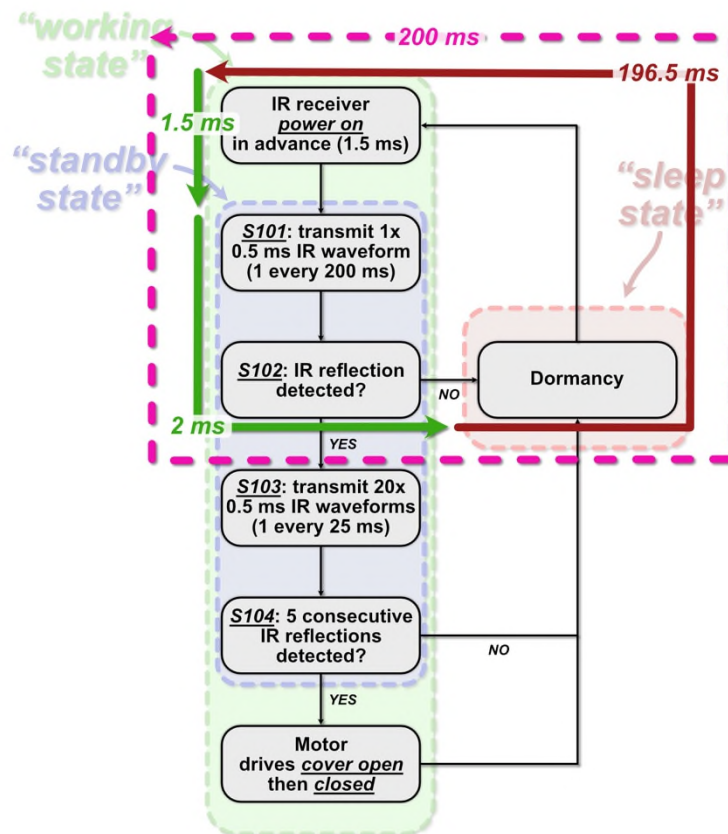
[1-4] “after a preset time, via a watchdog timer, waking up the microcontroller from the sleep state to the working state, so as to have the microcontroller reenter the working state and repeat the above steps under the standby state”

This is rendered obvious by Zheng. Zheng employs a 200 millisecond long timer to ensure that its “first pulse waveform” is transmitted at the appropriate interval. The microcontroller automatically enters (and wakes from) the dormancy mode between transmissions.

More particularly, Zheng explains that its microcontroller causes its “infrared transmitting tube to transmit” an “infrared signal of a first pulse waveform” “once” “every first preset time” during step S101. Zheng, [0051]. This “first preset time” can be “200 milliseconds.” *Id.*, [0052]. If no “reflected infrared signal” is detected by the “infrared receiving tube” during step S102, the process will not proceed to step S103 and will instead repeat step S101 in 200 milliseconds. *Id.*, [0053]-[0054].

Further, according to Zheng, its infrared sensor is not “turned on all the time” and will instead be “turned off after being turned on for a period of time.” *Id.*, [0066]. In one example, “before step S101” is performed, the “infrared receiving tube” is “powered on in advance of a third preset time” of “1.502 milliseconds.” *Id.* Zheng then keeps the sensor “powered on for a fourth preset time” of “2.104 milliseconds.” *Id.*, [0064]-[0066]. Of this time, it takes “0.526 milliseconds” to transmit the “first pulse waveform.” *Id.*, [0051]. Assuming Zheng’s system does not proceed to step S103, the sensor will then “turned off” at the end of the 2.104 millisecond period to “reduce[]” “energy consumption.” *Id.* The microcontroller also “automatically enters” a “dormancy mode” to further save power when the sensor is not powered. *Id.*, [0113]. The microcontroller will then exit dormancy and power on the sensor to transmit another “first pulse waveform” at the 200 millisecond mark. *See id.*, [0053]-[0054].

This results in the operation shown below. The sensor powers up for 1.5 milliseconds (first green arrow). The sensor then maintains power for 2.0 milliseconds to transmit and then detect an infrared pulse (second green arrow). The sensor will remain powered off for 196.5 milliseconds (red arrow) before powering back on and repeating the process. This on / off process results in a complete cycle that ensures that one first pulse waveform is transmitted every 200 milliseconds as required:



Ex. 1005, ¶¶ 219-228.

