Keywords: computer animation, education, e-learning.

Introduction

Tagia a //acc a c /cgic a a /a ca, cagi a a a / -/ a a.

A c🖛 a 🔗 a a a \mathbf{ac} с a 🛃 a 🗸 ca aa b \mathbf{a} \mathbf{a} \mathbf{a} a .T a a аса ac arca a , ac \mathbf{c} с 4 c 🖛 / b a ff c \mathbf{a} ac 2? / -. Т 🖬 \mathbf{a} \mathbf{a} . S c c a / a æ c fic \mathbf{c} b a с / а.

Creating educational animation — design approach

4 a a Ι ar b r ac -8 1 £?aca, / a a 🖝 a 7 *g*? b a a ca c a / ca a . I a 🤗 a a , 🗶 🖌 ав са 🛃 а а a / , 🛥 ff c . T a -a / b с 4 с \mathbf{a} a ar × æ • . W ΄, a-🗯 🔺 आ са 🛃 а a / a ac \mathbf{c} а 🥵 . Т a a С / 1 c ca b b / ₿ ba c a :

- A a
- C c
- Raa
- P 🙎
- C
- •Т 🧝

N an a an a c a / a ac a ac .

Analytical phase

Ι æ?, a c с 🖌 🛥 a a \mathbf{b} с - Pi / / 🛥 🍋 \mathbf{a} b 🛥 . W / C / 🖌 a b \mathbf{ab} a a a , , ar. I b⊯c • / b de la £ 1 a / \mathbf{a} a / b ab \mathbf{b} ac . T а \mathbf{c} ? . W a \mathbf{c} 🖌 a \mathbf{a} \mathbf{a} 🖌 a a 🔺 : a -, b \mathbf{a} \mathbf{a} / 🖢 ac с \mathbf{a} c a- $^{\rm ab}$. A / \mathbf{a} \mathbf{a} ан 2 b \mathbf{c} de la / 🛥 , a 🛥 \mathbf{ba} а / a a / ac ∕₽.. W a c c a a с - \mathbf{c} а **?** , a a**∢**ab , fi с а a / a ac Α æ? 🔺 **g**?a g? ટ્ટી 🛥 a / a a⁄ . I 🖌 a , ca a / a 🙎 🕷 с а ff . N a⊲a , ag?a b a⁄a a ca b / . 🖫 а 🧖 \mathbf{a} ⁄ fi a ac a .

Concept

сса, 🛥 Ι / a ₽?a \mathbf{a} c . W 🖛 🕖 bac 🛥 a cfica 🛥 a 🗸 а \mathbf{a} , G**a**r ∕ \mathbf{a} de de a / caacc / a c/ / ac c . 🖌 \mathbf{ba} a**∢**a с a a / C / C \mathbf{a} \mathbf{a} , са 🧟 . [a \mathbf{a} Т 🙎 а / c c \mathbf{a} С / \mathbf{a} aba 🖌 a c a 🙎 a a**4** . I a с c , a / c a a C / / - **1** 1 c fic $\,a$ **4** T a а, a / a / \mathbf{a} ac c a $^{\rm ab}$ / a 🙎 4

Realization

T a a g aca cag a a .W a c / SW c a cfic b c , a / a / c acc / g a / / .H , a g c a a acc a a / caab a / c.D / g b a, ca c c a a a g a a , bg g a /, c a / a a a a a a a a b fi a / c.

Piloting

B 2 a a ca , a ab / -ca / 2, . a a a a a [2]. A a a b / c b ac 2 (b a c 2) / a a c a ca 2 a a A a a c / b a b / , a / a ab a a a a A 2 / fic c a a b c / , a a b / , ca b /.

Completion

T c ga b g a a-. T ca b / a . I ca , / c b / a b g a / a c c a g -(LSM) b c . T / c a c b acc b a c b acc b a c b acc a -/ a b c. I - a g a a ab , ca c a a b g a / b . T a a a a a c a / b g .

Testing

| Т | a | | a b a | | | Ι | a |
|---|----|---|---------|---|------------|---|-----|
| | 2? | a | 📽 / C / | с | æ ? | | ca |
| | | a | í fic c | | | | A - |

The process of creating an animation

I c / a a / a c fic a c a 2 a / ca a a a . F a , a a a c a a a a . T a a 2 b / c a ca 2 2 c a 2 - c -/ . W / a , fica .

