

EXHIBIT 2



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Metz

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- (54) **CONTROLLER INTERFACE WITH DYNAMIC SCHEDULE DISPLAY**
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See application file for complete search history.

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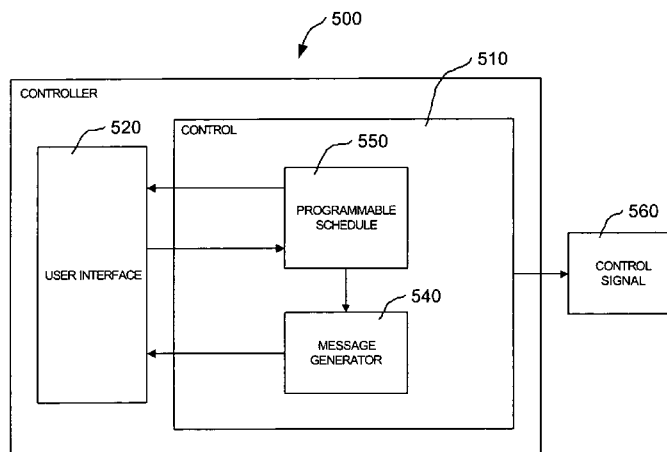
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- (57) **ABSTRACT**

A controller includes a programmable schedule and a user interface, adapted and configured to illustratively display at least a portion of the programmable schedule along a time axis and a current time indicator positioned to indicate the current time along the time axis. A method is also described including the steps of: operating a programmable controller having a scheduled current set point and a scheduled future set point; and providing a message indicating a time of the scheduled future set point change.

8 Claims, 6 Drawing Sheets



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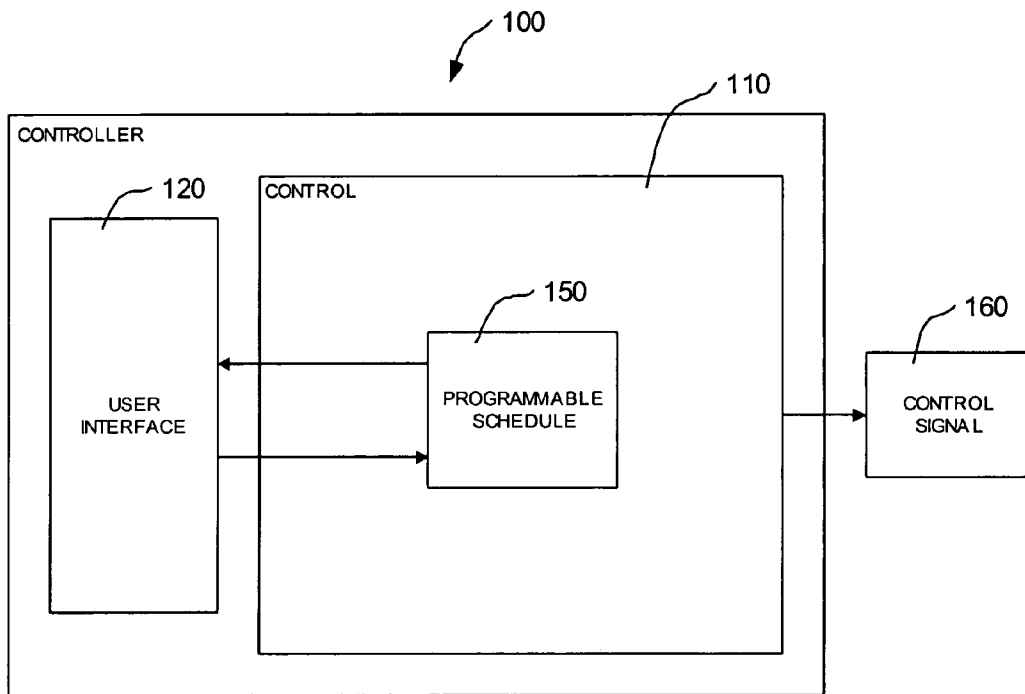