Per Zheng, three pre-specified times are used during this on / off process: (1) a “third preset time” of 1.5 milliseconds dictates how long sensor power up takes,

(2) a “fourth preset time” of 2.0 milliseconds dictates how long the sensor remains powered for purposes of transmission / detection, and (3) a “first preset time” of 200 milliseconds controls the overall process timing by determining how often a “first pulse waveform” is transmitted. See Zheng, [0051]-[0052] (discussing “first preset time”), [0064]-[0066] (discussing “third” and “fourth preset time[s]”). The “first preset time” of 200 milliseconds is the claimed **“preset time”** for **“waking up the microcontroller.”** This time determines when Zheng’s system will transmit a subsequent first pulse waveform and also when Zheng’s microcontroller must emerge from dormancy and power up the sensor in preparation for this transmission. See Ex. 1005, ¶¶ 228-229.

While Zheng does not specifically state that it employs a **“timer”** for purposes of waking its microcontroller from dormancy, a POSITA would have considered this obvious. Again, Zheng employs a “first preset time” of 200 milliseconds for purposes of controlling how often a “first pulse waveform” is transmitted. And as explained, this “first preset time”—along with the “third preset time” and “fourth preset time”—will dictate how long the microcontroller keeps the sensor powered on, and how long it remains in the dormancy mode after powering off. See *id.*, [0050]-[0052]; see also *id.*, [0064]-[0066]. A POSITA would have recognized that one straightforward and highly obvious way to ensure proper signal timing would be to simply start a 200 millisecond timer when powering on the infrared sensor at

the start of the “third preset time.” The sensor would then remain powered on for 3.5 milliseconds (1.5 seconds as specified by the “third preset time,” followed by 2.0 seconds as specified by the “fourth preset time”). 196.5 milliseconds would remain on this timer when the sensor is powered down and the microcontroller enters the dormancy mode. When the timer reaches zero, the microcontroller would exit dormancy mode, the infrared sensor would be powered on, and the process would repeat. See Ex. 1005, ¶¶ 230-233.

Next, in Zheng, upon **“waking up[,]” “the microcontroller”** transitions **“from the sleep state to the working state.”** Zheng’s microcontroller is in a “dormancy mode” whenever its infrared sensor is not powered. Zheng, [0113]. And Zheng explains that it performs its “power[] on” procedure “in advance [of the] third preset time” whenever it exits dormancy and “before step S101.” *Id.*, [0064]-[0066]. Thus, whenever Zheng wakes the microcontroller, it will perform the sensor power up (*i.e.*, enter the **“working state”**) before transmitting infrared signals. Zheng then proceeds to perform steps S101 through S104 (the **“standby state”**) as appropriate. See *id.*, [0050]-[0063]; Fig. 1. Thus, after exiting dormancy, **“the microcontroller reenter[s] the working state and repeat[s] the above steps under the standby state.”** See Ex. 1005, ¶¶ 234-239.

A POSITA would also have considered it obvious to implement Zheng’s 200 millisecond timer (which again controls when the microcontroller powers on the

infrared sensor and how often the first pulse waveform is transmitted) as a “**watchdog timer.**” At the time the ’796 patent was filed, watchdog timers were known to be typically associated with and used in the monitoring of microcontroller operation. See Ex. 1005, ¶ 240-255. Zheng’s system employs a “microcontroller unit” to control operation of its trash bin. Zheng, [0037]-[0043]. Further, watchdog timers typically operated by issuing a reset command to restart normal microcontroller operation if the timer expires. See Ex. 1005, ¶¶ 243-244. This is the very functionality that Zheng’s system requires. If its infrared sensor (and the associated microcontroller unit) does not detect a reflected infrared signal at step S102, the microcontroller will enter a dormancy state and power off the infrared sensor. Then, Zheng resets the microcontroller at the appropriate time allowing it to re-perform the entire process, including power up, transmission of a signal at step S101, and signal detection at step S102. Because watchdog timers are both (1) typically used to control microcontroller operation, and (2) provide the timing functionality Zheng’s system requires, a POSITA would have been motivated—and considered it obvious—to employ such a timer with Zheng. See *id.*, ¶ 245.

