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THE BIRTH OF PICTORIALITY IN COMPUTER MEDIA[1]

The aim of the paper is to follow some milestones of the story of computer media as far as the notion of pictoriality is concerned. I am going to describe in the most general way how it happens that two quite separate technologies as computer machine and pictorial representation met and since then became almost inseparable.

1. Definitions

1. Visuality and pictoriality

What does it mean "visuality"? It can be defined as "a quality of being visual"[2]. We don't want to identify it with "visibility"[3]. The latter would be "a quality or state of being visible". "Visibility" concerns process of perception, whereas "visuality" would indicate an ontological dimension of existence. At first the word can seem superfluous and hasn't been noticed by some prominent dictionaries[4]. However it has

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2 Visuality, in: *Wiktionary, The Free Dictionary*, https://en.wiktionary.org/wiki/visuality (retrieved 23.02.2015)

3 As both *Merridan-Webster* dictionary and *American Heritage Dictionary of the English Language* do: visuality, in: *Merridan-Webster*, 2015, http://www.merriam-webster.com/dictionary/visuality (retrieved 23.02.2015); *American Heritage Dictionary of the English Language*, 2011, http://www.thefreedictionary.com/visuality (retrieved 23.02.2015)

4 Like dictionary.com, for instance.

quite a venerable genealogy, as it appears in Thomas Carlyle's *On Heroes, Hero-Worship, and the Heroic in History* as early as in 1840. “Clear visuality”, according to Carlyle, is a feature of Dante's work, which gives it its incomparable excellence and is close in meaning to “intense earnestness” and “truth”[5]. One can notice here a framework of Plato's concept of knowledge coming form ideas acquired by means of visual perception.

For the need of this paper I would tend to understand visuality as a substantive correlate of a notion of “visual” in the meaning it is used in an expression “visual culture”. Leading scholar on the topic, Nicholas Mirzoeff, explains it in terms of visual technology, which is:

> “any form of apparatus designed either to be looked at or to enhance natural vision, from oil painting to television and the Internet”[6]

However, when Mirzoeff enumerates examples of phenomena of visual culture, he refers mostly not actually to visual media technologies in general, but rather to pictorial media[7]. Visuality is a broader term than pictoriality. Every pictorial entity must be simultaneously visual, whereas not every visual entity is mandatory pictorial[8].

The difference between visual and pictorial becomes clearer, when one takes into consideration Marshall McLuhan's tradition in media theory. He distinguishes between “the magical world of the ear” and “the neutral visual world”[9]. By the latter he meant a world peopled by humans changed by internalization of technology of a phonetic alphabet. Hence,

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5 Thomas Carlyle, *On Heroes, Hero-Worship, and the Heroic in History*, Project Gutenberg, 2008, http://www.gutenberg.org/files/1091/1091-h/1091-h.htm (retrieved 23.02.2015)

6 Nicholas Mirzoeff, *The visual culture reader*, London: Routledge 2002, p. 3.

7 Nicholas Hiley, *The Pictorial Media*, “The Historical Journal”, 31, 1988.

8 More on relation between visuality and pictoriality: Whitney Davis, *Visuality and Pictoriality*, “RES: Anthropology and Aesthetics”, No. 46, Autumn, 2004. However, in the current paper I'm not following Davis's approach and understand these terms as defined above.

9 Marshall McLuhan, *The Gutenberg Galaxy: the making of typographic man*, Toronto, Canada: University of Toronto Press 1962, p.21.

written communication is a constitutive part of visual media in the same way as oil painting or television. We should contrast then two classes of visuality. Symbols would be the first of them. This kind of visual object refers to its designate by sheer convention, in such a way as language symbol according to Ferdinand de Saussure. The second class of visuality would consists of icons, or pictures. They relate to their meanings by similarity, so there is no need to learn any special code or convention to recognize them. One can say that pictures are not so demanding for a recipient as symbolic scripture. They pose lower entry threshold than symbols of a conventional code do.

No surprise that a picture was appreciated as a communication media in Middle Ages, while system of literary education was fairly poor developed. Idea expressed in sentence "*Pictura est laicorum litteratura*" appears in writings of Honorius Augustodunensis[10]. Pictures become in this perspective a substitute of written communication, applied when there is a lack of competence on the side of recipients, i. e. when recipient of a message is not familiar with the symbolic code.

