

In one exemplary embodiment N=6, and wall control unit 1 114' can, and sometimes does, control 6 fan devices (fan device 1 110', fan device 2, fan device 3, fan device 4, fan device 5, fan device 6 112') to turn on their fans, at the same time, via a command, e.g., a command communicated in an RF control signal sent from wall control unit 1 114'. In some such embodiments, all 6 fans are being powered from the same AC line, e.g., the same 20 A AC input power line. In some such embodiments, the 6 fans, e.g., Brushless DC motor fans, do not include an optical encoder, magnetic encoder, e.g., resolver or synchro, or Hall effect sensor. In various embodiments, (fan device 1 110', fan device 2, fan device 3, fan device 4, fan device 5, fan device 6 112'), which can be, and sometimes are, turned on concurrently while on the same input power line, each include an exemplary AC power interface including: a varistor, a common mode choke, an X capacitor, and two Y capacitors. In some embodiments, the AC power interface of each fan device includes a multi-layer board, e.g., a 4 layer circuit board, in which one copper layer is connected to earth ground. In some embodiments, the 6 fan devices may, and sometimes do, include one or more 10 ft ceiling fans. In some embodiments, each of the 6 fan devices includes a 10 ft ceiling fan.

In another embodiment, N=10, and wall control unit 1 114' can, and sometimes does, control 10 fan devices (fan device 1 110', . . . , fan device 10 112') to turn on their fans, at the same time, via a command, e.g., a command communicated in an RF control signal sent from wall control unit 1 114'. In some such embodiments, all 10 fans are being powered from the same AC line, e.g., the same 20 A AC input power line. In some such embodiments, the 10 fans, e.g., Brushless DC motor fans, do not include an optical encoder, magnetic encoder, e.g., resolver or synchro, or Hall effect sensor. In some embodiments, the 10 fan devices may, and sometimes do, include one or more 10 ft ceiling fans. In some embodiments, each of the 10 fan devices includes a 10 ft ceiling fan.

FIG. 9 is a drawing 1000 of an exemplary AC power interface 322' coupled to an exemplary DC power supply 324' which may be used in the fan device 300 of FIG. 3 in accordance with an exemplary embodiment. In some embodiments, AC power interface 322' is AC power interface 322 of fan device 300 of FIG. 3, and DC power supply 324' is DC power supply 324 of fan device 300 of FIG. 3.

AC power, e.g., 90-264 VAC 47-63 Hz input via 16 AWG wires, is input via L terminal 342, and N (Neutral) terminal 340, and G terminal 343 is connected to earth ground. The line connected to L terminal is referred to a Line IN and Line IN is fused, with fuse F1 1002, e.g., a 3.15 A fuse. After the fuse F1 1002, there are several components, varistor RV1 1004, common mode choke L1 1006, and capacitors C5 1008, C7 1010 and C11 1012, which contribute to the AC filtering, and produce a filtered AC.

Varistor RV1 1004 is, e.g., a 510V 2.5 KA DISC 10 MM varistor, suppresses voltage spikes. Common mode choke L1 1006, e.g., a 15 MH 1 A 2LN TH common mode choke, plays an important role in the system in that it that actually helps with line noise entering and exiting the fan device 300, which includes receivers. Line noise is coupled within the choke 1006 to remove the noise from the AC line.

Capacitors C5 1008, C7 1010, and C11 1012 suppress high frequency noise. Capacitor C5 1008, which is a X capacitor, shunts the high frequency noise across the input AC lines (L 1007, N 1009). Capacitor C7 1010, which is a Y capacitor, shunts the high frequency noise on the AC L line 1007 to earth ground 1011. Capacitor C11 1012, which is a Y capacitor, shunts the high frequency noise on the AC

N line 1009 to earth ground 1011. In one exemplary embodiment, C5 1008, C7 1010, and C11 1012 are 0.22 UF 20% 760 RAD capacitors. In another embodiment, C5 is a 220 micro Farad 275 VAC capacitor; C7 is a 820 pF 1000V capacitor and C11 is a 820 pF 1000V capacitor.

DC power supply 324' includes full bridge rectifier BR1 1014, capacitors C6 1016, C4 1018, and DC/DC converter circuits and filters 1020, which are coupled together as shown in FIG. 9. In one embodiment, capacitor C6 1016 and capacitor C4 1018, which are across the outputs (1015, 1017) of BR1 1014, are each 82 micro Farad 400V electrolytic capacitors. BR1 1014, is a Full bridge rectifier BR1 1014, e.g., a GPP 10 A 1000V GBU rectifier bridge, takes the filtered AC from lines (1007, 1009) and makes a DC BUS, V BUS 1022, with respect to DC ground 329, across its outputs 1015, 1017. In one exemplary embodiment, the DC Bus 1022 voltage is approximately 170 VDC with respect to DC ground 329, in the case of a filtered 120 VAC input to BR1 1014. For example, DC Bus voltage=RMS (AC)*sqrt(2). In some embodiments, the DC Bus 1022 voltage, e.g., 170 VDC, is used directly to provide power to the fan motor. From the DC VBUS voltage, e.g., of approximately 170 VDC, other DC rail voltages are created. DC VBUS voltage 1022 is used as input to DC/DC converter circuits and filters 1022, which generates a plurality of DC output voltages (DC output voltage 1 1024, . . . , DC output voltage N 1026), which are utilized by the fan device 300. In various embodiments, the generated plurality of DC output voltages includes a 16 VDC supply and a 3.3 VDC supply. In various embodiments, basic filtering is implemented, e.g., including decoupling and bypass capacitors, before and after each supply.

In various embodiments, the exemplary AC power interface 322' coupled to an exemplary DC power supply 324' of FIG. 9 does not include a Negative Temperature Coefficient (NTC) InRush Protection device.

In some embodiments, fan device 300 including the AC power interface 322' and DC power interface 324', uses a four layer board and the AC power interface section 322' has an internal layer, e.g., a copper internal layer, referenced to earth ground. Having an adjacent copper layer like this, which is reference to earth ground, also helps to couple noise out of the system.

Various aspects and/or features of some, but not necessarily all, embodiments, are further discussed below.