Fig.1

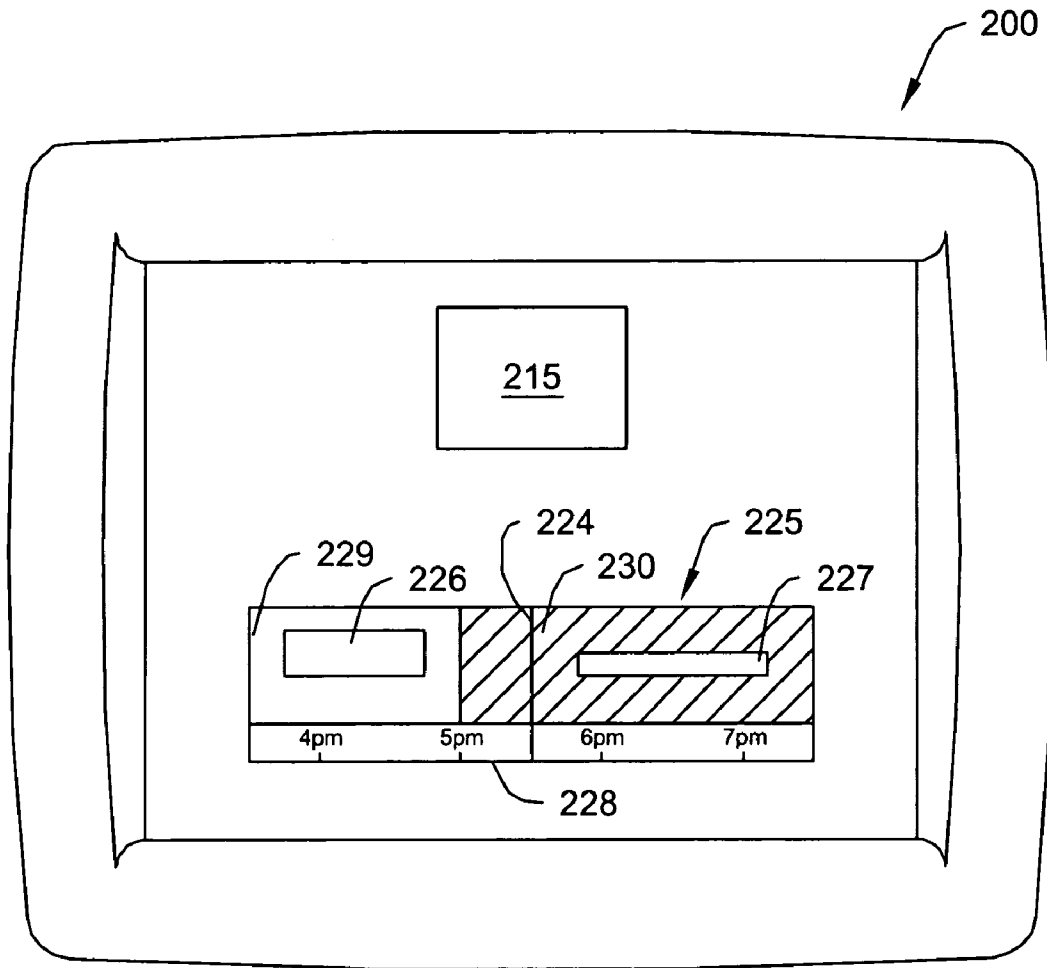


Fig.2

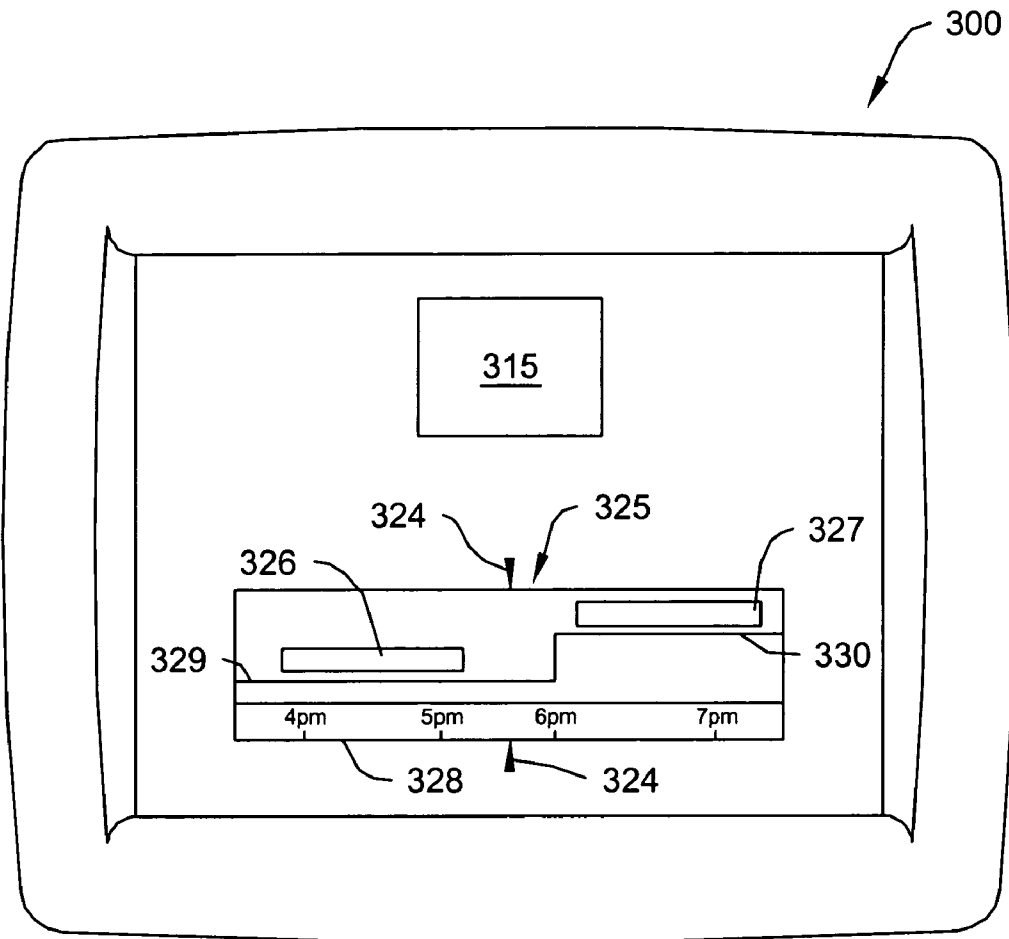


Fig.3

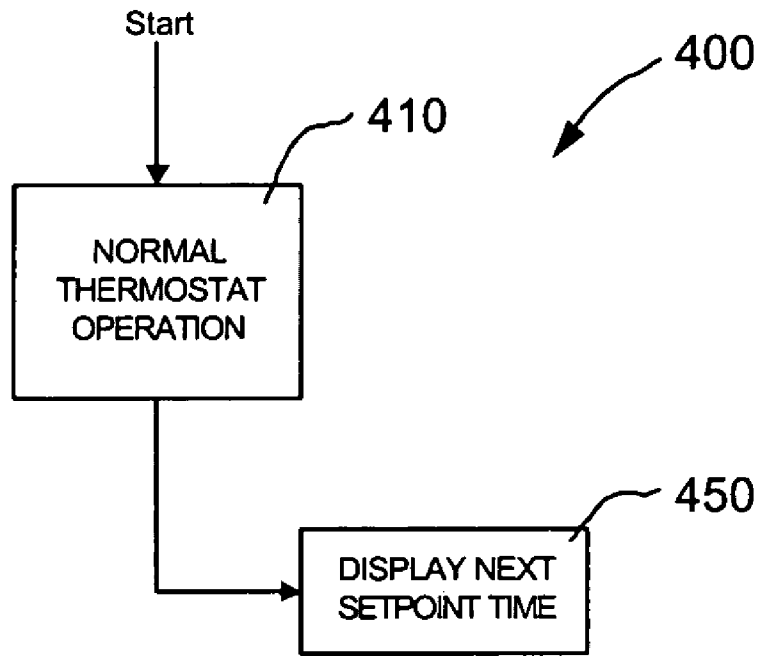


Fig.4

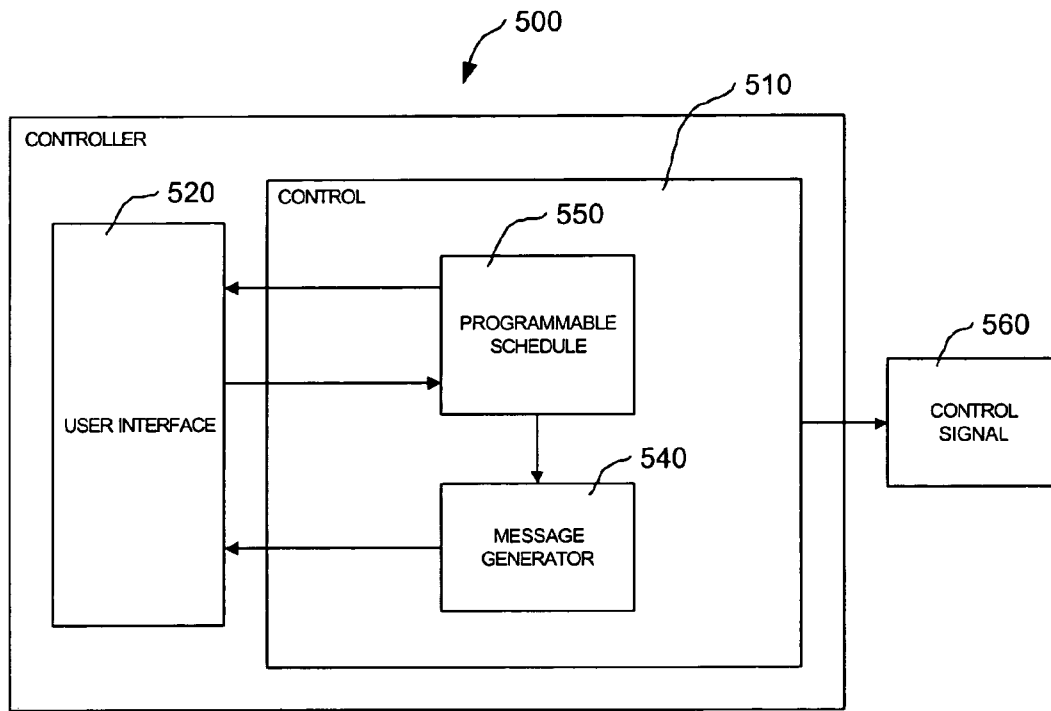


Fig.5

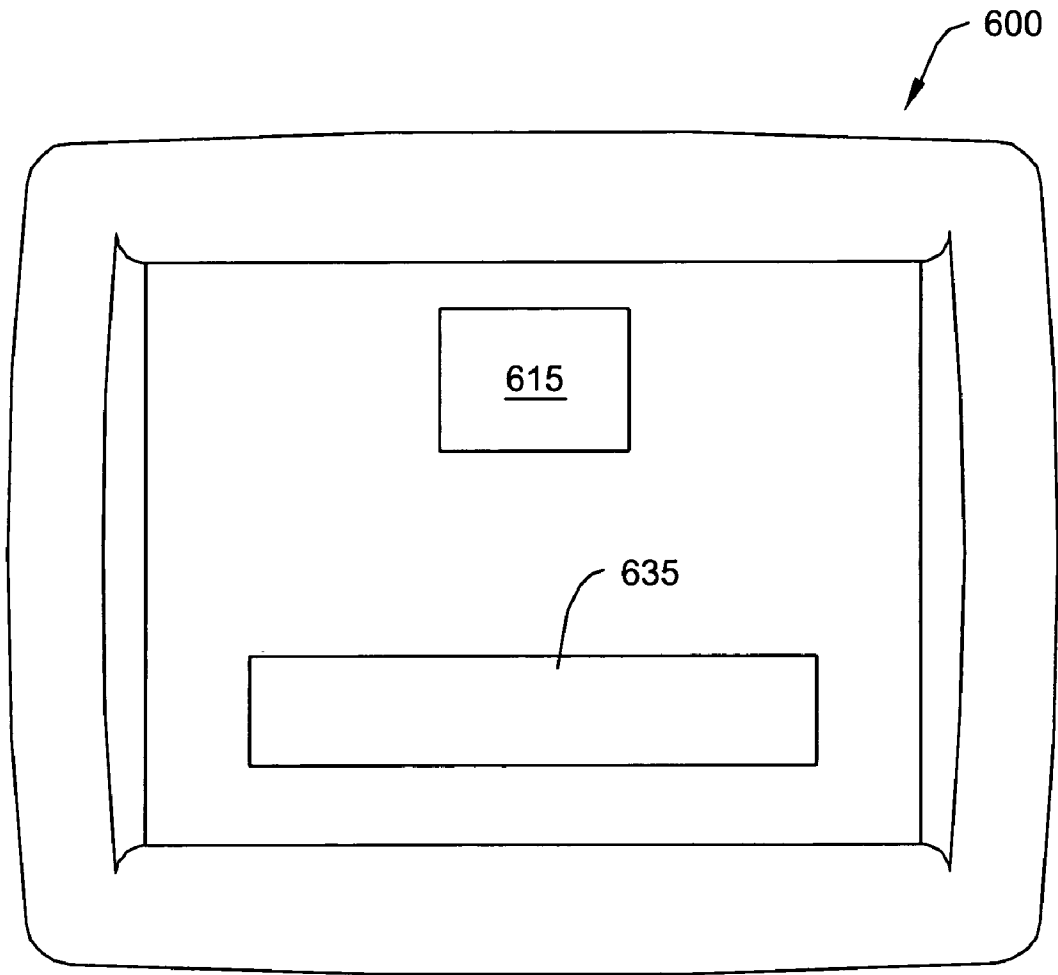


Fig.6

CONTROLLER INTERFACE WITH DYNAMIC SCHEDULE DISPLAY

FIELD OF THE INVENTION

The present invention relates generally to the field of programmable controllers for devices. More specifically, the present invention pertains to simplified interfaces for device controllers having a dynamic schedule display.

BACKGROUND OF THE INVENTION

Controllers are used on a wide variety of devices and systems. Some controllers have schedule programming that modifies schedule parameters such as set points as a function of date and/or time. Some device or system controllers that utilize schedule programming include, for example, HVAC controllers, security system controllers, lawn sprinkler controllers, and lighting system controllers.