2. Computer

It is not easy to decide where to start the history of computers. What actually is a computer? A computing machine? If so, one should count as it also our fingers that used to serve as first tools to perform arithmetical calculations, what determined the form of our contemporary numeral system based on the number 10[11]. A restriction of not being part of our body still would lead us to call an abacus or a slide rule with a name of a computer, since both of these devices were invented and used for a purpose of arithmetical computations.

Well, the main point of a definition of a computer and what distinguish it from any other computing machines construed before it was a possibility of programming it. In this perspective one starts a history of computers with Charles Babbage's analytical engine,

10 Honorius Augustodunensis, *Gemma animae*, I, 132, in: *Patrologiae cursus completus; Series Latina*, ed. J.-P. Migne, Paris 1854, vol. 172, s. 586.

11 Compare: Michael R. Williams, *A Preview of Things to Come: Some Remarks on the First Generation of Computers*, in: *The first computers: history and architectures*, ed. R. Rojas, U. Hashagen, Cambridge, Mass.: MIT Press 2000, p. 8.

programmed with punched cards. However, one can presume that moving stones on abacus or sliding a rule of a slide rule also can be named "programming". Yet, these terminological troubles can be easily solved and a mathematically precise definition of a computer can be proposed, thanks to research of Alan Turing. In his famous paper entitled "On computable numbers" British mathematician introduces a notion of an "automatic machine" (a-machine):

> "The machine is supplied with a "tape" (the analogue of paper) running through it, and divided into sections (called "squares") each capable of bearing a "symbol"."[12]

The machine, called later Turing machine, was quite limited in its functionality. It was able to read a symbol and write a new one dependently on the symbol read previously. Nevertheless, it happened to be as effective as our contemporary computers, including the biggest ones, supercomputers. Turing created a definition of computer that was accepted universally. Babbage analytical engine is a computer in this sense, an abacus and a slide rule – not at all.

From a point of view of media theory Turing machine belongs fully to the world of scripture, seems to be a radical consequence of the logic of writing[13]. It employs technology of a scroll, named "tape" here. Scroll provides a feature of preserving written signs from a limited repertoire, constituting a language code based on a finite alphabet. A-machine doesn't offer a possibility of drawing and displaying a picture. This heritage will determine the evolution of computers for a long time. We will be waiting two decades, till the first computer apt to handle graphics.

Despite its name Turing machine was a sheer theoretical entity, a thought experiment, not intended to be built in reality[14]. In actual realization it would be too ineffective form technical point of view. This

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12 Alan Turing, *On Computable Numbers, With an Application to the Entscheidungsproblem*, "Proceedings of the London Mathematical Society" (1937), s2-42, p. 231.

13 Jack Goody, *The Logic of Writing and the Organization of Society*, Cambridge University Press 1986.

14 It has been though implemented for modern computers and nowadays one can find several Turing machines accessible on-line.

is why von Neumann architecture became such a crucial point in the history of computing machines. It makes possible to put in practice theoretical ideas of Turing. John von Neumann designed "the general-purpose automatic computing system" consisting of

> "units for arithmetic, storage, control, input, and output"[15]

All these parts we can still found in structure of our contemporary computers. Von Neumann decided, oppositely to original Turing's idea, to store data and instructions of a program in the same memory space. Von Neumann hasn't precisely determined the form instructions controlling the computer should be input in.

> "These instructions must be given in some form which the device can sense: Punched into a system of punchcards or on teletype tape, magnetically impressed on steel tape or wire, photographically impressed on motion picture film, (…) this list being by no means necessarily complete."[16]

As we can see he prophesied even photographic film as a medium for introducing data to computing machine. It had been indeed already used by Konrad Zuse in 1936 in this Z3, the first working programmable computer[17]. Zuse, however, hadn't applied suggested by von Neumann photographic technology, but used punched movie tape instead. Therefore the input was in fact "numerical data", since the aim of a computer was, logic goes, to compute, i. e. to perform arithmetical operations. Computer still belongs to the world of writing and the realm of picture is beyond its reach.

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15 William Aspray, *John von Neumann and the origins of modern computing*, Cambridge, Mass.: MIT Press 1990, p. 64.

16 John von Neumann, *First Draft of a Report on the EDVAC*, University of Pennsylvania 1945, https://web.archive.org/web/20130314123032/http://qss.stanford.edu/~godfrey/vonNeumann/vnedvac.pdf (retrieved 23.02.2015)

17 Lev Manovich, *The Language of New Media*, Cambridge, Mass. : MIT Press 2002, p. 47

3. New Media

There comes a moment when these two technologies, a computer and visual media join. This is where Lev Manovich seeks origin of new media.

