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ADAPTIVE MEETING ROOM TEMPERATURE CONTROL

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ABSTRACT

Smart buildings are typically able to facilitate temperature controls in meeting rooms today by monitoring temperature within the rooms using sensors, thermostat devices, and the like. Presented herein are techniques through which room temperature can be adapted in a more dynamic manner, by accounting for the number of people in a room and heat from electronic devices either present in or carried into the room. This adaptive temperature control uses real-time factors that other solutions fail to include, thereby providing both improved comfort and reduced power consumption.

DETAILED DESCRIPTION

In modern offices and commercial/industrial buildings, it is common for the temperature and humidity to be controlled. The indoor thermal comfort in a working or living place can directly impact a person's productivity and efficiency. A common approach to address such an issue typically involves the installation of air conditioning systems. Most buildings use very basic programmable thermostats to control heating and cooling cycles based on a predefined threshold, and with respect to deviation from a set point temperature.

Smart building concepts look to apply 'intelligence' to the monitoring, control, and operation of building spaces, thereby providing for the ability to optimizing the environment for the occupants, reducing energy consumption and costs as well as aiming to reduce impact on the environment.

Despite the deployment of smart buildings systems, shared meeting spaces are often too cold or too hot for the occupants and struggle to adapt the temperature in time for the meeting or for the meeting duration.

This proposal provides an adaptive temperature control system that can proactively make temperature adjustments for a meeting room and may also provide for the ability to respond to too "hot/cold" conditions, thereby addressing the challenge of maintaining a building's indoor temperature at a given nominal comfort level. Figure 1, below, illustrates example details that may be associated with the adaptive temperature control system of this proposal.

With reference to Figure 1, below, consider an example in which a meeting room has the capacity to accommodate 10 people and may contain various electronic equipment, such as projectors, displays, teleconferencing equipment, etc.

In this example, when a meeting needs to be scheduled, an electronic meeting invitation is sent out that includes the required people and the selected meeting room. The room's attendee capacity is known at this time. The meeting invitation can be enhanced to add mechanisms in which the recipients of the invite can perform the following actions – accept the invite and mark as "attend in person" or "virtual", decline or tentative (A1). Based on this information and the meeting room capacity, the temperature of the room can be set to a predefined/calculated value (A2) to provide adequate comfort for the people that will be attending the meeting. It is to be understood that other input mechanisms can be used to determine the number of attendees that are expected to attend a given meeting.

As the meeting starts, the number of people attending the meeting in-person may change; it could be more or less. It is expected that attendees will bring electronic equipment such as laptops, mobile phones, tablets, etc. to the meetings. These devices, when in operation, also emit heat in addition to the existing room devices such as projectors, teleconference systems, access points, etc. The increase in the number of devices and people in the meeting room will change the temperature in the room.

At this point, the system can re-evaluate the thermal energy in the room in order to make relevant changes to the temperature in the room.