In one example, HVAC controllers are often employed in monitoring and, if necessary, controlling various environmental conditions within a home, office or other enclosed space. Such devices are useful, for example, in regulating the temperature, humidity, venting, air quality, etc., within a particular space. The controller may include a microprocessor that interacts with other components in the HVAC system. For example, in many modern thermostats for use in the home or office setting, a controller unit may be provided to interact with a heater, blower, flue vent, air compressor, humidifier and/or other components, to control the temperature, humidity or other environmental conditions at various locations within the home or office. One or more sensors located within the controller unit and/or one or more remote sensors may be employed to sense when the temperature and/or humidity (or other environmental conditions) reaches a certain threshold level, causing the controller unit to send a signal to activate or deactivate one or more component in the system.

The controller may be equipped with an interface that allows the user to monitor and adjust the environmental conditions at one or more locations within the building. With more modern designs, the interface typically includes a liquid crystal display (LCD) panel inset within a housing that contains a microprocessor as well as other components of the controller. In some designs, the interface may permit the user to program the controller to activate on a certain schedule determined by the user. For example, the interface may include a menu routine that permits the user to change the temperature at one or more times during a particular day. Once the settings for that day have been programmed, the user can repeat the process to change the settings for the other remaining days.

In some cases, the interface is simply too complex or cumbersome to be conveniently used to inform the user of where the schedule is in relation to the current time and is simply by-passed or programmed by the user to a temperature set point beyond the desired value in an attempt to achieve a desired temperature quickly. Accordingly, there is an ongoing need in the art to improve the ease of use and understanding of the current schedule in a programmable controller.

SUMMARY OF THE INVENTION

Generally, the present invention pertains to simplified interfaces for controllers having a dynamic schedule display.

In one illustrative embodiment, a controller includes a programmable schedule and a user interface, adapted and configured to illustratively display at least a portion of the programmable schedule along a time axis and a current time indicator positioned to indicate the current time along the time axis.

In a further illustrative embodiment, a method is described including the steps of: operating a programmable controller having a scheduled current set point and a scheduled future set point; and providing a message indicating a time of the scheduled future set point change.

In another illustrative embodiment, a method includes the steps of: operating a programmable controller to cause an HVAC system to change an environmental condition of an inside space from a first initial set point to a second desired set point, the HVAC system achieving the change in the environmental condition to the second desired set point in an amount of time; and providing a message during the amount of time indicating when the desired second set point is anticipated to be achieved in the inside space.