Various embodiments are directed to use of an RF and WiFi control in a fan device, e.g., fan device 300, to control fan 303 status and speed and/or fan light 306 on/off status and intensity. The fan device 300 includes both an RF interface 314 and a WiFi interface 312. The customer premises, e.g., customer premises 1 102, includes a WiFi router 118 through which WiFi communications can be sent from a WiFi capable device, e.g., a cell phone 120, to control the fan device 300 and its various functions. While WiFi control is via a WiFi router 118 in the home, the control signals normally do not traverse the Internet 106 or another external network. Accordingly, WiFi control is possible without the need for a connection to an external network or server 108. In addition to WiFi control, control of the fan device 300 can be via an RF control device 200, e.g., a wall mounted controller. In some embodiments 120V power is supplied to the fan device 300 via the wall mounted controller 202. While 120V power may be supplied via the wall controller 202, control signals from the wall mounted controller 202 are transmitted using RF signals to the RF interface 314 of the fan device 300. The RF interface 314 uses a different frequency band than the frequency band used

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for WiFi signals sent to/from the WiFi router 118. In some embodiments the RF interface 314 uses an unlicensed frequency spectrum which is different than that used for WiFi signals.

Since the RF and WiFi control signals need not pass over an external communications network as in the case of systems where commands must first be sent to a network server outside a customer premises, e.g., CP1 102, and then sent from the network server to the device to be controlled, the fan device 300 can be controlled either by the wall controller 202 or a WiFi device even if a connection to the Internet or another external network is not available.

In some, but not necessarily all embodiments, the fan device 300 reports its state and/or changes in state due to received commands to a server, e.g., control server 108, e.g., located outside the customer premises 102. The communication with the external server 108 may be, and sometimes is, via a WiFi router 118 and Internet 106 connection. The server 108 logs the state information of one or more devices, e.g., fan device 1 110 and fan device N 112, at each customer premises it is associated with. The server 108 generates, e.g., automatically, a recommended normal schedule based on historical device state information including device on/off times, fan speed information and/or light intensity information. Machine learning and historical device state information may be, and sometimes is, used for generating the recommended schedule for a customer premises. The recommended normal control schedule is communicated to an individual, e.g., a customer at the customer premises to which the schedule relates. The communication of the proposed schedule may be, and sometimes is, from the server 108 via the Internet 106 and WiFi router 118 at the customer premises, e.g., CP 1 102, to which the schedule relates. The customer can approve the recommended schedule and/or provide a revised normal schedule to be used by the server 108 to control devices at the customer premises.

In addition to generating a normal control schedule for a customer premises, an away schedule to be used when a customer indicates that the customer premises is in an away state is generated. An away state corresponds to when the normal occupants of the customer premises are away from the customer premises. The away schedule is generated based on a random function so that devices, e.g. fan device 1 110, . . . , fan device N 112, will be turned on at somewhat randomized times making it difficult for a potential burglar to determine whether the devices are being controlled by an automated system or by a human present at the premises, e.g., CP 1 102. In some embodiments historical device use information is taken into consideration when the server, e.g., control server 108, automatically generates the away schedule with the on/off times being somewhat random but remaining within a reasonable time, e.g., 30 minutes or an hour, of when the devices are turned on and off when a human is present.

While a user can control the devices, e.g., a fan device 300, while in the home via the RF controller 202 or a WiFi controller, e.g., including in WT 1 120, without having to send commands outside the home, remote control of devices, e.g., fan devices, is also supported. A user can login to the control server 108 and once authenticated is allowed to send control commands to devices, e.g., fan devices 110, 112 at the home via the control server 108 and the WiFi router 118. In this way a user can control devices, e.g., fan devices 110, 112, while away from the home. In the case of commands sent via the server 108, the server 108 can, and sometimes does, update device state information based on the commands sent from the server 108 to the device, e.g.,

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device 110, to be controlled thereby eliminating the need for the device, e.g., device 110 to report a state change to the server 108. While in some embodiments devices, e.g., fan devices 110, 112, do not report state changes to the server 108 which are in response to commands communicated by the server 108 to the device, e.g., fan device 110, being controlled, in other embodiments the devices being controlled, e.g., fan devices 110, 112, routinely report a state change to the control server 108 regardless of whether the command was from the server 108, wall controller 202 or WiFi device, e.g., WT 120, in the home.

The customer to which a home corresponds can enable/disable use of a control schedule by the server 108. For example the user can send a signal, e.g., via WT 1 120, to the control server 108 to indicate that the normal device control schedule should be used or the away device control schedule should be used or that no control schedule should be used. The signal may indicate automated control is to be set to off for the home, automated control should be set to on for the home, and, when the automated control is on whether an away state is indicated indicating that the away schedule should be used or that the premises is in a normal state and thus the normal schedule should be used.

In various embodiments a controller, e.g., wall control unit 202, with an RF interface 208 is used to control a fan device, e.g., fan device 300, which includes a fan motor 304 and may also include a lighting device, e.g., light 306. The controller 202 in some embodiments is in the form of a wall control module which may be, and sometime is, mounted in a standard electrical wall box, e.g., box 190, in a room in which the fan device, e.g., fan device 300, to be controlled is located. To simplify installation and avoid the need for more than the normal 120 v power line used to power an outlet of light, from a 120V AC prospective the controller 202 acts as a simple pass through device through which AC power is supplied to the fan device unit 300. As a safety, the controller 202 includes an AC disconnect 206 which can be used to cut all power to the fan device unit 300. The disconnect switch 206 may be in the form of a push or pull switch or a pull tab which can interrupt the power to the fan device 300.

Control of the fan device 300 is via an RF interface 208 included in the wall controller 202. In some embodiments activation of the safety disconnect switch 206 will cut power to the RF interface 208 of the wall controller 202 in addition to power to the fan device 300. In this way, in some but not necessarily all embodiments, the safety cut off 206 serves as a physical kill switch integrated into the wall controller 202 for both the wall controller 202 and the fan device 300.

