



IMPORTANCE OF STUDYING COMPUTER GRAPHICS AT FACULTIES FOR COMPUTER AND INFORMATICS ENGINEERS

Dejan Viduka^{1*},
Luka Ilić¹,
Davor Vrandečić²

¹Faculty of Applied Management,
Economics and Finance, Belgrade,
University of Business Academy,
Novi Sad, Serbia

²Faculty of Electrical Engineering,
Computer Science and
Information Technology,
J. J. Strossmayer University of Osijek,
Osijek, Croatia

Abstract:

The modern way of life and work tasks of computer and informatics engineers also require knowledge of working with computer graphics. This segment is mostly neglected or very little applied, so engineers during their education at the faculties acquire minimal or almost no knowledge about this area. This field has been widely applied in recent decades in various software and experts of that profile and knowledge are in great demand on the market. In this paper, we deal with the basic knowledge that we believe that every engineer dealing with digital products should possess. We have proposed subjects that could be studied so that future experts from the faculty would be more competent in the field of computer graphics. The primary goal of this paper is to encourage experts and creators of new programs at colleges to consider the application of these programs to acquire defined skills that would give users greater opportunities in choosing the final occupation and specialization.

Keywords:

computer graphics, vector graphics, raster graphics, user experience and user interface.

INTRODUCTION

In their work, computer and computer engineers often come across computer graphics. Or to be more precise, it is difficult to do anything in the digital world without computer graphics. [1] This imposes on us the need for every future engineer to encounter the subjects they are studying during their schooling. [2] This is very often the case, but mostly in one subject that deals with this topic in general, which is only possible given the small number of classes during one semester.

If we take into account that subjects such as Internet programming and mobile programming are studied at faculties, then there is a need for knowledge that would be acquired in a block of subjects that would cover a wider range of knowledge in the field of computer graphics. [3] Both the web and mobile applications abound with a lot of computer graphics, so it is necessary to have basic knowledge. [4] Developers need this knowledge as much as knowledge from subjects such as: operating systems, computer networks, computer architecture, etc. [5]

Correspondence:

Dejan Viduka

e-mail:

dejan@viduka.info



Most programmers deal only with programming languages, but they need to have general technical knowledge in these areas in order to adapt their software to the given criteria and better synchronize with experts whose specializations in these areas.

Most of the programs at the faculties are dedicated mainly to programmers with general knowledge from other fields. This is probably dictated by the labor market itself, which has high demands on developers. This is quite legitimate, but when you take into account that engineers choose their specializations themselves, they need to be able to master all the necessary skills that will help them in their further life and development. [6]

When we look at all this, it is clear that computer graphics skills are very necessary [7] or at least desirable. [8] Knowing 5 or 6 programming languages for every engineer is an excellent basis, but one programming language is enough for learning programming. We are always guided by the slogan that the basics are mastered at the faculty and one slowly enters the world that is being studied, and that in his independent work a person improves himself for further challenges he encounters. All of the above shows how important it is for all knowledge to develop evenly.

2. COMPUTER GRAPHICS

This area is very broad and requires basic specific knowledge. This knowledge should be acquired from a block of subjects that can be divided into three to four subjects in order to acquire only the basics that would be studied from those subjects. Some of the subjects that deal with specific graphic knowledge deal with:

- a. vector graphics,
- b. raster graphics,
- c. user interface - UI,
- d. user experience - UX.

In addition to these subjects, I have many others who can deal with 2d and 3d graphics [9] and similar specific knowledge, but this is an area that should be left for specific areas such as graphics engineers. [10] The above subjects only serve to provide computer and computer engineers with a foundation that can help them in their further work or direct them to new areas of computer graphics that they want to deal with.

2.1. VECTOR GRAPHICS

Vector graphics in its work relies on mathematical support to draw various shapes using dots, straight and curved lines. An example of the work is the drawing of a square of size 300 dpi, which is drawn using four points that are mathematically connected and filled, making the shape of a square. Some of the vector graphics that we often come across are fonts or logos.