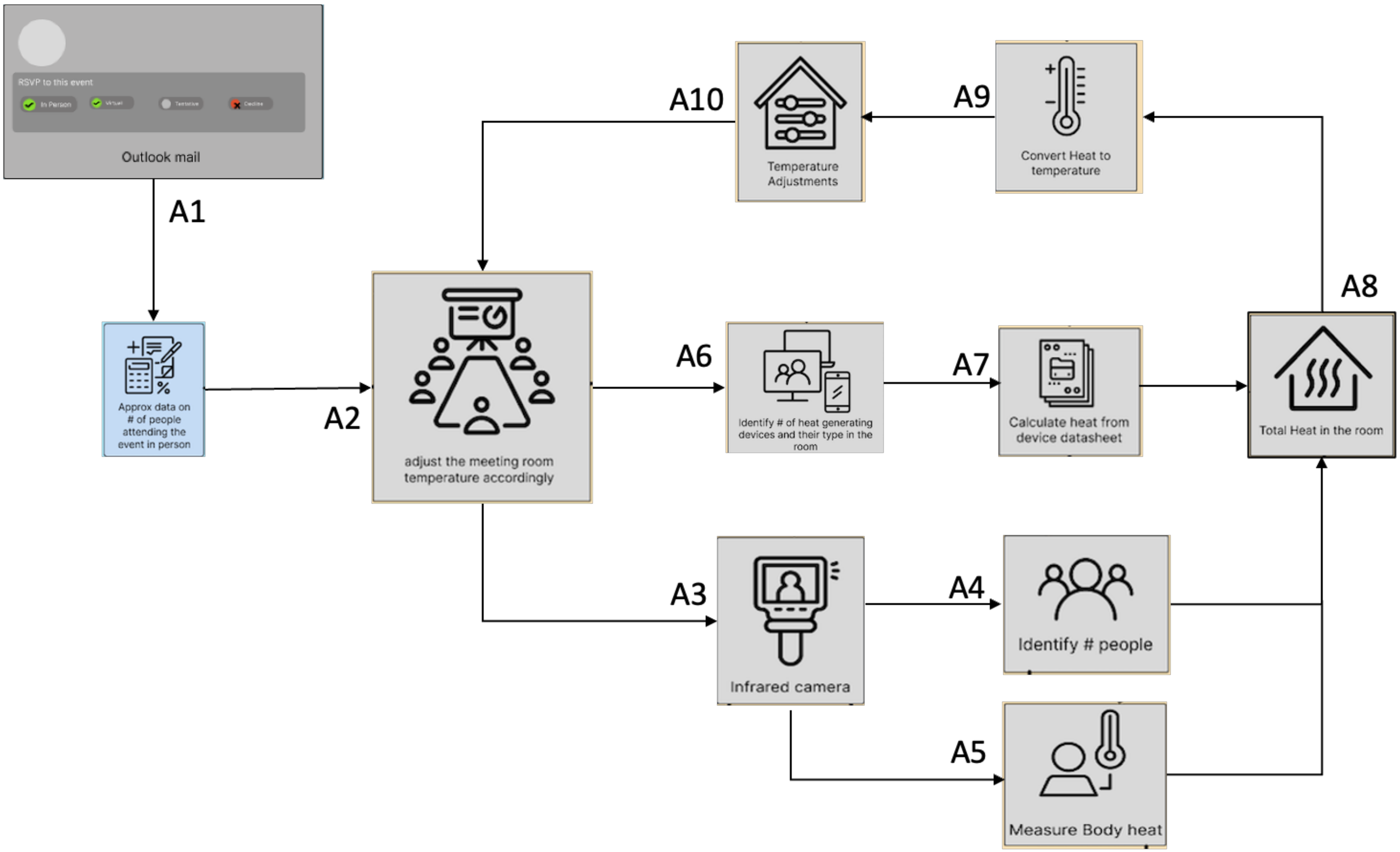

Figure 1: Adaptive Temperature Control System

To re-evaluate the thermal energy in the room, the system can take into consideration the presence of:

- The number of people in the room/building; and
- Electronic Devices (mobiles, laptops, projectors, display screens, etc.).

To account for the number of people in the room (or building), the system can utilize additional sensing capabilities, such as, for example, an infrared camera (A3) embedded in a meeting room device. In this example, the sensor can use an algorithm to identify the number of people in the room (A4) and detect the total heat dissipated from the people (A5)

To account for electronic devices that may be present in the room (or building), it can be assumed that many portable electronic devices use wireless or Bluetooth® Low Energy (BLE) for wireless communication purposes. Thus, the system can identify the electronic devices in the room using such communication technologies. The communications protocols are able to obtain the MAC addresses of the devices and through a look-up table, the system can identify the device type of the devices present in the room (A6). Once the device type of the devices in the room is known, further information can be obtained such as the expected heat dissipation (A7).

The system can then calculate the total heat in the room using the above methods (A8), can convert the heat value into temperature (A9), and can determine the necessary temperature adjustments (A10) for the meeting room; thereby achieving the required thermal comfort.

By comparison to a current Smart HVAC (Heating, Ventilation and Air Conditioning) control system, the solution of this proposal can leverage in-room sensing mechanisms to calculate total heat and adjust temperature accordingly. Thus, the solution can consider multiple real time factors in managing room temperature, such as number of people in the room and heat generated by electronic devices, in addition to predetermining comfort level in the room using the number of invites accepted for an in-person meeting.

Accordingly, the solution proposed herein involving the adaptive temperature control system may provide several advantages over current Smart building solutions. For example, the system can use real time factors such as number of people/devices in the room and heat generated in an adaptive and proactive manner to actively adjust the temperature of a room based on multiple factors/considerations. Additionally, the system can use meeting invitation responses to set the meeting room temperature within a predetermined comfort range, which can help to limit or reduce meeting attendees from calling management services to adjust the temperature of a given room. Further, the system is able to identify the number and type of devices in the room, thereby enabling the heat dissipation to be evaluated. Further, the number of people in the room and their thermal energy output can be identified, which can further improve temperature control for the room. Additionally, the system may facilitate power savings as the indoor temperature of the room is kept within a predetermined comfort range and adjusting room temperatures before meeting starts; potential further savings may be provided if the temperature control can be switched off entirely when the room is not in use.

Further, conventional thermostats cannot deal with/predict undershoot/overshoot of temperature; whereas smart thermostats typically work on gathered historical data and use that data to perform a 'best fit' against a model. Thus, such approaches operate based on the measured temperature of a space, and do not take into account the sources of heat that are present. In contrast, the adaptive temperature control system as proposed herein can utilize additional information to avoid undershoot/overshoot and provide optimal temperature control using comparison mechanisms based on thermal temperature of devices and people present in a room. Thus, the solution proposed herein may provide the ability to optimize or minimize the temperature undershoot/overshoot that may occur with conventional thermostats that may go up and down/between -ve and +ve.

Additionally, conventional/Smart thermostats compare the measured temperature against a set point temperature and make temperature adjustments based on the set point. Thus, such thermostats are not adaptive with respect to the presence of temporary heat sources in a room, such as people and heat-emitting devices. While there can be fixed heat-emitting devices in the room, temporary heat-emitting sources present within a room will result in temperature changes, which can be considered utilizing the adaptive temperature control system as proposed herein.

In some instance, techniques of this proposal can be extended to manage the operating temperature of electronic devices. For example, Undershoot/Overshoot of the thermal output of an electronic device that is determined to be outside of the normal operating profile of the electronic device can be used for maintenance purposes. A device that is behaving in such a manner may be displaying symptoms of a pending failure or of a failure having occurred. For example, in a solar panel, if one cell is exhibiting too much heat or does not heat at all, the panel/cell can be identified and replaced using techniques as proposed herein. Further, the mechanism can be applied to 'assurance of cold-chain' scenarios involving the movement of food, medicines, etc. across logistics and transport systems, where temperature levels must be maintained.

Accordingly, techniques herein may provide for the ability to adaptively manage temperature of a device, space, room, or building in a dynamic manner, by considering multiple factors that may be impacting the generation of heat, such as the number of people present in a room, heat from electronic devices either present in or carried into the room, and/or any other factors that may be considered heat generating or heat contributing factors that can impact temperature for a device, space, room, etc.