



.1.

... , ... , ... (, -), ... eye-tracking – (,). [2]. (eye-tracking ... [2]. / , (, CAPTCHA,); [3]. [2-10]: 1) - « » ; 2) « » ; 3) « » -

4) «...» () ;

«...» () «...»

5) ;

6) ;

7) ;

(), (, ,);

8) ;

9) / ;

10) ;

11) ;

12) ;

13) ;

[11] 4

); [12]

; [13]

[14]

[15]

[15]

[16]

[17]

eye-tracking

eye-tracking

eye-tracking

«...», «...», «...» (...) , «...» (...) .

UB = {pr, pdt, tdt, nf, aft, nvv, tffst}, (1)
 pr – (...) , pdt – (...) , tdt – (...) , nf – (...) , aft – (...) , nvv – (...) , tffst – (...) .

GP = {tbf, nbf, pr, pdt, tdt, nf, aft, nvv, tffst}, (2)

tbf – (...) , nbf – (...) .

1) eye-tracking (7) :

$$UI = \begin{vmatrix} u_{i1} & \dots & u_{ij} & \dots & u_{in} \\ \dots & \dots & \dots & \dots & \dots \\ u_{i1} & \dots & u_{ij} & \dots & u_{in} \\ \dots & \dots & \dots & \dots & \dots \\ u_{m1} & \dots & u_{mj} & \dots & u_{mn} \end{vmatrix}, \quad (3)$$

u_{ij} – i, j – (...) , $i = \overline{1..m}$, $j = \overline{1..n}$, m – (« ... ») , n – (« ... »);

2) (...) » u_{ij} ; « ... » ,

$$UIPR = \begin{vmatrix} pr_{11} & \dots & pr_{1j} & \dots & pr_{1n} \\ \dots & \dots & \dots & \dots & \dots \\ pr_{i1} & \dots & pr_{ij} & \dots & pr_{in} \\ \dots & \dots & \dots & \dots & \dots \\ pr_{m1} & \dots & pr_{mj} & \dots & pr_{mn} \end{vmatrix}, \quad (4)$$

pr_{ij} – « ... » , i, j – (...) ; u_{ij} UI , UIPR

3) « ... »

» u_{ij} ;

:

$$UIPDT = \begin{vmatrix} pdt_{11} \dots pdt_{1j} \dots pdt_{1n} \\ \dots \dots \dots \\ pdt_{i1} \dots pdt_{ij} \dots pdt_{in} \\ \dots \dots \dots \\ pdt_{m1} \dots pdt_{mj} \dots pdt_{mn} \end{vmatrix}, \quad (5)$$

pdt_{ij} – « UI » i, j -
 ; u_{ij} , $UIPDT$

-1;
 4)

» u_{ij} ;

:

$$UITDT = \begin{vmatrix} tdt_{11} \dots tdt_{1j} \dots tdt_{1n} \\ \dots \dots \dots \\ tdt_{i1} \dots tdt_{ij} \dots tdt_{in} \\ \dots \dots \dots \\ tdt_{m1} \dots tdt_{mj} \dots tdt_{mn} \end{vmatrix}, \quad (6)$$

tdt_{ij} – « UI » i, j -
 ; u_{ij} , $UITDT$

-1;
 5)

» u_{ij} ;

:

$$UINF = \begin{vmatrix} nf_{11} \dots nf_{1j} \dots nf_{1n} \\ \dots \dots \dots \\ nf_{i1} \dots nf_{ij} \dots nf_{in} \\ \dots \dots \dots \\ nf_{m1} \dots nf_{mj} \dots nf_{mn} \end{vmatrix}, \quad (7)$$

nf_{ij} – « UI » i, j -
 ; u_{ij} , $UINF$

-1;
 6)

» u_{ij} ;

:

$$UIAFT = \begin{vmatrix} aft_{11} \dots aft_{1j} \dots aft_{1n} \\ \dots \dots \dots \\ aft_{i1} \dots aft_{ij} \dots aft_{in} \\ \dots \dots \dots \\ aft_{m1} \dots aft_{mj} \dots aft_{mn} \end{vmatrix}, \quad (8)$$

aft_{ij} – « UI » i, j -
 ; u_{ij} , $UIAFT$

-1;
 7)

