Graphics Annotation Usability in eLearning Applications

Dorian Gorgan, Teodor Ştefănuț
Computer Science Department
Technical University of Cluj-Napoca
dorian.gorgan@cs.utcluj.ro

Contents

PLT'07

- Objectives
- Graphics annotation techniques
- eTrace platform
- Knowledge assessment
- Usability evaluation
- Experiments
- Measurements
- Results
- Conclusions

Objectives – I-Trace Project

PLT'07

- Study the requirements and specifications for graphics pen annotation based eLearning environments

  User requirements (i.e. professor, students), eLearning environment functional specifications, usability requirements, lesson structure, user interaction techniques.

- Adapt and integrate graphical annotation capabilities in eTrace eLearning framework

  Develop eTrace eLearning environment, design and implement the client-server architecture, resource management, security, annotation model, annotation persistence.

- Integrate graphical interaction techniques in teaching materials

  Develop lessons in various domains including Computer Science, Medicine, Physics, Mathematics, Algorithms, Computer Graphics.

- Usability evaluation for graphics annotation techniques

  Design and produce evaluation instruments for pen and mouse based graphics annotation; Develop test cases for graphics annotation according with usability requirements and specifications.

  Usability measurements, analyse data, usability evaluation.

- Disseminate the results on usability tests and lesson development

  Conference (PLT2007, CBMS2007, RoCHI2007), Web sites (I-TRACE, eTrace), technical reports.

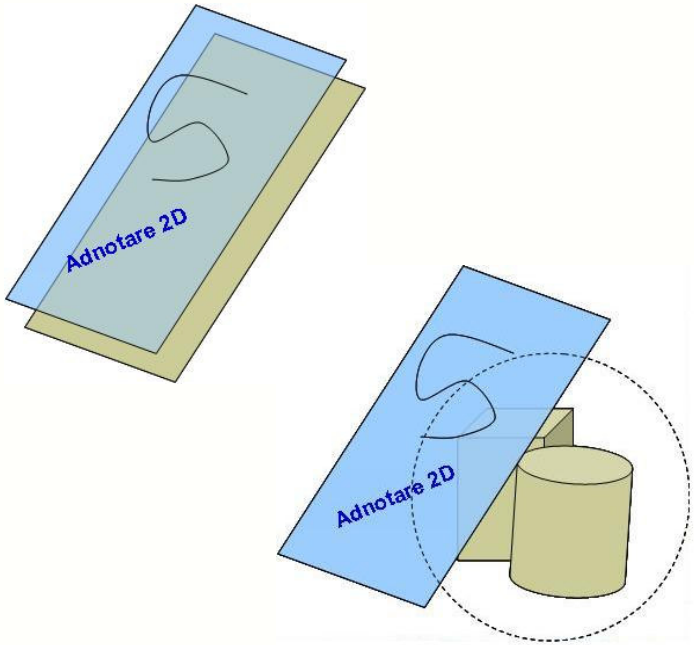
Objectives – Usability evaluation

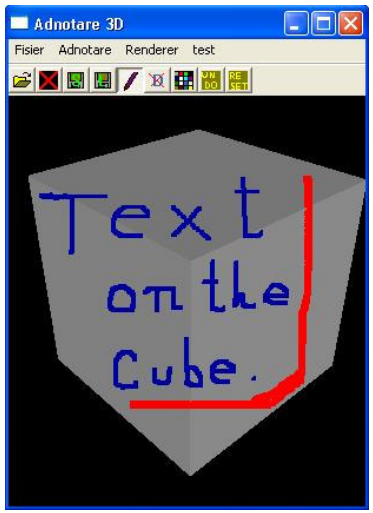
PLT'07

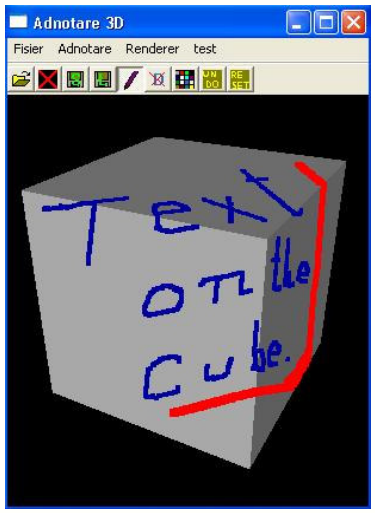
- Design and produce evaluation instruments for pen and mouse based graphics annotation
- Develop test cases for graphics annotation according with usability requirements and specifications
- Usability measurements
- Data visualization and analysis
- Usability evaluation

Graphics annotation techniques

- 2D graphical annotation techniques on text, images, and documents
- 2D graphical annotation techniques for 3D objects
- 3D graphical annotation techniques on 3D objects
- E-learning framework based on 2D and 3D annotation techniques







eTrace Platform

PLT'07

- eTrace – eLearning Environment based on graphics annotation
- Developed at the Technical University of Cluj-Napoca (UNI-CLUJ)
- Developed through the I-TRACE Project

  "*Interactive Tracing and Graphical Annotation in Pen-based e-learning*",

  223434-CP-I-2005-IT-Minerva-M (2005-2007)

  ITrace project: http://users.utcluj.ro/~gorgan/res/cgis/itrace/

- eTrace references:

