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THE METHOD OF THE FUNCTIONAL PARAMETERS ESTIMATION OF THE SLEEP MONITORING SYSTEM BASED ON NEURAL NETWORK

The article considers the choice of environment and user parameters for the neural network that will monitor the status, provide advice or directly influence the microclimate, with prototypes of the data acquisition device and the neural network for processing the data.

Key words: neural networks, environment data collection, sleep monitoring system.

Fig.: 3. Bibl.: 8.

Target setting. The choice of data for the sleep monitoring system is very important, as it directly affects its effectiveness during implementation, and for a system that aims to control the microclimate, the selected parameters must be controlled.

Actual scientific researches and issues analysis. The main area of research and publications that have been developed is the diagnosis of sleep apnea, narcolepsy [1], [2], [3], [4]. To collect data in these publications, use special devices that record the activity of the brain, lungs. These can be as sensors attached to the chest, special bracelets and bandages that are attached to certain parts of the body.

Uninvestigated parts of general matters defining. The reviewed scientific works are aimed at the study of a particular disease and represent a method of its diagnosis, which is based on the use of narrowly focused equipment, which in turn limits its use because the devices are expensive, which will not provide them to many people. This can be achieved by changing the data collected, using new devices, the cost of which will provide a large part of the population and using a neural network that will process this data.

The research objective. Identify parameters that have a direct impact on sleep quality, select components that will receive this data, their transmission to the neural network and its further processing.

The statement of basic materials. The main parameters that a person can control to improve sleep are ambient temperature, humidity, air quality, light level. Each of these parameters affects the quality of our sleep.

Temperature [5] is one of the key parameters of the environment that is important and affects the quality of sleep. The DS18B20 sensor was selected to obtain temperature readings.

This sensor is digital, has an error of 0.5 degrees Celsius, in the environment that will be used in this system.

To control the temperature, you can use air conditioners, which will need to be connected to the neural network, so that it can change the parameter according to the results of training according to the optimal for a particular user.

Humidity [6] is also one of the important parameters of the environment, as it affects the nasopharynx, eyes, skin. Low humidity can lead to damage that will lead to eye and breathing problems, which in turn can affect sleep quality. You can measure the humidity level with a sensor.

Although this sensor has an error of 3% at a temperature of 25 degrees, but due to its compactness and the ability to measure values in the range from 0 to 99.9% humidity, can be used in the system. The control of this indicator can be carried out by means of an air humidifier, at its connection to system and adjustment of water supply to the tank.

Air [7] quality affects the condition of the heart and lungs, and research has a direct effect on sleep quality, people with more air pollution sleep worse and more anxiously. The MQ-135 sensor can be used to analyze indoor air.

The control of this indicator clearly depends on the place of residence, and this in turn determines how the level of air pollution can be influenced. So when placing near the green zone of air in which it is much cleaner possible to control the ventilation capacity of the room, at the same time when living in an industrial region, you can use a home air purifier.

The level of illumination [8] of the room affects the productivity of the body and how quickly the human body goes to sleep. Finding the optimal values of sleep that will not interfere, and further control with a gradual decrease in brightness can accelerate the transition of the body to sleep, to assess this parameter, you can use the module of the light sensor analog-digital.

This indicator can be controlled by reducing the brightness of monitors, table lamps and other lighting devices, at a constant speed. For example, a change in brightness of 25 percent per hour will be quite invisible, but will have an impact on processes in the human body.

To obtain these parameters, a prototype device was developed (Fig. 1) according to the scheme (Fig. 2).