In another illustrative embodiment, a method includes the steps of: operating a programmable controller to cause an HVAC system to change an environmental condition of an inside space from a first initial set point to a second desired set point, the HVAC system achieving the change in the environmental condition to the second desired set point in an amount of time; allowing a user to change the second desired set point to a third over-controlling set point; and informing the user that changing the second desired set point to the third over-controlling set point will not decrease the amount of time needed to achieve the second desired set point. Controllers adapted to provide the above methods are also contemplated.

The above summary of the present invention is not intended to describe each disclosed embodiment or every implementation of the present invention. The Figures, Detailed Description and Examples which follow more particularly exemplify these embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

FIG. 1 is a block diagram of an illustrative controller;

FIG. 2 is a schematic drawing of an illustrative user interface in accordance with the present invention;

FIG. 3 is a schematic drawing of another illustrative user interface in accordance with the present invention;

FIG. 4 is a flow diagram of an illustrative controller program;

FIG. 5 is a block diagram of the illustrative controller program shown in FIG. 4; and

FIG. 6 is a schematic drawing of another illustrative user interface in accordance with the present invention.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention.

DETAILED DESCRIPTION OF THE
INVENTION

The following description should be read with reference to the drawings, in which like elements in different drawings are numbered in like fashion. The drawings, which are not necessarily to scale, depict selected embodiments and are not intended to limit the scope of the invention. Although examples of construction, dimensions, and materials are illustrated for the various elements, those skilled in the art will recognize that many of the examples provided have suitable alternatives that may be utilized.

Generally, the present invention pertains to simplified interfaces for controllers having schedule override programming capabilities. These controllers can be used in a variety of systems such as, for example, HVAC systems, sprinkler systems, security systems, lighting systems, and the like. The Figures depict illustrative HVAC controllers. While the present invention is not so limited, an appreciation of various aspects of the invention will be gained through a discussion of the examples provided below.

HVAC controllers can regulate environmental conditions such as, for example, temperature within an enclosed space. The controller can regulate the environmental condition as a function of time by using, for example, a programmable schedule. That is, the programmed schedule may cause the controller to activate one or more components of an HVAC system such that the desired environmental condition follows the programmed schedule.

In some cases, a user interface may include a separate menu routine that builds and/or modifies a schedule to permit the user to change the temperature at one or more times during a particular day such as, for example, a temperature setting for a "wake" time interval, a "leave" time interval, a "return" time interval and/or a "sleep" time interval. The user can program a start time and/or end time (and/or time duration) for each and a heat and/or cool temperature for each desired time interval. Once the settings for that day have been programmed, the user can often repeat the process to change the settings for the other remaining days of the week with the schedule. In some cases, the programmable controller may include a feature that allows the user to set a separate schedule for weekday and weekend use, and/or to copy the settings from a particular day to another day, as desired. Other methods for programming the schedule are also contemplated.

FIG. 1 is a block diagram of an illustrative controller 100. Controller 100 includes a control module 110 that can be a microprocessor or the like. The control module 110 can include a programmable schedule 250 as described above, for example. The control module 110 communicates with a user interface 120. The control module can also generate one or more control signals 260 to a device (not shown), such as an HVAC system or device.

In the illustrative embodiment, the user interface 120 is adapted and configured to display at least a portion of the programmable schedule 150 along a time axis. A current time indicator can be positioned to indicate the current time in relation to the time axis, and thus the schedule. The current time indicator may allow a user to easily identify the current schedule setting, the duration of the current schedule setting, the prior schedule setting and/or the next schedule setting, for example.

FIG. 2 is a schematic drawing of an illustrative user interface 200. The user interface 200 can illustratively display at least a portion of the programmable schedule 225 along a time axis 228. A current time indicator 224 can be

positioned to indicate the current time in relation to the time axis 228, and thus the schedule. This embodiment illustrates a current time indicator 224 superimposed on the time axis 228, however, this is not required in all embodiments.