Watchdog timers were also routinely used with microcontrollers to control the on/off timing of infrared sensors. For instance, one reference to Gropper (Ex. 1006) teaches a system for remotely monitoring the fill level of a waste receptacle. *Id.*, 1:15-37, 2:26-34. The system—like Zheng—uses a “sensor 4” with an “infra red

transmitter 97 and infra red receiver 98.” *Id.*, 7:53-55. The sensor is “aimed at a central position of the material stored in a” waste “receptacle 22.” *Id.*, 7:55-60. Gropper explains that its infrared monitoring system improves “efficiency” via “power saving modes during the vast majority of time that sensor 4 is not sensing....” *Id.*, 12:19-21. Per Gropper, “[o]ften the best power saving mode is to have” a “microcontroller ... turn off power to all peripheral units” and then “place [the] microcontroller ... in a sleep mode.” *Id.*, 12:22-26. A “watch dog timer within [the] microcontroller ... is used to wake up” the “microcontroller ... from the sleep mode” when, for instance, “a preset time has passed.” *Id.*, 12:26-31.

Another patent to Wegelin (Ex. 1007) teaches “‘hands-free’ fluid dispensers and methods for dispensing liquid fluid when an object enters a target field.” *Id.*, 1:6-10. A “photodetector 22” that “detects ... light of [an] infrared light emitting diode” detects close objects for purposes of controlling the dispenser. *Id.*, 4:4-26. The dispenser employs a “controller” with a “watchdog timer ... so that the controller may be stopped or halted for a predetermined period of time.” *Id.*, 4:65-5:1. This allows “full operation of the controller” to “only occur[] at predetermined increments so as to reduce current draw from a power supply.” *Id.*, 5:1-3. “This conserves power and helps increase the life of the power supply which may be in the form of a battery.” *Id.*, 5:3-5.

A patent to Parsons (Ex. 1008) provides yet another example of use of a watchdog timer. Parsons teaches “automatic sensor based faucets and methods of operating such faucets.” *Id.*, 1:63-64. To control faucet operation, the faucet employs “a known infrared type” “[t]ransceiver” with a “light emitting diode” and an “infrared sensor which detects light reflected from a hand or other object positioned under the faucet spout.” *Id.*, 18:60-19:4. A “microcontroller ... communicates” with this infrared sensor. *Id.*, 21:64-22:2. The “microcontroller” “goes to a ‘sleep’ mode” at the end of its control procedure to “conserv[e] battery power.” *Id.*, 22:5-10. Then, the “microcontroller ... receives ‘wake-up’ signals from a timer (i.e., watchdog) ... every 250 msec.” *Id.*

In sum, watchdog timers were routinely used in the prior art to wake up microcontrollers from sleep states. Such timers were also used in systems analogous to Zheng, including those employing infrared sensors for monitoring waste containers (Ex. 1006), activating hands-free fluid dispensers (Ex. 1007), and controlling automatic faucets (Ex. 1008). And watchdog timers were known to improve the efficiency of systems employing infrared sensors for object detection. *See, e.g.*, Ex. 1006, 12:19-31; Ex. 1007, 5:1-5; Ex. 1008, 22:5-10. The routine use of watchdog timers—along with the fact that this type of timer provides the very type of wakeup and power saving functionality Zheng requires—would have provided a strong motivation to use such a timer with Zheng. *See* Ex. 1005, ¶¶ 255-

258. It also would have provided a POSITA with a more than reasonable expectation of success: as watchdog timers had already been successfully employed in the art to wake up infrared sensor controlling microcontrollers, a POSITA would have every reason to believe that Zheng would be able to successfully employ such a timer for a similar purpose. *See id.*, ¶¶ 258-259.