The characteristics of vector graphics are: the possibility of infinite magnification, small file size, the possibility of modification, etc. In addition to the listed features that are among the advantages, there are some limitations, such as: limited possibilities for details and effects.

The most common programs used and used in practice are: Adobe Illustrator, Inkscape and Corel Draw.

2.2. RASTER GRAPHICS

Unlike vector graphics, a raster is made up of many (hundreds, thousands or millions) of small squares (dots) that make up one complete image. These squares are also called points that contain information that makes up a given image. This kind of graphics has a lot more details and effects, but also flaws in terms of file size and image magnification. Such a graph contains the same number of points in one square of size 300 dpi, which makes it much more complex than the square drawn in vector graphics. The most common type of raster graphic that we encounter every day is photography.

The most common programs for working with raster graphics are: Adobe Photoshop and Gimp.

2.3. USER INTERFACE (UI)

UI is a software environment that allows the user to adequately communicate with the computer [11] using predefined functions. [12] UI users are also defined as GUI (Graphical User Interface). Apple Macintosh and Microsoft Windows operating systems are most responsible for its development. While learning how to make it easier for the user to work on their operating systems, they developed GUIs that are still used today and are constantly being developed and improved. [13] The graphical user interface replaced the impractical and difficult text interfaces of earlier computers (e.g., MS-DOS) with a relatively intuitive system, which not only simplified computer handling but made it much



more natural and enjoyable. In addition to computers, the GUI is used in many mobile devices, gaming devices, smartphones, and home and office control devices.

2.4. USER EXPERIENCE (UX)

A relatively new concept in the IT world, but very important and a large number of companies are increasingly paying attention to this segment when creating new digital products. This term is defined as emphasized by the International Organization for Standardization, as "the perception and reaction of a person that results from the use or expected use of a product, system or service". [14] Or simply put, this is what you feel when you interact with a product while using it.

Manufacturers have realized how important customer experience is to their existing and future customers, and that this is the way to build the trust and loyalty of those customers. [15] Precisely because of the manufacturer's awareness of UX [16], there have been greater demands from customers who have become less and less tolerant of bad experiences. [17] This means that this field has a future and will be increasingly sought after, and thus create new jobs for UX designers or researchers. When we talk about UX we mean all kinds of products, not just digital products and if it all started with them.

3. MARKET NEEDS

Market analysis is done through online job search platforms such as :

- a. Upwork,
- b. Fiverr,
- c. Freelancer.com,
- d. PeoplePerHour.com or
- e. Guru.com.

These are global platforms for freelancers with a large number of job offers, mainly from technical fields. The Upwork platform also includes specific jobs such as those in the field of computer graphics. It is interesting that on this platform, jobs in the field of vector and raster graphics are divided into separate units, and the same is the case with UI and UX jobs. The Design & Creative sector includes jobs from vector and raster graphics, while the UI / UX sector is located in Development & IT.

On other platforms that are much less popular and used, they are mostly in similar categories. Somewhere it is web design in another place Graphics & Design, Graphic Design, Web Development & Design, Programming & Development. From these divisions, it can be seen that experts connect them with design as well as with development and programming. This is exactly what says that this is a difficult segment to separate in the daily work of an engineer and that it is very necessary.

On all these platforms, there is a very large number of business offers for jobs that we have defined in this paper as computer graphics. On these platforms, there are a large number of divisions by jobs and by names of positions, which are quite branched in relation to our basic division.

Some of the jobs are divided as :

- a. UX/UI Designer,
- b. Product designer UX/UI,
- c. UI Designer,
- d. UI researchers,
- e. UX Designer,
- f. UX researchers,
- g. UX Architect,
- h. UX Writer,
- i. UX Analyst,
- j. UX Strategist or
- k. UX Consultant.

All of these jobs are in demand and require a basic set of computer graphics skills that we wrote about in this paper. This shows the justification for the introduction of this group of subjects in the basic study of computer engineers and informatics. Some of these jobs listed above have their application in the field of electronic marketing. For this set of occupations and jobs in which they can participate, it is safe to say that they are multidisciplinary, combining established knowledge of design, programming, analysis, research, design and strategy. Unfortunately, due to the exceptional similarity in the mentioned jobs, it is difficult to make precise statistics on how many jobs from which area were requested on the mentioned platforms. Users who post jobs very often define jobs with multiple position tags as mentioned above, so there is a big overlap of results.