> „new media represents a convergence of two separate historical trajectories: computing and media technologies. Both begin in the 1830's with Babbage's Analytical Engine and Daguerre's daguerreotype."[18]

Under the term "media technologies" Manovich understands mostly visual media technologies such as cinema. Symbolized by Dziga Vertow's movie it plays for him a key role for the language of new media[19]. Other enumerated exemplary media technologies are as follows:

> "a photographic plate, a film stock, a gramophone record"[20]

All of these media represent pictorial media in a broad sense, providing iconic copy of its designates.

2. Pictoriality and Computers

At the beginning of this paper I introduced an opposition between two classes of visuality: symbolic, conventional visual code and iconic, pictorial visuality. All the above invoked examples of computing machines represented the realm of symbolic code, since it needed input in a form of numerical date and produced output of the same type. It was closely related to the fact that all of them was digital computers, exactly the same as all the computers around us. Nonetheless, there existed also analogue computers we are not able to include to our analysis. For an analogue computing technology pictorial reality is a natural environment, since the essence of the opposition between analogue and digital is very much the same as between symbolic and iconic. Thus, I am going to investigate the birth of iconic visuality in the history of digital computers. The point of a clash between analogue-pictorial and digital-

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18 Manovich, p. 44.

19 Manovich, p. VI.

20 Manovich, p. 44.

symbolic would be the center of interest here. This is where the question of translation from one form of a message to another one, completely incompatible, emerges.

1. Computer Graphics

When telling a story of a computer art, Marek Hołyński remarks that the first branch of art computers entered was music[21]. One can suppose that its proximity to maths, stressed especially by Pythagoreans, contributed to this fact. Graphical applications of computing machines followed musical experiments. Hołyński recalls such examples of use of computers in visual arts as image analyzing, image recognition and image generation. In general specialists discriminate three main fields of computer science dealing with picture according to a type of an input and an output.

1. Computer graphics: description → image
2. Image processing: image → image
3. Image recognition: image → description[22]

The aim of computer graphics consists of generating an image on the basis of a description. Thus, an input has a form of conventional code, is language-like, whereas expected output is a graphical, iconic object. An example of a task of computer graphics would be generating a fictional world of a computer game. Programmers receive description of objects to generate and to create a software able to produce specified images and animations. For this kind of technology one needs an output interface allowing to convey a pictorial message, even though it's not necessary to employ an input interface of this type.

A case of the second field, image processing is different. Here, one needs to provide a way of passing an image both as an input and as an output. Typical image processing would be application of filters to better a photo quality or change mood of it. A user provides input data such as a photo and obtains as an output this very photo modified in an expected

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[21] Marek Hołyński, *Sztuka i komputery*, Warsaw 1976.

[22] Dariusz Sawicki, *Grafika komputerowa*, 2008, http://wazniak.mimuw.edu.pl/index.php?title=GKIW_Moduł_0_-_Wstęp (retrieved 23.02.2015)

manner. The first big problem of image processing is encoding an iconic image of visual reality into computer memory. Real world and its images are continuous, not digital as computer memory is. Thus, a picture of an empirical world needs to be cropped so as to fit to a form of zeros and ones. Its dimensions are supposed to be approximated to integers, since only natural numbers can be precisely represented and operated by a digital computer. The reality, both visual and acoustical undergoes a process of standardization and normalization. All the representable values of sound and colors get round to the nearest integer number. Here we encounter a fundamental digitalisation problem I'll try to describe a bit further below.

The third type of cooperation between graphics and computer science, image recognition, is a sub-domain of general pattern recognition problem[23]. In this case machines get an image as an input and returns symbolic (*scil*. language) description of it as an output. One of the most important issues on this field is Optical Character Recognition (OCR). How this problem is difficult and how far are we from its final solution, everyone who ever digitized a print text knows very well. For some reasons pattern recognition problem is much more difficult for digital, electronic machines than it is for humans, analogue, biological machines.

> "Pattern Classification, more often called Pattern Recognition, is the primary bottleneck in the task of automation."[24]

This phenomenon of superiority of humans over automata on the filed of information processing is employed by WWW interface in a form of CAPTHA: pictures of distorted writing preventing a malicious software to enter to an internet service, whereas letting real people in. It is possible only because of a fact that a human can decode slightly distorted writing much easier than a computer. Computing machine is best at what it was doing from its beginning: reading and manipulating

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[23] Konstantinos Koutroumbas, Sergios Theodoridis, *Pattern Recognition*, Boston: Academic Press 2008.

