SLEEP SYSTEM WITH FEATURES FOR PERSONALIZED SLEEP RECOMENDATIONS

[0001] The present document relates to automated sensing of sleep quality and recommendations for improvement.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0002] This application claims the benefit of U.S. Provisional Application Serial No. 63/166,490, filed March 26, 2021. The disclosure of the prior application is considered part of (and is incorporated by reference in) the disclosure of this application.

BACKGROUND

[0003] In general, a bed is a piece of furniture used as a location to sleep or relax. Many modern beds include a soft mattress on a bed frame. The mattress may include springs, foam material, and/or an air chamber to support the weight of one or more occupants.

SUMMARY

[0004] A system of one or more computers can be configured to perform particular operations or actions by virtue of having software, firmware, hardware, or a combination of them installed on the system that in operation causes or cause the system to perform the actions. One or more computer programs can be configured to perform particular operations or actions by virtue of including instructions that, when executed by data processing apparatus, cause the apparatus to perform the actions. One general aspect includes a clock. The system also includes a sensor configured to sense physical phenomenon of a user and generate objective sleep-quality data for a particular sleep-session of the user based on readings from the sensor. The system also includes a computer system may include: at least one input element configured to receive user input from a user of the computer system and at least one output element configured to render output to the user of the computer system. The computer system is configured to provide a behavior recommendation to the user through the output element, the behavior recommendation presented based at least on i) the objective sleep-quality data, ii) time data from the clock, and iii) a first input from the user through the input element, the

first input specifying a subjective alertness rating reported by the user for the particular sleep-session after awakening from the particular sleep session. Providing the behavior recommendation comprises: accessing a plurality of templates each indexed with at least one user parameter of demographic information; determining demographics for the user; selecting a selected template from the plurality of templates based on a match of the demographics for the user with the at least one user parameter of demographic information for the selected template.

Other embodiments of this aspect include corresponding computer systems, apparatus, and computer programs recorded on one or more computer storage devices, each configured to perform the actions of the methods.

[0005] Implementations may include one or more of the following features. The system where to provide the behavior recommendation to the user, the computer system is configured to: receive, from the sensor, the readings; receive, from the clock, the time data; and receive, through the input element, user selection of the alertness rating. The clock is one of the group may include of a component of the computer system; and physically separate from the computer system and connected to the computer system by a data network. The sensor is one of the group may include of a pressure sensor of a bed on which the user sleeps in the sleep session; and a wearable device worn by the user as the user sleeps in the sleep session. The computer system may include at least one of the group may include of a controller device of a bed on which the user sleeps in the sleep session; a phone device of the user; a home-automation hub; and a server physically separate from the sensor and connected to the sensor by a data network. The subjective alertness rating is a rating wakefulness and/or alertness selected from a plurality of possible ratings to be selected by the user at least a threshold time after the end of the sleep session. The threshold time is two hours. To provide a behavior recommendation to the user, the computer system is configured to assemble the behavior recommendations from a template of general behavior recommendations that has been completed with information specific to the user. The sensor is a pressure sensor in fluid communication with the air chamber. The system may include means for controlling pressure of a bed that includes the sensor. Implementations of the described techniques may include hardware, a method or process, or computer software on a computer-accessible medium.

One general aspect includes at least one input element configured to receive user input from a user of the computer system. The computer system also includes and at least one output element configured to render output to the user of the computer system. The computer system is configured to provide a behavior recommendation to the user through the output element, the behavior recommendation presented based at least on i) objective sleep-quality for a particular sleep-session of the user based on readings from a sensor configured to sense physical phenomenon of the user, ii) time data from a clock, and iii) a first input from the user through the input element, the first input specifying a subjective alertness rating reported by the user for the particular sleep-session

after awakening from the particular sleep session. Providing the behavior recommendation comprises: accessing a plurality of templates each indexed with at least one user parameter of demographic information; determining demographics for the user; and selecting a selected template from the plurality of templates based on a match of the demographics for the user with the at least one user parameter of demographic information for the selected template.

Other embodiments of this aspect include corresponding computer systems, apparatus, and computer programs recorded on one or more computer storage devices, each configured to perform the actions of the methods.