» u_{ij} ;

:

$$UINVV = \begin{pmatrix} nvv_{11} \dots nvv_{1j} \dots nvv_{1n} \\ \dots \\ nvv_{i1} \dots nvv_{ij} \dots nvv_{in} \\ \dots \\ nvv_{m1} \dots nvv_{mj} \dots nvv_{mn} \end{pmatrix}, \tag{9}$$

nvv_{ij} – « UI » i, j -
 ; ui_{ij} , $UINVV$
 -1;
 8) «
 » ui_{ij} ;

$$UITFFST = \begin{pmatrix} tffst_{11} \dots tffst_{1j} \dots tffst_{1n} \\ \dots \\ tffst_{i1} \dots tffst_{ij} \dots tffst_{in} \\ \dots \\ tffst_{m1} \dots tffst_{mj} \dots tffst_{mn} \end{pmatrix}, \tag{10}$$

$tffst_{ij}$ – « UI » i, j -
 ; ui_{ij} ,
 $UITFFST$ -1;
 9) «
 » ui_{ij} ;

$$UITFBF = \begin{pmatrix} tbf_{11} \dots tbf_{1j} \dots tbf_{1n} \\ \dots \\ tbf_{i1} \dots tbf_{ij} \dots tbf_{in} \\ \dots \\ tbf_{m1} \dots tbf_{mj} \dots tbf_{mn} \end{pmatrix}, \tag{11}$$

tbf_{ij} – « UI » i, j -
 ; ui_{ij} ,
 $UITFBF$ -1;
 10) «
 » ui_{ij} ;

$$UINFBF = \begin{pmatrix} nfbf_{11} \dots nfbf_{1j} \dots nfbf_{1n} \\ \dots \\ nfbf_{i1} \dots nfbf_{ij} \dots nfbf_{in} \\ \dots \\ nfbf_{m1} \dots nfbf_{mj} \dots nfbf_{mn} \end{pmatrix}, \tag{12}$$

$nfbf_{ij}$ – « UI » i, j -
 » i, j - ; ui_{ij} ,
 $UINFBF$ -1;
 11) , (4)-(12),

12)

eye-tracking,

eye-tracking

: 1)

; 2)

; 3)

eye-tracking.

1. . . . : / . . . , 2011. – 206 .

2. : / – : 2017. – 188 .

3. WEB UI [. . .]. – : <http://positivecrash.com/geshtalt-princypy-web-ui-design-s-primerami/> (07.02.2018) –

4. Web UI Design for the Human Eye: Colors, Space, Contrast. URL: https://issuu.com/fransiscustobias/docs/uxpin_web_ui_design_for_the_human_e (viewed on February 7, 2018). – Title from the screen.

5. The Gestalt Principle: Design Theory for Web Designers. URL: <https://webdesign.tutsplus.com/articles/the-gestalt-principle-design-theory-for-web-designers--webdesign-1756> (viewed on February 7, 2018). – Title from the screen.

6. The Gestalt Principles. URL: <http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm> (viewed on February 7, 2018). – Title from the screen.

7. Gestalt Principles. URL: <https://www.interaction-design.org/literature/topics/gestalt-principles> (viewed on February 7, 2018). – Title from the screen.

8. The Law of Similarity – Gestalt Principles (1). URL: <https://www.interaction-design.org/literature/article/the-law-of-similarity-gestalt-principles-1> (viewed on February 7, 2018). – Title from the screen.

9. Laws of Proximity, Uniform Connectedness, and Continuation – Gestalt Principles (2). URL: <https://www.interaction-design.org/literature/article/laws-of-proximity-uniform-connectedness-and-continuation-gestalt-principles-2> (viewed on February 7, 2018). – Title from the screen.

10. The Building Blocks of Visual Design. URL: <https://www.interaction-design.org/literature/article/the-building-blocks-of-visual-design> (viewed on February 7, 2018). – Title from the screen.

11. . . . // . – 2012. – 2. – . 40–45.

12. . . . // . – 2017. – 70. – . 25–57.