The controller 202 includes inputs (216, 214, 224, 226, 220, 222, 218) for controlling fan on/off operations, light on/off operations, fan speed, e.g., up/down, and/or light intensity, e.g., fan device light output up/down, and fan direction. In some embodiments light output and fan speed can be smoothly controlled, e.g., with light intensity being controlled in a smooth fashion over a wide range of intensity value as opposed to simply a few discrete output levels. The wall controller 202 transmits RF control signals to implement or communicate commands that are generated based on the pressing or altering of the control inputs (214, 216, 218, 220, 222, 224, 226) on the wall controller 202. The control signals are transmitted to the fan device 300 using a RF frequency band which is different from that used for WiFi signals at the customer premises where the controller 202 is located.

In some embodiments, the wireless terminal 120 is not a mobile device but is instead a wall mounted device which is

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mounted in the customer premises in which one or more fan devices, e.g., fan devices 1 110, . . . , fan device N 112 are located. The wall mounted wireless terminal, may, and in some embodiments does, include a touch screen display upon which menus are presented to a user through which the user can select options to control the operation of one or more functions of the fan devices located at the customer premises, such as the light intensity, fan speed, fan direction, light on/off, fan on/off for one or more of the fans located at the customer premises.

FIG. 10 illustrates several different perspective views of an exemplary wall mounted wireless terminal in accordance with an embodiment of the present invention. Illustrated in FIG. 10 is a first perspective view 1102 of a wall mounted wireless terminal showing its touchscreen 1108 and an exemplary user menu. The second perspective view 1104 of the wall mounted wireless terminal shows an angled side view of the wall mounted wireless terminal. The third perspective 1106 shows a view of the back of the wireless wall mounted terminal.

FIG. 11 illustrates an exemplary wall control unit with a safety switch in accordance with an exemplary embodiment of the present invention. FIG. 11 illustrates a front perspective view of an exemplary wall control unit 1202 with a safety switch in accordance with an exemplary embodiment of the present invention and a side view 1204 of the same exemplary wall control unit. The wall control unit 1202 includes a light control on/off button 1206, a light up (increase light intensity) button 1208 and a light down (decrease light intensity) button 1210, a fan on/off button 1212, a fan increase speed button 1214, a fan decrease speed button 1216, a fan reverse direction button 1218 and a mechanical emergency/safety cut off switch 1220.

In some embodiments, a full calendar year (e.g., 365 day) scheduler application in the control server allows a user to store settings, instructions and commands for the operation of one or more of a set of fans devices included on a customer premises with the fan devices then being automatically controlled by the control server in accordance with the user inputted settings, e.g., timing as to when to turn on and off the fan, turn on and off the light, set direction of the rotation of the fan blades, setting of the light intensity, setting of the fan speed, etc.

In some embodiments as previously discussed, the control server includes software instructions which when executed by a processor of the control server operate the control server to generate a recommended customer fan device schedule for an upcoming time period, e.g., one or more days, one or more weeks, or one or months, for controlling the operation of one or more functions or events, e.g., light on/off, light intensity, fan on/off, fan speed, fan direction, for one or more fan devices located at a customer premises based on historical fan device state information gathered over a time frame, e.g., a plurality of days, weeks, or months. The generated recommended customer fan device schedule, e.g., a weekly schedule of fan device events, is then transmitted by the control server to the fan device via the Internet. The fan device receives and stores the generated customer fan device schedule on its memory. A copy of the fan device recommended schedule also being retained in the memory of the control server. A user may then access the local copy of the recommended fan device schedule, e.g., the weekly fan device event schedule, residing in the fan device from a wireless terminal via WiFi and determine whether to accept or modify the recommended schedule. To the extent that the user modifies the recommended schedule the modifications to the schedule are transmitted from the fan device to the

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control server to update the weekly schedule for the fan device in the control server. The processor of the fan device will then automatically operate the fan device to perform the functions/events on the weekly schedule which have been approved by the user, that is if the user opt in to the recommended schedule. The fan device functions/events perform include for example, turning the fan on on a specific day at a specific time, turning off the fan on a specific day at a specific time, turning on the lights on specific days at specific times, setting the light intensity to a specific level when the light is turned on, setting the fan speed and direction when the fan is turned on, or turning off the light on a specific day at a specific time. A user may also decide to not opt in to the recommended schedule or to modify the schedule but to instead leave the fan device in a manual mode of operation for certain days of the week or the whole week. Storing a weekly schedule of fan device events on the device that may be automatically executed by the fan device if chosen by a user to operate in an automatic mode of operation provides the benefit that if the WIFI router or internet connection to the control server becomes disabled the processor of the fan device can still operate the fan device in accordance with the automated weekly schedule as selected or programmed by the user whereas if the control server is the only device to maintain the weekly schedule then when the connection between the control server and the fan device is interrupted or fails the processor of the fan device will not properly operate the fan device in accordance with the user approved weekly schedule.

A few exemplary embodiments of how the control server identifies patterns of events and uses machine learning to generate recommended schedules will now be discussed.

For example, the control server will be operated to identify patterns of events, e.g., light on, light off, light intensity setting, fan on, fan off, fan speed, fan direction, occurring a specified number of times N within a time frame, where N is an integer number, e.g., 3. The time frame may be, and in some embodiments is, a plurality of consecutive weeks such as for example 3 weeks. Identification of patterns of daily events may be, and in some embodiments are, based on the same event occurring at the same time or approximately the same time (e.g., within a time window such as +/-15 minutes) on a number M of consecutive days to not become intrusive, where M is integer number, e.g., M=3. Weekly events will be identified over the course of the time frame, e.g., three week period. For example, if the fan device is controlled to perform a particular function or event, e.g., the fan of the fan device is turned on at 8 p.m. Tuesday of week one of the time frame, the fan of the fan device is turned on at 8:06 p.m. Tuesday of week two of the time frame, and the fan of the fan device is turned on at 7:54 p.m. on week three of the time frame then the control server after analyzing the historical fan device state data for the 3 week period time frame identifies the function or event as being a pattern, e.g., turning on the fan of the fan device at approximately 8:00 p.m. on Tuesday as the fan device's fan is turned on within a 15 minute window of 8 p.m. each Tuesday, 8 p.m. being the average of the fan turn on time of the three repetitive events identified by the control server. The control server generates a recommendation that the fan for the fan device whose state data was analyzed to determine the event pattern is to be turned on at Tuesday at 8 p.m. The recommendation of time fan turn on of 8 p.m. being the average of the time of the fan turn on event occurrence for the three events identified in the pattern.