[0006] Implementations may include one or more of the following features. The computer system where to provide the behavior recommendation to the user, the computer system is configured to: receive, from the sensor, the readings; receive, from the clock, the time data; and receive, through the input element, user selection of the alertness rating. The clock is one of the group may include of a component of the computer system; and physically separate from the computer system and connected to the computer system by a data network. The sensor is one of the group may include of a pressure sensor of a bed on which the user sleeps in the sleep session; and a wearable device worn by the user as the user sleeps in the sleep session. The computer system may include at least one of the group may include of a controller device of a bed on which the user sleeps in the sleep session; a phone device of the user; a home-automation hub; and a server physically separate from the sensor and connected to the sensor by a data network. The subjective alertness rating is a rating wakefulness and/or alertness selected from a plurality of possible ratings to be selected by the user at least a threshold time after the end of the sleep session. The threshold time is two hours. To provide a behavior recommendation to the user, the computer system is configured to assemble the behavior recommendation from a template of general behavior recommendations that has been completed with information specific to the user. Implementations of the described techniques may include hardware, a method or process, or computer software on a computer-accessible medium.

[0007] One general aspect includes a method for generation of computer system output, the method comprising receiving, from a sensor configured to sense physical phenomenon of a user, objective

sleep-quality data based on readings for a particular sleep-session of the user. The method also includes receiving, from a clock, time data. The method also includes receiving, through an input element, user selection of an alertness rating for the particular sleep-session after awakening from the particular sleep-session. The method also includes accessing a template of general behavior recommendation that has been completed with information specific to the user. The method also includes generating the information specific to the user based at least on the i) objective sleep-quality for a particular sleep-session of the user based on the readings. The method also includes ii) time data. The method also includes and iii) user selection of alertness rating. The method also includes assembling behavior recommendation by completing the template with the information specific to the user. The method also includes generating the

computer system output may include the assembled behavior recommendation, wherein generating the computer system output comprises accessing a plurality of templates each indexed with at least one user parameter of demographic information; determining demographics for the user; and selecting a selected template from the plurality of templates based on a match of the demographics for the user with the at least one user parameter of demographic information for the selected template. Other embodiments of this aspect include corresponding computer systems, apparatus, and computer programs recorded on one or more computer storage devices, each configured to perform the actions of the methods.

[0008] Implementations can include some, all, or none of the following advantages. The technology of home automation is improved. Automatic sensing of a user's sleep combined with a user's subjective rating of sleep can be combined by computer technology to generate, without need of time from expert human (e.g., doctor, therapist) for each use. This can allow for the provisioning of beneficial behavioral therapy to users who would otherwise not be able to access such information. For example, users in particularly remote or low-population-density areas may not have convenient access to behavioral therapy serves, and these users can instead access recommendations that machine generated but nevertheless specific to the particular user's life and situation. As will be understood, this can also allow the limited number of behavioral experts to provide help to many more recipients than would be possible without this technology. Instead of requiring the experts to spend time in one-on-one analysis to provide a single recipient with personalized advice, this technology can allow the experts to craft a rule-set that, when combined with a data of a particular user, generates user-specific recommendations that embody the best advice from the experts. This technology advantageously mixes both objective measures of sleep quality as well as subjective measures of sleep quality (e.g., a user-entered wakefulness rating). By combining both subjective and objective measures, the technology can advantageously work better than technology that uses only one or the other. For example, a user may be dealing with a physiological issue that is not (yet) reflected in objective measures (e.g., heartrate, breathing, length of sleep) but that is reflected in subjective measures (e.g., user-answered questions about their subjective feeling). For example, a user dealing with depression may initially show objective measures of very good sleep (e.g., longer sleep sessions, slower heartbeats, less gross movement), but may also as an expression of their depressive state may feel subjectively very sleepy or lethargic. This technology can advantageously consider the user's subjective

feelings where technology using only objective measures may incorrectly identify the user as receiving significant high quality sleep and thus assume a high level of alertness. As will be understood, there are both clinical and sub-clinical reasons a user's objective and subjective measures of sleep and wakefulness may be atypical, and this technology can advantageously account for such a user.

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WHAT IS CLAIMED IS:

1. A system comprising:

a clock;

a sensor configured to sense physical phenomenon of a user and generate objective sleep-quality data for a particular sleep-session of the user based on readings from the sensor;

a computer system comprising:

at least one input element configured to receive user input from a user of the computer system; and

at least one output element configured to render output to the user of the computer system; and

wherein the computer system is configured to provide a behavior recommendation to the user through the output element, the behavior recommendation presented based at least on i) the objective sleep-quality data, ii) time data from the clock, and iii) a first input from the user through the input element, the first input specifying a subjective alertness rating reported by the user for the particular sleep-session after awakening from the particular sleep-session, wherein providing the behavior recommendation comprises:

accessing a plurality of templates each indexed with at least one user parameter of demographic information;

determining demographics for the user;

selecting a selected template from the plurality of templates based on a match of the demographics for the user with the at least one user parameter of demographic information for the selected template.