13. Vicentiy A. V. The Development of Dynamic Cognitive Interfaces for Multisubject Information Systems (on the Example of Geosocial Service) / A. V. Vicentiy, M. G. Shishaev, I. V. Vicentiy // *Advances in Intelligent Systems and Computing*. – 2017. – Vol. 575. – P. 449–459.

14. Flach J. Supporting productive thinking: The semiotic context for Cognitive Systems Engineering (CSE) / J. Flach // *Applied Ergonomics*. – 2017. – Vol. 59. – P. 612–624.

15. Sani SM. Minimalism in Designing User Interface of Commercial Websites Based on Gestalt Visual Perception Laws / SM. Sani, YK. Shokooh // *2016 Second International Conference on WEB Research (ICWR), April 27-28, 2016: Proceedings*. – Tehran (Iran), 2016. – P. 115–124.

16. Moller B. What should a corporate website look like? The influence of Gestalt principles and visualisation in website design on the degree of acceptance and recommendation / B. Moller, C. Brezing, D. Unz // *Behaviour & Information Technology*. – 2012. – Vol. 31. – Issue 7. – P. 739–751.
17. Chang D. The Gestalt principle of continuation applies to both the haptic and visual grouping of elements / D. Chang, KV. Nesbitt, K. Wilkins // *Second Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems, March 22–24, 2007: Proceedings*. – Tsukuba (Japan), 2007.
18. Zhou XZ. An Evaluation Method of Visualization Using Visual Momentum Based on Eye-Tracking Data / XZ. Zhou, CQ. Xue, L. Zhou, YF. Niu // *International Journal of Pattern Recognition and Artificial Intelligence*. – 2018. – Vol. 32. – Issue 5.
19. Kim H. Multi-modal user interface combining eye tracking and hand gesture recognition / H. Kim, K. Suh, E. Lee // *Journal on Multimodal User Interfaces*. – 2017. – Vol. 11. – Issue 3. – P. 241–250.
20. Zhang XB. Eye Tracking Based Control System for Natural Human-Computer Interaction / XB. Zhang, XL. Liu, SM. Yuan, SF. Lin // *Computational Intelligence and Neuroscience*. – 2017. – Vol. 2017.
21. Fu B. Eye tracking the user experience – An evaluation of ontology visualization techniques / B. Fu, NF. Noy, MA. Storey // *Semantic Web*. – Vol. 8. – Issue 1. – P. 23–41.
22. Rodas CM. INTERFACE SEARCH GOOGLE AND YAHOO: the user experience from the viewpoint of eye tracking / CM. Rodas, SABG. Vidotti, SD. Monteiro // *Informacao & Sociedade-Estudos*. – 2016. – Vol. 26. – Issue 2. – P. 37–50.