2. *Claim 2*

Claim 2 depends on claim 1 and first requires:

[2-1] “cutting off the power supply of the active infrared sensor when the microcontroller enters the sleep state; and”

This is disclosed by Zheng. In particular, as explained, Zheng’s “infrared receiving tube” is not “turned on all the time.” Zheng, [0066]. Thus, when not in use it is “turned off” for purposes of saving power. *Id.* Moreover, Zheng’s “microcontroller unit” “automatically enters a dormancy mode when the infrared transmitting tube and the infrared receiving tube do not work” (*i.e.*, when not powered) for purposes of “saving more power.” *Id.*, [0113]. Thus, just as required, Zheng “*cut[s] off the power supply*” to its “*active infrared sensor*” (the infrared receiving tube—part of its sensor—is not powered) “*when the microcontroller enters the sleep state*” (the microcontroller is in dormancy when the infrared sensor is not powered). *See* Ex. 1005, ¶¶ 262-264.

Claim 2 next requires:

[2-2] “restoring the power supply of the active infrared sensor, delaying for a preset threshold time for the active infrared sensor to enter a stable working state, and controlling the active infrared sensor to emit the infrared pulse signal to the induction area when the microcontroller is in the standby state.”

This is also disclosed by Zheng. Again, Zheng explains that “before step S101” is performed (the step where an infrared signal is transmitted), the “infrared receiving tube” is “powered on in advance of a third preset time” of “1.502 milliseconds.” Zheng, [0064]-[0066]. At the end of this 1.502 millisecond period, Zheng then performs step S101 and causes its “infrared transmitting tube” to transmit “an infrared signal of a first pulse waveform once.” *Id.*, [0051]. This transmitted signal can then be “detect[ed]” by the “infrared receiving tube” during step S102. *Id.*, [0053]-[0054]. The infrared receiving tube operates by detecting “reflected infrared signals.” *Id.*, [0054], [0063], [0103], [0114]. It is also “located close” to the “infrared transmitting tube” “fac[ing] in the same direction.” *Id.*, [0054]. Thus, Zheng ***“restor[es] the power supply of the active infrared sensor”*** (it turns on its infrared receiving tube prior to performing transmitting step S101), ***“delay[s] for a preset threshold time”*** (it waits a third preset time of 1.502 milliseconds before performing step S101). Because this period of delay occurs prior to the transmission or detection of any signals, a POSITA would have understood that it is intended to allow the Zheng’s sensor to ***“enter a stable working state.”*** See Ex. 1005, ¶¶ 267-270. Zheng then ***“control[s] the active infrared sensor to emit the infrared pulse signal to the induction area when the microcontroller is***

in the standby state” (its infrared transmitting tube transmits a signal in step S101 which can be detected by the infrared receiving tube in step S102). Zheng’s infrared receiving tube also faces an **“induction area”** (it is designed to receive—and detect—reflected infrared signals reflected from the area in front of the trash bin). See *id.*, ¶¶ 271-272.

3. **Claims 3 and 4**

Claims 3 and 4 respectively depend on claims 1 and 2. Both further require: **“wherein the preset time is between 100 ms and 500 ms.”**

This is disclosed by Zheng. As explained when discussing claim 1, Zheng employs a “first preset time” of 200 milliseconds to control how often a “first pulse waveform” is transmitted. See Zheng, [0051]-[0052] (discussing “first preset time”). This also dictates how long Zheng’s microcontroller will remain in dormancy before waking up to transmit another first pulse waveform. See *supra* discussion of limitation [1-4]. 200 milliseconds is within the claimed range of **“100 ms and 500 ms.”** See Ex. 1005, ¶¶ 275-277.

4. **Claims 5 and 6**

Claims 5 and 6 respectively depend on claims 2 and 4. Both further require: **“wherein the preset threshold time is between 2 ms and 50 ms.”**

As explained when discussing claim 2, Zheng’s system delays for a preset time of 1.502 milliseconds before performing infrared signal transmitting step S101 and signal detection step S102. See *supra* discussion of limitation [2-2].

While this preset delay time slightly outside the range of “**2 ms and 50 ms**” required by these claims, “where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.” *E.I. DuPont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018); *see also Teva Pharms. USA v. Corcept Therapeutics*, 18 F.3th 1377, 1382 (Fed. Cir. 2021). Because of this, “obviousness exists when the claimed range and the prior art range do not overlap but are close enough such that one skilled in the art would have expected them to have the same properties.” *Id.* (quoting *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003).)