2. The system of claim 1, wherein to provide the behavior recommendation to the user, the computer system is configured to:

receive, from the sensor, the readings;

receive, from the clock, the time data; and

receive, through the input element, user selection of the alertness rating.

3. The system of one of the claims 1-2, wherein the clock is one of the group consisting of a component of the computer system; and physically separate from the computer system and connected to the computer system by a data network.

4. The system of one of the claims 1-3, wherein the sensor is one of the group consisting of a pressure sensor of a bed on which the user sleeps in the sleep session; and a wearable device worn by the user as the user sleeps in the sleep session.

5. The system of one of the claims 1-4, wherein the computer system comprises at least one of the group consisting of a controller device of a bed on which the user sleeps in the sleep session; a phone device of the user; a home-automation hub; and a server physically separate from the sensor and connected to the sensor by a data network.

6. The system of claim 1, wherein the subjective alertness rating is a rating wakefulness and/or alertness selected from a plurality of possible ratings to be selected by the user at least a threshold time after ending the sleep session.

7. The system of claim 6, wherein the threshold time is two hours.

8. The system of one of the claims 1-5, wherein to provide a behavior recommendation to the user, the computer system is configured to assemble the behavior recommendations from a template of general behavior recommendations that has been completed with information specific to the user.

9. The system of one of the claims 1-5, the system further comprising a mattress with at least one air chamber; and wherein the sensor is a pressure sensor in fluid communication with the air chamber.

10. The system of one of the claims 1-5, the system further comprising means for controlling pressure of a bed that includes the sensor.

11. A computer system comprising:

at least one input element configured to receive user input from a user of the computer system; and

at least one output element configured to render output to the user of the computer system; and

wherein the computer system is configured to provide a behavior recommendation to the user through the output element, the behavior recommendation presented based at least on i) objective sleep-quality for a particular sleep-session of the user based on readings from a sensor configured to sense physical phenomenon of the user, ii) time data from a clock, and iii) a first input from the user through the input element, the first input specifying a subjective alertness rating reported by the user for the particular sleep-session after awakening from the particular sleep session, wherein providing the behavior recommendation comprises:

accessing a plurality of templates each indexed with at least one user parameter of demographic information;

determining demographics for the user; and

selecting a selected template from the plurality of templates based on a match of

the demographics for the user with the at least one user parameter of demographic information for the selected template.

12. The computer system of claim 11, wherein to provide the behavior recommendation to the user, the computer system is configured to:

receive, from the sensor, the readings;

receive, from the clock, the time data; and

receive, through the input element, user selection of the alertness rating.

13. The computer system of one of the claims 11-12, wherein the clock is one of the group consisting of a component of the computer system; and physically separate from the computer system and connected to the computer system by a data network.

14. The computer system of one of the claims 11-13, wherein the sensor is one of the group consisting of a pressure sensor of a bed on which the user sleeps in the sleep session; and a wearable device worn by the user as the user sleeps in the sleep session.

15. The computer system of one of the claims 11-14, wherein the computer system comprises at least one of the group consisting of a controller device of a bed on which the user sleeps in the sleep session; a phone device of the user; a home-automation hub; and a server physically separate from the sensor and connected to the sensor by a data network.

16. The computer system of one of the claims 11-15, wherein the subjective alertness rating is a rating wakefulness and/or alertness selected from a plurality of possible ratings to be selected by the user at least a threshold time after ending the sleep session.

17. The computer system of claim 16, wherein the threshold time is two hours.

18. The computer system of one of the claims 11-15, wherein to provide a behavior recommendation to the user, the computer system is configured to assemble the behavior recommendation from a template of general behavior recommendations that has been completed with information specific to the user.

19. A method for generation of computer system output, the method comprising:

receiving, from a sensor configured to sense physical phenomenon of a user, objective sleep-quality data based on readings for a particular sleep-session of the user;

receiving, from a clock, time data;

receiving, through an input element, user selection of an alertness rating for the particular sleep-session after awakening from the particular sleep-session;

accessing a template of general behavior recommendation that has been completed with information specific to the user;

generating the information specific to the user based at least on the i) objective sleep-quality for a particular sleep-session of the user based on the readings; ii) time data; and iii) user selection of alertness rating;

assembling behavior recommendation by completing the template with the information specific to the user; and

generating the computer system output comprising the assembled behavior recommendation, wherein generating the computer system output comprises:

accessing a plurality of templates each indexed with at least one user parameter of demographic information;

determining demographics for the user; and

selecting a selected template from the plurality of templates based on a match of the demographics for the user with the at least one user parameter of demographic information for the selected template.