References

1. O. V. Pomorova, T. O. Hovorushchenko. Proektuvannya interfeysiv korystuvacha: Navchalnyi posibnyk. – Khmelnytskyi: KhNU, 2011. – 206 s.
2. A. Gordeyev, D. V. Gordeyeva. Primenenie tekhnologii eye-tracking dlya issledovaniya cheloveko-mashinnogo vzaimodeystviya: Uchebnoe posobie. – Kiev: Universitet bankovskogo dela, 2017. – 188 s.
3. Gestalt-principi v WEB UI dizayne s primerami // [Elektronnyi resurs]: [Web-site]. – Elektronniye danniyе. – Regim dostupa <http://positivecrash.com/geshalt-princypy-web-ui-design-s-primerami/> (data obrashcheniya 07.02.2018) – Nazavanie s ekrana.
4. Web UI Design for the Human Eye: Colors, Space, Contrast [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: https://issuu.com/fransiscustobias/docs/uxpin_web_ui_design_for_the_human_e (viewed on February 7, 2018). – Title from the screen.
5. The Gestalt Principle: Design Theory for Web Designers [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <https://webdesign.tutsplus.com/articles/the-gestalt-principle-design-theory-for-web-designers--webdesign-1756> (viewed on February 7, 2018). – Title from the screen.
6. The Gestalt Principles [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <http://graphicdesign.spokanefalls.edu/tutorials/process/gestaltprinciples/gestaltprinc.htm> (viewed on February 7, 2018). – Title from the screen.
7. Gestalt Principles [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <https://www.interaction-design.org/literature/topics/gestalt-principles> (viewed on February 7, 2018). – Title from the screen.
8. Laws of Proximity, Uniform Connectedness, and Continuation – Gestalt Principles (2) [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <https://www.interaction-design.org/literature/article/laws-of-proximity-uniform-connectedness-and-continuation-gestalt-principles-2> (viewed on February 7, 2018). – Title from the screen.
9. The Building Blocks of Visual Design [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <https://www.interaction-design.org/literature/article/the-building-blocks-of-visual-design> (viewed on February 7, 2018). – Title from the screen.
10. The Law of Similarity – Gestalt Principles (1) [Electronic resource]: [Web-site]. – Electronic data. – Mode of access: <https://www.interaction-design.org/literature/article/the-law-of-similarity-gestalt-principles-1> (viewed on February 7, 2018). – Title from the screen.
11. S. Zvenigorodskiy, A. I. Shevchenko, O. A. Kolomyitsev. Kriteriy otsenki graphicheskogo interfeisa na osnove Gestalt principov // *Shtuchnyi intelekt*. – 2012. – No. 2. – S. 40–45.
12. M. A. Bakayeva, O. M. Razumnikova. Opredelenie slojnosti zadach dlya zritelno-prostranstvennoy pamyati i propusknoy sposobnosti cheloveka-operatora // *Upravlenie bolshimi sistemami*. – 2017. – Vypusk 70. – S. 25–57.
13. V. Vicentiy, M. G. Shishaev, I. V. Vicentiy. The Development of Dynamic Cognitive Interfaces for Multisubject Information Systems (on the Example of Geosocial Service) // *Advances in Intelligent Systems and Computing*. – 2017. – Vol. 575. – Pp. 449–459.
14. J. Flach J. Supporting productive thinking: The semiotic context for Cognitive Systems Engineering (CSE) // *Applied Ergonomics*. – 2017. – Vol. 59. – Pp. 612–624.
15. SM. Sani, YK. Shokooh. Minimalism in Designing User Interface of Commercial Websites Based on Gestalt Visual Perception Laws // *2016 Second International Conference on WEB Research (ICWR), April 27–28, 2016: Proceedings*. – Tehran (Iran), 2016. – Pp. 115–124.
16. Moller, C. Brezing, D. Unz. What should a corporate website look like? The influence of Gestalt principles and visualisation in website design on the degree of acceptance and recommendation // *Behaviour & Information Technology*. – 2012. – Vol. 31. – Issue 7. – Pp. 739–751.
17. Chang, KV. Nesbitt, K. Wilkins. The Gestalt principle of continuation applies to both the haptic and visual grouping of elements // *Second Joint Eurohaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems, March 22–24, 2007: Proceedings*. – Tsukuba (Japan), 2007.
18. XZ. Zhou, CQ. Xue, L. Zhou, YF. Niu. An Evaluation Method of Visualization Using Visual Momentum Based on Eye-Tracking Data // *International Journal of Pattern Recognition and Artificial Intelligence*. – 2018. – Vol. 32. – Issue 5.
19. H. Kim, K. Suh, E. Lee. Multi-modal user interface combining eye tracking and hand gesture recognition // *Journal on Multimodal User Interfaces*. – 2017. – Vol. 11. – Issue 3. – Pp. 241–250.
20. XB. Zhang, XL. Liu, SM. Yuan, SF. Lin. Eye Tracking Based Control System for Natural Human-Computer Interaction // *Computational Intelligence and Neuroscience*. – 2017. – Vol. 2017.
21. Fu, NF. Noy, MA. Storey. Eye tracking the user experience – An evaluation of ontology visualization techniques // *Semantic Web*. – Vol. 8. – Issue 1. – Pp. 23–41.
22. CM. Rodas, SABG. Vidotti, SD. Monteiro. INTERFACE SEARCH GOOGLE AND YAHOO: the user experience from the viewpoint of eye tracking // *Informacao & Sociedade-Estudos*. – 2016. – Vol. 26. – Issue 2. – Pp. 37–50.