[24] Michael D. Alder, *An Introduction to Pattern Recognition: Statistical, Neural Net and Syntactic methods of getting robots to see and hear*. HeavenForBooks.com, 2007, p. 4 (retrieved 23.02.2015)

numbers, even though there was a lot of effort made to "teach" a computer how to "see", how to accept input in form other than symbolic code. In the following section I present some of them.

2. Graphical User Interface

Interfaces of first computers let their operators to handle "electronic brains" according to a scheme of batch processing. The computer gets input data in a form of punched cards, for instance, and the program starts. There is no possibility of interaction then, a user is not able to change a way a software is executed till it finishes. This kind of interface has no any "pictorial" characteristic in it, it is fully textual and symbolic (a string of numerical values).

Very quickly other approaches to input data into computer memory was elaborated. Joystick had already been used in aircraft and in a natural way was used to operate machines in general and computing machines in particular in this industry. A track-ball was invented in 1946 for a need of radar echolocation and used at first with an analogue computer by Ralph Benjamin, an engineer employed by the British Defense Research Agency.

> "We used a joystick because at the time it was readily available, but in my paper proposing this, I had included what I called the roller ball, now known as a mouse, which I said was going to be more elegant and would be the long-term solution."[25]

However, a light pen was much more popular at these early stages of computer evolution than track ball and its offspring, born by rolling a trackball over on its back – a computer mouse. The idea of a light pen, or as it first was called and looked like, a light gun, came to mind of Robert Everett in 1952, working for US Navy. Everett worked on Whirlwind, the first computer to interact with a user in real-time[26]. Thus, he needed something that would allow this kind of interaction by giving a quick and

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[25] *Oral-History: Ralph Benjamin*, http://www.ieeeghn.org/wiki/index.php/Oral-History:Ralph_Benjamin (retrieved 23.02.2015)

[26] *A Critical History of Computer Graphics and Animation*, http://design.osu.edu/carlson/history/lesson2.html (retrieved 23.02.2015)

easy way to point out any particular pixel on the screen, very much like our today's touch screens.

A computer mouse appeared in the early 60. and since then holds its stable place among computer input devices[27]. It became the most popular way of working with a graphical interface. Only nowadays, in the time of mobile computer devices it is being displaced by a touch pad[28], which provides more intuitive, direct, albeit less precise, manner of pointing out a place on the screen. How intuitive it is one can easily perceive when a toddler, not able to use a mouse, let alone to read, succeeds in controlling some basic functions of a mobile phone or an electronic tablet with a touchscreen.

The first full-fledged graphical computer interface system, based on pictorial technology, was Sketchpad, constructed by Ivan Sutherland, as topic of his PhD thesis in 1963 at MIT[29]. An input interface device was a light pen allowing a user to draw directly on a computer screen.

> "The Sketchpad system uses drawing as a novel communication medium for a computer. The system contains input, output, and computation programs which enable it to interpret information drawn directly on a computer display."[30]

Following the story of computer interface one can realize that development of pictorial interfaces was parallel to growing interactivity of computers. It is possibly easier and more effective to administrate a work of an electronic computer in real time, giving an instant response to results of its work. In such a way a dialog between a human and a

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27 Benj Edwards, *The computer mouse turns 40*, „Macworld" Dec 9, 2008, http://www.macworld.com/article/1137400/mouse40.html (retrieved 23.02.2015)

28 The first working touchscreen was supposedly constructed by Bent Stumpe, a CERN engineer in 1973. See: *Another of CERN's many inventions*, "CERN Bulletin" 2010, No. 12.

29 *A Critical History of Computer Graphics and Animation*, http://design.osu.edu/carlson/history/lesson3.html (retrieved 23.02.2015)

30 Ivan Sutherland, *Sketchpad: A Man-Machine Graphical Communication System*, „Technical Report" No. 574, September 2003, University of Cambridge Computer Laboratory, p. 9.

computer is established. Sutherland uses a metaphor of a “conversation”:

> "The Sketchpad system makes it possible for a man and a computer to converse rapidly through the medium of line drawings."[31]

The way Sutherland's Sketchpad communicates seems (to its creator) more natural then earlier text-based interfaces:

> “Sketchpad is able to accept topological information from a human being in a picture language perfectly natural to the human”[32]

Not only new way of inputting data into computer, but also a graphical output has a crucial importance for Sutherland.

