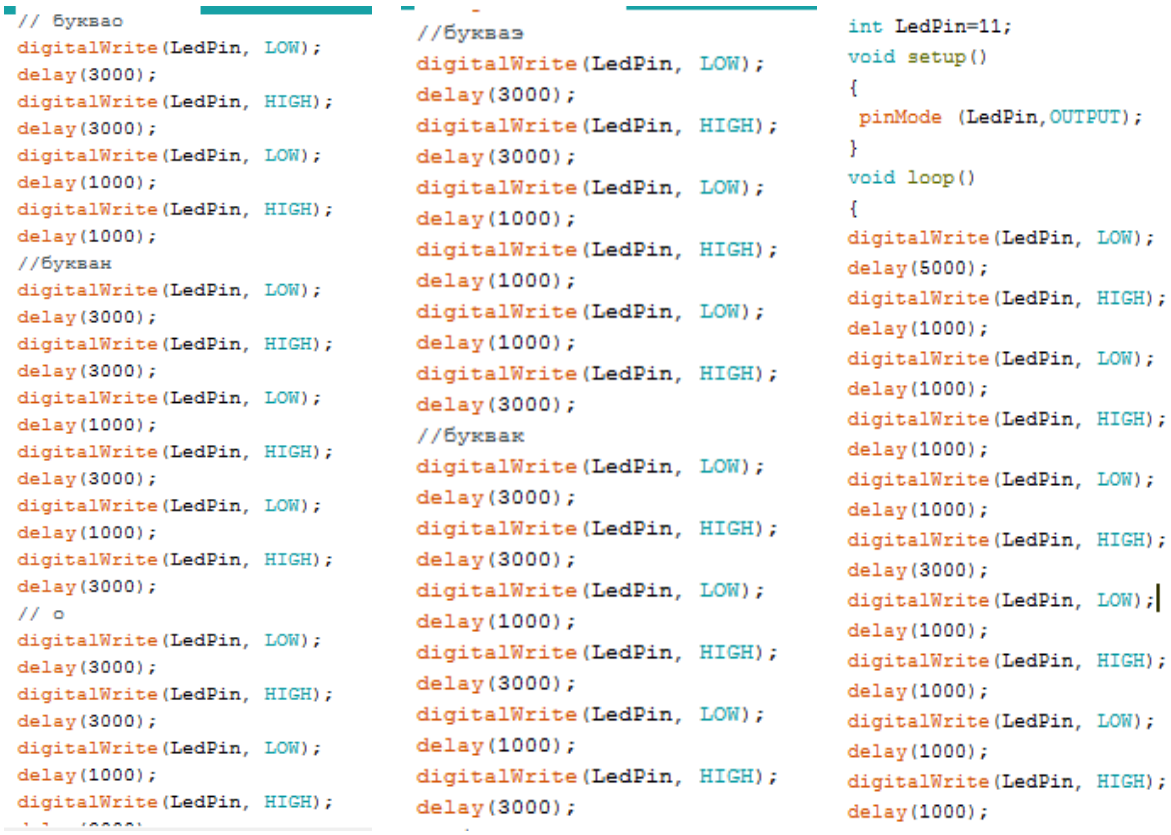

Рисунок 1 – Программный код мигание светодиода, передающий информацию о слове «эконом»

Таким образом, применение данного учебного комплекса дает возможность одновременного освоения, закрепления знаний и отработки навыков сразу по нескольким предметам. В свою очередь, формирование комплексных знаний способствуют развитию системности мышления, учит комплексно подходить к решению реальных практических задач.

УДК 004.2

ASSESSING THE IMPACT OF ERGONOMIC MANIPULATORS ON THE CURSOR CONTROL

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Abstract. *The analysis of the ergonomic mice efficiency for the cursor movement is presented based on the experiments with both self-reported parameters and biometric measurements. The adequacy of choice as well as the overall speed and physical load are examined.*

The initial design of the computer mouse, including both Xerox prototypes and the vast majority of models of the early 1980s, was focused primarily on engineering solutions, rather than ergonomics. With the evolution of graphical interfaces, this fact increasingly came into strong contradiction with the tendency to refuse keyboard input in favor of pointing devices.