  eTrace eLearning Environment: http://dataserver.mediogrid.utcluj.ro/adnotare/

  eTrace presentation: http://users.utcluj.ro/~gorgan/res/cgis/itrace/

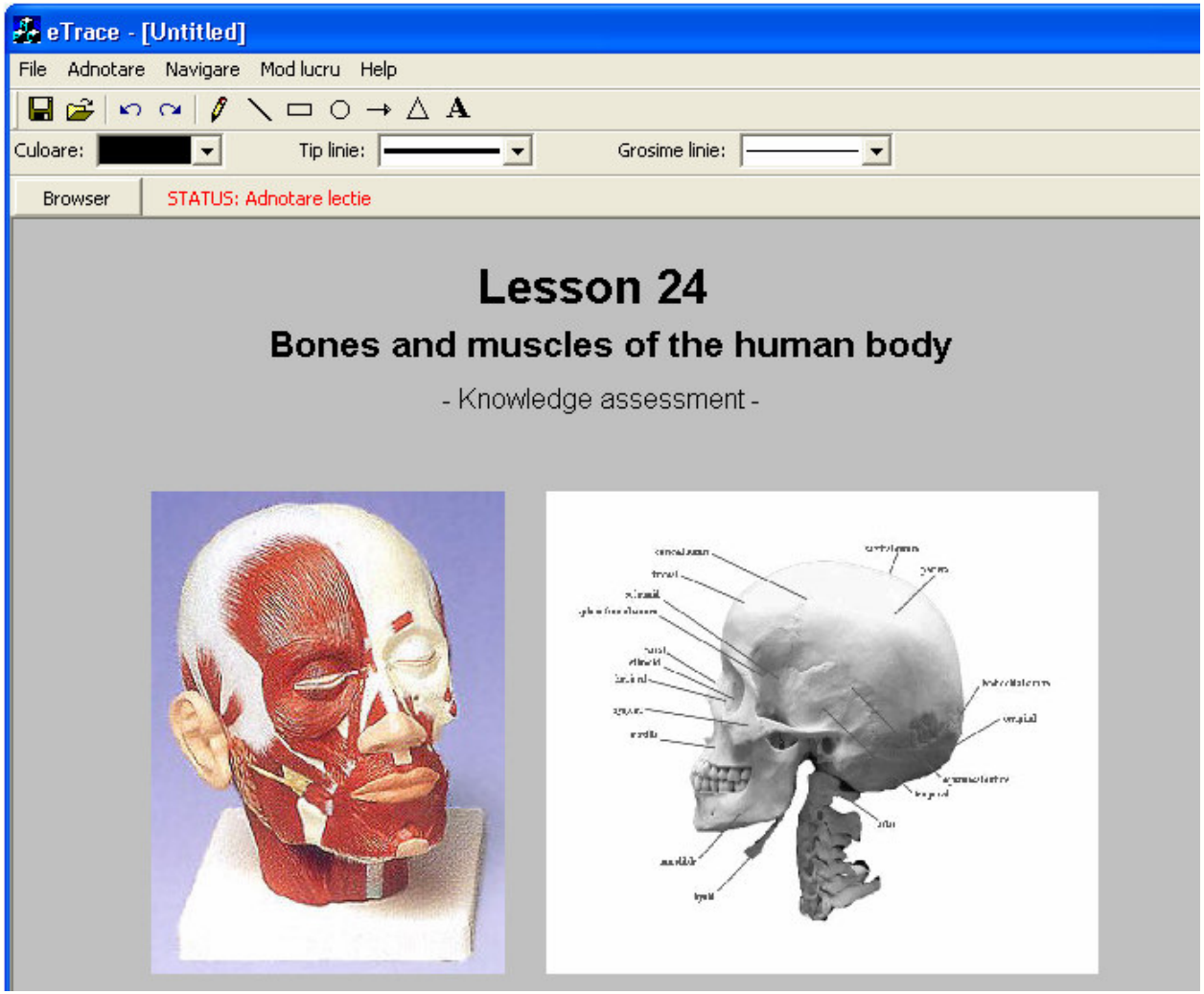
eTrace Platform

PLT'07

- Experiment the annotation techniques on 2D and 3D scenes
- Support annotation independence against document type (text, image), format and 3D scene description
- Annotation modeling
- User interaction techniques
- Annotation description and communication
- Synchronization between object and annotation
- Annotation processing and interpretation
- Persistence among working sessions and users
- Visualization
- Security
- Integration into e-learning lessons
- Implementation and experimentation of the annotation techniques in e-learning applications

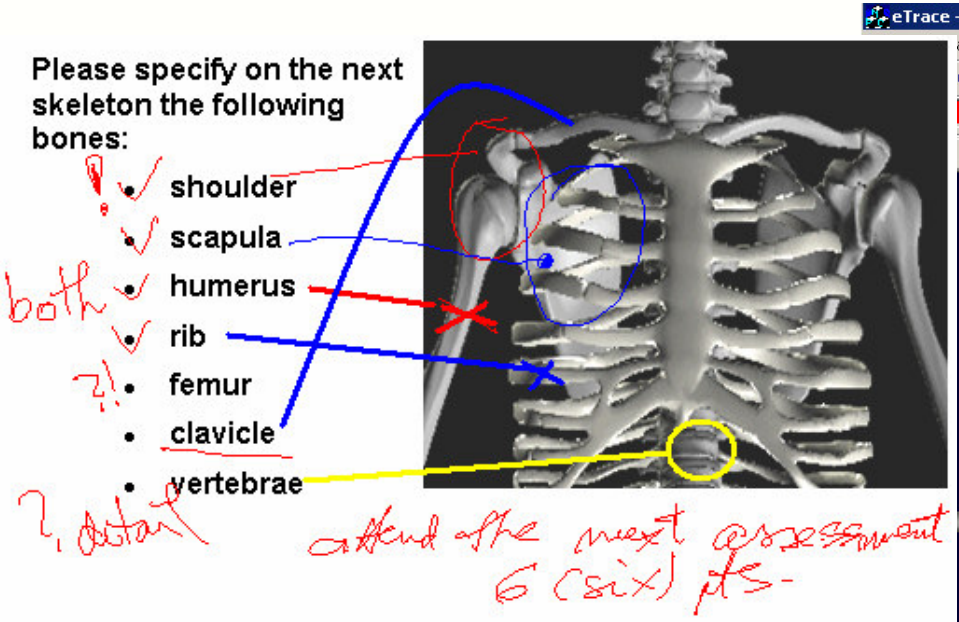
eTrace – Graphics Annotation eLearning Environment