Here, there is no meaningful difference between the delay employed by Zheng and the '796 patent. Both delay upon power on for a preset time before transmitting and detecting infrared signals (Zheng delays for 1.502 milliseconds; the '796 patent delays for 2-50 milliseconds). A POSITA would also have understood that both Zheng and the '796 patent employ this period of delay for similar purposes. Because Zheng's delay occurs immediately upon powering on its sensor and before step S101 is performed (*see* Zheng, [0064]-[0065]), a POSITA would have understood that it is intended to prepare the now powered infrared sensor for the later transmitting and detecting steps. *See* Ex. 1005, ¶¶ 280-285. The '796 patent's period of delay is likewise intended to allow its sensor to “enter a stable working state” before transmitting and detecting infrared signals. Ex. 1001, 2:36-42.

Zheng also explains that while the applied delay after power on can be 1.502 milliseconds, it is just an “optional[]” value. Zheng, [0066]. Thus, when implementing Zheng, a POSITA would also have considered it obvious to use other values. Zheng controls its infrared sensors in increments of “T” or “0.526 milliseconds.” *Id.*, [0052] (discussing transmission for “T”); [0066] (referencing control for “2T” and “4T”). This would have led a POSITA to also consider—among other things—using delay times that are either 1T above or 1T below 1.5 milliseconds (*i.e.*, delays of about 1.0 or 2.0 milliseconds). *See* Ex. 1005, ¶¶ 286-288. A POSITA would have considered use of these alternate delay times—in particular, a slightly longer 2.0 millisecond delay (falling within the claimed range)—to amount to nothing more than a routine, obvious design choice and optimization exercise. *See id.* Use of a slightly longer delay would better ensure that the infrared sensor is prepared to transmit and detect signals. *See id.*, ¶ 289. While an excessively long delay could introduce latency causing the trashcan to fail to detect a hand, a POSITA would have recognized that small changes in the power on delay time (*e.g.*, using 2 milliseconds rather than 1.5 milliseconds) would not have such an effect. *See id.*, ¶ 290. An additional 0.5 milliseconds of delay would be imperceptible. *See id.* Thus, a POSITA would have recognized that using a slightly longer delay would have improved operation of Zheng’s trashcan (by better ensuring that the infrared sensor is prepared to transmit/detect) while not otherwise

adversely impacting operation (an additional 0.5 milliseconds of power on delay would not present a substantial risk of a missed detection). *See id.*, ¶ 291.

5. ***Claims 7, 8, 9, 10, 11, and 12***

Claims 7, 8, 9, 10, 11, and 12 respectively depend on claims 1, 2, 3, 4, 5, and 6. They all further require:

“wherein the induction area is arranged above the induction window that is located on the front can edge of the trash can.”

Again, Zheng explains that its trash bin includes an “infrared transmitting tube and ... infrared receiving tube” that are both “arranged” on the “trash bin” to “face the same direction ... and are located close to each other.” Zheng, [0103]. The “infrared receiving tube” operates to detect “reflected” infrared signal that was “blocked by a person or an object.” *Id.* Further, Zheng explains that its trash bin is designed to detect a person—and open—“when a person carrying garbage walks up to the smart environmentally-friendly trash bin.” *Id.*, Abstract; *id.*, [0004] (same); *see also id.*, [0043] (noting that “a person or object walks up to the smart environmentally-friendly trash bin” and “blocks the infrared signal” causing the bin to automatically open); [0054], [0063], [0114] (similar). The bin includes an “upper cover” that allows this approaching “user” to “throw garbage into the trash bin.” *Id.*, [0092].

This renders everything this limitation requires obvious. In particular, Zheng’s infrared sensor includes an ***“induction window”***: it includes an infrared

receiving tube that is situated adjacent to its infrared transmitter and operates to detect reflected infrared signals. *Id.*, [0103]. This receiving tube is designed to detect objects in its **“induction area”**: the infrared receiving tube will only detect a user when the user passes close enough to the tube such that the user “block[s]” and “reflect[s]” the transmitted infrared signal. *Id.*, [0054], [0063], [0103], [0114]; *see also* Ex. 1005, ¶¶ 293-298.

