

## EYE-TRACKING

Метою даного дослідження є оцінювання зручності використання інтерфейсу користувача (ІК), а також оцінювання ІК на відповідність гештальт-принципам за рахунок використання технології eye-tracking в процесі проектування ІК. В статті виконано вибір метрик айтрекінгу, застосовних для оцінювання зручності використання ІК, а також для оцінювання ІК на відповідність гештальт-принципам. На основі обраних метрик розроблено метод використання технології eye-tracking у проектуванні ІК, який забезпечує: оцінювання та інтерпретацію експертами значень метрик айтрекінгу, придатних для оцінювання зручності використання ІК; оцінювання та інтерпретацію експертами значень метрик айтрекінгу, придатних для оцінювання ІК на відповідність гештальт-принципам; експертні висновки щодо зручності використання ІК та відповідності ІК гештальт-принципам.

Ключові слова: інтерфейс користувача (ІК), гештальт-принципи, зручність використання ІК, технологія eye-tracking, метрики айтрекінгу.

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### METHOD OF USE OF EYE-TRACKING TECHNOLOGY IN THE USER INTERFACE DESIGN

The aim of this study is the evaluating the usability of the user interface (UI), as well as the evaluating the UI for compliance with gestalt principles by using the eye-tracking technology in the user interface design. One of the key determinants of the success of modern commercial, technical, social and scientific projects is the user interface, which determines the effectiveness of human-machine interaction and perception of software, provides access to the functional components of the software and the satisfaction of the user by software and its practicality. Currently, the main task of the UI developers is the design of a flexible, user-friendly, intuitive, user-oriented interface, which will provide full access to the functionality of the software. Therefore, the basis for the UI design can be the basic principles of cognitive psychology (for example, gestalt principles), and the main criterion for success is the usability of UI. The modern technique, which is used in the design of user-oriented interface, is eye-tracking technology, using of which is reasonable and expedient in assessing the usability of UI, and in evaluating the UI for compliance with gestalt principles. In this paper, the choice of eye-tracking metrics, which are applicable for the evaluating the usability of UI, and for the evaluating the UI for compliance with gestalt principles, has been made. On the basis of the selected eye-tracking metrics, the method of use of eye-tracking technology in the user interface design is developed. The developed method provides: 1) assessment and interpretation (by the experts) of the values of eye-tracking metrics, which are applicable for the evaluating the usability of UI; 2) assessment and interpretation (by the experts) of the values of the eye-tracking metrics, which are applicable for the evaluating the UI for compliance with gestalt principles; 3) expert conclusions about the usability of UI and compliance UI with the gestalt principles. The prospect for further research of the authors is the selection of experts and conducting the experiments on the assessment of the usability of the UI and on the assessment of UI for compliance with gestalt principles using eye-tracking technology.

Keywords: user interface (UI), gestalt principles, usability of UI, eye-tracking technology, metrics of eye-tracking.

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[1].

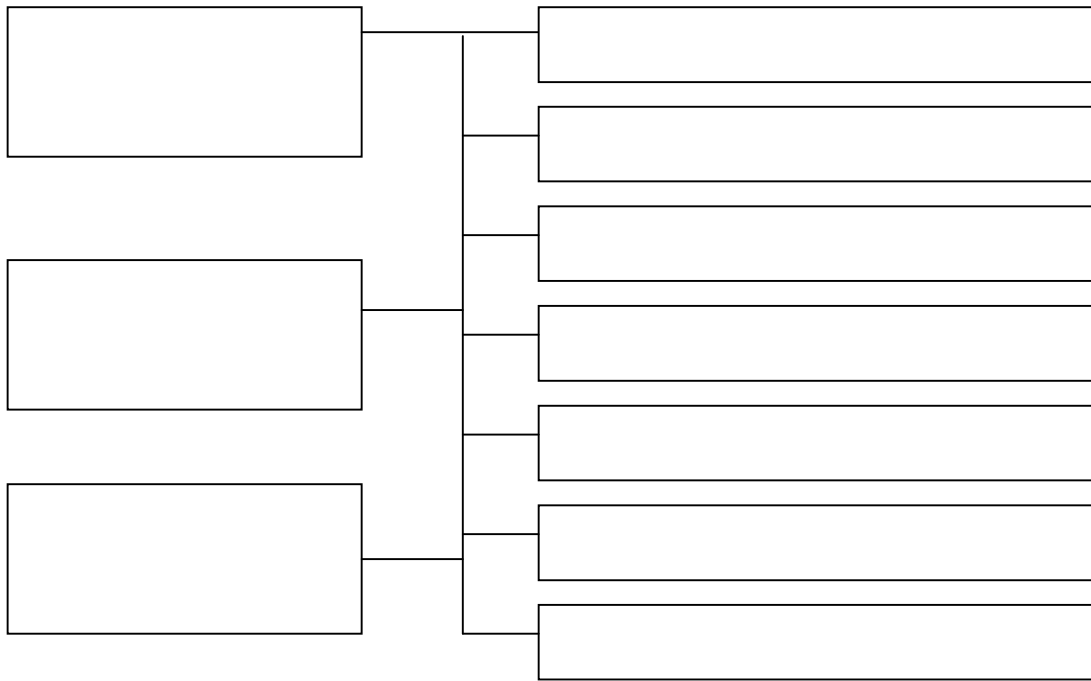
(usability),

[1].

( .1

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

4) «...» ( ) ;

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**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) :

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

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

2) ( ... ) »  $u_{ij}$  ;

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

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

»  $u_{ij}$  ;

:

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

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

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

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

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

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

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

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

(4)-(12),

12)

eye-tracking,

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