> ''A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland.''[33]

The creator of Sketchpad proposes a new metaphor describing work of a computing machine. Its display, demonstrating in a pictorial form results of calculations, serves as a magical looking glass, giving an insight to a possible world defined in a software executed on the computer. This approach, interpreting conceptual work of a mathematician in terms of seeing, refers to Plato's theory of knowledge as watching eternal ideas.

Following Sutherland's metaphor of a looking glass, several other metaphors would appear, invented by computer engineers and intended to explain and visualize a function of a computer screen and a computer in general. To the most influential ones belong:

a) Paper and Ink Metaphor, used by creators of Xerox Alto, one of the first experimental personal computers in 1973. They strove to model traditional media such paper and ink in new electronic one[34]. The output screen of Alto was shaped as a

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31 Ivan Sutherland, *Sketchpad*, p. 17.

32 Ivan Sutherland, *Sketchpad*, p. 9.

33 Ivan Sutherland, *The Ultimate Display*, w: Proceedings of the IFIP Congress, red. W. A. Kalenich, Waszyngton 1965

34 Charles P. Thacker et alii. *Alto: A Personal Computer*, in: *Computer Structures: Principles and Examples*, ed. D. Siewiorek, C. G. Bell, and A. Newell, McGraw-Hill, New

sheet of paper with its resolution 608 by 808, thus having a portrait orientation and of size of an A4 page[35].

b) Desktop Metaphor appeared later, even though it is not easy to determine who was the real pioneer here[36]. The idea was implicit to Xerox Alto display, though the authors of report hadn't use the expression. There is no doubt it was employed by Apple Lisa in the 80. by using icons called folders, wastebasket, or clipboard, and software such a calculator, whose window was stylized on an electronic mini-calculator.

c) Room With A View Metaphor is a direct follower of Desktop Metaphor, since it basically generalizes it, providing access to several desktops placed in several rooms[37]. This metaphor fits better to multitasking characteristics of modern computer operating systems, allowing to work with several applications simultaneously.

Graphical User Interface (GUI) became inseparable from personal computers in form of laptop, tablets, phones, watches and others. Pictorial, iconic interface helps to store, organize, access information, which in represented by a digital code. Here we face a digitalisation problem, we've already encountered when talking about image processing.

3. Digitalisation problem

One of the first computer games in the history was Pong designated by Allan Alcorn and produced by Atari Corporation in 1972[38].

York, 1982, p. 15.

35 Charles P. Thacker et alii. *Alto: A Personal Computer*, p. 16.

36 David K. Every, *Innovation: Desktop Metaphor Who innovated what*, http://www.mackido.com/Innovation/Desktop.html (retrieved 23.02.2015)

37 Larry Koved, Ted Selker, *Room with a view (RWAV): A metaphor for interactive computing*, IBM TJ Watson Research Center, 1990, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.22.1340&rep=rep1&type=pdf (retrieved 23.02.2015)

38 *About Pong*, http://www.ponggame.org/ (retrieved 23.02.2015)

It was a computer version of ping-pong game. The ball in this games has a shape of square. It is a consequence of translating a real object into digital form. One needs to apply an approximation. A digital object cannot be an exact copy of a non-digital entity. A pixel, the smallest portion of a computer image, a visual atom of electronic output can be turn off or turn on. It can shine with one of millions of colors, nonetheless it cannot be turn on partly. None of digital visual object can measure half of a pixel. A digital image is made of non-divisible pixel atoms, very much like the world according to Democritus. When one tries to magnify a digital picture one always comes to moment, when pixels become visible and digital picture discloses its jagged nature. Pixelosis is a feature of a digital image with pixels too big, too visible, which means that resolution is too low for size of the image.

What follows from digitalisation problem[39] for the question of pictoriality, is that an iconic object cannot be input in form of a computer data as it is, with no loss of information, whereas a symbolic message can. A digital world is not a “natural environment” for iconic representations, as it is for a language code. This is simply because of the fact that scripture is a digital code, while a picture is an analogue code.

4. Graphical Internet

So far I pursued a function of pictorial representation and ways it was accomplished in general history of computers. A similar evolution can be traced in development of Internet. From first experiment of connecting computers from the early 60., till beginnings of the 90. the interface of Internet communication software provided a command-line access through protocol as Telnet or Gopher. It meant that a user was supposed to write commands with a keyboard, with no mouse pointer, nor icons present. Only after inventing a concept of World Wide Web and making up such standards as HyperText Markup Language (HTML) and HyperText Transfer Protocol (HTTP) by Tim Berners-Lee in 1989 it became possible to build first graphical web browsers[40].