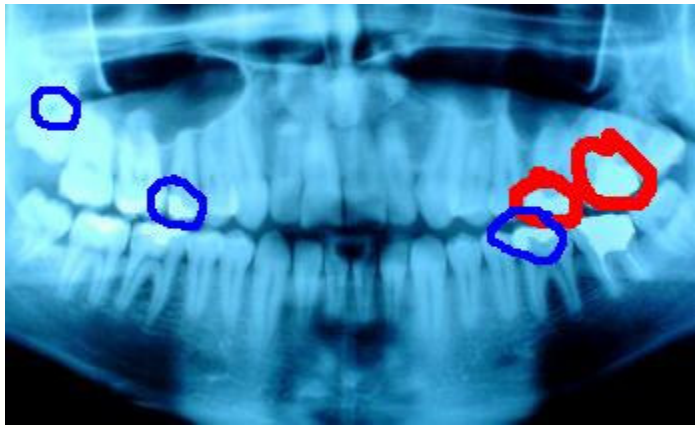
PLT'07

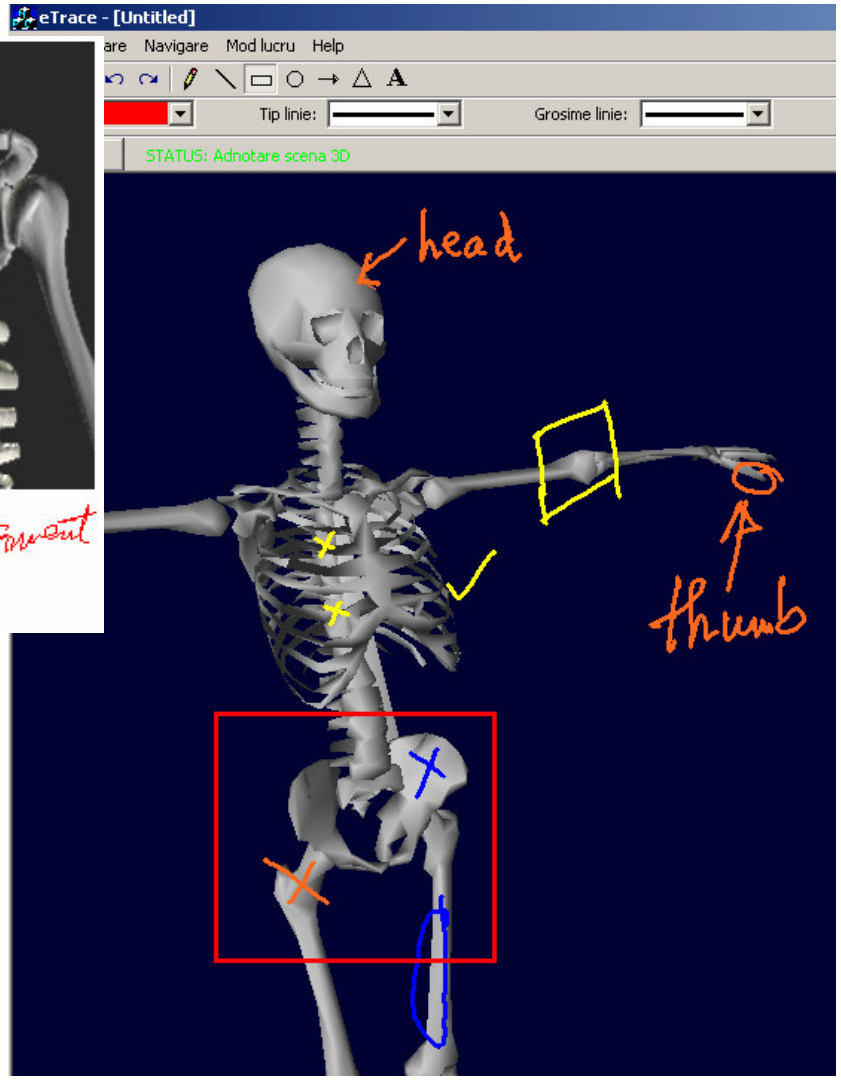


eTrace – Graphics Annotation Based Lessons

PLT'07

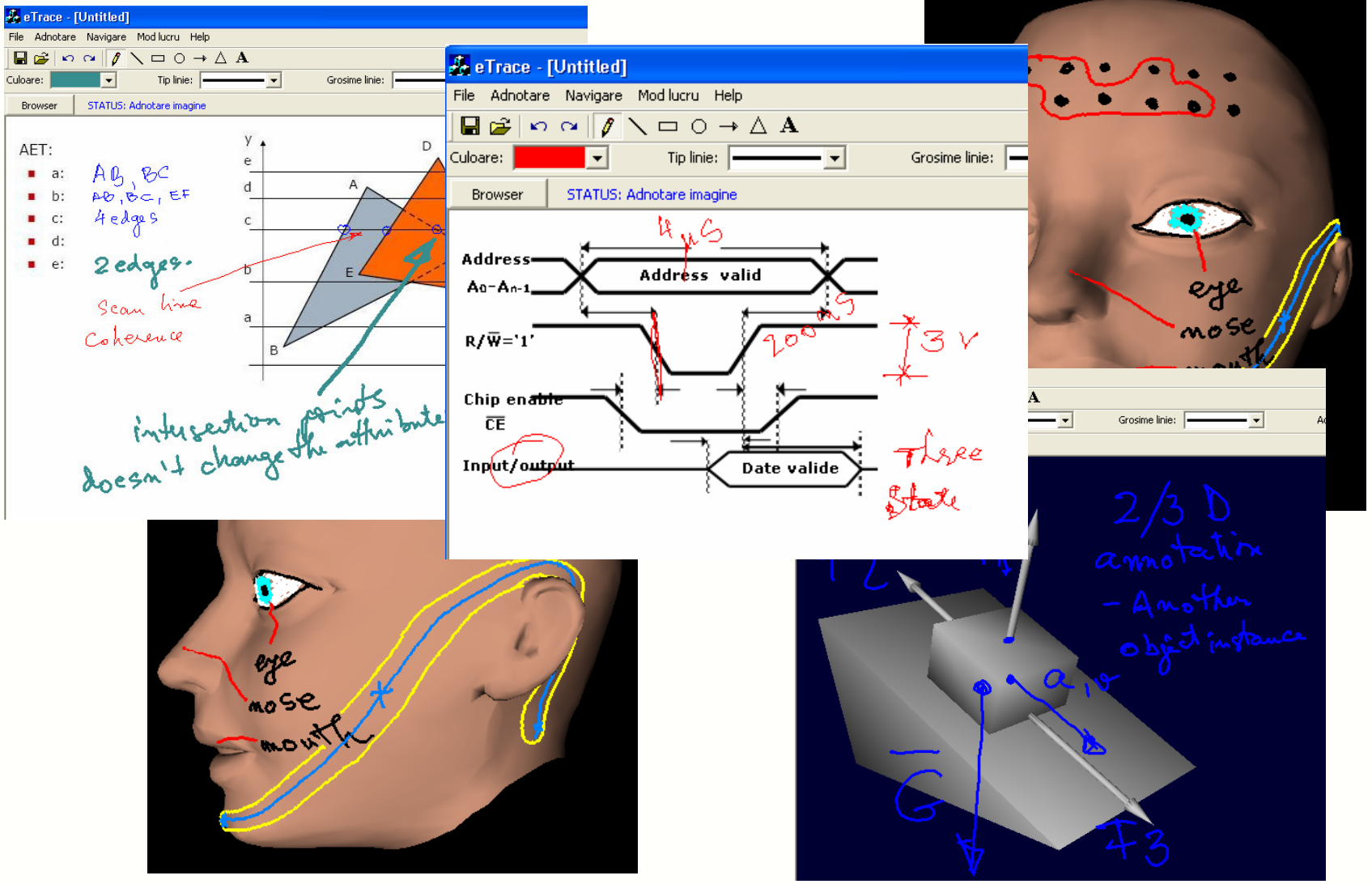






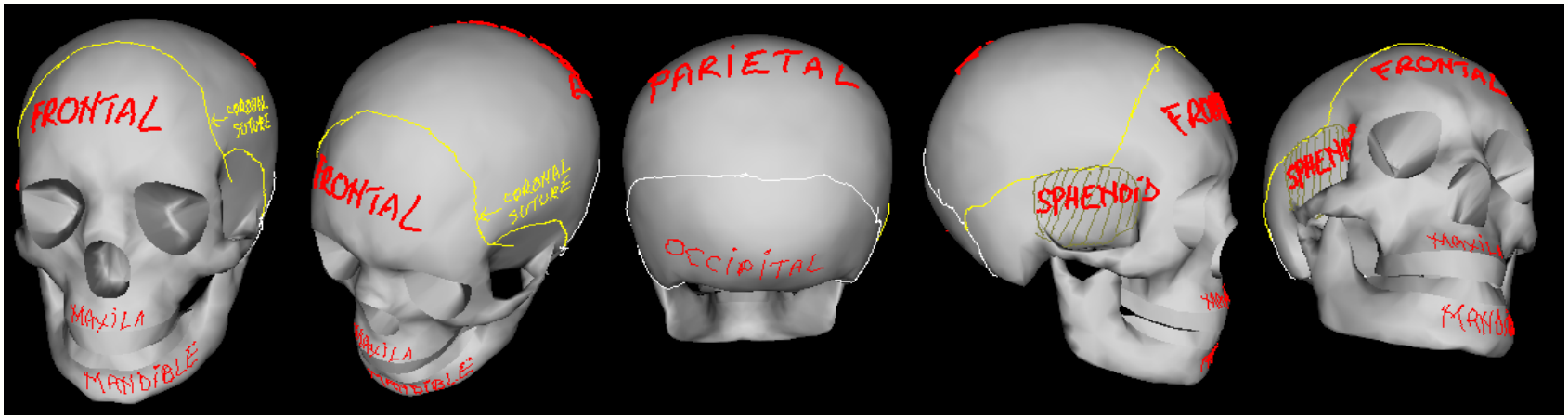
eTrace – Graphics Annotation Based Lessons

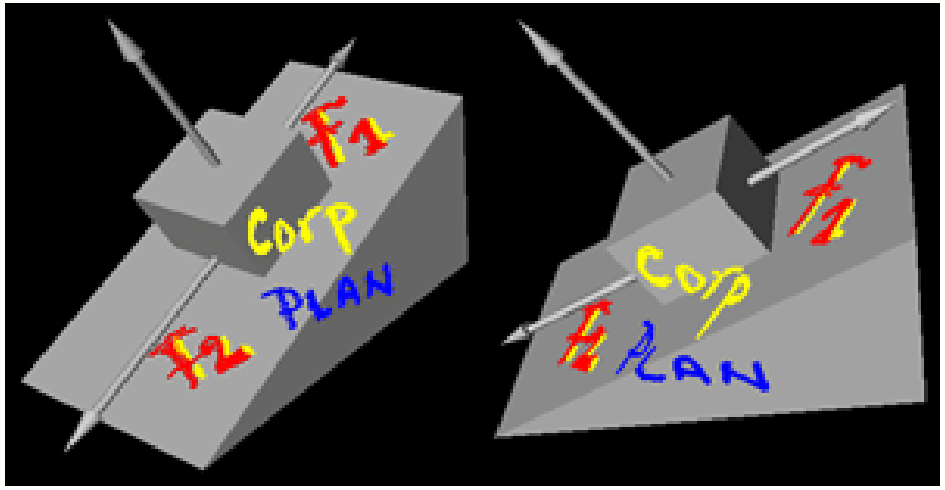