In another example, a fan of a fan device is turned on Monday at 8 p.m., Tuesday at 9:00 p.m. and Wednesday at

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7 p.m. of the same week, that is on three consecutive days. The control server after analyzing the historical state data for the fan device will identify the turn on of the fan of the fan device on the three consecutive days as a pattern of event fan turn on of the fan device. In the case of identifying a pattern of events for consecutive days, the time window for the same event to occur on consecutive days may be, and in some embodiments is, different than the window for an event occurring on the same day for consecutive weeks as discussed in the previous example. In this example instead of a 15 minute window, an exemplary 60 minute window is used. The control server on determining that a pattern of turning on the fan of the fan device on three consecutive days within a 60 minute window has occurred generates a recommendation that the fan of the fan device be turned on at 8 p.m. as an option for a daily schedule. The 8:00 p.m. time of the fan turn on recommendation being generated based on the time of occurrence of the events forming the identified pattern which occurred on the three consecutive days. In this example, the 8:00 p.m. time recommended for fan turn on of the fan device being the average of the 8:00 p.m., 9:00 p.m. and 7:00 p.m. fan turn on event times of the three events in the identified pattern.

In yet another example, the fan of a fan device is turned on every Monday, Wednesday and Friday at 8:00 p.m. The same happens on week two and three of the three week time frame. The control server identifies the fan turn on events as a pattern and generates a recommended schedule based on the pattern of turning on the fan on the days and at the times the fan was turned on. For example, the control server recommends in a weekly schedule to turn on the fan of the fan device on Monday, Wednesday and Friday at 8:00 p.m. in a succeeding week.

In some, but not all, embodiments, the control server waits till the end of the time frame, e.g., 3 weeks, to analyze the fan device historical status information, identify patterns of events and generate a recommended schedule, e.g., a weekly recommended schedule of events for the fan device, based on the identified pattern of events. In some other embodiments, the control server identifies patterns of events on an on-going basis over the time frame, e.g., 3 weeks, as events are occurring using current and historical event status data for the fan device to identify fan device event patterns. The control server can then either generate a recommended schedule on an on-going basis or wait till end of the time frame to generate a recommended schedule. In some embodiments, after the first time frame, e.g., 3 weeks, expires, the control server uses a sliding time frame window to identify new event patterns and generate a new recommended schedule. For example, with the expiration of the first 3 week time frame, the control server identifies fan device event patterns and generates a recommended schedule. With a sliding time frame window of one week, the second time frame will consist of the last two weeks of the first time frame and the first week after the expiration of the first time frame. In this way, the control server will identify event patterns and generate a second recommended schedule at the end of a fourth consecutive week based on the historical event status data for the fan device of the three most recent weeks. In this way, recommended schedules are generated on a weekly basis using the three most recent weeks fan device even status data.

As previously discussed, in most, but not all embodiments, the recommended weekly schedule for each of the fan devices in a customer premises after being generated is transmitted from the control server to the fan device to which the weekly schedule pertains for customer review

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and/or modification and/or approval. This assumes that the customer has opted into using a weekly schedule to control the operation of the fan device and has selected to review a recommended schedule of fan device events. The automated weekly schedule and the recommended schedule can be cancelled at any time by the user through the input of a cancellation request via a control menu presented on the remote wireless WiFi control device. While the generation of recommended schedules and the operation of an automated schedule of events for a single fan device has been discussed, the control server also generates recommended schedules of events for groups of fan devices. The automated schedules for a time period, e.g., a weekly schedule is also available to automatically control the operation of groups of fans. For example, in a manufacturing facility a group of fans of a set of fan devices may be automatically turned on before the beginning of the work day. E.g., starting up fans of each device of a group of fan devices concurrently at 6:30 p.m. at a particular speed, then turning on the lights at 6:45 p.m. before the workers arrive at 7:00 a.m. and turning off the fans and lights at 8:00 p.m. after the manufacturing facility is closed for the day. Similarly, the automated weekly schedule set the fan schedules to off on Saturday, Sunday and identified holidays.

In addition to automated operation of the fan device based on a pre-programmed schedule of fan device events, e.g., a weekly 7-day schedule or 365 day (366 on leap year) schedule of fan device events, in some embodiments, the fan device can also be programmed to take actions in response to the fan device receiving one or more inputs, e.g., signals from one or more sensors or devices that provide data on the current environmental conditions of the customer premises such as for example the temperature of the customer premises and/or the room in which the fan device is located, whether the air conditioning system is on or off, or whether the heating system is on or off. For example, the fan device may be, and in some embodiments does, offer two modes of automatic operation of the fan device in connection with the HVAC system on the customer premises. In the first mode of operation, the fan device turns on the fan automatically a specified time, e.g., five minutes, after the fan device receives a message or signal indicating that the heating or air conditioning system is turned off, e.g., HVAC turns off five minutes after the fan device turns the fan on to a preset speed and direction set by the user. In a second mode of operation, the fan of the fan device is turned on to a preset speed and direction automatically when the fan device receives a message or signal indicating that the heating or air conditioning system has turned on and the fan of the fan device turns the fan off automatically after a preset amount of time, e.g., five minutes, after receiving a message or a signal that the heating or air conditioning system has turned off. The use of the fan device assists the distribution of either the cold or hot air provided by the HVAC system.

In some embodiments, the fan device is set to turn on or off automatically based on the temperature in the customer premises. For example after receiving a signal or message indicating a temperature in or on the customer premises, the processor of the fan device or the control server compares the temperature to a temperature threshold value, e.g., 80 degrees Fahrenheit, and if temperature exceeds the temperature threshold value the fan device is operated to turn on the fan if it is not already on. In some additional embodiments, the speed and direction of the fan of the fan device is also automatically set when temperatures corresponding to fan speed threshold are exceeded. For example when 80 degrees Fahrenheit is exceed the fan speed is set to low, when 85

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degrees Fahrenheit is exceeded the fan speed is increased, when 90 degrees Fahrenheit is exceeded the fan speed is increased again.