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[39] Lev Manovich refers to a similar question examining “the myth of the digital”, see: Manovich, p. 68.

[40] Tim Berners-Lee, *Biography*, http://www.w3.org/People/Berners-Lee/ (retrieved

One of them was Mosaic, released in 1993[41]. It was the first to achieve global success and contributed to popularizing Internet usage outside of scientific centers. Graphical User Interface (GUI) once again help to transfer a computer technology to a broader audience. A metaphor of a Web of Internet sites help to understand an idea of computer network faster, making it more accessible than it used to be. Use of a mouse and a desktop made browsing of Internet content more intuitive. Thanks to that one didn't need to be anymore an engineer or a computer scientist for joining Internet community. A critical mass was achieved and internet technology spread all over the world.

Only after Graphical User Interface become a standard interface for computers, a term “Text User Interface” (TUI) was invented. It designates former, text-based interface of computer machines. One should remark that introduction of Graphical User Interface doesn't imply that textual access to computer resources has been discarded. It got specialized. Command-line interpreters still serve for IT specialists like programmers and net administrators as more comfortable and effective way of controlling of work of a computer.

3. „What does the medium retrieve that had been obsolesced earlier?”

A famous sentence of Marshall McLuhan, third one of his tetrad of media effects, seems to describe several phenomena we are witnessing nowadays. A new ways of communication surprisingly enough reclaim solutions abandoned long time ago. An example is an evolution of writing and reading media.

Christianity brought a revolution not only in religion, but also in means of communication. It is in the time of early Christianity, when codex is displacing widely used at that time technology of scroll and dominates writing and reading practice until our times[42]. Nonetheless,

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23.02.2015)

[41] Marc Andreessen, *Mosaic — The First Global Web Browser*, http://www.livinginternet.com/w/wi_mosaic.htm (retrieved 23.02.2015)

[42] Colin H. Roberts, T. C. Skeat, *The birth of the codex*, London: Oxford University Press 1983.

the most recent textual media such as Internet sites breaks with a codex technology. A typical WWW page, in spite of its name, is equipped with a scrolling bar and follow a scroll approach. Not everyone is happy with it.

> „adopting the scroll metaphor (...) leads to chopped lines of text, and doesn't work so well on mice-less devices. And, mankind misses the beauty of a nicely laid out page.''[43]

The author of quoted words is Håkon Wium Lie, an inventor of Cascading Style Sheets (CSS) concept that along with HTML defined look of WWW as we know it nowadays[44]. A Norwegian web pioneer is convinced that when advancing mobile Internet technologies we need to come back to a codex design and in such a way a web browsing software is developed by him. He insists on preserving "natural" use of such keys as PageUp and PageDown. In his opinion a flourishing of e-book readers should also maintain the best features of a traditional codex, such as paging, easily performed without any pointing devices of kind of a computer mouse.

A backlash of traditional media technology gets even deeper than coming back to a codex page. Text-based User Interface belongs to a world of literacy, whereas Graphical User Interface is capable to transcend limits of writing and accomplish whole communication process in the realm of orality.

> ''The immediacy provided by touch screen technology in conjunction with audio-visual feedback can enable illiterate people to engage with digital information''[45]

Farmer in India, not able to read and in consequence excluded from

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43 Håkon Wium Lie, Chris Mills, *Opera Reader: Paging the Web*, http://people.opera.com/howcome/2011/reader/2011-10-19

44 *CSS: It was twenty years ago today — an interview with Håkon Wium Lie*, https://dev.opera.com/articles/css-twenty-years-hakon/ (retrieved 23.02.2015)

45 Ken Banks, *Mobile Learning: How Smartphones Help Illiterate Farmers in Rural India*, „National Geographic'', June 5, 2012, http://newswatch.nationalgeographic.com/2012/06/05/mobile-learning-how-smartphones-help-illiterate-farmers-in-rural-india/ (retrieved 23.02.2015)

benefits of computer technology based on textual interface, can operate, however, a computer furnished with an appropriate graphical interface. Secondary orality has been already noticed by Walter Jackson Ong as present in such new media as telephone, radio, and other electronic means of communication[46].

In such a way the latest and the most sophisticated fruit of evolution of writing devices, a computer, comes back to origins of human communication, oral language, what is allowed, paradoxically enough, thanks to conceiving and advancing pictorial user interface. Once again, "*Pictura est laicorum litteratura".*

[46] Walter Jackson Ong, *Orality and Literacy. The Technologizing of the Word*, London: Routledge 2005, p. 10.