PLT'07

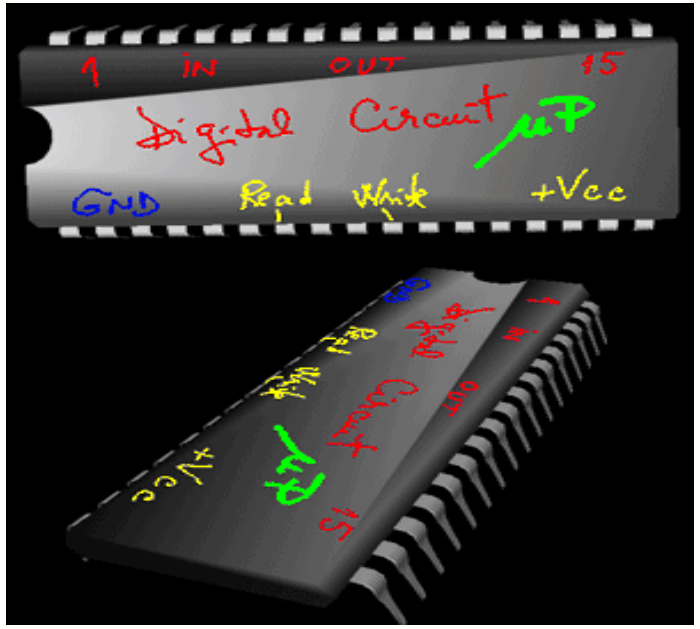


eTrace – Graphics Annotation Based Lessons

PLT'07







Usability evaluation

Evaluation methodology

1. Usability attributes

   efficiency of the pen related annotation, number of errors by drawing a symbol, precision, and graphics quality

