

and sensors on the body in an environment different from home causes stress and makes it difficult to sleep. As a result, it is difficult to test the normal sleep state correctly.

[0006]

In light of the above circumstances, the present invention provides a sleep-wakefulness determination apparatus and program, which determine sleep-wakefulness with a sufficiently high level of accuracy using a small number of wearing devices.

Means for Solving Problems

[0007]

According to one aspect of the present invention, there is provided a sleep-wakefulness determination apparatus configured to determine sleep and wakefulness of a user comprising a scalar calculation unit configured to calculate scalar value based on each component of the acceleration vector in a part of a body of the user, wherein the scalar value is an L2 norm or an L1 norm; a feature value calculation unit configured to calculate feature value for each epoch defined by a predetermined time of 5 minutes or less based on the scalar value, wherein the feature value is a histogram generated by dividing the scalar value or logarithm thereof into classes with a plurality of threshold values; and a sleep-wakefulness determination unit configured to determine the sleep and wakefulness of the user based on the feature value of a desired epoch and the feature value of peripheral epochs included in a plurality of epochs before and after the desired epoch in a time series, in the epoch.

[0008]

With the sleep-wakefulness determination apparatus, it is possible to determine sleep and wakefulness by the subject to be examined wearing only a bio-acceleration measuring device.

BRIEF DESCRIPTION OF DRAWINGS

[0009]

FIG. 1 is a schematic diagram of a sleep-wakefulness determination system for the present system.

FIG. 2A is a hardware configuration of the sleep-wakefulness determination system shown in FIG. 1.

FIG. 2B is a functional block diagram of a controller of the sleep-wakefulness determination system.

CLAIMS

1. A sleep-wakefulness determination apparatus configured to determine sleep and wakefulness of a user, comprising:

a scalar calculation unit configured to calculate a scalar value based on each component of an acceleration vector in a part of a body of the user, wherein the scalar value is an L2 norm or an L1 norm;

a feature value calculation unit configured to calculate a feature value for each epoch defined by a predetermined time of 5 minutes or less based on the scalar value, wherein the feature value is a histogram generated by dividing the scalar value or logarithm thereof into classes with a plurality of threshold values; and

a sleep-wakefulness determination unit configured to determine the sleep and wakefulness of the user based on the feature value of a desired epoch and the feature value of peripheral epochs included in a plurality of epochs before and after the desired epoch in a time series, in the epoch.

2. The sleep-wakefulness determination apparatus according to claim 1, wherein the scalar calculation unit is configured to calculate the scalar value based on each component of a time difference vector, the time difference vector being a difference vector of two acceleration vectors in a time series.

3. The sleep-wakefulness determination apparatus according to claim 1, wherein the scalar calculation unit is configured to calculate the scalar value based on each component of an n-th-order time derivative vector, the n-th-order time derivative vector being a vector in which the acceleration vector is differentiated by n-th-order time derivative, and n being a natural number.

4. The sleep-wakefulness determination apparatus according to any one of claims 1 to 3, wherein the feature value is a power spectrum based on a product of the scalar value multiplied by a window function.

5. The sleep-wakefulness determination apparatus according to any one of claims 1 to 4, further comprising a storage unit which stores a machine learning model allowed to learn correlation of the feature value of the desired epoch, the feature value of the peripheral epochs and the sleep and wakefulness of the user, wherein the sleep-wakefulness determination unit is configured to determine the sleep and

wakefulness based on the machine learning model.

6. The sleep-wakefulness determination apparatus according to any one of claims 1 to 5, further comprising a storage media reading unit configured to read the acceleration vector stored in storage media.

7. The sleep-wakefulness determination apparatus according to any one of claims 1 to 5, further comprising a communication unit configured to communicate with an acceleration sensor worn on a part of a body of the user, and to receive the acceleration vector measured by the acceleration sensor.

8. The sleep-wakefulness determination apparatus according to any one of claims 1 to 5, the apparatus being a wearable device worn on a part of a body of the user, and further comprising an acceleration sensor configured to measure the acceleration vector.

9. The sleep-wakefulness determination apparatus according to any one of claims 1 to 8, further comprising a determination result conversion unit configured to convert a result determined by the sleep-wakefulness determination unit.

10. A program which allows a computer to function as a sleep-wakefulness determination apparatus configured to determine sleep and wakefulness of a user, the apparatus comprising:

a scalar calculation unit configured to calculate a scalar value based on each component of an acceleration vector in a part of a body of the user, wherein the scalar value is an L2 norm or an L1 norm;

a feature value calculation unit configured to calculate a feature value for each epoch defined by a predetermined time of 5 minutes or less based on the scalar value, wherein the feature value is a histogram generated by dividing the scalar value or logarithm thereof into classes with a plurality of threshold values; and

a sleep-wakefulness determination unit configured to determine the sleep and wakefulness of the user based on the feature value of a desired epoch and the feature value of peripheral epochs included in a plurality of epochs before and after the desired epoch in a time series, in the epoch.