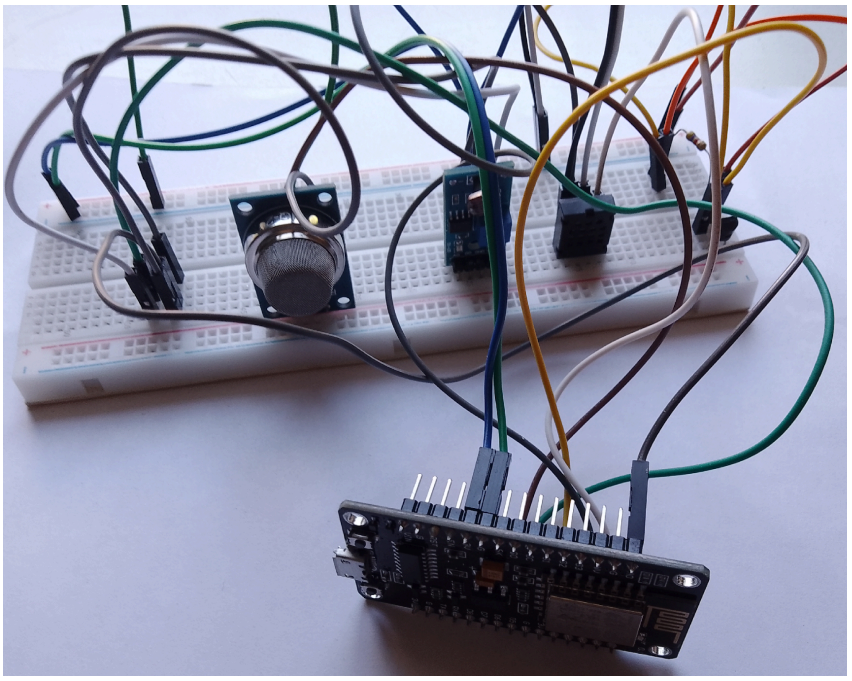

Fig. 1. Photo of the prototype

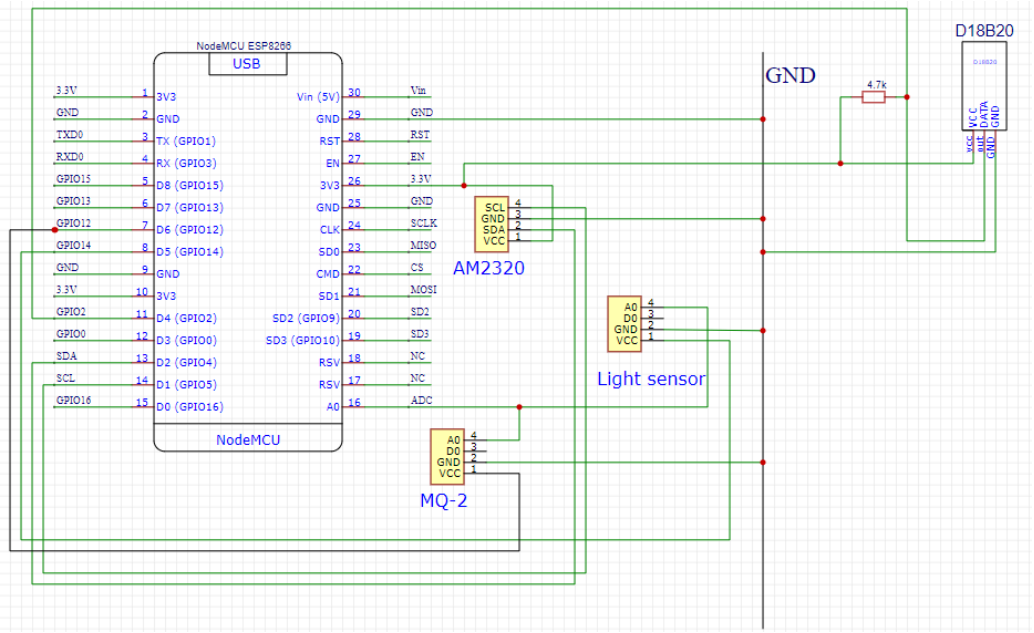

Fig. 2. Scheme of the data collection device

Data on a person's heart rate and motor activity can be obtained from smart bracelets or watches, and based on the obtained values to draw conclusions about whether a person is sleeping or not and to determine the phase of sleep.

The neural network based on the data obtained from these sensors should determine the optimal sleep parameters for the user. This is done by identifying the relationship between the parameters of the environment and how much a person changes motor activity and heart rate. In the phase of deep sleep, the pulse will be reduced, motor activity is minimal, and in the case of fast sleep, these values will be higher.

It is proposed to use a network with such an architecture for data processing (Fig. 3).

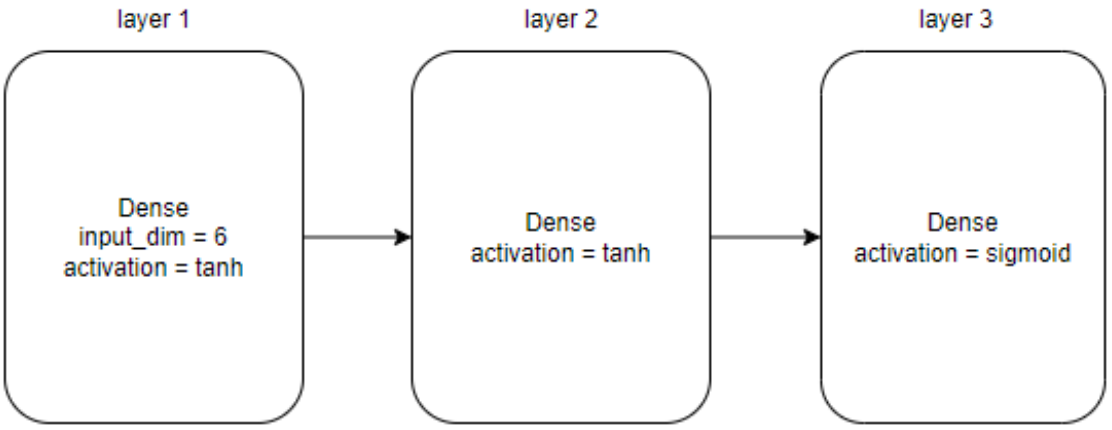

Fig. 3. Neural network model architecture.

You also need to add the loss and optimization function to the network, binary cross entropy and Adam, respectively.

Conclusions. The selected set of parameters of the environment and the user is important for determining the quality of sleep and its phase, and adding control parameters through these devices allows you to create the best conditions, increase sleep efficiency, which in turn will affect user performance. The above network architecture can process the data received from the sensors, but requires further study.

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