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THERMAL PERFORMANCE ENHANCEMENT CONTROL BY SENSORS

HP INC

Thermal Performance Enhancement Control by Sensors

Abstract: The operating performance of an electronic device is automatically adjusted based on detection of the device's various use cases such that the skin temperature is comfortable when a user is holding the device, and performance is maximized when it is not being handheld.

This disclosure relates to the field of thermal control of electronic devices.

A technique is disclosed that automatically adjusts the operating performance of an electronic device so that the skin temperature is comfortable when a user is holding the device and performance is maximized when it is not being handheld.

The designers of today's electronic products, such as for example notebook computers, are challenged by having to design thermal solutions that assume that the device could be in direct contact with the user at its heaviest workload, and thus highest skin temperature. As a result, the customer experience suffers two drawbacks. First, the performance of systems is limited by the skin temperature limits, even if the system is docked and not in direct contact with the user's hand. Second, the skin temperature during workloads when the user is in direct contact may not be as comfortable as desired.

According to the present disclosure, and as understood with reference to the Figure, the performance and skin temperature of an electronic device 10 are optimized based upon detection of whether or not the user is physically in contact with the device during operation.

Several System Modes of the electronic product are defined. Performance Mode is the default mode used most commonly in office and docked environments. It implements the system thermals (fan speeds and/or power design) for operation at a higher temperature (e.g. 45 degrees C) that would be uncomfortable for a user in continual contact with the device. The Cool Mode adjusts the system thermals (speeds of the fans 15 and/or system power design) to drop the skin temperature to a more comfortable working condition for the user.

Different use cases can be envisioned for the product, for example: (1) Normal working on table in a System table mode, (2) Normal working on table in a x360 System table mode, (3) Use device in hand, (4) Working on Dock, and (5) Idle or Moving. In use case (4) the product will operate in Performance Mode. In use cases (1), (2), and (3) the product will operate in Cool Mode. And in use case (5), the product will be in an Idle (or Sleep) Mode.

The electronic device 10 can detect the present use case via sensors, and then set the System Mode accordingly in order to deliver each optimized thermal mode to provide the best condition of usability, as follows.

Normal Working Mode (Table Mode): this is for Normal working mode where the product is on a table and operating in Cool Mode'. Two or more capacitive sensors 25 on the palm rest area will detect the placement of the user's palm(s) thereon (in a Windows system, as part of an i2c flag within the BIOS). This detection then triggers a fan speed and power change to accommodate Cool Mode.

Normal Working Mode (Table Mode with 360): this is for Normal working mode on a table for an x360, 2-in-1 or tablet case. This mode is detected by a system mode detection switch which defines a clamshell or x360 mode. Once the system detects x360, fan speed and power change to enable Cool Mode.

Handheld Mode: this occurs when a person takes the electronic device in hand for operation; for example, while standing. This mode is determined by an accelerometer 30 detecting that the device is 'in-the-air' while the system is on. If not already in Cool Mode, the fan speed and power are changed accordingly.

Dock Mode: this occurs when the electronic product is coupled to a docking station. Dock Mode occurs by connecting a USB-C or legacy docking connector, which in Windows computers causes an i2c flag to be triggered in the BIOS. Detection then triggers a fan speed and power change to the full power of Performance Mode.

Idle/Sleep Mode: this occurs when the product is either not in use or being transported. When the system has been idle for a period of time, or when the lid on a clamshell device has been closed, the system enters its sleep mode (S3, for a Windows system) automatically without the need for any extra sensing.

The disclosed technique advantageously optimizes performance and skin temperature automatically based on the current usage of an electronic product.

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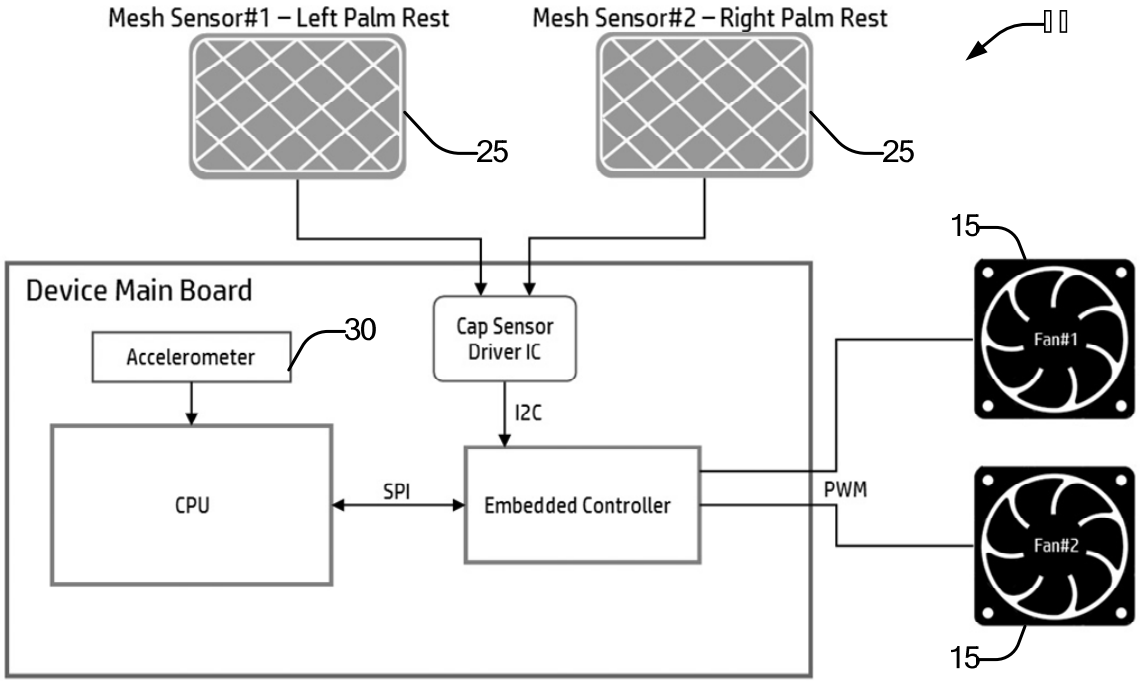
Mesh Sensor#1 – Left Palm Rest
Mesh Sensor#2 – Right Palm Rest
25
25
15
Device Main Board
Accelerometer
30
Cap Sensor Driver IC
I2C
CPU
SPI
Embedded Controller
PWM
Fan#1
Fan#2
15