This embodiment also illustrates a programmable schedule 225 displayed as a block bar graph. The block bar graph can display the programmable schedule 225 as a block bar broken into segments 229 and 230. The segments 229 and 230 can represent different schedule set points. The segments 229 and 230 can be graphically contrasting such as first segment 229 may be a lighter color or shade than the second segment 330, for example. Alternatively or in addition, each segment 229 and 230 can display a numerical or textual message 226 and/or 227, informing the user of the name of the block bar segment 229 and 230 or a particular numerical value associated with the block bar segment 229 and 230. For example, block bar segment 229 message 226 could display "Wake," "68°" or "Wake-68°" and block bar segment 230 message 227 could display "Leave," "72°", or "Leave-72°."

In some cases, any portion of the programmable schedule 225 may be displayed on the user interface 200. The illustrative embodiment of FIG. 2 shows an approximate 4 hour time window, however any length of time can be displayed such as, for example, 24 hour or more, 12 hour, 8 hour, 4 hour, 2 hour or less, as desired. The programmable schedule 225 may move or scroll in relation to the current time indicator 224. Alternatively, the current time indicator 224 may move or scroll in relation to the programmable schedule 225.

Additional information may be displayed on the user interface 200 at, for example block 215. This additional information may include a current scheduled parameter setting (e.g., temperature, humidity), a current parameter reading, and/or any other information as desired.

FIG. 3 is another illustrative user interface 300 in accordance with the present invention. Like above, the user interface 300 can illustratively display at least a portion of the programmable schedule 325 along a time axis 328. A current time indicator 324 can be positioned to indicate the current time in relation to the time axis 328, and thus the schedule. This embodiment illustrates a current time indicator 324 positioned below the time axis 228 and a current time indicator 324 above the programmable schedule 325.

This embodiment also illustrates a programmable schedule 325 displayed as a line graph. The line graph can display the programmable schedule 325 as step segments 329 and 330. The segments 329 and 330 can represent different schedule set points. The step segments 329 and 330 can be graphically contrasting such as first line segment 329 may be a lighter color or shade than the second line segment 330, for example. Alternatively or in addition, each segment 329 and 330 can display a numerical or textual message 326 and/or 327, informing the user of the name of the step segment 329 and 330 or a particular numerical value associated with the step segment 329 and 330. For example, step segment 229 message 226 may display "Wake," "68°", or "Wake-68°" and step segment 230 message 227 could display "Leave," "72°", or "Leave-72°."

In some cases, any portion of the programmable schedule 325 may be displayed on the user interface 300. The illustrative embodiment shows an approximate 4 hour time window, however any length of time can be displayed such as, for example, 24 hour or more, 12 hour, 8 hour, 4 hour, 2 hour or less. The programmable schedule 325 may move or scroll in relation to the current time indicator 324. Alterna-

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tively, the current time indicator 324 may move or scroll in relation to the programmable schedule 325.

Additional information could be displayed on the user interface 300 at, for example block 315. This additional information may include a current scheduled parameter setting (e.g., temperature, humidity), a current parameter reading, and/or other information as desired.

FIG. 4 is a flow diagram of an illustrative controller program 400. The program starts at a normal thermostat operation block 410, although this is not required in all embodiments. In the illustrative embodiment, when operating in normal thermostat operation block 410, a programmed thermostat schedule may be followed to regulate one or more environmental conditions of an inside space. The programmed schedule can activate the controller to send one or more control signals to HVAC equipment on a certain schedule having at least a current set point and a future set point, as described above.

In the illustrative embodiment, a message 450 is provided via the user interface indicating a time of a scheduled next future set point change. The message 450 can be graphical, textual, aural or any other suitable message. The message 450 may provide a time of day and/or duration of time until the controller changes set points or the inside space environmental condition changes to the desired set point. Alternatively or in addition, the message 450 may provide a name or title of the current and/or next set point interval, such as, for example, "Wake," "Leave," "Return," and/or "Sleep", as described above. Alternatively or in addition, the message 450 may provide the next set point value and/or that the inside room environmental condition will be increasing or decreasing to a desired next set point such as displaying that the inside space will be cooling or heating to a desired set point in a predicted or anticipated amount of time.

The message 450 may be displayed continuously, or at a predetermined time before a next scheduled future set point change occurs. For example, the message 450 can be displayed 12 hours, 8 hours, 4 hours, 2 hours, 1 hour, 30 minutes or less before a next scheduled future set point change occurs. The message 450 may also be displayed during an amount of time that an inside space is ramping from a first set point to a next scheduled set point.