4. DISCUSSION

The paper lists the basic segments of computer graphics that we believe that every computer and computer engineer should encounter during their schooling. Observing these divisions, we can see that raster and vector graphics complement each other, so they need to be studied individually. On the other hand, UI and UX are often assumed to go together [18], which is normal when one affects the other and vice versa. [19]

In the entire educational process at the faculty, the student encounters 30-40 subjects and it makes sense that three subjects are dedicated to such an important segment as computer graphics. It is similar with the blocks dealing with programming languages, computer administration, databases, information systems and general education subjects. Despite the fact that most faculties strive to educate programmers, in reality a large number of engineers resort to other mentioned segments.

Regardless of whether students want to deal with this segment of computing, we believe that this would facilitate work with experts in this field who have become an integral part of every development team. This approach avoids only a superficial acquaintance with the important segments of computing that every faculty strives for. On the other hand, students are given the opportunity to choose and specialize within the sciences for which they are studying.

5. CONCLUSION

Computing and informatics is a broad term and requires a large number of specific knowledge from future engineers. One of those specific knowledge is computer graphics. Therefore, it is desirable that future engineers have knowledge that can change in further work or in interaction with other associates who work in this field within a development team. Despite the belief that all engineers will be programmers, experts in other fields often meet in practice. Some of these areas are network or server administration, databases or UI / UX designers, etc. Precisely because of this, it is necessary to innovate study programs and give greater emphasis to the basics of computer graphics.

The intention of the author was to encourage the professional public to pay more attention to computer graphics and thus enable future engineers for the greater demands of future labor markets. When you look at the

fact that Microsoft and Apple pay a lot of attention to this, it can be expected that others will follow this example, and therefore this knowledge and skills will be desirable for any new expert.

6. REFERENCES

- [1] J. Sánchez-Ramírez, J. E. Muñoz-Rodríguez, C. A. Collazos, L. D. Rodríguez-Torres, G. J. Cabrera-Reynaga and R. D. Estrada-Esponda, The Human Computer Interaction in the Curricula of Mexican Higher Education Institutions, *Scientia et Technica Año XXVI*, Vol. 26, No. 02, junio de 2021. Universidad Tecnológica de Pereira, DOI: <https://doi.org/10.22517/23447214.24496>
- [2] F. Yu, L. Ruel, R. Tyler, Q. Xu, H. Cui, S. Karanasios, B. X. Nguyen, A. Keilbach, J. Mostafa, Innovative UX Methods for Information Access Based on Interdisciplinary Approaches: Practical Lessons from Academia and Industry, *Data and Information Management*, 2020; 4(1): 74–80, <https://doi.org/10.2478/dim-2020-0004>
- [3] I. U. Hipiny and H. Ujir, "User Interface/User Experience (UI/UX) Analysis & Design of Mobile Banking App for Senior Citizens: A Case Study in Sarawak, Malaysia," 2021 International Conference on Electrical Engineering and Informatics (ICEEI), 2021, pp. 1-6, doi: <https://doi.org/10.1109/ICEEI52609.2021.9611136>
- [4] M. Sheikh, A. H. Muhammad and Q. N. Naveed, Enhancing Usability of E-Learning Platform: A Case Study of Khan Academy, *Sir Syed Journal of Education & Social Research*, Vol. 4, Issue 2, 2021, [https://doi.org/10.36902/sjesr-vol4-iss2-2021\(40-50\)](https://doi.org/10.36902/sjesr-vol4-iss2-2021(40-50))
- [5] T. C. Bagiritima, J. M. Tesha, M. Kimani, Investigation on the Poor Computer Graphic Design Skills among Art and Design Students at University, *International Journal of Humanities Social Sciences and Education (IJHSSE)*, Volume 6, Issue 10, October 2019, PP 61-71, <http://dx.doi.org/10.20431/2349-0381.0610007>
- [6] W. S. L. Nasution and P. Nusa, UI/UX Design Web-Based Learning Application Using Design Thinking Method, Nasution, et.al., *ARRUS Journal of Engineering and Technology*, Vol. 1, No. 1, 2021., <https://doi.org/10.35877/jetech532>
- [7] R. Obradovic, M. Vujanovic, B. Popkonstantinovic, D. Ivetic, P. Sidanin, Computer Graphics - Engineering Animation Study Program at the Faculty of Tehnical Sciences in Novi Sad, Vol. 14 Issus 1, *JIDEG*, 2019.



