The change of bus driver’s functional condition, moving in the plain road

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Abstract – The driver’s functional condition is one of the indicators that reflects his readiness to perform professional tasks. At the same time, the driver is forced to work in different conditions in terms of complexity. Some of these are motion, the flat conditions of motive. Studies show that these conditions can be attributed to the simplest according to the impact on the drivers body.

Keywords – psychophysiological indicators, driver, functional state, traffic conditions.

I. Introduction

One of road’s traffic management main tasks is road safety. In this case, this indicator depends on the driver’s actions. So, today it’s not enough to use only the traditional methods of traffic safety level improvement. Also, there are increasing the analyzing methods importance, that describes the reliability of link “driver” in “driver-vehicle-road-environment” system. This is due to the fact, that the safety of all traffic participants depends on driver’s actions and on the state of his organism. Therefore, by studying these issues, we can increase the road safety level and decrease the probability of accidents.

II. The driver’s functional state and methods of its research

Nowadays physiological studies of drivers get new techniques. Each year, researchers from different countries are offering modern and advanced means of determining the drivers functional condition. To choose the method, and then to develop an application method based on it, it is necessary to determine what indicators we need.

As you know, the human condition is examined using an electrocardiogram, an electroencephalogram, or a skin-galvanic reaction [1].

The latter method makes possible to assess the emotional status of the driver as a vegetative reaction of the central nervous system, which is manifested in the change in the electrical properties of the skin. The results of the leather-galvanic reaction give an opportunity to assess the driver’s reliability not only in the emotional status, but also in the reflection of such mental processes as readiness for future action, level of vigilance, intensity of attention and degree of overwork. As a drawback, it should be noted that the skin-galvanic reaction fading as soon as the stimuli lose the properties of novelty or significance for a person [2].

Electrocardiogram – a record of electrical activity of the brain, which allows you to identify some characteristics of neural areas activity in natural conditions. In the analysis of electroencephalograms, first of all, the frequency, amplitude, form, duration, character of the distribution of its waves are taken into account [2]. This method is very informative, since it shows direct changes in human psycho-emotional reactions to the environment. The disadvantage of this method is, first of all, the cumbersome – the measuring device must be constantly connected to a personal computer, and 32 leads to the head of the subject should be pressurized, which creates discomfort. Besides, the quality of the signals that the device handles the surrounding electromagnetic fields.

Using the electrocardiogram can test the functioning of the cardiovascular system, which is a functional system with multi-level regulation. The ultimate result of its activity is to provide a given level of functioning by the whole organism. As a result, the blood circulation system can be considered as a universal indicator of adaptive activity. This leads to the fact that the researched values are powerful indicators of the general human body condition or its response to any external influence, use an electrocardiogram [3].

Electroencephalogram – a graphical record of changes in the difference in electrical potentials arising on the surface of the body as a result of the heart [4]. To assess the psycho-physiological condition of a person, most often, analyze the change in pulse, the shape of the apexes and the ratio of intervals between individual complexes. In this case, the relative changes in these characteristics of the electrocardiogram do not depend on the number of sensors used with this or that device [2, 4]. This investigation can be considered the most convenient method for determining the functional condition of drivers in real conditions. This is due to the fact that such an analysis gives quantitative indicators, the limits of which are determined for one or another driver’s status, which means that the analysis of the data is fast enough. Also, the convenience of using an electrocardiogram is due to the portability of used devices, which does not prevent the explored drivers from moving and do not interfere with the control of the vehicle.

Heart rate variability (HRV) is one of the most advanced methods for studying the mechanisms of the cardiovascular system based on the records of the electrocardiogram. Using this method, one can describe the condition of regulation tools, that manage physiological oscillations in the human body [2, 4, 5]. One of the basic methods, providing complex evaluation of functional condition based on electrocardiogram analysis is regulatory systems activity (RSA) index. The determination of this indicator is possible using the next algorithm [5]:

\[
\text{ПАРС} = |A| + |B| + |C| + |D| \]

(1)

The RSA index is a heart rate variability complex value and displays level of driver’s functional condition. This indicator is measured with the ten-point scale: from 1 to 3 – means regulatory systems condition being optimal.
normal stress; 4 and 5 – medium stress which demands the body to additional reserves for better adaptation to the environment. This body shape is observed during the adaptation to working activities in the start of working day or under the emotional stress; 6 and 7 – pronounced regulatory systems stress, within it, the body's defense mechanism is able to be activated; from 8 to 10 –, failure of regulatory systems adaptation. This condition is characterized by reducing of regulatory mechanisms activity when the accumulated tiredness and nervous strain are observed. The protective and adaptation body tools cannot carry out the impact of environmental factors.

III. Results of full-scale research

The research was conducted on buses with different technical parameters. Taking into account their specific power, all of them are divided into three groups: 1 group – from 11 kW/t to 13 kW/t; 2 group – from 13 kW/t to 15 kW/t; 3 group – from 15 kW/t to 17 kW/t.

The highways that lie in the plain conditions were characterized by a large number of straight road parts with a considerable length. In such conditions, the driver's work becomes monotonous. Often the drivers said that such conditions didn't lead to the appearance of fatigue. The results of the research are shown in Fig. 1.

According to the Fig. 1, the driver’s RSA index during driving the bus on the road in plain conditions increases to 6 – 7 points. It depends on the parameters of the bus. Founded that while driving a bus from the first group, the driver’s RSA index varies in the range of 7 points, the second and third groups – 6 points. Also driving a bus from the third group, the driver’s functional state starts to increase only after one hour of the work.

It was found that the functional state of the driver’s organism in this conditions didn’t move to the state of regulatory systems adaptation failure. Also made the analysis of the driver’s RSA index data while he was driving the bus in these conditions. The results of distribution are shown in the histogram (Fig. 2).

![Histogram of bus driver's RSA index distribution](image)

Investigated that the driver’s RSA index during driving the bus on the roads that lie in the plain conditions is varying from 2 to 5 points.

**Conclusion**

Studies show that the drivers body in such motion conditions is usually in optimal and moderate tension of regulatory systems. The results of researches show that in 89% of the total work duration, drivers body is ready to perform assigned professional tasks. Such cases as 1, 7 and 8 points of RSA index value does not exceed 6%.

**References**