Further, a POSITA would have understood that Zheng’s **“induction area”** is **“above”** its **“induction window,”** and that the area and window are—or at the very least obviously would be—located **“on the front can edge of the trash can.”** Again, Zheng’s bin includes an “upper cover.” Zheng, Abstract, [0002], [0004], [0010], [0043], [0095]. And the bin is designed to open when a user “walks up” to the bin. *Id.*, [0004], [0043], [0054], [0063], [0114]. Given this, a POSITA would have understood that the most obvious location to situate Zheng’s infrared transmitting and receiving tubes would be at the top, front-facing edge of the bin. Trash bins are often situated with their backs against a wall. Bins are also frequently shorter in height than users. Thus, users seeking to dispose of garbage in the bin will—in almost all cases—approach the bin from the front and above. A POSITA would have understood that Zheng’s infrared sensor (and the receiving tube it contains) must be situated such that it is able to detect users approaching from this direction. Locating the infrared transmitting tube and the infrared receiving tube on the front, top edge

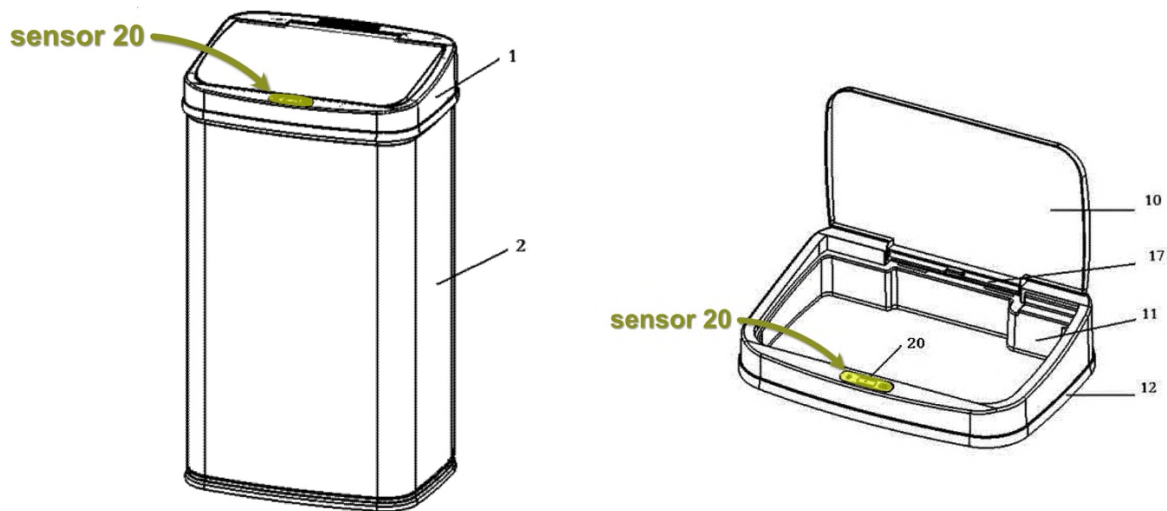
of Zheng's trash bin would have best facilitated detection of users approaching from this direction. See Ex. 1005, ¶¶ 299-305. It would make little sense to locate the tubes elsewhere. For instance, locating the infrared sensor at the rear of the bin would not facilitate proper detection (as the user cannot approach from the direction of the wall, and the wall itself would interfere with proper infrared signal detection). See *id.*, ¶¶ 306.

IX. GROUND 2: OBVIOUSNESS IN VIEW OF ZHENG AND CHANG

As explained in Ground 1, Zheng itself renders claims 7, 8, 9, 10, 11, and 12 obvious: a POSITA would have considered it highly obvious to locate Zheng's infrared transmitting and receiving tube at the front of the trash bin. These same claims are also rendered obvious by the combination of Zheng and Wang. Wang provides an example of how a POSITA would have understood Zheng's trash bin to be structured: with its infrared sensor mounted on the top front of the bin.