- [8] S. Kross and P. Guo, Five Pedagogical Principles of a User-Centered Design Course that Prepares Computing Undergraduates for Industry Jobs. In Proceedings of the 53rd ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2022), March 3–5, 2022, Providence, RI, USA. ACM, New York, NY, USA, 7 pages. <https://doi.org/10.1145/3478431.3499341>
- [9] I. Sajovic and B. B. Podgornik, Bibliometric Analysis of Visualizations in Computer Graphics: A Study, SAGE Open, January-March 2022: 1–17, <https://doi.org/10.1177/21582440211071105>
- [10] D. S. D. Ugli and A. B. I. Ugli, Modular Technology of Teaching Engineering Computer Graphics to Future Teachers Drawing, Current Research Journal of Philological Sciences, Vol. 03, Issue 0,1 Pages: 101-107, 2022., doi: <https://doi.org/10.37547/philological-crjps-03-01-17>
- [11] K. V. Vlasenko, I. V. Lovianova, S. V. Volkov, I. V. Sitak, O. O. Chumak, A. V. Krasnoshchok, N. G. Bohdanova and S. O. Semerikov, UI/UX design of educational on-line courses, CTE 2021: 9th Workshop on Cloud Technologies in Education, Kryvyi Rih, Ukraine
- [12] F. E. Pamudyaningrum, H. Rante, M. A. Zainuddin, and M. Lund, UI/UX Design for Metora: A Gamification of Learning Journalism Interviewing Method, E3S Web of Conferences 188, 00008, ICESTI 2019, <https://doi.org/10.1051/e3sconf/202018800008>
- [13] M. Dhirana, V. Bhat and A. Kaushik, Role of Human Computer Interaction, Turkish Journal of Computer and Mathematics Education, Vol.12 No.13, 2021., 159-163.
- [14] A. Yasushi, "Human-Computer Interaction Research and Education--Crossing Boundaries Between Academic Research and Industry Practices," Interface: An International Interdisciplinary Studies Journal: Vol. 1 : Iss. 1 , Article 1., 2021., Available at: <https://stars.library.ucf.edu/iids/vol1/iss1/1>
- [15] E. Krisnanik and T. Rahayu, UI/UX integrated holistic monitoring of PAUD using the TCSD method, Bulletin of Electrical Engineering and Informatics, Vol. 10, No. 4, August 2021, pp. 2273~2284, DOI: <https://doi.org/10.11591/eei.v10i4.3108>
- [16] F. Jackson, UX in Industry: An 'Unconference' w/ the Practitioners, Proceedings of the Human Factors and Ergonomics Society 2019 Annual Meeting
- [17] L. Fathauer and D. M. Rao, Accessibility in an educational software system: Experiences and Design Tips, IEEE Frontiers in Education Conference (FIE), Covington, KY, USA, 2019., DOI: <https://doi.org/10.1109/FIE43999.2019.9028402>
- [18] B. Lim and R. Soetantio, The Sail Model – Professional Pathways for UI/UX Designers in the Digital Age, Southeast Asia: A Multidisciplinary Journal, Vol 19, 2019, pp 86–94.
- [19] D. Hodges, Old Dog, New Tricks: The Shift From Graphic Designer to UX/UI Designer in Higher Education Graphic Design Curriculum, West Texas A&M University Canyon, Texas, Master of Arts, 2021.