In some embodiments, the control server receives messages indicating the environmental conditions at the customer premises and/or the activation or deactivation of the heating or air conditioning system, compares the environmental conditions and/or state of the heating or air conditioning system, and sends one or more commands/messages to the fan device to turn on or off the fan of the fan device and set the speed and direction of the fan thereby automatically controlling the fan device in accordance with settings of the fan device inputted by a user without the fan device requiring separate sensor inputs.

In some embodiments, the fan device is configured to be updateable via over the air (OTA) updates allowing for future features and enhancements to be downloaded into the fan device from the control server or another device. Similarly the applications being executed on the wireless WiFi terminals may be updated over the air.

As previously discussed in some embodiments, multiple fan devices are grouped together allowing for the control of all of the fan devices in the group at one time. For example, a first set of fan devices at a customer premises may be placed in a first group, e.g., fan devices on the first floor of a house may be placed in a first group such as fan devices in a living room, kitchen, hall way and dining room. These fan devices may all be mated or paired to a first wall control unit so that any RF messages sent from the first wall control unit (e.g., light on/off, fan on/off, etc.) will be received and acted upon by all of the fan devices in the first group in unison. Additionally, the control server will identify all of these fan devices as being in the first group and will allow the user to control the multiple fan devices in the first group at the same time. For example, a user may input via the wireless terminal device a group instruction to turn on all of the fans of the group in which case, all of the fans of the group will be turned on at the same time or concurrently. A customer premise may include one or more groups of fan devices. For example, while a first group of fan devices allow for the control of the fan devices in the first group such as those fan devices on the first floor or a house, a second fan group can be used to control the fan devices on the second floor of the house which are included in a second fan device group. In addition to the fan devices in a group being controlled as a group, the fan devices of the group can also still be controlled as individual fan devices. For example, at a first time the fan device group lights on event command may be given and all of the lights on the fan devices in the group will have their lights turned on. At a second later time a fan device light off command may be given to turn off a particular light on one of the fan devices in the group. While the light on that particular fan will turn off the lights on the remaining fan devices of the group will remain on. If a fan device group command to turn the lights off in the group is give the light for the individual fan device that is off will remain off while the lights on the remaining fan devices in the group will turn off. In this way, fan devices can be controlled both as a group and individually.

In some embodiments, control of one or more fan devices at a customer premise may be shared with one or more users. For example, control of fan devices at a customer premise can be shared by parents and children, employees, and guests. In an exemplary embodiment a guest is given permission to control one or more fan devices in a customer premises. The owner or operator selects which fan devices the guest can control and inputs this information into the

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control server and/or the fan device. The owner or operator of the customer premises at which the fan devices are located then sends an invite message to a guest's mobile device. In response to the invite the guest via his or her mobile device would, after authentication such as entry of a password provided by the owner or operator of the customer premises to the guest, be allowed to login to an application running on the control server or the fan device from which the guest could operate the fan device using the guest's mobile device. As previously discussed, the guest's access may be restricted to certain fan devices at the customer premises such as for example allowing the guest to control the fan device(s) in the guest bedroom and/or living room while being restricted from controlling the fan devices in other areas of the customer premises. The owner or operator of the customer premises also concurrently having the ability to control the same devices as the guest. In this way, multiple users may control the same fan devices. When the owner or operator of the customer premises decides to end the guest's access to the system and control of the fans device(s) the owner or operator of the customer premises inputs a request or command to the control server and/or fan device(s) indicating that the guest is no longer allowed to access the system and/or control the fan devices upon which the control server and/or fan device prevents the guest from accessing the system, e.g., by no longer accepting the login credentials, e.g., user id or password, of the guest.

In some embodiments, the fan devices include a sleep mode in which the user can set independent timers for when the fan of the fan device and when light of the fan device can be turned off e.g., after 45 minutes after activation of sleep mode, so that when the sleep timer for the fan expires the fan of the fan device turns off and when the sleep timer for the light of the fan device expires, the light of the fan device will automatically turn off. Additionally, a synch command activated from a menu presented to the user on the WiFi mobile device allows the independent sleep mode timer for the fan and light of the fan device to be synchronized so that if they are set to different time values they will be synchronized and will both turn off at the same time. The independent sleep timers being synchronized to the shorter time period of either the fan sleep timer value or the light sleep timer value of the sleep timer values being synchronized.

LIST OF EXEMPLARY NUMBERED METHOD EMBODIMENTS

Method Embodiment 1

A control method comprising: receiving, at a fan device including a radio frequency signal receiver and a WiFi interface, a first radio frequency (RF) control signal from a control unit, said fan device and said control unit being located at a customer premises; implementing, at the fan device, an operation in response to a first command communicated by the first RF control signal; and operating the fan device to communicate to a server located outside the customer premises, via the WiFi interface, information indicating the operation implemented in response to the first command.

Method Embodiment 2

The method of Method Embodiment 1, wherein said fan device and said control unit are located in the same room.

Method Embodiment 3

The method of Method Embodiment 1, wherein said control unit is a wall mounted unit through which power is

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supplied to the fan device, said first RF control signal being a wireless signal transmitted from an RF transmitter in the control unit to an RF receiver in the fan device.

Method Embodiment 4

The method of Method Embodiment 3, wherein the control unit does not include a WiFi interface.

Method Embodiment 5

The method of Method Embodiment 1, wherein said first command is one of: a fan on command, a fan off command, a fan power state change command, a fan speed up command, a fan speed down command, a fan direction change command, a light on command, a light off command, a light power state change command, a light increase command, a light decrease command.

Method Embodiment 6

The method of Method Embodiment 1, wherein said RF control signal is sent using an RF frequency which is not used for WiFi signals.

Method Embodiment 7

The method of Method Embodiment 6, further comprising: operating a WiFi router located at the customer premises to receive a first WiFi control signal from a wireless terminal located at the customer premises, said first WiFi control signal communicating a second command used to control the fan device; operating the WiFi router to communicate, via a WiFi signal, the second command to the fan device; and operating the fan device to implement the second command.

Method Embodiment 8

The method of Method Embodiment 7, further comprising: operating the fan to communicate to the server located outside the customer premises, via the WiFi interface, information indicating the operation implemented in response to the second command.