Analysis

L c / £? / a :• Wa ac £ac £? £?a / caacca 🧟 ca 🍰 🤗 c-c cara.Ta/ a∎c ∎ a aa b ac.I 2 / / a a 🛥 c c , a a**4** ca b c / a CDROM a 🖛 a / g / . B a a a g, a / -b c a / a a / acca, -g g a bacba / a / ca, a / a ca a a / a a a g a a £? bc / ab a/ ca . W a / c ca a ac a, g?.bag?, cg?- , c. a a c?- , c. I , ac , ', ca a, -c a , c, , c, , a a a a c ca, c ac . A c c , a a a ab , -ca a CDROM ? a ca , a a a **▲c ▲a**▲ / **g** a ▲ a-/ c/ / fi / a / с . W c a a a a .



Fig. 1: Sketch for an intended animation

÷ / a c W ca с 2 / caa cabg? a 🖌 . W a b c 🛦 b Fa a _ [4]. W c / C $\mathbf{b}\mathbf{a}$ a с.

Concept

L \mathbf{c} \mathbf{a} а a с ${\rm fl} \, \, {\rm c}$ \mathbf{a} \mathbf{a} с 🔺 2? \mathbf{a} . W 2 Т \mathbf{c} a a b , \mathbf{a} caa b ab \mathbf{a} \mathbf{a} \mathbf{c} a / ᡟ a 🛥 / fi / a a F**g**? 1. I \mathbf{a} (🙎 🛥 2 **?**) ∎a c 🖬 / b a , b a \mathbf{b} ×, 🤗 а / a a / 🙎 а. F ar \mathbf{a} b**∢**a∕ ab \mathbf{a} \mathbf{a} а **-** A. -/ a , b ca / b с -c 2. W a a a ff . T c a **, a** 7 \mathbf{a} b Fa . I A/ \mathbf{c} 🔏 a с \mathbf{c} a 🖛 a 4 с . I a, , с a a / /

/ ffic a a / c са 🖉 а 🕷 , a / a a с \mathbf{a} a / b ab a . M , Faca 🖌 a a 2? \mathbf{c} \mathbf{b} a b 🦉 ca fi \prime a I a a / 🧝 🖌 b a a c са 🛃 / 💈 С / aс \mathbf{a} ज ज . , c , a / / a c c с а са 🛃 , 🛃 .: • M (Motion Tween) • S • R a 🛥 • C / • S a c a ? (Shape Tween) С са 🖉 Ac ba 🔹 , c b a c A**ab** Fa b , a / ff a / / a c ba c

3. c a \mathfrak{L} b ff Button .

| Ι | ca , | | 4 | fi | | , b - |
|----|-----------------------|-----|-----|---------|-------|-------|
| ca | a | с а | a / | a | a | a |
| | a | ac | ्य | 44. | Q | b |
| | F g ? 1 | ca | b / | / / ace | c / 🙎 | |
| | 🤵 ab | : | | | | |

Table 1: Choice of type for individual symbols

| Symbol | Type of symbol in Adobe Flash |
|----------------|--------------------------------|
| Rotor | Graphic |
| Animated rotor | Movie clip |
| Cabin | Graphic |
| Cables | Without type (line) / Graphics |

 \mathbf{L} b c a fica b a \mathbf{a} \mathbf{b} \mathbf{a} с \mathbf{a} a a Т ■Mavie Clip \mathbf{a} \mathbf{a} a c \mathbf{b} Graphic \mathbf{c} / W cab caa \mathbf{a} \mathbf{a} 1 \mathbf{b} b \mathbf{a} b \mathbf{b} cab \mathbf{a} / , \mathbf{c} \mathbf{a} Т 2? \mathbf{c} \mathbf{a} \mathbf{c} \mathbf{c} \mathbf{a} \mathbf{a} b \mathbf{a} cab b- a . 🖫 a a 🧜 ca b a ff a a **g**?. H **g**? a \mathbf{a} \mathbf{a} \mathbf{c} \mathbf{a} \mathbf{a} 4 W a a \mathbf{c} b a \mathbf{c} \mathbf{c} a \mathbf{c} b \mathbf{a} а ÷. a . $A_{\!\scriptscriptstyle \prime}$ Fac fic b $_{\mathrm{ff}}$ a / ff \mathbf{a} , a . F 2? a \mathbf{a} \mathbf{a} ffic a a \mathbf{b} Normal \mathbf{a} a / cab \mathbf{a} a / Guide \mathbf{b} a a • cab с cab Guide• a a \mathbf{c}

T a 4 / / a a a / / a b / c b / 2 c

Implementation

Т \mathbf{a} \mathbf{c} с \mathbf{a} 2? b-c a c a FaТ b-A/ b \mathbf{c} . fi a 🏻 a \mathbf{c} жT a

b \mathbf{a}_{\prime} \mathbf{a} æ?, 🛋 с car a / \mathbf{a} a \mathbf{a} с , a 1 . F b, \mathbf{a} caс $^{\mathrm{ab}}$ Ι \mathbf{c} 2? a de la / ca \mathbf{b} b \mathbf{a} \mathbf{a} \mathbf{a} \mathbf{c} W \mathbf{a} a ca \mathbf{b} \mathbf{a} \mathbf{a} \mathbf{a} a a 🖌 ar Т с \mathbf{a} \mathbf{c} а.