2. Scenario

   user actions, the objects and the text which are subject of the annotation

3. Measurement method

   parameters which are to be measured (e.g. execution time), the measurement and recording approach (e.g. automatically)

4. Evaluation criteria

   assessment approach, and the parameter value range for normal, accepted and critical cases

Experiments

- 17 exercises of eTrace lessons

  2D graphics annotation in the context of eTrace lessons

- Group of 20 users

  women and men, 22-52 years, 12-20 experimented users

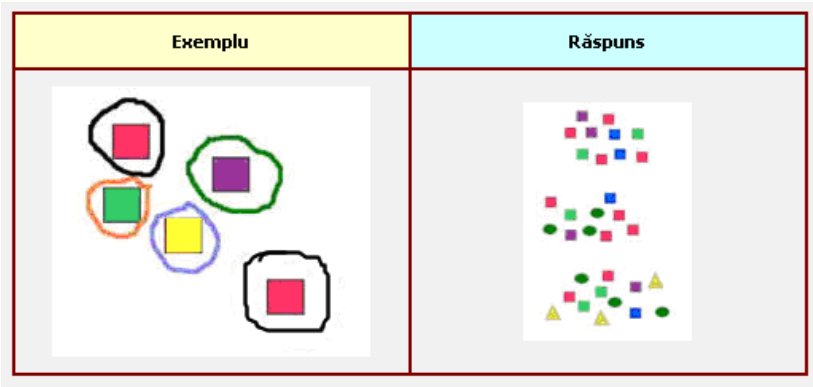
- Measurements:
  - Runtime: Execution Time
  - Off-line: Aspect, Number of Errors
- Usability estimation:

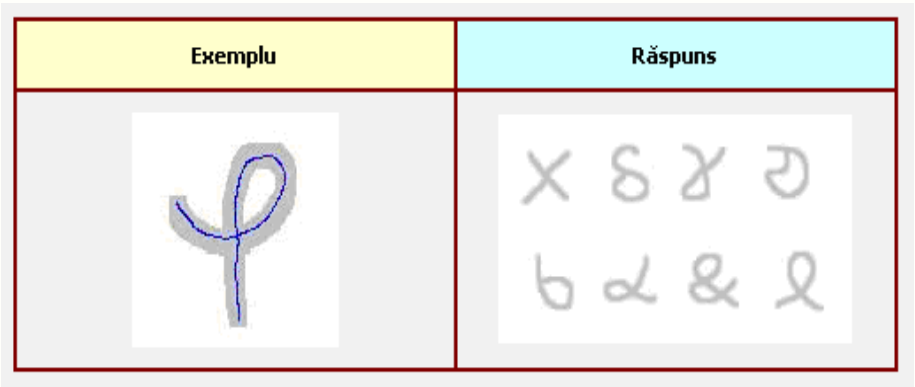
  `Usability ← Aspect / Time x Number_of_Errors)`

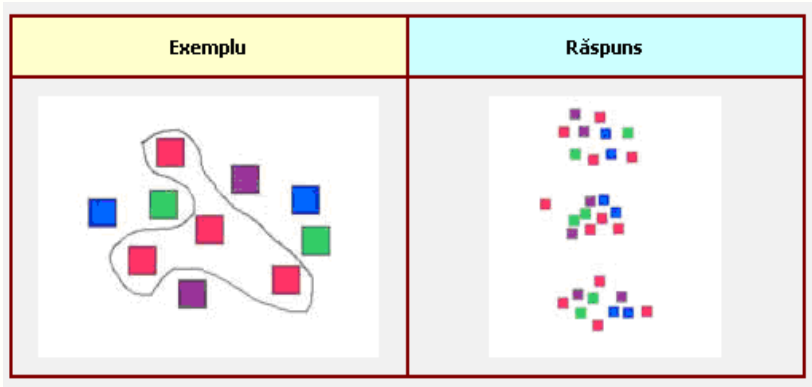
- Experiment cases:
  - Pen vs mouse
  - Selection
  - Drawing
  - Handwriting
  - . . .