Today, the average time of active use of the mouse exceeds the same parameter for the keyboard by almost three times [1]. Ergonomics is even more important for gaming mice, given the periods of intensive use associated with them. When using a typical mouse, the ulnar and radial bones of the arm are crossed, and this creates problems under regular loads.

To mitigate the problems associated with carpal tunnel syndrome, arthritis and other injuries from repetitive stresses, the design of some modern ergonomic mice makes a turn of the hand at an angle close to a vertical plane to achieve a more natural position. In addition,

a number of designs intentionally limit the movement of the wrist. Some manufacturers provide the ability to adjust the shape of the mouse - make removable and/or extendable support for the wrist, support for the thumb and little finger. The vast majority of ergonomic manipulators are asymmetric, which is why it is necessary to acquire the correct modification of the product, depending on whether the left or right hand is working. Also, questions of operator productivity remain open when using mice with the listed design solutions. As a result, in combination with lower production volumes (and, therefore, a higher selling price), this does not contribute to their mass adoption.

This study is designed to evaluate both the subjective perception of ergonomic mice of various shapes by users and the operator's efficiency when performing typical cursor movements.

Four ergonomic mice, shown in Figure 1, were selected for the study. We used a mouse of a traditional (conservative) design related to the game segment, two vertical mice differing in the type of a grip, and a horizontal mouse with support for the wrist and fingers.

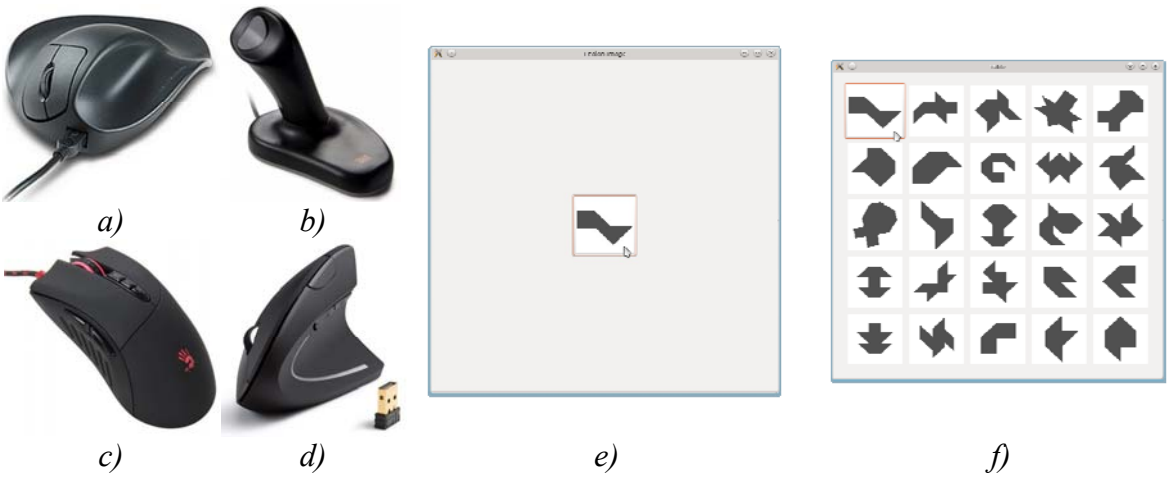

Figure 1 – Mice examined:
A4Tech Bloody Ultra Gear mouse *(a)*,
Anker Vertical Ergonomic Mouse *(b)*,
Hippus Handshoe Mouse *(c)*, Anir Vertical Mouse *(d)*;
The testing software *(e, f)*

Test software for studying cursor control during operation showed the "Source" (Fig. 1, e) and "Destination" (Fig. 1) windows containing geometric shapes. The button with the figure in the "Source" window indicates which figure should be found in a 5x5 matrix in the "Destination" window. This step was repeated a predetermined number of times with randomly selected shapes. The approach is based on the methodology of the study of memorization and pattern recognition, made by R.M. Granovskaya and Ya. Bereznaya [2].

