can be monitored, a radio sensor may be used to monitor changes in low emission radio waves, and "background noise on the main powerline [can be] monitored and filtered to detect the use of electronic devices, which indicates a likelihood of occupancy in the dwelling."

[0006] Monitoring the main powerline is taught as employing "smart utility meters, such as Smart Meters, [] to monitor energy consumption reflecting the likely presence of occupants" where changes in activity imply changes in occupancy. In the reference, the term "Smart Meter" refers to any advanced utility meter that identifies consumption in greater detail than a conventional utility meter." It should be apparent that monitoring background noise on the main powerline and other references to powerline monitoring in the patent are describing building level monitoring made at the building's utility meter.

SUMMARY

[0006a] Aspects of the invention are defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

[0007] An exemplary method optionally comprises configuring a building with a gateway device and smart thermostats and/or smart electricity meters and/or other sensors. Configuring the building in this way can include wirelessly connecting the gateway to the thermostats, electricity meters, and any other sensors, and also can include connecting the gateway to a web server running a cloud-based service.

[0008] Further steps of the exemplary method are performed, for example, by the cloud-based service. For example, the method can comprise a step of receiving power usage data from the plurality of electricity monitors within the building, where each electricity monitor includes a unique identifier. Here, the power usage data, as received, is associated with the unique identifiers of the electricity monitors that produced the data. The data can be in watts and reported every two minutes, in some embodiments. In some

In still other embodiments the method further comprises adjusting a setting of a thermostat within the building based on a change in the number of occupied seats.

[0013] In other embodiments, the method further comprises updating an occupancy model for the building based on a comparison of the occupied seats to seats predicted by the occupancy model. Various methods can further comprise categorizing each seat according to the amount of time that power is used. Still other methods comprise dynamically assigning unoccupied seats.

[0014] An exemplary system is for use in a building including a number of distributed thermostats. The system comprises a plurality of electricity monitors, each including a unique identifier and each plugged into a different power outlet within the building, each configured to measure power usage and periodically transmit power usage, a gateway in communication with the number of thermostats and the plurality of electricity monitors, a database, and a server, such as a web server, in communication with the gateway and the database. In some embodiments, the electricity monitors communicate with the gateway by Zigbee. The system comprises the number of thermostats, in some embodiments.

[0015] The server also includes logic, where the logic is configured to receive, from the plurality of electricity monitors, power usage data associated with the unique identifier for each electricity monitor, determine a change in building occupancy based on the received power usage data, and vary a temperature setting of a thermostat of the number of thermostats based on the change in building occupancy. In various embodiments the logic is further configured to maintain an occupancy model for the building. The logic optionally is further configured to receive a weather forecast and to vary a temperature setting of a thermostat of the number of thermostats based on the weather forecast. In still other embodiments the logic is further configured to receive a report, to use natural

language processing to interpret the report, and to vary a temperature setting of a thermostat of the number of thermostats based on an interpretation of the report.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015a] The invention will now be described, by way of non-limiting example only, and with reference to the figures, in which:

[0016] FIG. 1 shows a schematic illustration of a building including a control system according to various embodiments of the present disclosure.

[0017] FIG.2 shows a schematic illustration of exemplary logic for implementing various methods of the present disclosure.

DETAILED DESCRIPTION

[0018] The present invention is directed to control systems and methods for use in conjunction with buildings, especially larger facilities including multi-level structures. According to the present invention, a building is equipped with at least a heating system, and preferably both heating and cooling, which is controlled by smart thermostats. The building receives electric power, such as from the public utility grid, and distributes the power throughout the building according to conventional wiring terminating in a plurality of conventional power outlets. Smart electricity monitors placed at these power outlets and then electric devices are plugged into the electricity monitors. Power usage at each monitored power outlet is one of several inputs used to determine proper settings for the smart thermostats. More particularly, power consumption at individual outlets is used to revise a predictive occupancy model, and the model is then used to determine the proper settings. Other systems, such as ventilation systems, home automation systems, enterprise energy management systems, work station plug load management systems, home security, battery charging systems, building monitoring systems, hot water systems, security and emergency response systems, workplace management systems (ordering supplies,

CLAIMS

1. A method comprising:

receiving, from a plurality of electricity monitors distributed within a building, each electricity monitor including a unique identifier, power usage data associated with the unique identifier for each electricity monitor;

for each unique identifier, storing in a database the received power usage data in association with that unique identifier;

for each unique identifier, determining whether the stored power usage data matches a pattern for occupancy, wherein the pattern for occupancy is a pattern of power use that correlates with use by a person residing in a seat;

for each unique identifier with power usage data matching the pattern for occupancy, determining whether recent data within the stored power usage data exceeds a power usage threshold; and

counting as an occupied seat every unique identifier having power usage data matching the pattern for occupancy and having recent data within the power usage data exceeding the power usage threshold to determine a number of occupied seats.

2. The method of claim 1 further comprising, for each unique identifier, storing in the database, in association with that unique identifier, a location of the electricity monitor within the building.

3. The method of claim 1 or 2 further comprising for each unique identifier, filling in missing values in the power usage data stored in the database.

4. The method of claim 1, 2, or 3 further comprising revising a power usage threshold for a unique identifier.

5. The method of claim 1-3 or 4 further comprising adjusting a setting of a thermostat within the building based on a change in the number of occupied seats.

6. The method of claim 1-4 or 5 further comprising updating an occupancy model for the building based on a comparison of the occupied seats to seats predicted by the occupancy model.

7. The method of claim 1-5 or 6 further comprising categorizing each seat according to the amount of time that power is used.

8. The method of claim 1-6 or 7 further comprising dynamically assigning unoccupied seats.

9. The method of claim 1-7 or 8 further comprising receiving and aggregating data from a 3rd party source located outside of the building.

10. A system for use in a building, the building including a number of distributed thermostats, the system comprising:

a plurality of electricity monitors, each including a unique identifier and each for plugging into a different power outlet within the building, each configured to measure power usage and periodically transmit power usage;

a gateway configured for communication with the number of thermostats and the plurality of electricity monitors;

a database; and

a server configured for communication with the gateway and the database, the server including logic configured to

receive, from the plurality of electricity monitors, power usage data associated with the unique identifier for each electricity monitor, determine a change in building occupancy based on the received power usage data, and

vary a temperature setting of a thermostat of the number of thermostats based on the change in building occupancy.

11. The system of claim 10 wherein the server is a web server.

12. The system of claim 10 or 11 wherein the electricity monitors are configured to communicate with the gateway by Zigbee.

13. The system of claim 10, 11, or 12 further comprising the number of thermostats.

14. The system of claim 10-12 or 13 wherein the logic is further configured to maintain an occupancy model for the building.

15. The system of claim 10-13 or 14 wherein the logic is further configured to receive a weather forecast and to vary a temperature setting of a thermostat of the number of thermostats based on the weather forecast.

16. The system of claim 10-14 or 15 wherein the logic is further configured to receive a report, to use natural language processing to interpret the report, and to vary a temperature setting of a thermostat of the number of thermostats based on an interpretation of the report.