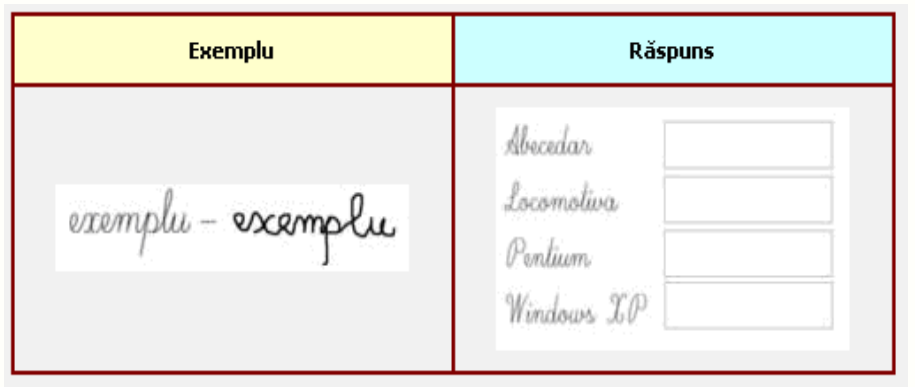
Experiments - Exercises

PLT'07



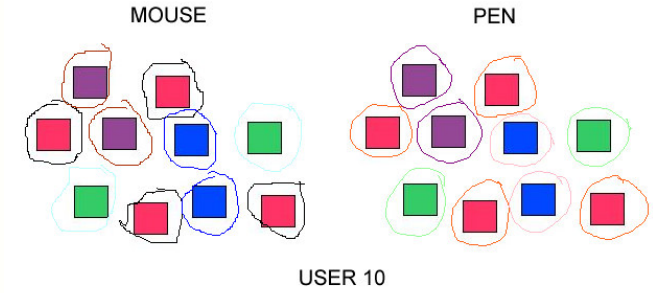


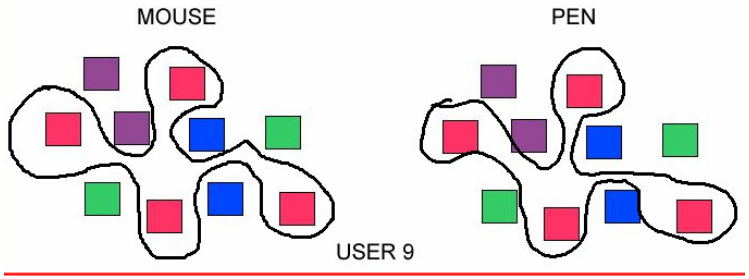


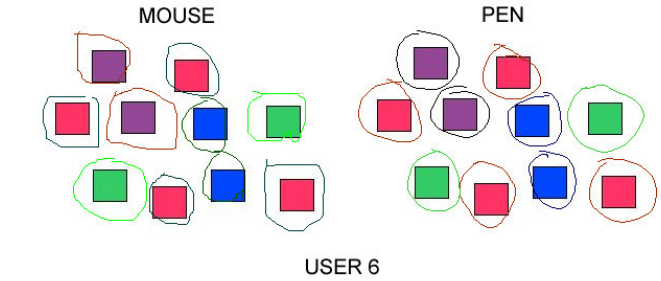


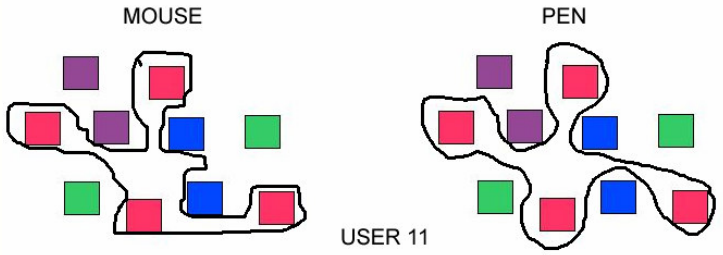
Other exercises (17): http://users.utcluj.ro/~gorgan/res/cgis/itrace/