Method Embodiment 9

The method of Method Embodiment 8, wherein the second command is communicated from the wireless terminal to the fan device via the WiFi router located in the customer premises without said second command traversing a network outside the customer premises.

Method Embodiment 10

The method of Method Embodiment 9, further comprising: operating the server to receive a third command directed to the first fan device; and operating the server to communicate the third command via the Internet and said WiFi router to the fan device.

Method Embodiment 11

The method of Method Embodiment 10, further comprising: operating the server to update information about the

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state of one or more devices at the first customer premises based on the third command communicated to the fan device.

Method Embodiment 12

The method of Method Embodiment 11, wherein said updating of the information about the state of one or more devices at the first customer premises is performed in response to transmitting the third command from the server.

Method Embodiment 13

The method of Method Embodiment 9, further comprising: operating the server to generate a proposed normal device control schedule for the first customer premises from stored information indicating the state of one or more devices at the first customer premises over a period of; communicate from the server the proposed device control schedule to a device corresponding to the first customer premise; receive at the server a message indicating approval of the proposed normal device control schedule for the first customer premises or a revised schedule for the first customer premises; and storing as an approved normal control schedule for the first customer premises the approved proposed normal device control schedule or the revised schedule.

Method Embodiment 14

The method of Method Embodiment 13, further comprising: operating the server to control one or more devices at the first customer premises based on the stored approved normal device control schedule, said one or more devices including the first fan device.

Method Embodiment 15

The method of Method Embodiment 14, wherein operating the server to control one or more devices at the first customer premises based on the stored approved normal device control schedule includes transmitting a control signal from the server to the first fan device via the Internet and WiFi router to control the fan device to turn on at a time indicated by said approved normal control schedule.

Method Embodiment 16

The method of Method Embodiment 13, further comprising: operating the server to generate an away schedule to be used to control one or more device at the first customer premises when the customer indicates they are away from the customer premises.

Method Embodiment 17

The method of Method Embodiment 16, wherein operating the server to generate an away schedule includes generating said away schedule as a function of a random function used to at least partially randomize the on or off times of one or more devices.

Method Embodiment 18

The method of Method Embodiment 17, wherein operating the server to generate the away schedule includes using information about past device on and off status in combi-

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nation with said random function to control the on and off times of at least one device, said on and off times deviating from historical on and off times by an amount of time which does not exceed a set maximum amount of time and which is determined by said random function.

Method Embodiment 19

The method of Method Embodiment 16, further comprising: receiving, at the server, a signal from a user indicating an away status; and switching, at the server, from using the stored approved normal schedule to using the stored away schedule to control the one or more devices at the first customer premises.

LIST OF EXEMPLARY NUMBERED SYSTEM EMBODIMENTS

System Embodiment 1

A system comprising: a fan device comprising: a fan motor; a radio frequency (RF) signal receiver configured to receive radio frequency (RF) control signals from a control unit, said fan device and said control unit being located at a customer premises; a WiFi interface; a fan motor control circuit configured to control the fan motor in response to a received first radio frequency control signal, said first radio frequency control signal communicating a first command; and a first processor configured to communicate to a server, located outside the customer premises, via the WiFi interface, information indicating an operation implemented in response to the first command.

System Embodiment 2

The system of System Embodiment 1, wherein said fan device further comprises: a light; and a light control circuit configured to control the light in response to a received second radio frequency control signal, said second radio frequency control signal communicating a second command; and wherein said first processor is further configured to communicate to said server, via the WiFi interface, information indicating an operation implemented in response to said second command.

System Embodiment 3

The system of System Embodiment 2, wherein said fan device and said control unit are located in the same room.

System Embodiment 4

The system of System Embodiment 2, further comprising said control unit; wherein said control unit includes an RF transmitter; and wherein said control unit is a wall mounted unit through which power is supplied to the fan device, said first RF control signal and said second RF control signal being wireless signals transmitted from said RF transmitter in the control unit to said RF signal receiver in the fan device.

System Embodiment 5

The system of System Embodiment 4, wherein the control unit does not include a WiFi interface.

System Embodiment 6

The system of System Embodiment 2, wherein said first RF control signal communicates one of: a fan on command,

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a fan off command, a fan power state change command, a fan speed up command, a fan speed down command, a fan direction change command; and wherein said second RF control signal communicates one of: a light on command, a light off command, a light power state change command, a light increase command, a light decrease command.

System Embodiment 7

The system of System Embodiment 2, wherein said first RF control signal and said second RF control signal are sent using RF frequencies which are not used for WiFi signals.

System Embodiment 8

The system of System Embodiment 7, further comprising: a WiFi router located at the customer premises, said WiFi router comprising: a receiver configured to receive a first WiFi control signal from a wireless terminal located at the customer premises, said first WiFi control signal communicating a third command used to control the fan device; a transmitter configured to communicate, via a WiFi signal, the third command to the fan device; and wherein said first processor is configured to control at least one of the fan motor control circuit or the light control circuit to implement the third command.

System Embodiment 9

The system of System Embodiment 8, further comprising: wherein said first processor is configured to control the WiFi interface in said fan device to send information indicating the operation implemented in response to the third command.

System Embodiment 10

The system of System Embodiment 9, further comprising: said wireless terminal, wherein said wireless terminal includes: a WiFi interface; and a fan device control application configured to generate said third command in response to user input; and wherein the third command is communicated from the wireless terminal to the fan device via the WiFi router located in the customer premises without said third command traversing a network outside the customer premises.

System Embodiment 11

The system of System Embodiment 10, further comprising: said server, wherein said server includes a second processor configured to: operating the server to receive a fourth command directed to the first fan device; and operating the server to communicate the fourth command via the Internet and said WiFi router to the fan device.

System Embodiment 12

The system of System Embodiment 11, wherein said second processor is further configured to: operating the server to update information about the state of one or more devices at the first customer premises based on the fourth command communicated to the fan device.

System Embodiment 13

The system of System Embodiment 12, wherein said updating of the information about the state of one or more

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devices at the first customer premises is performed in response to transmitting the fourth command from the server.

