CLAIMS

What is claimed is:

1. A personnel on-duty status early-warning method, comprising:

continuously collecting human body data of personnel in an actual working environment;

determining on-duty status of the personnel corresponding to the human body data based on the collected human body data by using a status detection model, wherein the status detection model is obtained by pre-training a preset model based on a training dataset, and the training dataset comprises human body data and corresponding on-duty status annotation information, wherein the on-duty status annotation information in the training dataset corresponding to the status detection model comprises cognitive load level annotation information, fatigue level annotation information and emotion level annotation information;

performing on-duty status monitoring on the personnel based on the on-duty status determined for the personnel; and

outputting early-warning prompt information in response to the on-duty status of the personnel during the on-duty status monitoring satisfying a preset early-warning condition,

wherein the performing on-duty status monitoring on the personnel based on the on-duty status determined for the personnel, comprises:

determining whether the cognitive load level, fatigue level and emotion level exceed respective level thresholds; and

determining that the on-duty status of the personnel does not meet the preset early-warning condition in response to all of the cognitive load level, fatigue level and emotion level do not exceed respective level thresholds, or determining that the on-duty status of the personnel meets the preset early-warning condition in response to any one of the cognitive load level, fatigue level and emotion level exceeds respective level threshold.

2. The personnel on-duty status early-warning method according to claim 1, wherein the training dataset comprises human body data collected in a simulated working environment, and corresponding on-duty status annotation information and on-duty information, and/or, the training dataset comprises historical human body data collected in an actual working

environment and corresponding on-duty status annotation information and on-duty information; and

wherein the on-duty information comprises years of work and types of work.

3. The personnel on-duty status early-warning method according to claim 1, further comprising:

determining work tasks, interactive elements, control methods and feedback mechanisms;

building a simulated working environment based on the work tasks, the interactive elements, the control methods and the feedback mechanisms;

generating task instructions and sending the task instructions to a terminal device of tested personnel to prompt the tested personnel to execute the work tasks corresponding to the task instructions in the simulated working environment;

obtaining human body data corresponding to the tested personnel when executing the work tasks and corresponding on-duty status annotation information and on-duty information;

generating the training dataset based on the human body data corresponding to the tested personnel and corresponding on-duty status annotation information and on-duty information; and

training the preset model with the training dataset to obtain the status detection model.

4. The personnel on-duty status early-warning method according to claim 3, wherein the training dataset comprises a training set, a test set and a validation set, and

the training the preset model with the training dataset to obtain the status detection model, comprises:

performing initial training on the preset model to obtain an initial model based on the training set, wherein the preset model is obtained by pre-training based on an initial training dataset, and the initial training dataset at least comprises human body data of ordinary personnel and corresponding on-duty status annotation information;

performing metric testing on the initial model based on the test set to obtain an initial status detection model; and

verifying the initial status detection model based on the validation set to obtain the status

detection model.

5. The personnel on-duty status early-warning method according to claim 3, wherein the obtaining human body data corresponding to the tested personnel when executing the work tasks and corresponding on-duty status annotation information and on-duty information, comprises:

during the process of the tested personnel executing the work tasks, obtaining the human body data corresponding to the tested personnel, a working duration of the tested personnel, and limb movement data of the tested personnel;

inputting the human body data corresponding to the tested personnel into the preset model to generate simulated on-duty status of the tested personnel;

determining whether the simulated on-duty status is an abnormal state, whether the working duration reaches a preset duration, and/or whether limb movements of the tested personnel are qualified based on the limb movement data; and

generating the on-duty status annotation information and on-duty information of the tested personnel based on the determination result.

6. The personnel on-duty status early-warning method according to claim 5, wherein the on-duty status annotation information at least comprises fatigue data and/or emotion data, and the generating the on-duty status annotation information of the tested personnel, comprises:

sending a fatigue assessment scale and/or an emotion scale to the terminal device of the tested personnel through a subjective questionnaire; and

receiving fatigue data of the fatigue assessment scale and/or emotion data of the emotion scale corresponding to the tested personnel.

7. The personnel on-duty status early-warning method according to claim 1, wherein the determining on-duty status of the personnel corresponding to the human body data based on the obtained human body data by using a status detection model, comprises:

performing data pre-processing and feature extraction on the human body data;

inputting the extracted features into the status detection model to determine fatigue data

and emotion data corresponding to the human body data, wherein the on-duty status annotation information in the training dataset corresponding to the status detection model comprises fatigue data and emotion data; and

inputting the fatigue data and emotion data into a preset classification model to obtain the on-duty status of the personnel corresponding to the human body data, wherein the on-duty status comprises a cognitive load level, a fatigue level and an emotion level.

8. The personnel on-duty status early-warning method according to claim 1, wherein the determining on-duty status of the personnel corresponding to the human body data based on the obtained human body data, comprises:

performing data pre-processing and feature extraction on the human body data; and

inputting the extracted features into the status detection model to determine the on-duty status of the personnel corresponding to the human body data.

9. The personnel on-duty status early-warning method according to claim 1, wherein the human body data comprises a variety of physiological data and/or electroencephalogram data.

10. A personnel on-duty status early-warning apparatus, comprising:

an acquisition module, configured to continuously collect human body data of personnel in an actual working environment;

a determination module, configured to determine on-duty status of the personnel corresponding to the collected human body data based on the obtained human body data by using a status detection model, wherein the status detection model is obtained by pre-training a preset model based on a training dataset, and the training dataset comprises human body data and corresponding on-duty status annotation information, wherein the on-duty status annotation information in the training dataset corresponding to the status detection model comprises cognitive load level annotation information, fatigue level annotation information and emotion level annotation information;

a monitoring module, configured to perform on-duty status monitoring on the personnel based on the on-duty status determined for the personnel; and

an output module, configured to output early-warning prompt information in response to the on-duty status of the personnel during the on-duty status monitoring satisfying a preset early-warning condition,

wherein the monitoring module is configured to:

determining whether the cognitive load level, fatigue level and emotion level exceed respective level thresholds; and

determining that the on-duty status of the personnel does not meet the preset early-warning condition in response to all of the cognitive load level, fatigue level and emotion level do not exceed respective level thresholds, or determining that the on-duty status of the personnel meets the preset early-warning condition in response to any one of the cognitive load level, fatigue level and emotion level exceeds respective level threshold.

11. An electronic device, comprising:

at least one processor;

a memory; and

at least one application program stored in the memory and executed by the at least one processor, wherein the at least one application program is configured to execute the personnel on-duty status early-warning method according to any one of claims 1-9.

12. A personnel on-duty status early-warning system, comprising: the electronic device according to claim 11 and a wearable terminal, wherein the wearable terminal is configured to collect the human body data and/or display the early-warning prompt information.

13. The personnel on-duty status early-warning system according to claim 12, further comprising: a simulation assembly, and wherein the simulation assembly comprises:

a simulation device configured for tested personnel to execute work tasks through the simulation device; and

a collection device configured for collecting the human body data of the tested personnel in a simulated working environment;

wherein the electronic device is further configured to obtain the input on-duty status annotation information and on-duty information.

14. A non-transitory computer-readable storage medium on which a computer program is stored, wherein when the computer program is executed in a computer, the computer is instructed to execute the personnel on-duty status early-warning method according to any one of claims 1-9.