January 2023

ADJUSTING POWER OFF WAITING TIME BASED ON USER'S WAKEUP FREQUENCY

HP INC

Adjusting Power Off Waiting Time Based on User's Wakeup Frequency

Abstract: Fast wakeup from low-power standby mode of electronic devices while minimizing stress on components subject to wear is achieved by adjusting the power-off waiting time of the components based on the wakeup frequency experienced by the device.

This disclosure relates to the field of electronic devices.

To satisfy low-power standby time requirements, the sleep standby time of electronic equipment, such as for example a multifunction device, is also shortened and thus the device goes to sleep quickly. To achieve the lowest possible standby power usage, most or all components of the device are turned off while in the low-power mode. As a result, wakeup (i.e., power-on) of these components must be performed to use the device. In many use cases, most or all the components within the multifunction device are turned off and on frequently. The wakeup frequency typically varies based on the usage pattern of the device by its user.

For example, assume that the multifunction device is operated every 5 minutes, and the multifunction device's sleep waiting time is 1 minute. In this case, the multifunction device processes the work, waits for 1 minute, goes to sleep and wait for the next task. If a new task is entered after 4 minutes, the multifunction device wakes up and turns on the power to the installed components to perform the requested task. As a result, power cycling of the components occurs 12 times per hour, and the number of power cycling increases to 288 times in 24 hours, 2016 times in 1 week, and the like. In an environment where frequent wakeups such as this occur, frequent power-cycling may damage some of the components and/or shorten their lifetimes. Among these, the hard disk drive (HDD) is one example. The HDD has many mechanical parts, such as the spindle that rotates the disk and the arm actuator that moves the head to read or write the disk. Frequent power cycling can cause damage or wear to these or other parts of the HDD.

A technique is disclosed that prevents damage to a hard disk drive by analyzing the user's wakeup frequency pattern and adjusting the interval between cycling off and on the power of the HDD, while still satisfying fast low-power entry times for the electronic device.

According to the present disclosure, an initial interval period is assigned at manufacture having an initial wakeup count value. For example, the initial period interval may be set to 12 days, and the initial frequency interval to 2500 times. The initial basis assumes that device wake-up of about 8 times per hour is an appropriate value to prevent damage caused by power cycling of the HDD. The initial HDD power off waiting time is the shortest, for example 20 seconds, and monitored. When either the initial period section or the initial count section is exceeded, the monitoring ends, and the HDD power off waiting time is adjusted according to the wakeup frequency.

The number of wakeups per day from 0:00 to 24:00 is recorded for a particular span of time, such as for example 7 days. As an example, assume that the number of wakeups recorded during a 7-day period are: 250 times on day, 1 200 times on day, 2250 times on day 3, 100 times on day 4, 200 times on day 5, 30 times on day 6, and 20 times on day 7 As an example, it is assumed that it is managed for about 7 days.

The standby time is adjusted to prevent damage to the HDD. Assume that the appropriate reference value to prevent damage in an example HDD is 190 times. In this case, the next day's HDD power-off standby time is determined according to the following calculation:

1. If the number of times the previous day is less than or equal to the reference value, the HDD power off standby time is set to shortest time (20 seconds).

2. If the number of times the previous day is greater than the appropriate reference value, the HDD power off standby time is set to 24 * 60 minutes / (optimal standard value * 2 - the number of previous days). Further, if the HDD power off standby time exceeds the maximum time (e.g., 15 minutes), it becomes the maximum time.

Therefore, the HDD power off standby time for each day will be 11 minutes on day 2; 8 minutes on day 3; 11 minutes on day 4; 20 seconds on day 5; 8 minutes on day 6; 20 seconds on day 7; and 20 seconds on day 8.

The next day after the spontaneous wakeup section is found, the HDD power off standby time is adjusted to prevent damage to the HDD.

Furthermore, it is possible to predefine the HDD power-off standby time for a week by using an average pattern of 7 days (e.g., Monday to Sunday). For example, if the previous example is the result of one week, the next week's value can be estimated in advance to determine the HDD power-off standby time and apply it to that week. In other words, in an environment where the set usage frequency is low, such as on Saturday and Sunday, the default HDD power-off waiting time of 20 seconds is applied on Monday, so to prevent too frequent HDD power-off in the Monday work environment, By referring to the Monday pattern from the previous week, it is possible to prevent an abnormal increase in the number of HDD power-offs due to too short an abnormal HDD power standby time.

The disclosed technique advantageously prevents damage to a HDD due to HDD power cycling within a short period of time and increases its lifespan, while maintaining fast activation from the low-power state.

Disclosed by Sang-Hyun Park, Jungjin Park, and Joon Hyung Hwangbo, HP Inc.