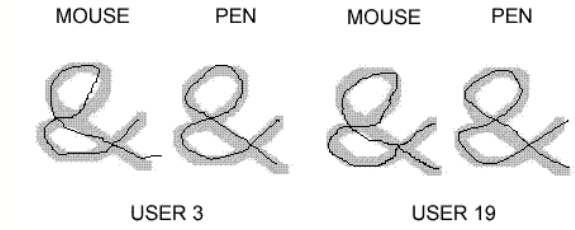
Measurements

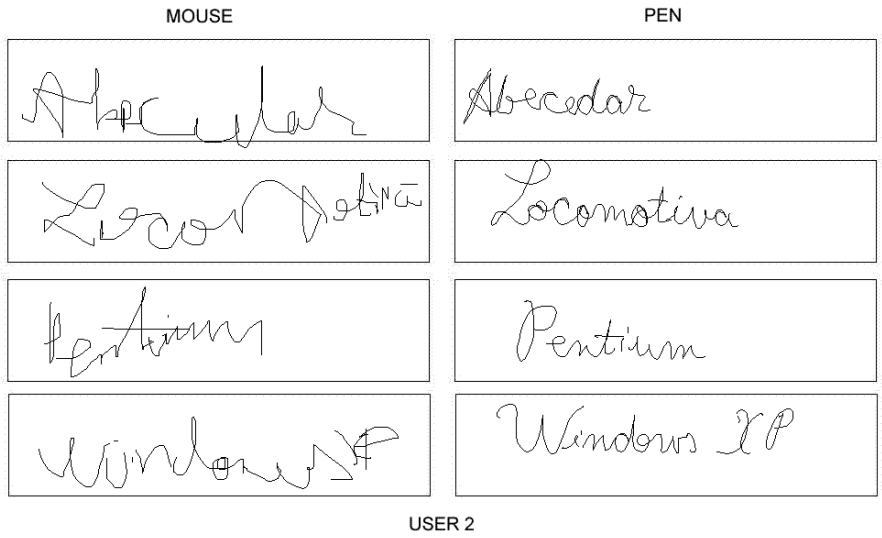










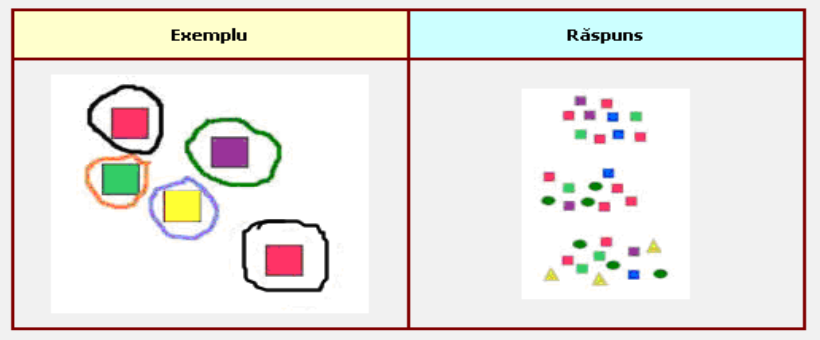


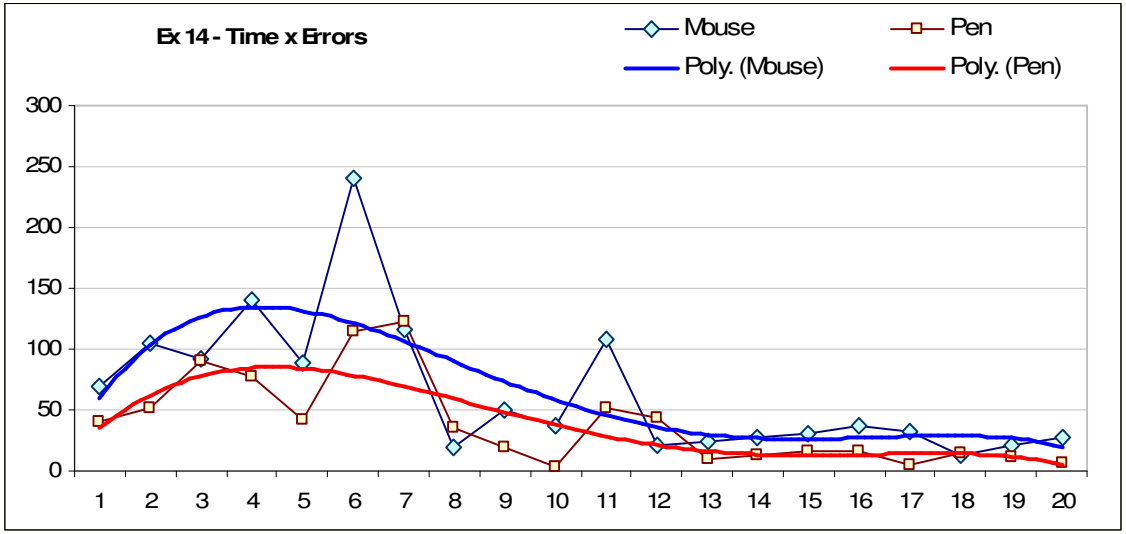
Measurements and Results

PLT'07

User	Time [sec]		Omission Errors		Time x Errors	
	mouse	pen	mouse	pen	mouse	pen
1	278.10	265.19	15	9	69.52	39.78
2	301.25	283.56	21	11	105.44	51.99
3	370.56	319.57	15	17	92.64	90.54
4	312.61	202.60	27	23	140.68	77.66
5	333.80	232.96	16	11	89.01	42.71
6	534.07	431.92	27	16	240.33	115.18
7	578.97	462.05	12	16	115.79	123.21
8	164.55	195.30	7	11	19.20	35.81
9	200.45	141.95	15	8	50.11	18.93
10	156.55	155.88	14	1	36.53	2.60
11	258.11	205.82	25	15	107.55	51.46
12	304.97	262.89	4	10	20.33	43.81
13	206.41	200.07	7	3	24.08	10.00
14	160.43	61.67	10	12	26.74	12.33
15	167.60	120.06	11	8	30.73	16.01
16	149.13	108.40	15	9	37.28	16.26
17	137.75	111.91	14	3	32.14	5.60
18	114.33	122.44	7	7	13.34	14.28
19	141.13	119.54	9	6	21.17	11.95
20	138.61	138.88	12	3	27.72	6.94

Usability measurements for individual selection by contour (Exercise 14).



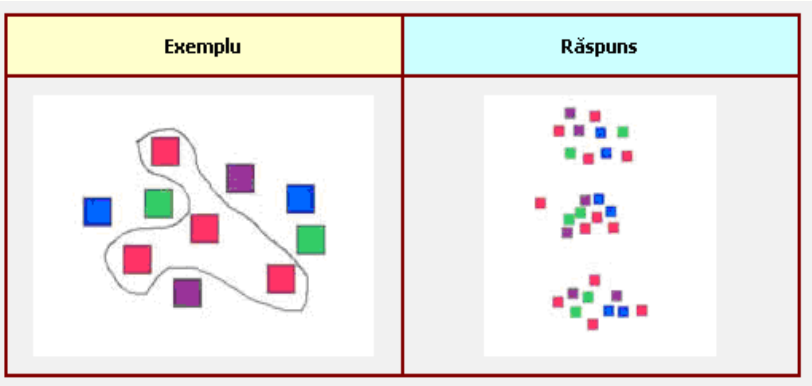


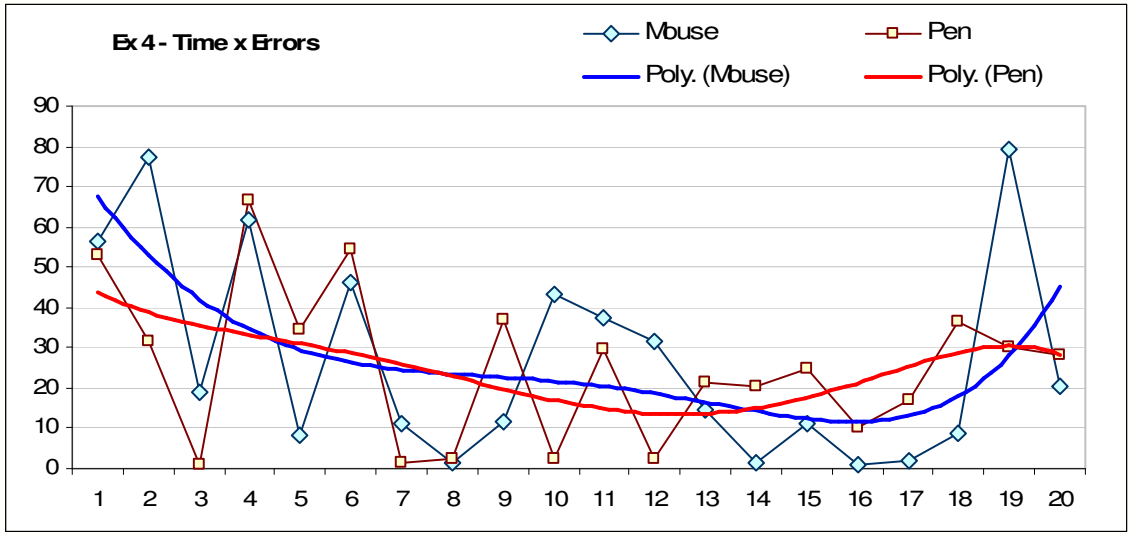
Measurements and Results

PLT'07

User	Time [sec]		Wrong inclusion		Time x Errors	
	mouse	pen	mouse	pen	mouse	pen
1	9.43	17.70	6	3	56.60	53.11
2	9.69	7.95	8	4	77.52	31.80
3	9.56	11.38	2	0.1	19.12	1.14
4	10.26	16.65	6	4	61.54	66.59
5	8.06	8.61	1	4	8.06	34.43
6	11.56	9.08	4	6	46.25	54.49
7	11.10	12.53	1	0.1	11.10	1.25
8	15.30	24.43	0.1	0.1	1.53	2.44
9	11.87	12.29	1	3	11.87	36.87
10	14.38	22.24	3	0.1	43.13	2.22
11	27.88	15.91	8	5	37.66	29.71
12	31.45	25.55	1	0.1	31.45	2.55
13	14.55	10.78	1	2	14.55	21.55
14	16.07	20.42	0.1	1	1.61	20.42
15	11.24	12.39	1	2	11.24	24.77
16	8.29	10.44	0.1	1	0.83	10.44
17	19.21	17.09	0.1	1	1.92	17.09
18	8.86	12.23	1	3	8.86	36.70
19	13.20	10.03	6	3	79.20	30.09
20	20.32	14.09	1	2	20.32	28.17

Usability measurements for group selection by contour (Exercise 4).