To study the subjective level of expectations from mice, the usability scale questionnaire (SUS) of J. Brook was used [3]. An assessment of the objective level of mastership was studied using the system usability questionnaire (PSSUQ) [4]. Microsoft Desirability Toolkit (Microsoft Reaction Card Method) was used to determine the level of satisfaction [5].

The study involved 50 students 18-23 years old. During the experiment, the operating time was measured, and physical activity was estimated using biometric measurements. Heart rate (HR) was used as an indicator of physical activity.

A comparison of the subjective level of expectations, the objective level of mastership and the level of satisfaction made it possible to distinguish three types of product choice for the studied target group (table 1).

Table 1 – Types of choice (as a percentage of the number of respondents from the entire sample)

Mouse / Type of choice	A4Tech Ultra Gear mouse	Anker Vertical Ergonomic Mouse	Hippus Handshoe Mouse	Anir Vertical Mouse
Adequate	54	40	28	44
Overestimation	12	6	22	14
Underestimation	34	54	50	42

Half of the respondents demonstrate underestimation when working with the Hippus Handshoe Mouse (which turned out to be the most productive manipulator). The traditional gaming mouse, which does not have additional supports, showed the lowest productivity - maximum physical activity with minimum operator speed. The compromise solution (Anker Vertical Ergonomic Mouse, in which the vertical grip is combined with the approximate classical position of the palm) showed itself worse among the vertical manipulators (Fig 2).

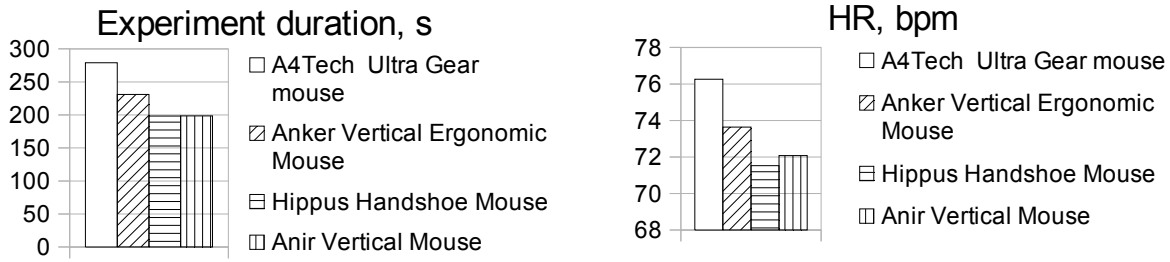

Figure 2 – The experiment duration and mean HR values

References

1. Odel D., Johnson P. Evaluation of flat, angled, and vertical computer mice and their effects on wrist posture, pointing performance, and preference // Work. – Vol. 52. – No. 2. – 2015. – P. 245–253.

2. Грановская Р.М., Березная И.Я. Запоминание и узнавание фигур. / Л.: Изд-во Ленинградского ун-та., 1974. – 96 с.

3. Tullis T., Albert W. Measuring the User Experience Collection, Analyzing and Presenting Usability Metrics – Morgan Kaufmann, 2013. – 320 p.

4. Lewis, J. R. IBM computer usability satisfaction questionnaires – Psychometric evaluation and instructions for use. International Journal of Human-Computer Interaction, №7, 1995. – P. 57–78.

5. Lindgaard G., Dudek C. What is this evasive beast we call user satisfaction? // Interacting with computers, 2003. – Vol. 15, Iss. 3. – P. 429–452.

6. Interacting with computers, 2003. – Vol. 15, Iss. 3. – P. 429–452.

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SAVE WATER SYSTEM

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Abstract. *For environmental purposes, namely resource conservation, it is proposed to install a rainwater gathering system. You can collect rainwater by means of the system and use this water for the needs of the trolley fleet (washing of rolling stock). This system reservoirs can be also used for storage of excess filtered water.*