Again, claims 7, 8, 9, 10, 11, and 12 all require a trash bin with an infrared sensor including an ***“induction area ... arranged above the induction window that is located on the front can edge of the trash can.”*** To begin, “induction” or “touchless” trash cans were admittedly “well known in the art” when the '796 patent was filed. See, e.g., Ex. 1002, p. 170 (Patent Owner conceding during prosecution that “touchless” trash cans were well known); Ex. 1001, 1:25 (induction cans characterized as “[c]onventional” in the '796 patent specification). Wang teaches

one such known, conventional trash bin. And Wang's bin, like the known bins available at the time, would obviously include the very type of sensor this claim requires. Wang's bin includes an "upper can body 1" and a "lower can body 2." Wang, [0018]. The "lower can body" serves as a "garbage storage space." *Id.* The "upper can body" includes an automatically opening "can cover 10" and houses the trash bin's "opening-closing apparatus." *Id.* The "opening-closing apparatus" includes "a sensor 20." *Id.* "The sensor 20 is disposed on the front side" of the upper can body, and "extend[s] out" of a "mounting hole" in the top of can body's "covering housing." *Id.*, [0019]. This is shown in Figures 1 and 3 below:



Id., Figs. 1, 3 (annotated). According to Wang, the sensor is intended to detect "[w]hen a hand approaches the sensing trash can." *Id.*, [0023].

A POSITA would have considered it highly obvious that Zheng's trash bin would be structured in the same way. The bin would include an automatically opening cover at its top. An infrared sensor would be located at the top front of the trash bin for purposes of detecting a user approaching the front of the bin to throw away trash. *See* Ex. 1005, ¶¶ 311-315. Locating the sensor in the same place depicted in Wang would have ensured that Zheng's trash bin operates as intended: users approaching the bin from the front would be detected allowing the bin to automatically open for purposes of disposing trash. *See id.*, ¶ 316.

A POSITA would also have considered the location of Zheng's infrared transmitting and receiving tubes to amount to nothing more than a routine, obvious design choice. Again, "the touchless trash can is well known in the art." Ex. 1002, p. 170; *see also* Ex. 1001, 1:25 (induction trash cans were "[c]onventional"). Thus, a POSITA would have been well aware of how to best situate the infrared sensor employed by such a bin. *See* Ex. 1005, ¶ 317, 319-320. Wang simply provides one example of where an automatically opening trash bin's sensor should be located to properly and consistently detect an approaching user. *See id.*

Zheng and Wang are also directed to similar subject matter: automatically opening trash bins that use a sensor to detect an approaching user. *See, e.g.*, Zheng, [0004]; Wang, [0003]. This would have further motivated combination of the references and provided a POSITA with a more than reasonable expectation of

success. *See* Ex. 1005, ¶¶ 321-322. Wang also explains that its trash bin has a “compact structure, a proper design, a stable and reliable transmission mechanism, and good waterproof, moisture-proof, and corrosion-proof performance.” Wang, [0003]. A POSITA would have understood that locating and mounting Zheng’s sensor in the same way exemplified by Wang would have improved Zheng by similarly rendering its trash can’s opening mechanism waterproof, moisture-proof, and corrosion-proof. *See* Ex. 1005, ¶¶ 323-324. The sensor—and Zheng’s other internal components—would be better protected from the contents of the trash bin and other potential contaminants. *See id.*, ¶ 324. This would have further motivated use of Wang’s specific trash bin design (including its method of mounting—and protecting—its sensor within its bin housing). *See id.*, ¶ 325.

X. CONCLUSION

For the foregoing reasons, Petitioner respectfully requests institution of IPR and cancellation of claims 1-12.

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing PETITION FOR *INTER PARTES* REVIEW complies with the type volume limitation in 37 C.F.R. § 42.24. According to the utilized word-processing system's word count, the petition—excluding the caption, table of contents, table of exhibits, mandatory notices, certificate of word count, and certificate of service—contains 10,834 words.

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CERTIFICATE OF SERVICE

The undersigned hereby confirms that the foregoing PETITION FOR IPR and associated exhibits were caused to be served on August 13, 2025 via overnight courier upon the following counsel of record for Patent Owner:

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