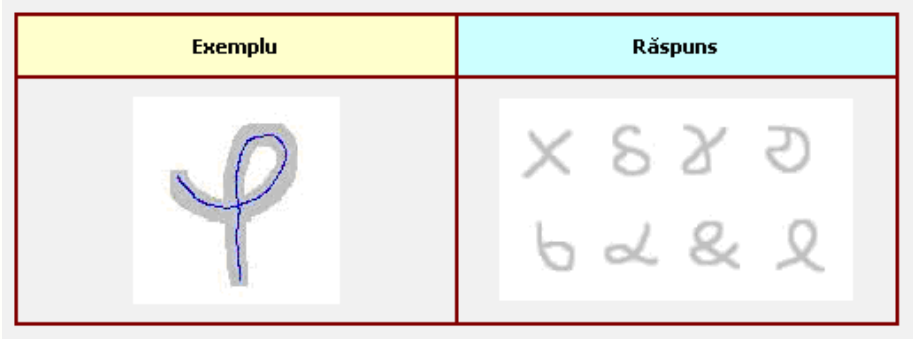


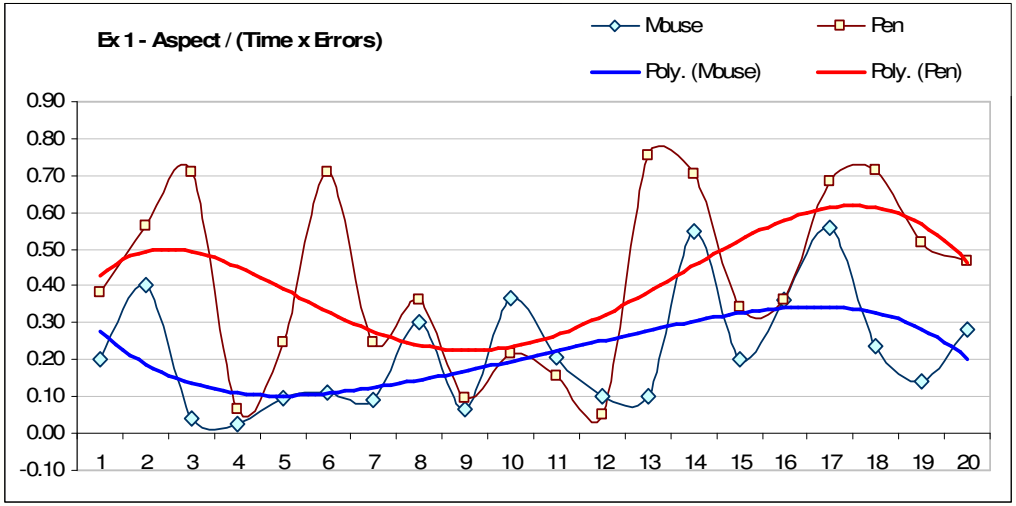
Measurements and Results

PLT'07

User	Time [sec]		Errors		Aspect		Aspect / (Time x Errors)	
	mouse	pen	mouse	pen	mouse	pen	mouse	pen
1	4.99	6.56	3	2	3	5	0.20	0.38
2	2.50	1.77	2	4	2	4	0.40	0.56
3	4.23	3.53	6	2	1	5	0.04	0.71
4	4.55	7.62	8	4	1	2	0.03	0.07
5	3.42	3.03	6	4	2	3	0.10	0.25
6	5.99	5.65	3	1	2	4	0.11	0.71
7	4.41	4.01	5	4	2	4	0.09	0.25
8	6.63	6.87	2	2	4	5	0.30	0.36
9	7.59	8.27	4	5	2	4	0.07	0.10
10	10.91	11.54	1	2	4	5	0.37	0.22
11	9.60	6.50	2	4	4	4	0.21	0.15
12	13.38	12.30	3	5	4	3	0.10	0.05
13	5.83	6.62	5	1	3	5	0.10	0.76
14	7.30	7.09	1	1	4	5	0.55	0.71
15	3.69	3.91	4	3	3	4	0.20	0.34
16	2.78	3.70	5	3	5	4	0.36	0.36
17	8.92	7.34	1	1	5	5	0.56	0.68
18	2.56	2.80	5	2	3	4	0.23	0.71
19	3.55	4.81	4	2	2	5	0.14	0.52
20	4.73	4.28	3	2	4	4	0.28	0.47

Usability measurements for gesture drawing (Exercise 1).





Conclusions

- Free forms of expression
- New types of questions and answers in the eLearning applications
- Visual free form answer provides support for creativity, flexibility, imagination, and artistic ability
- Annotation based interaction techniques must be designed according with the characteristics of each interaction device
- The assessment of the annotation quality has a significant impact on the quality of the answer
- Automatically evaluation of the annotation based answer

Future work

PLT'07

- Usability of the 3D annotation techniques
- Develop automatically techniques for knowledge assessment in graphics annotation based lessons
- Multi user sessions
- Real time communication
- Develop graphics annotation lessons in various domains
- Propose technical specifications for standards concerning with
    1. Graphical annotation model
    2. User interaction techniques
    3. Automatically knowledge evaluation

Questions

Thanks

Dorian Gorgan, Teodor Ştefănuț
Computer Science Department
Technical University of Cluj-Napoca
dorian.gorgan@cs.utcluj.ro