Fig. 2: Animation of the rotor



Fig. 3: Motif of the cabin

| 🔺 A | | b | / | 4 | IDE |
|---------|-----|----|---|---|-----|
| A b F a | . I | а, | | / | a |
| a | | | | | |

Piloting

| Α | æ ? | ; * | \mathbf{a} | a | | \mathbf{a} | \mathbf{a}_{\prime} | | |
|-----|------------|------------|--------------|---|---|--------------|-----------------------|------------|------------|
| Ν, | | / Ca | a | | a | | 2? | a / | 4 |
| | | | 4 | | | | | a 1 | ba∕, |
| b | a | | 12 | | | | с а | / ca | $_{ m ff}$ |
| b c | G | с | . W | | | a | \mathbf{a} | c ą | ? |
| a a | a / | | a | | a | | a | . I | a |
| | | | | | | | | | |



Fig. 4: Drawing of the guiding cables

| Formats Flash HTML | |
|--------------------------|--|
| Version: | Flash Player 8 |
| Load order: | Bottom up |
| ActionScript version: | ActionScript 2.0 Settings |
| Options: | Generate size report Protect from import Omit trace actions Debugging permitted Compress movie Optimize for Flash Player 6 r65 |
| Password: | |
| JPEG quality: | 0 100 |
| Audio stream: | MP3, 16 kbps, Mono Set |
| Audio event: | MP3, 16 kbps, Mono Set Override sound settings Export device sounds |
| Local playback security: | Access local files only |

Fig. 5: Example of an export into an appropriate format

| | 4 | | | | | | | 4 | | | |
|---|--------------|---|-----|-----|-----|---|---|-----|--------|---|---|
| 2 | / | a | a | C- | | | | / | , | | |
| | \mathbf{a} | a | a | / a | | | | 4 | ra b 🖛 | | - |
| a | | | . 🕌 | b | ca | , | | , | · C · | | |
| Ś | 2? | | a / | a | a | | с | a | са 🖉 | Т | |
| | 4 | | | bab | | b | | a | . H | , | |
| с | / | 4 | a b | ? | 4 | | | a∎a | a | | - |
| a | , a | / | | | / 1 | b | | 1. | | | |

Completion

Т $b \ c$ \mathbf{a} \mathbf{a} **a** C a W \mathbf{a} $^{\mathrm{ab}}$ \mathbf{a} F ab ca b \mathbf{a} 2? a a a . W a 🛥 \mathbf{c} a/ ac \mathbf{a} b acc \mathbf{b} \mathbf{c} a . I ab \mathbf{a} b - \mathbf{c} с (\mathbf{c} 2? baba), с ca a a CDROM. A CDROM ca \mathbf{a} \mathbf{a} \mathbf{a} a a bac \mathbf{a} .

Testing

Т a fi æ \mathbf{a} a I C a*g*? 2 \mathbf{c} a a- \mathbf{a} a а a . . A **∢**c b , \mathbf{a} А ca🖛 a a_{\prime} \mathbf{a} а a . $^{\mathrm{ab}}$ \mathbf{a} \mathbf{a} ÷ a А а . 4 a 🛥 a \mathbf{c} a \mathbf{a} а а \mathbf{c} / . I \mathbf{a} / \mathbf{a} \mathbf{a} a ca a / / ac c a / a a / a / a

Conclusion

Т 🛃 а a a \mathbf{ac} \mathbf{a} a \mathbf{a} b c \mathbf{c} с \mathbf{a} Ś Т 🖌 ca a a \mathbf{a} b a b . / a \mathbf{b} caa ff 🔺 ccfi \mathbf{a} \mathbf{a} 1 c). W∢ a a 🛥 🛥 a \mathbf{a} ar a £? / ac c c b 🔗 с а / \mathbf{a} \mathbf{a} ffic . I acc ac . W 🛥 a \mathbf{a} ac \mathbf{a} а b 🤌 caa -2. T 2? a \mathbf{a} a \mathbf{c} a ba _ a cca ba \mathbf{c} зłе **?** / . T \mathbf{a} caa a \mathbf{a} \mathbf{a} \mathbf{a} ac ca \mathbf{a} ca . T \mathbf{c} \mathbf{c} \mathbf{b} \mathbf{a} ca \mathbf{a} \mathbf{a} / c. W \mathbf{a} a a ab



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I g?. Bc. Ja J a E- a : jirsaj@fel.cvut.cz

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