System Embodiment 14

The system of System Embodiment 10, wherein said second processor is further configured to: operating the server to generate a proposed normal device control schedule for the first customer premises from stored information indicating the state of one or more devices at the first customer premises over a period of time; operate the server to send the proposed device control schedule to a device corresponding to the first customer premise; operate the server to receive a message indicating approval of the proposed normal device control schedule for the first customer premises or a revised schedule for the first customer premises; and operate the server to store as an approved normal control schedule for the first customer premises the approved proposed normal device control schedule or the revised schedule.

System Embodiment 15

The system of System Embodiment 14, wherein said second processor is further configured to: operating the server to control one or more devices at the first customer premises based on the stored approved normal device control schedule, said one or more devices including the first fan device.

System Embodiment 16

The system of System Embodiment 15, wherein said second processor is configured to: operate the server to send a control signal from the server to the first fan device via the Internet and WiFi router to control the fan device to turn on at a time indicated by said approved normal control schedule, as part of being configured to operate the server to control one or more devices at the first customer premises based on the stored approved normal device control schedule.

System Embodiment 17

The system of System Embodiment 14, wherein said second processor is further configured to: operate the server to generate an away schedule to be used to control one or more device at the first customer premises when the customer indicates they are away from the customer premises.

System Embodiment 18

The system of System Embodiment 17, wherein said second processor is configured to: generate said away schedule as a function of a random function used to at least partially randomize the on or off times of one or more devices, as part of being configured to operate the server to generate an away schedule.

System Embodiment 19

The system of System Embodiment 18, wherein said second processor is configured to use information about past device on and off status in combination with said random function to control the on and off times of at least one device, said on and off times deviating from historical on and off

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times by an amount of time which does not exceed a set maximum amount of time and which is determined by said random function, as part of being configured to operate the server to generate the away schedule.

System Embodiment 20

The system of System Embodiment 17, wherein said server further comprises: a receiver configured to receive a signal from a user indicating an away status; and wherein said second processor is further configured to control the server to switch from using the stored approved normal schedule to using the stored away schedule to control the one or more devices at the first customer premises.

LIST OF EXEMPLARY NUMBERED APPARATUS EMBODIMENTS

Apparatus Embodiment 1

A fan device controller including: an AC voltage input; an AC output for supplying power to a fan device; an RF signal interface including an RF signal transmitter for transmitting commands to a device to be controlled; an RF controller for controlling the RF signal interface to send control signals including one or more commands to said fan device; and a disconnect switch for disconnecting said AC output from said AC input when said disconnect switch is switched to a disconnect state from a connect state.

Apparatus Embodiment 2

The fan device controller of Apparatus Embodiment 1, further comprising: a fan control input for turning a fan on or off; and a light control input for turning a light on or off.

Apparatus Embodiment 3

The fan device controller of Apparatus Embodiment 2, further comprising: a light up input coupled to said RF controller; and a light down input coupled to said RF controller.

Apparatus Embodiment 4

The fan device controller of Apparatus Embodiment 3, further comprising: a fan speed up input coupled to said RF controller; and a fan speed down input coupled to said RF controller.

Apparatus Embodiment 5

The fan device controller of Apparatus Embodiment 4, further comprising: a fan reverse input coupled to said RF controller.

Apparatus Embodiment 6

The fan device controller of Apparatus Embodiment 5, further comprising: a DC power supply connected to said disconnect switch and to said RF controller, said DC power supply receiving AC power from said disconnect switch and supplying DC power generated from said AC power to the RF controller.

Apparatus Embodiment 7

The fan device controller of Apparatus Embodiment 6, wherein switching the disconnect switch to a disconnect

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state cuts power to both the AC output and to said DC power supply thereby cutting power to a fan device coupled to said fan device controller and to the RF controller at the same time.

Apparatus Embodiment 8

The fan device controller of Apparatus Embodiment 7, wherein said RF controller includes a processor; and wherein said processor is configured to: generate commands in response to input received via one of the inputs included in said fan device controller; and control said RF interface to transmit said commands in RF signals to the fan device.

Apparatus Embodiment 9

The fan device controller of Apparatus Embodiment 8, wherein said fan device controller is configured to fit in an electrical box in a wall of a customer premises.

The techniques of various embodiments may be implemented using software, hardware and/or a combination of software and hardware. Various embodiments are directed to apparatus, e.g., fan devices, control server, WiFi router, control units, mobile devices. Various embodiments are also directed to methods, e.g., method of controlling and/or operating devices, e.g., control server device, mobile device, control units. Various embodiments are also directed to machine, e.g., computer, readable medium, e.g., ROM, RAM, CDs, hard discs, etc., which include machine readable instructions for controlling a machine to implement one or more steps of a method. The computer readable medium is, e.g., non-transitory computer readable medium.

It is understood that the specific order or hierarchy of steps in the processes and methods disclosed is an example of exemplary approaches. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes and methods may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented. In some embodiments, one or more processors are used to carry out one or more steps or elements of the described methods.

In various embodiments each of the steps or elements of a method are implemented using one or more processors. In some embodiments, each of the steps or elements are implemented using hardware circuitry.

In various embodiments elements described herein are implemented using one or more components to perform the steps corresponding to one or more methods, for example, generating, sending, comparing, determining and/or transmission steps. Thus, in some embodiments various features are implemented using components or in some embodiments logic such as for example logic circuits. Such components may be implemented using software, hardware or a combination of software and hardware. Many of the above described methods or method steps can be implemented using machine executable instructions, such as software, included in a machine readable medium such as a memory device, e.g., RAM, floppy disk, etc. to control a machine, e.g., general purpose computer with or without additional hardware, to implement all or portions of the above described methods, e.g., in one or more elements. Accordingly, among other things, various embodiments are directed to a machine-readable medium, e.g., a non-transitory computer readable medium, including machine executable instructions for causing a machine, e.g., processor and

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associated hardware, to perform one or more of the steps of the above-described method(s). Some embodiments are directed to a device, e.g., fan device, mobile device, WiFi device, wall unit controller, including a processor configured to implement one, multiple or all of the steps of one or more methods of the invention.