In some cases, a user may try to over-control the controller by entering an over-controlling set point in an attempt to increase the rate of temperature change and/or decrease the amount of time required to change the temperature in an inside space. However, if the HVAC device is a simple on/off device, as is typically the case, the over-controlling set point does not affect the rate of temperature change from a first set point to a desired second set point. Thus, the message 450 can be adapted to inform the user that entering an over-controlling set point will not increase the rate of temperature change and/or decrease the amount of time required to change the temperature of the inside space. In some embodiments, the message 450 can continue to inform the user of the time and/or duration of time until the inside space reaches the next scheduled set point value, even if the user modifies the current temperature setting.

FIG. 5 is a block diagram of the illustrative controller program shown in FIG. 4. In the illustrative embodiment, a controller 500 includes a control module 510 than can be a microprocessor or the like. The control module 510 can include a programmable schedule 550 as described above, for example. The control module 510 communicates with a user interface 520 and a message generator 540. The control module can also generate one or more control signals 560 to a device (not shown), such as an HVAC system or device.

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The message generator 540 provides a message to the user interface 520 indicating when the next set point is scheduled to occur, as described above.

FIG. 6 is a schematic drawing of an illustrative user interface 600 in accordance with the present invention. In the illustrative embodiment, the user interface 600 can display a message at block 635 on the user interface 600 indicating when the next set point change is scheduled to occur, as described above. For example, the message displayed at block 635 can be "Cooling in 10 min," "65° F. in 10 min," "Cooling to 65° F. in 10 min," "Heating in 5 min" "70° in 5 min," "Heating to 70° in 5 min," and the like.

Additional information could be displayed on the user interface 600 at, for example block 615. This additional information may include a current scheduled parameter setting (e.g., temperature, humidity), a current parameter reading, and/or other information as desired.

The present invention should not be considered limited to the particular examples described above, but rather should be understood to cover all aspects of the invention as fairly set out in the attached claims. Various modifications, equivalent processes, as well as numerous structures to which the present invention can be applicable will be readily apparent to those of skill in the art to which the present invention is directed upon review of the instant specification.

What is claimed is:

1. A method comprising the steps of:

operating a programmable controller to cause an HVAC system to change an environmental condition of an inside space from a first initial set point to a second desired set point, the HVAC system achieving the change in the environmental condition to the second desired set point in an amount of time; and

providing a message during the amount of time indicating when the desired second set point is anticipated to be achieved in the inside space.

2. The method according to claim 1, further comprising entering a third over-controlling set point and still providing a message during the amount of time indicating when the desired second set point is anticipated to be achieved in the inside space.

3. The method according to claim 1, wherein the providing a message comprises providing a message of a duration of time until the desired second set point is anticipated to be achieved in the inside space.

4. The method according to claim 1, wherein the providing a message comprises providing a message of a time of day when the desired second set point is anticipated to be achieved in the inside space.

5. The method according to claim 1, wherein the providing a message comprises providing a message of when the desired second set point is anticipated to be achieved in the inside space and what the desired second set point is.

6. A controller comprising:

a programmable controller arranged and configured to cause an HVAC system to change an environmental condition of an inside space from a first initial set point to a second desired set point, the HVAC system achieving the change in the environmental condition to the second desired set point in an amount of time; and a message displayed during the amount of time indicating when the desired second set point is anticipated to be achieved in the inside space.

7. A method comprising the steps of:

operating a programmable controller to cause an HVAC system to change an environmental condition of an inside space from a first initial set point to a second

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desired set point, the HVAC system achieving the change in the environmental condition to the second desired set point in an amount of time;
allowing a user to change the set point to a third over-controlling set point during the amount of time; and
informing the user that changing the set point to the third over-controlling set point will not decrease the amount of time needed to achieve the second desired set point.
8. A method comprising the steps of:
operating a programmable controller to cause an HVAC system to change an environmental condition of an

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inside space from a first initial set point to a second desired set point; and
selectively displaying a message when the HVAC system is attempting to change the environmental condition of an inside space from the first initial set point to the second desired set point, the message indicating when the second desired set point is anticipated to be achieved in the inside space.

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