In some embodiments, the processor or processors of one or more devices, e.g., control server, fan device, mobile device, wall control unit are configured to perform the steps of the methods described as being performed by the devices. The configuration of the processor may be achieved by using one or more components, e.g., software components, to control processor configuration and/or by including hardware in the processor, e.g., hardware components, to perform the recited steps and/or control processor configuration. Accordingly, some but not all embodiments are directed to a device, e.g., fan device, control unit device, mobile server, control server, WiFi router, with a processor which includes a component corresponding to each of the steps of the various described methods performed by the device in which the processor is included. In some but not all embodiments a device, e.g., fan device, control unit device, mobile server, control server, WiFi router, includes a component corresponding to each of the steps of the various described methods performed by the device in which the processor is included. The components may be implemented using software and/or hardware.

Some embodiments are directed to a computer program product comprising a computer-readable medium, e.g., a non-transitory computer-readable medium, comprising code for causing a computer, or multiple computers, to implement various functions, steps, acts and/or operations, e.g., one or more steps described above. Depending on the embodiment, the computer program product can, and sometimes does, include different code for each step to be performed. Thus, the computer program product may, and sometimes does, include code for each individual step of a method, e.g., a method of controlling a fan device, control unit device, mobile server, control server, WiFi router. The code may be in the form of machine, e.g., computer, executable instructions stored on a computer-readable medium, e.g., a non-transitory computer-readable medium, such as a RAM (Random Access Memory), ROM (Read Only Memory) or other type of storage device. In addition to being directed to a computer program product, some embodiments are directed to a processor configured to implement one or more of the various functions, steps, acts and/or operations of one or more methods described above. Accordingly, some embodiments are directed to a processor configured to implement some or all of the steps of the methods described herein. The processor may be for use in, e.g., a fan device, a communications device such as a WiFi mobile device, a control unit, control server or other device described in the present application.

Numerous additional variations on the systems, methods and apparatus of the various embodiments described above will be apparent to those skilled in the art in view of the above description and the claims which follow. Such variations are to be considered within the scope of the invention.

What is claimed is:

1. A system comprising:

a fan motor;

a fan motor control circuit;

a processor in electrical communication with the fan motor control circuit;

a radio frequency interface configured to receive, at a first frequency, a signal; and

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a WiFi interface configured to communicate at a second frequency that is different from the first frequency;
 wherein;
 the fan motor control circuit is configured to cause the fan motor to perform an operation in response to the signal; 5
 and
 the processor is configured to transmit, via the WiFi interface, to a server, an indication corresponding to the operation.
 2. The system of claim 1 further comprising, when the signal is a first signal, the operation is a first operation, and the indication is a first indication:
 a light; and
 a light control circuit configured to cause the light to perform a second operation in response to a second signal received by the radio frequency interface;
 wherein the processor is further configured to transmit to the server, via the WiFi interface, a second indication corresponding to the second operation.
 3. The system of claim 2 wherein:
 the first indication corresponds to an operation selected from the group consisting of: fan on, fan off, fan power state change, fan speed-up, fan speed-down, and fan direction-change; and
 the second indication corresponds to an operation selected from the group consisting of: light on, light off, light power state change, light increase, and light decrease.
 4. The system of claim 1 further comprising a housing; wherein the fan motor, the fan motor control circuit, the processor, the radio frequency interface, and the WiFi interface are disposed in the housing.
 5. The system of claim 1 further comprising a WiFi router comprising:
 a receiver configured to receive a WiFi control signal from a wireless terminal, the control signal communicating a command for controlling the fan motor; and
 a transmitter configured to communicate, via a WiFi signal, the command to the WiFi interface;
 wherein the processor is further configured to cause the fan motor control circuit to implement the command.
 6. The system of claim 5 wherein the processor is further configured to cause the WiFi interface to send information indicating an operation implemented in response to the command.

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7. The system of claim 6 further comprising, when the WiFi interface is a first Wifi interface, the wireless terminal; wherein:
 the wireless terminal includes:
 a second WiFi interface; and
 a fan device control application configured to generate the command in response to user input; and
 the wireless terminal, the WiFi router, and the processor are configured for operation in a wireless local network such that the wireless terminal communicates the command to the processor via the WiFi router without the command traversing the Internet.
 8. The system of claim 1 further comprising, when the processor is a first processor, the server;
 wherein the server includes a second processor configured to cause the server to:
 receive a command directed to the first processor; and
 communicate the command via the Internet and a WiFi router to the first processor.
 9. The system of claim 8 wherein the second processor is further configured to cause the server to update information about a state of a device that is in a wireless local network based on the command.
 10. The system of claim 9 wherein the second processor is further configured to cause the server to update the information in response to transmitting the command from the server.
 11. The system of claim 8 wherein the second processor is further configured to cause the server to:
 generate a proposed normal device control schedule for a device, comprising the fan motor, at a wireless local network from stored information indicating states of the device over a period of time;
 send the schedule to the device;
 receive a message indicating approval of the schedule;
 and
 store, as an approved normal control schedule, the approved schedule.
 12. The system of claim 11 wherein the second processor is further configured to cause the server to:
 receive a revised schedule for the wireless local network;
 and
 store, as the approved normal control schedule, the revised schedule.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 11,028,854 B2
APPLICATION NO. : 15/871044
DATED : June 8, 2021
INVENTOR(S) : Eric Stefankiewicz and Shelley Wald

Page 1 of 1

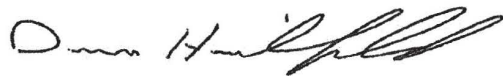
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Claim 1, at Column 43, Line 3 replace “wherein;” with “wherein:”

In Claim 5, at Column 43, Line 36 replace “control” with “WiFi control”

Signed and Sealed this
Twenty-first Day of September, 2021



Drew Hirshfeld
*Performing the Functions and Duties of the
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office*

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 11,028,854 B2
APPLICATION NO. : 15/871044
DATED : June 8, 2021
INVENTOR(S) : Eric Stefankiewicz and Shelley Wald

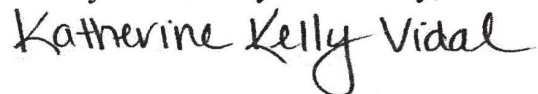
Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the Title Page

Item (72) In the Inventors:
Add Kevin Darrah, Medina, OH (US) as an Inventor.

Signed and Sealed this
Twenty-fourth Day of January, 2023



Katherine Kelly Vidal
Director of the United States Patent and Trademark Office